دفتر مرکزی برشنا شرکت،
کابل
Da Afghanistan Breshna Sherkat
Headquarters in Kabul

ISLAMIC REPUBLIC OF AFGHANISTAN
DA AFGHANISTAN BRESHNA SHERKAT (DABS)

INTERNATIONAL COMPETITIVE BIDDING FOR PROCURMENT OF PLANT

SINGLE STAGE TWO-ENVELOPE BIDDING PROCEDURE

BIDDING DOCUMENT FOR DESIGN, SUPPLY, INSTALLATION, TESTING AND COMMISSIONING
Of
NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot

RFP No. : DABS-94-ICB-014

RFP Title: NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot

AFG No.: 830021

DATE: February 10, 2015

LETTER OF INVITATION
(International Competitive Bidding)

ISLAMIC REPUBLIC OF AFGHANISTAN
DA AFGHANISTAN BRESHNA SHERKAT (DABS)

RFP Issue Date: **February 10, 2015**

RFP No.: **DABS-94-IBC-014**

RFP Title: **NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot**

AFG No.: **830021**

1. Da Afghanistan Breshna Sherkat (DABS), Islamic Republic of Afghanistan has received funding from USAID toward the cost under the contract for the **NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot** under USAID Grant Agreement Number 306-05-00 for USAID Strategic Objective Grant Agreement for a Thriving Economy Led by the Private Sector.

2. DABS ("the Employer"), now invites sealed bids from the eligible bidders for **NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot** Construction, including all Work incidental thereto as more particularly described in Section 6 of this International Competi tive Bidding Tender, in one lot as under:

Item	Place/Places of Delivery	Description	Bid Security (USD)
1	Ghazni Province, Afghanistan	Qarabagh Substation	$1,700,000
2	Ghazni Province, Afghanistan	Moqor (Gelan) Substation	
3	Zabul Province, Afghanistan	Shah Joy Substation	
4	Zabul Province, Afghanistan	Qalat Substation	
5	Kandahar Province, Afghanistan	Kandahar East Substation	
Addendum 1, addition of RPC and SVC			
1	Kabul City, Afghanistan	Chimtala SS RPC & SVC	
2	Wardak Province, Afghanistan	Sayedabad SS RPC	
3	Ghazni Province, Afghanistan	Ghazni SS RPC	
4	Kandahar Province, Afghanistan	Kandahar East SVC	

Bidders shall quote for the full quantity of goods specified on a single responsibility basis, failing which such bids will be rejected and will not be considered for award.

Section 5: The Grantor Requirements of the RFP provide guidance on available tax exemptions for USAID-financed projects. Available tax exemptions include, in summary, an exemption for (1) taxes on the income, profits or property of all non-Afghan organizations, on non-Afghan employees of both Afghan and non-Afghan organizations and on non-Afghan individual contractors and grantees, including social security taxes and taxes on the property, personal or real, owned by non-Afghan organizations or persons and (2) customs duties, import taxes and other levies on all goods and equipment imported by both Afghan and non-Afghan contractors for use on the project. The Grantor Requirements section also contains other important limitations on the goods and services that can be financed by USAID. **All bidders are advised to review Section 5 in detail.**

3 Bidding will be conducted through the International Competitive Bidding procedure specified in the Public Procurement Law and Circulars, and is open to all Bidders from Eligible Source Countries as defined in the Guidelines.

4. Interested eligible bidders may obtain further information from Procurement Unit, DABS, and inspect the bidding documents at the address given below from 9:00 hrs.to 15:00 hours on any working day from Saturday to Wednesday.

5. A complete set of Bidding Documents in English may be obtained by interested bidders by contacting at e-mail address tenders.dabs@dabs.af and copy to shafiqullah.hanif@dabs.af .

6. Bids must be delivered to the address below at or before **10:00 Hrs** (local time) on **May 12, 2015/ (22-SAUR-1394)**. Electronic bids will not be permitted. Late bids will be rejected. Bids will be opened immediately after the deadline of bid submission, at the same place of bid submission in the presence of the bidders' representatives who choose to attend in person.

7. All bids must be accompanied by a Bid Security in the amount specified under Para 2 above that will remain valid for 180 days.

8. The address (es) referred to above is(are):

Chaman Houzouri, District 8,
Kabul City, Kabul - Afghanistan
Telephone: **0093 (0) 0752002063**

Ahmad Shah Sahil,
Chief Financial Officer
Da Afghanistan Breshna Sherkat (DABS), H.Q.
Kabul, Afghanistan

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PART I BIDDING PROCEDURES

Section 1 - Instructions to Bidders

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Section 1 - Instructions to Bidders

A. General

1. Scope of Bid

1.1 In connection with the Invitation for Bids indicated in the Bid Data Sheet (BDS), the Employer, as indicated in the BDS, issues this Bidding Document for the procurement of plant and services as specified in Section 6 (Employer's Requirements). The name, identification, and number of lots (contracts) of the International Competitive Bidding (ICB) are provided in the BDS.

1.2 Unless otherwise stated, throughout this Proposal definitions and interpretations shall be as prescribed in Section 7 (General Conditions of Contract).

2. Source of Funds

2.1 DABS ("the Employer") has received funding from USAID toward the cost under the contract for the **NEPS/SEPS Connector Five Substations From Qarabagh to Kandahar East in One Lot** Construction under USAID Grant Agreement Number 306-05-00, USAID Strategic Objective Grant Agreement for a Thriving Economy Led by the Private Sector.

2.2 The Employer guarantees that adequate public funds have been budgeted and allotted and are also available for managing the procurement proceedings toward the cost of the project. The Employer intends to apply a portion of the public funds to eligible payments under the contract for which this Bidding Documents are issued.

2.3 The Employer guarantees that adequate public funds are available. For the purpose of this provision, "PUBLIC FUNDS" defines any monetary resources appropriated to procuring entities under Government budget, or revenues generated by statutory bodies and corporations or aid grants and credits put at the disposal of procuring entities by the development partners through the Government...

3. Corrupt Practices

3.1 It is the Government of the Islamic Republic of Afghanistan's policy to require that Purchasers, as well as Bidders, Suppliers, and Contractors and their subcontractors under Government-financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts[1]. In pursuance of this policy, the Government:

(a) Defines, for the purpose of this provision, the terms set forth as follows:

(i) "CORRUPT PRACTICE" is the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party[2];

(ii) "FRAUDULENT PRACTICE" is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party[3] to obtain a financial or other benefit or to avoid an obligation;

[1] *In this context, any action taken by a Bidder, Supplier, Contractor, or a sub-Contractor to influence the procurement process or contract execution for undue advantage is improper.*

[2] *"ANOTHER PARTY" refers to a public official acting in relation to the procurement process or contract execution. In this context, "PUBLIC OFFICIAL" includes Government staff and employees of other organizations taking or reviewing procurement decisions.*

[3] *A "PARTY" refers to a public official; the terms "BENEFIT" and "OBLIGATION" relate to the procurement process or contract execution; and the "ACT OR OMISSION" is intended to influence the procurement process contract execution.*

(iii) "COLLUSIVE PRACTICE" is an arrangement between two or more parties[4] designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iv) "COERCIVE PRACTICE" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party[5] or the property of the party to influence improperly the actions of a party;

(v) "OBSTRUCTIVE PRACTICE" is

I. Deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Government investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or,

II. Acts intended to materially impede the exercise of the Government's inspection and audit rights provided for under sub-clause 3.1(e) below.

(b) Will reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for the contract in question;

(c) Will sanction and prosecute any procurement official if it is found at any time that representative of the procuring entity engaged in corrupt, fraudulent, collusive ,coercive or obstructive practices during the procurement or the execution of the contract, without the procuring entity having taken timely and appropriate action satisfactory to the Government to address such practices when they occur;

(d) Will sanction a firm or individual, including declaring ineligible, either indefinitely or for a stated period of time, to be awarded a Government Islamic Republic of Afghanistan (GIRoA) financed contract if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for, or in executing, a GIRoA financed contract; and

(e) Will have the right to require that a provision be included in bidding documents and in contracts financed by the GIRoA, requiring Bidders, suppliers, and contractors and their sub-contractors to permit the Government to inspect their accounts and records and other documents relating to the Bid submission and contract performance and to have them audited by auditors appointed by the Government.

3.2 Furthermore, the Bidder shall be aware of the provision stated in the Conditions of Contract (GCC 42.2.1(c)).

4. Eligible Bidder

4.1 A Bidder, and all parties constituting the Bidder, may have the nationality of

[4] *"PARTIES" refers to participants in the procurement process (including officials) attempting to establish Bid prices at artificial, non-competitive levels.*

[5] *a "PARTY" refers to a participant in the procurement process or contract execution.*

any country as **specified in the BDS.** A Bidder shall be deemed to have the nationality of a country if the Bidder is a citizen or is constituted, incorporated, or registered and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed subcontractors.

4.2 A Bidder shall not have a conflict of interest. All Bidders found to have conflict of interest shall be disqualified. Bidders may be considered to have a conflict of interest with one or more parties in this bidding process, if they are affiliated, directly or indirectly, with the consultant or any other entity that has prepared the design, specifications, and other documents for the Project or being proposed as Project Manager for the Contract. A firm, or any individual that has been engaged by the Procuring Entity to provide consulting services for the preparation or supervision of the

Works, and any of its affiliates ***shall not be eligible to bid.***

4.3 A Bidder that is under a declaration of ineligibility by the GoA in accordance with ITB Clause 3, at the date of contract award, shall not be eligible to be awarded a contract. The list of such debarred firms is available at the electronic address **specified in the BDS**.

4.4 Government-owned enterprises may be eligible only if they can establish that they do not have conflict of interest.

4.5 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.

5. Eligible Plant and Services

5.1 The plant and services to be supplied under the Contract shall have their origin in eligible source countries as defined in ITB 4.2 above and all expenditures under the Contract will be limited to such plant and services.

5.2 For purposes of ITB 5.1 above, “origin” means the place where the plant, or component parts thereof are mined, grown, produced or manufactured, and from which the services are provided. Plant components are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that is substantially in its basic characteristics or in purpose or utility from its components.

B. Contents of Bidding Document

6. Sections of Bidding Document

6.1. The Bidding Document consists of Parts 1, 2, and 3, which include all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 8.

PART I Procedures

Section 1 - Instructions to Bidder (ITB)

Section 2 - Bid Data Sheet (BDS)

Section 3 - Evaluation and Qualification Criteria (EQC)

Section 4 - Bidding Forms (BDF)

Section 5 - Grantor Requirements

PART II Requirements

Section 6 - Employer’s Requirements (ERQ)

PART III Conditions of Contract and Contract Forms

Section 7 - General Conditions of Contract (GCC)

Section 8 - Special Conditions of Contract (SCC)

Section 9 - Contract Forms (COF)

6.2. The Invitation for Proposal issued by the Employer is not part of the Proposal.

6.3. The Employer is not responsible for the completeness of the Bidding Document and its addenda, if they were not obtained directly from the source stated by the Employer in the Invitation for Bids.

6.4. The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of the Proposal.

7. Clarification of Bidding Document, Site Visit, Pre-Bid Meeting

7.1. A prospective Bidder requiring any clarification of the Bidding Document shall contact the Employer in writing at the Employer's address indicated in the BDS or raise his enquiries during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond to any request for clarification, provided that such request is received no later than twenty-one (21) days prior to the deadline for submission of bids. The Employer's response shall be in writing with copies to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 24.2.

7.2. The Bidder is advised to visit and examine the site where the plant is to be installed and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the Bid and entering into a contract for the provision of plant and services. The costs of visiting the site shall be at the Bidder's own expense. The Employer is in no way responsible for any differences, in the information provided in the Bidding document with that of the ground reality, which may arise on account of the Contractor's scope after submission of the Bid.

7.3. The Bidder and any of its personnel or agents will be granted permission by the Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the Bidder, its personnel, and agents will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection

7.4. The Bidder's designated representative is invited to attend a pre-bid meeting, if provided in the BDS. The purpose of the meeting will be to clarify issues and to answer questions relevant to preparation of the Bids.

7.5. The Bidder is requested, as far as possible, to submit any questions in writing, to reach the Employer not later than one week before the pre-bid meeting.

7.6. Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of

an Addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.

7.7. Nonattendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.

8. Amendment of Bidding Document

8.1. At any time prior to the deadline for submission of Bids, the Employer may amend the Bidding document by issuing an addendum.

8.2. Any addendum issued shall be part of the Bidding Document and shall be communicated in writing to all who have obtained the Bidding Document from the Employer in accordance with ITB 6.3.

8.3. To give prospective Bidders reasonable time in which to take an addendum into account in preparing the Bids, the Employer may, at its discretion, extend the deadline for the submission of bids, pursuant to ITB 24.2.

C. Preparation of Bid

9. Cost of Bidding

9.1. The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall not be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

10. Language of Bid

10.1. The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in the English language. Supporting documents and printed literature that are part of the Bid may be in another language provided they are accompanied by an accurate translation of the relevant passages into the English language, in which case, for purposes of interpretation of the Bid, such translation shall govern.

11. Documents Comprising the Bid

11.1. The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Bid containing the documents listed in ITB 11.2 and the other the Price Bid containing the documents listed in ITB 11.3, both envelopes enclosed together in an outer single envelope.

11.2. The Technical Bid submitted by the Bidder shall comprise the following:

(a) Letter of Technical Bid;

(b) Bid Security or Bid Securing Declaration, in accordance with ITB 21;

(c) Alternative bids, if permissible, in accordance with ITB 13;

(d) Written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB 22.2;

(e) Documentary evidence establishing in accordance with ITB 14.1 that the plant and services offered by the Bidder in its bid or in any alternative bid, if permitted, are eligible;

(f) Documentary evidence in accordance with ITB 15 establishing the Bidder's eligibility and qualifications to perform the contract if its Bid is accepted;

(g) Technical Proposal in accordance with ITB 17;

(h) Documentary evidence establishing in accordance with ITB 16 that the plant and services offered by the Bidder conform to the Bidding Document;

(i) In the case of a bid submitted by a JV, JV agreement, or letter of intent to enter into a JV including a draft agreement, indicating at least the parts of the Plant to be executed by the respective partners;

(j) List of subcontractors, in accordance with ITB 17.2; and

(k) any other document required in the BDS.

11.3. The Price Bid submitted by the Bidder shall comprise the following:

(a) Letter of Price Bid;

(b) Completed schedules as required, including Price Schedules, in accordance with ITB 12 and 18;

(c) Alternative price bids, if permissible, in accordance with ITB 13; and,

(d) any other document required in the BDS

12. Letter of Bid and Schedules

12.1. The Letters of Technical Bid and Price Bid, and the Schedules, and all documents listed under ITB 11, shall be prepared using the relevant forms furnished in Section 4 (Bidding Forms). The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.

13. Alternative Bids

13.1. Unless otherwise indicated in the BDS, alternative bids shall not be considered. If they are allowed, the BDS will also indicate whether they are permitted in accordance with ITB 13.3, or invited in accordance with ITB13.2 and/or ITB 13.4.

13.2. When alternatives to the Time Schedule are explicitly invited, a statement to that effect will be included in the BDS, and the method of evaluating different time schedules will be described in Section 3 (Evaluation and Qualification Criteria).

13.3. Except as provided under ITB 13.4 below, Bidders wishing to offer technical alternatives to the Employer's requirements as described in the bidding document must also provide: (i) a price at which they are prepared to offer a plant meeting the Employer's requirements; and (ii) all information necessary for a complete evaluation of the alternatives by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed installation methodology and other relevant details. Only the technical alternatives, if any, of the lowest evaluated Bidder conforming to the basic technical requirements shall be considered by the Employer.

13.4. When bidders are invited in the BDS to submit alternative technical solutions for specified parts of the facilities, such parts shall be described in Section 6 (Employer's Requirements). Technical alternatives for the specific parts of the facilities that comply with the performance and technical criteria specified for the plant and services shall be considered by the Employer on their own merits, pursuant to

ITB 32.

14. Documents Establishing the Eligibility of Plant and Services

14.1. To establish the eligibility of the plant and services in accordance with ITB Clause 5, the Bidders shall complete the country of origin declarations in the Price Schedule Forms, included in Section 4 (Bidding Forms).

15. Documents Establishing the Eligibility and Qualifications of the Bidder

15.1. To establish its eligibility and qualifications to perform the Contract in accordance with Section 3 (Evaluation and Qualification Criteria), the Bidder shall provide the information requested in the corresponding information sheets included in Section 4 (Bidding Forms).

15.2. Domestic Bidders, individually or in joint ventures, applying for eligibility for domestic preference shall supply all information required to satisfy the criteria for eligibility as described in ITB 38.

16. Documents Establishing Conformity of the Plant and Services

16.1. The documentary evidence of the conformity of the plant and services to the Bidding Document may be in the form of literature, drawings and data, and shall furnish:

(a) A detailed description of the essential technical and performance characteristics of the plant and services, including the functional guarantees of the proposed plant and services, in response to the Specification;

(b) A list giving full particulars, including available sources, of all spare parts, special tools, etc., necessary for the proper and continuing functioning of the plant for the period named in the BDS, following completion of plant and services in accordance with provisions of contract; and,

(c) A commentary on the Employer's Specification and adequate evidence demonstrating the substantial responsiveness of the plant and services to those specifications. Bidders shall note that standards for workmanship, materials and equipment designated by the Employer in the Bidding Document are intended to be descriptive (establishing standards of quality and performance) only and not restrictive. The Bidder may substitute alternative standards, brand names and/or catalog numbers in its Bid, provided that it demonstrates to the Employer's satisfaction that the substitutions are substantially equivalent or superior to the standards designated in the Specification.

16.2. In order to facilitate evaluation of Technical Bids, deviations, if any, from the terms and conditions or Specification shall be listed as indicated in ITB 18.2.

17. Technical Proposal, Subcontractors

17.1. The Bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in Section 4 (Bidding Forms), in sufficient detail to demonstrate the adequacy of the Bidder's proposal to meet the work requirements and the completion time.

17.2. For major items of plant and services as listed by the Employer in Section 3 (Evaluation and Qualification Criteria), which the Bidder intends to purchase or subcontract, the Bidder shall give details of the name and nationality of the proposed Subcontractors, including manufacturers, for each of those items. In addition, the Bidder shall include in its bid information establishing compliance with the

requirements specified by the Employer for these items. Bidders are free to list more than one Subcontractor against each item of the plant and services. Quoted rates and prices will be deemed to apply to whichever Subcontractor is appointed, and no adjustment of the rates and prices will be permitted.

17.3. The Bidder shall be responsible for ensuring that any Subcontractor proposed complies with the requirements of ITB 4, and that any plant, or services to be provided by the Subcontractor comply with the requirements of ITB 5 and ITB 15.1

18. Bid Prices and Discounts

18.1. Unless otherwise specified in the BDS or Section 6 (Employer's Requirements), bidders shall quote for the entire plant and services on a "single responsibility" basis such that the total bid price covers all the Contractor's obligations mentioned in or to be reasonably inferred from the bidding document in respect of the design, manufacture, including procurement and subcontracting (if any), delivery, construction, installation and completion of the plant. See Bidders Forms – Section 4 This includes all requirements under the Contractor's responsibilities for testing, pre-commissioning and commissioning of the plant and, where so required by the bidding document, the acquisition of all permits, approvals and licenses, etc.; the operation, maintenance and training services and such other items and services as may be specified in the Bidding Document, all in accordance with the requirements of the General Conditions. Items against which no price is entered by the Bidder will not be paid for by the Employer when executed and shall be deemed to be covered by the prices for other items.

18.2. Bidders are required to quote the price for the commercial, contractual and technical obligations outlined in the bidding document. If a Bidder wishes to make a deviation, such deviation shall be listed in the relevant form in Section 4 (Bidding Forms). The Bidder shall also provide the additional price if any, for withdrawal of the deviation.

18.3. Bidders shall give a breakdown of the prices in the manner and detail called for in the Price Schedules included in Section 4 (Bidding Forms). Where no different Price Schedules are included in the Bidding Document, bidders shall present their prices in the following manner: Separate numbered Schedules included in Section 4 (Bidding Forms) shall be used for each of the following elements. The total amount from each Schedule shall be summarized in a Grand Summary giving the total bid price(s) to be entered in the Bid Form. See Section No. 4 for details.

18.4. The current edition of Incoterms, published by the International Chamber of Commerce shall govern.

18.5. The prices shall be either fixed or adjustable as specified in the BDS.

(a) In the case of Fixed Price, prices quoted by the Bidder shall be fixed during the Bidder's performance of the contract and not subject to variation on any account. A bid submitted with an adjustable price quotation will be treated as non-responsive and rejected.

(b) In the case of Adjustable Price, prices quoted by the Bidder shall be subject to adjustment during performance of the contract to reflect changes in the cost elements such as labor, material, transport and contractor's equipment in accordance with the procedures specified in the corresponding Appendix to the Contract Agreement. A bid submitted with a fixed price quotation will not be rejected, but the price adjustment will be treated as zero. The Bidders are required to indicate the source of labor and

material indices in the corresponding Form in Section 4 (Bidding Forms).

18.6. If so indicated in BDS 1.1, bids are being invited for individual lots (contracts) or for any combination of lots (packages). Bidders wishing to offer any price reduction (discount) for the award of more than one contract shall specify in their Letter of Price Bid the price reductions applicable to each package, or alternatively, to individual contracts within the package, and the manner in which the price reductions will apply.

19. Currencies of Bid and Payment

19.1. The currency (ies) of the Bid shall be, as specified in the BDS.

19.2. The Bidder shall indicate in the Schedule of Prices and the Letter of Bid price as detailed in Schedule No. 4 that corresponds to expenditures incurred in the currency of the Employer's country.

19.3. The Bidder expecting to incur expenditures in other currencies for inputs to the Facilities supplied from outside the Employer's country and wishing to be paid accordingly, may indicate in the Schedule of Prices and the Letter of Bid up to three foreign currencies of their choice.

20. Period of Validity of Bids

20.1. Bids shall remain valid for the period specified in the BDS after the bid submission deadline date prescribed by the Employer. A bid valid for a shorter period shall be rejected by the Employer as non-responsive.

20.2. In exceptional circumstances, prior to the expiration of the bid validity period, the Employer may request Bidders to extend the period of validity of their bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 21, it shall also be extended for a corresponding period. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its bid.

21. Bid Security

21.1. Unless otherwise specified in the BDS, **the Bidder shall furnish as part of its bid, in original form**, either a Bid Securing Declaration or a bid security as specified in the BDS. In the case of a bid security, the amount shall be as specified in the BDS.

21.2. The bid security shall be a demand guarantee, at the Bidder's option, in any of the following forms:

(a) An unconditional bank guarantee; or

(b) An irrevocable letter of credit; or

(c) A casher's or certified check;

all from a reputable source from an eligible country. If the institution issuing the bid security furnished by the Bidder is located outside the Employer's country, the issuer shall have a correspondent financial institution located in the Employer's country to make it enforceable. In the case of a bank guarantee, the bid security shall be submitted either using the Bid Security Form included in Section 4 (Bidding Forms) or another form acceptable to the Employer. The form must include the complete name of the Bidder. **The bid security shall be valid for twenty-eight days (28) beyond the original validity period of the bid, or beyond any period of extension if requested under ITB 20.2.**

21.3. Any bid not complying with ITB 21.1 and ITB 21.2, shall be rejected by the Employer as non-responsive.

21.4. If a bid security is specified pursuant to ITB 21.1, the bid security of the

successful Bidder shall be returned as promptly as possible once the successful Bidder has signed the Contract and furnished the required performance security.

21.5. If a bid security is specified pursuant to ITB 21.1, the bid security of unsuccessful Bidders shall be returned as promptly as possible upon the successful Bidder's furnishing of the performance security pursuant to ITB 43.

21.6. The bid security may be forfeited:

(a) If a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letter of Bid Form, except as provided in ITB 20.2; or

(b) If the successful Bidder fails to

(i) Sign the Contract in accordance with ITB 42;

(ii) furnish a performance security in accordance with ITB 43; or

(iii) Furnish a domestic preference security if so required.

21.7. The Bid Security of a JV shall be in the name of the JV that submits the bid. If the JV has not been legally constituted at the time of bidding, the Bid Security shall be in the names of all future partners as named in the letter of intent referred to in ITB 4.1.

21.8. If a bid securing declaration is executed in accordance with ITB 20.7, the Employer will declare the Bidder ineligible to be awarded a contract by the Employer for the period of time stated in the Form of Bid Securing Declaration.

22. Format and Signing of Bid

22.1. The Bidder shall prepare one original of the Technical Bid and one original of the Price Bid comprising the Bid as described in ITB 11 and clearly mark it "ORIGINAL – TECHNICAL BID" and "ORIGINAL – PRICE BID". Alternative bids, if permitted in accordance with ITB 13, shall be clearly marked "ALTERNATIVE". In addition, the Bidder shall submit copies of the bid, in the number specified in the BDS and clearly mark each of them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.

22.2. The original and all copies of the Bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as specified in the BDS and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the bid where entries or amendments have been made shall be signed or initialed by the person signing the bid.

22.3. A bid submitted by a Joint Venture (JV) shall be signed so as to be legally binding on all partners.

22.4. Any interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the bid.

D. Submission and Opening of Bids

23. Submission, Sealing and Marking of Bids

23.1. Bidders may always submit their bids by mail or by hand. When so **specified in the BDS,** bidders shall have the option of submitting their bids electronically. Bidders submitting bids electronically shall follow the procedures **specified in the BDS.** The Bidder shall seal the

original and all copies of the Bid in two inner envelopes and one outer envelope, duly marking the inner envelopes as "ORIGINAL" and "COPIES."

23.2. The inner and outer envelopes shall:

(a) be addressed to the Employer at the address **provided in the BDS**;

(b) bear the name and identification number of the Contract as **defined in the BDS and SCC**; and

(c) Provide a warning not to open before the specified time and date for Bid opening as **defined in the BDS.**

23.3. In addition to the identification required in ITB Sub-Clause 23.2, the inner envelopes shall indicate the name and address of the Bidder to enable the Bid to be returned unopened in case it is declared late, pursuant to ITB Clause 25.

23.4. If the outer envelope is not sealed and marked as above, the Employer shall assume no responsibility for the misplacement or premature opening of the Bid.

24. Deadline for Submission of Bids

24.1. The Bid must be received by the Employer at the address and no later than the date indicated in the BDS.

24.2. The Employer may, at its discretion, extend the deadline for the submission of Proposal by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and the Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.

25. Late Bids

25.1. The Employer shall not consider any bid that arrives after the deadline for submission of bids, in accordance with ITB 24. Any bid received by the Employer after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder.

26. Withdrawal, Substitution, and Modification of Bids

26.1. A Bidder may withdraw, substitute, or modify its bid after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITB 22.2, (except that withdrawal notices do not require copies). The corresponding substitution or modification of the bid must accompany the respective written notice. All notices must be:

(a) prepared and submitted in accordance with ITB 22 and ITB 23 (except that withdrawals notices do not require copies), and in addition, the respective envelopes shall be clearly marked "Withdrawal," "Substitution," "Modification;" and

(b) Received by the Employer prior to the deadline prescribed for submission of Bids, in accordance with ITB 24.

26.2. Bid requested to be withdrawn in accordance with ITB 26.1 shall be returned unopened to the Bidder.

26.3. No Bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of Bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Technical Bid or any extension thereof.

27. Bid Opening

27.1. The Employer shall open the bids, including modifications made pursuant to Clause 23, in the presence of the bidders' representatives who choose to attend at the time and in the place **specified in the BDS.** Any specific opening procedures required if electronic bidding is

permitted in accordance with ITB Sub-Clause 20.1, shall be as specified in the BDS.

27.2. First, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding bid shall not be opened, but returned to the Bidder. No bid withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening.

27.3. Second, outer envelopes marked "SUBSTITUTION" shall be opened. The inner envelopes containing the Substitution Technical Bid and/or Substitution Price Bid shall be exchanged for the corresponding envelopes being substituted, which are to be returned to the Bidder unopened. Only the Substitution Technical Bid, if any, shall be opened, read out, and recorded. Substitution Price Bid will remain unopened in accordance with ITB Sub-Clause 25.1. No envelope shall be substituted unless the corresponding Substitution Notice contains a valid authorization to request the substitution and is read out and recorded at bid opening.

27.4. Next, outer envelopes marked "MODIFICATION" shall be opened. No Technical Bid and/or Price Bid shall be modified unless the corresponding Modification Notice contains a valid authorization to request the modification and is read out and recorded at the opening of Technical Bids. Only the Technical Bids, both Original as well as Modification, are to be opened, read out, and recorded at the opening. Price Bids, both Original as well as Modification, will remain unopened in accordance with ITB Sub-Clause 25.1.

27.5. All other envelopes holding the Bids shall be opened one at a time, and the following read out and recorded: The bidders' names, the Bid prices, the total amount of each Bid and of any alternative Bid (if alternatives have been requested or permitted), any discounts, Bid withdrawals, substitutions, or modifications, the presence or absence of Bid Security or Bid-Securing Declaration, if required, and such other details as the Employer may consider appropriate, shall be announced by the Employer at the opening. Substitution Bids and modifications submitted pursuant to ITB Clause 25 that are not opened and read out at bid opening shall not be considered for further evaluation regardless of the circumstances. No Bid shall be rejected at the opening of Bids except for late bids, in accordance with ITB Sub-Clause 25.1.

27.6. The Employer shall prepare a record of the opening of Bids that shall include, as a minimum: the name of the Bidder and whether there is a withdrawal, substitution, or modification; and alternative proposals; and the presence or absence of a bid security or a bid securing declaration, if one was required. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders who submitted bids in time, and posted online when electronic bidding is permitted.

E. Evaluation and Comparison of Bids

28. Confidentiality

28.1. Information relating to the evaluation of bids and recommendation of contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on Contract award is communicated to all Bidders.

28.2. Any attempt by a Bidder to influence the Employer in the evaluation of the bids or Contract award decisions may result in the rejection of its bid.

28.3. Notwithstanding ITB 28.2, from the time of bid opening to the time of

Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it should do so in writing.

29. Clarification of Bids

29.1. To assist in the examination, evaluation, and comparison of the Technical and Price Bids, and qualification of the Bidders, the Employer may, at its discretion, ask any Bidder for a clarification of its bid. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the substance of the Technical Bid or prices in the Price Bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the bids, in accordance with ITB 36.

29.2. If a Bidder does not provide clarifications of its bid by the date and time set in the Employer's request for clarification, its bid may be rejected.

30. Deviation, Reservations, and Omission

30.1. During the evaluation of bids, the following definitions apply:

(a) "Deviation" is a departure from the requirements specified in the Bidding Document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Documents; and

(c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Documents.

31. Preliminary Examination of Technical Bids

31.1. The Employer shall examine the Technical Bid to confirm that all documents and technical documentation requested in ITB Sub-Clause 11.2 have been provided, and to determine the completeness of each document submitted. If any of these documents or information is missing, the Bid may be rejected.

31.2. The Employer shall confirm that the following documents and information have been provided in the Technical Bid. If any of these documents or information is missing, the offer shall be rejected.

(a) Letter of Technical Bid;

(b) Written confirmation of authorization to commit the Bidder;

(c) Bid Security, if applicable;

(d) Technical Proposal in accordance with ITB 17.

32. Responsive of Technical Bid

32.1. The Employer's determination of a bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB11.

32.2. A substantially responsive Technical Bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that,

(a) if accepted, would

(i) affect in any substantial way the scope, quality, or performance of the plant and services specified in the Contract;

(ii) limit in any substantial way, inconsistent with the Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or

(b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive bids.

32.3. The Employer shall examine the technical aspects of the Bid submitted in accordance with ITB 17, Technical Proposal, in particular to confirm that all requirements of Section 6 (Employer's Requirements) have been met without any material deviation or reservation.

32.4. If a bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

33. Nonmaterial Non conformities

33.1. Provided that a Bid is substantially responsive, the Employer may waive any nonconformity in the bid that does not constitute a material deviation, reservation or omission.

33.2. Provided that a Bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the Price Bid. Failure of the Bidder to comply with the request may result in the rejection of its Bid.

33.3. Provided that a Bid is substantially responsive, the Employer shall rectify nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the method indicated in Section 3 (Evaluation and Qualification Criteria).

34. Detailed Evaluation of Technical Bids

34.1. The Employer will carry out a detailed technical evaluation of the bids not previously rejected as being substantially non-responsive, in order to determine whether the technical aspects are in compliance with the Bidding Document. In order to reach such a determination, the Employer will examine and compare the technical aspects of the bids on the basis of the information supplied by the bidders, taking into account the following:

(a) overall completeness and compliance with the Employer's Requirements; deviations from the Employer's Requirements; conformity of the plant and services offered with specified performance criteria; suitability of the plant and services offered in relation to the environmental and climatic conditions prevailing at the site; and quality, function and operation of any process control concept included in the bid. The bid that does not meet minimum acceptable standards of completeness, consistency and detail will be rejected for non-responsiveness;

(b) type, quantity and long-term availability of mandatory and recommended spare parts and maintenance services; and

(c) other relevant factors, if any, listed in Section 3 (Evaluation and Qualification Criteria).

34.2. Where alternative technical solutions have been allowed in accordance with ITB 13, and offered by the Bidder, the Employer will make a similar evaluation of the alternatives. Where alternatives have not been allowed but have been offered, they shall be ignored.

35. Eligibility and Qualification of Bidders

35.1. The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether a Bidder meets the eligibility and qualifying criteria specified in Section 3 (Evaluation and Qualification Criteria).

35.2. The determination shall be based upon an examination of the

documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 15.

35.3. An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. A negative determination shall result into the disqualification of the Bid, in which event the Employer shall return the unopened Price Bid to the Bidder.

35.4. The capabilities of the manufacturers and subcontractors proposed in its Bid to be used by the Bidder will also be evaluated for acceptability in accordance with Section 3 (Evaluation and Qualification Criteria). Their participation should be confirmed with a letter of intent between the parties, as needed. Should a manufacturer or subcontractor be determined to be unacceptable, the Bid will not be rejected, but the Bidder will be required to substitute an acceptable manufacturer or subcontractor without any change to the bid price? Prior to signing the Contract, the corresponding Appendix to the Contract Agreement shall be completed, listing the approved manufacturers or subcontractors for each item concerned.

36. Correction of Arithmetical Error

36.1. During the evaluation of Price Bids, the Employer shall correct arithmetical errors on the following basis:

(a) where there are errors between the total of the amounts given under the column for the price breakdown and the amount given under the Total Price, the former shall prevail and the latter will be corrected accordingly;

(b) where there are errors between the total of the amounts of Schedule Nos. 1 to 5 and the amount given in Schedule No. 6 (Grand Summary), the former shall prevail and the latter will be corrected accordingly; and

(c) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetical error, in which case the amount in figures shall prevail subject to (a) and (b) above.

36.2. If the Bidder that submitted the lowest evaluated bid does not accept the correction of errors, its bid shall be disqualified.

37. Conversion to Single Currency

37.1. For evaluation and comparison purposes, the currency(ies) of the bid shall be converted into a single currency as specified in the BDS.

38. Margin of Preference

38.1. Unless otherwise specified in the BDS, a margin of preference shall not apply.

39. Evaluation of Price Bids

39.1. The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted.

39.2. To evaluate a Price Proposal, the Employer shall consider the following:

(a) the bid price, excluding provisional sums and the provision, if any, for contingencies in the Price Schedules;

(b) price adjustment for correction of arithmetical errors in accordance with ITB 36.1

(c) price adjustment due to discounts offered in accordance with ITB 18.6;

(d) converting the amount resulting from applying (a) to (c) above, if relevant, to a single currency in accordance with ITB 37; and

(e) The evaluation factors indicated in Section 3 (Evaluation and

Qualification Criteria).

39.3. If price adjustment is allowed in accordance with ITB 18.5 the estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.

39.4. If this Bidding Document allows Bidders to quote separate prices for different lots (contracts), and the award to a single Bidder of multiple lots (contracts), the methodology to determine the lowest evaluated price of the lot (contract) combinations, including any discounts offered in the Letter of Price Bid, is specified in Section 3 (Evaluation and Qualification Criteria).

39.5. If the bid, which results in the lowest Evaluated Bid Price, is seriously unbalanced or front loaded in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Price Schedules, to demonstrate the internal consistency of those prices with the methods and time schedule proposed. After evaluation of the price analyses, taking into consideration the terms of payments, the Employer may require that the amount of the performance security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.

40. Comparison of Bids

40.1. The Employer shall compare all substantially responsive Bids to determine the lowest evaluated bid, in accordance with ITB 39.2.

41. Employer's Right to Accept Any Bid, and to Reject Any or All Bids

41.1. The Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.

F. Evaluation and Comparison of Bids Award of Contract

42. Award Criteria

42.1. The Employer shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be eligible and qualified to perform the Contract satisfactorily.

42.2. The Employer reserves the right to accept any of the deviations submitted in accordance with ITB 18.2 by the lowest evaluated bidder, at the price shown for the deviation in the bid.

43. Notification of Award

43.1. Prior to the expiration of the period of bid validity, the Employer shall notify the successful Bidder, in writing, that its bid has been accepted. The notification letter (hereinafter and in the Conditions of Contract and Contract Forms called the "Letter of Acceptance") shall specify the sum that the Employer will pay the Contractor in consideration of the execution and completion of the plant and services (hereinafter and in the Conditions of Contract and Contract Forms called "the Contract Price").

43.2. At the same time, the Employer will publish in an English language newspaper or well-known freely accessible website the results identifying the bid and lot numbers and the following information: (i) name of each Bidder who submitted a Bid; (ii) bid prices as read out at bid opening; (iii) name and evaluated prices of each Bid that was evaluated; (iv) name of bidders whose bids were rejected and the reasons for their rejection; and (v) name of the winning Bidder, and the price it offered, as well as the duration and summary scope of the

contract awarded. After publication of the award, unsuccessful bidders may request in writing to the Employer for a debriefing seeking explanations on the grounds on which their bids were not selected. The Employer shall promptly respond in writing to any unsuccessful Bidder who, after Publication of contract award, requests a debriefing.

43.3. Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.

43.4. The Employer shall promptly respond in writing to any unsuccessful Bidder who, after notification of award in accordance with ITB 43.1, requests in writing the grounds on which its bid was not selected.

44. Signing of Contract

44.1. Promptly after notification, the Employer shall send the successful Bidder the Contract Agreement.

44.2. Within twenty-eight (28) days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

45. Performance Security

45.1. Within twenty-eight (28) days of the receipt of notification of award from the Employer, the successful Bidder shall furnish the performance security in accordance with the conditions of contract, subject to ITB 39.5, using for that purpose the Performance Security Form included in Section 9 (Contract Forms), or another form acceptable to the Employer. If the institution issuing the performance security is located outside the country of the Employer, it shall have a correspondent financial institution located in the country of the Employer to make it enforceable.

45.2. Failure of the successful Bidder to submit the above-mentioned Performance Security or sign the Contract shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security. In that event the Employer may award the Contract to the next lowest evaluated Bidder whose offer is substantially responsive and is determined by the Employer to be qualified to perform the Contract satisfactorily.

45.3. The above provision shall also apply to the furnishing of a domestic preference security if so required.

Section 2 - Bid Data Sheet

This Section consists of provisions that are specific to each procurement and they supplement the information or requirements included in Section 1 Instructions to Bidders.

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A. Introduction

ITB 1.1	The number of the Invitation for Bids is : DABS-94-ICB-014 The Employer is: Da Afghanistan Breshna Sherkat (DABS) The name of the ICB is: NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot The identification number of the ICB is: DABS-94-ICB-014 The number and identification of lots (contracts) comprising this ICB is: One Lot
ITB 2.1	The Employer is: Da Afghanistan Breshna Sherkat (DABS) The name of the Project is: NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot
ITB 4.1	Bidders from the following countries are not eligible: Section 5
ITB 4.3	A list of firms debarred from participating in Government Procurement is available at: http://www.un.org/sc/committees/1267/consolist.shtml

B. Bidding Documents

ITB 7.1	Employer's address **for clarification** is: Attention: Shafiqullah Hanif, Director Procurement Street Address: Chaman Houzouri, Floor/Room number CFO's office, 2nd Floor, Da Afghanistan Breshna Sherkat (DABS), H.Q City: Kabul ZIP Code: N/A Country: Afghanistan Telephone: **0752002063** Electronic mail address: tenders.dabs@dabs.af
ITB 7.4	A pre-bid meeting will be held on March 15, 2015 at the following address: CFO's Office, 2nd Floor Da Afghanistan Breshna Sherkat (DABS), HQ Chaman Houzouri, Kabul, Afghanistan Contact Persons: Shafiqullah Hanif, Director Procurement Email: tenders.dabs@dabs.af Date: Time:

C. Preparation of Bids

ITB 11.1	The Bidder shall submit with its Technical Bid the following additional documents: (a) Average Annual Turnover: The Bidder shall have had an average annual turnover as prime supplier (calculated as total certified payments received for contracts in progress or completed) over the last three years of at least USD 65 million per annum; (b) Financial Capability: (applicable for each lot) (1) The Bidder shall have sufficient cash flow capacity of at least USD 30 million to be met by the Bidder or Joint Venture (i) from working capital net of current contract commitments based on submitted audited financial statements, or (ii) by confirmed letter of credit from reputable banks, or (iii) by a combination of both; and (2) The Bidder shall have a positive net worth based on the same audited financial statements. (c) Litigation: The Bidder shall provide accurate information on any litigation or arbitration resulting from contracts completed or under execution by it over the last six years. Claims, arbitration or other litigation proceedings pending or already resolved, with a possible impact of more than 50 per cent of the Bidder's net worth shall be a ground for declaring the Bidder not qualified for the award of the contract. (d) Project Experience: A. For Substations: See Section 3 Paragraph 2.4.2 Specific Experience (a) Project Experience. The Bidder must have completed within the last six (6) years at least three (3) Substation projects of at least each 220 kV or higher. One of these projects must have been in satisfactory operation for at least two (2) years. B. To substantiate the above, the Bidder shall submit duly authenticated user's certificates and other relevant documents. (e) Manufacturing Experience: Manufacturers of the major components of plant, materials and equipment, be they the sole bidder, member of a joint venture or a proposed subcontractor shall have manufactured not less than two times the amount of plant/materials/equipment to that to be supplied by them as proposed in the bid that has been in use for a period of not less than 1 year and Demonstrate ISO 9000 or equivalent registration. In the event that the bidder is not the manufacturer of the major components of plant, equipment and materials it shall obtain from the manufacture its authorization to supply as per the provisions of the bidding document.
ITB 11.3 (d)	The Bidder shall submit with its Price Bid the following additional documents:

ITB 13.1	Alternative bids are not permitted.
ITB 13.2	Alternatives to the Time Schedule are not to be permitted.
ITB 13.4	Alternative technical solutions shall not be permitted
ITB 16.1 (b)	The period following completion of plant and services in accordance with provisions of contract shall be 36 months
ITB 18.1	Bidders shall quote for the entire plant and services on a "**single responsibility**" basis
IT 18.4(a)(i)	The Incoterm for quoting plant to be supplied from abroad is: DDP – the seller delivers the goods to the buyer, cleared for import, ready for unloading at the named places of destination on the agreed date or within the agreed period.
IT 18.4(b)(i)	The Incoterm for quoting plant manufactured within the Employer's country is: EX-works plus transportation, insurance and delivery to the project site.
ITB 18.6	The prices quoted by the Bidder shall be fixed, without price escalation
ITB 19.1	The currency of the bid prices shall be quoted in United States Dollars ($US).
ITB 20.1	The bid validity period shall be one hundred eighty (180) days.
ITB 21.1	A Bid Security is required. The amount and currency of the Bid Security shall be estimated at US Dollars Bid Security shall be as established in Invitation to Bid on page i-2 **NOTE:BID SECURITY MUST BE PLACED WITH TECHNICAL BID**
ITB 22.1	In addition to the original of the Bid, the number of copies is: Three (3) + 1 CD
ITB 22.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of a Letter of Authority Signed by the Bidder's Executive Management.

D. Submission and Opening of Bids

ITB 23.1	Electronic submission of the Bid is not acceptable.
ITB 24.1	For **Proposal submission purposes** only, the Employer's address is Attention: Shafiqullah Hanif, Director Procurement Street Address: Chaman Houzouri,

	Floor/Room number: CFO's Office, 2nd Floor Da Afghanistan Breshna Sherkat (DABS), H.Q City: Kabul ZIP Code: N/A Country: Afghanistan **The deadline for Bid submission is** Date: **22-SAUR-1394 / May 12, 2015** Time: **10:00 hrs.**
ITB 27.1	The Bid Opening will take place at Street Address: Chaman Houzouri, Floor/Room number: CFO's Office, 2nd Floor Da Afghanistan Breshna Sherkat (DABS), H.Q City: Kabul Country: Afghanistan Date: **22-SAUR-1394 / May 12, 2015** Time: **10:00 hrs- immediately after bid submission deadline**

E. Evaluation and Comparison of Bids

ITB 37.1	The currency exchange rate that shall be used for bid evaluation and comparison purposes to convert all bid prices expressed in various currencies into a single currency is United States Dollars (US$). The source of exchange rate shall be: The Selling Exchange rate of a Da Afghanistan Bank for cheques. The date for the exchange rate shall be: on the date of opening the technical proposals or the nearest following date, if the exchange rates are not published on the day of bid opening.
ITB 38.1	A margin of preference will not apply.

Section 3 - Evaluation and Qualification Criteria

This Section contains all the criteria that the Employer shall use to evaluate bids and qualify Bidders. In accordance with ITB 34 and ITB 35, no other methods, criteria and factors shall be used. The Bidder shall provide all the information requested in the forms included in Section 4 (Bidding Forms).

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1. Evaluation

1.1 Technical Evaluation

The following information shall be supplied for evaluation by the Employer.

1.1.1 Method Statement

A method statement which shall cover the design and construction of the works shall be submitted by the Bidder. The method statement shall be in sufficient detail to demonstrate the adequacy of the bidder's proposal to complete the work in accordance with the Technical Specifications and the specified time for completion. This shall be as evidenced by written method statement(s) and work program(s) in the form of a Gantt chart or similar chart for the Substation(s) Works.

The method statement(s) shall confirm that the design, the supply, the Construction documents, the execution and the completed works shall comply with the Country's national specification, technical standards, building, construction and environmental regulations where and if available and applicable to the product being produced from the Works, and the standards specified in the Schedule for Supply, applicable to the Contractor's Proposal and Schedules, or defined by law. In the absence of the Country's national standards, specifications and regulations the Contractor's design, the Construction documents, the execution and the completed works shall comply with international standards as specified in the Schedule of Supply In respect of technical specifications and standards, any national or international standards which promise to confer equal or better quality than the standards specified will also be acceptable. This shall be as evidenced by the completed technical schedules.

1.1.2 Type Test Certificates

A Type test certificates or type test reports shall be supplied in the bidding documents for the following major equipment items:

220kV or 110kV Power Transformers
220kV or 110kV Circuit Breakers
220kV or 110kV Motorized Disconnects
220kV or 110kV Power Components
Metal Clad Switchgear
Relays and Meters
UPS and DC System Components
SCADA Components
220kV Reactors
220kV Capacitors
Static VAr Controller Systems

1.2 Economic Evaluation

Any adjustments in price that result from the procedures outlined below shall be added, for purposes of comparative evaluation only, to arrive at an "Evaluated Bid Price." Bid prices quoted by bidders shall remain unaltered.

1.2.1 Quantifiable Deviations and Omissions

Quantifiable Deviations and Omissions from the contractual obligations: the evaluation shall be based on the evaluated cost of fulfilling the contract in compliance with all contractual obligations under this bidding document. The Employer will assess the cost of such a deviation for the purpose of ensuring fair comparison of bids.

1.2.2 Time Schedule

Time to complete the plant and services from the effective date specified in Article 3 of the Contract Agreement for determining time for completion of pre-commissioning activities is 36

months. No credit will be given for earlier completion. Bids offering time for completion in excess of these specified time requirements shall be rejected.

1.3 Domestic Preference

A margin of preference will not be applied.

1.4 Technical Alternatives

Technical alternatives are not permitted (refer to ITB 13.4)

2. Qualification

If the bidding was preceded by a prequalification process then the Bidder and any subcontractors shall continue to meet the criteria used at the time of prequalification and reiterated below.

2.1 Eligibility

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	At Least One Partner	
2.1.1 Nationality					
Nationality in accordance with ITB Sub-Clause 4.2.	must meet requirement	must meet requirement	must meet requirement	not applicable	Forms ELI - 1; ELI - 2 with attachments
2.1.2 Conflict of Interest					
No conflicts of interest in accordance with ITB Sub-Clause 4.3.	must meet requirement	must meet requirement	must meet requirement	not applicable	Application Submission Sheet
2.1.3 DABS Eligibility					
Not having been declared ineligible by DABS, as described in ITB Sub-Clause 4.4.	must meet requirement	must meet requirement	must meet requirement	not applicable	Application Submission Sheet
2.1.4 Government-owned Entity					
Bidder required meeting conditions of ITB Sub-Clause 4.5.	must meet requirement	must meet requirement	must meet requirement	not applicable	Forms ELI - 1; ELI - 2 with attachments
2.1.5 UN Eligibility					
Not having been excluded by an act of compliance with UN Security Council resolution or Employer's country law in accordance with ITB Clause 4, and meeting all requirements as outlined in Section 5-Grantor Requirements	must meet requirement	must meet requirement	must meet requirement	not applicable	Application Submission Sheet

2.2 Pending Litigation

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	

2.2.1 Pending Litigation

All pending litigation shall be treated as resolved against the Bidder and so shall in total not represent more than 50 percent of the Bidder's net worth.	must meet requirement by itself or as partner to past or existing JV	not applicable	must meet requireme nt by itself or as partner to past or existing JV	not applicable	Form LIT

2.3 Financial Situation

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
2.3.1 Historical Financial Performance					
Submission of audited balance sheets or, if not required by the law of the Bidder's country, other financial statements acceptable to the Employer, for the last three years to demonstrate the current soundness of the Bidder's financial position and its prospective long-term profitability. As a minimum, an Applicant's net worth calculated as the difference between total assets and total liabilities should be positive	must meet requirem ent	not applicable	must meet requireme nt	not applicable	Form FIN - 1 with attachments
2.3.2 Average Annual Turnover					
Minimum average annual turnover over the last three (3) years of USD 65 million calculated as total certified payments received for contracts in progress or completed,	must meet requirem ent	must meet requireme nt	Each partner must meet 25% of the requireme nt	Lead partner must meet 40% of the requireme nt	Form FIN - 2
2.3.3 Financial Resources					
Using Forms FIN - 3 and FIN - 4 in Section 4 (Bidding Forms) the Bidder must demonstrate access to, or availability of, financial resources such as liquid assets, unencumbered real assets, lines of credit, and other financial means, other than any contractual mobilization payments to meet: Cash flow capacity of at least USD 100 million and positive net worth	must meet requireme nt	must meet requireme nt	Lead partner must meet 50% of the requirem ent	Not applicable	Form FIN - 3

2.4 Experience

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	

2.4.1 General Experience

Experience under contracts in the role of contractor, subcontractor, or management contractor for at least the last three years prior to the bid submission deadline.	must meet requirement	not applicable	must meet requirement	not applicable	Form EXP - 1

2.4.2 Specific Experience

(a) **Contracts of Similar Size and Nature**

(1) The Bidder must have completed within the last six (6) years at least three (3) turnkey Substation projects of 220 kV or higher. One of these projects must have been in satisfactory operation for at least two years. (2) In case of joint venture, the leading partner shall have the 220 kV experience as per (1); the other partners shall have participated as a sub-contractor or joint venture partner within the last five (5) years at least two substation projects of 220 kV or higher. (3) To substantiate the above, the Bidder shall submit duly authenticated user's certificates and other relevant documents	must meet requirement	must meet requirement	not applicable	not applicable	Form EXP - 2

2.5 Personnel

The Bidder must demonstrate that it has the personnel for the key positions that meet the following requirements:

Nº	Position	Total Work Experience (years)	Experience in Similar Works (years)	Experience as Manager of Similar Works (years)
1	Project Manager	15	10	5
2	Design Engineer	10	5	
3	Quality Control Engineer	10	5	
4	Substation Engineer	10	5	
5	Substation Site Surveyor	10	5	
6	Health, Safety and Environmental Officer	10	5	
7	SVC Engineer	10	5	

The Bidder shall provide details of the proposed personnel and their experience records in the relevant Information Forms included in Section 4 (Bidding Forms).

2.6 Equipment

The Bidder shall list below the key items of equipment that it proposes or has access to that will be mobilized for the contract.

No.	Equipment Type and Characteristics	Min. Number Required
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

The Bidder shall provide further details of proposed items of equipment using the relevant Form in Section 4 (Bidding Forms)

2.7 Subcontractors

Subcontractors/manufacturers for the following major items of supply or services must meet the following minimum criteria, herein listed for that item. Failure to comply with this requirement will result in rejection of the subcontractor.

Item No.	Description of Item	Minimum Criteria to be met
1		
2		
3		
4		
5		

In the case of a Bidder who offers to supply and install major items of supply under the contract that the Bidder did not manufacture or otherwise produce, the Bidder shall provide the manufacturer's authorization, using the form provided in Section 4 (Bidding Forms), showing that the Bidder has been duly authorized by the manufacturer or producer of the related plant and equipment or component to supply and install that item in the Employer's country. The Bidder is responsible for ensuring that the manufacturer or producer complies with the requirements of ITB 4 and 5 and meets the minimum criteria listed above for that item.

Section 4 - Bidding Forms

This Section contains the forms which are to be completed by the Bidder and submitted as part of his Bid.

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Letter of Bid

[Bidder's Letterhead]

Date: .....

RFP No.: DABS-94-ICB-014

To: Da Afghanistan Breshna Sherkat (DABS)

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to design, supply, test, deliver, install, precommission and commission in conformity with the Bidding Document the following Plant and Services: NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot;

(c) Our Bid consisting of the Technical Bid and the Price Bid shall be valid for a period of 180 days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period

(d) If our bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents;

(e) We, including any subcontractors or manufacturers for any part of the contract , have or will have nationalities from eligible countries, in accordance with ITB-4.2;

(f) We, including any subcontractors or suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 4.3;

(g) We are not participating, as a Bidder or as a Subcontractor, in more than one bid in this bidding process in accordance with ITB 4.3, other than alternative offers submitted in accordance with ITB 13;

(h) Our firm, its affiliates or subsidiaries, including any Subcontractors or Suppliers for any part of the contract, has not been declared ineligible by DABS, under the Employer's country laws or official regulations or by an act of compliance with a decision of the United Nations Security Council or by any requirements as listed in Section 5;

(i) We are not a government owned entity / We are a government owned entity but meet the requirements of ITB4.5; *

(j) We agree to permit DABS or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by DABS.

(k) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and

(l) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

Name .....

In the capacity of .....

Signed .....

.....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

***** *Use one of the two options as appropriate*

****** *If none has been paid or is to be paid, indicate "none"*

Letter of Price Bid

[Bidder's Letterhead]

Date: .....

RFP No.: DABS-94-ICB-014

To: Da Afghanistan Breshna Sherkat (DABS)

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Document, including Addenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to design, manufacture, test, deliver, install, precommission and commission in conformity with the Bidding Document the following Plant and Services: NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot;

_____ (Signature)

(c) The total price of our Bid, excluding any discounts offered in item (d) below is the sum of:

_____
(USD in words or No Bid)

_____
(USD in figures or No Bid)

(d) The discounts offered and the methodology for their application are:

_____
(USD in words or No Bid)

_____
(USD in figures or No Bid)

(e) Our bid shall be valid for a period of one hundred eighty (180) days from the date fixed for the submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(f) If our bid is accepted, we commit to obtain a performance security in accordance with the SCC of the Bidding Document;

(g) We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract: **

Name of Recipient	Address	Reason	Amount
.....	.....	.....	.....
.....	.....	.....	..... .

(h) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall be the basis for the Negotiation of Contract and the Notice of Award of Contract on basis of the negotiated Contract Price and shall constitute a binding contract between us, until a formal contract is prepared and executed; and

(i) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

(j) We agree to permit DABS, USAID or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by the bank.

Name .....

In the capacity of .....

Signed .....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

Corporate Seal (where appropriate)

** ***If none has been paid or is to be paid, indicate "none"***

Price Schedules

PREAMBLE

General

1. The Price Schedules are divided into separate Schedules as follows:

Addendum 1: Substations and RPC Pricing Summary Sheet

Substation Pricing Summary Sheet

Qarabagh Substation Price Schedules
Schedule No. 1: Supply of Major Plant and Equipment
Schedule No. 2: Supply of 110kV Plant and Equipment
Schedule No. 3: Supply of General Plant and Equipment
Schedule No. 4: Mandatory Spare Parts
Schedule No. 5: Standard Tools
Schedule No. 6: Design, Drawings and Documentation
Schedule No. 7: Installation and Other Charges
Schedule No. 8: Transfer of Knowledge

Moqor Substation Price Schedules
Schedule No. 1: Supply of Major Plant and Equipment
Schedule No. 2: Supply of 110kV Plant and Equipment
Schedule No. 3: Supply of General Plant and Equipment
Schedule No. 4: Mandatory Spare Parts
Schedule No. 5: Standard Tools
Schedule No. 6: Design, Drawings and Documentation
Schedule No. 7: Installation and Other Charges
Schedule No. 8: Transfer of Knowledge

Shah Joy Substation Price Schedules
Schedule No. 1: Supply of Major Plant and Equipment
Schedule No. 2: Supply of 110kV Plant and Equipment
Schedule No. 3: Supply of General Plant and Equipment
Schedule No. 4: Mandatory Spare Parts
Schedule No. 5: Standard Tools
Schedule No. 6: Design, Drawings and Documentation
Schedule No. 7: Installation and Other Charges
Schedule No. 8: Transfer of Knowledge

Qalat Substation Price Schedules
Schedule No. 1: Supply of Major Plant and Equipment
Schedule No. 2: Supply of 110kV Plant and Equipment
Schedule No. 3: Supply of General Plant and Equipment
Schedule No. 4: Mandatory Spare Parts
Schedule No. 5: Standard Tools
Schedule No. 6: Design, Drawings and Documentation
Schedule No. 7: Installation and Other Charges
Schedule No. 8: Transfer of Knowledge

Kandahar East Substation Price Schedules
Schedule No. 1: Supply of Major Plant and Equipment
Schedule No. 2: Supply of 110kV Plant and Equipment
Schedule No. 3: Supply of General Plant and Equipment
Schedule No. 4: Mandatory Spare Parts
Schedule No. 5: Standard Tools
Schedule No. 6: Design, Drawings and Documentation

Schedule No. 7: Installation and Other Charges
Schedule No. 8: Transfer of Knowledge

Glossary of Bidding Schedules for Substations

Addendum 1

Reactive Power Compensation (RPC) Pricing Summary sheet

Chimtala SVC & RPC Price Schedules
Schedule No. 1: Supply of Major Plant and Equipment
Schedule No. 2: Supply of 110kV Plant and Equipment
Schedule No. 3: Supply of General Plant and Equipment
Schedule No. 4: Mandatory Spare Parts
Schedule No. 5: Standard Tools
Schedule No. 6: Design, Drawings and Documentation
Schedule No. 7: Installation and Other Charges
Schedule No. 8: Transfer of Knowledge

Sayedabad RPC Price Schedules
Schedule No. 1: Supply of Major Plant and Equipment
Schedule No. 2: Supply of 110kV Plant and Equipment
Schedule No. 3: Supply of General Plant and Equipment
Schedule No. 4: Mandatory Spare Parts
Schedule No. 5: Standard Tools
Schedule No. 6: Design, Drawings and Documentation
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Ghazni RPC Price Schedules
Schedule No. 1: Supply of Major Plant and Equipment
Schedule No. 2: Supply of 110kV Plant and Equipment
Schedule No. 3: Supply of General Plant and Equipment
Schedule No. 4: Mandatory Spare Parts
Schedule No. 5: Standard Tools
Schedule No. 6: Design, Drawings and Documentation
Schedule No. 7: Installation and Other Charges
Schedule No. 8: Transfer of Knowledge

Kandahar East SVC Price Schedules
Schedule No. 1: Supply of Major Plant and Equipment
Schedule No. 2: Supply of 110kV Plant and Equipment
Schedule No. 3: Supply of General Plant and Equipment
Schedule No. 4: Mandatory Spare Parts
Schedule No. 5: Standard Tools
Schedule No. 6: Design, Drawings and Documentation
Schedule No. 7: Installation and Other Charges
Schedule No. 8: Transfer of Knowledge

Glossary of Bidding Schedule for Reactive Power Compensation

The price schedules include estimates of the equipment required to complete five 220kV substations at Qarabagh, Moqor, Shah Joy, Qalat, and Kandahar East and Addendum 1 which is a complete Reactive Power Compensation (RPC) system, including Static VAr Controllers (SVC) at existing 220kV substation located at Chimtala (RPC &SVC), substations which are under design and construction at Sayedabad (RPC), and Ghazni (RPC), and SVC at Kandahar East SS which is to be constructed as part of this bid package . The objective of these

estimates is to provide sufficient information to enable bids to be prepared efficiently and accurately.

Bidders are requested to visit site to get knowledge for the preparation of Price Schedules.

After a contract has been awarded, the Contractor will perform detailed design, to include exact substation equipment layout and arrangement so that the final design will fit within the available space for each of five new and three existing Substations. The design will take into account irregular shapes of substations if they exist.

2. The Schedules do not generally give a full description of the plant to be supplied and the services to be performed under each item. Bidders shall be deemed to have read the Employer's Requirements and other sections of the Bidding Document and reviewed the Drawings to ascertain the full scope of the requirements included in each item prior to filling in the rates and prices. The entered rates and prices shall be deemed to cover the full scope as aforesaid, including overheads and profit.

3. If bidders are unclear or uncertain as to the scope of any item, they shall seek clarification in accordance with ITB 7 prior to submitting their bid.

4. Prices shall be filled in indelible ink, and any alterations necessary due to errors, etc., shall be initialed by the Bidder.

   As specified in the Bid Data Sheet and Special Conditions of Contract, prices shall be fixed and firm for the duration of the Contract, or prices shall be subject to adjustment in accordance with the corresponding Appendix (Price Adjustment) to the Contract Agreement.

5. Bid prices shall be quoted in the manner indicated and in the currencies specified in the Instructions to Bidders in the Bidding Document.

   For each item, bidders shall complete each appropriate column in the respective Schedules, giving the price breakdown as indicated in the Schedules.

   Prices given in the Schedules against each item shall be for the scope covered by that item as detailed in Section 6 (Employer's Requirements) or elsewhere in the Bidding Document.

6. Payments will be made to the Contractor in the currency or currencies indicated under each respective item.

7. When requested by the Employer for the purposes of making payments or part payments, valuing variations or evaluating claims, or for such other purposes as the Employer may reasonably require, the Contractor shall provide the Employer with a breakdown of any composite or lump sum items included in the Schedules.

8. The Bidders shall provide details of quantities and unit rates where required in the Schedules. The quantities and unit rates will be used for the valuation of additional works and variations, should additional works and variations be required.

9. The following abbreviations for units of quantity are used in the Schedules:

cu.m; m^3	=	cubic meters
l.m; m	=	linear meters
sq.m; m^2	=	square meters
LS	=	lump sum
No.	=	number
EA	=	each
Ton	=	metric ton
cct-km or cct-m	=	three phase circuit kilometer length;

10. Where there are discrepancies between the unit prices to compute the total price in Schedules, the unit prices shall prevail and the total prices will be corrected.

    Where there are discrepancies between the total of the amounts given under the column for the price breakdown and the amount given under the Total Price, the former shall prevail and the latter will be corrected accordingly.

    Where there are discrepancies between the total of the amounts of the Schedules and the amount given in Substations Price Summary Sheet for any of the five substations, the former shall prevail and the latter will be corrected accordingly.

    Where there are discrepancies between amounts stated in figures and amounts stated in words, the amounts stated in words shall prevail.

11. Items left blank will be deemed to have been included in other items. The TOTAL for each Schedule and the TOTAL of the Summary shall be deemed to be the total price for executing the Works and sections thereof in complete accordance with the Contract, whether or not each individual item has been priced.

12. When requested by the Employer for the purposes of making payments or part payments, valuing variations or evaluating claims, or for such other purposes as the Employer may reasonably require, the Contractor shall provide the Employer with a breakdown of any composite or lump sum items included in the Schedule.

13. The Bidders shall submit in the Financial Proposal one electronic file (Microsoft Excel) on CDROM containing the financial schedules; in case of any discrepancies between the soft and hard copies, the amounts stated on hard copy shall prevail.

14. The prices to be filled in the price schedule by the Bidders shall be full inclusive value of the work described under the several items, including all costs and expenses which may be required in and for the completion and maintenance of the works, together with all risks, liabilities and obligations set forth or implied in the documents provided for the purposes of tendering.

15. The prices shall include all material supply and installation, tools and equipment, mobilization/demolition, labor, supervision, transport, storage, installation, testing and commissioning, execution and maintenance, facilities, insurances, overheads, profits, taxes and duties of the works.

16. Employer shall direct to the Bidders to furnish the detail breakdown price for the quoted prices. In such case Bidders shall provide the detail breakdown prices for the said items as required by the Employer.

17. Employer shall have the right to remove any item from the Scope of Work due to any requirements and the appropriate value shall be deducted from the Contract Price without any claim from the Contractor, in accordance with the provisions Clause No 7 of the General Condition of Contract.

Summary of Scope of Work

NEPS/SEPS CONNECTOR CONSISTING OF FIVE SUBSTATIONS LOCATED AT QARABAGH, MOQOR, SHAH JOY, QALAT, AND KANDAHAR EAST

Design, Construct, Test, Deliver and Commission 220kV Substations located at Qarabagh, Moqor, Shah Joy, Qalat and Kandahar East according to the concept design drawings and specifications contained within this bidding document.

This scope of work is to construct High Voltage 220KV Substations at Qarabagh, and Moqor in Ghazni Province; Shah Joy, and Qalat in Zabul Province; and Kandahar East in Kandahar Province. Technical documents are contained in Section 6 Employer's Requirements.

An over view of this project is as follows:

220KV transmission line will be constructed, under a separate construction package, with two circuits from Ghazni Substation and extended thru new substations to be constructed by this contractor located at Qarabagh, Moqor, Shah Joy, and Qalat, and terminate at Kandahar East substation yard; Substations Yard consists of 220kV buss work, circuit breakers and components, Power Transformers, and Reactive Power Compensation equipment;

Secondary 20kV extension from transformers will extend into control building for medium voltage distribution and controls, and out to riser poles; medium voltage feeder extension to load centers will be performed by DABS;

Four guard towers, one guard shack, control and MV distribution buildings will be constructed in substation.

This construction contractor will be responsible for complete construction including all activities to turnover a fully functional and commissioned substation, Force Protection (guard towers and guard shack) and surrounding boundary wall, and MV distribution system as identified within Section 6 Employer's Requirements.

Summary of Scope of Work ADDENDUM 1

NEPS/SEPS CONNECTOR REACTIVE POWER COMPENSATION SYSTEMS CONSISTING OF EXPANSION OF EXISTING SUBSTATIONS LOCATED AT CHIMTALA, SAYADABAD, GHAZNI, AND NEW SUBSTATION LOCATED AT KANDAHAR EAST

Design, Construct, Test, Deliver and Commission Reactive Power Compensation systems at four locations on the NEPS/SEPS Connector at the following locations and according to the concept design drawings and specifications contained within this bidding document:

Existing Chimtala Substation—System consists of extending the 220kV bus system to accommodate new RPC equipment including Mechanically Switched Reactor (MSR), Mechanically Switched Capacitors (MSC's), and Static VAr Compensator (SVC). Existing 220kV MSR, and 110kV MSC's will be part of the control system of the new Chimtala SVC;

Sayadabad Substation—This is a substation which is currently in the design and construction phase, under a separate contract. This project consists of adding two MSR's to the substation, which will be part of the Chimtala and Kandahar East SVC control systems;

Ghazni Substation—This is a substation which is currently in the design and construction phase, under a separate contract. This project consists of adding two MSR's to the substation, which will be part of the Chimtala and Kandahar East SVC control systems;

Qarabagh, Moqor, Shah Joy, and Qalat Substations—Each of these substations, which are part of this project and listed in separate technical documents, contains two MSR's, which will be part of the Chimtala and Kandahar East SVC control system;

Kandahar East Substation—This project, under separate technical documents, will construct a new substation at Kandahar East. Work for this addendum consists of the SVC system located at the Kandahar East Substation.

Bidding documents include a PSS/E data file to be used for pricing development of SVC. File is Password protected with Password available from DABS. Upon completion of bidding vendors are to delete files. More complete Data will be provided to successful vendor.

This construction contractor will be responsible for complete construction including all activities to turnover a fully functional and commissioned Reactive Power Compensation system for the NEPS/SEPS Connector from Chimtala to Kandahar East Substations, and including monitoring and control at the National Load Control Center (NLCC) located at the Tarakhil Power Plant Site as identified within Section 6 Employer's Requirement Addendum 1.

Substations and Reactive Power Compensation Pricing Summary Sheet			
DABS Project Reference Number: DABS-93-ICB-037			
Bidder Data			
Company Name			
Technical Offer Number			
Date of Bid			
Name of authorized Signatory			
Title of Authorized Signatory			
Bid Summary for:	**Total Substations**	**Total RPC & SVC**	**Grand Total**
Schedule No. 1 (Supply of Major Plant and Equipment)	$0.00	$0.00	
Schedule No. 2 (Supply of 110 KV Plant and Equipment)	$0.00	$0.00	
Schedule No. 3 (Supply of General Plant and Equipment)	$0.00	$0.00	
Schedule No. 4 (Mandatory Spare Parts)	$0.00	$0.00	
Schedule No. 5 (Standard Tools)	$0.00	$0.00	
Schedule No. 6 (Design, Drawings and Documentation)	$0.00	$0.00	
Schedule No. 7 (Installation and Other Charges)	$0.00	$0.00	
Schedule No. 8 (Transfer of Knowledge)	$0.00	$0.00	
Base All Substations and Total RPC & SVC	**$0.00**	**$0.00**	**$0.00**
Contingencies(10% of Base All Substations and Total RPC & SVC)			
Contract Total			

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

PRICE SHEETS

Substation Pricing Summary Sheet						
DABS Project Reference Number: DABS-93-ICB-037						
Bidder Data						
Company Name						
Technical Offer Number						
Date of Bid						
Name of authorized Signatory						
Title of Authorized Signatory						
Bid Summary for:	**Totals**	**Qarabagh**	**Moqor**	**Shah Joy**	**Qalat**	**Kandahar East**
Schedule No. 1 (Supply of Major Plant and Equipment)	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00
Schedule No. 2 (Supply of 110 kV Plant and Equipment)	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00
Schedule No. 3 (Supply of General Plant and Equipment)	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00
Schedule No. 4 (Mandatory Spare Parts)	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00
Schedule No. 5 (Standard Tools)	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00
Schedule No. 6 (Design, Drawings, and Documentation)	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00
Schedule No. 7 (Installation and Other Charges)	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00
Schedule No. 8 (Transfer of Knowledge)	**$0.00**	$0.00	$0.00	$0.00	$0.00	$0.00
Subtotal	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Grand Total					**$0.00**	

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature for Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qarabagh					
Schedule No. 1					
Qarabagh Substation: Supply of Major Plant and Equipment					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
1.1	Supply of 220kV Feeder Bays	EA	4		$0.00
1.2	Supply of 220kV Future Feeder Bay	EA	0		$0.00
1.3	Supply of 220kV Transformer Bay	EA	2		$0.00
1.4	Supply of 220kV Future Transformer Bay	EA	0		$0.00
1.5	Supply of 220/110kV Autotransformer Bay	EA	0		$0.00
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
1.7	Supply of Auto Capacitor Bank Bay	EA	0		$0.00
1.8	Supply of Future Auto Capacitor Bay	EA	0		$0.00
1.9	Supply of Reactor Bay	EA	2		$0.00
1.10	Supply of Future Reactor Bay	EA	0		$0.00
1.11	Supply of 20kV Switchgear & Station Battery	LS	1		$0.00
1.12	Supply of Control/Relay/Metering Panels	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 1 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qarabagh					
Schedule No. 2					
Qarabagh Substation: Supply of 110kV Plant and Equipment					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
2.1	Supply of 110kV Feeder Bays	EA	0		$0.00
2.2	Supply of 110kV Future Feeder Bay	EA	0		$0.00
2.3	Supply of 110kV Source Bay	EA	0		$0.00
2.4	Supply of 110kV Future Source Bay	EA	0		$0.00
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 2 Total			$0.00

Design, Procure, Construct, Test and Commission a 220kV Substation at Qarabagh					
Schedule No. 3 **Qarabagh Substation: Supply of General Plant and Equipment**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
3.1	Supply of Substation Fence & Gates	LS	1		$0.00
3.2	Supply of Control and Other Buildings	LS	1		$0.00
3.3	Supply of 400V Building Power Distribution	LS	1		$0.00
3.4	Supply of Utility Systems & Connections	LS	1		$0.00
3.5	Supply of General Area Ground Grid System	LS	1		$0.00
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1		$0.00
3.7	Supply of Concrete Wireway Trenches	LS	1		$0.00
3.8	Supply of Emergency Generator & Fuel System	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 3 Total			$0.00

I hereby certify that the above information is correct. Name of Bidder:

Seal: Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qarabagh					
Schedule No. 4 **Qarabagh Substation: Mandatory Spare Parts**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
4.1	Protection System	LS	1		$0.00
4.2	HV Control Equipment	LS	1		$0.00
4.3	LV AC System	LS	1		$0.00
4.4	DC Distribution System	LS	1		$0.00
4.5	HV Equipment	LS	1		$0.00
4.6	20kV Metal Clad Switchgear	LS	1		$0.00
4.7	Power Transformers	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 4 Total			$0.00

Design, Procure, Construct, Test and Commission a 220kV Substation at Qarabagh					
Schedule No. 5 **Qarabagh Substation: Standard Tools**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
5.1	Substation Maintenance Tools & Appliances	LS	1		$0.00
5.2	20kV MV Cables	LS	1		$0.00
5.3	20kV Metal Clad Switchgear	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 5 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qarabagh

Schedule No. 6

Qarabagh Substation: Design, Drawings and Documentation

Item No.	Description	Units	QTY	Unit Price	Amount
6.1	Structural Design And General Arrangement Drawings	LS	1		$0.00
6.2	Site Civil Design Drawings	LS	1		$0.00
6.3	Building and Structure Design Drawings	LS	1		$0.00
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1		$0.00
6.5	Control Circuits & Wiring Drawings	LS	1		$0.00
6.6	Coordination Study & Relay Settings Instructions	LS	1		$0.00
6.7	General Construction Drawings	LS	1		$0.00
6.8	As Built Drawings	LS	1		$0.00
6.9	Maintenance Manual And Completion Report	LS	1		$0.00
		Schedule No. 6 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qarabagh

Schedule No.7

Qarabagh Substation: Installation and Other Charges

Item No.	Description	Units	QTY	Unit Price	Amount
7.1	Project Management	LS	1		$0.00
7.2	Project Reporting	LS	1		$0.00
7.3	Project Insurance	LS	1		$0.00
7.4	Compliance with MOSS	LS	1		$0.00
7.5	Surveying, Grading, Roads, Site Preparation & Finish	LS	1		$0.00
7.6	Pavement of Road & Parking Areas	LS	1		$0.00
7.7	Security Wall, Towers, & Gates	LS	1		$0.00
7.8	Installation of 220kV Feeder Bays	EA	4		$0.00
7.9	Installation of 220kV Future Feeder Bay	EA	0		$0.00
7.10	Installation of 220kV Transformer Bay	EA	2		$0.00
7.11	Installation of 220kV Future Transformer Bay	EA	0		$0.00
7.12	Installation of 220/110kV Autotransformer Bay	EA	0		$0.00
7.13	Installation of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
7.14	Installation of Auto Capacitor Bank Bay	EA	0		$0.00
7.15	Installation of Future Auto Capacitor Bay	EA	0		$0.00
7.16	Installation of Reactor Bay	EA	2		$0.00
7.17	Installation of Future Reactor Bay	EA	0		$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qarabagh

Schedule No.7

Qarabagh Substation: Installation and Other Charges (continued)

Item No.	Description	Units	QTY	Unit Price	Amount
7.18	Installation of 20kV Switchgear	LS	1		$0.00
7.19	Installation of Control/Relay/Metering Panels	LS	1		$0.00
7.20	Installation of 110kV Feeder Bays	EA	0		$0.00
7.21	Installation of 110kV Future Feeder Bay	EA	0		$0.00
7.22	Installation of 110kV Source Bay	EA	0		$0.00
7.23	Installation of 110kV Future Source Bay	EA	0		$0.00
7.24	Installation of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
7.25	Installation of Substation Fence & Gates	LS	1		$0.00
7.26	Installation of Control and Other Buildings	LS	1		$0.00
7.27	Installation of 400V Building Power Distribution	LS	1		$0.00
7.28	Installation of Utility Systems & Connections	LS	1		$0.00
7.29	Installation of General Area Ground Grid System	LS	1		$0.00
7.30	Installation of Underground Conduit, Control & Power Cables	LS	1		$0.00
7.31	Installation of Concrete Wireway Trenches	LS	1		$0.00
7.32	Installation of Emergency Generator & Fuel System	LS	1		$0.00
7.33	Testing and Commissioning	LS	1		$0.00
		Schedule No.7 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qarabagh					
Schedule No. 8 **Qarabagh Substation: Transfer of Knowledge**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
8.1	Training of Operation & Maintenance Management Staff	LS	1		$0.00
8.2	On-Site training during construction and commissioning	LS	1		$0.00
8.3	Training of Operation & Maintenance General Staff	LS	1		$0.00
		Schedule No. 8 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Moqor					
Schedule No. 1					
Moqor Substation: Supply of Major Plant and Equipment					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
1.1	Supply of 220kV Feeder Bays	EA	4		$0.00
1.2	Supply of 220kV Future Feeder Bay	EA	0		$0.00
1.3	Supply of 220kV Transformer Bay	EA	2		$0.00
1.4	Supply of 220kV Future Transformer Bay	EA	0		$0.00
1.5	Supply of 220/110kV Autotransformer Bay	EA	0		$0.00
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
1.7	Supply of Auto Capacitor Bank Bay	EA	0		$0.00
1.8	Supply of Future Auto Capacitor Bay	EA	0		$0.00
1.9	Supply of Reactor Bay	EA	2		$0.00
1.10	Supply of Future Reactor Bay	EA	0		$0.00
1.11	Supply of 20kV Switchgear & Station Battery	LS	1		$0.00
1.12	Supply of Control/Relay/Metering Panels	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 1 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Moqor

Schedule No. 2

Moqor Substation: Supply of 110kV Plant and Equipment

Item No.	Description	Units	QTY	Unit Price	Amount
2.1	Supply of 110kV Feeder Bays	EA	0		$0.00
2.2	Supply of 110kV Future Feeder Bay	EA	0		$0.00
2.3	Supply of 110kV Source Bay	EA	0		$0.00
2.4	Supply of 110kV Future Source Bay	EA	0		$0.00
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 2 Total			$0.00

Design, Procure, Construct, Test and Commission a 220kV Substation at Moqor

Schedule No. 3

Moqor Substation: Supply of General Plant and Equipment

Item No.	Description	Units	QTY	Unit Price	Amount
3.1	Supply of Substation Fence & Gates	LS	1		$0.00
3.2	Supply of Control and Other Buildings	LS	1		$0.00
3.3	Supply of 400V Building Power Distribution	LS	1		$0.00
3.4	Supply of Utility Systems & Connections	LS	1		$0.00
3.5	Supply of Ground Grid System	LS	1		$0.00
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1		$0.00
3.7	Supply of Concrete Wireway Trenches	LS	1		$0.00
3.8	Supply of Emergency Generator & Fuel System	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 3 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Moqor					
Schedule No. 4 **Moqor Substation: Mandatory Spare Parts**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
4.1	Protection System	LS	1		$0.00
4.2	HV Control Equipment	LS	1		$0.00
4.3	LV AC System	LS	1		$0.00
4.4	DC Distribution System	LS	1		$0.00
4.5	HV Equipment	LS	1		$0.00
4.6	20kV Metal Clad Switchgear	LS	1		$0.00
4.7	Power Transformers	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 4 Total			$0.00
Schedule No. 5 **Moqor Substation: Standard Tools**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
5.1	Substation Maintenance Tools & Appliances	LS	1		$0.00
5.2	20kV MV Cables	LS	1		$0.00
5.3	20kV Metal Clad Switchgear	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 5 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Moqor

Schedule No. 6

Moqor Substation: Design, Drawings and Documentation

Item No.	Description	Units	QTY	Unit Price	Amount
6.1	Structural Design And General Arrangement Drawings	LS	1		$0.00
6.2	Site Civil Design Drawings	LS	1		$0.00
6.3	Building and Structure Design Drawings	LS	1		$0.00
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1		$0.00
6.5	Control Circuits & Wiring Drawings	LS	1		$0.00
6.6	Coordination Study & Relay Settings Instructions	LS	1		$0.00
6.7	General Construction Drawings	LS	1		$0.00
6.8	As Built Drawings	LS	1		$0.00
6.9	Maintenance Manual And Completion Report	LS	1		$0.00
		Schedule No. 6 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Moqor

Schedule No. 7

Moqor Substation: Installation and Other Charges

Item No.	Description	Units	QTY	Unit Price	Amount
7.1	Project Management	LS	1		$0.00
7.2	Project Reporting	LS	1		$0.00
7.3	Project Insurance	LS	1		$0.00
7.4	Compliance with MOSS	LS	1		$0.00
7.5	Surveying, Grading, Roads, Site Preparation & Finish	LS	1		$0.00
7.6	Pavement of Road & Parking Areas	LS	1		$0.00
7.7	Security Wall, Towers, & Gates	LS	1		$0.00
7.8	Installation of 220kV Feeder Bays	EA	4		$0.00
7.9	Installation of 220kV Future Feeder Bay	EA	0		$0.00
7.10	Installation of 220kV Transformer Bay	EA	2		$0.00
7.11	Installation of 220kV Future Transformer Bay	EA	0		$0.00
7.12	Installation of 220/110kV Autotransformer Bay	EA	0		$0.00
7.13	Installation of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
7.14	Installation of Auto Capacitor Bank Bay	EA	0		$0.00
7.15	Installation of Future Auto Capacitor Bay	EA	0		$0.00
7.16	Installation of Reactor Bay	EA	2		$0.00
7.17	Installation of Future Reactor Bay	EA	0		$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Moqor					
Schedule No. 7 **Moqor Substation: Installation and Other Charges (continued)**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
7.18	Installation of 20KV Switchgear	LS	1		$0.00
7.19	Installation of Control/Relay/Metering Panels	LS	1		$0.00
7.20	Installation of 110kV Feeder Bays	EA	0		$0.00
7.21	Installation of 110kV Future Feeder Bay	EA	0		$0.00
7.22	Installation of 110kV Source Bay	EA	0		$0.00
7.23	Installation of 110kV Future Source Bay	EA	0		$0.00
7.24	Installation of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
7.25	Installation of Substation Fence & Gates	LS	1		$0.00
7.26	Installation of Control and Other Buildings	LS	1		$0.00
7.27	Installation of 400V Building Power Distribution	LS	1		$0.00
7.28	Installation of Utility Systems & Connections	LS	1		$0.00
7.29	Installation of Ground Grid System	LS	1		$0.00
7.30	Installation of Underground Conduit, Control & Power Cables	LS	1		$0.00
7.31	Installation of Concrete Wireway Trenches	LS	1		$0.00
7.32	Installation of Emergency Generator & Fuel System	LS	1		$0.00
7.33	Testing and Commissioning	LS	1		$0.00
		Schedule No. 7 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Moqor `					
Schedule No. 8 **Moqor Substation: Transfer of Knowledge**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
8.1	Training of Operation & Maintenance Management Staff	LS	1		$0.00
8.2	On-Site training during construction and commissioning	LS	1		$0.00
8.3	Training of Operation & Maintenance General Staff	LS	1		$0.00
		Schedule No. 8 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Shah Joy

Schedule No. 1

Shah Joy Substation: Supply of Major Plant and Equipment

Item No.	Description	Units	QTY	Unit Price	Amount
1.1	Supply of 220kV Feeder Bays	EA	4		$0.00
1.2	Supply of 220kV Future Feeder Bay	EA	0		$0.00
1.3	Supply of 220kV Transformer Bay	EA	2		$0.00
1.4	Supply of 220kV Future Transformer Bay	EA	0		$0.00
1.5	Supply of 220/110kV Autotransformer Bay	EA	0		$0.00
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
1.7	Supply of Auto Capacitor Bank Bay	EA	0		$0.00
1.8	Supply of Future Auto Capacitor Bay	EA	0		$0.00
1.9	Supply of Reactor Bay	EA	2		$0.00
1.10	Supply of Future Reactor Bay	EA	0		$0.00
1.11	Supply of 20kV Switchgear & Station Battery	LS	1		$0.00
1.12	Supply of Control/Relay/Metering Panels	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 1 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Shahjoy

Schedule No. 2

Shah Joy Substation: Supply of 110kV Plant and Equipment

Item No.	Description	Units	QTY	Unit Price	Amount
2.1	Supply of 110kV Feeder Bays	EA	0		$0.00
2.2	Supply of 110kV Future Feeder Bay	EA	0		$0.00
2.3	Supply of 110kV Source Bay	EA	0		$0.00
2.4	Supply of 110kV Future Source Bay	EA	0		$0.00
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 2 Total			$0.00

Design, Procure, Construct, Test and Commission a 220kV Substation at Shahjoy

Schedule No. 3

Shah Joy Substation: Supply of General Plant and Equipment

Item No.	Description	Units	QTY	Unit Price	Amount
3.1	Supply of Substation Fence & Gates	LS	1		$0.00
3.2	Supply of Control and Other Buildings	LS	1		$0.00
3.3	Supply of 400V Building Power Distribution	LS	1		$0.00
3.4	Supply of Utility Systems & Connections	LS	1		$0.00
3.5	Supply of General Area Ground Grid System	LS	1		$0.00
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1		$0.00
3.7	Supply of Concrete Wireway Trenches	LS	1		$0.00
3.8	Supply of Emergency Generator & Fuel System	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 3 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Shahjoy

Schedule No. 4

Shah Joy Substation: Mandatory Spare Parts

Item No.	Description	Units	QTY	Unit Price	Amount
4.1	Protection System	LS	1		$0.00
4.2	HV Control Equipment	LS	1		$0.00
4.3	LV AC System	LS	1		$0.00
4.4	DC Distribution System	LS	1		$0.00
4.5	HV Equipment	LS	1		$0.00
4.6	20kV Metal Clad Switchgear	LS	1		$0.00
4.7	Power Transformers	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 4 Total			$0.00

Schedule No. 5

Shah Joy Substation: Standard Tools

Item No.	Description	Units	QTY	Unit Price	Amount
5.1	Substation Maintenance Tools & Appliances	LS	1		$0.00
5.2	20kV MV Cables	LS	1		$0.00
5.3	20kV Metal Clad Switchgear	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 5 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Shahjoy					
Schedule No. 6					
Shah Joy Substation: Design, Drawings and Documentation					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
6.1	Structural Design And General Arrangement Drawings	LS	1		$0.00
6.2	Site Civil Design Drawings	LS	1		$0.00
6.3	Building and Structure Design Drawings	LS	1		$0.00
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1		$0.00
6.5	Control Circuits & Wiring Drawings	LS	1		$0.00
6.6	Coordination Study & Relay Settings Instructions	LS	1		$0.00
6.7	General Construction Drawings	LS	1		$0.00
6.8	As Built Drawings	LS	1		$0.00
6.9	Maintenance Manual And Completion Report	LS	1		$0.00
		Schedule No. 6 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Shahjoy					
Schedule No. 7					
Shah Joy Substation: Installation and other charges					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
7.1	Project Management	LS	1		$0.00
7.2	Project Reporting	LS	1		$0.00
7.3	Project Insurance	LS	1		$0.00
7.4	Compliance with MOSS	LS	1		$0.00
7.5	Surveying, Grading, Roads, Site Preparation & Finish	LS	1		$0.00
7.6	Pavement of Road & Parking Areas	LS	1		$0.00
7.7	Security Wall, Towers, & Gates	LS	1		$0.00
7.8	Installation of 220kV Feeder Bays	EA	4		$0.00
7.9	Installation of 220kV Future Feeder Bay	EA	0		$0.00
7.10	Installation of 220kV Transformer Bay	EA	2		$0.00
7.11	Installation of 220kV Future Transformer Bay	EA	0		$0.00
7.12	Installation of 220/110kV Autotransformer Bay	EA	0		$0.00
7.13	Installation of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
7.14	Installation of Auto Capacitor Bank Bay	EA	0		$0.00
7.15	Installation of Future Auto Capacitor Bay	EA	0		$0.00
7.16	Installation of Reactor Bay	EA	2		$0.00
7.17	Installation of Future Reactor Bay	EA	0		$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Shahjoy

Schedule No. 7

Shah Joy Substation: Installation and Other Charges (continued)

Item No.	Description	Units	QTY	Unit Price	Amount
7.18	Installation of 20kV Switchgear	LS	1		$0.00
7.19	Installation of Control/Relay/Metering Panels	LS	1		$0.00
7.20	Installation of 110kV Feeder Bays	EA	0		$0.00
7.21	Installation of 110kV Future Feeder Bay	EA	0		$0.00
7.22	Installation of 110kV Source Bay	EA	0		$0.00
7.23	Installation of 110kV Future Source Bay	EA	0		$0.00
7.24	Installation of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
7.25	Installation of Substation Fence & Gates	LS	1		$0.00
7.26	Installation of Control and Other Buildings	LS	1		$0.00
7.27	Installation of 400V Building Power Distribution	LS	1		$0.00
7.28	Installation of Utility Systems & Connections	LS	1		$0.00
7.29	Installation of General Area Ground Grid System	LS	1		$0.00
7.30	Installation of Underground Conduit, Control & Power Cables	LS	1		$0.00
7.31	Installation of Concrete Wireway Trenches	LS	1		$0.00
7.32	Installation of Emergency Generator & Fuel System	LS	1		$0.00
7.33	Testing and Commissioning	LS	1		$0.00
		Seal: Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Shahjoy					
Schedule No. 8 **Shah Joy Substation: Transfer of Knowledge**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
8.1	Training of Operation & Maintenance Management Staff	LS	1		$0.00
8.2	On-Site training during construction and commissioning	LS	1		$0.00
8.3	Training of Operation & Maintenance General Staff	LS	1		$0.00
		Schedule No. 8 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qalat					
Schedule No. 1 **Qalat Substation: Supply of Major Plant and Equipment**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
1.1	Supply of 220kV Feeder Bays	EA	4		$0.00
1.2	Supply of 220kV Future Feeder Bay	EA	0		$0.00
1.3	Supply of 220kV Transformer Bay	EA	2		$0.00
1.4	Supply of 220kV Future Transformer Bay	EA	0		$0.00
1.5	Supply of 220/110kV Autotransformer Bay	EA	0		$0.00
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
1.7	Supply of Auto Capacitor Bank Bay	EA	0		$0.00
1.8	Supply of Future Auto Capacitor Bay	EA	0		$0.00
1.9	Supply of Reactor Bay	EA	2		$0.00
1.10	Supply of Future Reactor Bay	EA	0		$0.00
1.11	Supply of 20kV Switchgear & Station Battery	LS	1		$0.00
1.12	Supply of Control/Relay/Metering Panels	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 1 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qalat

Schedule No. 2

Qalat Substation: Supply of 110kV Plant and Equipment

Item No.	Description	Units	QTY	Unit Price	Amount
2.1	Supply of 110kV Feeder Bays	EA	0		$0.00
2.2	Supply of 110kV Future Feeder Bay	EA	0		$0.00
2.3	Supply of 110kV Source Bay	EA	0		$0.00
2.4	Supply of 110kV Future Source Bay	EA	0		$0.00
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 2 Total			$0.00

Design, Procure, Construct, Test and Commission a 220kV Substation at Qalat

Schedule No. 3

Qalat Substation: Supply of General Plant and Equipment

Item No.	Description	Units	QTY	Unit Price	Amount
3.1	Supply of Substation Fence & Gates	LS	1		$0.00
3.2	Supply of Control and Other Buildings	LS	1		$0.00
3.3	Supply of 400V Building Power Distribution	LS	1		$0.00
3.4	Supply of Utility Systems & Connections	LS	1		$0.00
3.5	Supply of Ground Grid System	LS	1		$0.00
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1		$0.00
3.7	Supply of Concrete Wireway Trenches	LS	1		$0.00
3.8	Supply of Emergency Generator & Fuel System	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 3 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qalat					
Schedule No.4 **Qalat Substation: Mandatory Spare Parts**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
4.1	Protection System	LS	1		$0.00
4.2	HV Control Equipment	LS	1		$0.00
4.3	LV AC System	LS	1		$0.00
4.4	DC Distribution System	LS	1		$0.00
4.5	HV Equipment	LS	1		$0.00
4.6	20kV Metal Clad Switchgear	LS	1		$0.00
4.7	Power Transformers	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No.4 Total			$0.00
Schedule No.5 **Qalat Substation: Standard Tools**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
5.1	Substation Maintenance Tools & Appliances	LS	1		$0.00
5.2	20kV MV Cables	LS	1		$0.00
5.3	20kV Metal Clad Switchgear	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No.5 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qalat					
Schedule No. 6					
Qalat Substation: Design, Drawings and Documentation					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
6.1	Structural Design And General Arrangement Drawings	LS	1		$0.00
6.2	Site Civil Design Drawings	LS	1		$0.00
6.3	Building and Structure Design Drawings	LS	1		$0.00
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1		$0.00
6.5	Control Circuits & Wiring Drawings	LS	1		$0.00
6.6	Coordination Study & Relay Settings Instructions	LS	1		$0.00
6.7	General Construction Drawings	LS	1		$0.00
6.8	As Built Drawings	LS	1		$0.00
6.9	Maintenance Manual And Completion Report	LS	1		$0.00
		Schedule No. 6 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qalat

Schedule No. 7

Qalat Substation: Installation and Other Charges

Item No.	Description	Units	QTY	Unit Price	Amount
7.1	Project Management	LS	1		$0.00
7.2	Project Reporting	LS	1		$0.00
7.3	Project Insurance	LS	1		$0.00
7.4	Compliance with MOSS	LS	1		$0.00
7.5	Surveying, Grading, Roads, Site Preparation & Finish	LS	1		$0.00
7.6	Pavement of Road & Parking Areas	LS	1		$0.00
7.7	Security Wall, Towers, & Gates	LS	1		$0.00
7.8	Installation of 220kV Feeder Bays	EA	4		$0.00
7.9	Installation of 220kV Future Feeder Bay	EA	0		$0.00
7.10	Installation of 220kV Transformer Bay	EA	2		$0.00
7.11	Installation of 220kV Future Transformer Bay	EA	0		$0.00
7.12	Installation of 220/110kV Autotransformer Bay	EA	0		$0.00
7.13	Installation of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
7.14	Installation of Auto Capacitor Bank Bay	EA	0		$0.00
7.15	Installation of Future Auto Capacitor Bay	EA	0		$0.00
7.16	Installation of Reactor Bay	EA	2		$0.00
7.17	Installation of Future Reactor Bay	EA	0		$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qalat					
Schedule No. 7 **Qalat Substation: Installation and Other Charges continued**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
7.18	Installation of 20kV Switchgear	LS	1		$0.00
7.19	Installation of Control/Relay/Metering Panels	LS	1		$0.00
7.20	Installation of 110kV Feeder Bays	EA	0		$0.00
7.21	Installation of 110kV Future Feeder Bay	EA	0		$0.00
7.22	Installation of 110kV Source Bay	EA	0		$0.00
7.23	Installation of 110kV Future Source Bay	EA	0		$0.00
7.24	Installation of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
7.25	Installation of Substation Fence & Gates	LS	1		$0.00
7.26	Installation of Control and Other Buildings	LS	1		$0.00
7.27	Installation of 400V Building Power Distribution	LS	1		$0.00
7.28	Installation of Utility Systems & Connections	LS	1		$0.00
7.29	Installation of Ground Grid System	LS	1		$0.00
7.30	Installation of Underground Conduit, Control & Power Cables	LS	1		$0.00
7.31	Installation of Concrete Wireway Trenches	LS	1		$0.00
7.32	Installation of Emergency Generator & Fuel System	LS	1		$0.00
7.33	Testing and Commissioning	LS	1		$0.00
		Schedule No. 7 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Qalat					
Schedule No. 8 **Qalat Substation: Transfer of Knowledge**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
8.1	Training of Operation & Maintenance Management Staff	LS	1		$0.00
8.2	On-Site training during construction and commissioning	LS	1		$0.00
8.3	Training of Operation & Maintenance General Staff	LS	1		$0.00
		Schedule No. 8 Total			$0.00

Name of Bidder:

Seal: Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Kandahar East					
Schedule No. 1					
Kandahar East Substation: Supply of Major Plant and Equipment					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
1.1	Supply of 220kV Feeder Bays	EA	2		$0.00
1.2	Supply of 220kV Future Feeder Bay	EA	5		$0.00
1.3	Supply of 220kV Transformer Bay	EA	2		$0.00
1.4	Supply of 220kV Future Transformer Bay	EA	2		$0.00
1.5	Supply of 220/110kV Autotransformer Bay	EA	2		$0.00
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
1.7	Supply of Auto Capacitor Bank Bay	EA	0		$0.00
1.8	Supply of Future Auto Capacitor Bay	EA	2		$0.00
1.9	Supply of Reactor Bay	EA	2		$0.00
1.10	Supply of Future Reactor Bay	EA	0		$0.00
1.11	Supply of 20kV Switchgear & Station Battery	LS	1		$0.00
1.12	Supply of Control/Relay/Metering Panels	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 1 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Kandahar East

Schedule No. 2

Kandahar East Substation: Supply of 110kV Plant and Equipment

Item No.	Description	Units	QTY	Unit Price	Amount
2.1	Supply of 110kV Feeder Bays	EA	4		$0.00
2.2	Supply of 110kV Future Feeder Bay	EA	0		$0.00
2.3	Supply of 110kV Source Bay	EA	2		$0.00
2.4	Supply of 110kV Future Source Bay	EA	0		$0.00
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 2 Total			$0.00

Design, Procure, Construct, Test and Commission a 220kV Substation at Kandahar East

Schedule No. 3

Kandahar East Substation: Supply of General Plant and Equipment

Item No.	Description	Units	QTY	Unit Price	Amount
3.1	Supply of Substation Fence & Gates	LS	1		$0.00
3.2	Supply of Control and Other Buildings	LS	1		$0.00
3.3	Supply of 400V Building Power Distribution	LS	1		$0.00
3.4	Supply of Utility Systems & Connections	LS	1		$0.00
3.5	Supply of General Area Ground Grid System	LS	1		$0.00
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1		$0.00
3.7	Supply of Concrete Wireway Trenches	LS	1		$0.00
3.8	Supply of Emergency Generator & Fuel System	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 3 Total			$0.00

I hereby certify that the above information is correct. Name of Bidder:

Seal: Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Kandahar East					
Schedule No. 4					
Kandahar East Substation: Mandatory Spare Parts					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
4.1	Protection System	LS	1		$0.00
4.2	HV Control Equipment	LS	1		$0.00
4.3	LV AC System	LS	1		$0.00
4.4	DC Distribution System	LS	1		$0.00
4.5	HV Equipment	LS	1		$0.00
4.6	20kV Metal Clad Switchgear	LS	1		$0.00
4.7	Power Transformers	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 4 Total			$0.00
Schedule No. 5					
Kandahar East Substation: Standard Tools					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
5.1	Substation Maintenance Tools & Appliances	LS	1		$0.00
5.2	20kV MV Cables	LS	1		$0.00
5.3	20kV Metal Clad Switchgear	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 5 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Kandahar East

Schedule No. 6

Kandahar East Substation: Design, Drawings and Documentation

Item No.	Description	Units	QTY	Unit Price	Amount
6.1	Structural Design And General Arrangement Drawings	LS	1		$0.00
6.2	Site Civil Design Drawings	LS	1		$0.00
6.3	Building and Structure Design Drawings	LS	1		$0.00
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1		$0.00
6.5	Control Circuits & Wiring Drawings	LS	1		$0.00
6.6	Coordination Study & Relay Settings Instructions	LS	1		$0.00
6.7	General Construction Drawings	LS	1		$0.00
6.8	As Built Drawings	LS	1		$0.00
6.9	Maintenance Manual And Completion Report	LS	1		$0.00
		Schedule No. 6 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Kandahar East					
Schedule No. 7					
Kandahar East Substation: Installation and Other Charges					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
7.1	Project Management	LS	1		$0.00
7.2	Project Reporting	LS	1		$0.00
7.3	Project Insurance	LS	1		$0.00
7.4	Compliance with MOSS	LS	1		$0.00
7.5	Surveying, Grading, Roads, Site Preparation & Finish	LS	1		$0.00
7.6	Pavement of Road & Parking Areas	LS	1		$0.00
7.7	Security Wall, Towers, & Gates	LS	1		$0.00
7.8	Installation of 220kV Feeder Bays	EA	2		$0.00
7.9	Installation of 220kV Future Feeder Bay	EA	5		$0.00
7.10	Installation of 220kV Transformer Bay	EA	2		$0.00
7.11	Installation of 220kV Future Transformer Bay	EA	2		$0.00
7.12	Installation of 220/110kV Autotransformer Bay	EA	2		$0.00
7.13	Installation of 220kV Bus Coupler & Metering Bay	EA	1		$0.00
7.14	Installation of Auto Capacitor Bank Bay	EA	0		$0.00
7.15	Installation of Future Auto Capacitor Bay	EA	2		$0.00
7.16	Installation of Reactor Bay	EA	2		$0.00
7.17	Installation of Future Reactor Bay	EA	0		$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Kandahar East					
Schedule No. 7					
Kandahar 220kv SS Substation: Installation and Other Charges continued					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
7.18	Installation of 20kV Switchgear	LS	1		$0.00
7.19	Installation of Control/Relay/Metering Panels	LS	1		$0.00
7.20	Installation of 110kV Feeder Bays	EA	4		$0.00
7.21	Installation of 110kV Future Feeder Bay	EA	0		$0.00
7.22	Installation of 110kV Source Bay	EA	2		$0.00
7.23	Instrallation of 110kV Future Source Bay	EA	0		$0.00
7.24	Installation of 110kV Bus Coupler & Metering Bay	EA	1		$0.00
7.20	Installation of Substation Fence & Gates	LS	1		$0.00
7.21	Installation of Control and Other Buildings	LS	1		$0.00
7.22	Installation of 400V Building Power Distribution	LS	1		$0.00
7.23	Installation of Utility Systems & Connections	LS	1		$0.00
7.24	Installation of General Area Ground Grid System	LS	1		$0.00
7.25	Installation of Underground Conduit, Control & Power Cables	LS	1		$0.00
7.26	Installation of Concrete Wireway Trenches	LS	1		$0.00
7.27	Installation of Emergency Generator & Fuel System	LS	1		$0.00
7.28	Testing and Commissioning	LS	1		$0.00
		Schedule No. 7 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission a 220kV Substation at Kandahar East					
Schedule No. 8 **Kandahar East Substation: Transfer of Knowledge**					
Item No.	**Description**	**Units**	**QTY**	**Unit Price**	**Amount**
8.1	Training of Operation & Maintenance Management Staff	LS	1		$0.00
8.2	On-Site training during construction and commissioning	LS	1		$0.00
8.3	Training of Operation & Maintenance General Staff	LS	1		$0.00
		Schedule No. 8 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:
awaiting

Seal:

Signature of Bidder:

Glossary of Bidding Schedules for Substations		
Schedule Number	**Item No.**	**Item Description**
Schedule No. 1 Supply of Major Plant and Equipment	**1.1**	**Supply of 220kV Feeder Bays:** Supply of all the 220KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.2	**Supply of 220kV Future Feeder Bay:** Supply of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.3	**Supply of 220kV Transformer Bay:** Supply of all the 220KV/20KV power transformers with OLTC (if specified), all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.4	**Supply of 220kV Future Transformer Bay:** Supply of all the structures, foundations, and related area ground grid system required for 220kV Future Transformer Bay(s) as shown and detailed in drawing package.
	1.5	**Supply of 220/110kV Autotransformer Bay**: Supply of all the 220KV/110KV power transformers, all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.6	**Supply of 220kV Bus Coupler & Metering Bay:** Supply of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system. Couplers and metering equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.7	**Supply of Auto Capacitor Bank Bay:** Supply of all the capacitors, breakers, manual/motorized switches, associated equipment, accessories, and related area ground grid system as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.

Schedule Number	Item No.	Item Description
Schedule No. 1 Supply of Major Plant and Equipment (continued)	**1.8**	**Supply of Future Auto Capacitor Bay:** Supply of all the structures, foundations, and related area ground grid system required for Future Auto Capacitor Bay(s) as shown and detailed in drawing package.
	1.9	**Supply of Reactor Bay:** Supply of all the substation dead end Gantry structures, station steel, manual motorized switches, breakers, buses, insulators, RPC, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.10	**Supply of Future Reactor Bay:** Supply of all the substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for future Reactor Bay(s) as shown and detailed in drawing package.
	1.11	**Supply of 20kV Switchgear & Station Battery:** Supply of all the switchgear equipment, station batteries, conduit stubs, concrete ducting, insulators, surge arrestors, connectors, and the associated termination hardware kits. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.12	**Supply of Control/Relay/Metering Panels:** Supply of all the panels, breakers, relays, contactors, conductors, indicator lights, labeling, starters, meters, associated equipment and accessories. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
Schedule No. 2 Supply of 110kV Plant and Equipment	**2.1**	**Supply of 110kV Feeder Bays** Supply of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	2.2	**Supply of 110kV Future Feeder Bay** Supply of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	2.3	**Supply of 110kV Source Bay** Supply of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	2.4	**Supply of 110kV Future Source Bay** Supply of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	2.5	**Supply of 110kV Bus Coupler & Metering Bay** Supply of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system. Couplers and metering equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.

Schedule Number	Item No.	Item Description
Schedule No. 3 Supply of General Plant and Equipment	**3.1**	**Supply of Substation Fence & Gates:** Supply of all suitable and appropriate fencing materials, posts, gates, and warning labels. Equipment shall be designed and manufactured IAW rated performance specifications.
	3.2	**Supply of Control and Other Buildings:** Supply of all the equipment and materials necessary for completion of Control and Other Buildings along with their necessary water, sewer and HVAC systems.
	3.3	**Supply of 400V Building Power Distribution:** Supply of all panels, breakers, wiring, outlets, switches, lights, and other equipment required for 400V Building Power Distribution.
	3.4	**Supply of Utility Systems & Connections:** Supply of all the equipment necessary for complete connection of all the sewer, water, and 230/400V electrical mains to the Utility system at the location shown on the Drawings.
	3.5	**Supply of General Area Ground Grid System:** Supply of all the ground rods and ground conductors required for a complete Ground Grid System. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications. This item is for grounding systems external to HV Bays; each bay price includes its ground grid system.
	3.6	**Supply of Underground Conduit, Control & Power Cables:** Supply of all conduit (PVC or steel), control, and power cables required for a complete substation as shown in the Drawings and performance specifications such that wiring can be completed without splicing of cables.
	3.7	**Supply of Concrete Wireway Trenches:** Supply of pre-fabricated concrete wireway trenches and any associated equipment and accessories. All material shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	3.8	**Supply of Emergency Generator & Fuel System:** Supply of a generator, fuel, and fuel storage. Equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.

Schedule Number	Item No.	Item Description
Schedule No. 4 Mandatory Spare Parts	**4.1**	**Protection System:** The Supply of all the spare relays, SCADA spare parts, optical fiber cables, and fuses.
	4.2	**220kV Control Equipment:** The Supply of spare relays, fuses, and control panels.
	4.3	**LV AC System:** The supply of all the spares for power distribution boards, breakers, backup generator, lights, outlets, wires, conduits, back diesel generator and automatic transfer switches.
	4.4	**DC Distribution System:** Parts for the batteries, associated cables, charger / supply system, DC loads, and distribution power boards.
	4.5	**HV Equipment:** The supply of power transformers parts, parts for switches, breakers, insulators, jumpers, and connectors.
	4.6	**20kV Metal Clad Switchgear:** The switchgear equipment parts, surge arrestors, connectors, and the associated termination hardware kits. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	4.7	**Power Transformers:** All the associated spare parts and accessories for such transformer.
Schedule No.5 Standard Tools	**5.1**	**Substation Maintenance Tools & Appliances:** All the necessary tools required to install, test, inspect and maintain the substation equipment.
	5.2	**20kV MV Cables:** All the tools that are necessary to install, test, maintain and replace such cables.
	5.3	**20kV Metal Clad Switchgear:** All the tools necessary to install, test inspect and maintain this equipment class.

Schedule Number	Item No.	Item Description
Schedule No.6 Design, Drawings and Documentation	**6.1**	**Structural Design And General Arrangement Drawings:** Structural steel calculations, and general arrangement drawings for the equipment and support facilities in the new substation. Design calculations, detailed design drawings, final design deliverables including detailed supporting analyses, survey drawings, soil resistivity measurements, and geological investigation works.
	6.2	**Site Civil Design Drawings:** All civil work drawings for excavating, grading, refilling, forming of the site, leveling and compacting, graveling, control buildings, office, workshop, storage room, battery room, water well, wastewater, drainage system, internal roads, fences, gates, oil interceptor tanks, concrete foundations.
	6.3	**Building and Structure Design Drawings:** All the drawings and any structural calculations and documentations for the control buildings, office, workshop, storage room, battery room and concrete fire protection separation walls.
	6.4	**Single & 3 Line Drawings with Protective Relay Equipment:** All the single and three lines drawings showing the power flow into and out of the substation along with all the control and protective relays functions, protective meters, and panel names where the relays units will be located.
	6.5	**Control Circuits & Wiring Drawings:** The control panels and the wirings connections drawings showing all the control wirings from the control panels to substation yard equipment.
	6.6	**Coordination Study & Relay Settings Instructions:** All the coordination studies for fault zone isolation along with the required settings for the relays determined by the coordination studies with the complete instructions to perform these settings.
	6.7	**General Construction Drawings:** Construction Drawings of all the civil and steel structures showing the construction sequencing for all these structures in the substation.
	6.8	**As Built Drawings:** Updated final documents and design drawings showing all the modifications made on the designs in the field, all CAD drawings for design, construction and installation.
	6.9	**Maintenance Manual And Completion Report:** All the equipment maintenance, repair and adjustments manuals, and full set of assembly drawings including wiring diagrams. Completion report for each section of the works showing the acceptable testing and proper operations of all the installed equipment. Complete instructions for operations, apparatus lists, and spare parts lists containing information needed for ordering all equipment supplied under the contract. The delivery of the following manuals: general description of the equipment, operating instructions that are suitable for training of personnel, general maintenance instructions, spare parts manuals, all layout, and installation drawings.

Schedule Number	Item No.	Item Description
Schedule No.7 Installation and Other Charges	**7.1**	**Project Management:** Planning, execution, monitoring and closing all the design, procurement, construction, testing and commissioning activities and ensuring they are carried out IAW the relevant technical standards and design specifications.
	7.2	**Project Reporting:** The set up of a reporting system from the beginning until the end of the project in which the frequency, format, contents, and the level of details for these reports will be maintained throughout the life cycle of the project.
	7.3	**Project Insurance:** Coverage for any bodily injury or property damage during the performance of the work. Coverage for faulty workmanship. Coverage for error and omission in the design of the project. Coverage for damage caused by hazard materials. Coverage for damage caused by non-excusable delay. The Coverages should cover damages to project during and after construction.
	7.4	**Compliance with MOSS (Minimum Operating Safety Standards):** Strict implementation and compliance with all of the relevant and applicable codes dealing with health, safety, environmental and social safe guards at the site as required per project and the AIF. Site regulations, security plan procedures for the staff, the employer, visiting missions from employer and AIF and the equipment. Implementation of an effective Earthing system at the new substation IAW the latest pertinent standards. Operational and safety labels in both English and local language.
	7.5	**Surveying, Grading, Roads, Site Perpetration & Finish:** Marking and staking the selected location of the substation. Determination of the suitability of the selected site. Testing the soil condition of the site to ensure its ability to support the facility's size and construction requirements. Testing the soil for any toxic contamination of the site. Surveying the wildlife, vegetation, and archeological or historic resources of the site. A development of a detailed site preparation work plan to include measures for any wetlands and endangered species. The marking of any wetlands and special habitats. The consideration of annual breeding and hibernation cycles of certain species in creating the construction schedules. Briefing procedures for the crews on special care while working in sensitive areas, including limiting ground disturbances. The installation of erosion and sedimentation controls at the outer limits of the construction area. The laying of access roads to the site in preparation for the construction activities. Clearing any vegetation present in the access roads and the site of the substation. The grading of the site with all the required fill/cut in accordance with the specifications. The finishing of the ground inside of the substation site with a layer of suitable gravel as determined in the design specifications to ensure proper drainage and provide crews with safe work surface.
	7.6	**Pavement of Road & Parking Areas:** Paving and marking of road and parking areas and materials included. Marking of the roads and parking areas shall be durable paint and/or signs.
	7.7	**Security Wall, Towers, & Gates:** Installation of suitable and appropriate walls, towers, and gates and materials included around the complete substation site.

Schedule Number	Item No.	Item Description
Schedule No.7 Installation and Other Charges (continued)	**7.8**	**Installation of 220kV Feeder Bays:** Installation of all the 220KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
	7.9	**Installation of 220kV Future Feeder Bay:** Installation of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV Future Feeder Bay(s) as shown and detailed in drawing package.
	7.10	**Installation of 220kV Transformer Bay:** Installation of all the 220K/20K power transformers with OLTC (if specified), all associated equipment and accessories, and related area ground grid system.
	7.11	**Installation of 220kV Future Transformer Bay:** Installation of all the structures, foundations, and related area ground grid system required for 220kV Future Transformer Bay(s) as shown and detailed in drawing package.
	7.12	**Installation of 220/110kV Autotransformer Bay:** Installation of all the 220KV/110KV power transformers, all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	7.13	**Installation of 220kV Bus Coupler & Metering Bay:** Installation of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system.
	7.14	**Installation of Auto Capacitor Bank Bay:** Installation of all the capacitors, breakers, manual/motorized switches, associated equipment, accessories, and related area ground grid system.
	7.15	**Installation of Future Auto Capacitor Bay:** Supply of all the structures, foundations, and related area ground grid system required for Future Auto Capacitor Bay(s) as shown and detailed in drawing package.
	7.16	**Installation of Reactor Bay:** Installation of all the substation dead end Gantry structures, station steel, manual motorized switches, breakers, buses, insulators, RPC, and related area ground grid system.
	7.17	**Installation of Future Reactor Bay:** Installation of all the substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for future Reactor Bay(s) as shown and detailed in drawing package.
	7.18	**Installation of 20kV Switchgear:** Installation of all the switchgear equipment, conduit stubs, concrete ducting, insulators, surge arrestors, connectors, and the associated termination hardware kits.
	7.19	**Installation of Control/Relay/Metering Panels:** Installation of all the panels, breakers, relays, contactors, conductors, indicator lights, labeling, starters, meters, associated equipment and accessories.
	7.20	**Installation of 110kV Feeder Bays** Installation of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.

Schedule Number	Item No.	Item Description
Schedule No.7 Installation and Other Charges (continued)	**7.21**	**Installation of 110kV Future Feeder Bay** Installation of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package.
	7.22	**Installation of 110kV Source Bay** Installation of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
	7.23	**Installation of 110kV Future Source Bay** Installation of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Source Bay(s) as shown and detailed in drawing package.
	7.24	**Installation of 110kV Bus Coupler & Metering Bay** Installation of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system.
	7.25	**Installation of Substation Fence & Gates:** The installation of a suitable and appropriate fence around the substation side with the required access gates with warning signs in the local language.
	7.26	**Installation of Control and Other Buildings:** Installation of all the equipment and materials necessary for completion of Control and Other Buildings along with their necessary water, sewer and HVAC systems.
	7.27	**Installation of 400V Building Power Distribution:** Installation of all panels, breakers, wiring, outlets, switches, lights, and other equipment required for 400V Building Power Distribution.
	7.28	**Installation of Utility Systems & Connections:** The permitting and proper connection of all the sewer, water and 230/400V electrical mains to the utilities and the testing of these systems to ensure their proper operations.
	7.29	**Installation of General Area Ground Grid System:** Installation of all the ground rods and ground conductors required for a complete General Area Ground Grid System.
	7.30	**Installation of Underground Conduit, Control & Power Cables:** Installation of all conduit (PVC or steel), control, and power cables and materials included required for a complete substation as shown in the Drawings and performance specifications such that wiring can be completed without splicing of cables.
	7.31	**Installation of Concrete Wireway Trenches:** Digging of trenches and installation of pre-fabricated concrete wireway trenches and any associated equipment and accessories (materials included).
	7.32	**Installation of Emergency Generator & Fuel System:** Installation of a generator, fuel, and fuel storage. Equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	7.33	**Testing and Commissioning:** Completion and full documentation of testing and commissioning for all substation equipment to the satisfaction or the Employer's Engineer.

Schedule Number	Item No.	Item Description
Schedule No.8 **Transfer of Knowledge**	**8.1**	**Training of Operation & Maintenance Management Staff:** Training of the maintenance management personnel on the general operation and maintenance schedules of the substation. Furnishing of all detailed operation, service, maintenance manuals, and complete spare parts list for the substation equipment.
	8.2	**On-Site training during construction and commissioning:** Training of personnel, workers, and laborers to handle the installation, testing and commissioning of the substation equipment. Training for six Employer's appointed personnel on factory inspections and witnessing performance tests for the substation equipment.
	8.3	**Training of Operation & Maintenance General Staff:** Providing the maintenance general personnel a complete and detailed O&M training program on how to operate and perform the periodical maintenance procedures.

Addendum 1 RPC Pricing Summary Sheet					
SVC & RPC Systems at Four Substations					
DABS Project Reference Number: DABS-93-ICB-037					
Bidder Data					
Company Name					
Technical Offer Number					
Date of Bid					
Name of authorized Signatory					
Title of Authorized Signatory					
Bid Summary for:	**Total RPC & SVC**	**Chimtala SVC & RPC**	**Sayadabad RPC**	**Ghazni RPC**	**Kandahar East SVC**
Schedule No. 1 (Supply of Major Plant and Equipment)	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Schedule No. 2 (Supply of 110 KV Plant and Equipment)	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Schedule No. 3 (Supply of General Plant and Equipment)	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Schedule No. 4 (Mandatory Spare Parts)	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Schedule No. 5 (Standard Tools)	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Schedule No. 6 (Design, Drawings and Documentation)	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Schedule No. 7 (Installation and Other Charges)	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Schedule No. 8 (Transfer of Knowledge)	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Each Sub	$0.00	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Grand Total					**$0.00**

I hereby certify that the above information is correct.

Name of Bidder:

Signature of Bidder:

Seal:

Design, Procure, Construct, Test and Commission Chimtala SVC & RPC					
Schedule No. 1					
Chimtala SVC & RPC Substation: Supply of Major Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
1.1	Supply of 220kV Feeder Bays	EA	0		$0.00
1.2	Supply of 220kV Future Feeder Bay	EA	0		$0.00
1.3	Supply of 220kV Transformer Bay	EA	0		$0.00
1.4	Supply of 220kV Future Transformer Bay	EA	0		$0.00
1.5	Supply of 220/110kV Autotransformer Bay	EA	0		$0.00
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	0		$0.00
1.7	Supply of Auto Capacitor Bank Bay	EA	4		$0.00
1.8	Supply of Future Auto Capacitor Bay	EA	0		$0.00
1.9	Supply of 220kV SVC Feeder Bay	EA	2		$0.00
1.10	Supply of SVC System (with 24 month warranty & spares)	LS	1		$0.00
1.11	Supply of Reactor Bay (25 Mvar)	EA	1		$0.00
1.12	Supply of Future Reactor Bay	EA	0		$0.00
1.13	Supply of 20kV Switchgear & Station Battery	LS	0		$0.00
1.14	Supply of Control/Relay/Metering Panels	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 1 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Chimtala SVC & RPC					
Schedule No. 2					
Chimtala SVC & RPC Substation: Supply of 110kV Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
2.1	Supply of 110kV Feeder Bays	EA	0		$0.00
2.2	Supply of 110kV Future Feeder Bay	EA	0		$0.00
2.3	Supply of 110kV Source Bay	EA	0		$0.00
2.4	Supply of 110kV Future Source Bay	EA	0		$0.00
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 2 Total			$0.00
Schedule No. 3					
Chimtala SVC & RPC Substation: Supply of General Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
3.1	Supply of Substation Fence & Gates	LS	1		$0.00
3.2	Supply of Control and Other Buildings	LS	0		$0.00
3.3	Supply of 400V Building Power Distribution	LS	1		$0.00
3.4	Supply of Utility Systems & Connections	LS	1		$0.00
3.5	Supply of General Area Ground Grid System	LS	1		$0.00
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1		$0.00
3.7	Supply of Concrete Wireway Trenches	LS	1		$0.00
3.8	Supply of Emergency Generator & Fuel System (housed)	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 3 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Chimtala SVC & RPC					
Schedule No. 4					
Chimtala SVC & RPC Substation: Mandatory Spare Parts					
Item No.	Description	Units	QTY	Unit Price	Amount
4.1	Protection System	LS	1		$0.00
4.2	HV Control Equipment	LS	1		$0.00
4.3	LV AC System	LS	1		$0.00
4.4	DC Distribution System	LS	1		$0.00
4.5	HV Equipment (SVC spares priced in SVC materials)	LS	1		$0.00
4.6	20kV Metal Clad Switchgear	LS	0		$0.00
4.7	Power Transformers	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 4 Total			$0.00
Schedule No. 5					
Chimtala SVC & RPC Substation: Standard Tools					
Item No.	Description	Units	QTY	Unit Price	Amount
5.1	Substation Maintenance Tools & Appliances	LS	1		$0.00
5.2	20kV MV Cables	LS	0		$0.00
5.3	20kV Metal Clad Switchgear	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 5 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Chimtala SVC & RPC					
Schedule No. 6					
Chimtala SVC & RPC Substation: Design, Drawings and Documentation					
Item No.	Description	Units	QTY	Unit Price	Amount
6.1	Structural Design And General Arrangement Drawings	LS	1		$0.00
6.2	Site Civil Design Drawings	LS	1		$0.00
6.3	Building and Structure Design Drawings	LS	1		$0.00
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1		$0.00
6.5	Control Circuits & Wiring Drawings	LS	1		$0.00
6.6	Coordination Study & Relay Settings Instructions	LS	1		$0.00
6.7	General Construction Drawings	LS	1		$0.00
6.8	As Built Drawings	LS	1		$0.00
6.9	Maintenance Manual And Completion Report	LS	1		$0.00
		Schedule No. 6 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Chimtala SVC & RPC					
Schedule No. 7					
Chimtala SVC & RPC Substation: Installation and Other Charges					
Item No.	Description	Units	QTY	Unit Price	Amount
7.1	Project Management	LS	1		$0.00
7.2	Project Reporting	LS	1		$0.00
7.3	Project Insurance	LS	1		$0.00
7.4	Compliance with MOSS	LS	1		$0.00
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1		$0.00
7.6	Pavement of Road & Parking Areas	LS	1		$0.00
7.7	Security Wall, Towers, & Gates	LS	0		$0.00
7.8	Installation of 220kV Feeder Bays	EA	0		$0.00
7.9	Installation of 220kV Future Feeder Bay	EA	0		$0.00
7.10	Installation of 220kV Transformer Bay	EA	0		$0.00
7.11	Installation of 220kV Future Transformer Bay	EA	0		$0.00
7.12	Installation of Auto Capacitor Bank Bay	EA	4		$0.00
7.13	Installation of Future Auto Capacitor Bay	EA	0		$0.00
7.14	Installation of 220/110kV Autotransformer Bay	EA	0		$0.00
7.15	Installation of 220kV Bus Coupler & Metering Bay	EA	0		$0.00
7.16	Installation of 220kV SVC Feeder Bay	EA	2		$0.00
7.17	Installation of SVC System	LS	1		$0.00
7.18	Installation of Reactor Bay	EA	1		$0.00
7.19	Installation of Future Reactor Bay	EA	0		$0.00
Continued		Schedule No. 7 Subtotal			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Signature of Bidder:

Seal:

Design, Procure, Construct, Test and Commission Chimtala SVC & RPC					
Schedule No. 7 Continued					
7.20	Installation of 20kV Switchgear	LS	0		$0.00
7.21	Installation of Control/Relay/Metering Panels	LS	1		$0.00
7.22	Installation of 110kV Feeder Bays	EA	0		$0.00
7.23	Installation of 110kV Future Feeder Bay	EA	0		$0.00
7.24	Installation of 110kV Source Bay	EA	0		$0.00
7.25	Instrallation of 110kV Future Source Bay	EA	0		$0.00
7.26	Installation of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
7.27	Installation of Substation Fence & Gates	LS	1		$0.00
7.28	Installation of Control and Other Buildings	LS	0		$0.00
7.29	Installation of 400V Building Power Distribution	LS	1		$0.00
7.30	Installation of Utility Systems & Connections	LS	1		$0.00
7.31	Installation of General Area Ground Grid System	LS	1		$0.00
7.32	Installation of Underground Conduit, Control & Power Cables	LS	1		$0.00
7.33	Installation of Concrete Wireway Trenches	LS	1		$0.00
7.34	Installation of Emergency Generator & Fuel System	LS	1		$0.00
7.35	Testing and Commissioning	LS	1		$0.00
		Schedule No. 7 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Chimtala SVC & RPC					
Schedule No. 8					
Chimtala SVC & RPC Substation: Transfer of Knowledge					
Item No.	Description	Units	QTY	Unit Price	Amount
8.1	Training of Operation & Maintenance Management Staff	LS	1		$0.00
8.2	On-Site training during construction and commissioning	LS	1		$0.00
8.3	Training of Operation & Maintenance General Staff	LS	1		$0.00
8.4	On-Going Training & Operation Assistance	LS	1		$0.00
		Schedule No. 8 Total			$0.00
		Chimtala SVC & RPC Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Sayedabad RPC					
Schedule No. 1					
Sayedabad RPC Substation: Supply of Major Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
1.1	Supply of 220kV Feeder Bays	EA	0		$0.00
1.2	Supply of 220kV Future Feeder Bay	EA	0		$0.00
1.3	Supply of 220kV Transformer Bay	EA	0		$0.00
1.4	Supply of 220kV Future Transformer Bay	EA	0		$0.00
1.5	Supply of 220/110kV Autotransformer Bay	EA	0		$0.00
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	0		$0.00
1.7	Supply of Auto Capacitor Bank Bay	EA	0		$0.00
1.8	Supply of Future Auto Capacitor Bay	EA	0		$0.00
1.9	Supply of 220kV SVC Feeder Bay	EA	0		$0.00
1.10	Supply of SVC System	LS	0		$0.00
1.11	Supply of Reactor Bay	EA	2		$0.00
1.12	Supply of Future Reactor Bay	EA	0		$0.00
1.13	Supply of 20kV Switchgear & Station Battery	LS	0		$0.00
1.14	Supply of Control/Relay/Metering Panels	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 1 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Sayedabad RPC					
Schedule No. 2					
Sayedabad RPC Substation: Supply of 110kV Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
2.1	Supply of 110kV Feeder Bays	EA	0		$0.00
2.2	Supply of 110kV Future Feeder Bay	EA	0		$0.00
2.3	Supply of 110kV Source Bay	EA	0		$0.00
2.4	Supply of 110kV Future Source Bay	EA	0		$0.00
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 2 Total			$0.00
Schedule No. 3					
Sayedabad RPC Substation: Supply of General Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
3.1	Supply of Substation Fence & Gates	LS	0		$0.00
3.2	Supply of Control and Other Buildings	LS	0		$0.00
3.3	Supply of 400V Building Power Distribution	LS	0		$0.00
3.4	Supply of Utility Systems & Connections	LS	0		$0.00
3.5	Supply of General Area Ground Grid System	LS	1		$0.00
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1		$0.00
3.7	Supply of Concrete Wireway Trenches	LS	0		$0.00
3.8	Supply of Emergency Generator & Fuel System	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 3 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Sayedabad RPC					
Schedule No. 4					
Sayedabad RPC Substation: Mandatory Spare Parts					
Item No.	Description	Units	QTY	Unit Price	Amount
4.1	Protection System	LS	1		$0.00
4.2	HV Control Equipment	LS	1		$0.00
4.3	LV AC System	LS	0		$0.00
4.4	DC Distribution System	LS	0		$0.00
4.5	HV Equipment	LS	1		$0.00
4.6	20kV Metal Clad Switchgear	LS	0		$0.00
4.7	Power Transformers	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 4 Total			$0.00
Schedule No. 5					
Sayedabad RPC Substation: Standard Tools					
Item No.	Description	Units	QTY	Unit Price	Amount
5.1	Substation Maintenance Tools & Appliances	LS	1		$0.00
5.2	20kV MV Cables	LS	0		$0.00
5.3	20kV Metal Clad Switchgear	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 5 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Sayedabad RPC					
Schedule No. 6					
Sayedabad RPC Substation: Design, Drawings and Documentation					
Item No.	Description	Units	QTY	Unit Price	Amount
6.1	Structural Design And General Arrangement Drawings	LS	1		$0.00
6.2	Site Civil Design Drawings	LS	1		$0.00
6.3	Building and Structure Design Drawings	LS	0		$0.00
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1		$0.00
6.5	Control Circuits & Wiring Drawings	LS	1		$0.00
6.6	Coordination Study & Relay Settings Instructions	LS	1		$0.00
6.7	General Construction Drawings	LS	1		$0.00
6.8	As Built Drawings	LS	1		$0.00
6.9	Maintenance Manual And Completion Report	LS	1		$0.00
		Schedule No. 6 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Sayedabad RPC					
Schedule No. 7					
Sayedabad RPC Substation: Installation and Other Charges					
Item No.	Description	Units	QTY	Unit Price	Amount
7.1	Project Management	LS	1		$0.00
7.2	Project Reporting	LS	1		$0.00
7.3	Project Insurance	LS	1		$0.00
7.4	Compliance with MOSS	LS	1		$0.00
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1		$0.00
7.6	Pavement of Road & Parking Areas	LS	0		$0.00
7.7	Security Wall, Towers, & Gates	LS	0		$0.00
7.8	Installation of 220kV Feeder Bays	EA	0		$0.00
7.9	Installation of 220kV Future Feeder Bay	EA	0		$0.00
7.10	Installation of 220kV Transformer Bay	EA	0		$0.00
7.11	Installation of 220kV Future Transformer Bay	EA	0		$0.00
7.12	Installation of Auto Capacitor Bank Bay	EA	0		$0.00
7.13	Installation of Future Auto Capacitor Bay	EA	0		$0.00
7.14	Installation of 220/110kV Autotransformer Bay	EA	0		$0.00
7.15	Installation of 220kV Bus Coupler & Metering Bay	EA	0		$0.00
7.16	Installation of 220kV SVC Feeder Bay	EA	0		$0.00
7.17	Installation of SVC System	LS	0		$0.00
7.18	Installation of Reactor Bay	EA	2		$0.00
7.19	Installation of Future Reactor Bay	EA	0		$0.00
Continued		Schedule No. 7 Subtotal			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Sayedabad RPC					
Schedule No. 7 Continued					
7.20	Installation of 20kV Switchgear	LS	0		$0.00
7.21	Installation of Control/Relay/Metering Panels	LS	1		$0.00
7.22	Installation of 110kV Feeder Bays	EA	0		$0.00
7.23	Installation of 110kV Future Feeder Bay	EA	0		$0.00
7.24	Installation of 110kV Source Bay	EA	0		$0.00
7.25	Instrallation of 110kV Future Source Bay	EA	0		$0.00
7.26	Installation of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
7.27	Installation of Substation Fence & Gates	LS	0		$0.00
7.28	Installation of Control and Other Buildings	LS	0		$0.00
7.29	Installation of 400V Building Power Distribution	LS	0		$0.00
7.30	Installation of Utility Systems & Connections	LS	0		$0.00
7.31	Installation of General Area Ground Grid System	LS	1		$0.00
7.32	Installation of Underground Conduit, Control & Power Cables	LS	1		$0.00
7.33	Installation of Concrete Wireway Trenches	LS	0		$0.00
7.34	Installation of Emergency Generator & Fuel System	LS	0		$0.00
7.35	Testing and Commissioning	LS	1		$0.00
		Schedule No. 7 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Sayedabad RPC					
Schedule No. 8					
Sayedabad RPC Substation: Transfer of Knowledge					
Item No.	Description	Units	QTY	Unit Price	Amount
8.1	Training of Operation & Maintenance Management Staff	LS	1		$0.00
8.2	On-Site training during construction and commissioning	LS	1		$0.00
8.3	Training of Operation & Maintenance General Staff	LS	1		$0.00
8.4	On-Going Training & Operation Asssistance	LS	0		$0.00
		Schedule No. 8 Total			$0.00
		Sayedabad RPC Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Ghazni RPC					
Schedule No. 1					
Ghazni RPC Substation: Supply of Major Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
1.1	Supply of 220kV Feeder Bays	EA	0		$0.00
1.2	Supply of 220kV Future Feeder Bay	EA	0		$0.00
1.3	Supply of 220kV Transformer Bay	EA	0		$0.00
1.4	Supply of 220kV Future Transformer Bay	EA	0		$0.00
1.5	Supply of 220/110kV Autotransformer Bay	EA	0		$0.00
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	0		$0.00
1.7	Supply of Auto Capacitor Bank Bay	EA	0		$0.00
1.8	Supply of Future Auto Capacitor Bay	EA	0		$0.00
1.9	Supply of 220kV SVC Feeder Bay	EA	0		$0.00
1.10	Supply of SVC System	LS	0		$0.00
1.11	Supply of Reactor Bay	EA	2		$0.00
1.12	Supply of Future Reactor Bay	EA	0		$0.00
1.13	Supply of 20kV Switchgear & Station Battery	LS	0		$0.00
1.14	Supply of Control/Relay/Metering Panels	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 1 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Ghazni RPC					
Schedule No. 2					
Ghazni RPC Substation: Supply of 110kV Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
2.1	Supply of 110kV Feeder Bays	EA	0		$0.00
2.2	Supply of 110kV Future Feeder Bay	EA	0		$0.00
2.3	Supply of 110kV Source Bay	EA	0		$0.00
2.4	Supply of 110kV Future Source Bay	EA	0		$0.00
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 2 Total			$0.00
Schedule No. 3					
Ghazni RPC Substation: Supply of General Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
3.1	Supply of Substation Fence & Gates	LS	0		$0.00
3.2	Supply of Control and Other Buildings	LS	0		$0.00
3.3	Supply of 400V Building Power Distribution	LS	0		$0.00
3.4	Supply of Utility Systems & Connections	LS	0		$0.00
3.5	Supply of General Area Ground Grid System	LS	1		$0.00
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1		$0.00
3.7	Supply of Concrete Wireway Trenches	LS	0		$0.00
3.8	Supply of Emergency Generator & Fuel System	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 3 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Ghazni RPC					
Schedule No. 4					
Ghazni RPC Substation: Mandatory Spare Parts					
Item No.	Description	Units	QTY	Unit Price	Amount
4.1	Protection System	LS	1		$0.00
4.2	HV Control Equipment	LS	1		$0.00
4.3	LV AC System	LS	0		$0.00
4.4	DC Distribution System	LS	0		$0.00
4.5	HV Equipment	LS	1		$0.00
4.6	20kV Metal Clad Switchgear	LS	0		$0.00
4.7	Power Transformers	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 4 Total			$0.00
Schedule No. 5					
Ghazni RPC Substation: Standard Tools					
Item No.	Description	Units	QTY	Unit Price	Amount
5.1	Substation Maintenance Tools & Appliances	LS	1		$0.00
5.2	20kV MV Cables	LS	0		$0.00
5.3	20kV Metal Clad Switchgear	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 5 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Ghazni RPC					
Schedule No. 6					
Ghazni RPC Substation: Design, Drawings and Documentation					
Item No.	Description	Units	QTY	Unit Price	Amount
6.1	Structural Design And General Arrangement Drawings	LS	1		$0.00
6.2	Site Civil Design Drawings	LS	1		$0.00
6.3	Building and Structure Design Drawings	LS	0		$0.00
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1		$0.00
6.5	Control Circuits & Wiring Drawings	LS	1		$0.00
6.6	Coordination Study & Relay Settings Instructions	LS	1		$0.00
6.7	General Construction Drawings	LS	1		$0.00
6.8	As Built Drawings	LS	1		$0.00
6.9	Maintenance Manual And Completion Report	LS	1		$0.00
		Schedule No. 6 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Ghazni RPC					
Schedule No. 7					
Ghazni RPC Substation: Installation and Other Charges					
Item No.	Description	Units	QTY	Unit Price	Amount
7.1	Project Management	LS	1		$0.00
7.2	Project Reporting	LS	1		$0.00
7.3	Project Insurance	LS	1		$0.00
7.4	Compliance with MOSS	LS	1		$0.00
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1		$0.00
7.6	Pavement of Road & Parking Areas	LS	0		$0.00
7.7	Security Wall, Towers, & Gates	LS	0		$0.00
7.8	Installation of 220kV Feeder Bays	EA	0		$0.00
7.9	Installation of 220kV Future Feeder Bay	EA	0		$0.00
7.10	Installation of 220kV Transformer Bay	EA	0		$0.00
7.11	Installation of 220kV Future Transformer Bay	EA	0		$0.00
7.12	Installation of Auto Capacitor Bank Bay	EA	0		$0.00
7.13	Installation of Future Auto Capacitor Bay	EA	0		$0.00
7.14	Installation of 220/110kV Autotransformer Bay	EA	0		$0.00
7.15	Installation of 220kV Bus Coupler & Metering Bay	EA	0		$0.00
7.16	Installation of 220kV SVC Feeder Bay	EA	0		$0.00
7.17	Installation of SVC System	LS	0		$0.00
7.18	Installation of Reactor Bay	EA	2		$0.00
7.19	Installation of Future Reactor Bay	EA	0		$0.00
		Schedule No. 7 Subtotal			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Ghazni RPC					
Schedule No. 7 continued					
7.20	Installation of 20kV Switchgear	LS	0		$0.00
7.21	Installation of Control/Relay/Metering Panels	LS	1		$0.00
7.22	Installation of 110kV Feeder Bays	EA	0		$0.00
7.23	Installation of 110kV Future Feeder Bay	EA	0		$0.00
7.24	Installation of 110kV Source Bay	EA	0		$0.00
7.25	Instrallation of 110kV Future Source Bay	EA	0		$0.00
7.26	Installation of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
7.27	Installation of Substation Fence & Gates	LS	0		$0.00
7.28	Installation of Control and Other Buildings	LS	0		$0.00
7.29	Installation of 400V Building Power Distribution	LS	0		$0.00
7.30	Installation of Utility Systems & Connections	LS	0		$0.00
7.31	Installation of General Area Ground Grid System	LS	1		$0.00
7.32	Installation of Underground Conduit, Control & Power Cables	LS	1		$0.00
7.33	Installation of Concrete Wireway Trenches	LS	0		$0.00
7.34	Installation of Emergency Generator & Fuel System	LS	0		$0.00
7.35	Testing and Commissioning	LS	1		$0.00
		Schedule No. 7Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Ghazni RPC					
Schedule No. 8					
Ghazni RPC Substation: Transfer of Knowledge					
Item No.	Description	Units	QTY	Unit Price	Amount
8.1	Training of Operation & Maintenance Management Staff	LS	1		$0.00
8.2	On-Site training during construction and commissioning	LS	1		$0.00
8.3	Training of Operation & Maintenance General Staff	LS	1		$0.00
8.4	On-Going Training & Operation Asssistance	LS	0		$0.00
		Schedule No. 8 Total			$0.00
		Ghazni RPC Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Kandahar East SVC					
Schedule No. 1					
Kandahar East SVC Substation: Supply of Major Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
1.1	Supply of 220kV Feeder Bays	EA	0		$0.00
1.2	Supply of 220kV Future Feeder Bay	EA	0		$0.00
1.3	Supply of 220kV Transformer Bay	EA	0		$0.00
1.4	Supply of 220kV Future Transformer Bay	EA	0		$0.00
1.5	Supply of 220/110kV Autotransformer Bay	EA	0		$0.00
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	0		$0.00
1.7	Supply of Auto Capacitor Bank Bay	EA	3		$0.00
1.8	Supply of Future Auto Capacitor Bay	EA	0		$0.00
1.9	Supply of 220kV SVC Feeder Bay	EA	1		$0.00
1.10	Supply of SVC System (with 24 month warranty & spares)	LS	1		$0.00
1.11	Supply of Reactor Bay	EA	0		$0.00
1.12	Supply of Future Reactor Bay	EA	0		$0.00
1.13	Supply of 20kV Switchgear & Station Battery	LS	0		$0.00
1.14	Supply of Control/Relay/Metering Panels	LS	1		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 1 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Kandahar East SVC					
Schedule No. 2					
Kandahar East SVC Substation: Supply of 110kV Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
2.1	Supply of 110kV Feeder Bays	EA	0		$0.00
2.2	Supply of 110kV Future Feeder Bay	EA	0		$0.00
2.3	Supply of 110kV Source Bay	EA	0		$0.00
2.4	Supply of 110kV Future Source Bay	EA	0		$0.00
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 2 Total			$0.00
Schedule No. 3					
Kandahar East SVC Substation: Supply of General Plant and Equipment					
Item No.	Description	Units	QTY	Unit Price	Amount
3.1	Supply of Substation Fence & Gates	LS	1		$0.00
3.2	Supply of Control and Other Buildings	LS	0		$0.00
3.3	Supply of 400V Building Power Distribution	LS	0		$0.00
3.4	Supply of Utility Systems & Connections	LS	0		$0.00
3.5	Supply of General Area Ground Grid System	LS	1		$0.00
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1		$0.00
3.7	Supply of Concrete Wireway Trenches	LS	0		$0.00
3.8	Supply of Emergency Generator & Fuel System	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 3 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Kandahar East SVC					
Schedule No. 4					
Kandahar East SVC Substation: Mandatory Spare Parts					
Item No.	Description	Units	QTY	Unit Price	Amount
4.1	Protection System	LS	1		$0.00
4.2	HV Control Equipment	LS	1		$0.00
4.3	LV AC System	LS	0		$0.00
4.4	DC Distribution System	LS	0		$0.00
4.5	HV Equipment (SVC spares priced in SVC materials)	LS	1		$0.00
4.6	20kV Metal Clad Switchgear	LS	0		$0.00
4.7	Power Transformers	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 4 Total			$0.00
Schedule No. 5					
Kandahar East SVC Substation: Standard Tools					
Item No.	Description	Units	QTY	Unit Price	Amount
5.1	Substation Maintenance Tools & Appliances	LS	1		$0.00
5.2	20kV MV Cables	LS	0		$0.00
5.3	20kV Metal Clad Switchgear	LS	0		$0.00
		Shipping, Handling & Inland Transportation			
		Schedule No. 5 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Kandahar East SVC					
Schedule No. 6					
Kandahar East SVC Substation: Design, Drawings and Documentation					
Item No.	Description	Units	QTY	Unit Price	Amount
6.1	Structural Design And General Arrangement Drawings	LS	1		$0.00
6.2	Site Civil Design Drawings	LS	1		$0.00
6.3	Building and Structure Design Drawings	LS	0		$0.00
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1		$0.00
6.5	Control Circuits & Wiring Drawings	LS	1		$0.00
6.6	Coordination Study & Relay Settings Instructions	LS	1		$0.00
6.7	General Construction Drawings	LS	1		$0.00
6.8	As Built Drawings	LS	1		$0.00
6.9	Maintenance Manual And Completion Report	LS	1		$0.00
		Schedule No. 6 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Kandahar East SVC					
Schedule No. 7					
Kandahar East SVC Substation: Installation and Other Charges					
Item No.	Description	Units	QTY	Unit Price	Amount
7.1	Project Management	LS	1		$0.00
7.2	Project Reporting	LS	1		$0.00
7.3	Project Insurance	LS	1		$0.00
7.4	Compliance with MOSS	LS	1		$0.00
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1		$0.00
7.6	Pavement of Road & Parking Areas	LS	0		$0.00
7.7	Security Wall, Towers, & Gates	LS	0		$0.00
7.8	Installation of 220kV Feeder Bays	EA	0		$0.00
7.9	Installation of 220kV Future Feeder Bay	EA	0		$0.00
7.10	Installation of 220kV Transformer Bay	EA	0		$0.00
7.11	Installation of 220kV Future Transformer Bay	EA	0		$0.00
7.12	Installation of Auto Capacitor Bank Bay	EA	3		$0.00
7.13	Installation of Future Auto Capacitor Bay	EA	0		$0.00
7.14	Installation of 220/110kV Autotransformer Bay	EA	0		$0.00
7.15	Installation of 220kV Bus Coupler & Metering Bay	EA	0		$0.00
7.16	Installation of 220kV SVC Feeder Bay	EA	1		$0.00
7.17	Installation of SVC System	LS	1		$0.00
7.18	Installation of Reactor Bay	EA	0		$0.00
7.19	Installation of Future Reactor Bay	EA	0		$0.00
Continued		Schedule No. 7 Subtotal			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Kandahar East SVC					
Schedule No. 7 Continued					
7.20	Installation of 20kV Switchgear	LS	0		$0.00
7.21	Installation of Control/Relay/Metering Panels	LS	1		$0.00
7.22	Installation of 110kV Feeder Bays	EA	0		$0.00
7.23	Installation of 110kV Future Feeder Bay	EA	0		$0.00
7.24	Installation of 110kV Source Bay	EA	0		$0.00
7.25	Instrallation of 110kV Future Source Bay	EA	0		$0.00
7.26	Installation of 110kV Bus Coupler & Metering Bay	EA	0		$0.00
7.27	Installation of Substation Fence & Gates	LS	1		$0.00
7.28	Installation of Control and Other Buildings	LS	0		$0.00
7.29	Installation of 400V Building Power Distribution	LS	0		$0.00
7.30	Installation of Utility Systems & Connections	LS	0		$0.00
7.31	Installation of General Area Ground Grid System	LS	1		$0.00
7.32	Installation of Underground Conduit, Control & Power Cables	LS	1		$0.00
7.33	Installation of Concrete Wireway Trenches	LS	0		$0.00
7.34	Installation of Emergency Generator & Fuel System	LS	0		$0.00
7.35	Testing and Commissioning	LS	1		$0.00
		Schedule No. 7 Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Design, Procure, Construct, Test and Commission Kandahar East SVC					
Schedule No. 8					
Kandahar East SVC Substation: Transfer of Knowledge					
Item No.	Description	Units	QTY	Unit Price	Amount
8.1	Training of Operation & Maintenance Management Staff	LS	1		$0.00
8.2	On-Site training during construction and commissioning	LS	1		$0.00
8.3	Training of Operation & Maintenance General Staff	LS	1		$0.00
8.4	On-Going Training & Operation Asssistance	LS	1		$0.00
		Schedule No. 8 Total			$0.00
		Kandahar East SVC Total			$0.00

I hereby certify that the above information is correct.

Name of Bidder:

Seal:

Signature of Bidder:

Addendum 1 Glossary of Bidding Schedules for RPC		
Schedule Number	Item No.	Item Description
Schedule No. 1 Supply of Major Plant and Equipment	1.1	Supply of 220kV Feeder Bays: Supply of all the 220KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.2	Supply of 220kV Future Feeder Bay: Supply of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.3	Supply of 220kV Transformer Bay: Supply of all the 220KV/20KV power transformers with OLTC (if specified), all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.4	Supply of 220kV Future Transformer Bay: Supply of all the structures, foundations, and related area ground grid system required for 220kV Future Transformer Bay(s) as shown and detailed in drawing package.
	1.5	Supply of 220/110kV Autotransformer Bay: Supply of all the 220KV/110KV power transformers, all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.6	Supply of 220kV Bus Coupler & Metering Bay: Supply of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system. Couplers and metering equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.7	Supply of Auto Capacitor Bank Bay: Supply of all the capacitors, breakers, manual/motorized switches, associated equipment, accessories, and related area ground grid system as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.8	Supply of Future Auto Capacitor Bay: Supply of all the structures, foundations, and related area ground grid system required for Future Auto Capacitor Bay(s) as shown and detailed in drawing package.
	1.9	Supply of 220kV SVC Feeder Bay: Supply of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV SVC Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.

	1.10	Supply of SVC System: Supply of all the buildings, structures, foundations, and related area ground grid system required for a complete automated SVC system as shown and detailed in drawing package. Includes all transformers, reactors, filters, bus work, electronic switching, controls, and cabling.
	1.11	Supply of Reactor Bay: Supply of all the substation dead end Gantry structures, station steel, manual motorized switches, breakers, buses, insulators, RPC, and related area ground grid system as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.12	Supply of Future Reactor Bay: Supply of all the substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for future Reactor Bay(s) as shown and detailed in drawing package.
	1.13	Supply of 20kV Switchgear & Station Battery: Supply of all the switchgear equipment, station batteries, conduit stubs, concrete ducting, insulators, surge arrestors, connectors, and the associated termination hardware kits. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	1.14	Supply of Control/Relay/Metering Panels: Supply of all the panels, breakers, relays, contactors, conductors, indicator lights, labeling, starters, meters, associated equipment and accessories. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
Schedule No. 2 Supply of 110kV Plant and Equipment	2.1	Supply of 110kV Feeder Bays Supply of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	2.2	Supply of 110kV Future Feeder Bay Supply of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	2.3	Supply of 110kV Source Bay Supply of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	2.4	Supply of 110kV Future Source Bay Supply of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	2.5	Supply of 110kV Bus Coupler & Metering Bay Supply of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system. Couplers and metering equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
Schedule No. 3 Supply of	3.1	Supply of Substation Fence & Gates: Supply of all suitable and appropriate fencing materials, posts, gates, and warning labels. Equipment shall be designed and manufactured IAW rated performance specifications.

General Plant and Equipment	3.2	Supply of Control and Other Buildings: Supply of all the equipment and materials necessary for completion of Control and Other Buildings along with their necessary water, sewer and HVAC systems.
	3.3	Supply of 400V Building Power Distribution: Supply of all panels, breakers, wiring, outlets, switches, lights, and other equipment required for 400V Building Power Distribution.
	3.4	Supply of Utility Systems & Connections: Supply of all the equipment necessary for complete connection of all the sewer, water, and 230/400V electrical mains to the Utility system at the location shown on the Drawings.
	3.5	Supply of General Area Ground Grid System: Supply of all the ground rods and ground conductors required for a complete Ground Grid System. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications. This item is for grounding systems external to HV Bays; each bay price includes its ground grid system.
	3.6	Supply of Underground Conduit, Control & Power Cables: Supply of all conduit (PVC or steel), control, and power cables required for a complete substation as shown in the Drawings and performance specifications such that wiring can be completed without splicing of cables.
	3.7	Supply of Concrete Wireway Trenches: Supply of pre-fabricated concrete wireway trenches and any associated equipment and accessories. All material shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	3.8	Supply of Emergency Generator & Fuel System: Supply of a generator, fuel, and fuel storage. Equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
Schedule No. 4 Mandatory Spare Parts	4.1	Protection System: The Supply of all the spare relays, SCADA spare parts, optical fiber cables, and fuses.
	4.2	220kV Control Equipment: The Supply of spare relays, fuses, and control panels.
	4.3	LV AC System: The supply of all the spares for power distribution boards, breakers, backup generator, lights, outlets, wires, conduits, back diesel generator and automatic transfer switches.
	4.4	DC Distribution System: Parts for the batteries, associated cables, charger / supply system, DC loads, and distribution power boards.
	4.5	HV Equipment: The supply of power transformers parts, parts for switches, breakers, insulators, jumpers, and connectors.
	4.6	20kV Metal Clad Switchgear: The switchgear equipment parts, surge arrestors, connectors, and the associated termination hardware kits. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	4.7	Power Transformers: All the associated spare parts and accessories for such transformer.
Schedule No.5 Standard Tools	5.1	Substation Maintenance Tools & Appliances: All the necessary tools required to install, test, inspect and maintain the substation equipment.
	5.2	20kV MV Cables: All the tools that are necessary to install, test, maintain and replace such cables.
	5.3	20kV Metal Clad Switchgear: All the tools necessary to install, test inspect and maintain this equipment class.

Schedule No.6 Design, Drawings and Documentation	6.1	Structural Design And General Arrangement Drawings: Structural steel calculations, and general arrangement drawings for the equipment and support facilities in the new substation. Design calculations, detailed design drawings, final design deliverables including detailed supporting analyses, survey drawings, soil resistivity measurements, and geological investigation works.
	6.2	Site Civil Design Drawings: All civil work drawings for excavating, grading, refilling, forming of the site, leveling and compacting, graveling, control buildings, office, workshop, storage room, battery room, water well, wastewater, drainage system, internal roads, fences, gates, oil interceptor tanks, concrete foundations.
	6.3	Building and Structure Design Drawings: All the drawings and any structural calculations and documentations for the control buildings, office, workshop, storage room, battery room and concrete fire protection separation walls.
	6.4	Single & 3 Line Drawings with Protective Relay Equipment: All the single and three lines drawings showing the power flow into and out of the substation along with all the control and protective relays functions, protective meters, and panel names where the relays units will be located.
	6.5	Control Circuits & Wiring Drawings: The control panels and the wirings connections drawings showing all the control wirings from the control panels to substation yard equipment.
	6.6	Coordination Study & Relay Settings Instructions: All the coordination studies for fault zone isolation along with the required settings for the relays determined by the coordination studies with the complete instructions to perform these settings.
	6.7	General Construction Drawings: Construction Drawings of all the civil and steel structures showing the construction sequencing for all these structures in the substation.
	6.8	As Built Drawings: Updated final documents and design drawings showing all the modifications made on the designs in the field, all CAD drawings for design, construction and installation.
	6.9	Maintenance Manual And Completion Report: All the equipment maintenance, repair and adjustments manuals, and full set of assembly drawings including wiring diagrams. Completion report for each section of the works showing the acceptable testing and proper operations of all the installed equipment. Complete instructions for operations, apparatus lists, and spare parts lists containing information needed for ordering all equipment supplied under the contract. The delivery of the following manuals: general description of the equipment, operating instructions that are suitable for training of personnel, general maintenance instructions, spare parts manuals, all layout, and installation drawings.
Schedule No.7 Installation and Other Charges	7.1	Project Management: Planning, execution, monitoring and closing all the design, procurement, construction, testing and commissioning activities and ensuring they are carried out IAW the relevant technical standards and design specifications.
	7.2	Project Reporting: The set up of a reporting system from the beginning until the end of the project in which the frequency, format, contents, and the level of details for these reports will be maintained throughout the life cycle of the project.

	7.3	Project Insurance: Coverage for any bodily injury or property damage during the performance of the work. Coverage for faulty workmanship. Coverage for error and omission in the design of the project. Coverage for damage caused by hazard materials. Coverage for damage caused by non-excusable delay. The Coverages should cover damages to project during and after construction.
	7.4	Compliance with MOSS (Minimum Operating Safety Standards): Strict implementation and compliance with all of the relevant and applicable codes dealing with health, safety, environmental and social safe guards at the site as required per project and the AIF. Site regulations, security plan procedures for the staff, the employer, visiting missions from employer and AIF and the equipment. Implementation of an effective Earthing system at the new substation IAW the latest pertinent standards. Operational and safety labels in both English and local language.
	7.5	Surveying, Grading, Roads, Site Perpetration & Finish: Marking and staking the selected location of the substation. Determination of the suitability of the selected site. Testing the soil condition of the site to ensure its ability to support the facility's size and construction requirements. Testing the soil for any toxic contamination of the site. Surveying the wildlife, vegetation, and archeological or historic resources of the site. A development of a detailed site preparation work plan to include measures for any wetlands and endangered species. The marking of any wetlands and special habitats. The consideration of annual breeding and hibernation cycles of certain species in creating the construction schedules. Briefing procedures for the crews on special care while working in sensitive areas, including limiting ground disturbances. The installation of erosion and sedimentation controls at the outer limits of the construction area. The laying of access roads to the site in preparation for the construction activities. Clearing any existing structures and vegetation present in the access roads and the site of the substation. The grading of the site with all the required fill/cut in accordance with the specifications. The finishing of the ground inside of the substation site with a layer of suitable gravel as determined in the design specifications to ensure proper drainage and provide crews with safe work surface.
	7.6	Pavement of Road & Parking Areas: Paving and marking of road and parking areas and materials included. Marking of the roads and parking areas shall be durable paint and/or signs.
	7.7	Security Wall, Towers, & Gates: Installation of suitable and appropriate walls, towers, and gates and materials included around the complete substation site.
	7.8	Installation of 220kV Feeder Bays: Installation of all the 220KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
	7.9	Installation of 220kV Future Feeder Bay: Installation of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV Future Feeder Bay(s) as shown and detailed in drawing package.
	7.10	Installation of 220kV Transformer Bay: Installation of all the 220K/20K power transformers with OLTC (if specified), all associated equipment and accessories, and related area ground grid system.
	7.11	Installation of 220kV Future Transformer Bay: Installation of all the structures, foundations, and related area ground grid system required for 220kV Future Transformer Bay(s) as shown and detailed in drawing package.

	7.12	Installation of 220/110kV Autotransformer Bay: Installation of all the 220KV/110KV power transformers, all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	7.13	Installation of 220kV Bus Coupler & Metering Bay: Installation of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system.
	7.14	Installation of Auto Capacitor Bank Bay: Installation of all the capacitors, breakers, manual/motorized switches, associated equipment, accessories, and related area ground grid system.
	7.15	Installation of 220kV SVC Feeder Bay: Supply of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV SVC Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	7.16	Installation of SVC System: Supply of all the buildings, structures, foundations, and related area ground grid system required for a complete automated SVC system as shown and detailed in drawing package. Includes all transformers, reactors, filters, bus work, electronic switching, controls, and cabling.
	7.17	Installation of Future Auto Capacitor Bay: Supply of all the structures, foundations, and related area ground grid system required for Future Auto Capacitor Bay(s) as shown and detailed in drawing package.
	7.18	Installation of Reactor Bay: Installation of all the substation dead end Gantry structures, station steel, manual motorized switches, breakers, buses, insulators, RPC, and related area ground grid system.
	7.19	Installation of Future Reactor Bay: Installation of all the substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for future Reactor Bay(s) as shown and detailed in drawing package.
	7.20	Installation of 20kV Switchgear: Installation of all the switchgear equipment, conduit stubs, concrete ducting, insulators, surge arrestors, connectors, and the associated termination hardware kits.
	7.21	Installation of Control/Relay/Metering Panels: Installation of all the panels, breakers, relays, contactors, conductors, indicator lights, labeling, starters, meters, associated equipment and accessories.
	7.22	Installation of 110kV Feeder Bays Installation of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
	7.23	Installation of 110kV Future Feeder Bay Installation of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package.
	7.24	Installation of 110kV Source Bay Installation of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.

	7.25	Installation of 110kV Future Source Bay Installation of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Source Bay(s) as shown and detailed in drawing package.
	7.26	Installation of 110kV Bus Coupler & Metering Bay Installation of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system.
	7.27	Installation of Substation Fence & Gates: The installation of a suitable and appropriate fence around the substation side with the required access gates with warning signs in the local language.
	7.28	Installation of Control and Other Buildings: Installation of all the equipment and materials necessary for completion of Control and Other Buildings along with their necessary water, sewer and HVAC systems.
	7.29	Installation of 400V Building Power Distribution: Installation of all panels, breakers, wiring, outlets, switches, lights, and other equipment required for 400V Building Power Distribution.
	7.30	Installation of Utility Systems & Connections: The permitting and proper connection of all the sewer, water and 230/400V electrical mains to the utilities and the testing of these systems to ensure their proper operations.
	7.31	Installation of General Area Ground Grid System: Installation of all the ground rods and ground conductors required for a complete General Area Ground Grid System.
	7.32	Installation of Underground Conduit, Control & Power Cables: Installation of all conduit (PVC or steel), control, and power cables and materials included required for a complete substation as shown in the Drawings and performance specifications such that wiring can be completed without splicing of cables.
	7.33	Installation of Concrete Wireway Trenches: Digging of trenches and installation of pre-fabricated concrete wireway trenches and any associated equipment and accessories (materials included).
	7.34	Installation of Emergency Generator & Fuel System: Installation of a generator, fuel, and fuel storage. Equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
	7.35	Testing and Commissioning: Completion and full documentation of testing and commissioning for all substation equipment to the satisfaction or the Employer's Engineer.
Schedule No.8 Transfer of Knowledge	8.1	Training of Operation & Maintenance Management Staff: Training of the maintenance management personnel on the general operation and maintenance schedules of the substation. Furnishing of all detailed operation, service, maintenance manuals, and complete spare parts list for the substation equipment.
	8.2	On-Site training during construction and commissioning: Training of personnel, workers, and laborers to handle the installation, testing and commissioning of the substation equipment. Training for six Employer's appointed personnel on factory inspections and witnessing performance tests for the substation equipment.

	8.3	Training of Operation & Maintenance General Staff: Providing the maintenance general personnel a complete and detailed O&M training program on how to operate and perform the periodical maintenance procedures.
	8.4	On-Going Training & Operation Asssistance: Provide long-term of operation & training assistance for the SVC system per Technical Section requirements.

Bid Security

Bank Guarantee

.....***Bank's Name, and Address of Issuing Branch or Office*.....**

Beneficiary: Da Afghanistan Breshna Sherkat (DABS)

Date:.....

We have been informed that . . . . . ***……..*** . . . . (hereinafter called "the Bidder") has submitted to you its bid dated . . . . . (hereinafter called "the Bid") for the execution of AFG # 830021 under Invitation for Bids No. DABS-94-ICB-014 ("the IFB").

Furthermore, we understand that, according to your conditions, bids must be supported by a bid guarantee.

At the request of the Bidder, we . . . . . ***name of Bank***. . . . . hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of:

_____

(USD in words or No Bid)

_____

(USD in figures or No Bid)

upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the bid conditions, because the Bidder:

(a) has withdrawn its Bid during the period of bid validity specified by the Bidder in the Form of Bid; or

(b) does not accept the correction of errors in accordance with the Instructions to Bidders (hereinafter "the ITB"); or

(c) having been notified of the acceptance of its Bid by the Employer during the period of bid validity, (i) fails or refuses to execute the Contract Agreement, or (ii) fails or refuses to furnish the Performance Security, in accordance with the ITB.

This guarantee will expire: (a) if the Bidder is the successful Bidder, upon our receipt of copies of the Contract Agreement signed by the Bidder and the performance security issued to you upon the instruction of the Bidder; and (b) if the Bidder is not the successful Bidder, upon the earlier of (i) our receipt of a copy your notification to the Bidder of the name of the successful Bidder; or (ii) 28 days after the expiration of the Bidder's bid.

Consequently, any demand for payment under this guarantee must be received by us at the office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

. . . . . *Bank's seal and authorized signature(s)* . . . . . .

Note: All italicized text is for use in preparing this form and shall be deleted from the final document

Form of Bid-Securing Declaration

Date:

RFP No. DABS-94-ICB-014

To: Da Afghanistan Breshna Sherkat (DABS)

We, the undersigned, declare that:

We understand that, according to your conditions, bids must be supported by a Bid-Securing Declaration.

We accept that we will automatically be suspended from being eligible for bidding in any contract with the Borrower for the period of time of [insert number of months or years] starting on the _____(date), if we are in breach of our obligation(s) under the bid conditions, because we:

(a) have withdrawn our Bid during the period of bid validity specified in the Form of Bid; or

(b) having been notified of the acceptance of our Bid by the *Employer* during the period of bid validity, (i) fail or refuse to execute the Contract, if required, or (ii) fail or refuse to furnish the Performance Security, in accordance with the ITB.

We understand this Bid-Securing Declaration shall expire if we are not the successful Bidder, upon the earlier of (i) our receipt of your notification to us of the name of the successful Bidder; or (ii) 28 days after the expiration of our Bid.

Signed:

In the capacity of:

Name:

Duly authorized to sign the bid for and on behalf of:

Dated on _____ day of _____, _____ *[insert date of signing]*

Corporate Seal (where appropriate)

[Note: In case of a Joint Venture, the Bid-Securing Declaration must be in the name of all partners to the Joint Venture that submits the bid.]

Technical Proposal

Site Organization

a) Preliminary Site Organization Chart

b) Narrative Description of Site Organization Chart

c) Description of Relationship between Head Office and Site Management[3]

Method Statement

Mobilization Schedule

Construction Schedule

Payment Schedule

Personnel

Equipment

Proposed Subcontractors for Major Items of Plant and Services

Time Schedule

Others

[3] *Indicate clearly which responsibility and what authority will be delegated to site management.*

Site Organization

Method Statement

Mobilization Schedule

Construction Schedule

Payment Schedule

Personnel

Bidders should provide the names of suitably qualified personnel to meet the requirements specified in Section 3 (Evaluation and Qualification Criteria). The data on their experience should be supplied using the Form below for each candidate.

Form PER – 1: Proposed Personnel

1.	**Title of position**	**Project Manager**
	Name	
2.	**Title of position**	**Field Engineer**
	Name	
3.	**Title of position**	**Quality Control Engineer**
	Name	
4.	**Title of position**	**Substation Engineer**
	Name	
5.	**Title of position**	**HSE Officer**
	Name	

As listed in Section 3 (Evaluation and Qualification Criteria).

Form PER – 2: Resume of Proposed Personnel

Position		
Personnel information	**Name**	**Date of birth**
	Professional qualifications	
Present employment	**Name of employer**	
	Address of employer	
	Telephone	**Contact (manager / personnel officer)**
	Fax	**E-mail**
	Job title	**Years with present employer**

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

From	To	Company / Project / Position / Relevant technical and management experience

Equipment

The Bidder shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section 3 (Evaluation and Qualification Criteria). A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

Item of Equipment		
Equipment Information	**Name of manufacturer**	**Model and power rating**
	Capacity	**Year of manufacture**
Current Status	**Current location**	
	Details of current commitments	
Source	**Indicate source of the equipment** ☐ **Owned** ☐ **Rented** ☐ **Leased** ☐ **Specially manufactured**	

Omit the following information for equipment owned by the Bidder.

Owner	**Name of owner**	
	Address of owner	
	Telephone	**Contact name and title**
	Fax	**Telex**
Agreements	**Details of rental / lease / manufacture agreements specific to the project**	

Proposed Subcontractors/Manufacturers for Major Items of Plant and Services

The following Subcontractors and/or manufacturers are proposed for carrying out the item of the facilities indicated. Bidders are free to propose more than one for each item

Major Items of Plant and Services	Proposed Subcontractors/Manufacturers	Nationality

Time Schedules

The Bidder shall include the proposed time schedule for the project showing the intended programme of complete works. The total time shall not exceed the specified maximum time period given in ITB 16.1 (b).

Others

The bidder should add any further information that it considers to be relevant to the evaluation of its Technical Proposal. If the bidder wishes to attach other documents, they should be listed below.

Bidders should not enclose testimonials, certificates, and publicity material with their Technical Proposals; they will not be taken into account in the evaluation of qualifications and will be discarded.

Manufacturer's Authorization

[***The Bidder shall require the Manufacturer to fill in this Form in accordance with the instructions indicated. This letter of authorization should be signed by a person with the proper authority to sign documents that are binding on the Manufacturer. The Bidder shall include it in its bid, if so indicated in the BDS.]***

Date: [***insert date (as day, month and year) of Bid Submission***]

RFP No.: DABS-94-ICB-014

To: Da Afghanistan Breshna Sherkat (DABS)

WHEREAS

We [***insert complete name of Manufacturer or Manufacturer's authorized agent***], who are official manufacturers or agent authorized by the manufacturer of [***insert type of goods manufactured***], having factories at [insert full address of Manufacturer's factories], do hereby authorize [***insert complete name of Bidder***] to submit a bid the purpose of which is to provide the following goods, manufactured by us [***insert name and or brief description of the goods***], and to subsequently negotiate and sign the Contract.

We hereby extend our full guarantee and warranty in accordance with Clause 27 of the General Conditions of Contract, with respect to the goods offered by the above firm.

Signed: [***insert signature(s) of authorized representative(s) of the Manufacturer***]

Name: [**insert complete name(s) of authorized representative(s) of the Manufacturer**]

Title: [***insert title***]

Duly authorized to sign this Authorization on behalf of: [***insert complete name of Bidder***]

Dated on _____ day of _____, _____ [***insert date of signing***]

Bidder's Qualification

To establish its qualifications to perform the contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder. If the bidding was preceded by a prequalification process then the forms included in this section and used earlier during the prequalification process need to be completed only if the information submitted at the time of prequalification requires updating.

Form ELI – 1: Bidder's Information Sheet

Page of Pages

Bidder's Information	
Bidder's legal name	
In case of JV, legal name of each partner	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	

Attached are copies of the following original documents.

- ❑ 1. In case of single entity, articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2.
- ❑ 2. Authorization to represent the firm or JV named in above, in accordance with ITB Sub-Clause 4.1.
- ❑ 3. In case of JV, letter of intent to form JV or JV agreement, in accordance with ITB Sub-Clause 4.1.
- ❑ 4. In case of a government-owned entity, any additional documents not covered under 1 above required to comply with ITB Sub-Clause 4.1.

Form ELI - 2: JV Information Sheet

For JV Partners and Specialist Subcontractors as per ITB 5.3

Page of Pages

Each member of a JV must fill in this form

JV Information	
Bidder's legal name	
JV Partner's or Subcontractor's legal name	
JV Partner's or Subcontractor's country of constitution	
JV Partner's or Subcontractor's year of constitution	
JV Partner's or Subcontractor's legal address in country of constitution	
JV Partner's or Subcontractors authorized representative information (name, address, telephone numbers, fax numbers, e-mail address)	

Attached are copies of the following original documents.

- ❑ 1. Articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2.
- ❑ 2. Authorization to represent the firm named above, in accordance with ITB 4.1.
- ❑ 3. In the case of government-owned entity, documents establishing legal and financial autonomy and compliance with commercial law, in accordance with ITB Sub-Clause 4.4
- ❑ 4. In the case of specialist Subcontractors, a formal intent to enter into an agreement.

Form LIT - Pending Litigation

Page of Pages

Bidder's Legal Name: _____Date: _____

JV Partner Legal Name:_____

Each Bidder or member of a JV must fill in this form

Pending Litigation			
❑ **No pending litigation in accordance with Criteria 2.2 of Section 3 (Evaluation and Qualification Criteria)** ❑ **Pending litigation in accordance with Criteria 2.2 of Section 3 (Evaluation and Qualification Criteria)**			
Year	**Matter in Dispute**	**Value of Pending Claim in US$ Equivalent**	**Value of Pending Claim as a Percentage of Net Worth**

Form FIN - 1: Historical Financial Performance

Page of Pages

Bidder's Legal Name: _____Date: _____

JV Partner Legal Name:_____

Each Bidder or member of a JV must fill in this form

Information from Balance Sheet

	Financial Data for Previous 3 Years [US$ Equivalent]		
	Year 1:	Year 2:	Year 3:
1. Total Assets			
2. Current Assets			
2. Total Liabilities			
4. Current Liabilities			
5. Profits Before Taxes			
6. Profits After Taxes			
7. Net Worth [= 1 - 3]			
8. Working Capital [= 2 - 4]			
9. Return on Equity [= 5 / 7 of prior year]			

❑ Attached are copies of the audited balance sheets, including all related notes, and income statements for the last three years, as indicated above, complying with the following conditions:

- All such documents reflect the financial situation of the Bidder or partner to a JV, and not sister or parent companies.
- Historic financial statements must be audited by a certified accountant.
- Historic financial statements must be complete, including all notes to the financial statements.
- Historic financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

Form FIN - 2: Financial Capability

Page of Pages

Bidder's Legal Name: _____Date: _____

JV Partner Legal Name:_____

Each Bidder or member of a JV must fill in this form

Annual Turnover Data for the Last 3 Years			
Year	**Amount Currency**	**Exchange Rate**	**US$ Equivalent**
		Average Annual Turnover	

The information supplied should be the Annual Turnover of the Bidder or each member of a JV in terms of the amounts billed to clients for each year for contracts in progress or completed, converted to US Dollars at the rate of exchange at the end of the period reported.

Form FIN – 3: Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as indicated in Section 3 (Evaluation and Qualification Criteria)

Financial Resources		
No.	**Source of financing**	**Amount (US$ equivalent)**
1		
2		
3		
4		

Form FIN- 4: Current Contract Commitments

Bidders and each partner to a JV should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Current Contract Commitments					
No.	**Name of Contract**	**Employer's Contact Address, Tel, Fax**	**Value of Outstanding Work [Current US$ Equivalent]**	**Estimated Completion Date**	**Average Monthly Invoicing Over Last Six Months [US$/month)]**
1					
2					
3					
4					
5					

Form EXP – 1: General Experience

Page of Pages

Each Bidder or member of a JV must fill in this form

General Experience				
Starting Month Year	**Ending Month Year**	**Years**	**Contract Identification and Name Name and Address of Employer Brief Description of the Works Executed by the Bidder**	**Role of Bidder**

Form EXP – 2: Specific Project Experience

Page of Pages

Each bidder or member of a JV must fill in this form

Contract of Similar Size and Nature			
Contract No . . . . . of	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **Management Contractor**	❑ **Subcontractor**
Total Contract Amount			**US$**
If partner in a JV or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's Name **Address** **Telephone/Fax Number** **E-mail**			
Description of the similarity in accordance with Criteria 2.4.2(a) of Section 3			

Form EXP - 3: Manufacturing Experience

Page of Pages

Bidder's Legal Name: _____Date: _____

JV Partner Legal Name:_____

Bidder or member of a JV must fill in this form

Manufacturing Experience				
Starting Month Year	**Ending Month Year**	**Years**	**Contract Identification and Name, Name and Address of Employer Brief Description of the Works Executed by the Bidder**	**Role of Bidder**

Section 5 – Grantor's Requirements

This section specifies the requirements to be followed by all Bidders, Contractors, and Subcontractors.

As a condition of funding, USAID, the Grantor, requires that contracts and subcontracts, including the contract described in these Bid Documents, be subject to the following requirements and conditions, which are incorporated in any final contract entered into pursuant to the Invitation to Bid and the Tender Documents, and required to be included in any subcontract entered into by Contractor in connection with the Works described herein. Bidders are advised to familiarize themselves with these requirements and conditions.

The Grantor has certain rights such as, but not limited to, the right to approve the terms of this contract, the Contractor, as well as subcontracts, subcontractors, and other documents related to this contract and the project of which it is part. The parties hereto further understand and agree that the Grantor, in reserving any or all of the foregoing approval rights, has acted solely as a financing entity to assure the proper use of United States Government funds, and that any decision by the Grantor to exercise or refrain from exercising these approval rights shall be made as a financier in the course of financing this project and shall not be construed as making the Grantor a party to the contract. The parties hereto understand and agree that the Grantor may, from time to time, exercise the foregoing approval rights, or discuss matters related to these rights and the project with the parties jointly or separately, without thereby incurring any responsibility or liability to the parties jointly or to any of them. Any approval (or failure to disapprove) by the Grantor shall not bar the United States Government or the Grantor from asserting any right, or relieve the Contractor of any liability which the Contractor might otherwise have to the United States Government or the Grantor.

1. The mandatory requirements and conditions required by Grantor are:

   No funds under this contract or subcontract may be used, directly, or indirectly, to produce, acquire, use, transport, store, sell, or otherwise deal with ammonium nitrate (AN) for agricultural applications or calcium ammonium nitrate (CAN) for agricultural or construction/demolition applications.

   No funds under this contract or subcontract may be used to finance any ineligible commodity, including commodities for police, prisons, military or paramilitary purposes, surveillance equipment, abortion equipment, luxury goods and gambling equipment, or weather modification equipment.

   No funds under this contract or subcontract may be used to finance any Grantor restricted commodities without the consent of USAID. These restricted commodities include agricultural commodities, motor vehicles, pharmaceuticals and contraceptive items, pesticides, fertilizer, used equipment, or U.S. Government-owned excess property.

2. **Prohibited Sources:** No funds under this contract or subcontract may be used to finance a good or service from a prohibited source, which is defined to mean any country to which assistance is prohibited by the annual appropriations acts of the United States Congress or other U.S. statutes, or those subject to U.S. Executive Branch restrictions, such as applicable sanctions administered by the U.S. Treasury Department's Office of Foreign Assets Control. For purposes of clarity related to this activity, prohibited sources include goods and services from Iran, including but not limited to transit costs in importing commodities through or from Iran.

3. **Permissible Geographic Sources:** The USAID geographic code for this requirement is 935. Authorized source countries include any area or country including the cooperating country, but excluding the foreign policy restricted countries. Further information is

available at: http://transition.usaid.gov/policy/ads/200/260.pdf.

4. **Security and Compliance Investigation:** USAID shall have the right to obtain information and to review for security and compliance purposes all companies, organizations, and individuals involved in award of any contracts resulting from this tender. USAID may prohibit contract award based upon the information obtained and/or the results of such review.

5. **Salary Supplements Prohibited:** No funds from any resulting contract or subcontract from this tender may be used for the payment of salary supplements to, or any benefit for employees or representatives of the Government of the Islamic Republic of Afghanistan, including, but not limited to DABS and the Ministry of Finance. No funds from this contract or subcontract shall be provided in any form including, but limited to, gratuities, favors, or anything of monetary value, to any employee or agent of the Government of Islamic Republic of Afghanistan in connection with the procurement of goods or services related to this contract or subcontract.

6. **Marking and Public Recognition**: The Da Afghanistan Breshna Sherkat (DABS) is required to cooperate with USAID in publicizing the Power Transmission, Expansion, and Connectivity (PTEC) project, including the marking of some of the Transmission Line (T/L) routings and/or Substation sites of program operations and commodities as being financed by USAID. Contractor shall cooperate with DABS and USAID in (a) allowing DABS to place signs at some of the T/L and/or Substation sites notifying of USAID financing; (b) providing information and consenting to the release of information about Contractor's activities and accomplishment of major milestones to the print and electronic media; and (c) organizing and participating in public ceremonies and events related to the project.

7. **Taxation:**

(a) General Exemption. This contract is funded by USAID through a bilateral agreement with the Government of the Islamic Republic of Afghanistan under the terms of the Point Four General Agreement for Technical Cooperation, dated as February 7,1951, between the Government of Afghanistan (herein after called the "Grantee") and the United States Government, and the assistance thereunder is free from any taxes imposed under laws in effect in the territory of the Grantee.

(b) Except as provided otherwise in this provision, the General Exemption in subsection (a) applies to, but is not limited to (1) any activity, contract, grant or other implementing agreement financed by USAID under its bilateral agreement with GIROA; (2) any transaction or supplies, equipment, materials, property or other goods (hereinafter collectively "goods") under (1) above; (3) any contractor, grantee, or other organization carrying out activities financed by USAID under its bilateral agreement with GIROA; (4) any employee of such organizations; and (5) any individual contractor or grantee carrying out activities financed by USAID under its bilateral agreement with GIROA.

(c) Except as provided otherwise in this provision, the General Exemption in sub-section (a) applies to, but is not limited to, the following taxes:

(1) Exemption 1. Customs duties, tariffs, import taxes, or other levies on the importation, use and re-exportation of goods or the personal belongings and effects (including personally-owned automobiles) for the personal use of non-national individuals or their family members.
Exemption 1 includes, but is not limited to all charges based on the value of such imported goods, but does not include service charges directly related to services performed to transfer goods or cargo.
(2) Exemption 2. Taxes on the income, profits or property of all (i) non-national organizations of any type, (ii) non-national employees of national and non-national

organizations, or (iii) non-national individual contractors and grantees. Exemption 2 includes income and social security taxes of all types and all taxes on the property, personal or real, owned by such non-national organizations or persons. The term "national" refers to organizations established under the laws of the Grantee and citizens of the Grantee, other than permanent resident aliens in the United States.
(3) Exemption 3. Taxes levied on the last transaction for the purchase of goods or services financed by USAID under its bilateral agreement with GIROA, including sales taxes, value-added taxes (VAT), or taxes on purchases or rentals of real or personal property. The term "last transaction" refers to the last transaction by which the goods or services were purchased for use in the activities financed by USAID under its bilateral agreement with GIROA.

(d) If a tax has been levied and paid contrary to the provisions of an exemption, USAID may, in its discretion, (1) require the Grantee to refund to USAID or to others as USAID may direct the amount of such tax with funds other than those provided under the Agreement, or (2) offset the amount of such tax from amounts to be disbursed under this or any other agreement between the Parties.
(e) In the event of a disagreement about the application of an exemption, the Parties agree to promptly meet and resolve such matters, guided by the principle that the assistance furnished by USAID is free from direct taxation, so that all of the assistance furnished by USAID will contribute directly to the economic development of the country of the Grantee.

8. **Applicable U.S. and Afghanistan Laws and Regulations and Adherence to Applicable Standards**: All applicable laws and regulations of Afghanistan and of the U.S Government , including applicable health and safety and environmental laws will be observed, as will all applicable national, international, and other standards for the rehabilitation, construction and operation of transmission lines, distribution systems, substations and controls. This requirement includes ensuring all applicable health and safety and environmental laws and regulations, including environmental requirements reflected through environmental impact statements and environmental assessments, and national, international or other rehabilitation and construction standards for electrical systems are included as requirements in all awarded contracts and subcontracts, including amendments thereto.

9. **Transportation and Insurance:** The following requirements shall apply to all activities financed by USAID provided funds:

9.1. Ocean transportation must be provided by United States-flag, privately owned commercial ocean vessels unless otherwise authorized by USAID in writing. If transportation on such vessels is not available to transport cargo in a timely manner or at a reasonable rate, Contractor shall notify the Ministry and USAID and request instructions on how to proceed with shipment.

9.2. Marine insurance shall (i) be placed at the most advantageous competitive rate, (ii) placed in a country included in Geographic Code 935; and (iii) under which claims are payable in U.S. Dollars or any freely convertible currency unless otherwise authorized by USAID in writing.

9.3. Any motor vehicles acquired (including through lease) must be of United States manufacture unless otherwise authorized by USAID in writing.

9.4. Transportation by air of property or persons for flights originating from or terminating in the U.S. will be on carriers holding United States certification, to the extent service by such carriers is available under the United States' Fly America Act.

9.5. Materials and goods imported will be insured against risks incident to their transit to the point of their use; such insurance will be issued on terms and conditions consistent with sound commercial practice and will insure the full value of the goods. Any indemnification received by DABS under such insurance will be used to replace or repair any material damage or any loss of the goods insured or will be used to reimburse the Grantee for the

replacement or repair of such goods. Any such replacement will be sourced and of origin from countries listed in USAID Geographic Code 935 as in effect at the time of replacement and, except as the parties may agree in writing.

PART II REQUIREMENTS

Section 6 - Employer's Requirements

AFGHANISTAN ENGINEERING SUPPORT PROGRAM

NEPS/SEPS CONNECTOR FIVE SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST IN ONE LOT

REQUEST FOR PROPOSALS
TECHNICAL SECTION REVISION 1
RFP NO: DABS-94-ICB-014
RFP TITLE: NEPS/SEPS CONNECTOR FIVE SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST IN ONE LOT

AFG NO: 830021

1.1. a.i.1.1 DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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Acronyms

ACSR	Aluminium Conductor Steel Reinforcement
ADB	Asian development Bank
AFRM	Afghanistan Residence Mission
ANSI	Amercan National Standard institute
AP	Angle Point
ASCE	American Society of Civil Engineers
ASTM	American Society of Testing Materials
BDS	Bid Data Sheet
BOQ	Bill of Quantity
BS	British Standard
Cct-km	Circuit Kilometer (Double Circuit, 3Phase, Twin Conductor Per Phase)
COF	Contract Forms
CPA	Condtions of Particular Application
Cu.m, m^3	Cubic Meters
DA	Double Circuit Tower Type – A (Suspension)
DABS	Da Afghanistan Breshna Sherkat
DB	Double Circuit Tower Type – B (Tension)
DC	Double Circuit Tower Type – C (Tension)
DCPT	Dynamic Cone Penetration Test
DD	Double Circuit Tower Type – D (Tension)
DDM/DDE	Double Circuit Tower Type – DDM/DDE (Tension/Dead End)
DDP	Delivery Duty Paid
DDU	Deliver Duty Unpaid
deg	Degree
DIN	Deutsches Institute für Normung e.V.
DS	Direct selection
ELC	Eligible countries
EQC	Evaluation and Qualification criteria
EXW	Ex factory, ex works or ex warehouse
FC	Foreign Currency
FIDIC	Federation Internationale des Ingenieurs Conseils (International Federation of Consulting Engineers
FOB	Free on Board
g/m^2	Gram Per Meters Square
GCC	General Conditions of Contract
ICC	International Chamber of Commerce
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IFB	Invition for Bids
ISO	International Standards Organization
ITB	Instruction to Bidders
kg	Kilogram
kg/cm^2	Kilogram Centimeter Square
kN	Kilo Newton
KV	Kilo Volt

l.m, m	Linear Meters, Meters
L.S	Lump Sum
LARP	Land Acquisition and Resettlement Plan
LC	Local Currency
m/sec	Meter per Second
MEW	Ministry of Energy and Water
MOSS	Minimum Operating Safety standards
N	Newton
No.	Number
NoC	Negotiation of Contract
N/mm^2	Newton per Milimeter Square
OPGW	Optical Fiber Ground Wire
Owner	DABS
Owners Engineer	DABS Appointed/Selected Technical Representative(s)
PCC	Plain Cement Concrete
PCU	Project Coordination Unit
PDF	Proposal Forms
PDS	Proposal Data Sheet
PISU	Programme Implementation Support Unit
PMG	Permanent Magnet Generator
PMO	Project Management Office
RCC	Reinforced Cement Concrete
RFP	Request for Proposal
RoW	Right of Way
SCADA	Supervisory Control and Data Acquisition
SCC	Special Conditions of Contract
SMEC	Snowy Mountains Engineering Corporation
SPT	Standard Penetration Test
sq.m, m^2	Square Meters
sq.mm, mm^2	Square Milimeter
TIF	Telephone Influence Factor
Ton	Metric Ton
UN	United Nation
UNMACA	United Nations Mine Action Center, Afghanistan
UXO	Unexploded Ordinance
VDE	Verband Der Electrotechnik Electronik Informationstechnik e.v

1.0 Technical Specification

1.1 Project Description

1.1.1 Overview

The existing Northeast Power System (NEPS) is a 220KV transmission system that extends power from Uzbekistan and Tajikistan down the Salang Pass to Pul-e-Khumri in northern Afghanistan. Efforts are currently underway "by others" including the Asian Development Bank (ADB) to construct a new substation at Arghandi and extend the 220KV transmission line system south from the Chimtala Substation, which is fed from the Pul-e-Khumri Substation, to this new substation. The Ghazni substation is fed from Arghandi via the Sayedabed Substation. Five new 220kV/20kV substations will be built southeast of the existing 220kV/20kV Ghazni Substation along the route of the approximately 405 km of 220KV transmission lines from Ghazni to Kandahar East substations.

The objective of this project is to design and construct five new substations. The contract will be to engineer/design, procure, construct, and commission these five new 220kV/20kV distribution substations (Qarabagh, Moqor/Gelan, Shah Joy, Qalat, and Kandahar East) to deliver 20kV distribution power from the Ghazni area to these new areas.

Conceptual drawings for project location and five substation site maps can be found in Section 3.0.

1.1.2 Design and Construct Five Substations

The scope for the substations shall include location staking, demining, grading, fencing, structures and buildings, as well as, design and installation of optical fiber cable for Supervisory Control and Data Acquisition (SCADA), telecommunication and trip signal, including ringed fiber optic cabling within the substations and all terminating and multiplexing equipment within the control rooms and at the termination to the transmission line overhead ground wire. Scope shall include coordination studies in electronic format (ASPEN DistriView Suite is the preferred software) and printed format to Employer's Engineer. Employer's Engineer must approve the settings before relay settings are installed. Contractor shall provide and program all relay settings for all protective equipment supplied under this specification.

SCADA scope for the project shall include integration of all transmission system control points, trip signals, and system indication (breaker trip, switch position, etc.) via marshaling panels located at each substation constructed under this contract. Hardware and software shall be specified, configured and tested to support remote control and indication of power flow through the transmission line from the National Load Control Center (NLCC). SCADA integration shall include new reactive power compensation equipment as detailed in 1.2.9.24 below. The Contractor shall provide software to facilitate remote, operator level decision making on switching/controlling of RPC equipment.

<u>Qarabagh Substation</u>

Design and construct a complete 220kV/20kV Qarabagh Substation. This substation will be powered by extending a double circuit transmission lines from the North East Power Sector (NEPS) to the South East Power Sector (SEPS) from Ghazni to Qarabagh.

Substation design and construction shall include all 220KV bus and structures necessary to support circuits as indicated in conceptual design drawings.

The installation shall include all required breakers, switches, arrestors, switchgears, reactors, transformers and metering equipment, and other components necessary to operate the system.

The MV switchgear shall be 20kV, metal-clad, indoor type. It shall connect the 20KV incoming underground cables from the power transformer to main circuit breakers. Switchgear shall contain bus tie circuit breakers between adjacent buses. Feeder breaker shall be provided for each of the individual MV feeders and fused disconnect cells for station service transformers. All 20KV power cables connecting the switchgear shall be routed underground. Electronic type relays located within the switchgear shall provide all protective functions as shown in drawings.

The Qarabagh Substation shall be designed and constructed per conceptual drawings Section 3.0; Drawings E-101, E-102, E-103, E-104 and E-105.

Moqor (Gelan) Substation

Design and construct a complete 220kV/20kV Moqor Substation. This substation will be powered by extending a double circuit transmission lines from the North East Power Sector (NEPS) to the South East Power Sector (SEPS) from Ghazni to Qarabagh to Moqor.

Substation design and construction shall include all 220KV bus and structures necessary to support circuits as indicated in conceptual design drawings. The installation shall include all required breakers, switches, arrestors, switchgears, reactors, transformers and metering equipment, and other components necessary to operate the system.

The MV switchgear shall be 20kV, metal-clad, indoor type. It shall connect the 20KV incoming underground cables from the power transformer to main circuit breakers. Switchgear shall contain bus tie circuit breakers between adjacent buses. Feeder breaker shall be provided for each of the individual MV feeders and fused disconnect cells for station service transformers. All 20KV power cables connecting the switchgear shall be routed underground. Electronic type relays located within the switchgear shall provide all protective functions as shown in drawings.

The Moqor Substation shall be designed and constructed per conceptual drawings Section 3.0; Drawings E-201, E-202, E-203, E-204 and E-205.

Shah Joy Substation

Design and construct a complete 220kV/20kV Shah Joy Substation. This substation will be powered by extending a double circuit transmission lines from the North East Power Sector (NEPS) to the South East Power Sector (SEPS) from Ghazni to Qarabagh to Moqor to Shah Joy.

Substation design and construction shall include all 220KV bus and structures necessary to support circuits as indicated in conceptual design drawings. The installation shall include all required breakers, switches, arrestors, switchgears, reactors, transformers and metering equipment, and other components necessary to operate the system.

The MV switchgear shall be 20kV, metal-clad, indoor type. It shall connect the 20KV incoming underground cables from the power transformer to main circuit breakers. Switchgear shall contain bus tie circuit breakers between adjacent buses. Feeder breaker shall be provided for each of the individual MV feeders and fused disconnect cells for station service transformers. All 20KV power cables connecting the switchgear shall be routed underground. Electronic type relays located within the switchgear shall provide all protective functions as shown in drawings.

The Shah Joy Substation shall be designed and constructed per conceptual drawings Section 3.0; Drawings E-301, E-302, E-303, E-304 and E-305.

Qalat Substation

Design and construct a complete 220KV/20kV Qalat Substation. This substation will be powered by extending a double circuit transmission lines from the North East Power Sector (NEPS) to the South East Power Sector (SEPS) from Ghazni to Qarabagh to Moqor to Shah Joy to Qalat.

Substation design and construction shall include all 220KV bus and structures necessary to support circuits as indicated in conceptual design drawings. The installation shall include all required breakers, switches, arrestors, switchgears, reactors, transformers and metering equipment, and other components necessary to operate the system.

The MV switchgear shall be 20kV, metal-clad, indoor type. It shall connect the 20kV incoming underground cables from the power transformer to main circuit breakers. Switchgear shall contain bus tie circuit breakers between adjacent buses. Feeder breaker shall be provided for each of the individual MV feeders and fused disconnect cells for station service transformers. All 20kV power cables connecting the switchgear shall be routed underground. Electronic type relays located within the switchgear shall provide all protective functions as shown in drawings.

The Qalat Substation shall be designed and constructed per conceptual drawings Section 3.0; Drawings E-401, E-402, E-403, E-404 and E-405.

Kandahar East Substation

Design and construct a complete 220kV/110kV/20kV Kandahar East Substation. This substation will be powered by extending a double circuit transmission lines from the North East Power Sector (NEPS) to the South East Power Sector (SEPS) from Ghazni to Qarabagh to Moqor to Shah Joy to Qalat to Kandahar East.

Substation design and construction shall include all 220KV and 110KV buses and structures necessary to support circuits as indicated in conceptual design drawings. The installation shall include all required breakers, switches, arrestors, switchgears, reactors, transformers and metering equipment, and other components necessary to operate the system. Substation bays designated as "Future" are not part of the construction of this project. However, the final design shall incorporate space for future bays as shown in drawings.

This substation will include two autotransformers to step down voltage from 220KV to 110KV as well as two buses to connect to the existing duplex 110KV SEPS system. This will serve as the connection between the NEPS and SEPS systems. All 110KV insulators, spacing, CVTs, CTs, circuit breakers and disconnect switches will be sized and rated for future 220KV operation except for the surge arrestors at the 110kV portion of this substation which should be rated for 110kV operation and later upgraded to 220kV rating when 110kVoperation portion is switched to 220kV operation. The CVTs operating as part of the 110KV system shall contain dual voltage ratio secondary connections to provide proper operation at the 110KV level.

The MV switchgear shall be 20kV, metal-clad, indoor type. It shall connect the 20KV incoming underground cables from the power transformer to main circuit breakers. Switchgear shall contain bus tie circuit breakers between adjacent buses. Feeder breaker shall be provided for each of the individual MV feeders and fused disconnect cells for station service transformers. All 20KV power cables connecting the switchgear shall be routed underground. Electronic type relays located within the switchgear shall provide all protective functions as shown in drawings.

The Kandahar East Substation shall be designed and constructed per conceptual drawings Section 3.0; Drawings E-501, E-502, E-503, E-504, E-505, E-506, E-507, E-508, and E-509.

1.1.3 Coordination Activities

Contractor shall interface and coordinate with other parties to ensure proper connection of substations and transmission lines constructed independently. The interface point between substation work and transmission line work shall be at the first gantry in the substations.

1.1.4 Code, Standards, Specifications

All material used, plant supplied and all workmanship and tests shall be in accordance with the latest editions of IEC and ISO Standards, or where International Standards are not applicable, with national standards such as ASA, ANSI, ASTM, BS or VDE + DIN, IEEE, ASCE. Where such standards and codes are national or relate to a particular country or region, other authoritative standards that ensure substantial equivalence to the standards and codes specified or in accordance with technical requirements of a Country where the site is located, will be acceptable. For any such standards which are not written in the English language, the Contractor shall make available copies of a certified English translation thereof.

Where no standards exist, as in the case of patent or special materials, all such materials and workmanship shall be of the best quality and full details of the material and any quality control tests to which they may be subjected shall be submitted to the Engineer for approval.

The Contractor shall deliver (soft copy and hard copy) at his own cost, one complete set of the selected and approved international code standards, and specifications to the Employer / Engineer within 28 days after commencement of the works.

The set shall contain codes, standards and specifications as referred to in the technical specifications or approved alternatives. One set shall be kept at the Contractor's site office and shall be accessible to the Employer or his representatives during working hours.

1.1.5 Equipment and Materials

All equipment and materials to be incorporated in the works must be new, unused, and of the most recent or current models, and must incorporate all recent improvements in design and materials unless provided for otherwise in the Contract. Where applicable, all equipment and material shall be of design suitable for adverse climatic conditions as experienced on site in Afghanistan. All equipment and material shall be inspected and tested in full, to prove compliance with the requirements of the Specifications to the satisfaction of the Engineer.

1.1.6 Workmanship

All work, method statements of work and workmanship, whether fully specified herein or not, shall be of the highest order. In all respects, the generally accepted requirements and commonly recognized good practice for first-class work of this nature are to be adhered to and the Contractor shall submit quality certificates for materials. Method statements shall be submitted for all works for review and approval before the work commences and shall be to the satisfaction and approval of the Engineer.

1.1.7 Design and Engineering

The Contractor shall design, manufacture, supply, erect, construct, install, test and commission all equipment and Materials, items and components of the Works, and carry out all installation services and work necessary so that the Works described herein shall be satisfactory for their intended purpose.

The Contractor shall design the complete Works in accordance with the design criteria and specifications given in the Supply Requirements, and as shown in the Bid Drawings. All design carried out by the Contractor shall comply with these Specifications and shall take into account all requirements of the Facilities and technical requirements of Afghanistan. The Contractor shall optimize the design of each component of the Works in order to achieve the most economic design. The Contractor shall be entirely responsible for all design carried out by him.

The Contractor shall inform themselves fully of the actual dimensions, levels, etc., of any other existing or proposed structures before commencing the manufacture of parts dependent on such data. The design calculations for each member forming part of the system shall be based on the most unfavorable combination of all the loads which the said member or part is intended to support or assist in supporting either permanently or temporarily. All design calculations shall be subject to the review and approval of the Engineer.

Where appropriate design criteria or specifications are not indicated in the supply requirements or shown in the Bid Drawings, then the Contractor shall carry out the design work in accordance with generally accepted engineering design theories, principles and criteria, to the satisfaction of the Engineer.

The Contractor shall provide the Employer with fully detailed design drawings, detailed design reports and design calculations relating to the Works. All design work shall be subject to the approval of the Employer, pursuant to the Conditions of Contract. Design drawings, design reports and design calculations shall be prepared and submitted in accordance with chapter Documentation of the General Requirements.

1.1.8 System Characteristics and Climatic Conditions

All equipment and material shall be designed for efficient operation under Afghanistan's climatic conditions, which can be harsh with snow and ice in winter and hot and dusty conditions in the summer. The following system characteristics and climatic conditions data are provided for guidance in designing the equipment and related material:

Specified clearances shall be considered minimums. The supplied values are elevation dependent and have been provided for information only. The designer shall consider elevation and adjust clearances tendered and applied to equipment design.

Table 1.1.1 Plant Design Conditions

HV System	
Nominal Voltage (U_n)	220KV
Highest System Voltage (U_{max})	245KV
Design Voltage (U_m)	245KV
Minimum continuous ac system voltage, line to line	187KV (0.85 pu)
Maximum short-term ac system voltage, line to line	297KV (1.35 pu) (Max. duration 1 s)
Continuous zero sequence component	5%
Rated short time current	40kA/1sec
Minimum three-phase fault current	1kA
System configuration	Double Circuit, 3 phase/Circuit
Number of Conductor	2 conductor per phase
Earthing	Solidly Earthed
Insulation Coordination	IEC 60071-1
Number of OPGW	1 OPGW
Rated lightning impulse withstand (peak)* :	
0m – 1,500m a.m.s.l.**	950KV
1,501m – 2,500m a.m.s.l.**	1,050KV
Rated 1 min power frequency withstand (KV rms) :	
0m – 1,500m a.m.s.l.**	395KV
1,501m – 2,500m a.m.s.l.**	460KV
Phase-to-earth air clearance :	
Minimum	2,000mm
0-750 m a.m.s.l.**	2,000mm
751-1,500 m a.m.s.l.**	2,100mm
1,501-2,500 m a.m.s.l.**	2,200mm
Phase-to-Phase air clearance :	
Minimum	2,200mm
0-750 m a.m.s.l.**	2,200mm
751-1,500 m a.m.s.l.**	2,300mm
1,501-2,500 m a.m.s.l.**	2,450mm
Creepage distance outdoor +	25mm/KV_{PG}
Frequency	
Standard frequency	50Hz
Maximum continuous ac system frequency	52.5Hz
Minimum continuous ac system frequency	47.5Hz
Maximum short-term ac system frequency	52.5Hz (Max. duration 900 s)
Maximum rate of change of frequency (df/dt)	0.2Hz/s
Minimum short-term ac system frequency	47.5Hz (Max. duration 1800 s)
MV (20KV) Distribution System	
Nominal Voltage (U_n)	20KV
Highest System Voltage (Umax)	24KV
Design Voltage (Um)	24KV
Standard Frequency	50Hz
Rated Short Time Current	12.5kA/1 sec

Table 1.1.1 Plant Design Conditions continued MV (20KV) Distribution System	
System Configuration	3 phase/3 wire
Earthing	Solidly earthed
Insulation Coordination	IEC 60071-1, -2
Rated Lightning Impulse Withstand (peak)	145KV
Rated 1 min Power Frequency Withstand (rms)	50KV
Minimum Phase-to-Earth Air Clearance	270mm
Creepage Distance Outdoor	25mm/KVPG
Vector Group of Feeding Transformers	Δyn0d11
LV Distribution System	
Nominal Voltage (Un)	400/230V
Design Voltage (Um)	0.6/1KV
Voltage Variation	±7.5%
Standard Frequency	50Hz
Rated Short Time Current	12.5kA/1 sec
Earthing	Solidly earthed
Climatic and Geographic Conditions	
Seismic Factor for design Data not available	(Contractor to nominate value)
Altitude (Project Area only)	
Qarabagh	2,050m
Moqor	2,024m
Shah Joy	1,855m
Qalat	1,552m
Kandahar East	1,029m
Dry Period	June to November
Rain Period	December to May
Annual Rainfall	327mm
Maximum Solar Radiation	1,200W/m2
Maximum Ground Snow Depth	1m
Maximum frost depth	1m
Average	12°C
Maximum	39°C
Minimum	-6.0°C
Humidity	
Average humidity summer	35%
Average humidity winter	75%
Ground Resistivity of Soil:	
Average	2000 Ohm-m Single soil layer
Wind:	
Maximum Wind Velocity	41m/s (148km/h)

Table 1.1.1 Climatic and Geographic Conditions continued Wind	
Wind gust factor or maximum wind gust	1.5
Wind and Dust	Sand and dust storms in summer
Isokeraunic Level Thunderstorm	23 days/year

*For nominal system voltages ≤ 300KV, the switching withstand voltage is not a factor. Only lightning impulse withstand voltage is a factor in insulation coordination calculations.
**a.m.s.l.: altitude mean sea level
+Light pollution level per IEC 60815 Standard.

1.1.9 Language

The English language shall be used in all Contract documents and in all correspondence between the Contractor and the Engineer, and between the Contractor and the Employer.

1.1.10 System of Units

In all correspondence, in all technical schedules and on all drawings, metric units of measurement, System International (SI) system of units, shall exclusively be used:

- Dimensions in meters and millimeters unless specified otherwise
- The unit of mass is the kilogram (kg)
- The unit of force is the Newton (N)
- Angular measurement shall be in degrees, with 90 degrees comprising one right angle

1.1.11 Documentation

1.1.11.1 General

The sizes of all documents and drawings shall conform to the ISO standard, and be of size A1, A2, A3 or A4. Larger sizes than A1 shall be avoided. All documents in size A3 and A4 shall be bound in hard covers. The schematic diagrams, apparatus and cable lists shall have a size of A3 or A4. The Contractor shall submit the hard copy and soft copy of the all documents as per the specification and price schedule.

All drawings shall be prepared and submitted in the latest version of AutoCAD or a similar computer aided drafting software package. Scales to be used on the drawings shall be 1:10, 1:20, 1:40, 1:50 and multiples of this series.

Operational and warning labels in the Afghan language shall also be indicated.

The Contractor shall, during the project duration, maintain a List of Documentation to be updated whenever needed. The List of Documentation shall include the date of the original issue of each document submitted as well as the dates of every revision. The List of Documentation shall also include a time schedule for the submittal of the documentation.

1.1.11.2 Documentation for Design and Manufacture

During the design period, full documentation on all plant equipment shall be supplied to the Engineer and to the Employer for review and approval. All drawings prepared by the Contractor shall be submitted in five (5) sets hard copy and two sets (2) of soft copy (CD) to the Employer for review and approval. All documentation shall have such information or instructions related to the drawings and the design as may be necessary.

Within twenty eight (28) days after receiving such drawings, calculations, samples, patterns and models, one copy of each document will be returned to the Contractor, dated, signed and marked by the Engineer and, where necessary, with proposed corrections indicated.

Any delay arising out of failure by the Contractor to rectify the design, calculations, drawings, etc. in good time should not alter Contract completion date.

Drawings marked **RETURNED FOR CORRECTION** shall be corrected by the Contractor and sent to the Engineer for further review.

When a drawing is marked **REVIEWED** or **REVIEWED AS AMENDED**, the Contractor will be allowed to use the drawing for manufacture and erection. The Contractor shall, however, make corrections according to the remarks given by the Employer, Engineer, expert and upon their approval, the Contractor could use the drawings. Manufacturing starting prior to receipt drawings marked REVIEWED or REVIEWED AS AMENDED is done at the Contractor's own responsibility.

The Engineer's approval does not however in any way relieve the Contractor of his full responsibility for the correctness of his documentation and the proper functioning, quality and compliance with the Specifications of all plant and equipment supplied by him.

The Engineer's approval shall not relieve the Contractor from full responsibility from mistakes or omissions therein or there from (including any resultant mistake or error in the Works) or for any discrepancy or deviation from the Technical Specification and other drawings.

Calculations, samples, patterns, models, etc., submitted to the Engineer for his review, shall be such as are called for herein or as may be necessary for proving compliance with the Contract.

1.1.11.3 Documentation for Installation

The Contract Price shall be deemed to include illustrated installation, operating, service and maintenance instructions for the Works, which shall be written in English. The installation, operation, service and maintenance manuals shall cover all aspects of the Works, including the civil works and structures, surface water drainage, sub-soil and under-structure drainage, etc., and all electrical equipment supplied. Hard copy and soft copy of the Method Statement with drawings/sketches shall be submitted for review and approval to Employer/Engineer for construction, erection, installation, etc. works.

The manuals shall include parts catalogues, and details of equipment installation, operation, maintenance and repair. If the manufacturer's standard bulletins are supplied, they shall be clearly marked to indicate the specifications applicable to the particular equipment that is supplied. Each manual shall include a full set of assembly drawings, including wiring diagrams, reduced to A3 size. The manual shall also contain a detailed service program adapted for each plant for all equipment explaining what action shall be done on which equipment and when.

Prior to the installation period the Contractor shall distribute copies of the REVIEWED documents and such other particulars, to the Employer in four (4) sets and to the Engineer in one (1) set.

The Contractor shall submit in due time but not less than one month before commissioning, two copies of preliminary Operation and Maintenance Instructions and Service handbooks to the Engineer for review and approval, following the same procedure as for the drawings.

The approved documentation shall be distributed in five (5) sets to the Employer two months before the start of commissioning.

If any descriptive brochures forming part of this documentation shall be provided in English versions, complete translations shall be enclosed.

The documentation shall continuously be updated during the installation and test period by the Contractor. During the initial period of operation, before receipt of As-built documentation at the site, one copy of the updated erection documentation, instructions, etc., shall be kept at the site.

1.1.11.4 Commissioning and Completion Report

Prior to the issue of the Taking-Over Certificate, the Contractor shall submit to the Employer's Representative one original and six copies of a Commissioning and Completion Report for each Section of the Works. The Works, or, if applicable, the Section, shall not be considered to be completed for the purposes of taking-over until such Commissioning and Completion Reports have been submitted to the Employer's Representative.

1.1.11.5 As-Built Documentation

General

Immediately after the Operational Acceptance of the Facilities, the Contractor shall update all final documents in accordance with the modifications made. When a document contains all modifications, it shall be marked As-built.

As-built documentation shall be submitted to the Employer in four (4) sets and to the Engineer in one set, at the latest two months after Operational Acceptance of the Facilities.

For drawings, A3 size and larger, one of the sets issued to the Employer, shall be of reproducible transparent material (PVC). In addition two soft copies, CD ROMS or similar computer storage media, shall be supplied for all As-Built drawings.

The supply of As-built documents shall comprise but not be limited to all AutoCAD drawings for construction and installation, calculations, instructions for operation, maintenance, repair and adjustment, apparatus lists, spare parts lists containing information needed for ordering for all equipment supplied under the Contract.

General Manuals

The following general manuals, covering the whole project, shall be delivered:

- A general description of the equipment in this contract
- Operating instructions, suitable for training of personnel
- General maintenance instructions, describing frequencies and methods for regular inspections, for planned maintenance and for regular part replacements. The instructions shall also include fault location guides.
- The manuals shall include spare part lists and description of any special tools needed for service of the equipment.
- All other drawings or manuals that are not mentioned, but are deemed necessary for a safe and proper handling of the delivered equipment.

System Design Documentation

The following documents shall be delivered:

- All layouts, construction and installation drawings
- All design, calculations, regarding civil, electrical and mechanical design data and computations
- Design Drawings, Sag and Tension Chart, tower schedule, tower spotting data, etc.

System Documentation

Documents for approval shall be delivered before the work is started but shall also be included in the as-built documentation as follows; in case of alterations agreed upon by all parties, new documents shall be issued:

- Type test certificates for important equipment and material: data specifications on other equipment
- Routine test certificates
- Data lists with Engineer required amendments incorporated. The contents of the lists shall correspond to the schedules of this document. Data lists will be regarded as binding for the manufacturer
- Dimension drawings. They shall be regarded as binding for the manufacturer and shall contain measures, weights and features of the equipment
- Detail drawings as required by the Engineer

1.1.12 Progress Reports

Work plans, monthly programs, and reports shall be provided by the Contractor. At the end of each month, the Contractor shall submit suitable written progress reports to the Employer and Engineer with the progress of design, manufacture, delivery, transport, erection, etc. If the progress of the Works does not conform to the approved Program, the Contractor shall indicate these deviations, with substantiating reasons.

1.1.13 Manufacture

Before commencing any manufacture of the equipment and structures, the Contractor shall submit for the approval of the Engineer, the drawings of the manufacturers of the equipment and structures. After such approval has been given, the manufacture shall be planned and performed according to the Specifications and to the satisfaction of the Engineer.

The Engineer shall be afforded every opportunity to control and inspect the manufacture and testing of materials in the steelworks, rolling mills, foundries, factories etc., and their assembly in the workshops of the Contractor and his Subcontractors.

1.1.14 Site Regulations and Safety

The Employer and the Contractor shall establish Site regulations according to the General Conditions of Contract.

The Contractor shall provide appropriate training in handling plant and machinery to the workers and laborers before the commencement of work. All workers employed by the Contractor shall be insured against any accident.

1.1.15 Notices and Permits

The Contractor shall give the requisite notice and obtain any necessary approvals from the Government or Authorities. Authorities' Inspectors may be required in the case of excavations, trenching and (in particular) blasting operations; the Contractor shall pay for all permits required prior to and during the execution of the Contract, including those required for all temporary works.

1.1.16 Verification of Dimensions

Before work is commenced on any structural element required to be fabricated, or provided under this Contract, the Contractor shall verify by measurement on site, the relevant dimensions of all work previously completed.

1.1.17 Site to be Kept Tidy

Throughout the progress of the Works, the Contractor shall keep the site and all working areas in a tidy and workmanlike condition, and free from rubbish and waste materials. Other items, which are not required for use by the Contractor at the present time, shall be dispersed about the site in an orderly fashion, or shall be properly and securely stored.

The Contractor shall not mobilize and demobilize of any construction plant, materials, etc. from the site without the approval of the Employer or Engineer.

1.1.18 Site Supervisors

The Contractor shall provide the services of competent specialists to supervise the construction of the Works and erection / installation of Plant at the Site. The Contractor's Site Supervisors shall be given full responsibility and authority to negotiate and agree points arising out of the Works, in order that the Works may proceed with a minimum of delay. Directions and instructions given by the Employer or the Engineer to the Site Supervisors shall be interpreted as having been given to the Contractor.

1.1.19 Safety of Personnel

The maximum safety, consistent with good erection/installation practices shall be afforded to personnel directly engaged on this Contract, or to persons who, in the normal course of their occupation, find it necessary to utilize temporary works erected by the Contractor to access the working area.

Once any section of the Works or Plant has been energized, the Contractor shall establish a system for ensuring the safety of personnel and plant. While the Works, Plant are under the control of the Contractor, the Contractor shall be primarily responsible for the safety precautions. While the Works, Plant are under the control of the Employer, the Employer shall be primarily responsible for these precautions.

1.1.20 Packing and Transport Marking

All parts of the Plant shall be well packed and protected against loss or damage during the transport by sea and land and whilst in storage under adverse climatic conditions. All packing shall be performed in such a way that the plant will not be damaged by overturning of the packages or by weather. Dimensions of packages, crates, etc., shall be suitable for road transport. Instructions for handling shall be clearly marked on all parts, packages and crates.

All parts, packages and crates shall be adequately marked to enable identification. Each item contained in a package shall be clearly identified on the packing list by its description and part number and assembly drawing reference, and each item shall be marked or labeled to correspond with the packing list. The marking system to be used shall be as instructed by the Engineer.

All packages shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked with signs showing 'up' and 'down' on the sides of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit by sea or storage on land.

The cost of all plant needed for the temporary fixing and supporting of the various parts of the Plant and the various packages to crane hooks, etc., during handling, transport and storage and the cost of load distribution beams, etc., where they form part of the packing or crates, shall be included in the Contract Price.

The Contractor shall be entirely responsible for all packing and any loss or damage shall be made good by the Contractor and, except where otherwise provided, at the Contractor's own expense.

Identification, reinforcement or upgrading of roads/bridges for access to the site and for transport of plant and materials shall be the responsibility of the Contractor. Any costs associated with identification, reinforcement and upgrading of roads and bridges shall be deemed to be included in the Contract Price.

1.1.21 Corrosion Protection and Painting

1.1.21.1 General

All parts of the Plant shall be protected against corrosion under service conditions. The protection shall also prevent corrosion during transport, storage and erection. Because of the high humidity at the Site, the protection shall be carried out at the Contractor's workshop.

Damage to the protection during transport, erection, etc., and erection joints, shall be repaired to the same quality as specified for the plant item.

1.1.21.2 Surface Protection

All steel and iron surfaces to be painted shall be prepared by means of sand or shot blasting or other approved methods. Before being blast-cleaned, the surfaces shall be cleaned of oil and grease. The surfaces shall be of clean metal and shall be dry and free from any foreign matter at the time of painting.

All surfaces to be painted shall be smooth, even and free from dirt, rubbish and shall be dry and protected from dampness; i.e., surfaces shall be free from anything that will adversely affect the adhesion or appearance of paint or galvanizing.

All defective concrete/cement plaster shall be cutout and trimmed, holes in internal plaster faces shall be made good with approved material. All dirt and powdery substrate shall be removed with slightly damp cloth.

All laitance shall be removed from concrete surfaces by wire brush or blasting. All holes, defects shall be filled and repaired by epoxy grouts. All dust and/or mill scale etc. shall - if necessary - be removed from new metal surfaces with a wire brush, chipping hammer or grinding. The surface of the metal work shall then be primed with an approved metal primer before application of the undercoat.

Pre-treatment of the galvanized surfaces includes etch-cleaning, sweep blasting (preferred) or emery paper used to clean and roughen the surface, remove any matter detrimental to the adhesion and to achieve a better anchor pattern.

Wood surfaces shall have all ironwork removed prior to the preparation of surfaces and re-fixed upon completion of the paint. All knots and resinous parts in wood surfaces shall be treated by two coats of shellac varnish. Cracks and holes shall be treated by one coat of primer and filled with approved filler.

1.1.21.3 Painting

The painting shall be carried out in an efficient and professional manner to the satisfaction of the Engineer. The quality and colors as well as the application of the paints shall be approved by the Engineer and the Contractor shall submit detailed information, samples and the Manufacturer's recommendations for the paints for approval.

Emulsion paints shall be used for internal cement plastering and internal fair-faced concrete of walls and ceilings. All emulsion paints shall be washable consisting of:

- One coat of Acrylic primer sealer
- Two coats of filler based on alkaline resistant polyvinyl-acetate
- Two coats of polyvinyl-acetate emulsion flat finish

Oil paints shall be used for wood surface and internal cement plastering and internal fair faced concrete in confined humid areas such as bathrooms, consisting of:

- One coat of Acrylic primer sealer
- Two coats of filler, based on alkaline resistant polyvinyl-acetate
- Two finish coats, based on alkyd resins

Varnishes shall be used for wood surfaces and shall be of one of the following types:

- Polyurethane varnish
- Synthetic varnish of linseed oil alkyd resin

All un-galvanized external surfaces except nuts, bolts and washers which may be removed for maintenance purposes shall be painted at the manufacturer's works as follows:

- A primary coat of rust-inhibiting paint.
- Two coats of non-glossy oil and weather resisting paint, the second of which shall be applied on completion of work tests.
- One final coat of aluminum, oil and weather-resisting non-fading paint.

The total thickness of the above coatings shall be minimum 160 µm for outdoor surfaces and 120 µm for indoor surfaces.

Other paint systems:

- Epoxy paints for concrete shall be as per the specification.
- Oil resistant paints shall be epoxy paint resistant to all types of oil.

Paints for steel and galvanized surfaces are specified under "General Technical Requirements Mechanical".

Application of Paints (General)

All paint application shall be done in line with the paint manufacturer's instructions. Before applying any paint, all prepared surface shall be dry and clean. All priming paints shall be applied by brush except for etch primer which may be applied by brush or spray. Paints shall be applied as evenly as possible to provide a smooth coating of uniform thickness. Damaged areas of priming coats or undercoats shall be made good before further coats of paints are applied. The various coats of paint shall be distinguishable from each other by their shade.

The Contractor shall inform the Engineer in good time before starting to apply the next coat so that the Engineer shall have the opportunity of approving the previous coat. Painting systems shall not be carried out at temperature below 5°C or above 35°C. Trial coats shall be prepared at the request of the Engineer. The Contractor shall, upon completion remove all paint where it has been spilled, splashed or spattered on surfaces including sanitary fixtures, glass, and hardware. It shall be removed without marring the surface finish of the item being cleaned.

1.1.21.4 Galvanizing

All ferrous parts shall be galvanized except where otherwise specified. The dry film thickness or galvanization thickness on steel shall be measured by means of a magnetic or electrical thickness gauge such as "Microtester" or "Electrometer", and recorded in a tabulated form, indicating each layer of coat and the total dry film thickness. Contractor is responsible to provide such instrument without any charge to the Employer.

Galvanizing shall be applied, not less than 98% of which must be pure Zinc. The galvanizing procedure shall be started only after having finished all chipping, trimming, fitting and bending. Also, all drilling, punching, cutting and welding shall have been completed and all burrs removed.

All steel, including bolts, nuts and washers, shall be galvanized at the manufacturer's premises by means of hot dipping in accordance with internationally recognized standards such as ASTM A 239, or equivalent. The Zinc coat applied shall conform to ASTM A-123, minimum thickness grade 85 and higher (see table 2, ASTM A 123-89a).

Galvanizing shall consist of a continuous coating to minimum weights (g/m^2) as follows:

Rolled steel exposed to the atmosphere only	600g/m²
Rolled steel under the ground surface	1,500g/m²
Cast iron and malleable iron	600g/m²
Bolts, nuts and washers	375g/m²

The zinc coating shall meet the requirements according to BS 729, ASTM, A123, A153, A239 and A385, DIN 50961, 50976, 50978 or other equivalent methods and international standards. All steel shall be fully fabricated before galvanizing, no machine or shop work, boring, punching, etc., will be allowed after galvanizing.

1.1.22 Structural Steel and Cast Iron

Structural steel shall be made by the open-hearth basic oxygen or electrical furnace process.

In order to reduce the risk for material confusions, only two strength classes may be used. Suitable classes are low tensile steel (yield point 220 - 260N/mm²) and high tensile steel (yield point 300 - 350N/mm²).

Steel shall comply with the requirements of ASTM A143 and embrittlement tests shall be made in accordance with that specification.

If the Contractor intends to use more than one quality of steel, they will be required to take every precaution to the satisfaction of the Engineer, against any possible intermixing of different qualities during transport, storing, handling manufacture and installation.

Cast iron shall have a tensile strength of at least 140N/mm². It shall be made from the best grey pig and scrap iron, and shall be close-grained, tough and uniform in character.

Malleable iron shall be of the black hearth type with a tensile strength of not less than 330 N/mm².

1.1.23 Copper, Aluminum Alloys and Clad Steel

Copper and aluminum stranded conductor material shall meet the requirements of IEC Standards. The specification of proposed aluminum alloys shall be submitted for approval.

The preferred aluminum-clad steel to be supplied is Alumoweld or substantially equivalent. The preferred copper-clad steel to be supplied is Copperweld or substantially equivalent.

1.1.24 Marking

A legible mark of origin shall be applied on all castings and forgings, particularly on conductor and overhead ground wire hardware, and on insulators and associated hardware. Insulators shall, in addition, be marked with the mechanical or electromechanical failing load or a corresponding code number. Each separate member of the structure shall be marked indicating tower/pole type and number and the piece corresponding to the shop drawings. These marks shall be embossed into the steel before galvanizing, or concrete as part of the casting, in such a manner as to be plainly visible after manufacture.

1.1.25 Concrete Works

1.1.25.1 General

In general, and except where otherwise specified, the Contractor shall supply all labor, materials and plant required for the concrete work and all tests thereon and shall:

- Nominate the sources of materials, testing and mix design
- Mix, transport, place, compact, finish and cure all concrete
- Erect and dismantle all forms and formwork
- Produce and install all steel reinforcement
- Embed, as required, all items, whether supplied and erected directly or by other Contractors, in accordance with these specifications and drawings.

1.1.25.2 Cement

The type of cement to be used shall depend on the constructional circumstances and on the prevailing local conditions.

Ordinary Portland cement, ASTM C-Type I, may be used at places not exposed to chemical aggressiveness. Moderate sulphate resistant cement and highly sulphate resistant cement shall be used as per the recommendation of the soil investigation reports and written approval of Engineer and the Employer. No extra payment will be made to the Contractor for the use of sulphate resistant cement.

Cement shall be delivered to the site in bulk cement containers or in sealed bags clearly marked with the maker's name and shall be carefully stored in a waterproof shed with a raised floor or in a silo of approved design. Each consignment of cement shall be stored apart from earlier consignments and the cement shall be used in the order in which it is delivered.

The Contractor shall ensure that each consignment is accompanied by a certificate from the manufacturer certifying that the cement in that consignment is in accordance with the Specification. Weathered or congealed cement, or cement more than three (3) months old after production, shall not be permitted to be used unless otherwise approved by the Engineer after the quality test.

Cement shall be stored in a suitable weather-tight enclosure on a board platform raised off the ground. The enclosure should be such that free circulation of air around the bags of cement is kept to a minimum. Any cement that has become damp, caked or lumpy shall not be used. Concrete batching operations shall be organized so that cement that has been manufactured first is used first.

Each consignment of cement may, after delivery to the site and at the discretion of the Employer, be subjected to the whole of the tests and analyses required by the standard Specification.

The Employer may reject any cement as a result of any tests thereof, notwithstanding the manufacturer's certificate. The Contractor may also reject cement which has deteriorated owing to inadequate protection or other causes or in any other case where the cement is not to his satisfaction. The Contractor must remove all rejected cement from the site without delay and expenses for the Employer.

The Contractor shall arrange for these tests to be carried out at his own expense.

1.1.25.3 Aggregates

All aggregates to be used for the Works shall be crushed rock type complying with the requirements of BS 882 or equivalent in all respects and shall be subject to the tests laid down in BS 812 or equivalent. The Contractor shall furnish to the Engineer samples of both the proposed fine and the coarse aggregates, together with such full details as the Engineer may require. No aggregates may be used in the Works until approved by the Engineer.

During the work, the Engineer shall order such tests he may consider necessary on the aggregates; any aggregates found to have unsuitable characteristics at any time shall not be used in the Works and shall be removed from the Site. Aggregates are subject to the Employer's approval.

The various fractions of fine and coarse aggregates shall be stored separately and in such a manner as to avoid the admixture of dirt in the concrete. Aggregates shall be handled in such a way that separation is avoided.

Maximum size of aggregate used in concrete shall not be more than 20 mm. The combined aggregate shall be as coarse-grained and dense-graded as possible. Fine and coarse aggregates shall be stored so that they are kept clean and free from contamination and are not subjected to segregation. Where a clean hard surface is not available for the stockpiles, the bottom 150 mm of the aggregate piles that are in contact with the ground shall not be used.

1.1.25.4 Grading of Aggregates

The grading of the fine and coarse aggregates shall be such that when they are mixed in the proportions decided for each class of concrete, the grading of the combined aggregate shall be suitable for making dense concrete of appropriate workability, containing the proportions of cement and water prescribed.

The proportions of fine and coarse aggregates and the maximum size of the coarse aggregate to be used in each class of concrete shall be approved by the Engineer.

The Contractor shall be responsible for mixing the aggregates in the proportions approved by the Engineer for each class of concrete and each section of the work. He shall submit samples of the concrete material to the Engineer and the Employer well before starting any concrete work, and have test cubes made and tested from the aggregates and the cement which he intends to use. Concrete works must not begin until such samples and tests are to the Engineer's satisfaction.

Fine aggregate (sand) shall consist of clean material or manufactured sands and coarse aggregate shall consist of clean gravel, crushed gravel or crushed stone. Both the fine and coarse aggregates shall comply with ASTM C33. Sulphate and sulphide shall be in such quantities that the whole proportion, in sulphur trioxide, be less than 1 percent of the mass. Prohibited aggregates include:

- Feldspathic or schistose rock
- Aggregates containing charcoals or their residues such as coke, ashes, clinkers, finders.

1.1.25.5 Water

The water to be used for mixing and curing of concrete shall at all times be kept clean and free from deleterious materials such as oil, acid, alkali, silt, etc. which effects to the cement, aggregate or the steel reinforcement. Water chemical analysis tests shall be carried out before commencement of foundation works.

1.1.25.6 Admixtures

No admixtures shall be used without written approval of Engineer and the suitability of admixtures must be proven in trial mixes in presence of representative of Employer. If required to improve the quality of concrete (workability, finish and water tightness), water reducing and set retarding agents and plasticizers shall be used in accordance with ASTM C-494. Under no circumstances shall calcium chloride or any admixtures containing calcium chloride be permitted in the concrete.

Manufacturer's recommendations and instructions concerning overdosing of additives shall be strictly observed and mixture containing chlorides shall not be used under any circumstance.

1.1.25.7 Concrete Mixing, Placing and Compaction, Protection and Curing

Mix Design

Full details of the components forming the concrete mix proposed to be used by the Contractor shall be submitted to the Engineer for assessment least one (1) month before any concreting operations are commenced. Once the proposed mix has been approved by the Engineer, it shall not be varied by the Contractor unless the Engineer's prior approval has been obtained.
No concreting shall be commenced in any portion of the work until the preparations and the concrete mix design have been approved, and permission been granted by the Employer.

The required minimum concrete class is a C 25 as per BS standard. The mix design of the concrete has to be approved, and its suitability proven in trial mixes at site. In case of use of ready mixed concrete, trial mixes may be waived if an earlier proven mix design is used.

The concrete mix shall be designed and tested and their submission shall include the following information:

- Source, nature and grading of both the fine and coarse aggregates
- Type and supplier of the cement to be used
- Proportions by weight of both the fine and coarse aggregates
- Weight of cement per cubic meter of concrete
- Water-cement ratio by weight
- Estimated slump of the mix
- Arithmetic mean compression strength of the mix at 7 days and 28 days using cube compression test samples, plus the standard deviation of the test strengths and the number of cubes tested.

Any admixtures specified for inclusion in the concrete mixes or that the Contractor intends to use in his mixes (and they have had the prior approval of the Engineer) shall be included in these trial mixes. The ratio of the weight of fine aggregate (sand) to the total weight of aggregates shall be between 0.35 and 0.50. The minimum cement content shall be 350-400kg/m3 and the maximum water cement ratio by weight shall be 0.45.

The Contractor shall allow for the cost of all such testing in his Tender as well as any further testing and additional reporting that the Employer/Engineer may require.

Mixing of Concrete

All concrete shall be mixed in power driven mixers, approved by the Engineer. If required in some locations (i.e., a mixing machine transportation problem), volume basis will be allowed as long as careful controls are maintained and written approval from the Engineer has been received.
The concrete materials shall be accurately measured to ensure the production of uniform batches of concrete. The Contractor will be required to proportion the materials by weight at all times. If required, the materials may be measured by volume and the proportions in each batch adjusted to suit whole bags of cement after getting written approval from the Engineer. Only unbroken bags of cement may be used. Bags of cement that have partially set, contain any lumps, or have become wet at any stage shall not be used.

Volume measurement shall be carried out using well-proportioned gauge boxes. Under no circumstances will the volumes be proportioned by shovels. The gauge boxes shall be loose-filled with the material being measured then struck off level with a straight edge then discharged into the mixer. The required volume of mixing water shall be adjusted to allow for the free moisture contained in the aggregates. Personnel in charge of the concrete mixing operations shall be trained and experienced in this method of concrete production.

The batch mixture shall be rotated at a speed recommended by the manufacturer and all concrete shall be mixed for a minimum of 1½ minutes from the time the last of the materials have been placed in the mixing drum. The mixing shall continue until the materials are thoroughly and uniformly mixed and the concrete is uniform in color and texture. The entire batch must be discharged from the mixer before recharging commences. Each batch of concrete shall have a similar appearance. The slump of the concrete shall normally be between 25mm and 50mm corresponding to a stiff, plastic consistency.

All plant for mixing shall be cleaned and free from all dirt and debris. All mechanical equipment (mixture, vibrator, etc.) and the stock of construction material (cement, aggregate and sand) shall be checked before starting a concrete pour to ascertain whether or not it is in good operation condition and sufficient in quantity for the foundation work. The Contractor shall always have at least two vibrators in operating condition at the location of the concrete placement.

In hot weather conditions, various means should be employed to lower the temperature of concrete as:

- Using cold water; the use of ice is to be limited to chill the mixing water, but no ice is to be used during batching.
- Avoiding the use of the hot cement
- Insulating water supply lines and tanks
- Cooling coarse aggregate
- Shading and/or cooling mixer drums
- Adequately watering of sub-grade, formwork and reinforcement
- Avoid concreting around midday
- The temperature of fresh concrete must in no case exceed +30°C

Placing and Compaction of Concrete

Concrete shall be conveyed from the mixer to moulds by a method that prevents segregation or loss of the ingredients. It shall be placed as nearly as practicable in its final position to avoid segregation due to re-handling or flowing.

The placement of concrete shall be at such a rate that the concrete is at all times plastic and flows smoothly, ensuring that the concrete in its final position shall be dense and homogeneous.

The placement of concrete in the moulds shall be completed within ½ hour after the introduction or the mixing water to the cement and the aggregates in the concrete mixer. Batches in excess of 30 minutes of mixing the concrete shall be rejected and replaced by fresh concrete without any extra cost to the Employer. Each formwork shall be filled with concrete as a continuous operation. The written approval is required for construction (working) joints, if required.

Concrete shall be placed and compacted/vibrated in horizontal layers of not more than 300 mm thickness each and vibrators and other compacting equipment shall be to the satisfaction of the Engineer.

An appropriate method must be adopted by the Contractor to prevent separation of concrete when placing concrete in the foundations with a fall over 1 meter.

Protection and Curing

Cement-based repairs may require some initial protection, because rapid drying could halt the hydration of the cement and lead to shrinkage cracking, de-lamination and weakness.

Careful curing is essential by covering with absorbent material that is kept damp, preferably covered in turn by polythene or similar sheets, which are sealed at the edges. Shading from the sun may be necessary. Importantly, alternate wetting and drying must be prevented because of the alternating stresses that it would cause.

If repairs are to be carried out during hot weather, it is advisable to shade the work from direct sunlight in order to prevent drying out of cement-based repairs or over-rapid stiffening of resin-based materials.

Requirements for curing large volume repairs are similar to those for new construction. Although they are less critical in this respect than thin patches, curing is important to a durable result. Normal curing methods are usable except that sprayed-on curing membranes are suitable if a surface coating is to be applied later.

During the initial stages of hardening, the concrete shall be protected from the direct rays of the sun and from drying winds. The formworks containing the hardened concrete shall not be disturbed or give external forces.

To ensure proper curing, all concrete shall be kept moist for a period of at least 10 days. Foundations shall not be backfilled before they have been cured and inspected. The foundations shall not be subjected to any loads in addition to those existing at the time of the placing of the foundation concrete until the curing period has elapsed. Curing compound membranes shall be applied uniformly by spray, leaving no pinholes or gaps, at a rate not to exceeding 4.91kg/m/liter. The curing compound shall be applied after finishing operations are completed and surface moisture has disappeared.

1.1.25.8 Ready-mixed Concrete

Ready-mixed concrete may be used in the Works, provided that adequate control is maintained of the supply, mixing, and placing of the concrete.

Concrete shall be placed and compacted in its final position within 90 minutes of the water being added to the mix. If the Bidder/Contractor proposes the use of pumps for the transporting and placing of concrete, he shall submit a detailed method statement. The Contractor shall ensure that pumping shocks shall not be transferred from the pipeline to the form-work, to previously laid concrete or to the structure. The initial discharge of any pumped concrete shall be discarded completely.

1.1.25.9 Steel Reinforcement

The steel reinforcement shall consist of hot rolled deformed bars conforming to the requirements of BS 4449, Grade 460 or higher. The specific number, type and location of ridges on the deformed bars shall be approved by the Engineer and the Employer.

The number, placing and fixing of bars shall be in accordance with the drawings and approved bar bending schedules, or otherwise, as directed by the Engineer.

All reinforcing bars shall be bent in accordance with the relevant standard. In particular, no reinforcement shall be heated. All reinforcement shall be rigidly fixed in position to the concrete cover specified by an approved means.

All chairs, tie-wires or other devices used to connect, support, secure or fasten reinforcement shall be provided as per the requirement and as directed by the Engineer.

All reinforcing bars shall be stored in a clean, dry place on platforms off the ground. Grease, oil, paint or any other substance that will affect the bond of the reinforcement shall not be allowed to come in contact with the bars. All such substances shall be cleaned off the reinforcement before it is placed for concreting.

All reinforcing bars shall have a protective cover of not less than 100 mm at the bottom of footings and on any surface of concrete that will be exposed to salt water and 50 mm for concrete exposed to weather or soil.

1.1.25.10 Formwork

The Contractor shall be entirely responsible for the design and construction of the formwork to be used for concreting.

The formwork shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in position.

All form-works shall be of such tight construction that slurry cannot flow out at the joints during pouring and compaction. If required, joints shall be sealed with foam rubber strips.

No concrete shall be placed until the Engineer or his representative has examined and approved the formwork.

1.1.25.11 Surface Finish

Unless otherwise shown on the drawings, all permanently visible concrete surfaces shall have a regular finish of uniform texture free from holes, pins and formwork.

Should any section of the concrete present a rough, uneven, honeycombed discolored or imperfect appearance when the shuttering is removed, it shall be chiseled to such a depth and refilled and properly refaced with such class of concrete as the Employer may direct.

In the event of excessive porosity being discovered, the defective area shall be chiseled and make well as specified above, all at Contractor's cost. No plastering of such concrete areas will be permitted.

Concrete foundation edges above the ground level and 300mm below the ground level shall be beveled by inserting 25mm triangular edges in the formwork.

Concrete foundation tops shall be designed and finished to prevent the accumulation of water.

Concrete surfaces shall be wood float or steel trowel finished as specified on the Drawings or instructed by the Engineer. All finishing works shall be carried out in accordance with the relevant specification of British Standard and to the satisfaction of the Engineer.

All concrete foundations shall be treated with an asphaltic or equivalent coating in order to be acid-resistant. The surface to be covered must be perfectly clean. The coating shall be applied on the formed surface of the foundation with a layer at least 2mm thick.

The required protective painting of foundations shall not be executed till the end of the curing period to obtain a completely dry surface. Painting shall be done according to the specifications of the supplier.

1.1.25.12 Fixing of Steel Structures

Where shown on the drawings or as directed by the Engineer, steel items shall be embedded directly in correct positions in primary concrete. All brackets, anchor bolts and other steel items, for which recesses in concrete have been made, shall be fixed by secondary concrete after careful alignment to correct positions.

1.1.25.13 Testing of Concrete

The Contractor shall design and test concrete mixes, which have 28 days cubicle compressive strength of 25N/mm^2.

All testing of concrete shall be carried out in accordance with the requirements of BS 5328: Part 4 and BS 1881 or equivalent. During the placing of concrete for each section of the work and at such other times as directed by the Engineer and the Employer, quality certificates of all materials shall be submitted and 3 sets of test cubes, size 15cm x 15cm x 15cm, shall be taken, each set consisting of 6 cubes. From each set 3 cubes shall be tested after 7 days and the remaining 3 cubes after 28 days. The compressive strength of the cubes shall not be less than 25N/mm^2 after 28 days.

Consistency and bleeding test and such other preliminary tests as the Engineer may direct, shall be taken as often as directed by the Engineer or Employer. No concrete of any type or class shall be used in the Works before the preliminary tests have shown specified compressive strength and workability.

All test cubes shall be well marked and cured as specified.

1.1.26 Maintenance Tools and Plant

The Contractor shall include and supply all tools and plant with latest calibration certifications that are required for the normal operation and maintenance of the equipment being supplied under the Contract. All tools and plant shall be subject to the inspections and/or tests on the functions specified in the Supply Requirements and guaranteed in the approved drawings.

Instruction manuals of tools and plant shall be submitted for approval in the same manner as the installation operation and maintenance manuals and when finally approved, one original and three copies shall be prepared and forwarded to the Employer.

Each tool and plant item shall be clearly marked with its size and/or purpose and shall be packed in the appropriate box with three (3) sets of an operation and maintenance instruction book. All nameplates, duty labels and instruction plates on tools and appliances shall be marked in English.

1.1.27 Auxiliary Electrical Supply

The Contractor shall be entirely responsible for providing auxiliary electricity supplies needed on Site for construction and commissioning.

1.1.28 Temporary Site Installation

The Contractor shall be entirely responsible for providing all temporary site installations of every kind that may be required for carrying out the works including the facilities concerning office, living accommodation, fenced storage areas, lockable sheds, installations for supply of industrial water, power and compressed air, etc. The Contractor shall plan all temporary site installations required for the works to the approval of the Engineer. After completion of the work, such temporary installations are to be removed and the site left clean.

All costs for the construction and/or supervision and the removal or handing over to the Employer of all temporary site installations shall be deemed to have been included in the price schedules.

1.1.29 Running Costs

The Contractor shall be entirely responsible for the running and maintenance costs throughout the period when the site works are being carried out, including all temporary site installation works.

The costs for running and maintaining the temporary site installations together with other running costs necessary for the satisfactory execution of the works shall be deemed to have been included in the price schedules.

1.1.30 Social Safeguards

The Contractor shall minimize the locations of transmission towers in agricultural and populated areas. Where routing of transmission towers across agricultural and populated areas is unavoidable, the tower locations shall be positioned to completely avoid houses, structures, and interference with social and cultural assets. The Contractor's detailed line route design will be reviewed and approved by the Employer, in consultation with any affected people, after verification of its land acquisition impacts.

1.2 Technical Requirements – Substation Equipment

The substation designs shall conform to conceptual design drawings included in Section 3.0.

1.2.1 220KV, 110KV, and 20KV Primary Equipment

1.2.1.1 General

All 220KV, 110KV and 20KV primary equipment shall be designed and manufactured in accordance with the latest edition of IEC standards. This includes the following main applicable standards:

- IEC 60044 Instrument transformers
- IEC 60099 Surge arresters
- IEC 60265 High voltage switches
- IEC 60282 High voltage fuses
- IEC 60694 Common specifications for high voltage switchgear and control gear standards
- IEC 61166 High-voltage alternating current circuit-breakers - Guide for seismic qualification of high-voltage alternating current circuit-breakers
- IEC 60071 Insulation Coordination
- IEC 60255 Electrical relays
- IEC 60273 Post Insulators
- IEC 60502 Power Cables
- IEC 62271 High-voltage switchgear and control gear

All 220KV and 110KV primary equipment and accessories shall be air insulated and installed outdoors. 20KV primary equipment (switchgear) and accessories shall be installed indoors.

Specified clearances shall be considered minimums. The supplied values are elevation dependent and have been provided for information only. The designer shall consider elevation and adjust clearances tendered and applied to equipment design.

1.2.1.2 220KV, 110KV, and 20KV Circuit Breakers and Disconector/Earthing Switches

The circuit breakers and disconnector/earthing switches shall be rated in accordance with Section 2.0 Technical Data Sheets.

Circuit Breakers

The 220KV and 110KV circuit breakers shall be of SF6 type. Breakers applied to the 110KV yard of Kandahar Substation shall be of same model and ratings as the 220KV units. The 20KV circuit breakers shall be indoor metal clad of vacuum or SF6 type. General electrical requirements shall comply with the parameters collected in Section 2.0 Technical Data Sheets.

Circuit breakers shall be equipped with motor-charged spring operated mechanism for 220VDC. The motor-charged spring-operated devices shall have a direct-on-line starter. It shall be possible to set the operating spring manually with a hand-crank. Motors shall be designed in accordance with valid IEC publication and operate correctly between 85% and 110% of rated voltage. The motors shall be effectively protected. The motor circuits shall be controlled 2-pole (Phase) from the motor-protection and end-position contacts. An auxiliary relay for alarm shall be connected to the motor-voltage and have a closed contact for no voltage, tripped motor-protection and unloaded spring.

The operating mechanism shall be provided with an anti-pumping device.

The circuit breaker shall have 220VDC shunt coils for closing and duplicate tripping. The coil and relays in the closing circuits shall operate correctly between 85% and 110% of the rated voltage. For tripping circuits the limits are 70% and 110%.

The operating devices shall be equipped with a selector switch for local and remote control.

Manual closing for maintenance work shall be possible. Manual tripping (mechanical) shall be possible even in the absence of supply voltage for emergency situations, unless the breaker is locked out.

Two sets (2a & 2b) of auxiliary contacts necessary for control purposes shall be mechanically linked to the circuit breaker. All contacts shall be wired and connected to terminals in the cubicle.

A LOCAL/REMOTE switch shall be provided for the operating voltage for each circuit breaker. The switch shall, in the open position, prevent all electrical operations of circuit breakers. The switch shall have at least 10 contacts and be labeled OPERATION.

The mechanism shall be provided with an operation counter for at least 9999 CO-cycles.

Disconnectors

The disconnectors shall be motor-operated, dual-break, center rotating type with horizontal operation. All disconnectors shall provide the possibility for a manual operation with a hand crank. General electrical requirements shall comply with 2.0 Technical Data Sheets.

Disconnectors with a manually operated earthing switch(s) shall be provided with mechanical interlocking between the disconnector and the earthing switch(s) to prevent closing of the earthing switch when the disconnector is in the closed position.

The disconnector and the earth switch(s) shall be possible to lock with padlock in open and closed position. Earthing switch(s) shall have an earthing platform, suitably connected to the earthing grid at not less than 2 points of connection, of size not less than 3m x 3m installed under the switch handle mechanism for operator safety when operating the earthing switch manually.

All disconnectors shall be motor operated and shall be designed with three-pole operation and shall operate on 220VDC. The motor shall be designed in accordance with valid IEC publication and work correctly between 85% and 110% of rated voltage. The motor shall be effectively protected. Electric control shall always be two-pole to avoid mal-operation in case of earth faults.

Motor operated disconnectors shall be designed for remote control and position indication. Two sets (2a & 2b) of auxiliary contacts necessary for control purposes shall be mechanically linked to the switch. The operating device shall be equipped with a selector switch for local and remote control.

1.2.1.3 20KV Switchgear

The equipment shall comply with the requirements of the appropriate IEC standards and comprise a metal enclosed, free-standing switchboard suitable for indoor application, dust and vermin proof and suitable for coordination with a 20KV, 3-wire system.

Design of the switchgear shall allow good accessibility with maximum personnel safety during operation, inspection and maintenance. Also maximum segregation shall be afforded between cubicles and between high and low voltage sections within the cubicles.

The 20KV circuit breakers shall be fitted with an auto-recloser relay, designed for automatic reclosing of the line in case of transient over current or earth faults. The relays shall lockout further operation after two unsuccessful attempts at reclosing.

Where required, the switchboard shall be complete with all necessary contacts, transducers etc. to provide full compatibility with the system SCADA.

The single line diagrams illustrate the equipment specified. The switchgear shall be suitable for 20KV, 3-phase, 3-wire, 50Hz section, with the neutral power source solidly earthed at the 220/20KV transformer. The source of 20KV supply is the zone substation transformer at each substation. Provision shall be made for future extension of the switchgear at either end.

The 20KV three phase busbars contained within the metal clad switchgear shall be installed in a conventional manner and shall be completely screened in a chamber running the length of the switchboard. Busbars shall be fully insulated busbars along their entire length with high dielectric strength sleeving.

Inter-panel connections shall be via insulated barriers designed to preserve an effective seal between cubicles under the most severe arcing fault conditions.

The busbars shall have a current rating of 1,250A and all components of the busbar system shall be able to withstand the stresses imposed by vibration, short circuits, thermal expansion or other causes.

The circuit breakers shall be of the vacuum or SF6 type as specified in Clause 2.4.1.2, carriage mounted for horizontal withdrawal. They shall be spring operated with a 230VAC single-phase motor for charging the springs. The springs shall also be able to be manually charged. The circuit breaker closing and tripping coils shall be 220VDC. The operating mechanism shall be trip free. All circuit breakers shall be fully interchangeable between circuits.

A mechanical means shall be provided to show whether the circuit breaker is open or closed. Electrical/mechanical interlocks shall be provided to ensure that:

- the circuit breaker may only be withdrawn when open
- the circuit breaker may only be restored to the service position when open

Auxiliary contacts, including 2-n/o and 2-n/c spares, shall be provided and wired out to terminal blocks, to be used for remote indications. Provision shall be made for operating the circuit breaker in the withdrawn position for test or maintenance purposes.

Each circuit breaker shall be equipped with a circuit breaker condition indicator that shall record the opening speed of the contacts, the gas pressure (if applicable) inside the poles and the wear of the breaker poles. At exceeded limits an alarm shall be given for remote indication.

The circuit cubicle shall be equipped with a door at the front that shall support the circuit breaker on its carriage when withdrawn into the maintenance position. The door shall have a window through which the circuit breaker condition indicator and mechanical open/closed indicator are viewed. The insertion or withdrawal of the circuit breaker from the service position shall be carried out with the door closed by means of a racking mechanism indicator operated by the racking mechanism and visible on the front panel of the racking mechanism.

The circuit cubicle shall be arranged so that the busbars and circuit connections are completely screened when the circuit breaker is withdrawn. Automatic shutters shall be operated by the circuit breaker truck to screen both the busbar and circuit fixed contacts when the circuit breaker is withdrawn. The shutters shall be clearly labeled "BUSBARS" and "CIRCUIT" and provided with means for padlocking in the closed position.

The high voltage cable termination compartment shall be equipped for the termination of the cable cores of the three phase circuit connections.

This surge arrester cubicle shall be equipped with three 24KV surge arresters connected between each phase of the busbars and the earth bar.

A surge arrester shall be provided with a counter able to be read from the front panel of the cubicle.

Current transformers shall be mounted in the cable compartment and shall be of the insulated bar primary type unless otherwise approved. Secondary windings shall be earthed at one point only and means shall be provided to short circuit these windings. All necessary terminals and rating plates shall be provided and characteristic curves shall be submitted for each current transformer.

Voltage transformers shall be single phase units, for three phase applications three single phase units shall be connected in star. Class 0.5 shall be provided for measuring applications and class 3P for protection.

An earth busbar shall be run internally through the length of the switchboard. All non-current carrying metalwork, earth switches, surge arresters, CT and VT secondary circuits, etc. shall be bonded to this earth busbar. A fixed/moving contact arrangement shall be provided for the positive earthing of the circuit breaker carriage.

Each circuit cubicle shall be provided with an integral fault making earthing switch for the safe and effective earthing of the 'circuit' connections. In addition, the surge arrester cubicle shall accommodate an equivalent earthing switch for the earthing of the busbars.

The earthing switches shall be interlocked with their associated circuit breakers. The earthing switches shall be manually operated from the front of the switchgear panel.

1.2.1.4 220KV, 110KV, and 20KV Current Transformers

The current transformers shall be rated in accordance with Section 2.0 Technical Data Sheets. All CTs applied to 110KV systems shall be rated for use at 220KV.

Earthing of secondary windings shall be done through a disconnectable terminal inside the low-voltage cabinet. Unused cores shall be wired to terminals and short-circuited in the low-voltage cabinet.

A legible circuit-diagram plate showing the transformer connection and terminal markings shall be permanently fixed inside the low-voltage cabinet. The separate main data for the different cores shall be shown on the plate.

1.2.1.5 220KV Capacitive and 20KV Voltage Transformers

The voltage transformers shall be rated in accordance with the following in Section 2.0 Technical Data Sheets. The Kandahar Substation 110KV CVTs shall be like model and ratings as those of the 220KV system. Dual-voltage secondaries shall provide proper sensing operation when operated at 110KV.

Rated voltage factor shall be as follows:

- Between phase and earth continuous 1.2
- Between phase and earth, 30 second 1.5

Earthing of secondary windings shall be done through a disconnectable terminal inside the low-voltage cabinet. Each secondary winding shall be protected with individual miniature circuit breakers (MCB) or fuses. To prevent mal-operation of relay protection, interlock system, etc. a supervision device for the MCBs or fuses shall be provided.

A legible circuit-diagram plate showing the transformer connection and terminal markings shall be permanently fixed inside the low-voltage cabinet. The separate main data for the different cores shall be shown on the plate.

1.2.1.6 220KV, 110KV, and 20KV Surge Arresters

The surge arrestors shall be rated in accordance with Section 2.0 Technical Data Sheets.

The surge arresters shall be of ZnO-type and heavy-duty station class. One common surge counter per three-phase group of arresters shall be provided.

1.2.1.7 Medium and High Voltage Terminals

Terminals shall normally be of module plate type. If the terminal is a direct extension of an internal conductor as for bushings or current transformers, pin type is accepted as an alternative.

Copper or copper alloy terminals shall be tinned to a thickness of minimum 50µm. Copper alloys shall not be sensitive to season cracking. Aluminum or aluminum alloy terminals shall not be treated. Aluminum alloys sensitive to layer or inter crystalline corrosion shall not be used.

1.2.2 Power Transformer

1.2.2.1 Reference Standards

All transformers shall be designed and manufactured in accordance with the latest edition of IEC standards. This includes the following main applicable standards:

IEC 60076	Power Transformers
IEC 60137	Insulating bushings for alternating voltages above 1000V
IEC 60214	Tap-changers
IEC 60296	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear
IEC 60354	Loading guide for oil-immersed transformers
IEC 60529	Degrees of protection provided by enclosures
IEC 60542	Application guide for on-load tap-changers

1.2.2.2 General Design

Power transformers shall be 3 phase, oil immersed consisting of a complete independent unit with on-load tap changer (OLTC), outdoor bushings, surge arrestors, cooling equipment, auxiliaries and accessories. All transformers supplied shall be installed outdoors and shall be required to operate under the system characteristics and climatic conditions specified in Section 2. Each transformer shall produce its full rated power at its designated substation after applying any derating factors due to climate and altitude. The transformers shall comply with IEC 60076.

The power transformers shall be located and rated in accordance with Section 2.0 Technical Data Sheets.

The transformers shall be capable of operating continuously at the specified output and at voltages 10% higher than the rated voltages at any tap without undue heating, vibration, noise and other operating difficulties. All items, except for windings, shall be designed for continuous current of 120% of the rated current, without exceeding the temperature rises prescribed in the Standards.

The substation electrical supply will be 400/230VAC available for operation of electric motors required for the proper operation of the power transformer.

1.2.2.3 Losses

The losses shall be stated and guaranteed in the Bid schedules. The capitalized value of the guaranteed losses will be taken into account when comparing Bids and will be added to the Bid price. The losses will be capitalized at the rates as follow:

- No load loss: US$ 6,500 per kilowatt
- Load loss: US$ 1,500 per kilowatt applied to the total transformer capacity proposed by the Bidder.

The guaranteed losses are to be maximum values and shall not be exceeded. If the tested losses exceed the guaranteed losses but are within the tolerances allowed in IEC 60076 then losses in excess of the guarantees shall be capitalized at the evaluation rate and the amount deducted from the contract price. There will be no credit for losses under guarantee.

The values for losses stated by the Contractor in the Bid Documents shall be verified during the factory tests.

The Employer has the right to reject transformers that exceed the tolerances allowed by IEC 60076.

1.2.2.4 20KV Surge Arrester

General

- The 20KV surge arrester shall conform in general to IEC: 60099-1 and/or IEC:60099-4 unless explicitly stated by the employer
- Gapless type Metal Oxide Arresters shall be used
- The arresters shall be hermetically sealed units, of self supporting construction, suitable for mounting on structures.
- Arresters shall be mounted directly on or to reactor complete with suitable ground connection from arresters to reactor ground pad

Duty Requirements

- The surge arresters shall be of station class type
- The surge arrester shall be capable of discharging overvoltage occurring during switching of unloaded transformers and reactors
- Surge arresters shall be capable of sparkover on switching surges and multiple strokes
- The surge arrester shall be able to withstand windload specified by the employer

Routine tests on Surge Arrester

- The surge arresters shall be subjected to routine tests as per IEC: 60099-1/IEC: 60099-4.
- The following additional acceptance tests shall be performed
    - Constructional check (visual check)
    - Measurement of insulation resistance by 1KV megger.

Type tests on Surge Arrester

- The surge arresters shall conform to type tests as per IEC: 60099-1 / IEC: 60099-4.

1.2.2.5 Cooling System

Transformers shall be capable of operating continuously at full load utilizing ONAF (or ODAF) type cooling. The manufacturer shall advise the maximum reduced rating output power with the cooling fans out-of-service.

The coolers shall be of the fin type, fully hot-dip galvanized, detachable and equipped with lifting eyes, vent holes with plugs, plugs for filling and draining and with shutoff valves to permit the removal of any cooler without draining the oil from the transformer tank. The coolers shall be removable during operation of the transformer. All radiator isolating valves shall be fully oil tight and vacuum capable and shall be mounted to the transformer and radiator by bolted flanges.

Only transformers less than 10MVA shall have radiators mounted directly to the transformer tank, all other transformers shall be mounted via a manifold. ODAF designs shall have main and standby oil circulating pumps.

1.2.2.6 Temperature Rise

In continuous service, at the specified ratings, the rise in temperature above the ambient air shall not exceed 60°C for the windings and 55°C for the top oil.

For cores and other parts the rise in temperature shall, in no case, reach a value that will damage the core itself, metallic parts or adjacent materials.

1.2.2.7 Short-Circuit Withstand Capability

The transformer shall be designed and constructed to withstand, on any tapping, without damage:

- Thermal and mechanical effects of any short-circuit (three-phase short-circuits and solid line-to-ground short circuits, etc.) that can appear at the terminal of any winding
- Transportation or impact forces of 3g or greater.

1.2.2.8 Vibration and Noise Levels

Special attention shall be given in order to avoid undue vibrations and noise in the transformer.

1.2.2.9 On-Load Tap Changer

General

On-load tap changers (OLTC) for automatic control, manual control, and electrical remote control shall be provided. The OLTC shall comprise a tap selector with changeover switch and a rotary diverter switch of high-speed transition resistor type. The OLTC shall be in conformity with IEC 60214 and IEC 60542. Only designs that have been type tested in accordance with the relevant IEC standards will be accepted. The OLTC shall be equipped with all devices necessary to automatically control secondary voltage regulation. Controls shall have provisions for (as a minimum):

- Automatic/Local Manual/Remote Manual Operation
- Return to neutral tap
- Set-point Regulating Voltage
- Resistive voltage drop compensator (current sensing)
- Inductive voltage drop compensator (current sensing)

The OLTC shall be mounted from the cover into the transformer tank at narrow sides of the transformer tank. The diverter switches and/or selector switches shall have oil compartments separate from the transformer oil as well as their own closed sub-sections in the oil conservator.

The tap changer head shall be equipped with a bleeding duct to be connected to Buchholz relay of main tank to avoid any gas collection underneath the tap changer head outside the diverter switch compartments. No piping or other equipment shall be arranged beyond the tap changer head to allow lifting of the diverter switches and/or selector switches without removing (dismantling) of any other equipment.

An oil-flow operated protection relay and a sudden-pressure operated protection relay shall be provided for internal failure protection. In addition a spring-loaded pressure relief device with trip contact shall be mounted directly onto the tap changer head.

The power of the transformers shall remain constant at all tap positions, and the OLTC shall be capable of successful tap changes for the maximum current to which the transformer can be loaded.

The permissible continuous through-current of each tap changer unit at rated switching capacity shall cover all cyclic loading duties as per IEC 60354 at highest current tap and at rated system operation voltage applied on the transformer terminals.

The OLTC shall withstand all kinds of through-fault currents for at least 3 (three) seconds without damage.

The motor drive, plus all auxiliary equipment for operation of the tap changer, shall be incorporated in a control cabinet made, protection class IP66, and shall be mounted onto the transformer tank in a convenient floor height.

The complete wiring shall be of highly flexible stranded copper and furnished with slip-over ferrules at both ends. Wiring shall also have crimped termination. The minimum cross-section of the wiring other than for step-position transmitters shall be 2.5mm^2.

An electrical supply of 400/230VAC, 3-phase, will be available from the substation for operation of electric motors required for the proper operation of the power transformer. The AC supply of the motor drive cabinet shall occur via the control cabinet for cooling equipment or marshalling box and an appropriate MCB with trip contact shall be provided in the concerned cabinet for the outgoing auxiliary supply cable.

The cabinet shall be mounted on a narrow side of the transformer and the following main equipment shall be installed:

- Driving motor with complete motor protection equipment
- Operation counter
- Control switch or push buttons for local raise/lower operations (properly protected against unauthorized operation)
- Electrical limit switches
- Mechanical stops in end positions
- Step position indicator ("1" related to the position with the maximum high voltage)
- Local/remote switch
- Voltage supervisory relays for all phases of supply voltage and main circuits of control voltage
- MCBs for driving motor and each auxiliary supply circuit
- Hand lamp (controlled via door contact)
- One heater, thermostatically controlled
- Minimum one conventional position transmitter of the resistor type
- Additional end position contacts
- Spare plug socket LV, AC (BS) with MCB 10A
- Terminal blocks with terminals of single insertion type with isolating facilities and test connectors and being universally suitable for connection of solid conductors from 0.5 mm^2 up to a cross-section of at least 10 mm^2 (Phoenix or equivalent), with ten percent spare terminals on each terminal block
- Crank handle for manual operation
- Padlock facilities for front door
- All equipment installed in the cabinet shall be designed for a cubicle inside temperature of at least 70°C
- A rigid pocket for storing the related paper drawings shall be securely fixed on the inner side of the door of this cabinet

The motor drive shall meet the following requirements:

- Mechanical indication of step position at the motor drive cabinet
- Transmission of step positions of the transformers to the local control room
- Manual operation in the case of a failure in the electrical supply system
- Step-by-step operation with automatic stop after each step
- Automatic restart of tap changing operation in the case of a failure in the electrical supply system, interlocking to be provided against simultaneous raise/lower operation

- Blocking of end positions by means of limit switches
- Provisions to be made for parallel running and automatic operation controlled by a voltage regulating device and parallel control unit

Parallel Operation and Voltage Regulation
The power transformers shall be able to be operated in parallel, if manually placed on common tap.

Performance Characteristics of Motors

- The motor shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following supply conditions:
  - Variation of supply voltage from rated motor voltage ±10%.
  - Variation of frequency ± 5%.
  - Combined over or under excitation ±10%.
- The motor shall be capable of starting and maintaining the load with the applicable method of starting without exceeding acceptable winding temperature when the supply voltage is in the range of 85% of the rated supply voltage.
- The motor shall be suitable for full voltage direct on line starting.
- AC motors shall be of the three-phase type, 400VAC.
- Motors less than 3.7kW may be single phase, 230VAC.
- The vibrations of motors shall be within the limits specified in applicable standards.
- Insulation shall be given fungicide treatment suitable for extremes of hot and cold climate.

1.2.2.10 Core

The flux density in the core shall not exceed 1.70 Tesla during normal operation at rated primary voltage on nominal tap and at rated frequency with no over-fluxing occurring.
The core shall be made of high grade, un-aging, cold rolled grain oriented steel. Laminations shall have low losses and high permeability. Insulated packets of the core are to be connected so that no potential differences will exist between them. Flux distortion shall be minimized to reduce noise level.

The cores, framework, and clamping arrangements shall be capable of withstanding any shocks to which the equipment may be subjected during transport and operation.

Both the core and frames shall be earthed via a single point earthing design where each connection to either the frame or core is brought out through separate 2KV bushings complete with removable bolted shorting links that connect them to an earth stud on the transformer tank lid.
All components shall be rated for the maximum possible circulating current should the core or frame becomes inadvertently earthed. The bushings located on the transformer lid shall be protected from inadvertent physical damage by a removable cover or similar.

1.2.2.11 Windings

The turns in coils shall be thoroughly treated in such a way as to develop the full mechanical and electrical strength of the transformer. Oil from radiators shall be directed into the bottom of each winding.

All windings 220KV and above connected in star shall have graded insulation; and all windings rated less than 220KV shall be fully insulated.

The transferred voltage from one winding to any other winding when open circuited shall not exceed the impulse test voltage of that winding. Where windings do not meet this criteria then surge arrestors located in their own separate compartment located outside the main tank shall be used to restrict such transferred voltages to the specified impulse levels.

All winding conductors and connections shall be manufactured from burr free profiled high conductivity copper or aluminum. All electrical connections within the windings shall be fully brazed or welded and capable of withstanding all shocks encountered in service, transport, earthquakes etc. All connections from windings shall be mechanically sound and fully supported.

All cylinders and wraps shall be made from pre-compressed transformer board. All cylinder joints shall be fully scarfed with overlaps being made only on duct strips. Only fully molded caps and collars are acceptable; designs utilizing "Petal" collars or caps are not acceptable.

When used, enamel covered wires shall have a minimum radial thickness of 0.05mm and where cross-overs or transpositions occur they shall be mechanically and electrically protected.

No electrical out-of-balance turns will be acceptable between phase windings. All duct strips and spacers shall be full contoured and shall be of a solid construction, strips and spacers stacked together are not acceptable. All paper covered conductors shall use thermally upgraded paper. All continuously transposed conductors shall be fully epoxy bonded to withstand all free buckling and short circuit forces.

1.2.2.12 Tank

The tank shall be constructed of high-grade steel plate, suitable reinforced to withstand handling and pressure during faulty condition without any destruction. The tank shall be provided with manholes, valves and de-aerating cocks as may be required for the prescribed maintenance of the transformer. The tank shall be provided with earthing terminals for a wire of $95mm^2$ at two opposite sides of the tank.

1.2.2.13 Corrosion Protection

The corrosion protection shall be carried out as specified in Section 1.1.21.

1.2.2.14 Oil

All oil used during the manufacture of the transformer shall be free of all additives. Oil supplied for the filling of the transformer shall be new and shall contain at least 0.3 per cent by weight oxidation inhibitor of type di-tert-butyl-para cresol (DBPC) according to IEC 60296.

The oil shall not contain PCB. If oil samples taken from the transformer on delivery contain 2ppm or more PCB, the Employer shall have the right to refuse the delivery of the transformer.

1.2.2.15 Bushings

Bushings shall be of type stated in IEC 60137.

Connections from the windings to the bushings shall have the necessary flexibility. The bushings shall be installed so that they are easy to check and place, without removing the tank cover pipe work.

The star point of the winding shall be separately bought out through the tank lid by means of an outdoor bushing, located so that it cannot be associated with the main phase bushings. All bushings shall have permanent phase markings adjacent to the bushing flange.

1.2.2.16 Accessories

The following accessories shall be provided for the transformer:

- Oil temperature indicator for the top oil equipped with a maximum reading device individually insulated and a minimum of two separately adjustable contacts for alarm and tripping, with all immersed parts able to be removed without the need to interfere with the tank
- Winding temperature indicator shall be equipped with a maximum reading device individually insulated and a minimum of two separately adjustable contacts for alarm and tripping, with all immersed parts able to be removed without the need to interfere with the tank
- An aseismic Buchholtz relay for gas protection with a minimum of two non-mercury separate contacts for signal and tripping. A gas capture and test device shall be connected to the Buchholtz and located adjacent to the control cubicle
- Oil level indicator equipped with a minimum of two separately adjustable contacts for alarm and tripping
- Oil drying device, type Silica Gel breather
- Terminal box equipped with disconnect able terminals for signal cables to the auxiliary cubicle
- The on-load-circuit tap changer shall be provided with a mechanism for automatic operation. The operating mechanism shall be provided with a tap position indicator.

1.2.2.17 Routine and Type Tests

General
Full and complete testing of the transformer with accessories shall be carried out according to the relevant IEC Standards. The more important tests are listed below.

The Contractor shall give a complete description of the proposed test methods. The test methods and the performance of the test shall be subject to the approval of the Employer / Engineer. All instruments and equipment necessary for the testing shall be provided by the Contractor.

Test Particulars
Testing shall include but not be limited to the following:

- When a transformer is to be subject to a temperature rise test, dielectric test including an impulse test shall be carried out as soon as practicable after this test, that is whilst the transformer is still hot
- The no-load losses and the current of the transformer shall be measured at 90%, 100% and 110% of rated voltage before commencement of the dielectric test. The no-load losses and current measured after completion of the dielectric test shall be the values used in determining the performance of the transformer
- Impulse test shall be applied on all transformer terminals, including neutrals. Impulse test oscillography records shall be made
- Noise level measurements shall be carried out according to IEC 60076
- Bushings shall be fully tested according to IEC 60137
- Insulation power factor tests shall be performed with bushings in place

Type Tests
The following type tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Temperature rise test
- Zero sequence impedance
- Noise level
- Examination of harmonics
- Tests on bushings

Routine Tests
The following routine tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Winding resistance measurements on all windings
- Ratio tests on the rated voltage connection
- Polarity tests
- No-load loss at 90%, 100% and 110% of rated voltage
- Exciting current at 90%, 100% and 110% of rated voltage
- Impedance and load loss at rated current
- Separate source withstand tests
- Induced voltage tests
- Impulse voltage withstand tests on all windings. Full wave and chopped wave
- Pressure tests on tank and coolers for oil tightness. If a temperature test is made, the pressure test shall
- be made while the transformer is still hot
- Operational tests of all devices and wiring
- Insulation tests on auxiliary devices and wiring
- Test on bushings

1.2.3 Mechanically Switched Shunt Reactor

1.2.3.1 Standards

All shunt reactors shall be designed and manufactured in accordance with the latest edition of IEC standards. This includes the following main applicable standards:

- IEC 60076 Power Transformers
- IEC 60137 Insulating bushings for alternating voltages above 1000V
- IEC 60296 Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear
- IEC 60529 Degrees of protection provided by enclosures
- IEC: 60099-1 and IEC:60099-4 Metal-oxide surge arresters without gaps for AC systems

1.2.3.2 General

Shunt reactors shall be 3 phase, oil immersed consisting of a complete independent unit with outdoor bushings, surge arrestors, cooling equipment, auxiliaries and accessories. All shunt reactors supplied shall be installed outdoors and shall be required to operate under the system characteristics and climatic conditions specified in Section 3.1.5 and 3.2.1. Each shunt reactor shall produce its full rated reactive power at its designated substation after applying any derating factors due to climate and altitude. The shunt reactors shall comply with guidelines established in IEC 60076.

The shunt reactors shall be rated in accordance with Table 2.1.10 of the Technical Data Sheets.

The shunt reactors shall be capable of operating continuously at the specified output and at voltages at 10% higher than the rated voltages without undue heating, vibration, noise and other operating difficulties.

Additional Requirements:

- Shunt Reactor shall be capable of controlling the dynamic over voltage occurring in the system due to load rejection.
- The reactor shall capable of withstanding switching surge overvoltage up to 2.5 p.u. followed by power frequency overvoltage up to 1.35 p.u. The reactor must withstand the stresses due to transient dynamic conditions which may cause additional current flow as a result of changed saturation characteristics.
- Reactor shall be completely shielded with no external stray flux.

An auxiliary electrical supply of 400/230VAC, 3-phase shall be available from the substation. This AC power is dedicated to operation of electric motors (fans, pumps, etc.) and AC control and protective devices required for the proper operation of the shunt reactor.

220VDC shall be available (from the substation) for Alarm and Protection and Control functionalities of the shunt reactor.

1.2.3.3 Cooling System

Shunt reactors shall be capable of operating continuously at full load utilizing ONAN type cooling.

The coolers shall be of the fin type, fully hot-dip galvanized, detachable and equipped with lifting eyes, vent holes with plugs, plugs for filling and draining and with shutoff valves to permit the removal of any cooler without draining the oil from the shunt reactor tank. The coolers shall be removable during operation or transportation of the shunt reactor. All radiator isolating valves shall be fully oil tight and vacuum capable and shall be mounted to the shunt reactor and radiator by bolted flanges.

Only shunt reactors less than 10MVA shall have radiators mounted directly to the tank, all other shunt reactors shall be mounted via a manifold.

1.2.3.4 Temperature Rise

In continuous service, at the specified ratings, the rise in temperature above the ambient air shall not exceed 60°C for the windings and 55°C for the top oil.

For cores and other parts the rise in temperature shall, in no case, reach a value that will damage the core itself, metallic parts or adjacent materials.

1.2.3.5 Short-Circuit Withstanding Capability

The shunt reactor shall be designed and constructed to withstand without damage:

- Three-phase short-circuits and solid line-to-ground short circuits that can appear at the winding terminal.
- Transportation or impact forces of 3g or greater.

1.2.3.6 Vibration and Noise Levels

Special attention shall be given in order to avoid undue vibrations and noise in the shunt reactor.

1.2.3.7 Core

The core shall be made of high grade, un-aging, cold rolled grain oriented steel. Laminations shall have low losses and high permeability. Insulated packets of the core are to be connected so that no potential differences will exist between them. Flux distortion shall be minimized to reduce noise level.

The cores, framework, clamping arrangements, shall be capable of withstanding any shocks to which the equipment may be subjected during transport and operation.

Both the core and frames shall be earthed via a single point earthing design where each connection to either the frame or core is brought out through separate 2KV bushings complete with removable bolted shorting links that connect them to an earth stud on the tank lid. All components shall be rated for the maximum possible circulating current should the core or the frame become inadvertently earthed. The bushings located on the lid shall be protected from inadvertent physical damage by a removable cover or similar.

1.2.3.8 Windings

The turns in coils shall be thoroughly treated in such a way as to develop the full mechanical and electrical strength of the shunt reactor. Oil from radiators shall be directed into the bottom of each winding.

All windings 220KV and above may have graded insulation; and all windings rated less than 220KV shall be fully insulated.

All winding conductors and connections shall be manufactured from burr free profiled high conductivity copper or aluminum. All electrical connections within the windings shall be fully brazed or welded and capable of withstanding all shocks encountered in service, transport, earthquakes etc. All connections from windings shall be mechanically sound and fully supported.

All cylinders and wraps shall be made from pre-compressed transformer board. All cylinder joints shall be fully scarffed with overlaps being made only on duct strips. Only fully molded caps and collars are acceptable; designs utilizing "Petal" collars or caps are not acceptable.

When used, enamel covered wires shall have a minimum radial thickness of 0.05mm and where cross-overs or transpositions occur they shall be mechanically and electrically protected.

No electrical out-of-balance turns will be acceptable between phase windings. All duct strips and spacers shall be full contoured and shall be of a solid construction, strips and spacers stacked together are not acceptable. All paper-covered conductors shall use thermally upgraded paper. All continuously transposed conductors shall be fully epoxy bonded to withstand all free buckling and short circuit forces.

1.2.3.9 Tank

The tank shall be constructed of high-grade steel plate, suitable reinforced to withstand handling and pressure during fault condition without any destruction.

The tank shall be provided with manholes, valves and de-aerating cocks as may be required for the prescribed maintenance of the shunt reactor. The tank shall be provided with earthing terminals for a wire of 95mm2 at two opposite sides of the tank.

1.2.3.10 Corrosion Protection

The corrosion protection shall be carried out as specified in Section 1.1.21.

1.2.3.11 Oil

All oil used during the manufacture of the shunt reactor shall be free of all additives. Oil supplied for the filling of the shunt reactor shall be new and shall contain at least 0.3% by weight oxidation inhibitor of type di-tert-butyl-para cresol (DBPC) according to IEC 60296.

The oil shall not contain PCB. If oil samples taken from the shunt reactor on delivery contain 2ppm or more PCB, the Employer shall have the right to refuse the delivery of the shunt reactor.

1.2.3.12 Bushings

Bushings shall be of type stated in IEC 60137.

The star point of the winding shall be separately bought out through the tank lid by means of an outdoor bushing, located so that it cannot be associated with the main phase bushings. All bushings shall have permanent phase markings adjacent to the bushing flange.

1.2.3.13 Accessories

The following accessories shall be provided for the shunt reactor:

- Oil temperature indicator for the top oil equipped with a maximum reading device individually insulated and a minimum of two separately adjustable contacts for alarm and tripping, with all immersed parts able to be removed without the need to interfere with the tank
- Winding temperature indicator shall be equipped with a maximum reading device individually insulated and a minimum of two separately adjustable contacts for alarm and tripping, with all immersed parts able to be removed without the need to interfere with the tank
- An aseismic Buchholtz relay for gas protection with a minimum of two non-mercury separate contacts for signal and tripping. A gas capture and test device shall be connected to the Buchholtz and located adjacent to the control cubicle
- Oil level indicator equipped with a minimum of two separately adjustable contacts for alarm and tripping
- Oil drying device, type Silica Gel breather
- Terminal box equipped with disconnect able terminals for signal cables to the auxiliary cubicle

1.2.3.14 Routine Type Tests

General

Full and complete testing of the shunt reactor with accessories shall be carried out according to the relevant IEC Standards. The more important tests are listed below.

The Contractor shall give a complete description of the proposed test methods. The test methods and the performance of the test shall be subject to the approval of the Project Manager. All instruments and equipment necessary for the testing shall be provided by the Contractor.

Test Particulars
Testing shall include but not be limited to the following:

- When a shunt reactor is to be subject to a temperature rise test, dielectric test including an impulse test shall be carried out as soon as practicable after this test, that is whilst the shunt reactor is still hot
- The no-load losses and the current of the shunt reactor shall be measured at 90%, 100% and 110% of rated voltage before commencement of the dielectric test. The no-load losses and current measured after completion of the dielectric test shall be the values used in determining the performance of the shunt reactor
- Impulse test shall be applied on all shunt reactor terminals, including neutrals. Impulse test oscillography records shall be made available
- Noise level measurements shall be carried out according to IEC 60076
- Bushings shall be fully tested according to IEC 60137
- Insulation power factor tests shall be performed with bushings in place

Type Tests
The following type tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Temperature rise test
- Noise level
- Examination of harmonics
- Tests on bushings

Routine Tests
The following routine tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Winding resistance measurements
- Polarity tests
- No-load loss at 90%, 100% and 110% of rated voltage
- Exciting current at 90%, 100% and 110% of rated voltage
- Load loss at rated current
- Separate source withstand tests
- Induced voltage tests
- Impulse voltage withstand tests. Full wave and chopped wave
- Pressure tests on tank and coolers for oil tightness. If a temperature test is made, the pressure test shall be made while the shunt reactor is still hot
- Operational tests of all devices and wiring
- Insulation tests on auxiliary devices and wiring
- Test on bushings

1.2.4 Earthing System

1.2.4.1 General

The station earthing system shall be designed according to IEEE 80 Guide to Safety in Substation Grounding. The earthing system shall consist of buried conductor loops around the substation building and the transformer foundation. The loops shall be connected to an earth bar inside the building. Connections to the earth bar shall be possible to disconnect. The connections shall be clearly labeled. To reach the desired earth resistance, additional grounding rods shall be installed and connected to the earth bar.

Connections shall be made by compressed clamps or by an approved welding process. No bolted clamps may be used under the ground surface. Connections to steel structures (riser connections) shall be made by compressed lugs with two holes in the contact pad. Risers or earth conductors shall not touch cables.

1.2.4.2 Earthing Parameters

The earthing system shall comply with Section 2.0 Technical Data Sheets.

1.2.4.3 Earthing of Enclosures

An earthing conductor of a sufficient cross-sectional area shall be provided extending the whole length of the switchboards and control cabinets. All metal parts of the enclosure/cubicle shall be earthed by risers from the conductor loop.

1.2.4.4 Earthing of Other Types of Equipment

Earth terminals of LV equipment shall be earthed by wire designed for the actual earth fault current.

Connection and marshalling cubicles, etc. for LV or control equipment shall be connected to the earthing system irrespective of whether they are mounted on otherwise grounded structures or not. Cubicle doors, where electrical apparatuses or instruments are installed, shall be earthed by a flexible earthing cord.

1.2.4.5 Temporary Earthing Devices

Two three-phase sets of temporary earthing devices with leads of sufficient length and short circuit capacity, one for each winding, shall be delivered for each transformer. One three-phase set of temporary earthing device with leads of sufficient length and short circuit capacity shall be delivered for the 20KV switchgear.

The design and test methods for temporary devices are subject to approval of the Employer. Both the phase conductor and the steel structure shall always have fixed contacts.

Earthing devices shall be designed for 1-second duration of the specified fault current. Earthing switches in connection with disconnectors shall be designed for the same fault current as the disconnectors.

1.2.4.6 Corrosion Risks

The Contractor shall be observant of the risks for corrosion of buried galvanized steel structures if connected to copper.

1.2.4.7 Earth Resistivity Modeling

Soil resistivity measurements will be taken at each substation location. The Werner 4-point method described in IEEE Standard 80 shall be followed. A minimum of two layer soil model will be developed using an industry standard approved computer earthing analysis software to develop the soil model. Due to the limitation of IEEE Standard 80 using the uniform soil model, the industry standard computer earthing model shall be developed following IEEE standard 80 guidelines.

1.2.5 Medium Voltage Cable

1.2.5.1 Standards

The equipment supplied shall conform to the latest edition of the appropriate IEC specifications or other recognized international standards. In particular:

IEC 60028	Standard resistance for copper
IEC 60060	High voltage test techniques
IEC 60071	Insulation co-ordination
IEC 60228	Conductors of insulated cables
IEC 60229	Tests on cable oversheaths
IEC 60230	Impulse tests on cables and accessories
IEC 60287	Electric Cables - Calculation of the current rating
IEC 60502	Power cables with extruded insulation and their accessories for rated voltages from 1KV up to 30KV
IEC 60811	Common test methods for insulating and sheathing materials of electric cables
IEC 60885	Electrical test methods for electric cables
VDE 0278	Power cable accessories with rated voltages up to 30KV
ASTM D2303	Inclined plane non-tracking test method

1.2.5.2 Inspection and Testing

Tests shall be performed at the manufacturer's works in accordance with the relevant IEC standards supplemented by the specific requirements indicated below.

The tests will be divided into the following categories:

Routine and Special Tests

- Check for compliance with specifications herein and with the scheduled quantities.
- Conductor electrical resistance measurements
- Partial discharge test
- High-voltage test
- Conductor examination
- Check of dimensions
- Electrical test for 4 hours
- Hot set test

Type Tests
The Employer may call for type tests to be carried out at the Manufacturer's Works and witnessed by the Employer or representative. Such test would be on random samples at the discretion of the Employer and failure to meet the conditions of test could result in the rejection of a complete batch of cable.

When such tests are called for they will comprise the following:

- Partial discharge test
- Bending test, plus partial discharge test
- Dielectric power factor as function of voltage and capacitance measurement, and as a function of temperature
- Heating cycle test plus partial discharge test
- Impulse withstand test, followed by power frequency voltage test
- High voltage ac test
- Non-electrical tests as stated in IEC 60502.

After Installation Test
When the installation of the cable and its accessories has been completed, a voltage test will be made by the Employer with a dc voltage of 70% x 2.4 times the rated power-frequency voltage for which the cable is designed, applied for 15 minutes.

1.2.5.3 MV Three Core XLPE Insulated Cables

General
Three core 11.5/20 (24)KV 185 mm^2 aluminum conductor, cross-linked polyethylene (XLPE) insulated, PVC sheathed cable shall be supplied for connecting the indoor 20KV switchgear to the outgoing 20KV distribution circuits.

Construction Details
The cable shall comprise three core stranded aluminum conductor, each with semi-conducting conductor shielding, cross-linked polyethylene insulation, semi-conductor shielding and copper tape screen. The three cores shall be laid up to form a circular cross-section using PVC fillers and bound overall with polyester tapes. The cables shall be bedded with extruded PVC, armored with steel wire and sheathed overall with black PVC.

Conductors
The cores shall be circular stranded conductor comprising 240mm^2 aluminum wires.

Conductor Screen
Conductor shielding shall be extruded semi-conductor 1mm thick.

Insulation
Insulation shall comprise cross-linked thermosetting polyethylene and shall be nominally 5.5mm thick.

Core Identification
The cores shall be identified by the numbers 1, 2 and 3 printed on the outer extruded semi-conductor.

Insulation Screen
The insulation screen shall consist of a semi-conducting part in combination with a metallic part.
The semi-conducting screen shall be extruded semi-conducting of minimum thickness 0.8mm applied in intimate contact with the insulation.

The metallic screen shall be plain annealed copper tape helically applied directly over the semi-conducting screen.

Laying Up
The screened conductors of the three cores shall be laid up together with PVC fillers to form a circular cross section and bound overall with two polyester tapes.

Armor
The armor shall consist of 0.85mm diameter steel wires. The armor shall be applied over PVC bedding.

Outer Sheath
The outer sheath shall comprise 3.5mm thick black extruded PVC, containing a termite repellent additive.

Manufacturer's Identification
'20,000 VOLTS', the year of manufacture, the Manufacturer's identification and the core cross-section shall be embossed in the cable sheath. A sequential number shall be embossed at meter intervals to facilitate cable measurements.

Current Carrying Capacity
The cables may be laid directly in the soil, or run in air or ducts, with air and ground temperatures as prevailing in Afghanistan.

The current capacity shall be stated by the Bidder for conditions detailed in Section 2.0 Technical Data Sheets.

In addition, the Bidder shall advise rating/de-rating factors for variations in the above conditions.

1.2.5.4 MV Single Core XLPE Insulated Cables

General
Single core 11.5/20 (24)KV 240mm^2 aluminum conductor, cross-linked polyethylene (XLPE) insulated, PVC sheathed cables shall be supplied for connecting the secondary of the power transformer to the 20KV incoming circuit breaker on the indoor 20KV switchgear.

Construction Details
The cables shall comprise stranded aluminum conductors with semi-conducting conductor shielding, cross-linked polyethylene insulation, semi-conductor shielding, copper wire screen, and sheathed overall with black PVC.

Conductors
The core shall be circular stranded conductor comprising 240mm2 aluminum wires.

Conductor Screen
Conductor shielding shall be extruded semi-conductor minimum of 1mm thick.

Insulation
Insulation shall comprise cross-linked thermosetting polyethylene and shall be nominally 5.5mm thick.

Insulation Screen
The insulation screen shall consist of a semi-conducting part in combination with a metallic part.
The semi-conducting screen shall be extruded semi-conducting of minimum thickness 0.8mm applied in intimate contact with the insulation.

The metallic screen shall be plain annealed copper wire helically applied directly over the semi-conducting screen.

The metallic screen shall be able to withstand a fault current of 25kA for one second.

Outer Sheath
The outer sheath shall comprise 2.0mm thick black extruded PVC, containing a termite repellent additive.

Manufacturer's Identification
'20,000 VOLTS', the year of manufacture, and the Manufacturer's identification shall be embossed in the cable sheath. A sequential number shall be embossed at meter intervals to facilitate cable measurements.

Current Carrying Capacity
The cables may be run in air or ducts, with air temperatures as prevailing in Afghanistan.

The current capacity shall be stated by the Bidder for the conditions detailed in Section 2.0 Technical Data Sheets.

In addition, the Bidder shall advise rating/de-rating factors for variations in the above conditions.

1.2.5.5 MV Terminating Kits

General
All high voltage terminations and joints shall be of a heat recoverable polymeric type. They shall be factory-engineered kits containing all the necessary components to reinstate the cable insulation, metallic shielding of each core, together with the reinstatement of the sheath, equivalent to the cable being terminated.

The Contractor shall submit at bidding, and supply with contract, complete illustrated instructions describing the methods for terminating or jointing the cable.

Each terminating or jointing kit shall be in a separate package and a list of materials indicating quantities and weights in the kit, and an illustrated instruction sheet shall be included in the package.

Kits shall contain sufficient cleaning solvents and cleaning cloths for the proper making of the joint or termination.

Voltage stress relief shall be provided and this shall be inherent in the heat recoverable polymeric material.

The termination or joint shall be capable of tolerating any variances in the manufactured dimensions of the cable such as oval, out of round, sectored or oversize cable cores. The termination shall be capable of immediate energization once all components have been installed. The terminating or jointing materials shall not be subject to storage limitations such as controlled temperature or humidity restrictions, nor have shelf life limitations.

Standards
The equipment supplied shall conform to the latest edition of the appropriate IEC specifications or other recognized international standards. In particular:

- IEC 60060 High voltage test techniques
- IEC 60071 Insulation co-ordination
- IEC 60230 Impulse tests on cables and accessories
- VDE 0278 Power cable accessories with rated voltages up to 30KV.

Inspection and Testing
Tests shall be performed at the manufacturer's works in accordance with the relevant IEC standards supplemented by the specific requirements indicated below.

Routine and Special Tests
Check for compliance with specifications herein and with the scheduled quantities.

Type Tests
The Employer may call for type tests to be carried out at the Manufacturer's Works and witnessed by the Employer or representative. Such test would be on random samples at the discretion of the Employer and failure to meet the conditions of test could result in the rejection of a complete batch of cable.

When such tests are called for they will comprise the following:

- AC voltage withstand test
- Loading cycle tests
- Partial discharge test
- Impulse voltage withstand test
- Thermal short circuit test
- DC voltage withstand test
- Humidity test (only for terminations)
- Non-tracking tests.
- Termination Materials

Termination materials for MV power cables shall provide for high permittivity electrical stress control, non-tracking exterior surfaces and complete environmental sealing. Electrical stresses shall be controlled by a high permittivity, high resistivity, heat shrinkable polymeric tubing.
Heat recoverable polymeric materials and terminations shall comply with requirements of IEC 60502, IEC 60446 Appendix C, IEC 60060 sub clause 3.3, IEC 60071, IEC 60507 Section 3, and VDE 0278.

The materials and the completed terminations shall be for the appropriate type of service, size and voltage and shall include ferrules, lugs and other materials necessary for the terminating of the conductor and clamps, braid, etc. necessary for the terminating of screen and sheath for earth continuity.

All heat shrinkable polymeric tubing and pre-molded materials shall be ultra violet stable, non-tracking (per ASTM D2303) and suitable for operation in the presence of severe external contamination and environmental pollution.

Three-core cable terminations shall use a heat shrinkable polymeric molded cable breakout to provide mechanical stress relief and sealing.

The entire termination or joint shall be environmentally sealed and capable of preventing the ingress of external moisture and contamination. Internal terminations shall fully insulate all bare metal adjacent to the termination.

MV Termination Kits
Termination kits shall be supplied for terminating the specified aluminum 20KV XLPE single and three core cables onto switchgear and transformer terminals. All 20KV terminations shall be of the fully shrouded type so that the terminations, when made, fully insulate the cable lug and the equipment terminal.

The termination kits shall comprise:

- Compression lugs
- Sealant tape
- Non-tracking lug sealing sleeve
- Non-tracking weather resistant exterior
- Stress control equipment
- Non-tracking three-way shed
- Non-tracking cable breakout
- Copper braid for earthing onto screen
- Jointing instructions
- All other items necessary to complete the kits

1.2.5.6 Tools

The following tools of well-proven design and performance shall be supplied for cable terminating and jointing and shall be handed over to the Employer at the end of the contract.

- Foot operated hydraulic 12 ton compressor complete with dies to fit all compression terminals and connectors as supplied with the terminating kits. One tool shall be suitable for all die sizes, and shall be complete with:
  - Recommended kit of spares, each kit to include at least three sets of all seals and other items required during normal servicing
  - Pressure test gauge including test blank dies
  - Complete set of repair and service tools
  - Maintenance and operating instructions
  - Service and repair manual
  - Strong metal box for protection of hydraulic compressor unit when not in use.
- Hand operated hydraulic compression tool
- Shear type cable cutters for cutting maximum cable size of 3 core 20KV 240mm2 cable
- Pencilling tool for XLPE insulation for shaping all cables specified
- Electric hot air blower suitable for shrinking heat recoverable jointing and terminating materials, 230V ac
- Gas hot air blower suitable for shrinking heat recoverable jointing terminating materials including hoses, regulator and 3kg gas bottle

1.2.6 Cable Racks

A sufficient number of fittings, rack-joints and angles shall be included in the supply. Medium voltage, low voltage and control cables shall each be laid on separate cable racks. Cable racks and suspension fittings shall be dimensioned for a distributed load of at least 150kg/m.

Cable racks, accessories and suspension fittings shall be hot dip galvanized after manufacturing or be made of aluminum. Accessories shall be designed so pulling of cables can be done without damage. Diversion plates shall be used at junctions.

The cable racks shall be erected in a way so cables can be laid without threading. The distance between a horizontal rack and the wall shall exceed 50mm to allow cables to be pulled down between the rack and the wall. Sharp edges, screw-tips, etc., shall be removed from the rack before cable pulling. Expansion bolts used for suspension fittings shall have a diameter of at least 6 mm.

The cable racks shall be connected to the station earth wire system. An earth wire laid along the rack shall be tied underneath to the rack at every second step.

1.2.7 Marking of Equipment

All main parts of the plant, including towers, gantries, busbars, apparatus, etc. shall be equipped with designation labels. All switchgear, distribution boards and control gear and units thereof, components mounted therein and wiring and cables, shall be labeled and marked according to IEC. The purpose of the labeling and marking is to facilitate the identification of switchgear and control gear and parts thereof and their relation to the relevant technical documentation in order to facilitate a rational and simple manner of installation, operation, troubleshooting, maintenance and repair.

All apparatus in the outdoor switchgear shall be labeled. Labels shall normally be placed adjacent to the middle phase. The main transformers shall be labeled with phase designations on all primary, secondary and tertiary bushings.

Designation system for text on designation labels will be provided by the Employer. Text on warning labels shall be approved by the Employer. The text on operational and safety labels shall be in both the English and the Afghan language.

Labels for outdoor use shall be of enameled sheet metal. Labels that are protected from solar radiation shall be made of fiberglass-reinforced polyester with embedded color layers. Labels shall be fixed by stainless steel screws or rivets. Enameled labels shall have stainless steel hole reinforcements.

Labels shall be white with red text and red frames. Phase designation labels shall be respectively colored red, yellow and blue for phases L1(R)-L2(Y)-L3(B). Sizes shall be chosen with regard to label location. Phase markings shall have the same height as designation labels at the same location, and shall be square.

Warning labels shall have a lightning bolt symbol in red at both ends. Warning labels shall be mounted on all dangerous parts of the installation. This means:

- A general warning label on low voltage distribution boards
- Special warnings shall be applied on all cubicles where back voltage can appear after switches are opened
- General warning labels outside all fences, gates or walls surrounding the substations. These shall be applied every 50 m along fences and walls. Completion with labels stating prohibitions against entrance, photographing, etc., shall be done at the Employer's request
- Labeling, as is deemed necessary to prevent dangers arising from mal-operation of equipment.

Inside the entrance doors to each building in the substation a large sign of poster type, of durable design, shall be set up. It shall show steps and methods to be taken and used in case of electrical accidents where persons are hurt, i.e. first aid principles and how to proceed.

Fire extinguishers shall be supplied and shall have a clearly readable sign applied to the wall above them, with notices about type and size.

In addition to the above, labeling and marking shall apply as follows:

- Each switchboard and control board shall have one label stating the make, the maker's identification data and rates, insulation voltage class and one label identifying the board in the plant.
- Each unit of switchgear or control gear (such as a cell, panel, cubicle or box as well as remote located switching and control devices) shall have a label identifying the unit and stating its purpose in the plant. The latter information is in more complicated cases suitably given in a mimic diagram.
- All apparatus or units of apparatus in the panels, cells, etc., shall have labels or markings identifying the apparatus or units thereof (normally the relevant apparatus designations used in the technical documents for the switchgear or control gear). In some cases this marking shall be completed with function marking in plain text. Apparatus labels shall be affixed by means of screw or reverts on the framework, so they remain in place when the apparatus is dismounted or changed.
- All terminals of apparatus or apparatus units shall be clearly marked. However, this marking may be omitted when the design and arrangement of the apparatus are such that a marking is obviously unnecessary.
- All electronic printed circuit boards shall have type marking. The electronic cubicles shall have item marking for each circuit board for identification of the circuit board in the schematic diagram.
- All instruments, indicating devices and control devices shall have identification marking in plain text or simple symbols or colors. Control devices shall in addition have marking of control positions in plain text, simple symbols or colors.
- Control cable terminals and, for small load circuits, also power terminals, shall be clearly marked for identification. The marking system shall be logically built up from letter and/or figures in one system consistently used within the switchgear or control gear.
- Internal wiring within switchgear, control gear or apparatus units shall have all wire ends marked, the marking to include as a minimum the same marking as has the terminal to which the wire end is connected. The marking shall be carried out with sleeves or similar. Tape is not permitted. Current and voltage circuits shall also have phase marking and, where necessary, polarity marking. Protective earth wires shall be marked with green-and-yellow.
- Cables connected to switchgear, control gear, external apparatus, etc., shall be marked with cable numbers according to the cable list and core number according to the external connection diagram. In addition, all cable cores shall have the same marking as the terminals to which cores are connected. Marking with glued tape is not permitted. The marking shall be indicated with ferrules. The ferrules shall be of white insulated material and be provided with a glossy finish preventing adhesion and dirt. They shall be clearly and durably marked in black and shall not be affected by damp or oil.
- Trenches with buried cables shall be marked with labels on walls where applicable or with labels on posts with one set up at each end of a road crossing, one set up for every point of change of direction of a cable trench, and one set up for each twentieth (20) meter of a cable trench. The cables shall be provided with warning tapes along all the trenches.
- All labels shall be of plastic or metal indoors and of enameled metal outdoors, and shall have the text or symbol engraved. Text and symbols shall be of dark color and the surface shall be light. All labels shall be permanently fixed to the switchboard and apparatus. Glued labels and marking tape are not acceptable.

Some of the above required markings and labeling may, subject to the Employer approval, be combined or omitted for uncomplicated parts of the equipment.

1.2.8 Optical Fiber Cables

Outdoor Optical Fiber Cable

Single mode outdoor optical fiber cable is required to connect the end of the OPGW cable at or near the terminal transmission tower to a fiber optic patch panel in the substation/switching station control room. In addition, outdoor single mode and/or multi mode cable shall be used between buildings if there is more than one operational building on a site.

Outdoor optical fiber shall be of loose tube, gel filled construction and shall be installed in HDPE cable ducts or direct buried in plastic conduit. The cable shall have a non-metallic central core sheathed with black polyethylene. An armored layer shall surround the inner sheath made up of corrugated steel or aluminum tape at least 0.2mm thick followed by an outer polyethylene sheath.

Indoor Optical Fiber Cable

Single mode and/or multi mode indoor optical fiber cable will be used to interconnect equipment within the control buildings. Indoor optical fiber cable shall be of tight buffered construction and shall be installed in cable ducts or on cable ladder. The cable shall have a non-metallic central core sheathed with black polyethylene. A non-metallic strength layer shall surround the inner sheath followed by an outer polyethylene sheath.

Table 1.2.1 Common Requirements for Optical Fiber Cables

Description	Specification
Number of fibers:	at least 36, but not less than the number of cores in any other cable to which the cable is joined
Standard:	ITU-T G.652D
Max. Tensile strength:	≥ 2700N
Cladding non-circularity:	≤ 2%
Covering material:	Polyethylene capable of resisting insects and rodents
Water proof capacity:	according to IEC 60794-1-F 5
Operating environment:	according to TCN- 68-149:1995
Environment temperature:	-5 to +650C

Single mode optical fibers shall be designed to optimize transmission of light at both the 1,310nm and 1,550nm wavelengths. The fiberglass core/cladding diameters shall be 9/125μm.

Multi mode optical fibers shall be designed to optimize transmission of light at the 850 nm wavelength. The fiberglass core/cladding diameters shall be 62.5/125μm.

Patch Leads/Pigtails

Fiber patch leads shall be used to connect between equipment within a cubicle, and may also be used between cubicles up to a distance of 10m. For lengths greater than this, indoor optical fiber cable shall be used with suitable breakout termination enclosures. When run externally between cubicles, the patch leads shall be suitably protected by being run in plastic conduit. Patch leads shall be Kevlar® (or aramide) reinforced and plastic coated optical fiber conforming to ITU-T Recommendation G.652, and be color coded depending on function (data, telecom, CCTV, protection etc.).

Where a termination enclosure is installed, all fibers of all cables are to be terminated on "pigtails" (or break-out cable) with a minimum length of 1m. The pigtail shall be a Kevlar® (or aramide) reinforced and plastic coated optical fiber conforming to ITU-T Recommendation G.652.

1.2.8.1 Fiber Optic Accessories

Junction (Splicing) Box
Outdoor junction boxes shall be provided as required. These junction boxes shall be used to house the fiber core splices which connect the trunk cable (e.g. OPGW) to the outdoor intermediate optical cable leading to the patch panel in the control room.

A fiber optic cable junction box shall provide the following:

- It shall support, organize, and protect the optical fibers and the fiber splices whilst ensuring that the optical fiber minimum-bending radius is not exceeded
- The splice tray shall not have any sharp edges or protrusions that may damage the optical fiber cable
- It shall provide entry for all cables
- Include number tags for tube and fiber identification
- The junction box shall be rated to IP65 in accordance with IEC 60529
- The enclosure shall be lockable.

The Junction box shall be mounted on a wall or pedestal at a conveniently accessible height.

Termination Patch Panels and Breakout Enclosures
Fiber optic cable patch panels shall be provided in the control room to patch the external optical fiber cable cores to the appropriate communications devices in the station.

Breakout enclosures shall be provided in cubicles to transition between optical fiber cable and individual fiber tails.

Sufficient connectors for all incoming and outgoing fibers, including spares, shall be provided in each enclosure.

A fiber optic cable termination patch panel shall provide the following:

- It shall support, organize, and protect the optical fibers and the fiber splices whilst ensuring that the optical fiber minimum-bending radius is not exceeded
- The splice tray shall not have any sharp edges or protrusions that may damage the optical fiber cable
- It shall provide entry for all cables
- Include number tags for tube and fiber identification
- It shall provide mounting positions for the bulkhead FC/PC type connectors on which the cable will be terminated
- It shall allow patching of fibers.

The patch panel shall have a fiber capacity equal to the total number of fibers (connected and spares) for all cables to be connected. Patch panels shall be designed for 19-inch rack mounting within a standard equipment cabinet.

All unused couplings shall have protective dust covers. The patch area shall be accessible behind a door or removable cover.

Sufficient factory manufactured patch cords with suitable color coding shall be provided.

Fiber Connectors
All optical connectors shall be field installable and perfectly matched to the cable used. The connectors shall provide tight fitting termination to the cladding and buffer coating.

Epoxy based or "hot melt" adhesives shall be used to bond the fiber and buffer to the connector ferrule and body prior to polishing the end face. No dry termination or "quick crimp" connectors are allowed.

After termination with connectors, the fiber ends must be visually inspected at a magnification of not less than 100 to check for cracks or pits in the end face of the fiber. If any irregularities found cannot be removed by further polishing, the entire process must be redone by cutting off and disposing the connector body.

Connectors shall have a maximum allowable connection loss of 0.3dB per mated pair, as measured per EA.-455-34, without use of index-matching gel (dry interfaces only). Single mode connectors shall be capable of field installation on 9/125 micron fibers with 900□m (OD) buffers.

Communications equipment shall use the industry standard FC/PC type connector, designed for single mode or multimode tolerances, and shall meet or exceed the applicable provisions of EA.-455-5, 455-2A, and 455-34, and shall be capable of 100 repeated matings with a maximum loss increase of 0.1dB. Substation equipment shall use either FC/PC type or ST type connectors. Connectors shall incorporate a key-way design and shall have a zirconium ceramic ferrule.

Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials, such as nickel plated zinc, designed to operate in humid environments without degradation of surface finishes.

Where a termination enclosure is installed, all fibers of all cables are to be terminated on "pigtails" with a minimum length of 1 m. The connector shall be inserted on the cable side of the bulkhead (feed-through) connector in the termination enclosure. All connectors shall be supplied with a removable cap to protect against moisture and dust ingress when not connected.

1.2.9 Control, Relay and Auxiliary Power Equipment

1.2.9.1 Control, Relay and Auxiliary General

The control panel in the control building shall include control and indication of all 220KV, 110KV, and 20KV circuit breakers and motor operated disconnectors. The control panel shall be integrated with the relay panel. The transformer control and protection and OLTC panels shall include control and indication of the power transformers. The control switches for the circuit breakers and disconnectors and indicating instruments shall be installed directly on the front of the control panel.

The panel front shall also include a mimic diagram, reflecting the actual layout of the complete 220KV, 110KV, and 20KV switchgear. The mimic diagram shall have different colors for different voltages and symbols for the main apparatus.

1.2.9.2 Design Data

Voltages shall be as indicated in Table 1.2.2.

Table 1.2.2 Control, Relay and Auxiliary Voltages

Description	Specification
Auxiliary power	400/230V AC three-phase, 4/5 wire with system earthing TN-C-S
General auxiliary voltage supply	220V DC2-wire insulated system
Tolerances	are +10% - 15% measured at the consuming objects

1.2.9.3 Control, Relay, Metering and Alarm Boards

The boards shall be made of sheet steel of at least 2 mm thickness and be of vermin-proof design IP 43 according to IEC 60529. Boards shall be wired at the Contractor's workshop before delivery to Site. To facilitate transportation, the boards should be assembled in convenient sections before delivery.

All boards shall have a maximum height of 2,300mm. The boards shall be equipped with a master key-locking system. Each board shall have lighting that is switched on when the door of the cubicle is opened. Humidity controlled heaters shall be provided.

Terminal blocks for cable termination shall be mounted on the sides inside the boards and all cable entrances supplied with glands. Terminal blocks for CT circuits shall be equipped with testing plugs for commissioning purpose. All boards shall be connected to the general earthing system. Each board shall be labeled.

1.2.9.4 Operation and Indication, Control Systems

General
All control and indication circuits shall be designed for 220V DC. Fuses for various DC circuits for control, relay protection, indication, etc., shall be mounted in separate boards. Each circuit shall be supervised by voltage relays giving alarm in case of lost voltage or tripped fuse.

Interlocking System
A complete interlocking system shall be incorporated in the operating circuits for motor-operated disconnectors. The purpose of the interlocking system is to prevent opening or closing of disconnectors while related circuit breakers are closed. An earth switch shall be mechanically interlocked to the disconnector to which it is attached so that earthing operation cannot occur if

Indicating Instruments
The indication instruments shall have dimensions 96 mm x 96 mm and be flush-mounted. The indication instruments shall be of angle type with 240° scales, indication errors shall not exceed ±1.5% of the full-scale value. The instrument scales shall have a white background and the same design of figures and gradation. The indicated values shall be given directly without constants such as x10 and the like. Panel instruments shall be provided as indicated in Section 2.0 Technical Data Sheets.

1.2.9.5 Control Panel Logic

The front panel mimic diagram shall be provided on panels. Mimic diagram shall be screwed onto the panels and shall be made of anodized aluminum or plastic of approved color. The mimic shall be 10mm wide for horizontal run and 5mm wide for vertical run. Mimic shall match the one-line diagrams indicated on the drawings and as specified herein.

Semaphore indicators (push-to-test type) shall be provided for the Operator and indications.

Each breaker control switch shall be paired with a control switch selector. The selector will place related breaker switch into local (control panel) control or remote (SCADA or breaker local) control. All necessary interface wiring to SCADA equipment to supply this function shall be provided.

Blue indicators shall be provided for energized indication of bus or line sections. The indicators shall be located in the related section of the mimic bus. Any mimic bus section over 500mm in length shall have multiple indicators evenly placed in mimic section.

White Sync OK indicators shall be provided for all breakers except the 20KV load feeders. These indicators shall illuminate when the respective breaker synchronization relay allows closure. All close signals (local and/or SCADA) shall be inhibited when related synchronization relay is not satisfied.

Control Panel wiring logic shall be provided to inhibit all operations (open and/or close control signals) of disconnectors when respective breaker is closed.

Control Panel wiring logic shall be provided to inhibit simultaneous closure of paired (common line or load connection) bus-select disconnectors.

Control Panel wiring (or internal programming of 87 relay) logic shall be provided to automatically select proper current transformers and breaker operation for bus differential zone relaying during all possible switching schemes provided through the disconnect switch positions. Each 87B shall be capable of monitoring two zones (Bus I & Bus II), and tripping only breakers associated with given zone for a bus fault.

Control Panel wiring logic shall be provided to automatically select proper voltage transformers for sync check (25) relaying and metering during all possible switching schemes provided through the above disconnect switch positions. Typical selection schematic is shown in drawings.

The system shall provide breaker failure protection for the 110KV & 220KV system. Typical sequence: During a fault breaker #A fails to open when receiving an overcurrent trip command. Breaker #A REL670 and/or P444 relays detect breaker failure and issue failure command to related 94 relay. The 94 relay will issue trip commands to all substation power source breakers, issue a command via SCADA to open the far substation source breaker (with lock out), Send "open" commands to failed breaker motor operated bus disconnects. This de-energiges the bus and isolates the failed breaker #A. Upon receiving "b" contacts signals of both breaker #A disconnects, a re-close command is sent to all substation line breakers, restoring bus power.

The colors for various voltages in the mimic diagram shall be as below.

Voltage Level	Mimic Color
20KV	Canary Yellow
110KV	Bright Orange
220KV	Signal Red

1.2.9.6 Alarm Equipment

An alarm annunciator shall audibly and visually identify the source and type of alarm. There is no requirement for a remote fault signal system.

1.2.9.7 Relay Protection

The proposed relay protection is listed in Section 2.0 Technical Data Sheets. The Contractor shall add all additional protection as necessary for their nominated plant and equipment:

The relay protection shall consist of numerical type relays with self-supervision. Each relay protection shall have test facilities of a type enabling testing of the entire relay combination while the protected part is in service. It shall be possible to block all tripping impulses by means of switches.

The setting ranges of the relays shall be selected to fit into the existing selectivity plan. All ranges will be settled at a later stage. All relay protection shall have individual indicating devices and be designed for easy resetting both by local and remote operation.

Possible influence from induced voltage in a control cable shall be taken into account, e.g. introducing barrier relays between relay protection and outgoing cables to switchgear, etc. Tripping outputs shall be of high-speed type. Tripping contacts shall be of heavy-duty design to obtain required contact duty for breaking.

Metering Equipment

Energy meters shall be provided as indicated in Section 2.0 Technical Data Sheets

Meters installed for monitoring of energy consumption shall be kWh delivered and kWh received for kWh (MWh) and four quadrant for KVAh (MVAh). Accuracy class for meters shall be 0.2 for active energy and 0.5 minimum for reactive energy. Meters shall have the facility for remote interrogation via modem and the SCADA/CSCS and shall provide pulsed outputs to the metering data processors. Two data processors (main and backup) shall be supplied for recording and totaling metering pulses, with programmable 20 or 30-minute printout facilities and 20 inputs minimum for each processor.

Each meter shall be provided with a testing terminal block enabling the meter to be switched off in a simple manner.

1.2.9.8 Control Cables and Earth Wires for Control Systems

Control Cables

Control cables shall be of multi-core type, PVC insulated, with screen and copper conductors. Cables shall be termite-proof in an approved manner. All cables shall be laid in plastic pipes of a suitable size and standard. Medium voltage, low voltage and control cables shall be laid in separate pipes.

For low level signals, e.g. outputs from transducers, cables shall have conductors of tin coated stranded copper wires and screen of aluminum foil and copper wires (Electronic cables). Cables containing more than 10 cores shall be so dimensioned that at least 25% of the cores will serve as standby cores.

The cables shall comply with design criteria detailed in Table 1.2.3.

Table 1.2.3 Design Criteria – Control and Electronic Cables

Cable	Control	Electronic
Nominal voltage	230V	0V - 220V
Maximum current	10A	2A
Insulation level	0.6/1KV	0.6/1KV
Frequency	DC or 50Hz	0Hz-1000Hz

As a protective jacket the cable shall have an extruded sheath of grey or white PVC in waterproof color marked with:

- Name of manufacturer
- Year of manufacture
- Cross-section area of phase-conductors and number of cores.

The cables shall be delivered in full lengths and, consequently, no joints are permitted. Cable terminations are normally not needed for these types of cables, however all cable terminations shall be provided with cable glands.

Earth Wires for Control Systems
All control boards, relay boards, marshalling boxes, transformers, apparatus, etc., shall be connected to the main earthing system.

An earth bar shall be installed in the control building for transition of earth wires in the different rooms. The earth wires shall be separated from control cables, etc. The earth wire system shall be of stranded copper wire designed for the maximum prospective fault current.

Secondary Circuits
Auxiliary cables shall be PVC-insulated for a test voltage of 2KV, 50Hz and shall be screened or metal-sheathed. The conductors, screens and metal sheaths shall be made of copper.

The following minimum areas shall be applicable:

- Current circuits for protection relays 2.5mm^2
- Instrument, voltage and control circuits 1.5mm^2

The auxiliary cables shall be designed for a maximum voltage drop from voltage transformers to instrument and meters of 0.1%, and to relays 1.0%. Total burden shall not load the secondary winding of voltage transformer more than 75% of rated burden. Total burden shall load the secondary winding of a current transformer between 25% and 75% of rated burden.

The screen of control cables in connection with the outdoor switchgear shall generally be earthed at both ends. All other cables shall generally be earthed at one end only. In case of earthing at one end only, the location of the earthing shall be indicated on the diagrams.

Auxiliary conductors in apparatus cubicles such as control and relay cubicles, etc. shall be stranded PVC cables with a minimum area of 1.5mm^2.

Conductors within cubicles and between terminal blocks and apparatus shall be laid in plastic ducts or covered with plastic bands. Conductor ends not connected to compression-type terminal blocks shall be provided with approved claw washers, which neatly retain all strands. Wiring shall be arranged to give easy access to the terminal of relays and other apparatus. All jointing and tying of wires shall be carried out only at the terminal points.

Spare cores, if any, shall be connected to terminal blocks in cubicles and marshalling boxes.

Boards and Marshalling Boxes for Control Systems
Boards and marshalling boxes shall be made of steel and designed for adverse conditions and be vermin-proof. The doors shall be of the lift-off and hinged type. Boards and boxes for indoor installation shall fulfill Degree of Protection IP 43 according to IEC 60529. Boards and boxes for outdoor installation shall fulfill Degree of Protection IP 54.

The cables shall be mounted so that they are protected against damage and vibrations. The cables shall enter through glands, which shall properly be above the gland plate to prevent moisture from entering the cables.

Boards and marshalling boxes located outdoors or in damp surroundings shall have ventilation and drainage openings as well as a heater for connection to 230V, 50Hz. They shall also be provided with lighting equipment. Boards and marshalling boxes and equipment installed in them shall be of satisfactory corrosion-proof design. All box openings shall be screened for protection against vermin, and be so arranged that entry of water is prevented. For screening of the holes, netting with at least one mesh per mm shall be used.

All marshalling boxes shall be placed at normal working height and shall be sufficiently spacious to facilitate the connection of leads. They shall be so designed as to make markings easily legible.

Not more than two cores shall be connected to each side of a terminal block. Each board and box, etc., shall be connected to the station earth system by a copper wire with a minimum area of $25mm^2$.

Terminal Blocks

All terminal blocks shall be equipped with visible isolating arrangements for testing purposes. They shall be provided with sockets for banana plugs, at both sides. The terminal blocks shall be insulated for 500V and shall have provisions for marking. The terminal blocks shall be mounted to give easy access to wires, terminations and ferrules. The terminal blocks shall also give a clear view of the arrangement of the cable tails.

Terminals connected to 400/230V shall be properly protected and separated from control circuits.

1.2.9.9 Auxiliary Power Transformers

General

The auxiliary power transformers shall be indoor, 3 phase, air cooled type included in the 20KV switchgear. The design shall comply with IEC 60076 and be rated in accordance with Section 2.0 Technical Data Sheets.

The auxiliary power transformers shall be of a suitable type for service under the specified ambient conditions.

The transformers shall be capable of withstanding continuous operation at the rated power and at a voltage 10% higher than the rated voltage without causing dangerously high temperatures or abnormal vibration.

The transformers shall be designed with cable entry boxes for direct cable connection on the medium voltage and low voltage side. Oil or compound filled cable boxes are not permitted.

Accessories

The following accessories shall be provided for the transformer:

- Bushings for HV side
- Cable entrance boxes for LV side
- Marshalling box including terminal blocks for connection of external cables to the transformer accessories
- Temperature indicator
- Lifting devices such as eyes or hooks for lifting the complete transformer and for lifting the coil and core assembly alone.

1.2.9.10 Auxiliary Power Equipment

Motors
Electrical motors shall fulfill the following requirements:

- Insulation Class F
- Enclosure Degree of Protection IP 54
- Cooling design IC 4

They shall have protected drainage holes, and be capable of operating continuously under equal service conditions without exceeding the specified temperature rises. All motors required to operate in damp or humid conditions or located outdoors shall be supplied with electrical heating equipment in order to protect the windings against moisture.

Low Voltage Boards
The requirements for boards are where applicable also valid for boxes for separately mounted apparatus. Boxes outdoors shall fulfill Degree of Protection IP 54 according to IEC 60529 and have thermostat-controlled heaters, ventilation and drainage.

All cables shall be connected to the boards with terminal blocks of approved type located near the cable entry. Cables with large cross-section areas are permitted to be connected directly to the apparatus.

All auxiliary circuits shall be connected to terminals with isolating arrangements having 4 mm banana plug sockets on both sides. All boards shall have 10% spare terminals for power circuits and 10% for auxiliary circuits. All distribution boards shall have 20% spare space for future extension.

The boards shall be complete with terminal block marking, full set of circuit breakers, switches and fuses as well as with other components required. The boards shall be designed for erection on wall without rear access. The operation devices for switches and control switches shall be operated from the front of the board without the doors being opened. The expanding gases developed in case of a short-circuit shall be directed in a safe direction in order to prevent injury to persons being near the board.

AC Boards
Boards for 400 V AC shall be of metal-enclosed panel type and vermin-proof designed; Degree of Protection shall be IP 43 according to IEC 60529.

The boards shall have Cu busbars for phases, neutral (N) and protective earth (PE). The neutral busbar shall also have full insulation against earth and be connected to earth with one link in the board only (power system TN-C-S). The earth busbar shall preferably be located near the outgoing cable terminals.

DC Boards
Main and battery boards for 220 V DC shall be of plastic-enclosed panel type and vermin proof designed; Degree of Protection shall be IP 43 according to IEC 60529.

Distribution boards for DC may be metal-enclosed but shall fulfill all requirements as for the main board. The battery boards shall have separate enclosures and shall be mounted as near the batteries as possible.

Circuit Breakers
Circuit breakers shall be capable of interrupting the available short-circuit energy. Miniature circuit breakers shall be used for all loads 430V / 80A and below.

Air Break Switches
The low voltage switches for the AC boards shall be of Utilization Category AC 23 and DC 23 respectively. The switches shall be front-operated and have distinct ON-OFF markings and have provision for locking. Switches on the main boards shall be of plug-in type.

Switch Disconnectors
Switch disconnectors shall be of utilization category AC 23 (DC 23). Switch disconnectors shall be operated from the front of the box and have distinct OFF-ON markings with possibility for locking with padlock in OFF position.

Fuses
Power fuses shall be of blade type according to IEC 60269 - 2A Section I. Fuses maximum 25A may be of screw type DII (IEC 60341). The fuses shall have a visible indication device. For small apparatuses, miniature fuses 5x20mm (IEC 60127) may be used.

Control Switches
Control switches shall be designed for 10A and be marked OFF-AUTO-ON, etc. Control switches shall be operated from the front of the cubicles.

Current Transformers
Current transformers shall be of the dry type for mounting on busbars or cores. Secondary current shall be 1A.

Measuring Instruments
Voltmeters and ammeters shall have dimensions 96mm x 96mm and be flush-mounted. The indication instruments shall be of square type with 240° scales, indication errors shall not exceed ±1.5% of the full-scale value. The instrument scales shall have a white background and the same design of figures and gradation. The indicated values shall be given directly without constants.

1.2.9.11 Back-up Diesel Generator

A self-contained diesel generator shall be provided as ultimate power back-up for station service. The generator shall be rated 250kW (minimum) after application of all de-rating factors per the station environment constraints. It shall have an integrated sound-suppressing enclosure, outdoor mounted, liquid cooled. The unit shall have self-contained electric heaters for both the enclosure and engine water jacket. The generator shall be connected to the station service transformers via automatic transfer switches. The unitized generator design shall provide sufficient fuel storage to operate at least 3 days at 80% load.

1.2.9.12 Solar Electric System

Solar electric system design is beyond the scope of this specification.

1.2.9.13 Lighting, Fittings and Accessories

General
Lighting fittings shall be of fluorescent type with electronic type ballast and have power factor compensation. All fittings shall be delivered complete with lamps.

Indoor Lighting
The lighting fixtures shall be surface mounted. Fittings for indoor lighting shall be IP 23 according to IEC 60529.

Outdoor Lighting
Fittings for outdoor lighting shall be splash-proof IP54 according to IEC 60529. The outdoor lighting shall be operated by means of a photocell relay, connected to a changeover switch, mounted in the lighting board, with three positions: ON; PHOTOCELL RELAY; OFF.

Socket Outlets
Single phase socket outlets shall be Shucko (CEE 7/4), 16A. Three phase socket outlets shall be splash-proof, 3P+N+PE according to IEC 60309. Outlets shall have a load breaker mechanically interlocked with the male device.

Socket outlets shall be provided as indicated in Table 1.2.4.

Table 1.2.4 Socket Outlets

Description	Specification
Control room	three 16A, 230VAC, one three phase, 16A, 400VAC
Auxiliary room	three 16A, 230VAC, one three phase, 16A, 400VAC
Office	three 16A, 230VAC
Store room and workshop	two 16A, 230VAC
Kitchen	two 16A, 230VAC
WC- bathroom	one 16A, 230VAC
Adjacent to outdoor power transformers	one 125A, three phase outlet for oil treatment plant.

Lighting Intensity and Socket Details
The intensity of the lighting installation shall be as detailed in Table 1.2.5.

Table 1.2.5 Lighting Intensity

Description	Specification
Control, battery and auxiliary rooms	300 lux
Office and kitchen	300 lux
WC/bathroom	200 lux
Store room and workshop	200 lux
Outdoor, entrance and gate	50 lux
Transformer cells	50 lux
Switchyard, in general	10 lux
Emergency lighting in control room (design for 90 minutes minimum)	50 lux

1.2.9.14 Auxiliary DC Systems

General
The 220V DC systems shall consist of two 220V batteries, two rectifiers, one main battery board and DC distribution board. Battery supervision shall be included for each. For discharge test of batteries, a portable enclosed resistor and a fused test outlet at the DC board shall be supplied. It shall be possible to adjust the resistor for different load currents.

The DC systems shall be designed for the power demand of the connected loads and a future extension of at least 30%, taking into account the load diversity factor and the maximum voltage drop.

The battery shall have a sufficient capacity for maintaining the power supply of the connected systems for a period of six hours in the event of failure of the AC supply, without the terminal voltage falling below the nominal value by more than 10%. Furthermore, the battery must be dimensioned for a secure and selective operation of the short circuit protection devices (fuses).

The rectifiers shall be designed to recharge the battery, up to 90% of rated C10-capacity within 12 hours after a six-hour discharge, whilst supplying the connected loads at the same time.

The voltage at individual components when the system is at no load must not exceed the nominal voltage by more than 10%, and must not fall below the nominal voltage by more than 15% when the system is at full load.

Batteries
The batteries shall have main design data per Section 2.0 Technical Data Sheets.

The Contractor shall design the capacity of the battery system, using appropriate temperature correction factor, design margin and ageing factor, in accordance with IEEE 485 *Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations*. The batteries shall be erected on non-corrosive stands and totally insulated from frames and earthed equipment. The batteries shall be of a type with transparent containers and be installed in maximum two layers in order to enable the observation of the acid level through the container walls. The batteries must be erected in such a way that maintenance and service can easily be carried out. Acid resistant vessels under the batteries shall be included. Each battery cell shall be equipped with explosive retarding valves.

Rectifiers
The rectifiers shall be of solid-state constant voltage charge type and have an automatic current limitation. The rectifiers shall be equipped with volt- and ammeters (accuracy class 1,5) indication lamps, main switch and a selector switch for automatic recuperative recharging (Float/Quick charge with locking device) as well as alarm indicators for AC supply failure and DC earth-fault, and quick charging. Test outlets for 4 mm banana-plugs shall be provided.

Auxiliary contacts for above-mentioned alarms shall be provided for remote alarms, including a no-voltage relay for AC-voltage loss. The rectifiers shall be enclosed in painted steel chassis with a Degree of Protection of IP 43 according to IEC 60529.

DC-Supervision
DC-supervision of the battery systems shall be provided and shall, as a minimum, consist of:

- Over- and under-voltage supervision in two steps for each function of the floating voltage level
- Earth fault supervision
- Battery circuit supervision
- Fuse supervision for all fuses

If the DC-supervision is mounted in the rectifier it shall be connected at the external side of the rectifier fuse to prevent maloperation if the fuse will trip. Auxiliary contacts for the above mentioned alarms shall be provided for remote alarms.

1.2.9.15 Auxiliary Power Cables AC/DC, Wires and Earthing

General
The cables and wires with accessories shall be continuously rated and suitable for service under the actual climatic conditions. The cables shall withstand all electrical, thermal and mechanical stresses under the stated service conditions, and at a voltage of 10% above the rated value. The insulation level shall be 1KV. Special mechanical protection of the cables shall be provided where required. The cables shall be protected against the short circuit current and earth fault current by fuses, with exception of use in current measuring circuits. Cables shall be protected against direct sunshine. Cables shall be marked with designation according to the cable list.

Design
The cables to be used shall be PVC-insulated, PVC-sheathed with copper conductors and copper screen. The neutral conductor shall be of the same cross-section as the phase-conductors. The surface of the sheath shall be marked as follows in English:

- Name of manufacturer
- Year of manufacture
- Cross-section area of phase-conductors and number of cores

Cable Accessories

General
The minimum requirement for cable joints and cable terminations are that they after installation shall withstand the environmental and climatic conditions as the cable itself. They shall also fulfill the same electrical standards as the cables regarding insulation and current rating.

Cable Joints
Jointing shall be avoided. If jointing is anyway deemed necessary by the Contractor, he shall obtain the approval of the Employer. The jointing of conductor ends shall be done by pressing or screwing technique. The insulation may be restored by taping, molding or shrinking techniques.

Cable Terminations
Connection of low voltage cables to distribution boards, contactor cubicles, motors, etc., shall be carried out by removal of the insulation to the required length of the conductors and by connecting the ends to the terminals. The terminals shall be of screw-joint type. Special cable terminations are thus not needed.

Earth Wires
All switchboards, transformers, apparatus, etc., shall be connected to the main earthing system.

1.2.9.16 Line Protection Signaling Systems

A trip signaling system via an optical ground wire (OPGW) system shall be installed to send/receive all trip signals related to the 220KV, 110KV, and/or 20KV line bays. This shall operate via the Synchronous Digital Hierarchy (SDH) equipment over the interconnecting optical ground wire (OPGW) system. Alternatively, line protection may use independent fibers depending on the Bidder's design.

Receipt of a trip signal from the remote substation shall be visually indicated. In addition, all relay protection, transformer guards, voltage supervision relays, etc. shall be provided with indication to show that the respective device has been activated. The situation and the reason for any tripping shall be clear to the operator. All indications shall be manually reset.

Teleprotection Equipment

Digital teleprotection signaling circuits shall be provided on the SDH network for all transmission lines. The data circuits shall use the standard 64 kbit/s G.703 (ISDN compatible) interface and shall employ multiplex section protection between the communication sites at each end of the transmission line to provide maximum reliability.

Teleprotection signaling equipment shall be provided at the SDH access channel level.

The configuration of the teleprotection systems shall be in accordance with the following:

The Contractor shall provide 2 (two) independent 64 kbit/s data circuits and 2 (two) sets of teleprotection signaling equipment for each 220KV transmission line.

The teleprotection signaling equipment shall be supplied, installed, tested and commissioned by the Contractor.

Typically, each 220KV transmission circuit is protected by two permissive schemes (under reach and over reach) and a direct intertrip scheme in each direction. Therefore at least three protection commands shall be provided for each teleprotection link.

The teleprotection equipment shall ensure with maximum security, availability and reliability rapid, full duplex transmission of trip commands (direct or permissive), blocking.

The equipment shall be of modular design and either be mounted into a slot of the communications multiplex equipment or installed in racks within the communications cubicle. It shall employ full solid-state microprocessor controlled circuitry techniques with self-monitoring functions. Exchange of faulty submodules shall be possible without switching off the communications equipment or influencing other channels.

Computerized diagnosis/testing and easy field programming (alarm levels, selection of permissive tripping/blocking signal features, etc.) of the equipment shall be possible. Programming and diagnosis shall preferably be carried out with a PC to be connected to the teleprotection equipment via a standardized service interface. Additionally, the equipment shall be furnished with local failure indications and potential free contacts for external alarm annunciation. As a minimum, the following alarms shall be generated and announced:

- General (internal) fault
- Auxiliary power supply failure
- Faulty transmission path, exceeding a specified time (e.g. some seconds)
- Signal-to-noise ratio too low, exceeding a specified time
- Continuous command
- Protection signal sent
- Protection signal received.

Test Facilities

A test mode or test points shall allow checking of equipment under operating conditions. It shall be ensured that testing will neither disturb or damage the teleprotection equipment nor cause any malfunction of connected high voltage circuit-breakers. Proper functioning and any malfunctions of the equipment during testing shall be indicated via LEDs. Under no circumstances shall real tripping commands be blocked or limited during tests, in order that full protection of the high voltage system is maintained. Loop tests shall be possible from each terminal station without the need of personnel at the opposite station.

1.2.9.17 Communications

The communication system supply shall conform to relevant technical requirements of the latest current applicable Standards:

ITU-T	International Telecommunications Union - Telecommunications Standardization Sector
ITU-R	International Telecommunications Union – Radio communication Sector
IEC 60794	Optical Fiber Cables
IEEE 1138	Construction of Composite Fiber Optic Overhead Ground Wire (OPGW) for Use on Electric Utility Power Lines
BS6651	Protection of Structures against Lightning
IEEE 1222-2003	Standard for All-Dielectric Self-Supporting Fiber Optic Cable
TIA/EIA RS-598A	Color-coding of Fiber Optic Cables

1.2.9.18 SDH Network

General

The primary optical network connecting substations with the National Load Control Center (NLCC) near Tarakhil and shall be based on Synchronous Digital Hierarchy (SDH) equipment using multiplexed channels on STM-1 (155Mbit/s) links for data, telephony and protection signaling. The SDH equipment at each site shall be linked via optical fiber cable on the transmission lines (generally OPGW) or via microwave radio where specified.

The SDH equipment is required eventually to fit in to a system wide communications network so the scope of supply shall include provision of equipment for future fiber optic links. In addition multiplex and sub-network connection protection is also required so some duplication is specified.

Network Services

The SDH network shall provide the following services:

A. Telephone Network
   The telephone exchanges (PABX) at each substation shall be linked over the SDH network by 2 Mbit/s G.703 E1 circuits.

B. SCADA Data
   Digital communications shall be provided to connect the Remote Terminal Unit (RTU) of the CSCS at each site with the Network Control Center (National or Area Load Control Center) at Tarakhil. 10 Mbit/s IEEE 802.3 Ethernet data links shall be provided over the SDH. In addition, asynchronous serial links shall be provided for other equipment that may need interconnection.

C. Teleprotection
   Digital teleprotection circuits shall be provided on the SDH network for all transmission line protection as described above.

D. Performance
   The technical requirements of the equipment specified for the communications network are based on ITU-T Recommendations and other international standards. Error performance objectives shall comply with ITU-T Recommendation G.826.

E. Redundancy
   Each SDH terminal shall communicate via two separate fiber circuits in an actual ring or flat ring configuration. Where possible, these circuits shall be connected by separate transmission lines to form a true ring.

1.2.9.19 SDH Multiplex Equipment

General

Digital multiplex equipment shall be provided to perform the necessary multiplexing between 2 Mbit/s and 34 Mbit/s tributaries at each site. The digital multiplex equipment shall also provide the optical interfaces to the fiber optic cables between the various sites. The digital multiplex equipment shall be in accordance with the latest ITU-T Recommendations for SDH equipment, namely: G.703, G.707, G.708, G.709, G.781, G.782, G.783, G.784, G.803, G.811, G.823, G.825, G.957 and G.958.

Interfaces

The types of interfaces required are:

- STM-1 Optical
- n x 2 Mbit/s
- The characteristics of the multiplex interface shall conform to the ITU-T Recommendations for systems operating at 155 Mbit/s or 52 Mbit/s, namely:
- G.709 for mapping and de-mapping
- G.708, G.783 for MSOH and RSOH insertion and extraction
- G.708 and G.709 for POH generation and termination
- G.709, G.783 for Pointer generation and interpretation
- G.708 for multiplexing
- G.709 for scrambling and de-scrambling

STM-1 Optical Interface

Optical interfaces shall be provided for connection to the fiber optic cable between the various sites. In addition to the general requirements listed above, the STM-1 Optical Interface shall conform to the requirements listed in ITUT Recommendation G.957.

The interface shall operate at a nominal optical wavelength of 1550nm and be suitable for operation over the required distances. The optical fiber on these routes shall conform to the ITU-T Recommendation G.652. For each link, the optical interface with the lowest transmitter output power that still meets the performance objective shall be supplied.

The STM-1 Optical Interface card shall include flexible patch cords to connect the optical interface to the patch panel. The patch cords shall be terminated at the patch panel end in Type FC/PC connectors. These connectors are also preferred for the STM-1 Optical Interface.

n x 2Mbit/s Interface

2 Mbit/s interfaces are required at each site to connect to primary multiplex equipment. Each interface card should accommodate at least 4 x 2Mbit/s interfaces to provide the immediate requirement together with spare capacity for future growth. All 2Mbit/s interfaces shall conform to the ITU-T Recommendations:

- G.703 section 6 for electrical characteristics. The 120Ω balanced pair option shall be used.
- G.704 for functional characteristics
- G.823 and G.783 for output jitter and jitter tolerance

The 2Mbit/s interfaces termination shall be 120Ω balanced.

Synchronizing
If a Primary Reference Clock for the synchronization of the SDH equipment is required, it shall be installed at the same location as the network management system and comply with ITU-T Recommendation G.811.

Each multiplexer shall have the ability to choose the timing source between external timing, incoming STM-1 signal (155 Mbit/s) or incoming 2Mbit/s. The order of priority in which these sources are chosen shall be programmable by the Employer.

The synchronization architecture shall conform to the recommendations in ITU-T Recommendation G.803 section 6. Where required according to G.803, the Contractor shall provide slave clocks compliant with ITU/T Recommendation G.812. Also, the synchronization using the ring shall be configured in such a way that synchronization is not lost to any loop node with any single break in the ring.

The SOH (Section Overhead) bits Z1 (b5-b8) shall be used to carry synchronization status messages as defined in the ITU-T Recommendation G.708. These status messages shall determine the source of the clock during normal and abnormal operation and shall be used to provide a robust synchronization network as described in ITU-T Recommendation G.803 section 6.2.7.

Each multiplexer shall be provided with a synchronization output interface conforming to ITU-T Recommendation G.703 section 10.

Jitter and Wander
The jitter tolerance on the STM-1 interfaces (155 Mbit/s) shall be in accordance with the ITU-T Recommendations G.825 and G.958. The output jitter shall be in accordance with ITU-T Recommendations G.783, G.825 and G.958. The jitter transfer function shall be in accordance with ITU-T Recommendations G.783 and G.958.

Channel Assignment
The multiplex supplied in the Contract shall be configured by the Contractor to provide the specified reliability for the various types of services.

The Contractor shall submit detailed multiplex design / channel assignment information to the Employer's Representative for approval prior to commencement of manufacture.

Installation
The multiplex equipment supplied in the Contract shall be installed and tested by the Contractor. Following this testing, the equipment shall be subjected to an availability test to prove compliance with the ITU-T Recommendation G.826.

1.2.9.20 Management and Maintenance

Network Management
A Network Management System (NMS) based on Open Systems architecture conforming to the ITU-T Recommendations M.3010 and G.784 shall be provided for the SDH network. This shall be provided as portable system incorporating the NMS software installed on a notebook/laptop PC together with appropriate interfaces and leads to allow the system to be easily moved between the areas covered by this Contract. Local interfaces shall be provided at each site to allow connection of the NMS.

The individual network elements (i.e. DXC and ADM units) supplied to this Specification shall be interconnected as a managed SDH sub-network according to the architecture of Figure 3.4 of ITU-T Recommendation G.784.

In connecting the network elements to form this sub-network, the data channels used shall be configured in a ring-protected arrangement so that no network management capability is lost in the event of failure of any part of the ring.

The interface to each network element shall be a Q3 interface as defined in the ITU-T Recommendation G.773.

Maintenance Functions
The Bidder shall provide details of alarms and parameters monitored in the multiplex equipment and presented to the network management interface. As a minimum, these parameters shall include those listed in section 4 ITU-T Recommendation G.736.

In addition to signaling external alarms, these fault conditions shall generate consequent actions as listed in Table 1 of ITU-T Recommendation G.736.

Control or Service Terminal
Each network element shall be provided with an 'F' interface to allow maintenance staff to locally interface to the network element with a hand held terminal or portable computer.

The maintenance technician shall be able to access locally all the information on alarms, settings and statistical information from each network element at the site. He shall also be able to change all software settings. The procedure for updating these software settings shall be designed to minimize the risk of the maintenance technician causing an inadvertent malfunction of the equipment.

The Bidder shall also provide details of measurements and settings that can be controlled on the radio with this terminal.

1.2.9.21 Telephone System

General
A modern digital Private Automatic Branch Exchange (PABX) shall be provided for each substation and switching station. Each PABX shall be inter-connected via 2Mbit/s G.703 E1 digital trunks over the SDH network.

The PABX shall be fitted with a 4-wire + E&M trunk to allow it to be connected to the local PSTN trunk at some time in the future, however for this project the Contractor shall supply and install two optical isolators and connect two incoming PSTN extension circuits, which will be arranged by the Employer. One PSTN extension shall be connected to a tele-facsimile (fax) machine and one to a telephone.

Telephones and Faxes
The requirements for telephones and faxes at each site are:

- Digital operator's console: 1
- Analogue telephones: At least 6 (one connected to a PSTN line)
- Fax machines: 2 (one on an internal extension and one on a PSTN line)

Telephones shall be installed at suitable locations within each station including in each office (if provided) and at the main operator's desk. A fax machine shall be installed beside the main operator's desk.

The digital operator's console for the PABX shall be located on the main operator's desk.

A structured cabling system shall be provided for the telephone network throughout the station and telephones shall be connected via suitable plug-in wall sockets located in convenient positions.

Administrative software for the PABX shall be provided and installed on the NMS PC. The necessary connection cables shall be provided. The administrative software shall allow easy configuration (adds, moves and changes) by the operator and provide an ability to collect and display error messages, traffic statistics, billing information etc.

PABX Facilities
The PABX shall have the following facilities:

- Subscriber interface
  - 16 x Analogue ports, expandable to 32 ports
  - 1 x Digital port.
- Trunk interface
  - 1 x Trunk 4-wire + E&M port, expandable to 2 ports
  - 1 x Trunk FXS-FXS (hot-line)
  - 1 x Trunk 2Mbps port expandable to 2 ports
- 1 x RS232 local maintenance communication port
- Cable as required
- Power supply: 230V AC station UPS supply, 220V DC battery supply or 48V DC communications supply

Requirements for the PABX:
Hardware
The PABX shall be of the Stored Program Control type constructed on modular principles. It shall be designed for full availability and be of the non-blocking type. It shall be constructed from components that require no routine maintenance.

The specified line and trunk expansion shall be achieved by no more than plugging in additional cards.

Software
The operating software and PABX configuration shall be stored in non-volatile memory. When new system firmware is available it shall be possible to upgrade the unit locally with the support of the configuration system supplied.

The PABX configuration software shall be supplied and installed on the computer as specified above.

Numbering Principle
The numbering capability of the system shall be flexible with at least four digit numbers being used for internal extensions and four or five digit numbers for dialing other subscribers on the telephone network.

The numbering plan shall be agreed with the Employer before implementation.

Features
The PABX equipment shall provide the following:

- Automatic connection by dialing between all internal subscribers
- Time billing for trunk calls
- Direct dial in
- Local extension to/from remote extension dialing
- QSIG (PSS1) support
- Conference call (up to 8 parties).

The operator console shall be an LCD screen based system and shall provide the following functions:

- Call hold
- Call transfer (internal and external calls)
- Break-in (intrusion)
- Call release
- Hands-free operation
- Delayed ringing
- Ability to connect hotline with telephone extensions
- Display call status information on the LCD screen

For subscribers, the following functions shall be supported:

- Personal access code for dialing outside line (PSTN network), (or otherwise external trunk access shall be provided via the operator)
- Call park/hold (camp on)
- Call forward/divert
- Call waiting
- Recall
- Direction select (call pickup)
- Speed Dialing
- Last number redial
- Hotline

1.2.9.22 Very High Frequency (VHF) Communications Systems

A VHF communication system is required for voice communications. The system allocated frequencies are 163.425MHz and 163.325MHz.

The scope of supply shall include, but not be limited to, the following:

- VHF transceiver with code calling facility
- Power supply unit for base sets
- Antenna tower, Minimum 18m, including guys, line traps, coupling devices, foundations, etc.

The transceivers shall conform to the following specifications:

- RF output power: 30 Watts nominal
- Nº of switchable channels: 6 Frequencies matching with the existing system
- Channel separation: 25kHz
- Frequency control: Synthesized
- Display: Digital LED/LCD
- Audio output: 2 Watts with less than 10% distortion
- Controls: Power, volume, channel selection, code calling, operator selectable channel scan function, etc.

The Contractor shall ascertain the height of the VHF antenna tower at all substations and switching stations after carrying out a VHF survey. The minimum height of the antenna tower, however, shall be 18m as specified above. The RF output power shall be ascertained by the Contractor after carrying out survey and design according to ITU standards.

The VHF mast shall be of galvanized steel. Aviation obstruction lights to be provided on VHF mast shall conform to the requirements of the Employer. The design wind velocity is 185km/hr.

The base antenna shall be an omni-directional ground-plane antenna. Maximum power input shall be 100 Watts with VSWR on tuned frequencies of 1.2.

The base antenna coaxial cable shall be of copper conductor polyethylene foam insulated type. The attenuation shall not exceed 1.5dB per 100 meters at 40MHz. The characteristic impedance shall be 50 ohms.

1.2.9.23 Computerized Substation Control System

General

This covers the design, manufacture, supply, installation, testing, commissioning and handing over of a microcomputer-based substation control system suitable for operation and data recording of the substations. All materials and parts that are not specifically mentioned hereinafter but are necessary for erection, assembly and operation of the equipment shall be furnished and are deemed to be included in the scope for this sub-section.

The Computerized Substation Control System (CSCS) shall be a microcomputer-based control and monitoring system and include protection functions.

A CSCS system is required for all substations.

Design and Operation

The arrangement shall follow the latest engineering practice, ensuring optimum continuity and reliability of supply and ensure the safety of equipment and the operating staff. The highest degree of uniformity and interchangeability shall be provided.

All components shall be suitable for the local climate; storage of equipment shall be possible in closed rooms without air conditioning at a maximum ambient temperature of 55°C. The system offered shall be suitable for operation under electrical conditions (including electrical discharge and disturbance levels) existing in high voltage substations.

The equipment shall be pre-assembled and pre-programmed at the Contractor's works. It is understood that all auxiliary facilities/devices and services necessary are to be provided, i.e. for generation of database of displays programming and testing, adjustments, parameter setting etc.

The design of the system shall be such that personnel without any computer background shall be able to operate the system with ease and shall incorporate user-friendly features without causing undue operational delay.

The design of the hardware and software shall be suitable for 220/110/20KV voltage levels used by the Employer to enable a standardized layout.

The CSCS shall be designed for easy modification of hardware and software and for easy extension of the substation. Maintenance, modifications or extension of components shall not require a shutdown of the CSCS. Self-monitoring of single components, modules and data transfer channels shall increase the availability and reliability of the equipment and minimize maintenance requirements. Failure of individual components shall not force a total system failure.

The entire substation shall be controlled and supervised at station level, while individual 220KV, 110KV, and 20KV bays shall also be protected, supervised and controlled from the appropriate control and relay panels. It shall not be possible to control the 220KV, 110KV and 20KV bays at the same time from the station and individual bay level.

The bay units shall be independent of each other and the operation shall not be affected by any fault occurring at the station level or in other bay units of the substation.

Each substation control system shall consist of the following main parts:

- Man Machine Communications (MMC)
- Substation Control Computer
- Serial high speed bus for data transmission between the different components via fiber optic links
- Bay Units (BU) for local control and protection
- Feeder related local control panels with mimic diagram pushbuttons and selector switches.
- 10Mbps Ethernet interface for remote communication over the SDH network.

The MMC system shall only contain information that is related to presentation and control of the substation.

Substation Control Supervision Functions

All control and monitoring functions have to provide for a secure and reliable operation of the substation, the following are the minimum functional requirements:

- Input of binary and analogue values
- Control, interlocking, protection and supervision of the bays of the substation
- Alarm handling in the bay computers and in the station computer
- Analogue value processing
- Indication of the bay and substation status
- Indication of measured and processed analogue values
- Station control via a monitor system
- Automatic chronological control of standard switching routines
- All hardware, software and telecommunication facilities for future remote control and supervision of the substation from a future Network Control Center.
- Emergency control of each bay from the related control panels
- Synchro-check functions for all breakers
- Display of trend values
- Fault indication

- Event recording
- Evaluation and archiving of historical data

Man Machine Communication System (MMC)
The MMC system shall be a high performance operator station with one operator workplace. The following functions are required:

- Presentation of user defined displays (switching status and analogue values), standard displays, trend curve displays and reports
- Effective and safe dialogues for manual control of the substation and for release of control sequence. Select before operation procedures are required
- Presentation of alarms and events on the operator's monitor and printouts on the printer

The HMI workstation shall incorporate security such that an operator has to log on by entering a user name and password before any interaction with the HMI is allowed. The system shall log any user out of if there has been no input activity for a user settable time.

The HMI computer system shall be Personal Computer (PC) based and shall include or be equipped with the following minimum features:

- High speed 64-bit Dual Xeon central processing units with processor clock speed of at least 2.66GHz, or if a RISC based processor is used, at least 1.5GHz
- Minimum of 12GB DDR3
- Minimum of 1TB Hard Disk Drive
- 2GB NVIDIA Quadro 4000
- Windows 7 Professional 64-bit
- CD Read/Write, DVD Read Drive
- One x 10BaseT/100BaseTX Ethernet LAN port
- 101 key AT-type keyboard or equivalent
- Optical mouse with at least 2 buttons
- At least one RS232C serial port
- Parallel port
- At least 3 USB ports
- High performance graphic card with a minimum resolution to 1280 x 1024 and 16.7 million colors that supports up to two monitors
- Two LCD flat screen monitors supporting up to 1280 x 1024 pixel resolution and 16.7 million colors. Each monitor shall have a viewable area measuring at least 19 inches on the diagonal
- Audio support and speakers

The MMC shall include two high-speed printers with a standard RS232 interface. The first printer shall be a black and white type for continuous listing of all events occurring in the substation. A second color printer shall be supplied for graphic hardcopies of the displays and for reports.

Both of the printers shall be compatible with the portable servicing unit specified below. The printers shall be capable of printing on single sheet A4 and shall be supplied with 40 ink cartridges for each ink jet printer and 40 toner cartridges for each laser printer. In addition, 40 reams of paper per printer shall be supplied.

The operator's keyboard shall have function keys that are configured to allow direct access to specific displays and functions. The operations procedure should be simple and easily understood.

The configuration of new displays shall be possible without taking the CSCS off line.

A DC/AC converter suitable for connection to the station battery shall supply the AC power for the MMC computer, monitor and printers.

Bay Computers

The bay computers shall be based on a microprocessor technology and a real time operating system.

The bay computers shall perform all bay internal programs, command sequences, collection of signals and information, outputs of commands and signal processing including the processing of the signals from the protection system required for the different switchgear units of the corresponding bays.

Generally the following tasks shall be performed:

- Signal acquisition including signals from protection systems
- Acquisition of measured and counted values
- Monitoring of execution of commands
- Data pre-processing
- Data communication to the station computer and connected subsystems
- Calculation of derived operational measured values
- Generation of group signals
- Self-monitoring routines

Power supply to the computers shall come from the station battery. The bay computers are placed together with all necessary input/output equipment in panels in the relay room of the substation control building.

Emergency control is defined as control without electronic assistance. In this status other control of this bay is without interlocking. The emergency control requires a special key. Normal control of the bay from the station computer shall be disabled, if the emergency select key is in the emergency operation position.

The electronic system shall be provided with functions for self-supervision and test. Each circuit board shall contain circuits for automatic testing of its own function. These circuits shall interact with a test and diagnostic program controlled by the central unit.

Faults in a unit have to be indicated by the illumination of a red LED on the front edge of the unit. The time for fault tracing and replacement of a faulty unit shall be reduced to a minimum. The supervision shall also comprise the power supply system, the internal system bus and the ability of the central unit to communicate with different circuit boards.

The power supply system shall have test terminals for all voltages used in the system.

The function and design of the switchgear interlocking systems shall be extremely reliable and safe. Perfect collection and processing of all switchgear position of the whole substation must be ensured at all times and unclear information, such as intermediate switchgear positions, switchgear faults, faulty data transfer etc., must never allow switching operations. Control regulation and synchronizing functions shall require perfect collection and processing of all substation information. The information must be up to date and valid. Mal-operation of control and regulation facilities such as on-load switching of an isolator, switching on in an asynchronous state etc. shall be avoided. When the station level control and indication facilities fail, back up control shall be possible.

Station Computers
The CSCS shall include a computer for supervisory functions. This computer shall be equipped with a high performance microprocessor and a real time operating system.
The station computer shall have access to all sub-systems at the bay level, collect signals and information, issue commands and perform the signal processing required for the substation.

The computer shall be placed together with all necessary input/output equipment in panels in the control room. 220V DC from the station batteries shall supply the computer.

LEDs shall indicate the status of the respective circuits on the front of each input/output module of the station computers.

CSCS Communication System
Data shall be transmitted between bay and station computers by high-speed fiber optic data bus.

Presentation, Supervision and Control
The CSCS shall be equipped with two monitors, which are connected to the station computer.
Display selection, parameter setting, alarm acknowledgement, selected printouts of reports and command outputs shall be performed from the operator's keyboard.

The system offered has to distinguish between alarm lists and event lists, selectable on the monitor by the operator. As well as the lists on the screen, there shall be a chronological print out of any alarm or event in an event log.

An acoustic alarm shall sound to indicate abnormalities (alarm conditions) and all unacknowledged alarms shall be presented on any screen selected by the operator. The alarm shall be silenced by keyboard or pushbutton action.

As a minimum, the following items shall be presented by the CSCS:

- Station diagram showing the switching status of the substation
- Diagrams of the different voltage levels
- Substation overall alarm lists
- CSCS internal alarm list
- System status list
- Substation overall event log
- Section event list
- Event and alarm log
- Trend graph showing critical station parameters such as import/export power and bus voltages

Station Diagrams and Station Control
The operational status of the substation, measured values of currents, voltages, active and reactive power flows are to be presented on the displays. The station displays shall present diagrams for each substation voltage level.

One display shall be able to show a single line with all the relevant data. The displays shall not take longer than 2 seconds to be updated, after selection by the operator. Layouts of the displays are subject to the approval by the Employer; the Employer's Personnel shall also be trained so that they can reconfigure the single line diagram.

To ensure a high degree of security against unwanted operations, a special operation procedure requiring "select before execution" shall be provided. After "selection" the operator shall be able to recognize the selected device on the screen and all other switching devices shall be blocked.

The computer shall check the interlocking conditions. The operator can only execute the command if the device is not blocked and interlocking conditions are not violated. After command execution the operator shall receive a message, either about the new switching position or that the switching operation has been unsuccessful or has been refused.

An integrated voltage-check and synchro-check function shall also be provided (separate from that used for auto-reclosing) for manual closing of the circuit breakers. The voltage-check function shall include live-bus/dead-line conditions, dead-bus/live line conditions and dead-bus/dead-line conditions.

It shall be possible to set or sect any combinations of these conditions that will allow closing. For live-bus/live-line conditions the synchro-check function shall take precedence.

The synchro check function shall allow circuit breaker closing only if the voltages on both sides of the breaker fulfill the pre-set conditions as to magnitude, phase and frequency difference. The voltages shall be considered in synchronism when their phase angles are measured to with the angle adjustable from 20 to 60 degrees (min.). During synchronizing a closing order shall only be accepted, if the synchronizing conditions are fulfilled.

Alarm List

Faults and errors which may occur in the substation have to be tabulated in the substation alarm list and have to be processed in order to allow them to be transmitted in future to the Network Control Center. The alarm list shall replace a conventional alarm table. The alarm list shall constitute an actual evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults.

Date and time of occurrence shall be indicated. The time shall be displayed beside each alarm.

The operator shall be able to select pictures which contain only a section or subsection of the substation overall alarm list. The operator shall be able to acknowledge alarms at the keyboard. Acknowledged alarms shall be marked in the list.

Faults that appear and disappear without being acknowledged shall be specially marked in the alarm list. The alarm list shall be presented on the display screen. It shall be possible obtain hardcopy on the printer.

CSCS Internal Alarm List

The CSCS shall constitute an actual evaluation of internal CSCS alarms, e.g. of defective CSCS input/outputs or defective CSCS communication nodes. It shall contain unacknowledged alarms and persisting faults.

System Status List

The system status list shall show the CSCS configuration and the status of all devices in CSCS system.

Event List

The substation event list shall contain events that are important for the control of the substation, e.g. "Circuit Breaker Closed". The time has to be displayed before each event. The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it. A printout of each display shall be possible on the hardcopy printer.

The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. The latest 600 events shall be stored in the computer. Previous information shall be obtainable from the printed event log. The chronological event list shall contain:

- Control operations initiated by the operator
- Indication of change of position of circuit breakers, disconnectors and earthing devices
- Indication of protective relay operations
- Fault signals from the switchgear
- Changes in the upper/lower limits of analogue measured values

Event and Alarm Log

The event and alarm log shall consist of the spontaneous listing of events and alarms on the event printer. This log shall contain the same events as mentioned above, but chronologically printed as soon as they occur. Additionally, the event log shall contain all alarms, with the time of each occurrence. Each alarm shall be configurable, so that a second alarm message can be printed if the alarm disappears. Events which occur when the printer is off-line (e.g. because of being out of paper) shall be queued in the computer until the printer is again available.

Quantity of Input and Outputs

The signals to be primarily handled are at the 220KV, 110KV and 20KV level, as indicated by the station single line diagram. The following signals shall be considered as a minimum:

- Binary inputs (single indications):
  - 8 per circuit breaker
  - 5 per disconnector
  - 4 per earthing switch
  - 16 per line feeder from protection
  - 6 from busbar protection; (220KV only)
  - 50 general auxiliaries for the whole substation
- Binary outputs (single commands):
  - 2 per circuit breaker
  - 2 per disconnector
  - 2 per earthing switch
- Analogue inputs (8 bit measurement):
  - 3 voltages per respective busbar sections
  - 3 voltages per line feeder
  - 3 voltages per transformer feeder
  - 3 currents per line feeder or bus-coupler
  - 1 active power per line feeder
  - 1 active energy counter per line feeder
  - 1 reactive power per line feeder
  - 1 reactive energy counter per line feeder
  - 3 currents per transformer winding
  - 1 active power per transformer
  - 1 active energy counter per transformer
  - 1 reactive power per transformer
  - 1 reactive energy counter per transformer

The measurement transducers shall be integrated in the CSCS at the bay level. In place of transducers, analogue values may be obtained via serial data link from protection relays, intelligent power monitors or other Intelligent Electronic Devices (IEDs).

Power Transformer
All the status indications, binary outputs and analogues supplied with the power transformer and on-load tap changer shall be made available to the CSCS and allowed for when sizing the CSCS, including:

- Temperature alarms and trip signals
- Oil temperature alarms and trip signals
- Buchholtz trip
- Group alarms from MCB in the local control cubicle
- Status of the cooling fan groups etc.
- Tap position of the tap changer
- Commands for raising and lowering the tap position etc.
- Local/remote
- Master/Follower

The measurement transducers shall be integrated in the RTU at the bay level, e.g. in the relay panel associated with the bay. The CSCS shall be capable of continuously trending a minimum of 20 data items selectable by the operator.

Servicing, Testing and Programming Equipment
Three portable servicing, testing and programming units shall be supplied. They shall be based on a standard laptop computer and portable printer. The portable servicing units shall be used for application programming, documentation, testing and commissioning. The portable servicing units shall be supplied with a CD ROM burner, 1000 CD ROM blank discs, and three 56 KBPS Modems. Any specialist software required shall be supplied free of charge, the specialist software shall include any future upgrades, user fees, support fees and license fees.

The laptop-based portable servicing units shall be used for the following purpose:

- Program entry
- Program testing
- Fault tracing
- Program amendment
- Graphical program documentation
- Uploading and downloading of programs including CMOS etc.
- Commissioning
- Reading of values in the data base
- Changing peripheral parameters
- Programming/reprogramming of RTUs if software configurable

The portable servicing units shall permit the user to study changes in the substation. The units shall be able to monitor data in the CSCS while the system is in use and to present changing variables on the display screen, selectable in a tabular or graphical format. The portable servicing units shall be supplied at the beginning of the commissioning period and be available for training of the Employer's personnel.

The programming entry procedure shall be based on a graphical user interface that provides the operator with visual control of the work.

The portable servicing units shall deliver alphanumeric and full graphical documentation of the work such as printouts of the application program in graphical form.

Both of the event printers of the MMC shall be compatible with the portable servicing unit. The event printers shall be capable of printing on single sheet A3 and A4 and shall be supplied with 40 ink cartridges (or toner cartridges) each, and 40 reams of paper per printer.

The engineering ports of all IEDs (protection relays, fault recorders, voltage regulators, RTUs, CSCS etc.) shall be connected via a serial network so they can be remotely interrogated from the Network Control Center when it is commissioned. A suitable interface with the SDH communications equipment shall be provided for this purpose. For example, one or more Terminal Servers may be provided on the Ethernet LAN.

Software Capabilities

The software shall consist of basic software modules and standardized supplementary function modules, the parameters of which can be changed depending on the layout and operational concept of the substation, as the operation and configuration of the substation may change over time. The software shall be either UNIX or LINUX based; or alternatively, MS windows operating system, with Windows 7 Professional 64 bit or latest Windows Server.

Security of control selections is of paramount importance and every precaution shall be taken in the software and hardware design to ensure that spurious control operations are rejected by the system and cannot occur. Failure of communication (partial, total, intermittent or permanent) shall not lead to erroneous control actions. Noise, either spuriously occurring or injected manually into any communication link, shall not lead to a false control action.

The system software shall be standard software that has been in use by other customers.

The system shall restart automatically after failure or loss of supply voltage, and no real time data collected up to the time of power failure shall be lost. After restart, the system shall automatically boot up into operational mode. It shall be possible to test the CSCS while the substation is live and being controlled by the CSCS. The testing shall not present any hazards to the safe operation of the substation. Test facilities shall include functional and data tests.

The following software programming shall be deemed to be included in the scope of supply of the equipment and services as a minimum:

- Design of the data base including entering all substation data
- Design of one overall display representing the substation
- Design of the displays for each voltage level
- Design of a detailed display for each individual bay
- Design of a display for station auxiliaries.

Station Interlocking and Control Sequence

The control program shall make it easy to reconfigure the system by adding new feeders (lines, transformers etc.) and future modification and extension of the station shall be possible without interference with the operation of other parts of the installation (e.g. moving of existing feeders including all parameters and settings to enable installation of new feeders).

The interlocking concept shall be as follows:

- The disconnector shall be operable only when the relevant circuit breaker is in the off position and the relevant grounding switch has been removed. Busbar change over shall be possible with the busbar isolators and bus coupler in the closed position without power supply interruptions
- The earthing switch is operable only when all related disconnectors have been opened and the circuit is dead (i.e. no voltage)

- Closing of circuit breakers shall only be possible when the relevant grounding switches have been removed and the protective relays and corresponding lock-out relays are not actuated or if they are actuated, the faults have been cleared and the respective lockout relays have been reset
- When a pressure drop signal is received from gas monitoring devices for SF6 circuit breakers, the tripping and closing signal shall be locked out
- The interlocking system is to be designed in such a way that testing is possible during normal operation of the CSCS

Station Metering
The CSCS shall be connected to the digital outputs of the station metering equipment. The station computer software shall include the same software used in the laptop PC supplied for metering analysis. In future the automatic transmission of metering data to the Network Control Center as well as remote setting of meter parameters shall be possible.

Program for the Delivery of Hardware and Software
Before starting the manufacture of the CSCS equipment complying with this specification, the following shall be supplied as early as possible to the Employer:

- A functional design specification (FDS) which describes in detail the equipment and the functions of the system to be installed
- A program for FAT (Factory Acceptance Testing)

Both these documents shall be supplied for approval by the Engineer. Their purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes testing to the degree required before the equipment leaves the factory.

In addition to the above, further documents shall be submitted to the Engineer for approval (e.g. the layout of all the station displays, the data base list and the documentation of the software) in the form of graphical diagrams. No factory acceptance tests shall be allowed without the approval of the FDS and the FAT.

Documentation
The hardware and software documentation shall comprise of but not be limited to hard copies and soft copies of the following:

- Front view and side view of all different cubicles (front and side elevations)
- Circuit diagrams for cubicles
- Apparatus lists for cubicles
- Connection tables for cubicles
- Data base listings
- Manuals for the MMC
- Manuals for the station and bay computers
- Programming manuals

All system hardware and software documentation and all the application hardware and software documentation shall be supplied in the English language.

Time Synchronization
Accurate time synchronization shall be provided for all IED internal clocks including the CSCS, the HMI workstation, the Bay level controllers, fault recorder, protection relays and any metering clocks.

The real-time clock or clocks within each device shall be synchronized to within 1mSec of Afghani time (UTC + 04:30:00.000) by a GPS clock provided at each substation and switching station. The GPS clock shall be connected to a suitable GPS antenna installed on the roof of the control building or at another suitable location providing adequate visibility to GPS satellites.

The GPS clocks shall also provide both unmodulated and amplitude modulated IRIG-B signal outputs which can be used for time synchronization. If necessary, a Network Time Protocol server (NTP server) is to be provided to synchronize devices on the substation LAN.

Proof of Quality
Only experienced and technically capable manufacturers of Control and Protection Systems will be accepted. In order to establish their capabilities, the Bidder is required to present the following documents with their bid:

- Block and functional diagrams showing the proposed control scheme
- Technical specifications and descriptions of systems, catalogues of equipment and devices to be used
- Brochures and references of the manufacturer supplying the CSCS
- A list of references of similar CSCS systems installed in the last 5 years

1.2.9.24 Remote Control

Philosophy
New substations and power stations shall be supplied with a built in SCADA interface, Synchronous Digital Hierarchy (SDH) communications equipment, and telephone equipment. The SDH equipment shall be connected to outgoing fiber optic cable and commissioned to communicate with other substations being supplied under the same contract. The stations shall be configured so they integrate with the overall NLCC SCADA and communications systems.

Interface to the Future Network Control Center
An interface shall be provided to connect to the future Network Control Center (National Load Control Center). This shall be achieved by either providing a physical RTU or by providing a virtual RTU within the Computerized Substation Control System (CSCS). Connection to the Network Control Center will be by 10 Mbps Ethernet over the SDH communications system or via serial data communication over Power Line Carrier if provided.

It shall be possible to fully remotely control and monitor each substation from the future Network Control Center. All control and supervision signals available to the local CSCS HMI workstation shall potentially be available to the remote control center interface, and selection of the required signals shall be by no more than configuration of a mapping table or equivalent within the CSCS.

The CSCS shall support both, and be equipped with at least one of the following data communications protocols for the remote interface:

- IEC 60870-5-101/104
- DNP 3.0 (Level 3 implementation)

Note that the NLCC will be responsible for the 220KV and 110KV HV system, going down to the 20KV MV circuit breaker/disconnector of the HV/MV transformer.

Minimum SCADA Interface Signals

The following remote interface signals shall be provided as a minimum:

A. Digital inputs:
   - 8 per circuit breaker (status - 2 bits, remote control available, alarms) – HV CBs and MV incomer CB only
   - 3 per disconnector (status - 2 bits, remote control available) – HV DISs and MV incomer DIS only
   - 2 per earth switch (status - 2 bits)
   - 16 per line feeder from line protection
   - 5 per transformer from transformer protection
   - 6 from busbar protection (220KV only)
   - 20 communication system status and alarms
   - 50 general auxiliaries for the whole substation (typically auxiliary AC and DC system status and alarms, fire alarm, intruder alarm etc.)

B. Digital outputs (commands):
   - Open/close per circuit breaker – HV CBs and MV incomer CB
   - Open/close per disconnector – HV CBs and MV incomer CB

C. Analogue inputs:
   - 3 voltages per respective busbar sections
   - 3 voltages per line feeder
   - 3 voltages per transformer feeder
   - 3 currents per line feeder or bus-coupler
   - 1 frequency per busbar section
   - 1 active power per line feeder
   - 1 active energy counter per line feeder
   - 1 reactive power per line feeder
   - 1 reactive energy counter per line feeder
   - 3 currents per transformer winding
   - 1 active power per transformer
   - 1 active energy counter per transformer
   - 1 reactive power per transformer
   - 1 reactive energy counter per transformer.

All the status indications, binary outputs and analogues supplied with the power transformer and on-load tap changer shall be made available to SCADA including:

- Winding temperature and temperature alarms and trip signals
- Oil temperature and temperature alarms and trip signals
- Buchholtz trip
- Group alarms from MCB in the local control cubicle
- Status of the cooling fan groups etc.
- Tap position of the tap changer
- Commands for raising and lowering the tap position etc.
- Local/remote status
- Master/Follower status

1.2.10 Civil Works

1.2.10.1 Execution of Works

The civil works shall include all necessary supply of equipment and materials, design, construction, excavating, refilling, etc. to complete a functioning substation. The civil works shall include the following main parts:

- Forming of the site to ensure correct surface drainage
- Leveling and compacting of substation area
- Gravelling of the complete substation area
- Install control building, office, workshop, storage room, battery room, kitchen and toilet
- Install air conditioning and heating equipment for the control building
- Install water well and storage facility; wastewater and septic tank facility
- Install drainage system for the complete substation area
- Excavation and backfilling as required
- Construct new internal roads
- Construct fences and gates
- Construct new oil interceptor tanks for all transformers
- Construct concrete foundation for all apparatus
- Construct steel structures and apparatus supports as required
- Construct concrete fire protection walls each side of all main transformers

Leveling of Site
A removal of top soil shall be carried out down to a minimum depth of 0.5m.

The Contractor shall level the area by excavating the high areas and filling and compacting the low areas. Any soft soil or other material unsatisfactory for the leveling work shall be excavated and removed from the Site.

After the bulk excavation and the filling and compacting works have been carried out, the Contractor shall remove any remaining high spots and fill in any depressions so that before the commencement of any construction work, the whole of the area has been leveled to the requisite ground level to the satisfaction of the Employer.

All necessary retaining walls shall be included in the contract.

Setting Out
Before any excavation of filling work begins, the Contractor shall set out accurately all excavation and filling lines according to the drawings and shall satisfy himself as to the correctness of all site levels shown on the drawings. During the work, the Contractor shall ensure that the excavation and filling follow the said lines and the Contractor shall set out as necessarily as the works precede, profiles and other markers for leveling purposes and he shall be in agreement with the Employer about the levels of the said profiles and markers.

Excavation
The Contractor shall excavate the ground to the lengths and widths and exact depths as indicated on the drawings required for the construction of the works. In cases where the bearing capacity of the subsoil under foundations or roads is insufficient, the excavation shall be continued to such greater depth as may be necessary. Based on the existing ground water level, the foundations shall not be deeper than necessary. All excavation may be carried out mechanically, but the final shaping and trimming of the sub-grade below foundations, etc. shall be done by hand. The Contractor shall handle and remove as necessary all water from a whatsoever source which may

come into the excavations and he shall provide, maintain, and remove on completion all planking, strutting, shoring or piling required to support the sides of the excavation.

The Contractor shall report all cases of unsuitable or weak ground to the Employer and shall follow the instructions given by the Project Manger during the excavation works. If due to negligence or mistakes on the part of the Contractor any excavations be taken to a level lower than that shown on the drawings or stated in the specification or required for the works, the Contractor shall at his own cost fill in the voids so formed to the proper level with approved fill material well compacted or, if necessary, under foundations and the like with approved blinding concrete.

Filling and Compacting

Filling of areas and around foundations and backfilling of trenches shall be executed in such a way and to such extra depths as will ensure that final surface after settlement and compacting conforms to the specified levels. All filling material shall be free from cinders, ashes, refuse vegetation or organic material, boulders and other unsuitable material.

All fill material shall be well compacted by mechanical means until a high degree of compacting is obtained. The filling material shall be placed in even layers of a depth not greater than 0.4 m and each layer shall be thoroughly compacted. A suitable power-driven roller of at least 5 tons weight, making at least 10 passes for each layer shall be used. For backfilling of narrow and steep sections, the thickness of each layer shall be maximum 150 mm, each layer being compacted to required density by using a vibrating plate compactor. Filling and compacting around any pipes, cables or ducts shall be done by hand using selected materials for a depth of at least 0.5 m above such pipes, cables or ducts.

The Employer's instructions regarding the addition of water to improve compacting of fill must be adhered to. For fill under roads and foundations every effort shall be made to compact the fill material at its optimum moisture content for compacting. In any case, the dry density of the compacted soil shall not be less than 95% of the maximum density according to ASSHTO T180.

The complete substation area shall be surfaced with a 100 mm layer of crushed aggregate, size 32mm-64mm.

Leveling

Depending on the ground socket level, leveling to the surroundings might be needed. The slope of such shall be between 1:100 and 1:50.

Disposal of Surplus

The Contractor shall remove from the Site all surplus soil or other excavated material not required or not suitable as fill material. Such material shall be transported to spoil dumps located as agreed upon with the Employer.

1.2.10.2 Drainage

The Contractor shall install an adequate drainage system for the new substation area. Building down pipes shall be connected to the drainage system. Open ditches are not allowed within the substation area.

The drainage system shall be designed for the relevant local climatic conditions.

1.2.10.3 Roads

The Contractor shall arrange for roads in the new switchyard for transport of the transformer to the transformer cell and for passage of a car to the control building. The roads shall be about 6 m wide and shall be surfaced with asphalt or concrete.

Irrespective of the type of bituminous surfacing proposed, a prime coat of at least 0.8 liter/m^2 shall be uniformly sprayed to penetrate and seal the surface of the base course.

Concerning the wearing course, the Contractor may propose a double seal coat or premixed asphaltic concrete. The proposal shall account for rates and types of bitumen and aggregates, plant and method of application.

The allowable tolerances are as specified in Table 1.2.6.

Table 1.2.6 Substation Road Tolerances

Description	Specification
Thickness	+6mm - 0mm
Level	±20mm
Maximum deviation	-6mm from a 4m straight edge.

1.2.10.4 Foundations

The foundation for the transformers shall be constructed in reinforced concrete, with space for the whole oil volume of the transformer under the crushed aggregate and steel grating.
Transformers shall be separated by a fireproof wall.

Foundations shall normally be placed on virgin soil or well-compacted fill.

If excavation has been performed to greater depth than required, sand or gravel shall be placed at bottom of the pit to bring the excavation to the required elevation. Such material shall be placed and compacted in layers not exceeding 100mm. Excavation pits shall be kept dry during construction and erection of foundations. Backfilling of the pits shall not be carried out until the Employer has inspected and approved the foundation.

Excavated soil may be used as backfill if it is suitable for compacting. Rock and soil that is not suitable for compacting shall be removed and replaced with a suitable backfill to the satisfaction of the Employer. Backfill shall be placed in layers approximately 150mm thick. Each layer shall be carefully compacted by means of a suitable plant.

1.2.10.5 Buildings

General
The rooms shall have painted concrete floor with a sufficient extent of cable channels for installation of control and auxiliary power cables. All cable penetrations in floor and walls shall be sealed with fire resistance material. All cable penetrations in outer walls shall be protected against the ingress of water.

Design
The substation building shall be constructed of reinforced concrete for beams and pillars with brick walls. The construction shall have good thermal isolation to minimize the need of air cooling. Internal walls shall have a fire resistance for 60 minutes.

The penetration seals between these rooms shall also meet this requirement. All air inlets and outlets shall be provided with applicable filters to avoid pollution of the rooms. The outer doors and windows shall be sealed. The design shall provide enough space for erection, operation, service and maintenance of the substation as well as for the future expansion of the control equipment with 100%.

The floors shall be steel toweled and painted in an approved manner with resistant epoxy paint. The internal wall and roof surfaces shall be painted in an approved manner with suitable plastic paint. The external walls shall be painted in an approved manner with suitable plastic paint. Walls below ground surfaces shall be painted with bituminous coat. The quality and colors as well as the application of the paints shall be approved by the Employer. The Contractor shall submit detailed information, samples and the manufacturer's recommendations for the paints for approval. The painting shall be carried out in an efficient and professional manner to the satisfaction of the Project Manager.

Down pipes shall be provided to lead the rain water from the roof to drainage which shall be adequate to prevent water from entering the building and from the formation of pools on the ground near the building.

Lockable doors, complete with frames, shall be provided. They shall have the same fire resistance as the walls. The doors shall be dimensioned for transport of goods even after the completion of works.

Installations

In order to maintain a temperature in the building below +25°C, air conditioning of wall unit type shall be installed in the control room. The air-conditioning units shall be divided into several units to provide redundancy.

The floor in the battery room shall be provided with a gully made of stainless steel, connected to the sewage pipe.

The floor surface shall have adequate sloping towards the gully and to be covered by tiles. The battery room shall be provided with one exhaust fan with jalousie (louvers) and air inlet with grill and filter.

1.2.10.6 Fire Protection Walls

Fire protection walls are protection against heat radiation, which means they prevent the NARPad of fire and damage of plant and equipment in the neighborhood. The fire protection walls shall be designed according DIN VDE 0101 or equivalent.

1.2.10.7 Fences and Gates

Fences

The Contractor shall design, furnish and install a masonry fence and gates around the whole substation area.

Masonry walls, 600mm thick, shall be constructed around the perimeter of the site.

Any roads inside the compound shall be at a standoff distance of no less than 3.0m from the inside face of the perimeter wall.

The walls shall be reinforced with rebar.

The walls shall be concrete reinforced with native stone masonry veneer.

The height of the walls shall measure at least 2.2m from the inside grade. Inside grade shall in all cases be higher than outside grade.

The wall shall be capped with a cast-in-place concrete capping.

Outriggers shall be installed to support barbed wires and 2 strands of concertina style razor wire.

The ground grade shall slope away from the wall for at least 5m and shall be kept a minimum of 2.2m below the top of wall for a minimum distance of 10m.

The wall shall be designed to prevent visual access to the inside of compound by all pedestrian and vehicular traffic outside the compound which may require the wall to be built at a higher level in some locations.

Any penetrations through the Perimeter Security Wall shall only be for site drainage purposes and shall have force protection such as a welded bar grill, welded grating, or other pre-engineered barrier.

Details of any penetrations shall be produced by the Contractor and provided in the design drawings.

Entry Control Point Gates – Swing Gates
Swing gates shall be designed and constructed as follows:

- Gates shall be K4 swing type.
- Gate shall be a minimum 2.2m tall, with 0.5m of high tension razor wire mounted on top.
- Gate shall be constructed of steel tubing, faced with steel plate.
- The design and construction of the gates shall insure that it is dimensionally stable, square, true and planar.
- Gate shall not rack or deflect when open, closed, or in motion.
- The Contractor shall provide a locking mechanism that holds the gate closed.
- The swing gate will also have a built- in personnel gate with its own locking mechanism

Optional Chain Link Fencing
At the option of the Employer, chain link fencing and gates may be substituted for masonry walls and steel sliding gates as follow:

The Contractor shall design, furnish and install a chain link fence and gates around the whole substation area including three numbers of 4-point galvanized barbed wire at the top. A bottom tension wire shall be provided. All parts of the fence shall be corrosion resistant, galvanized or aluminum.

The chain link shall have a mesh width of maximum $50mm^2$ and each wire shall have a minimum failure load of 2,000 N. Straight line posts shall have a minimum bending failure load, applied horizontally on the top, in the most unfavorable direction, of 600N. Top and bottom tension wires shall have a minimum failure load of 5,000N. In case of 2.5m or higher chain link, the top wire shall be substituted by a top rail. Barbed wires shall have a minimum failure load of 3,000N.

There shall be one main gate with one smaller gate for personnel passage. The main gate shall allow for passage of a truck, both gates shall have provision for securing by padlock. Fence posts and gates shall be set in concrete foundations of adequate strength.

Straight line posts shall have a spacing not exceeding 3m. Guyed tension posts shall be inserted each 50m along straight lines. End and corner posts shall be adequately braced. Straight line posts shall have 800mm – 1,000mm deep foundations, either a 6 inch concrete tube filled with concrete, or a directly cast foundation, at least 200mm wide. Foundations for corner or end posts shall extend minimum 1,000mm below surface and consist of either a filled 9 inch concrete pipe, or be a directly cast foundation, at least 300mm wide. The main gate shall be designed with a reinforced concrete foundation connecting both posts.

To prevent small animals from entering the substation, the space between the bottom of the chain link and the ground surface shall be filled in by a concrete curb, either consisting of prefabricated slabs or cast at site.

To prevent dangerous touch voltages, a 35mm^2 copper wire shall be buried 1 m outside the fence and 0.5 m deep. Connections between the fence and the encircling earth wire shall be made each 15m. All corner and gateposts shall be separately connected. The encircling earth wire shall be connected to the station grounding grid.

In case of an insulated (plastic coated) fence, the encircling earth wire may be omitted. Only gateposts will be connected to the station grounding grid. The top and bottom wires (or top rails) will be divided in 50m sections fully insulated from each other.

1.2.10.8 Switchyards

The layout of the 220KV and 110KV switchyards shall allow for future extensions.

The Contractor shall design and mount steel gantries with supported rigid tubular busbars of a suitable design for the 220KV and 110KV switchyards. The gantries shall be suitable for the incoming 220KV lines.

Each 220KV gantry bay shall withstand a load of one three-phase 220KV overhead line of equivalent 2 x 428mm^2. Aluminum ACSR wire, with a slack span of up to 150m. Each 20KV terminal pole shall withstand a minimum load of one three-phase 20KV overhead line of 158mm^2 ACSR conductor, with a slack span of up to 80m.

The 220KV and 110KV rigid tubular busbars shall be supplied with steel supports, conductor, insulators and accessories. The scope also includes bolted termination clamps and termination arrangements for all outgoing 220KV circuits.

The gantries and busbars shall be designed to ensure adequate clearance to other equipment, transmission lines, distribution lines, vehicles and personnel inside and outside the substation area. The poles used outside the substation area will support the 20KV distribution lines at 9.5m above ground level.

1.2.10.9 Lightning Protection

The 220KV, 110KV and 20KV switchyards shall be protected against lightning by providing earth wires or lightning rods on the strain portals for the busbars and the overhead lines. The lightning protection wires (earthwire0 wire) of the incoming lines shall terminate at strain portals (gantries) of the switchyard. The protected zone shall include all switchgear and transformers.

The earthing facilities necessary for lightning protection shall conform to DIN VDE 0141 or equivalent, with particular attention paid to the requirements for lightning protection in outdoor switching stations (e.g. back flashover). Lightning conductor wires and lightning rods shall be corrosion resistant.

1.2.10.10 Control Building

The control building shall include one room for the relay panel and the AC/DC equipment, a battery room, a storeroom and workshop, an office, a kitchen and a WC/Bathroom. There shall be spare space to extend the control relay panels by up to 100%. The entrance into the store and the battery room could also be from outside.

A desk, a chair and a bookshelf shall be placed in the control room as well as in the office room.

1.2.11 Testing

1.2.11.1 Workshop Testing

The type and routine tests described in the IEC recommendations shall be applied, but type tests may not be required if the Contractor can produce evidence of such tests having already been satisfactorily completed on similar equipment.

1.2.11.2 Tests on Completions

The procedures for the Tests on Completion shall be based on applicable standards and codes of practice and recommendations from manufacturers, and shall be specified by the Contractor in a separate document. The procedures are subject to the Employer's review. The extent of the Tests on Completion is tentatively summarized below.

A general check of the entire switchgear and ancillary equipment shall be made and shall include a check of the completeness, correctness and condition of earth connections, labeling, painted surfaces, cables, wiring, pipe work, valves, blanking plates and all other auxiliary and ancillary items.

Checks shall be made for oil and gas leaks and that insulators are clean and free from external damage. A check shall be made that loose items that are to be handed over to the Employer (e.g. blanking plates, tools, spares) are in order and are correctly stored or handed over. Shutters, earthing procedures and the interchangeability of components shall be checked. All interlocking arrangements both electrical and mechanical shall be fully checked and tested.

1.2.11.3 Power Transformers

After completed erection, the transformer shall be inspected and tested as follows:

- Visual inspection for oil leakage and correct erection
- Insulation test of high and low voltage windings, cables and accessories
- Functional check of all accessories, including transformers guards, level and temperature indicators, tap changer and heating elements
- Oil test
- Visual inspection of oil level, dehydrating breather, valves, control cabinet, electric clearances between live parts and earth, earthing connections

1.2.11.4 Switchgear and Controlgear

Circuit Breakers:

- Circuit breakers shall be visually inspected
- Contact resistance tests shall be carried out
- Operational tests will include local and remote trip/close
- For SF6 circuit breakers, testing is required on the gas system to prove the gas quantity, its dryness and its dielectric strength. The gas leakage shall also be measured

Disconnectors, Earthing Switches and Auto-Reclosers:

- Auto-reclosers, disconnectors and earthing switches shall be subject to operation tests to confirm contact pressures, contact resistance, simultaneous operation of all phases and the ease of operation
- Checks shall be made of the local and remote indications and operation of auxiliary contacts
- Checks shall be made of the interlock system, both electrical and mechanical, between the disconnectors and earthing switches

Voltage and Current Transformers:

- Insulation tests at 1,000 volts to earth and between windings
- All voltage transformers shall be checked for polarity phasing and for secondary output
- Burden, ratio and polarity check of all current transformers shall be carried out

Surge Arresters and Surge Counters:

- Surge arresters and surge counters shall be inspected including installation and earth connection tests

Conductors and Connections:

- Flexible connections shall be tested to ensure that the correct tensions, sags and clearances will be maintained over the range of environmental conditions and loads without stress to other equipment. If dynamometers are used to check the sags and tensions, they shall be checked both before and after use
- Conductivity tests are required without any exception on all connections and joints that are made on site
- The required torque shall be checked with a torque wrench for all bolts and nuts

Earthing System:

- Tests shall be made on the effectiveness of the bonding and earthing which will include conductivity tests on selected joints and at the connections to equipment and structures. Checks shall also be made and precautions taken to avoid corrosion on the earthing system
- The resistance of the earthing system to earth shall be tested and recorded including the method and equipment used to carry out the tests

Test of Wiring:

- Insulation resistance tests at 1,000V AC for one minute shall if possible be carried out on all AC and DC protection, control, alarm, and indication circuits to ensure that wiring is in satisfactory condition. Visual inspection shall be made on cable glands, cable jointing, fuse or circuit breaker ratings and small panel items such as indicating lamps
- Static equipment which may be damaged by the application of test voltages shall have the appropriate terminals short-circuited
- Inter-relay, inter-unit and cubicle wiring carried out at site is to be checked to the appropriate circuit and/or wiring diagram. This may be done by using bells or buzzers. DC supplied from the station battery may also be used. Where it is found necessary during pre-commissioning work to effect site modifications to the secondary wiring, site copies of the appropriate schematic and wiring diagrams shall be suitably marked as agreed with the Employer before the circuit is commissioned

- Loop resistance measurements are to be made on all current transformer circuits. Separate values are required for a current transformer and lead resistances and all measurements are to be recorded on lead resistance diagrams

Test of Relays:

- All relays are to be examined to ensure that they are in proper working condition and correctly adjusted, correctly labeled, and that the relay case, cover, glass. and gaskets are in good order and fit properly
- Secondary injection shall be carried out on all AC relays, using voltage and a current of sinusoidal wave form and rated power frequency. For circulating current protection employing high impedance voltage operated relays, the points of injection for relay voltage setting tests shall be across the relay and stabilizing resistance.
- The operation setting for the type of protection is to be established by secondary injection where it is impractical to ascertain this value by primary injection. Injection is to be made across the appropriate relay bus wires with all associated relays, setting resistors, and intermediate current transformers connected
- Fault setting test to establish the value of current and voltage necessary to produce operation of the relays. These tests are to be carried out by secondary injection applied at the current transformer terminals

Test of DC Circuits:

- Tests are to be carried out to prove the correctness of all DC polarities, the operating level of DC relays and the correct function of DC relay schemes, selection and control switching, indications and alarm

Test of Instruments:

- Instruments and instrument transformer circuits shall be checked for polarity of direction and for calibration including any interposing transformers or transducers. These checks shall be made on all current transformer ratios where applicable

1.2.11.5 On-Load Tests

On-load tests are required but due to the hazards inherent, they shall be carried out under the direct supervision of the Employer. The following tests are required:

- An operation and stability test shall be carried out for on-load commissioning
- Tests for restraint shall be carried out to prove the characteristics of protective systems with directional characteristics
- On-load checks shall be made after the protective gear has been placed in service to ensure that all connections and test links have been replaced and test leads removed, as well as to confirm the integrity of the current transformer circuits. Where necessary, voltage readings shall be taken at the terminals on each relay to ensure that loop connections between the relays are complete. Special attention shall be paid to broken delta voltages and residual current circuits where zero voltage or current respectively may not be a proof of the completeness of the circuit.

1.2.11.6 Communications System Tests

All routine tests as specified in the applicable standards shall be carried out on the communication system equipment. Certificates of routine tests carried out on the equipment supplied shall be submitted for approval.

In addition, the following VHF transceiver tests shall be carried out:

- RF level
- Frequency accuracy
- Loss for speech frequency level
- Signal levels
- Nominal impedance and return loss-VF side
- Automatic gain control
- Transmit/ receive frequency difference
- Linearity
- Noise generated
- Sensitivity (SINAD value)

1.2.12 Performance

All works shall be executed according to the requirements and in the manner set out in the Contract Documents. The Contractor shall design, construct and supply all materials for manufacture, tests at the manufacturer's works, transport from the works and delivery to the site, erection, tests, carry out all completion works, put into operation, remedy defects during the defects liability period for the above Plant as described in the Specifications and as shown on the Drawings. All components and accessories required for the satisfactory operation of the Plant shall be supplied as necessary.

1.2.13 Training

During the manufacture of the 220/20KV and 220/110KV transformers, the Contractor shall arrange for factory visits for Employer's appointed personnel. During each visit of 7 days, training shall be given to five Employer's appointed personnel on factory inspections and witnessing of performance tests. During the erection and test period, the Contractor's supervisor shall give 7 days of training, information and thorough instructions to the Employer's staff concerning the handling of the plant and the use of the operation and maintenance manuals. The Employer's appointed personnel shall also have the opportunity of taking part in the testing and commissioning of the Plant.

The training shall be performed according to a program approved by the Employer in advance. The price for this training shall be regarded as included in the price for installation.

1.3 Schedule of Supply

1.3.1 Qarabagh Substation Schedule of Supply

Schedule No. 1 Qarabagh Substation: Supply of Major Plant Equipment

Item No.	Description	Units	QTY
1.1	Supply of 220KV Feeder Bays	EA	4
1.2	Supply of 220KV Future Feeder Bay	EA	0
1.3	Supply of 220KV Transformer Bay	EA	2
1.4	Supply of 220KV Future Transformer Bay	EA	0
1.5	Supply of 220/110KV Autotransformer Bay	EA	0
1.6	Supply of 220KV Bus Coupler & Metering Bay	EA	1
1.7	Supply of Auto Capacitor Bank Bay	EA	0
1.8	Supply of Future Auto Capacitor Bay	EA	0
1.9	Supply of Reactor Bay	EA	2
1.10	Supply of Future Reactor Bay	EA	0
1.11	Supply of 20KV Switchgear & Station Battery	LS	1
1.12	Supply of Control/Relay/Metering Panels	LS	1

Schedule No. 2 Qarabagh Substation: Supply of 110KV Plant and Equipment

Item No.	Description	Units	QTY
2.1	Supply of 110KV Feeder Bays	LS	0
2.2	Supply of 110KV Future Feeder Bay	LS	0
2.3	Supply of 110KV Source Bay	LS	0
2.4	Supply of 110KV Future Source Bay	LS	0
2.5	Supply of 110KV Bus Coupler & Metering Bay	LS	0

Schedule No. 3 Qarabagh Substation: Supply of General Plant and Equipment

Item No.	Description	Units	QTY
3.1	Supply of Substation Fence & Gates	LS	1
3.2	Supply of Control and Other Buildings	LS	1
3.3	Supply of 400V Building Power Distribution	LS	1
3.4	Supply of Utility Systems & Connections	LS	1
3.5	Supply of General Area Ground Grid System	LS	1
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1
3.7	Supply of Concrete Wireway Trenches	LS	1
3.8	Supply of Emergency Generator & Fuel System	LS	1

Schedule No. 4 Qarabagh Substation: Mandatory Spare Parts

Item No.	Description	Units	QTY
4.1	Protection System	LS	1
4.2	220KV Control Equipment	LS	1
4.3	LV AC System	LS	1
4.4	DC Distribution System	LS	1
4.5	HV Equipment	LS	1
4.6	20KV Metal Clad Switchgear	LS	1
4.7	Power Transformers	LS	1

Schedule No. 5 Qarabagh Substation: Standard Tools

Item No.	Description	Units	QTY
5.1	Substation Maintenance Tools & Appliances	LS	1
5.2	20KV MV Cables	LS	1
5.3	20KV Metal Clad Switchgear	LS	1

Schedule No. 6 Qarabagh Substation: Design, Drawings, and Documentation

Item No.	Description	Units	QTY
6.1	Structural Design And General Arrangement Drawings	LS	1
6.2	Site Civil Design Drawings	LS	1
6.3	Building and Structure Design Drawings	LS	1
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1
6.5	Control Circuits & Wiring Drawings	LS	1
6.6	Coordination Study & Relay Settings Instructions	LS	1
6.7	General Construction Drawings	LS	1
6.8	As Built Drawings	LS	1
6.9	Maintenance Manual And Completion Report	LS	1

Schedule No. 7 Qarabagh Substation: Installation and Other Charges

Item No.	Description	Units	QTY
7.1	Project Management	LS	1
7.2	Project Reporting	LS	1
7.3	Project Insurance	LS	1
7.4	Compliance with MOSS	LS	1
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1
7.6	Pavement of Road & Parking Areas	LS	1
7.7	Security Wall, Towers, & Gates	LS	1
7.8	Installation of 220KV Feeder Bays	EA	4
7.9	Installation of 220KV Future Feeder Bay	EA	0
7.10	Installation of 220KV Transformer Bay	EA	2
7.11	Installation of 220KV Future Transformer Bay	EA	0
7.12	Installation of 220/110KV Autotransformer Bay	EA	0
7.13	Installation of 220KV Bus Coupler & Metering Bay	EA	1
7.14	Installation of Auto Capacitor Bank Bay	EA	0
7.15	Installation of Future Auto Capacitor Bay	EA	0
7.16	Installation of Reactor Bay	EA	2
7.17	Installation of Future Reactor Bay	EA	0
7.18	Installation of 20KV Switchgear	LS	1
7.19	Installation of Control/Relay/Metering Panels	LS	1
7.20	Installation of 110KV Feeder Bays	EA	0
7.21	Installation of 110KV Future Feeder Bay	EA	0
7.22	Installation of 110KV Source Bay	EA	0
7.23	Installation of 110KV Future Source Bay	EA	0
7.24	Installation of 110KV Bus Coupler & Metering Bay	EA	0
7.25	Installation of Substation Fence & Gates	LS	1
7.26	Installation of Control and Other Buildings	LS	1
7.27	Installation of 400V Building Power Distribution	LS	1
7.28	Installation of Utility Systems & Connections	LS	1
7.29	Installation of General Area Ground Grid System	LS	1
7.30	Installation of Underground Conduit, Control & Power Cables	LS	1
7.31	Installation of Concrete Wireway Trenches	LS	1
7.32	Installation of Emergency Generator & Fuel System	LS	1
7.33	Testing and Commissioning	LS	1

Schedule No. 8 Qarabagh Substation: Transfer of Knowledge

Item No.	Description	Units	QTY
8.1	Training of Operation & Maintenance Management Staff	LS	1
8.2	On-Site training during construction and commissioning	LS	1
8.3	Training of Operation & Maintenance General Staff	LS	1

1.3.2 Moqor Substation Schedule of Supply

Schedule No. 1 Moqor: Supply of Major Plant and Equipment

Item No.	Description	Units	QTY
1.1	Supply of 220KV Feeder Bays	EA	4
1.2	Supply of 220KV Future Feeder Bay	EA	0
1.3	Supply of 220KV Transformer Bay	EA	2
1.4	Supply of 220KV Future Transformer Bay	EA	0
1.5	Supply of 220/110KV Autotransformer Bay	EA	0
1.6	Supply of 220KV Bus Coupler & Metering Bay	EA	1
1.7	Supply of Auto Capacitor Bank Bay	EA	0
1.8	Supply of Future Auto Capacitor Bay	EA	0
1.9	Supply of Reactor Bay	EA	2
1.10	Supply of Future Reactor Bay	EA	0
1.11	Supply of 20KV Switchgear & Station Battery	LS	1
1.12	Supply of Control/Relay/Metering Panels	LS	1

Schedule No. 2 Moqor: Supply of 110KV Plant and Equipment

Item No.	Description	Units	QTY
2.1	Supply of 110KV Feeder Bays	LS	0
2.2	Supply of 110KV Future Feeder Bay	LS	0
2.3	Supply of 110KV Source Bay	LS	0
2.4	Supply of 110KV Future Source Bay	LS	0
2.5	Supply of 110KV Bus Coupler & Metering Bay	LS	0

Schedule No. 3 Moqor Substation: Supply of General Plant and Equipment

Item No.	Description	Units	QTY
3.1	Supply of Substation Fence & Gates	LS	1
3.2	Supply of Control and Other Buildings	LS	1
3.3	Supply of 400V Building Power Distribution	LS	1
3.4	Supply of Utility Systems & Connections	LS	1
3.5	Supply of General Area Ground Grid System	LS	1
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1
3.7	Supply of Concrete Wireway Trenches	LS	1
3.8	Supply of Emergency Generator & Fuel System	LS	1

Schedule No. 4 Moqor Substation: Mandatory Spare Parts

Item No.	Description	Units	QTY
4.1	Protection System	LS	1
4.2	220KV Control Equipment	LS	1
4.3	LV AC System	LS	1
4.4	DC Distribution System	LS	1
4.5	HV Equipment	LS	1
4.6	20KV Metal Clad Switchgear	LS	1
4.7	Power Transformers	LS	1

Schedule No. 5 Moqor Substation: Standard Tools

Item No.	Description	Units	QTY
5.1	Substation Maintenance Tools & Appliances	LS	1
5.2	20KV MV Cables	LS	1
5.3	20KV Metal Clad Switchgear	LS	1

Schedule No. 6 Moqor Substation: Design, Drawings, and Documentation

Item No.	Description	Units	QTY
6.1	Structural Design And General Arrangement Drawings	LS	1
6.2	Site Civil Design Drawings	LS	1
6.3	Building and Structure Design Drawings	LS	1
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1
6.5	Control Circuits & Wiring Drawings	LS	1
6.6	Coordination Study & Relay Settings Instructions	LS	1
6.7	General Construction Drawings	LS	1
6.8	As Built Drawings	LS	1
6.9	Maintenance Manual And Completion Report	LS	1

Schedule No. 7 Moqor Substation: Installation and Other Charges

Item No.	Description	Units	QTY
7.1	Project Management	LS	1
7.2	Project Reporting	LS	1
7.3	Project Insurance	LS	1
7.4	Compliance with MOSS	LS	1
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1
7.6	Pavement of Road & Parking Areas	LS	1
7.7	Security Wall, Towers, & Gates	LS	1
7.8	Installation of 220KV Feeder Bays	EA	4
7.9	Installation of 220KV Future Feeder Bay	EA	0
7.10	Installation of 220KV Transformer Bay	EA	2
7.11	Installation of 220KV Future Transformer Bay	EA	0
7.12	Installation of 220/110KV Autotransformer Bay	EA	0
7.13	Installation of 220KV Bus Coupler & Metering Bay	EA	1
7.14	Installation of Auto Capacitor Bank Bay	EA	0
7.15	Installation of Future Auto Capacitor Bay	EA	0
7.16	Installation of Reactor Bay	EA	2
7.17	Installation of Future Reactor Bay	EA	0
7.18	Installation of 20KV Switchgear	LS	1
7.19	Installation of Control/Relay/Metering Panels	LS	1
7.20	Installation of 110KV Feeder Bays	EA	0
7.21	Installation of 110KV Future Feeder Bay	EA	0
7.22	Installation of 110KV Source Bay	EA	0
7.23	Installation of 110KV Future Source Bay	EA	0
7.24	Installation of 110KV Bus Coupler & Metering Bay	EA	0
7.25	Installation of Substation Fence & Gates	LS	1
7.26	Installation of Control and Other Buildings	LS	1
7.27	Installation of 400V Building Power Distribution	LS	1
7.28	Installation of Utility Systems & Connections	LS	1
7.29	Installation of General Area Ground Grid System	LS	1
7.30	Installation of Underground Conduit, Control & Power Cables	LS	1
7.31	Installation of Concrete Wireway Trenches	LS	1
7.32	Installation of Emergency Generator & Fuel System	LS	1
7.33	Testing and Commissioning	LS	1

Schedule No. 8 Moqor Substation: Transfer of Knowledge

Item No.	Description	Units	QTY
8.1	Training of Operation & Maintenance Management Staff	LS	1
8.2	On-Site training during construction and commissioning	LS	1
8.3	Training of Operation & Maintenance General Staff	LS	1

1.3.3 Shah Joy Substation Schedule of Supply

Schedule No. 1 Shah Joy: Supply of Major Plant and Equipment

Item No.	Description	Units	QTY
1.1	Supply of 220KV Feeder Bays	EA	4
1.2	Supply of 220KV Future Feeder Bay	EA	0
1.3	Supply of 220KV Transformer Bay	EA	2
1.4	Supply of 220KV Future Transformer Bay	EA	0
1.5	Supply of 220/110KV Autotransformer Bay	EA	0
1.6	Supply of 220KV Bus Coupler & Metering Bay	EA	1
1.7	Supply of Auto Capacitor Bank Bay	EA	0
1.8	Supply of Future Auto Capacitor Bay	EA	0
1.9	Supply of Reactor Bay	EA	2
1.10	Supply of Future Reactor Bay	EA	0
1.11	Supply of 20KV Switchgear & Station Battery	LS	1
1.12	Supply of Control/Relay/Metering Panels	LS	1

Schedule No. 2 Shah Joy: Supply of 110KV Plant and Equipment

Item No.	Description	Units	QTY
2.1	Supply of 110KV Feeder Bays	LS	0
2.2	Supply of 110KV Future Feeder Bay	LS	0
2.3	Supply of 110KV Source Bay	LS	0
2.4	Supply of 110KV Future Source Bay	LS	0
2.5	Supply of 110KV Bus Coupler & Metering Bay	LS	0

Schedule No. 3 Shah Joy Substation: Supply of General Plant and Equipment

Item No.	Description	Units	QTY
3.1	Supply of Substation Fence & Gates	LS	1
3.2	Supply of Control and Other Buildings	LS	1
3.3	Supply of 400V Building Power Distribution	LS	1
3.4	Supply of Utility Systems & Connections	LS	1
3.5	Supply of General Area Ground Grid System	LS	1
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1
3.7	Supply of Concrete Wireway Trenches	LS	1
3.8	Supply of Emergency Generator & Fuel System	LS	1

Schedule No. 4 Shah Joy Substation: Mandatory Spare Parts

Item No.	Description	Units	QTY
4.1	Protection System	LS	1
4.2	220KV Control Equipment	LS	1
4.3	LV AC System	LS	1
4.4	DC Distribution System	LS	1
4.5	HV Equipment	LS	1
4.6	20KV Metal Clad Switchgear	LS	1
4.7	Power Transformers	LS	1

Schedule No. 5 Shah Joy Substation: Standard Tools

Item No.	Description	Units	QTY
5.1	Substation Maintenance Tools & Appliances	LS	1
5.2	20KV MV Cables	LS	1
5.3	20KV Metal Clad Switchgear	LS	1

Schedule No. 6 Shah Joy Substation: Design, Drawings, and Documentation

Item No.	Description	Units	QTY
6.1	Structural Design And General Arrangement Drawings	LS	1
6.2	Site Civil Design Drawings	LS	1
6.3	Building and Structure Design Drawings	LS	1
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1
6.5	Control Circuits & Wiring Drawings	LS	1
6.6	Coordination Study & Relay Settings Instructions	LS	1
6.7	General Construction Drawings	LS	1
6.8	As Built Drawings	LS	1
6.9	Maintenance Manual And Completion Report	LS	1

Schedule No. 7 Shah Joy Substation: Installation and Other Charges

Item No.	Description	Units	QTY
7.1	Project Management	LS	1
7.2	Project Reporting	LS	1
7.3	Project Insurance	LS	1
7.4	Compliance with MOSS	LS	1
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1
7.6	Pavement of Road & Parking Areas	LS	1
7.7	Security Wall, Towers, & Gates	LS	1
7.8	Installation of 220KV Feeder Bays	EA	4
7.9	Installation of 220KV Future Feeder Bay	EA	0
7.10	Installation of 220KV Transformer Bay	EA	2
7.11	Installation of 220KV Future Transformer Bay	EA	0
7.12	Installation of 220/110KV Autotransformer Bay	EA	0
7.13	Installation of 220KV Bus Coupler & Metering Bay	EA	1
7.14	Installation of Auto Capacitor Bank Bay	EA	0
7.15	Installation of Future Auto Capacitor Bay	EA	0
7.16	Installation of Reactor Bay	EA	2
7.17	Installation of Future Reactor Bay	EA	0
7.18	Installation of 20KV Switchgear	LS	1
7.19	Installation of Control/Relay/Metering Panels	LS	1
7.20	Installation of 110KV Feeder Bays	EA	0
7.21	Installation of 110KV Future Feeder Bay	EA	0
7.22	Installation of 110KV Source Bay	EA	0
7.23	Installation of 110KV Future Source Bay	EA	0
7.24	Installation of 110KV Bus Coupler & Metering Bay	EA	0
7.25	Installation of Substation Fence & Gates	LS	1
7.26	Installation of Control and Other Buildings	LS	1
7.27	Installation of 400V Building Power Distribution	LS	1
7.28	Installation of Utility Systems & Connections	LS	1
7.29	Installation of General Area Ground Grid System	LS	1
7.30	Installation of Underground Conduit, Control & Power Cables	LS	1
7.31	Installation of Concrete Wireway Trenches	LS	1
7.32	Installation of Emergency Generator & Fuel System	LS	1
7.33	Testing and Commissioning	LS	1

Schedule No. 8 Shah Joy Substation: Transfer of Knowledge

Item No.	Description	Units	QTY
8.1	Training of Operation & Maintenance Management Staff	LS	1
8.2	On-Site training during construction and commissioning	LS	1
8.3	Training of Operation & Maintenance General Staff	LS	1

1.3.4 Qalat Substation Schedule of Supply

Schedule No. 1 Qalat: Supply of Major Plant and Equipment

Item No.	Description	Units	QTY
1.1	Supply of 220KV Feeder Bays	EA	4
1.2	Supply of 220KV Future Feeder Bay	EA	0
1.3	Supply of 220KV Transformer Bay	EA	2
1.4	Supply of 220KV Future Transformer Bay	EA	0
1.5	Supply of 220/110KV Autotransformer Bay	EA	0
1.6	Supply of 220KV Bus Coupler & Metering Bay	EA	1
1.7	Supply of Auto Capacitor Bank Bay	EA	0
1.8	Supply of Future Auto Capacitor Bay	EA	0
1.9	Supply of Reactor Bay	EA	2
1.10	Supply of Future Reactor Bay	EA	0
1.11	Supply of 20KV Switchgear & Station Battery	LS	1
1.12	Supply of Control/Relay/Metering Panels	LS	1

Schedule No. 2 Qalat: Supply of 110KV Plant and Equipment

Item No.	Description	Units	QTY
2.1	Supply of 110KV Feeder Bays	LS	0
2.2	Supply of 110KV Future Feeder Bay	LS	0
2.3	Supply of 110KV Source Bay	LS	0
2.4	Supply of 110KV Future Source Bay	LS	0
2.5	Supply of 110KV Bus Coupler & Metering Bay	LS	0

Schedule No. 3 Qalat Substation: Supply of General Plant and Equipment

Item No.	Description	Units	QTY
3.1	Supply of Substation Fence & Gates	LS	1
3.2	Supply of Control and Other Buildings	LS	1
3.3	Supply of 400V Building Power Distribution	LS	1
3.4	Supply of Utility Systems & Connections	LS	1
3.5	Supply of General Area Ground Grid System	LS	1
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1
3.7	Supply of Concrete Wireway Trenches	LS	1
3.8	Supply of Emergency Generator & Fuel System	LS	1

Schedule No. 4 Qalat Substation: Mandatory Spare Parts

Item No.	Description	Units	QTY
4.1	Protection System	LS	1
4.2	220KV Control Equipment	LS	1
4.3	LV AC System	LS	1
4.4	DC Distribution System	LS	1
4.5	HV Equipment	LS	1
4.6	20KV Metal Clad Switchgear	LS	1
4.7	Power Transformers	LS	1

Schedule No. 5 Qalat Substation: Standard Tools

Item No.	Description	Units	QTY
5.1	Substation Maintenance Tools & Appliances	LS	1
5.2	20KV MV Cables	LS	1
5.3	20KV Metal Clad Switchgear	LS	1

Schedule No. 6 Qalat Substation: Design, Drawings, and Documentation

Item No.	Description	Units	QTY
6.1	Structural Design And General Arrangement Drawings	LS	1
6.2	Site Civil Design Drawings	LS	1
6.3	Building and Structure Design Drawings	LS	1
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1
6.5	Control Circuits & Wiring Drawings	LS	1
6.6	Coordination Study & Relay Settings Instructions	LS	1
6.7	General Construction Drawings	LS	1
6.8	As Built Drawings	LS	1
6.9	Maintenance Manual And Completion Report	LS	1

Schedule No. 7 Qalat Substation: Installation and Other Charges

Item No.	Description	Units	QTY
7.1	Project Management	LS	1
7.2	Project Reporting	LS	1
7.3	Project Insurance	LS	1
7.4	Compliance with MOSS	LS	1
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1
7.6	Pavement of Road & Parking Areas	LS	1
7.7	Security Wall, Towers, & Gates	LS	1
7.8	Installation of 220KV Feeder Bays	EA	4
7.9	Installation of 220KV Future Feeder Bay	EA	0
7.10	Installation of 220KV Transformer Bay	EA	2
7.11	Installation of 220KV Future Transformer Bay	EA	0
7.12	Installation of 220/110KV Autotransformer Bay	EA	0
7.13	Installation of 220KV Bus Coupler & Metering Bay	EA	1
7.14	Installation of Auto Capacitor Bank Bay	EA	0
7.15	Installation of Future Auto Capacitor Bay	EA	0
7.16	Installation of Reactor Bay	EA	2
7.17	Installation of Future Reactor Bay	EA	0
7.18	Installation of 20KV Switchgear	LS	1
7.19	Installation of Control/Relay/Metering Panels	LS	1
7.20	Installation of 110KV Feeder Bays	EA	0
7.21	Installation of 110KV Future Feeder Bay	EA	0
7.22	Installation of 110KV Source Bay	EA	0
7.23	Installation of 110KV Future Source Bay	EA	0
7.24	Installation of 110KV Bus Coupler & Metering Bay	EA	0
7.25	Installation of Substation Fence & Gates	LS	1
7.26	Installation of Control and Other Buildings	LS	1
7.27	Installation of 400V Building Power Distribution	LS	1
7.28	Installation of Utility Systems & Connections	LS	1
7.29	Installation of General Area Ground Grid System	LS	1
7.30	Installation of Underground Conduit, Control & Power Cables	LS	1
7.31	Installation of Concrete Wireway Trenches	LS	1
7.32	Installation of Emergency Generator & Fuel System	LS	1
7.33	Testing and Commissioning	LS	1

Schedule No. 8 Qalat Substation: Transfer of Knowledge

Item No.	Description	Units	QTY
8.1	Training of Operation & Maintenance Management Staff	LS	1
8.2	On-Site training during construction and commissioning	LS	1
8.3	Training of Operation & Maintenance General Staff	LS	1

1.3.5 Kandahar East Substation Schedule of Supply

Schedule No. 1 Kandahar East: Supply of Major Plant and Equipment

Item No.	Description	Units	QTY
1.1	Supply of 220KV Feeder Bays	EA	2
1.2	Supply of 220KV Future Feeder Bay	EA	5
1.3	Supply of 220KV Transformer Bay	EA	2
1.4	Supply of 220KV Future Transformer Bay	EA	2
1.5	Supply of 220/110KV Autotransformer Bay	EA	2
1.6	Supply of 220KV Bus Coupler & Metering Bay	EA	1
1.7	Supply of Auto Capacitor Bank Bay	EA	0
1.8	Supply of Future Auto Capacitor Bay	EA	2
1.9	Supply of Reactor Bay	EA	2
1.10	Supply of Future Reactor Bay	EA	0
1.11	Supply of 20KV Switchgear & Station Battery	LS	1
1.12	Supply of Control/Relay/Metering Panels	LS	1

Schedule No. 2 Kandahar East: Supply of 110KV Plant and Equipment

Item No.	Description	Units	QTY
2.1	Supply of 110KV Feeder Bays	LS	4
2.2	Supply of 110KV Future Feeder Bay	LS	0
2.3	Supply of 110KV Source Bay	LS	2
2.4	Supply of 110KV Future Source Bay	LS	0
2.5	Supply of 110KV Bus Coupler & Metering Bay	LS	1

Schedule No. 3 Kandahar East Substation: Supply of General Plant and Equipment

Item No.	Description	Units	QTY
3.1	Supply of Substation Fence & Gates	LS	1
3.2	Supply of Control and Other Buildings	LS	1
3.3	Supply of 400V Building Power Distribution	LS	1
3.4	Supply of Utility Systems & Connections	LS	1
3.5	Supply of General Area Ground Grid System	LS	1
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1
3.7	Supply of Concrete Wireway Trenches	LS	1
3.8	Supply of Emergency Generator & Fuel System	LS	1

Schedule No. 4 Kandahar East Substation: Mandatory Spare Parts

Item No.	Description	Units	QTY
4.1	Protection System	LS	1
4.2	220KV Control Equipment	LS	1
4.3	LV AC System	LS	1
4.4	DC Distribution System	LS	1
4.5	HV Equipment	LS	1
4.6	20KV Metal Clad Switchgear	LS	1
4.7	Power Transformers	LS	1

Schedule No. 5 Kandahar East Substation: Standard Tools

Item No.	Description	Units	QTY
5.1	Substation Maintenance Tools & Appliances	LS	1
5.2	20KV MV Cables	LS	1
5.3	20KV Metal Clad Switchgear	LS	1

Schedule No. 6 Kandahar East Substation: Design, Drawings, and Documentation

Item No.	Description	Units	QTY
6.1	Structural Design And General Arrangement Drawings	LS	1
6.2	Site Civil Design Drawings	LS	1
6.3	Building and Structure Design Drawings	LS	1
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1
6.5	Control Circuits & Wiring Drawings	LS	1
6.6	Coordination Study & Relay Settings Instructions	LS	1
6.7	General Construction Drawings	LS	1
6.8	As Built Drawings	LS	1
6.9	Maintenance Manual And Completion Report	LS	1

Schedule No. 7 Kandahar East Substation: Installation and Other Charges

Item No.	Description	Units	QTY
7.1	Project Management	LS	1
7.2	Project Reporting	LS	1
7.3	Project Insurance	LS	1
7.4	Compliance with MOSS	LS	1
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1
7.6	Pavement of Road & Parking Areas	LS	1
7.7	Security Wall, Towers, & Gates	LS	1
7.8	Installation of 220KV Feeder Bays	EA	2
7.9	Installation of 220KV Future Feeder Bay	EA	5
7.10	Installation of 220KV Transformer Bay	EA	2
7.11	Installation of 220KV Future Transformer Bay	EA	2
7.12	Installation of 220/110KV Autotransformer Bay	EA	2
7.13	Installation of 220KV Bus Coupler & Metering Bay	EA	1
7.14	Installation of Auto Capacitor Bank Bay	EA	0
7.15	Installation of Future Auto Capacitor Bay	EA	2
7.16	Installation of Reactor Bay	EA	2
7.17	Installation of Future Reactor Bay	EA	0
7.18	Installation of 20KV Switchgear	LS	1
7.19	Installation of Control/Relay/Metering Panels	LS	1
7.20	Installation of 110KV Feeder Bays	EA	4
7.21	Installation of 110KV Future Feeder Bay	EA	0
7.22	Installation of 110KV Source Bay	EA	2
7.23	Installation of 110KV Future Source Bay	EA	0
7.24	Installation of 110KV Bus Coupler & Metering Bay	EA	1
7.25	Installation of Substation Fence & Gates	LS	1
7.26	Installation of Control and Other Buildings	LS	1
7.27	Installation of 400V Building Power Distribution	LS	1
7.28	Installation of Utility Systems & Connections	LS	1
7.29	Installation of General Area Ground Grid System	LS	1
7.30	Installation of Underground Conduit, Control & Power Cables	LS	1
7.31	Installation of Concrete Wireway Trenches	LS	1
7.32	Installation of Emergency Generator & Fuel System	LS	1
7.33	Testing and Commissioning	LS	1

Schedule No. 8 Kandahar East Substation: Transfer of Knowledge

Item No.	Description	Units	QTY
8.1	Training of Operation & Maintenance Management Staff	LS	1
8.2	On-Site training during construction and commissioning	LS	1
8.3	Training of Operation & Maintenance General Staff	LS	1

1.3.6 Schedule of Supply Glossary

Schedule No. 1: Supply of Major Plant and Equipment

Item No.	Item Description
1.1	Supply of 220kV Feeder Bays: Supply of all the 220KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.2	Supply of 220kV Future Feeder Bay: Supply of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.3	Supply of 220kV Transformer Bay: Supply of all the 220KV/20KV power transformers with OLTC (if specified), all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.4	Supply of 220kV Future Transformer Bay: Supply of all the structures, foundations, and related area ground grid system required for 220kV Future Transformer Bay(s) as shown and detailed in drawing package.
1.5	Supply of 220/110kV Autotransformer Bay: Supply of all the 220KV/110KV power transformers, all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.6	Supply of 220kV Bus Coupler & Metering Bay: Supply of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system. Couplers and metering equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.7	Supply of Auto Capacitor Bank Bay: Supply of all the capacitors, breakers, manual/motorized switches, associated equipment, accessories, and related area ground grid system as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.8	Supply of Future Auto Capacitor Bay: Supply of all the structures, foundations, and related area ground grid system required for Future Auto Capacitor Bay(s) as shown and detailed in drawing package.
1.9	Supply of Reactor Bay: Supply of all the substation dead end Gantry structures, station steel, manual motorized switches, breakers, buses, insulators, RPC, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.10	Supply of Future Reactor Bay: Supply of all the substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for future Reactor Bay(s) as shown and detailed in drawing package.
1.11	Supply of 20kV Switchgear & Station Battery: Supply of all the switchgear equipment, station batteries, conduit stubs, concrete ducting, insulators, surge arrestors, connectors, and the associated termination hardware kits. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.12	Supply of Control/Relay/Metering Panels: Supply of all the panels, breakers, relays, contactors, conductors, indicator lights, labeling, starters, meters, associated equipment and accessories. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.

Schedule No. 2: Supply of 110KV Plant and Equipment

Item No.	Item Description
2.1	Supply of 110kV Feeder Bays Supply of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
2.2	Supply of 110kV Future Feeder Bay Supply of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
2.3	Supply of 110kV Source Bay Supply of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
2.4	Supply of 110kV Future Source Bay Supply of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
2.5	Supply of 110kV Bus Coupler & Metering Bay Supply of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system. Couplers and metering equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.

Schedule No. 3: Supply of General Plant and Equipment

Item No.	Item Description
3.1	Supply of Substation Fence & Gates: Supply of all suitable and appropriate fencing materials, posts, gates, and warning labels. Equipment shall be designed and manufactured IAW rated performance specifications.
3.2	Supply of Control and Other Buildings: Supply of all the equipment and materials necessary for completion of Control and Other Buildings along with their necessary water, sewer and HVAC systems.
3.3	Supply of 400V Building Power Distribution: Supply of all panels, breakers, wiring, outlets, switches, lights, and other equipment required for 400V Building Power Distribution.
3.4	Supply of Utility Systems & Connections: Supply of all the equipment necessary for complete connection of all the sewer, water, and 230/400V electrical mains to the Utility system at the location shown on the Drawings.
3.5	Supply of General Area Ground Grid System: Supply of all the ground rods and ground conductors required for a complete Ground Grid System. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications. This item is for grounding systems external to HV Bays; each bay price includes its ground grid system.
3.6	Supply of Underground Conduit, Control & Power Cables: Supply of all conduit (PVC or steel), control, and power cables required for a complete substation as shown in the Drawings and performance specifications such that wiring can be completed without splicing of cables.
3.7	Supply of Concrete Wireway Trenches: Supply of pre-fabricated concrete wireway trenches and any associated equipment and accessories. All material shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
3.8	Supply of Emergency Generator & Fuel System: Supply of a generator, fuel, and fuel storage. Equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.

Schedule No. 4: Mandatory Spare Parts

Item No.	Item Description
4.1	Protection System: The Supply of all the spare relays, SCADA spare parts, optical fiber cables, and fuses.
4.2	220kV Control Equipment: The Supply of spare relays, fuses, and control panels.
4.3	LV AC System: The supply of all the spares for power distribution boards, breakers, backup generator, lights, outlets, wires, conduits, back diesel generator and automatic transfer switches.
4.4	DC Distribution System: Parts for the batteries, associated cables, charger / supply system, DC loads, and distribution power boards.
4.5	HV Equipment: The supply of power transformers parts, parts for switches, breakers, insulators, jumpers, and connectors.
4.6	20kV Metal Clad Switchgear: The switchgear equipment parts, surge arrestors, connectors, and the associated termination hardware kits. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
4.7	Power Transformers: All the associated spare parts and accessories for such transformer.

Schedule No. 5: Standard Tools

Item No.	Item Description
5.1	Substation Maintenance Tools & Appliances: All the necessary tools required to install, test, inspect and maintain the substation equipment.
5.2	20kV MV Cables: All the tools that are necessary to install, test, maintain and replace such cables.
5.3	20kV Metal Clad Switchgear: All the tools necessary to install, test inspect and maintain this equipment class.

Schedule No. 6: Design, Drawings, and Documentation

Item No.	Item Description
6.1	Structural Design And General Arrangement Drawings: Structural steel calculations, and general arrangement drawings for the equipment and support facilities in the new substation. Design calculations, detailed design drawings, final design deliverables including detailed supporting analyses, survey drawings, soil resistivity measurements, and geological investigation works.
6.2	Site Civil Design Drawings: All civil work drawings for excavating, grading, refilling, forming of the site, leveling and compacting, graveling, control buildings, office, workshop, storage room, battery room, water well, wastewater, drainage system, internal roads, fences, gates, oil interceptor tanks, concrete foundations.
6.3	Building and Structure Design Drawings: All the drawings and any structural calculations and documentations for the control buildings, office, workshop, storage room, battery room and concrete fire protection separation walls.
6.4	Single & 3 Line Drawings with Protective Relay Equipment: All the single and three lines drawings showing the power flow into and out of the substation along with all the control and protective relays functions, protective meters, and panel names where the relays units will be located.
6.5	Control Circuits & Wiring Drawings: The control panels and the wirings connections drawings showing all the control wirings from the control panels to substation yard equipment.
6.6	Coordination Study & Relay Settings Instructions: All the coordination studies for fault zone isolation along with the required settings for the relays determined by the coordination studies with the complete instructions to perform these settings.
6.7	General Construction Drawings: Construction Drawings of all the civil and steel structures showing the construction sequencing for all these structures in the substation.
6.8	As Built Drawings: Updated final documents and design drawings showing all the modifications made on the designs in the field, all CAD drawings for design, construction and installation.
6.9	Maintenance Manual And Completion Report: All the equipment maintenance, repair and adjustments manuals, and full set of assembly drawings including wiring diagrams. Completion report for each section of the works showing the acceptable testing and proper operations of all the installed equipment. Complete instructions for operations, apparatus lists, and spare parts lists containing information needed for ordering all equipment supplied under the contract. The delivery of the following manuals: general description of the equipment, operating instructions that are suitable for training of personnel, general maintenance instructions, spare parts manuals, all layout, and installation drawings.

Schedule No. 7: Installation and Other Charges

Item No.	Item Description
7.1	Project Management: Planning, execution, monitoring and closing all the design, procurement, construction, testing and commissioning activities and ensuring they are carried out IAW the relevant technical standards and design specifications.
7.2	Project Reporting: The setup of a reporting system from the beginning until the end of the project in which the frequency, format, contents, and the level of details for these reports will be maintained throughout the life cycle of the project.
7.3	Project Insurance: Coverage for any bodily injury or property damage during the performance of the work. Coverage for faulty workmanship. Coverage for error and omission in the design of the project. Coverage for damage caused by hazard materials. Coverage for damage caused by non-excusable delay. The Coverages should cover damages to project during and after construction.
7.4	Compliance with MOSS (Minimum Operating Safety Standards): Strict implementation and compliance with all of the relevant and applicable codes dealing with health, safety, environmental and social safe guards at the site as required per project and the AIF. Site regulations, security plan procedures for the staff, the employer, visiting missions from employer and AIF and the equipment. Implementation of an effective Earthing system at the new substation IAW the latest pertinent standards. Operational and safety labels in both English and local language.
7.5	Surveying, Grading, Roads, Site Perpetration & Finish: Marking and staking the selected location of the substation. Determination of the suitability of the selected site. Testing the soil condition of the site to ensure its ability to support the facility's size and construction requirements. Testing the soil for any toxic contamination of the site. Surveying the wildlife, vegetation, and archeological or historic resources of the site. A development of a detailed site preparation work plan to include measures for any wetlands and endangered species. The marking of any wetlands and special habitats. The consideration of annual breeding and hibernation cycles of certain species in creating the construction schedules. Briefing procedures for the crews on special care while working in sensitive areas, including limiting ground disturbances. The installation of erosion and sedimentation controls at the outer limits of the construction area. The laying of access roads to the site in preparation for the construction activities. Clearing any vegetation present in the access roads and the site of the substation. The grading of the site with all the required fill/cut in accordance with the specifications. The finishing of the ground inside of the substation site with a layer of suitable gravel as determined in the design specifications to ensure proper drainage and provide crews with safe work surface.
7.6	Pavement of Road & Parking Areas: Paving and marking of road and parking areas and materials included. Marking of the roads and parking areas shall be durable paint and/or signs.
7.7	Security Wall, Towers, & Gates: Installation of suitable and appropriate walls, towers, and gates and materials included around the complete substation site.
7.8	Installation of 220kV Feeder Bays: Installation of all the 220KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
7.9	Installation of 220kV Future Feeder Bay: Installation of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV Future Feeder Bay(s) as shown and detailed in drawing package.
7.10	Installation of 220kV Transformer Bay: Installation of all the 220K/20K power transformers with OLTC (if specified), all associated equipment and accessories, and related area ground grid system.
7.11	Installation of 220kV Future Transformer Bay: Installation of all the structures, foundations, and related area ground grid system required for 220kV Future Transformer Bay(s) as shown and detailed in drawing package.
7.12	Installation of 220/110kV Autotransformer Bay: Installation of all the 220KV/110KV power transformers, all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
7.13	Installation of 220kV Bus Coupler & Metering Bay: Installation of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system.

Item No.	Item Description
7.14	Installation of Auto Capacitor Bank Bay: Installation of all the capacitors, breakers, manual/motorized switches, associated equipment, accessories, and related area ground grid system.
7.15	Installation of Future Auto Capacitor Bay: Supply of all the structures, foundations, and related area ground grid system required for Future Auto Capacitor Bay(s) as shown and detailed in drawing package.
7.16	Installation of Reactor Bay: Installation of all the substation dead end Gantry structures, station steel, manual motorized switches, breakers, buses, insulators, RPC, and related area ground grid system.
7.17	Installation of Future Reactor Bay: Installation of all the substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for future Reactor Bay(s) as shown and detailed in drawing package.
7.18	Installation of 20kV Switchgear: Installation of all the switchgear equipment, conduit stubs, concrete ducting, insulators, surge arrestors, connectors, and the associated termination hardware kits.
7.19	Installation of Control/Relay/Metering Panels: Installation of all the panels, breakers, relays, contactors, conductors, indicator lights, labeling, starters, meters, associated equipment and accessories.
7.20	Installation of 110kV Feeder Bays Installation of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
7.21	Installation of 110kV Future Feeder Bay Installation of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package.
7.22	Installation of 110kV Source Bay Installation of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
7.23	Installation of 110kV Future Source Bay Installation of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Source Bay(s) as shown and detailed in drawing package.
7.24	Installation of 110kV Bus Coupler & Metering Bay Installation of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system.
7.25	Installation of Substation Fence & Gates: The installation of a suitable and appropriate fence around the substation side with the required access gates with warning signs in the local language.
7.26	Installation of Control and Other Buildings: Installation of all the equipment and materials necessary for completion of Control and Other Buildings along with their necessary water, sewer and HVAC systems.
7.27	Installation of 400V Building Power Distribution: Installation of all panels, breakers, wiring, outlets, switches, lights, and other equipment required for 400V Building Power Distribution.
7.28	Installation of Utility Systems & Connections: The permitting and proper connection of all the sewer, water and 230/400V electrical mains to the utilities and the testing of these systems to ensure their proper operations.
7.29	Installation of General Area Ground Grid System: Installation of all the ground rods and ground conductors required for a complete General Area Ground Grid System.
7.30	Installation of Underground Conduit, Control & Power Cables: Installation of all conduit (PVC or steel), control, and power cables and materials included required for a complete substation as shown in the Drawings and performance specifications such that wiring can be completed without splicing of cables.
7.31	Installation of Concrete Wireway Trenches: Digging of trenches and installation of pre-fabricated concrete wireway trenches and any associated equipment and accessories (materials included).
7.32	Installation of Emergency Generator & Fuel System: Installation of a generator, fuel, and fuel storage. Equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
7.33	Testing and Commissioning: Completion and full documentation of testing and commissioning for all substation equipment to the satisfaction or the Employer's Engineer.

Schedule No. 8: Transfer of Knowledge

Item No.	Item Description
8.1	Training of Operation & Maintenance Management Staff: Training of the maintenance management personnel on the general operation and maintenance schedules of the substation. Furnishing of all detailed operation, service, maintenance manuals, and complete spare parts list for the substation equipment.
8.2	On-Site training during construction and commissioning: Training of personnel, workers, and laborers to handle the installation, testing and commissioning of the substation equipment. Training for six Employer's appointed personnel on factory inspections and witnessing performance tests for the substation equipment.
8.3	Training of Operation & Maintenance General Staff: Providing the maintenance general personnel a complete and detailed O&M training program on how to operate and perform the periodical maintenance procedures.

2.0 Technical Data Sheets

The contractor shall provide the transmission lines and substations using the following specification tables for basis of design. The data listed is the minimum requirements for all equipment and designs.

2.1 Substations and Components

Table 2.1.1 220KV (and 110KV) Breaker

Item	Description/Details	Unit	Specified
1	220KV Circuit Breaker		
1.1	Manufacturer's type and reference	Each	TBD
1.2	Number of poles	#	3
1.3	Class	class	Outdoor
1.4	Rated lightning impulse withstand voltage between terminals and earth	KV_{II}	1,050
1.5	Rated 1 minute power-frequency withstand voltage to earth	KV_{II}	620
1.6	Rated System Voltage	KV_{II}	245
1.7	Rated normal current – line bay	A	1,250
1.8	Rated normal current – bus coupler bay	A	1,600
1.9	Rated normal current –transformer, RPC, capacitor bay	A	1,250
1.10	Rated line-charging breaking current	A	
1.11	Rated making Current	kA	100
1.12	Rated inductive breaking current	kA	40
1.13	Rated short-circuit breaking/making current	kA	40
1.14	Rated out-of-phase breaking current	kA	40
1.15	Rated operation sequence	Sequence order	O-0.3s-CO-3m-CO
1.16	Rated duration of short circuit	s	3
1.17	Rated total breaking time	ms	50
1.18	Rated total closing time	ms	≤ 50
1.19	Type of arc quenching medium	Gas	SF6
1.20	Type of stored energy medium	Technology	Motor spring
1.21	Voltage for operation device	V_{DC}	220
1.22	Rated System Frequency	Hz	50

Table 2.1.2 220KV (and 110KV) Disconnector

Item	Description/Details	Unit	Specified
1	220KV Disconnector		
1.1	Manufacturer's type and reference	Each	TBD
1.2	Rated voltage	KV_{II}	245
1.3	Rated short-circuit withstand current, 3s	kA	40
1.4	Rated peak withstand current	kA	50
1.5	Rated lightning impulse withstand voltage		
1.5.1	• to earth and between poles	KV_{II}	1,050
1.5.2	• across open pole Rated 1 min. power-frequency withstand voltage	KV_{II}	1,050
1.5.3	• across open pole	KV_{II}	1,050
1.6	Rated normal current- line bay	A	1,250
1.7	Rated normal current- bus coupler bay	A	1,600
1.8	Rated normal current- transformer, RPC, capacitor bays	A	1,050
1.9	Creepage distance	Mm/KV_{II}	25
1.10	Voltage for operation device	V_{DC}	220
2	Earthing switch		
2.1	Rated 1 minute 50HZ Withstand	$KV_{(RMS)}$	530
2.2	Rated voltage	KV_{II}	245
2.3	Rated short-circuit withstand current, 1s	kA	20
2.4	Rated peak withstand current	kA	50
2.5	Rated lightning impulse withstand voltage		
2.5.1	• to earth and between poles	KV_{II}	1,050
2.5.2	• across open pole	KV_{II}	530

Table 2.1.3 220KV (and 110KV) Current Transformers

Item	Description/Details		Unit	Specified
1	220KV Current Transformers: Line, and Bus Coupler* Bays			
1.1	Rated voltage		KVII	245
1.2	Core 1, 2, 3 & 4 characteristics, each multi-ratio	Ratios	Turns	750/1500A/1A
1.3		Continuous Thermal Current (min)	I(cth)	200%
1.4		Accuracy	Class	5P
1.5		Winding Power	VA	30
1.6	Core 5 characteristics, multi-ratio	Ratios	Turns	200/750/1500A/1A
1.7		Continuous Thermal Current (min)	I(cth)	200%
1.8		Accuracy	Class	0.2
1.9		Winding Power	VA	30
2	220KV Current Transformer: Transformer, RPC, SVC, & Cap Bays			
2.1	Manufacturer's type and reference		Each	TBD
2.2	Rated voltage		KVII	245
2.3	Core 1 & 4 characteristics, each multi-ratio	Ratios	Turns	50/100/200A / 1A
2.4		Continuous Thermal Current (min)	I(cth)	200%
2.5		Accuracy	Class	5P
2.6		Winding Power	VA	30
2.7	Core 2 & 3 characteristics, each multi-ratio	Ratios	Turns	750/1500A/1A
2.8		Continuous Thermal Current (min)	I(cth)	200%
2.9		Accuracy	Class	5P
2.10		Winding Power	VA	30
2.11	Core 5 characteristics, multi-ratio	Ratios	Turns	20/50/100/200A / 1A
2.12		Continuous Thermal Current (min)	I(cth)	200%
2.13		Accuracy	Class	0.2
2.14		Winding Power	VA	30

*Note: One set of Bus Coupler CT's only requires a single (Core Type 2) winding.
Single secondary, or 5 secondary type may be supplied.

Table 2.1.4 220KV (and 110KV) Voltage Transformers

Item	Description/Details	Unit	Specified
1	220KV Voltage Transformers		
1.1	Primary Voltage	KVII	220KV/√3,
1.2	Secondary Voltages (Dual Voltages per winding)	V	110V/√3, 220V/√3
1.3	Rated Output, Metering/Protection	VA	100/100
1.4	Accuracy, Metering/Protection	CLASS	0.2/5P
1.5	Type	circuit	Capacitive
1.6	Minimum Creepage	mm/KV	25

Table 2.1.5 220KV Surge Arrestors

Item	Description/Details	Unit	Specified
1	220KV Surge Arresters		
1.1	System Voltage (Um)	KV_{II}	245
1.2	Rated Voltage (Ur IEC 60099-4)	KV $_{Rms}$	198
1.3	Class	Class	3 ; ZnO Heavy duty, station
1.4	Pressure relief class	kA	10
1.5	Temporary Overvoltage (TOV) capability (1s)	KV_{II}	247
1.6	Minimum Creepage	mm/KV_{II}	25
1.7	Maximum Residual Voltage with Current Wave, 8/20 µs at 5/10/20 kA, Lightning Protection Level	KV_{peak}	302/317/349
1.8	Rated Insulation Level	KV_{II}	1,050
1.9	MCOV (minimum)	KV_{IN}	140

Table 2.1.6 110KV Surge Arrestors

Item	Description/Details	Unit	Specified
1	110KV Surge Arresters		
1.1	System Voltage (Um)	KV_{II}	123
1.2	Rated voltage (Ur IEC 60099-4)	KV rms	123
1.3	Accuracy	Class	3; ZnO Heavy duty, station
1.4	Pressure relief class	kA	10
1.5	Temporary Overvoltage (TOV) capability (1s)	KV_{II}	125
1.6	Minimum Creepage	mm/KV	25
1.7	Maximum Residual Voltage with Current Wave, 8/20 µs at 5/10/20 kA, Lightning Protection Level	KV peak	302/317/349
1.8	Rated Insulation Level	KV_{II}	600
1.9	MCOV (minimum)	KV_{IN}	70

Table 2.1.7 20KV Surge Arrestors

Item	Description/Details	Unit	Specified
1	20KV Surge Arresters		
1.1	System Voltage (Um)	KV_{II}	24
1.2	Rated voltage (Ur IEC 60099-4)	KV_{Rms}	24
1.3	Accuracy	class	Class 2; ZnO Heavy duty, station class
1.4	Pressure relief class	kA	10
1.5	Temporary Overvoltage (TOV) capability (1s)	KV_{II}	125
1.6	Minimum Creepage	mm/KV_{II}	25
1.7	Maximum Residual Voltage with Current Wave, 8/20 µs at 5/10/20 kA, Lightning Protection Level	KV_{peak}	55.2/57.6/63.9
1.8	MCOV	KV_{IN}	13.9

Table 2.1.8 220/20KV Transformers

Item	Description/Details	Unit	Specified
1	Transformer 220/20KV		2
1.1	Windings (Pri/Sec)		Delta-Wye
1.2	Type		2 Winding
1.3	Rated power		
1.3.1	Qarabagh	MVA	10
1.3.2	Moqor	MVA	10
1.3.3	Shah Joy	MVA	10
1.3.4	Qalat	MVA	10
1.3.5	Kandahar East	MVA	30
1.4	Rated voltage, primary winding	KV	220
1.5	Rated voltage, secondary winding	KV	20
1.6	Number required		2
1.7	Load losses at rated voltage and power*	kW	Refer to Sub-Clause 1.3.2.3
1.8	Impedance voltage	%	10
1.9	Magnetic flux density	Tesla	1.55
1.10	Top oil temperature	°C	55
1.11	Hot spot / winding	°C	60
1.12	Impulse withstand voltage, primary winding	KV	1,050
1.13	Cooling Type		ONAF
1.14	Impulse withstand voltage, secondary winding	KV	550
1.15	Power frequency withstand voltage, primary winding	KV	480
1.16	Power frequency withstand voltage, secondary winding	KV	50
1.17	Vector Group		Dyn5
2	Off-load tap changer (220KV)		
2.1	Number of Steps		±2
2.2	Taps		±2.5% Each
3	On-load tap changer (OLTC) (20KV)		
3.1	Maker's type test and reference		IEC 60214 and IEC 60542
3.2	Rated Current	A	200
3.3	Number of steps		±16
3.4	Contact life (operations)		>200,000
3.5	Taps		±1.5% Each
4	Bushings – Primary		
4.1	Type		IEC 60137
4.2	Lightning impulse level	KV	1,000
4.3	Minimum creepage distance	mm/KV	25
5	Bushings – Secondary		
5.1	Type		IEC 60137
5.2	Lightning impulse level	KV	200
5.3	Minimum creepage distance	mm/KV	25
6	220KV Bushing Current Transformers		
6.1	Current Ratio		#1 – 25/50:1 #2 – 25/50:1
6.2	Thermal Rating Factor	%	200
6.3	Accuracy Class		#1 – C200 #2 – C200
6.4	Location		High Voltage bushing
6.5	Quantity	qty	2 per bushing

Table 2.1.8 220/20KV Transformers continued

Item	Description/Details		Unit	Specified
7	Neutral Current Transformer			
7.1	Current Ratio			#1 – 150/300:1 #2 – 150/300:1
7.2	Thermal Rating Factor		%	200
7.3	Accuracy Class			#1 – C200 #2 – C200
7.4	Location			Low Voltage bushing
7.5	Quantity		qty	2
8	20KV Bushing Current Transformers			
8.1	Current Ratio	For 10MVA Transformers		#1 – 150/300:1 #2 – 150/300:1
		For 30 MVA Transformers		#1 – 500/1000:1 #2 – 500/1000:1
8.2	Thermal Rating Factor		%	200
8.3	Accuracy Class			#1 – C200 #2 – C200
8.4	Location			Low Voltage bushing
8.5	Quantity		qty	2 per bushing

Table 2.1.9 220/110KV Transformers (Kandahar East Auto Transformer)

Item	Description/Details	Unit	Specified
1	Transformer 220/110KV		2
1.1	Windings (Pri/Sec)		Wye/Wye
1.2	Type		Auto Transformer
1.3	Rated power (at Substation location)	MVA	80
1.4	Rated voltage, primary winding	KV	220
1.5	Rated voltage, secondary winding	KV	110
1.6	Number required		2
1.7	Load losses at rated voltage and power*	kW	Refer to Sub-Clause 1.3.2.3
1.8	Impedance voltage	%	10
1.9	Magnetic flux density	Tesla	1.55
1.10	Top oil temperature	°C	55
1.11	Hot spot / winding	°C	60
1.12	Impulse withstand voltage, primary winding	KV	1,050
1.13	Cooling Type		ONAF
1.14	Impulse withstand voltage, secondary winding	KV	550
1.15	Power frequency withstand voltage, primary winding	KV	480
1.16	Power frequency withstand voltage, secondary winding	KV	50
1.17	Vector Group		YNyn0
2	Off-load tap changer (220KV)		
2.1	Number of Steps		±2
2.2	Taps		±2.5% Each
3	Bushings – Primary		
3.1	Type		IEC 60137
3.2	Lightning impulse level	KV	1,000
3.3	Minimum creepage distance	mm/KV	25
4	Bushings – Secondary		
4.1	Type		IEC 60137

Table 2.1.9 220/110KV Transformers (Kandahar East Auto Transformer)continued			
Item	Description/Details	Unit	Specified
4.2	Lightning impulse level	KV	200
4.3	Minimum creepage distance	mm/KV	25
5	220KV Bushing Current Transformers		
5.1	Current Ratio		#1 – 150/300:1 #2 – 150/300:1
5.2	Thermal Rating Factor	%	200
5.3	Accuracy Class		#1 – C200 #2 – C200
5.4	Location		High Voltage bushing
5.5	Quantity	Qty	2 per bushing
6	Neutral Current Transformer		
6.1	Current Ratio		#1 – 150/300:1 #2 – 150/300:1
6.2	Thermal Rating Factor	%	200
6.3	Accuracy Class		#1 – C200 #2 – C200
6.4	Location		Low Voltage bushing
6.5	Quantity	Qty	2
7	110KV Bushing Current Transformers		
7.1	Current Ratio		#1 – 300/600:1 #2 – 300/600:1
7.2	Thermal Rating Factor	%	200
7.3	Accuracy Class		#1 – C200 #2 – C200
7.4	Location		Low Voltage bushing
7.5	Quantity	Qty	2 per bushing

Table 2.1.10 Shunt Reactors

Item	Description/Details	Units	Specified
1	Reactor Power Ratings		
1.1	Qarabagh Substation	MVAR	10 x 2
1.2	Moqor Substation	MVAR	10 x 2
1.3	Shah Joy Substation	MVAR	10 x 2
1.4	Qalat Substation	MVAR	15 x 2
1.5	Kandahar East Substation	MVAR	25 x 2
2	Rated voltage	KV	220
3	Rated Frequency	Hz	50
4	Rated fault level	kA	40
5	Lighting Impulse withstand voltage	KVpeak	1050
6	Switching Impulse withstand voltage	KVpeak	850
7	One minute power frequency withstand Voltage	KVrms	460
8	Cooling system		Natural oil circulation (ONAN)
9	Neutral Connection		Star, Directly Earthed
10	Range of constant impedance	ohms	Up to 1.35 p.u. voltage
11	Tolerance on current at rated voltage		0 to +5% of rated current
12	Bushings Rated Voltage	KV	220
13	Total loss at rated voltage and frequency as a percentage of rated MVAR	%	<= 0.5

Table 2.1.11 20KV Metalclad Switchgear

Item	Description/Details	Unit	Specified
1	20KV Metalclad Switchgear		
1.1	Type of Construction	material	Metal clad
1.2	Location	Indoor / Outdoor	Indoor
1.3	Applicable design Standard	IEC	IEC 62271-200
1.4	Degree of Protection	level	IP54
1.5	Rated frequency	Hz	50
1.6	Rated voltage	KV_{rms}	24
1.7	Impulse withstand voltage (dry)	KV_{peak}	125
1.8	One minute power frequency withstand	KV_{LL}	55 ,rms
1.9	Short time withstand current (3 seconds)	kA	16,rms
1.10	Busbar current rating	A	1,250
1.11	Busbar material	material	Copper
2	Circuit Breakers		
2.1	Breaking medium	medium	Vacuum / SF6
2.2	Rated current, main and tie breakers	A	1,250
2.3	Rated current, feeder breakers	A	630
2.4	Breaking capacity	kA_{rms}	25
2.5	Making capacity	kA_{peak}	62.5
2.6	Operating mechanism	technology	Spring
2.7	Spring charging motor voltage	V_{LN}	230,Ac,1 phase
2.8	Closing coil voltage	V	220 V_{DC}
2.9	Tripping coil voltage	V	220 V_{DC}
3	Voltage Transformers		
3.1	Primary voltage	V_{LN}	20,000/√3
3.2	Secondary voltage	V_{LN}	110/√3
3.3	Output secondary	VA	100
3.4	Secondary Accuracy	class	.2
3.5	Type	circuit	Inductive
4	Current Transformers		
4.1	Ratio – mains and bus coupler	turns	800/400/200:1
4.2	Ratio – feeder	turns	400/200/100:1
4.3	Accuracy Protection	class	5P10/X
4.4	Accuracy Metering	class	.5

Table 2.1.12 Station Service Transformer 20/0.4KV

Item	Description/Details	Unit	Specified
1	Auxiliary Power Transformer 20/0.4KV		
1.1	No. of phases	number	3
1.2	Design Standard (Internal to Switchgear)	IEC	IEC 60076
1.3	Impedance	%	4
1.4	Continuous rated power	KVA	250
1.5	Vector group	Shift angle	Dyn5
1.6	Rated frequency	Hz	50
1.7	Voltage Ratio	turns	20,000/400
1.8	Type of tap-changer	type	Off-voltage
1.9	Taps (on 20KV)	%	+5% +2.5% 0% -2.5% -5%
1.10	Impulse withstand voltage of HV winding	KV$_{II}$	125
1.11	Transformer type	(Indoor / Outdoor)	Indoor (in switchgear)
1.12	Type of Cooling		Air
1.13	Hermetically sealed		No
1.14	MV bushing type	style	Dead front Plug in 200A
1.15	LV bushing type	style	NEMA 4 holes
1.16	Ambient maximum temperature rise	°C	65
1.17	Winding temperature rise (maximum)	°C	65

Table 2.1.13 Control / Protection Equipment

Item	Description/Details	Unit	Specified
1	Relay/Control Boards		
1.1	Test and reference	IEC	IEC 60529
1.2	Protection Accuracy	Class	IP43
2	Energy Meters		
2.1	Test and reference		Refer to Section 1.3.8.7
2.2	Type of KWh meters	class	0.2
2.3	Type of KVAR meters	class	0.5

Table 2.1.14 Proposed Relay Protection

Item	Description/Details	Specified
1	220KV Line	Duplicate numerical distance protection scheme. Each protection scheme shall incorporate directional and non-directional over current and earth fault protection, sync check, circuit breaker fail protection, fault location and transient recorder functionality. The relays supplied for the duplicate relay protection scheme shall not be supplied by the same manufacturer. The distance scheme design will be carrier signal assisted and intertrip signaling provided as required.
2	220KV Bus Coupler	Differential protection – high impedance, with two main zones and one check zone
3	220/20KV Transformer	One multi-function over current relay. One multi-function UV & OV relay, sync check. One multi-function differential transformer mounted protection including, Winding and oil temperature low level alarm, Winding and oil temperature high level trip, Oil level alarm, Gas relay (Buchholz relay), pressure relay
4	RPC & Cap Bays	One multi-function over current relay. One multi-function UV & OV & differential relay.
5	20KV Main	Over current and earth fault protection, sync check, UV, reverse power relay.
6	20KV Bus Coupler	One multi-function over current relay. One multi-function UV & OV relay, sync check. Bus Differential for each MV bus section.
7	20KV Feeder	Multi-function feeder over current, earth fault and reclosing relay.

Table 2.1.15 Energy Meters

Item	Panel	220KV	20KV
1	Line & Feeder Bay	kWh delivered, kWh received, Four-quadrantKVARh With data access facilities and pulse output, class 0.2	kWh delivered, Four-quadrantKVARh, With data access facilities and pulse output, class 0.2
2	Transformer Bay	kWh delivered, kWh received Four-quadrantKVARhWith data access facilities and pulse output, class0.2 (on the 20KV side of 220/20KV transformer)	None

Table 2.1.16 Batteries and Rectifiers

Item	Description/Details	Unit	Specified
1	220 V Batteries		
1.1	Manufacturer's type and reference		Refer to Section 1.2.8.14
1.2	Capacity, 10 h discharge	Ah	Refer to Section 1.2.8.14
1.3	Capacity, 1 h discharge	Ah	Refer to Section 1.2.8.14
1.4	Maximum charging current	A	Refer to Section 1.2.8.14
1.5	Number of cells	number	110
1.6	Floating charge voltage	V	100% x U_N
1.7	Lowest Voltage, discharged battery	V	90% x Un
1.8	Discharging Time (100% of C10)	H	6
1.9	Quick charge 1 voltage	V	Refer to Section 1.2.8.14
1.10	Quick charge 2 voltage	V	Refer to Section 1.2.8.14
2	220 V Rectifiers		
2.1	Manufacturer's type and reference		Refer to Section 1.3.8.14
2.2	Minimum current DC	A	50
2.3	Charging time (to 90% of C10)	H	12

Table 2.1.17 Earthing System

Item	Description/Details	Unit	Specified
1	Minimum Sizes of Copper Conductors		
1.1	Grounding loops	mm^2	120
1.2	Riser	mm^2	120
1.3	Connection of live neutrals	mm^2	50
1.4	Connection of other steelworks not part of high-voltage structures	mm^2	25
2	Maximum Permissible Fault Current Density for Connection of		
2.1	System neutrals	A/mm^2	100
2.2	HV-equipment	A/mm^2	200
2.3	LV-equipment auxiliary power transformers, etc.	A/mm^2	150
3	Grounding Rods		
3.1	Diameter	mm	16
3.2	Length, minimum	m	3m
3.3	Material	material	Copper-clad steel
4	Assumption for Calculations of Step Voltages, According to IEEE-80		
4.1	Maximum grid potential rise	KV_{rms}	5
4.2	Step	m	1
4.3	Body resistance	Ω	1000
4.4	Fault clearing time	s	1
5	Assumption for Soil Resistivity for Use, According to IEEE-80		
5.1	Common Soil resistivity	Ω-m	500

Table 2.1.18 Low Voltage Cables

Item	Description/Details	Unit	Specified
1	Cables		
1.1	Manufacturer's type and reference		Refer to Section 1.3.8.16

Table 2.1.19 MV Cable

Item	Description/Details	Unit	Specified
1	Nominal voltage rating	KV	11.5/20KV (24KV)
2	Number and nominal size of core	mm^2	1x240
3	Stranding type	material	Aluminum
4	Thickness of conductor shield	mm	1.0
5	Thickness of XLPE insulation	mm	5.5
6	Size of insulation shield		
6.1	- semi-conducting thickness	mm	0.8
6.2	Stranding-armour	mm	0.85
6.3	Maximum Conductor temp. rating	°C	90
7	Short circuit rating		
7.1	t = 0.1 seconds	kA	25
7.2	t = 0.2 seconds	kA	17
7.3	t = 0.5 seconds	kA	11
7.4	t = 1.0 seconds	kA	8
7.5	Minimum bending radius	mm	8 x diameter
7.6	Maximum drum wound lengths	m	>500
7.7	Maximum Pulling Tension	kN	3,000
8	Environmental Conditions		
8.1	Ground Temperature	°C	25
8.2	Maximum Conductor Temperature	°C	90
8.3	Thermal Resistivity of Soil	°C m/W	1.2
8.4	Depth of Burial	m	0.8

Table 2.1.20 MV Cable Termination Kits

Item	Description/Details	Unit	Specified
1	Nominal voltage rating	KV	20/24
2	Nominal size of cable	mm^2	240
3	Number of cores	number	1
4	Type of conductor	type	AAC

3.0 Drawings, Schedules, Maps

3.1 Maps, One-lines, and Substation Plans

1. G-100 Cover Sheet
2. G-101 Drawing Index
3. G-102 General Notes, Legend Symbols & Abbreviation
4. G-103 Typical Control & 20KV Distribution Building
5. G-104 220KV System Schematic Diagram
6. E-101 Qarabagh Substation Single Line Diagram – HV
7. E-102 Qarabagh Substation Single Line Diagram – MV
8. E-103 Qarabagh Substation General Arrangement – GA
9. E-104 Qarabagh Substation Site Location Map
10. E-105 Qarabagh Substation Elevation
11. E-201 Moqor Substation Single Line Diagram – HV
12. E-202 Moqor Substation Single Line Diagram – MV
13. E-203 Moqor Substation General Arrangement – GA
14. E-204 Moqor Substation Site Location Map
15. E-205 Moqor Substation Elevation
16. E-301 Shah Joy Substation Single Line Diagram – HV
17. E-302 Shah Joy Substation Single Line Diagram – MV
18. E-303 Shah Joy Substation General Arrangement – GA
19. E-304 Shah Joy Substation Site Location Map
20. E-305 Shah Joy Substation Elevation
21. E-401 Qalat Substation Single Line Diagram – HV
22. E-402 Qalat Substation Single Line Diagram – MV
23. E-403 Qalat Substation General Arrangement – GA
24. E-404 Qalat Substation Site Location Map
25. E-405 Qalat Substation Elevation
26. E-501 Kandahar East Substation Single Line Diagram – HV (1)
27. E-502 Kandahar East Substation Single Line Diagram – HV (2)
28. E-503 Kandahar East Substation Single Line Diagram – HV (3)
29. E-504 Kandahar East Substation Single Line Diagram – MV (1)
30. E-505 Kandahar East Substation Single Line Diagram – MV (2)
31. E-506 Kandahar East Substation General Arrangement – GA
32. E-507 Kandahar East Substation General Arrangement - GA
33. E-508 Kandahar East Substation Site Location Map
34. E-509 Kandahar East Substation Elevation (1)
35. E-510 Kandahar East Substation Elevation (2)

3.2 Informative Earthquake Maps

1. DWG ESDIP TL 04 01 : Seismicity of the Afghanistan Region
2. DWG ESDIP TL 04 02 : Earthquake Density Map
3. DWG ESDIP TL 04 03 : Seismic Hazard Map

3.1 – Maps, One-lines, and Substation Plans

ISLAMIC REPUBLIC OF AFGHANISTAN
AFGHANISTAN ENGINEERING SUPPORT PROGRAM (AESP)

SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST

CONCEPT DESIGN
DATE: NOVEMBER 10, 2014

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: MAY
SUBMITTED BY: TETRA TECH
CHECKED BY: DJ
CAD FILE NAME: LT0048-G-1000N

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
COVER SHEET

SHEET REFERENCE NUMBER:
G–100

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DRAWING REF. NUMBER	CAD FILE NAME	ISSUE DATE	ISSUE STATUTES	DRAWING TITLE
GENERAL DRAWINGS				
G-100	LT0048-G-100GN	09/26/14	CONCEPT DESIGN	COVER SHEET
G-101	LT0048-G-101SC	09/26/14	CONCEPT DESIGN	DRAWING INDEX
G-102	LT0048-G-102GN	09/26/14	CONCEPT DESIGN	GENERAL NOTES, LEGEND SYMBOLS & ABBRAVATION
G-103	LT0048-G-103GN	09/26/14	CONCEPT DESIGN	TYPICAL CONTROL & 20kV DISTRIBUTION BUILDING
G-104	LT0048-G-104DI	09/26/14	CONCEPT DESIGN	220kV SYSTEM SCHEMATIC DIAGRAM
QARABAGH SUBSTATION				
E-101	LT0048-E-101DI	09/26/14	CONCEPT DESIGN	QARABAGH SUBSTATION SINGLE LINE DIAGRAM-HV
E-102	LT0048-E-102DI	09/26/14	CONCEPT DESIGN	QARABAGH SUBSTATION SINGLE LINE DIAGRAM-MV
E-103	LT0048-E-103PN	09/26/14	CONCEPT DESIGN	QARABAGH SUBSTATION GENERAL ARRANGEMENT-GA
E-104	LT0048-E-104LS	09/26/14	CONCEPT DESIGN	QARABAGH SUBSTATION SITE LOCATION MAP
E-105	LT0048-E-105EL	09/26/14	CONCEPT DESIGN	QARABAGH SUBSTATION ELEVATION
MOQUAR SUBSTATION				
E-201	LT0048-E-201DI	09/26/14	CONCEPT DESIGN	MOQOR SUBSTATION SINGLE LINE DIAGRAM-HV
E-202	LT0048-E-202DI	09/26/14	CONCEPT DESIGN	MOQOR SUBSTATION SINGLE LINE DIAGRAM-MV
E-203	LT0048-E-203PN	09/26/14	CONCEPT DESIGN	MOQOR SUBSTATION GENERAL ARRANGEMENT-GA
E-204	LT0048-E-204LS	09/26/14	CONCEPT DESIGN	MOQOR SUBSTATION SITE LOCATION MAP
E-205	LT0048-E-205EL	09/26/14	CONCEPT DESIGN	MOQOR SUBSTATION ELEVATION
SHAH JOY SUBSTATION				
E-301	LT0048-E-301DI	09/26/14	CONCEPT DESIGN	SHAH JOY SUBSTATION SINGLE LINE DIAGRAM-HV
E-302	LT0048-E-302DI	09/26/14	CONCEPT DESIGN	SHAH JOY SUBSTATION SINGLE LINE DIAGRAM-MV
E-303	LT0048-E-303PN	09/26/14	CONCEPT DESIGN	SHAH JOY SUBSTATION GENERAL ARRANGEMENT-GA
E-304	LT0048-E-304LS	09/26/14	CONCEPT DESIGN	SHAH JOY SUBSTATION SITE LOCATION MAP
E-305	LT0048-E-305EL	09/26/14	CONCEPT DESIGN	SHAH JOY SUBSTATION ELEVATION
QALAT SUBSTATION				
E-401	LT0048-E-401DI	09/26/14	CONCEPT DESIGN	QALAT SUBSTATION SINGLE LINE DIAGRAM-HV
E-402	LT0048-E-402DI	09/26/14	CONCEPT DESIGN	QALAT SUBSTATION SINGLE LINE DIAGRAM-MV
E-403	LT0048-E-403PN	09/26/14	CONCEPT DESIGN	QALAT SUBSTATION GENERAL ARRANGEMENT-GA
E-404	LT0048-E-404LS	09/26/14	CONCEPT DESIGN	QALAT SUBSTATION SITE LOCATION MAP
E-405	LT0048-E-405EL	09/26/14	CONCEPT DESIGN	QALAT SUBSTATION ELEVATION
KANDAHAR EAST SUBSTATION				
E-501	LT0048-E-501DI	09/26/14	CONCEPT DESIGN	KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM-HV(1)
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E-505	LT0048-E-505DI	09/26/14	CONCEPT DESIGN	KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM-MV(2)
E-506	LT0048-E-506PN	09/26/14	CONCEPT DESIGN	KANDAHAR EAST SUBSTATION GENERAL ARRANGEMENT-GA
E-507	LT0048-E-507LS	09/26/14	CONCEPT DESIGN	KANDAHAR EAST SUBSTATION GENERAL ARRANGEMENT-GA
E-508	LT0048-E-508EL	09/26/14	CONCEPT DESIGN	KANDAHAR EAST SUBSTATION SITE LOCATION MAP
E-509	LT0048-E-509EL	09/26/14	CONCEPT DESIGN	KANDAHAR EAST SUBSTATION ELEVATION(1)
E-5010	LT0048-E-509EL	09/26/14	CONCEPT DESIGN	KANDAHAR EAST SUBSTATION ELEVATION(2)

DRAWINGS INDEX

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WOLT0048, AMD4 SUBSTATIONS
FROM QARABAGH TO KANDAHAR EAST
DRAWINGS INDEX

SHEET REFERENCE NUMBER:
G-101

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PLAN LEGEND (SINGLE LINE DIAGRAM–HIGH VOLTAGE)

SYMBOL	DESCRIPTION
X	HV(220KV) SURGE ARRESTER (SA) X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
X	HV(110KV) SURGE ARRESTER (SA) X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
X	HV CAPACITIVE VOLTAGE TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
X	HV AC CIRCUIT BREAKER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
X M	HV MOTORIZED, HORIZONTAL MOVEMENT, DOUBLE END BREAK DISCONNECT (ISOLATOR) SWITCH WITH SINGLE END MANUAL EARTHING SWITCH. X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
X M	HV MOTORIZED, HORIZONTAL MOVEMENT, DOUBLE END BREAK DISCONNECT (ISOLATOR) SWITCH WITH DOUBLE END MANUAL EARTHING SWITCH. X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	HV 3 PHASE BUS
	HV 3 PHASE AUTO TRANSFORMER
X FF P G FF FF FF CCC – MMM	PROTECTIVE ELECTRONIC RELAY/METERING RELAY FF–DEDICATED RELAY FUNCTION (IEEE) X –EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE CCC –MAKER COMPANY OF THE RELAY MMM –MODEL OF THE RELAY
	HV 3 PHASE CAPACITIVE REACTOR
	HV 3 PHASE INDUCTIVE REACTOR
	HV 3 PHASE INDUCTIVE REACTOR WITH NEUTRAL CT
X	HV MULTI CORE/MULTI RATIO CURRENT TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
X	HV BUSHING CURRENT TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	GROUND COMMON POINT (GC)

PLAN LEGEND (SINGLE LINE DIAGRAM–MEDIUM VOLTAGE)

SYMBOL	DESCRIPTION
F	MV MANUAL OPERATED FUSED 3 PHASE DISCONNECT SWITCH
	POWER TRANSFORMER 3 PHASE DELTA/WYE WINDING
X	SURGE ARRESTOR (SA) X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
X FF P G FF FF FF CCC – MMM	PROTECTIVE ELECTRONIC RELAY/METERING RELAY FF–DEDICATED RELAY FUNCTION (IEEE) X –EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE CCC –MAKER COMPANY OF THE RELAY MMM –MODEL OF THE RELAY
	LV 3 PHASE STATION SERVICE TRANSFORMER
X	MV SWITCHGEAR CIRCUIT BREAKER X –EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
X	MV CURRENT TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
X	MV POTENTIAL TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	MV 3 PHASE INSULATED / UNDERGROUND CONDUCTORS
	MV 3 PHASE INSULATED CONDUCTOR CONNECTIONS
1 2 3 4 5 6 7 . .	MV SWITCHGEAR LINE UP

PLAN LEGEND (GENERAL ARRANGEMENT–GA)

SYMBOL	DESCRIPTION
	HIGH VOLTAGE SURGE ARRESTER– SA
	HIGH VOLTAGE CAPACITIVE VOLTAGE TRANSFORMER–CVT
	HIGH VOLTAGE TENSION INSULATOR
	HIGH VOLTAGE TENSION GANTRY
	HIGH VOLTAGE DOUBLE END BREAK (ISOLATOR–ISO) SWITCH WITH SINGLE OR DOUBLE END EARTHLING SWITCH
	HIGH VOLTAGE CURRENT TRANSFORMER–CT
	HIGH VOLTAGE CIRCUIT BREAKER–CB
	HV INDUCTIVE REACTOR
	HIGH VOLTAGE POWER TRANSFORMER
	HV CAPACITIVE REACTOR
	MV TRANSFORMER RISER
	CONDUCTOR POST
	SUPPORT POST
	20kV RISER POLE
	STEEL MAST

ABBREVIATIONS

SYMBOL	DESCRIPTION
A	AMPERE
AFF	ABOVE FINISHED FLOOR
BLDG	BUILDING
CT	CURRENT TRANSFORMER
CVT	CAPACITOR VOLTAGE TRANSFORMER
GEC	GROUNDING ELECTRODE CONDUCTOR
GES	GROUNDING ELECTRODE SYSTEM
GFE	GOVERNMENT FURNISHED EQUIPMENT, CONTRACTOR INSTALLED
HZ	HERTZ
kAIC	AMPERE INTERRUPTING CAPACITY IN THOUSANDS
kV	KILOVOLT
kVA	KILOVOLT–AMPERE
kW	KILOWATT
MVA	MEGAVOLTS–AMPERE
LA	LIGHTNING ARRESTER
M	METERS
mm	MILLIMETERS
MVA	MEGAVOLT–AMPERE
MVAR	MEGA–VAR
N	NEUTRAL
NIC	NOT IN CONTRACT
P	POLE
PH, ϕ	PHASE
PLC	PROGRAMMABLE LOGIC CONTROLLER
SA	SURGE ARRESTER
TYP	TYPICAL
UGE	UNDERGROUND ELECTRIC
UNO	UNLESS NOTED OTHERWISE
V	VOLT
W	WATT
W/	WITH
W/O	WITHOUT
XFMR,T	TRANSFORMER

RELAY LEGEND

27– UNDER VOLTAGE RELAY
25– SYNCHRONISM CHECK RELAY
32– DIRECTIONAL POWER RELAY
50– INSTANTANEOUS OVER CURRENT RELAY
51– INVERSE–TIME OVER CURRENT RELAY
52– AC CIRCUIT BREAKER RELAY
50BF–AC CIRCUIT BREAKER RELAY
59– OVER VOLTAGE RELAY
67N– NEUTRAL AC DIRECTIONAL OVERCURRENT RELAY
81– FREQUENCY RELAY
86– LOCK OUT RELAY
87B– BUS DIFFERENTIAL PROTECTIVE RELAY
87– DIFFERENTIAL PROTECTIVE RELAY
87T– TRANSFORMER DIFFERENTIAL PROTECTIVE RELAY
87N– RESISTIVE EARTH FAULT RELAY
89– LINE SWITCH RELAY
94– BREAKER FAILURE RELAY

GENERAL NOTES, LEGEND SYMBOLS & ABBRAVATIONS

SCALE NTS

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CONCEPT DESIGN SUBMITTAL

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DESIGNED BY: MAY
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DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048–G–102GN

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
GENERAL NOTES, LEGEND SYMBOLS & ABBRAVATIONS

SHEET REFERENCE NUMBER:
G–102

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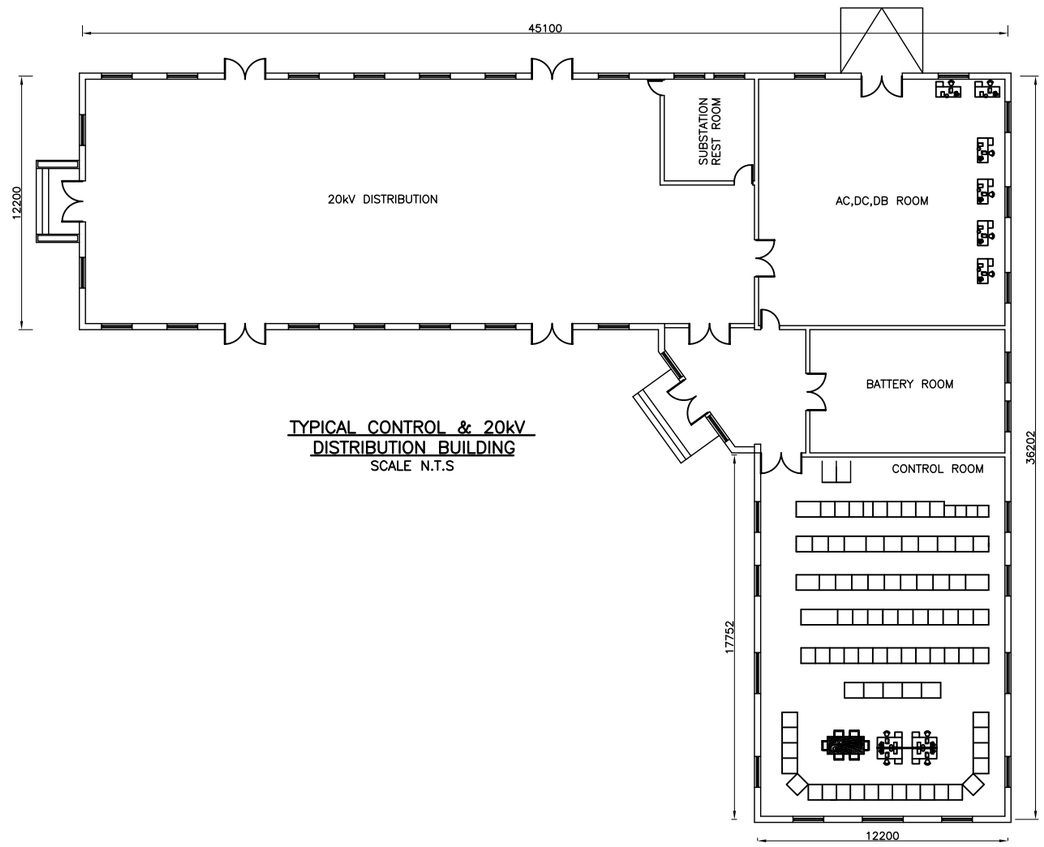

TYPICAL CONTROL & 20kV DISTRIBUTION BUILDING
SCALE N.T.S

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2. THE BUILDING SHOULD HAVE COMPLETE ELECTRICAL, SEWAGE, WATER, HVAC AND OTHER FACILITIES THAT IS REQUIRED FOR NORMAL ACCOMMODATION.

TYPICAL CONTROL & 20kV DISTRIBUTION BUILDING
SCALE N.T.S

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WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
TYPICAL CONTROL & 20kV DISTRIBUTION BUILDING

SHEET REFERENCE NUMBER:
G–103

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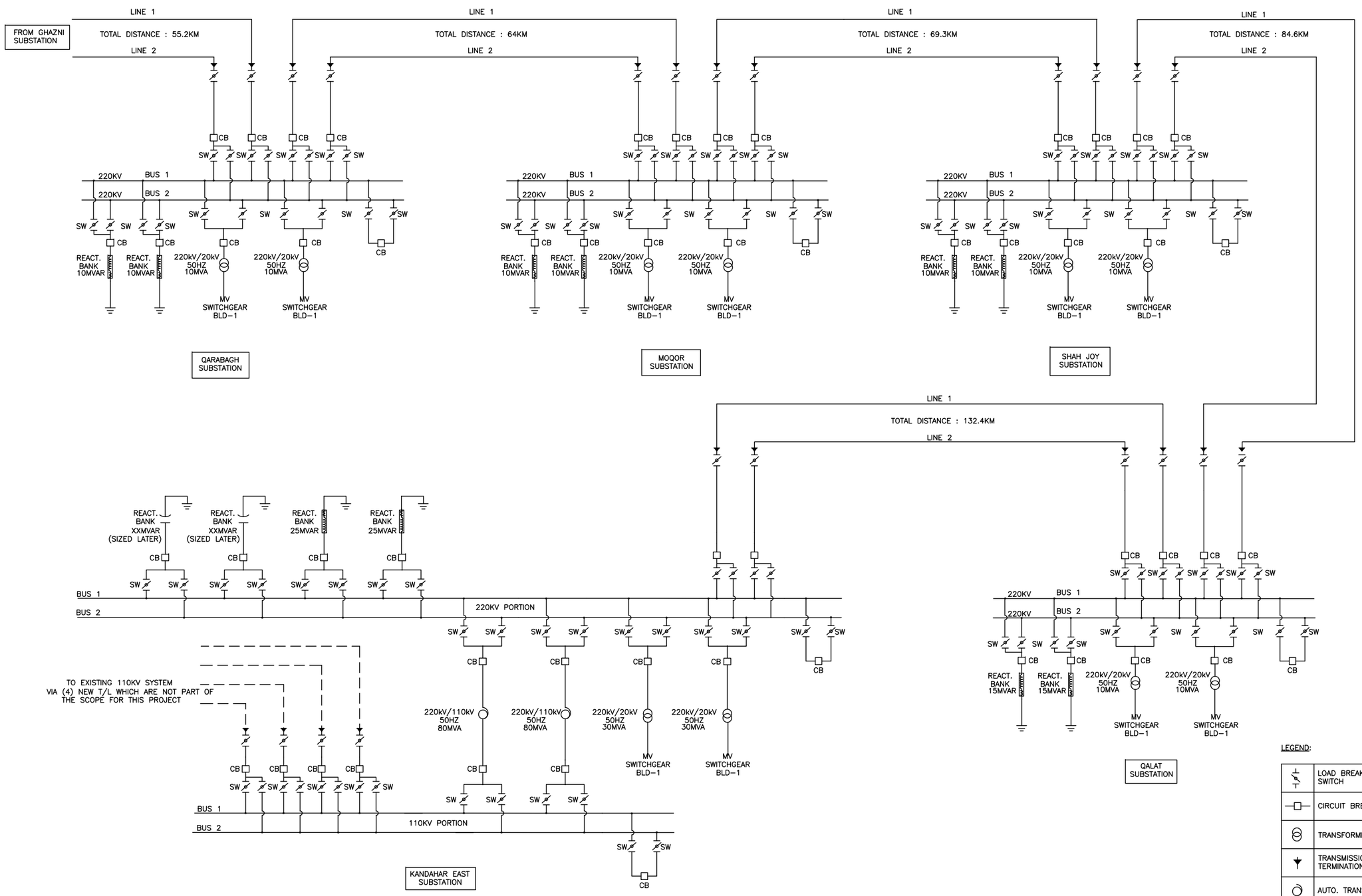

220KV SYSTEM SCHEMATIC DIAGRAM

SCALE: N.T.S

LEGEND:

	LOAD BREAK SWITCH
	CIRCUIT BREAKER
	TRANSFORMER
	TRANSMISSION LINE TERMINATION
	AUTO. TRANSFORMER
	INDUCTIVE BANK
	CAPACITIVE BANK

NOT FOR CONSTRUCTION

CONCEPT DESIGN SUBMITTAL

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CHECKED BY: DJ
CAD FILE NAME: LT0048-G-104DI

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220kV SYSTEM SCHEMATIC DIAGRAM

SHEET REFERENCE NUMBER:
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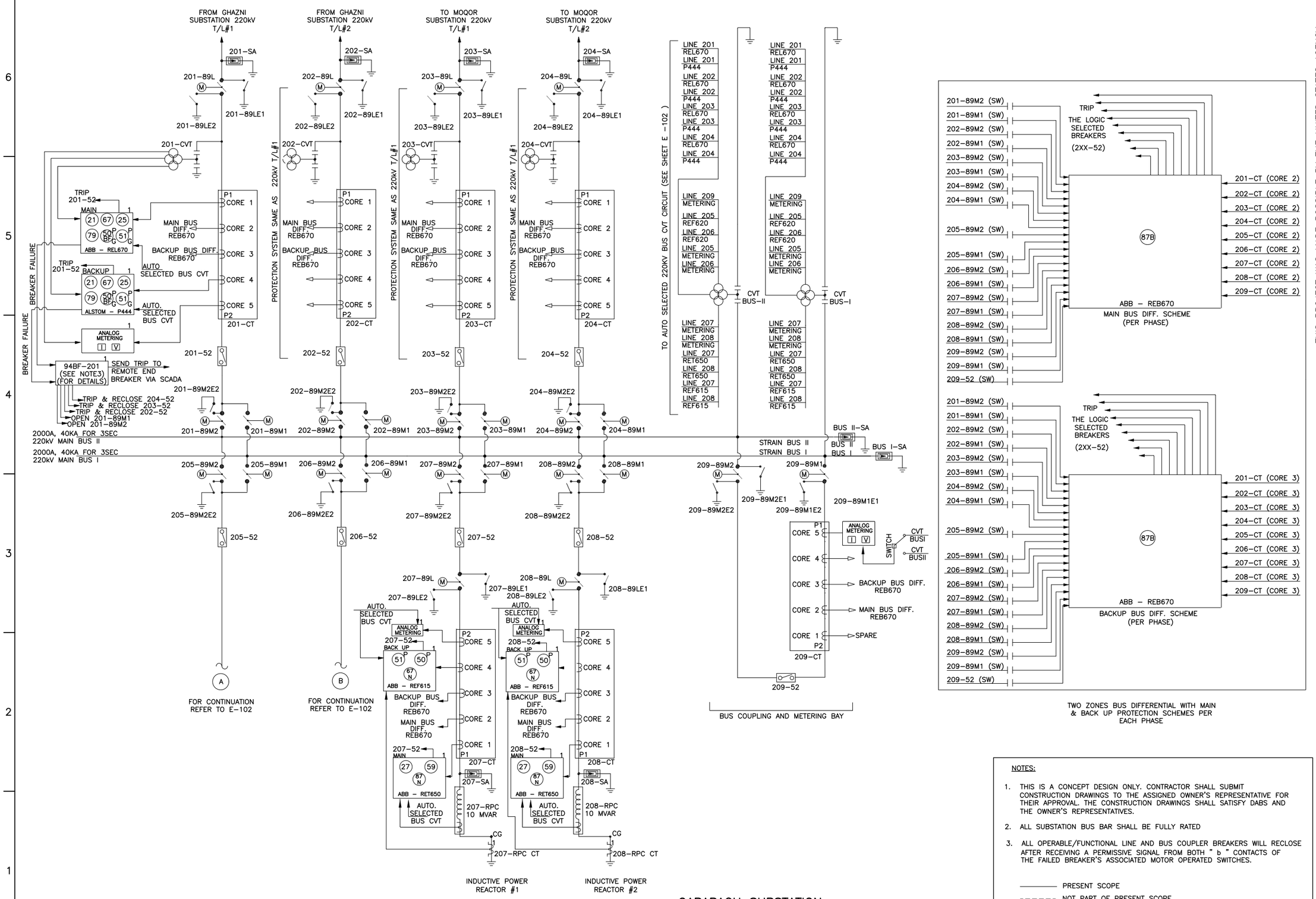

NOT FOR CONSTRUCTION

QARABAGH SUBSTATION
SINGLE LINE DIAGRAM–HV
SCALE: N.T.S

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3. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RECLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.

——— PRESENT SCOPE
- - - - - - NOT PART OF PRESENT SCOPE
XXX INDICATE THE CORRESPONDING CONTROLING BREAKER NUMBER ON THE LINE, FEEDER OR RPC BAY

CONCEPT DESIGN SUBMITTAL

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CHECKED BY: DJ
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WOLTO048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
QARABAGH SUBSTATION SINGLE LINE DIAGRAM – HV

SHEET REFERENCE NUMBER:
E–101

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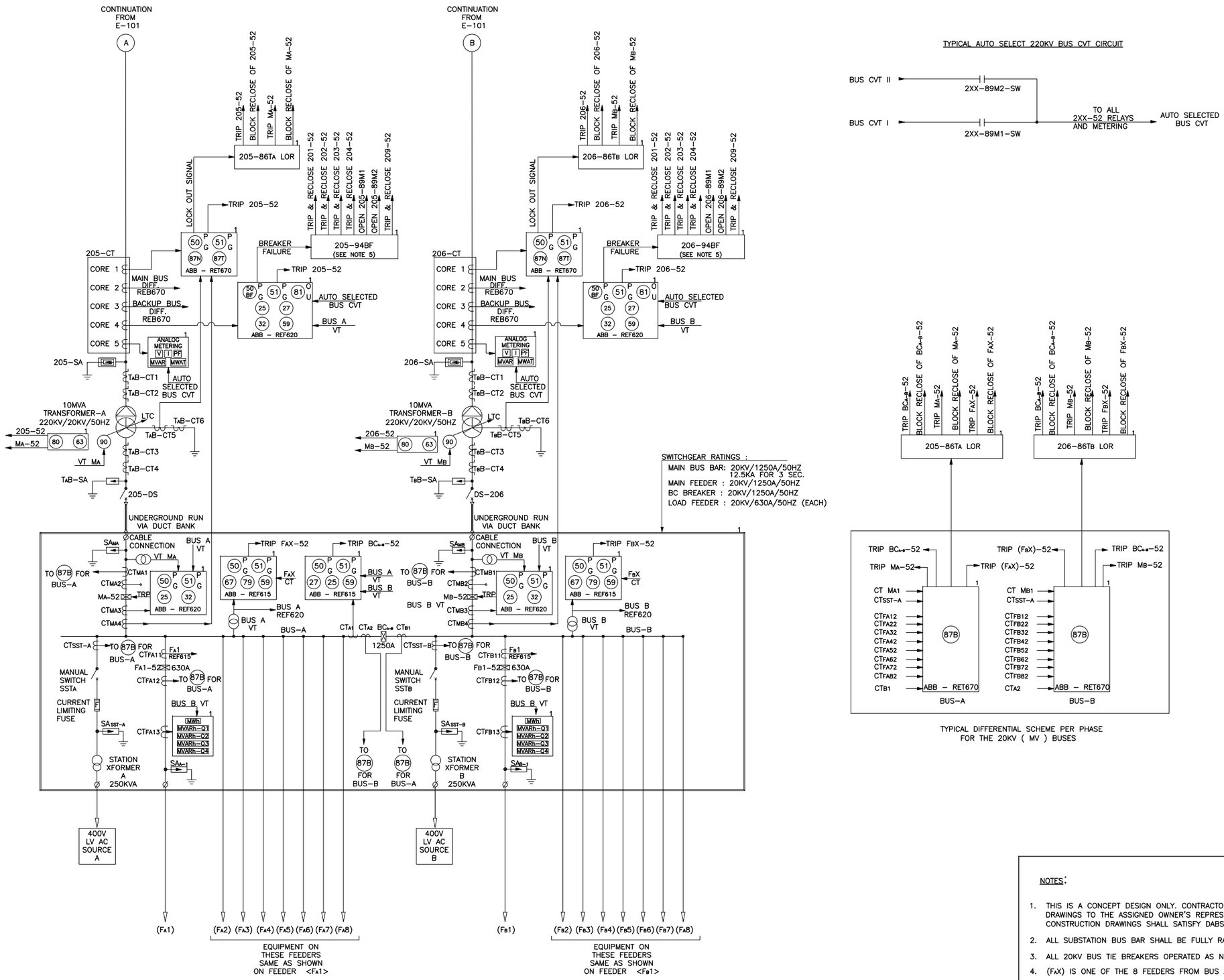

TYPICAL AUTO SELECT 220KV BUS CVT CIRCUIT

TYPICAL DIFFERENTIAL SCHEME PER PHASE FOR THE 20KV (MV) BUSES

QARABAGH SUBSTATION SINGLE LINE DIAGRAM-MV

SCALE: N.T.S

NOTES:

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3. ALL 20KV BUS TIE BREAKERS OPERATED AS NORMALLY OPEN.
4. (FAX) IS ONE OF THE 8 FEEDERS FROM BUS A .
5. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RECLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.

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CHECKED BY: DJ
CAD FILE NAME: LT0048-E-102DI

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WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
QARABAGH SUBSTATION SINGLE LINE DIAGRAM - MV

SHEET REFERENCE NUMBER:
E-102

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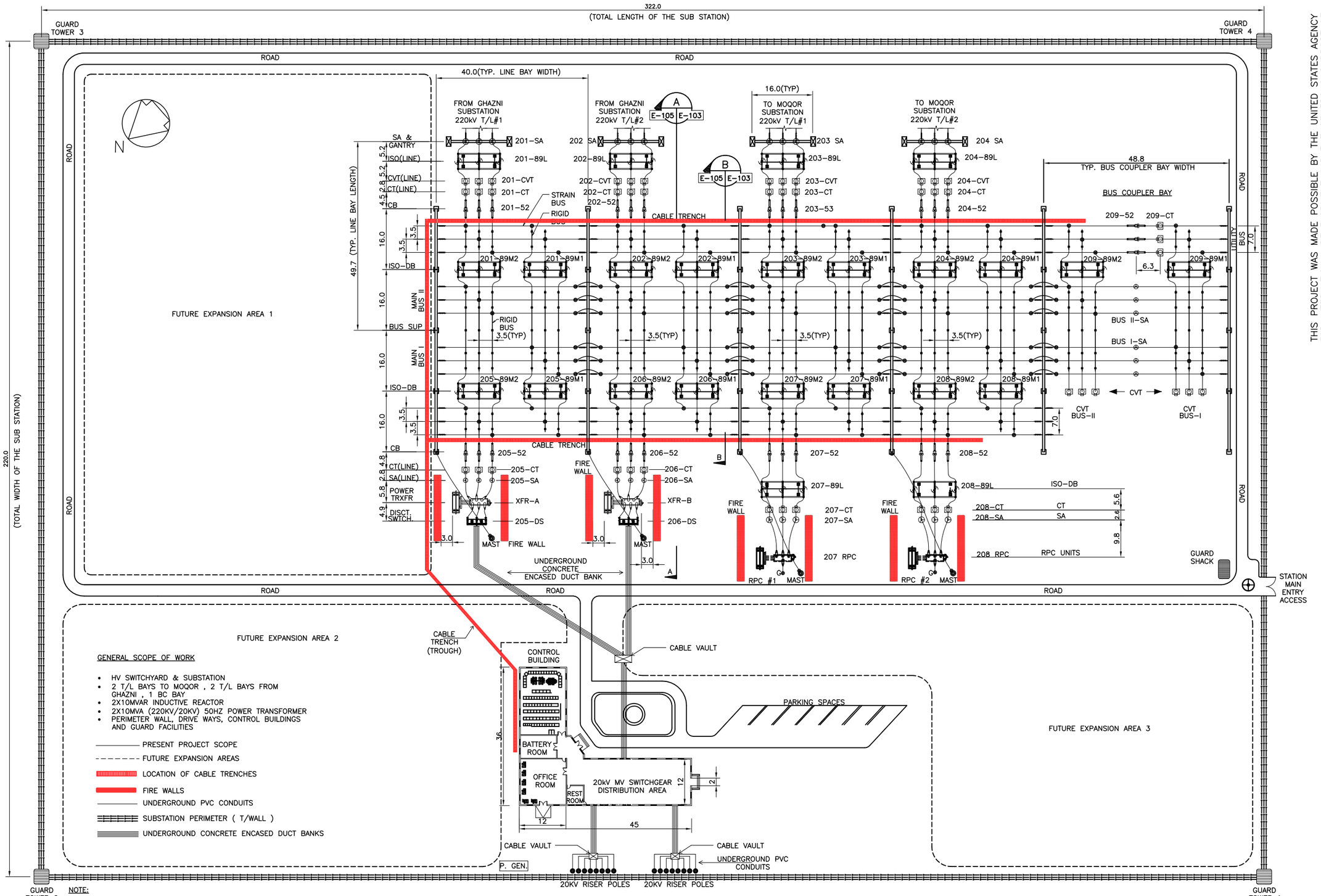

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WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
QARABAGH SUBSTATION GENERAL ARRANGEMENT – GA

SHEET REFERENCE NUMBER:
E-103

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QARABAGH SUBSTATION
SITE LOCATION MAP
SCALE 1:2

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DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
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CAD FILE NAME: LT0048-E-104LS

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WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
QARABAGH SUBSTATION SITE LOCATION MAP

SHEET REFERENCE NUMBER:
E-104

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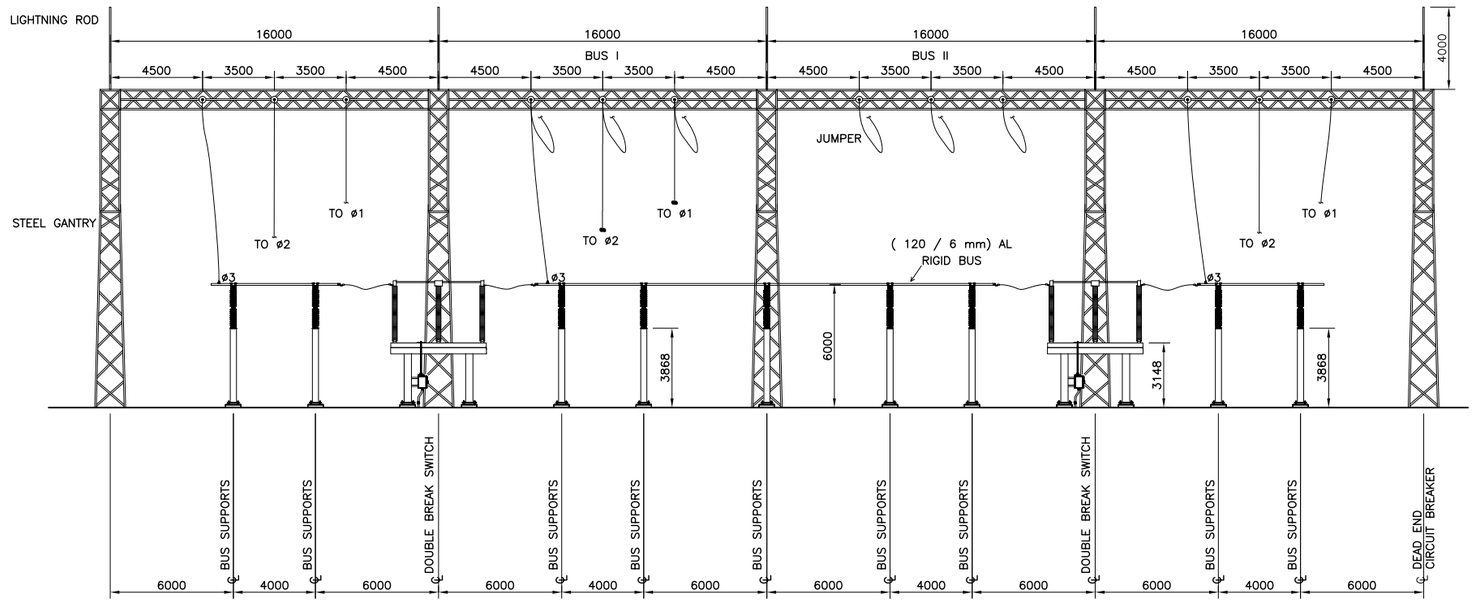
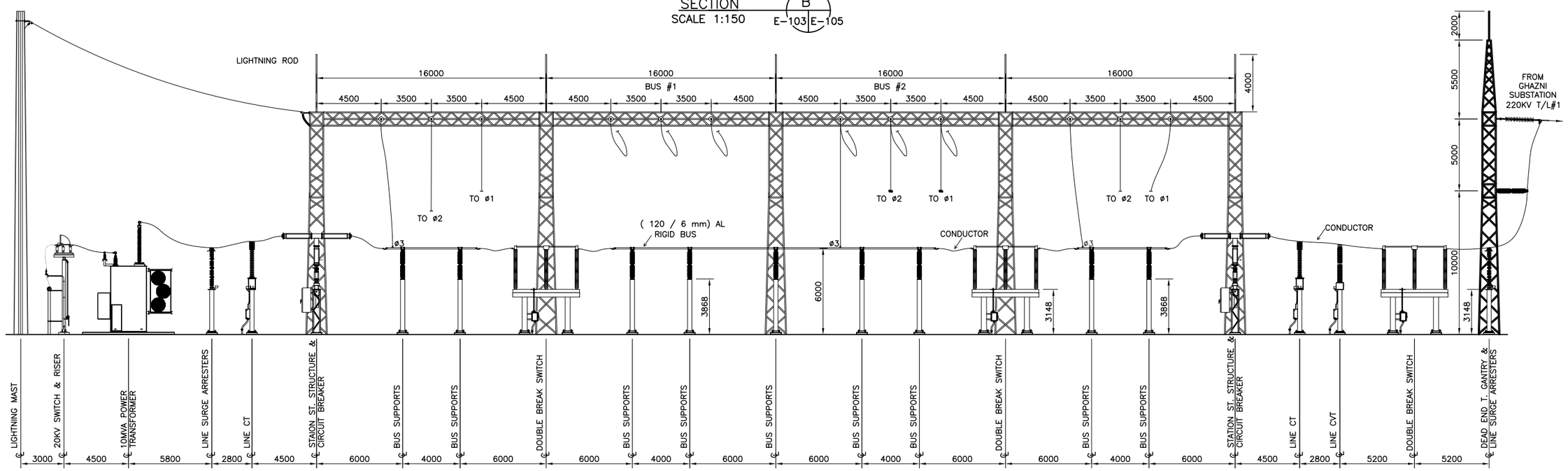


SECTION B
SCALE 1:150
E-103 E-105



SECTION A
SCALE 1:150
E-103 E-105

NOTES:

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2. DISTANCE BETWEEN ELECTRICAL COMPONENTS ARE IN mm.

QARABAGH SUBSTATION
ELEVATION
SCALE 1:150

0 3 6 9 15m
1:150

NOT FOR CONSTRUCTION

CONCEPT DESIGN SUBMITTAL

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WOLT0048, AMD4 SUBSTATIONS
FROM QARABAGH TO KANDAHAR
EAST
QARABAGH SUBSTATION
ELEVATION

SHEET REFERENCE NUMBER:
E-105

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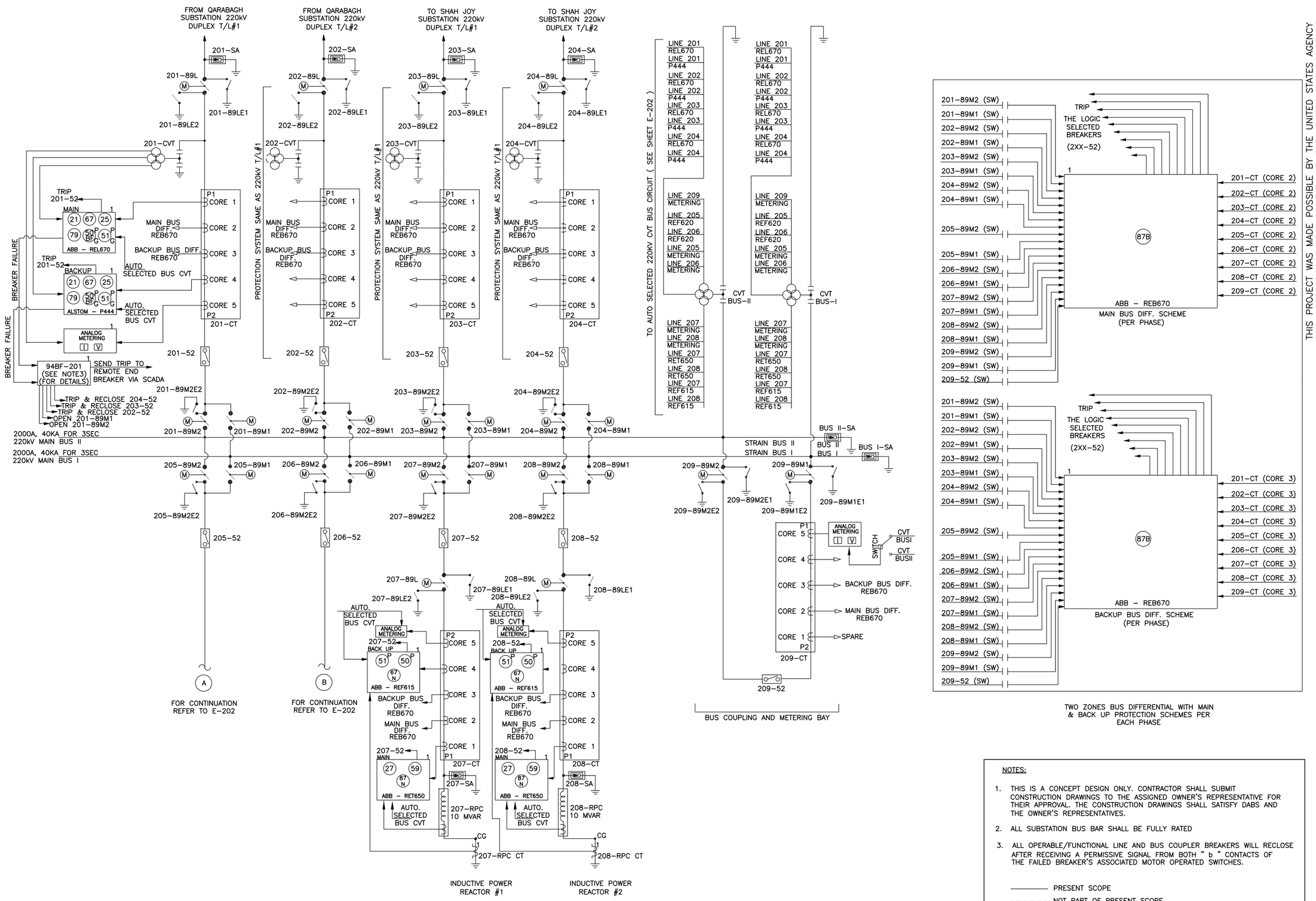

NOT FOR CONSTRUCTION

MOQOR SUBSTATION
SINGLE LINE DIAGRAM–HV
N.T.S

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——— PRESENT SCOPE
– – – – – – NOT PART OF PRESENT SCOPE
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WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
MOQOR SUBSTATION
SINGLE LINE DIAGRAM – HV

SHEET REFERENCE NUMBER:
E–201

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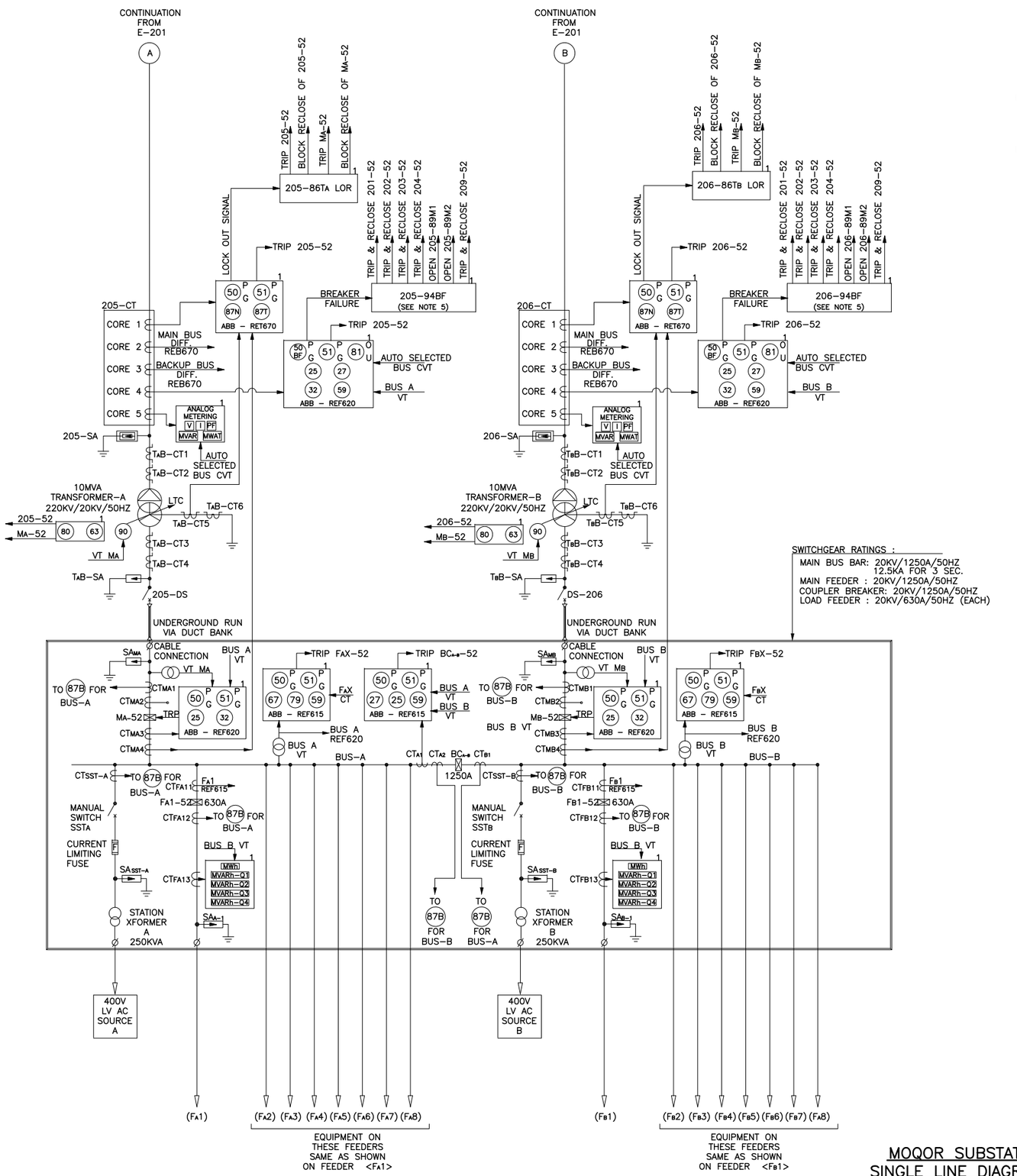
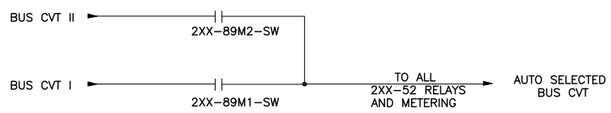
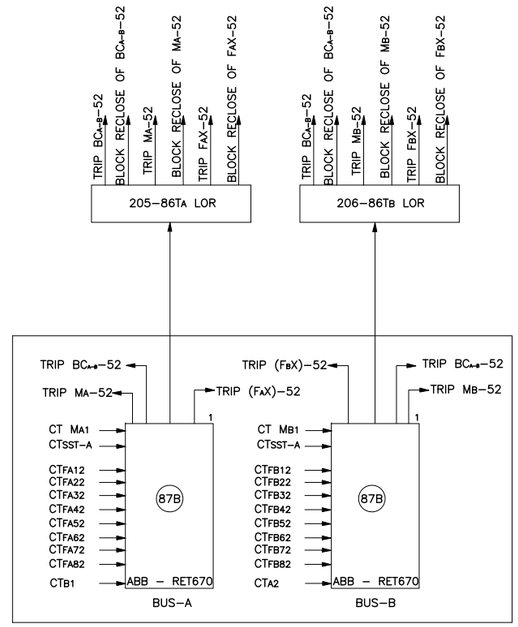


SWITCHGEAR RATINGS :
MAIN BUS BAR: 20KV/1250A/50HZ 12.5KA FOR 3 SEC.
MAIN FEEDER : 20KV/1250A/50HZ
COUPLER BREAKER: 20KV/1250A/50HZ
LOAD FEEDER : 20KV/630A/50HZ (EACH)

TYPICAL AUTO SELECT 220KV BUS CVT





TYPICAL DIFFERENTIAL SCHEME PER PHASE FOR THE 20KV (MV) BUSES

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MOQOR SUBSTATION
SINGLE LINE DIAGRAM-MV
SCALE: N.T.S

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CHECKED BY: DJ
CAD FILE NAME: LT0048-E-202DI

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WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
MOQOR SUBSTATION
SINGLE LINE DIAGRAM - MV

SHEET REFERENCE NUMBER:
E-202

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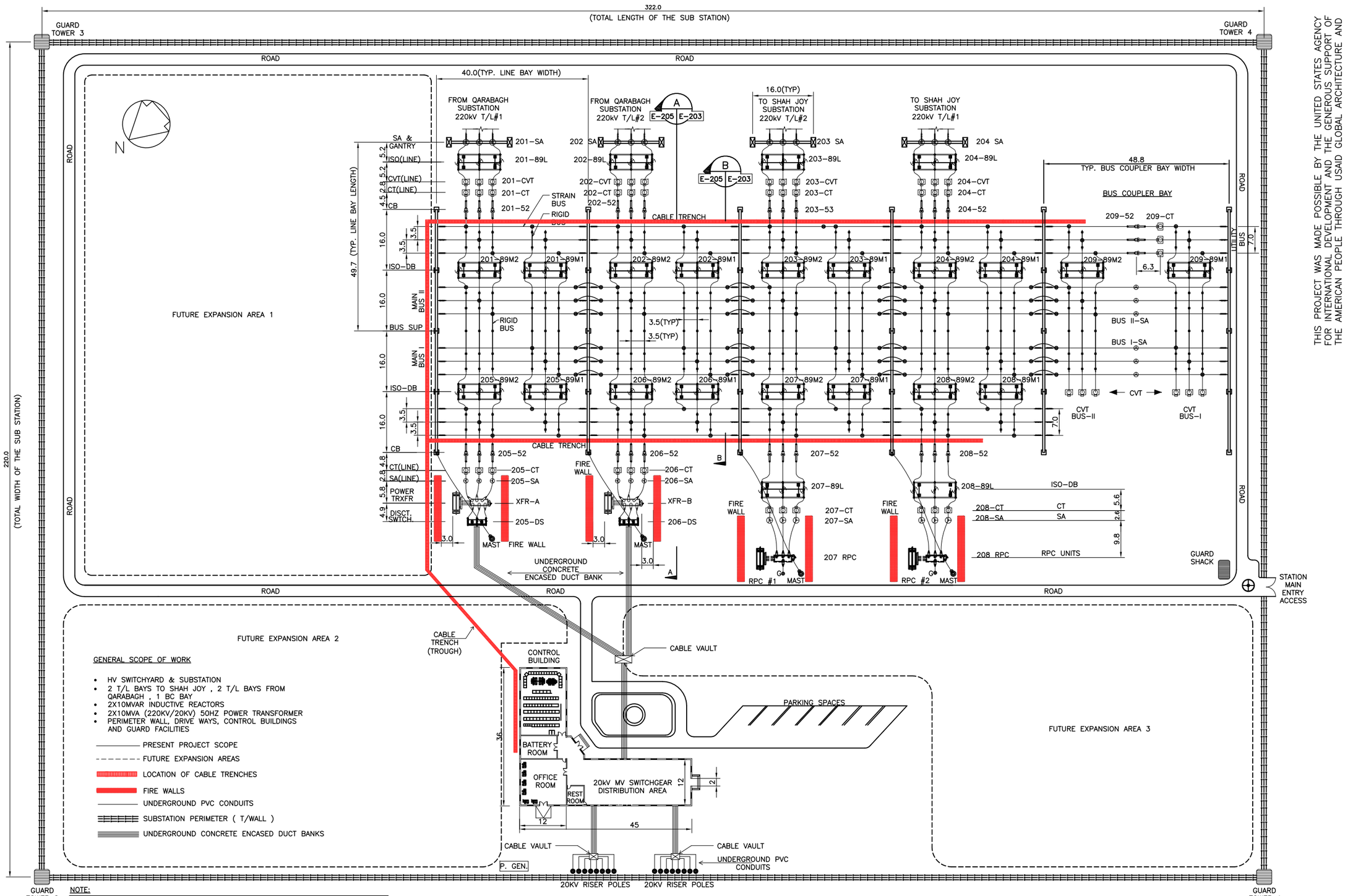

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WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
MOQOR SUBSTATION
GENERAL ARRANGEMENT - GA

SHEET REFERENCE NUMBER:
E-203

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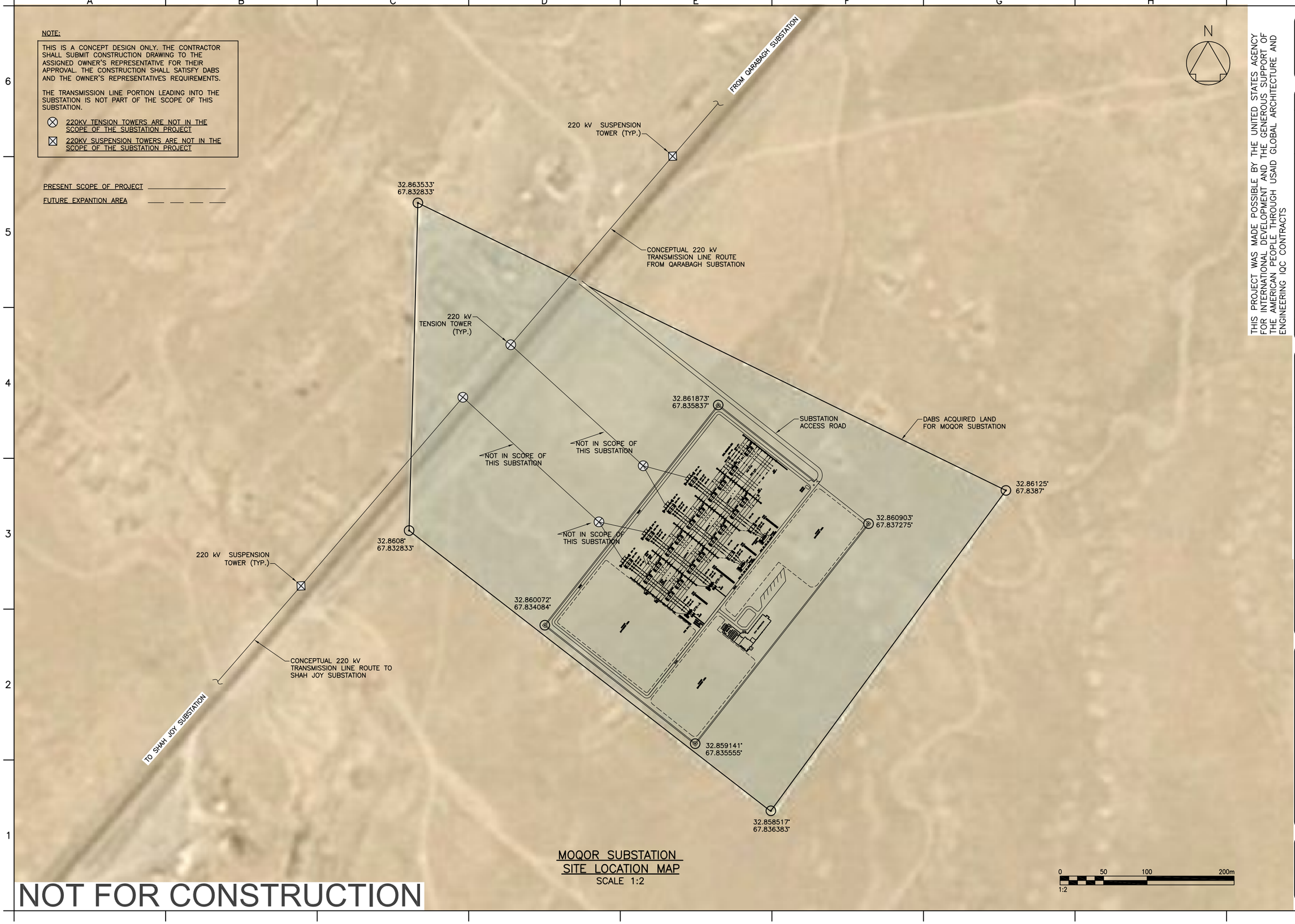


MOQOR SUBSTATION
SITE LOCATION MAP
SCALE 1:2

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-204LS

USAID FROM THE AMERICAN PEOPLE
A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
MOQOR SUBSTATION SITE LOCATION MAP

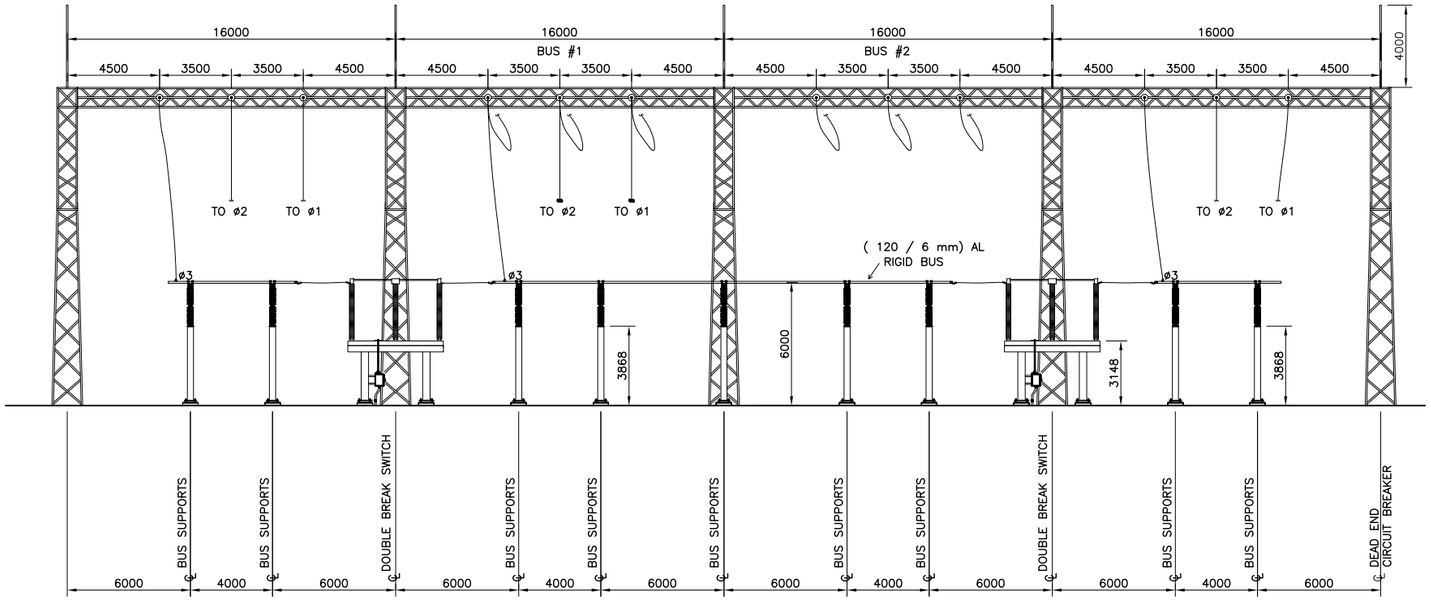
SHEET REFERENCE NUMBER:
E-204

P:\1298\Work Orders\WO-LT\WO-LT-0048 PTEC SOW Preparation\CAD\SheetFiles\141110_LT0048-AMD4 REVISED\MOQOR\CAD files\E-204.dwg 11/23/2014 9:29:22 AM Yarmand, Mohammad Arash

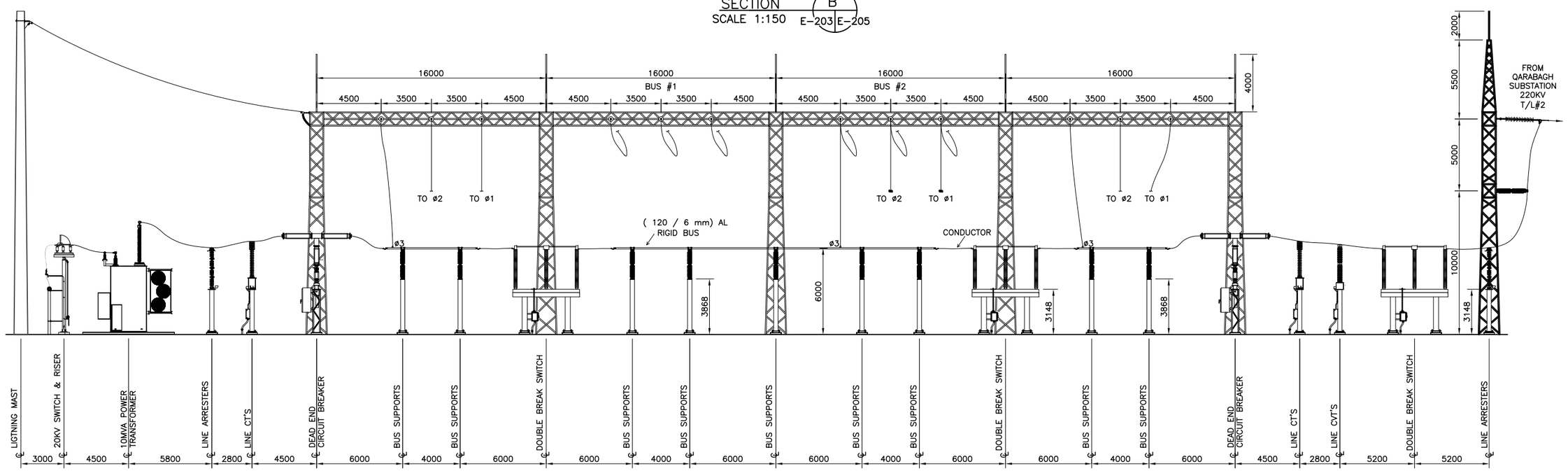
NOTES:

1. THIS IS A CONCEPT DESIGN ONLY,CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWING TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.

2. DISTANCE BETWEEN ELECTRICAL COMPONENTS ARE IN mm.



SECTION B E-203 E-205
SCALE 1:150



SECTION A E-203 E-205
SCALE 1:150

MOQOR SUBSTATION
ELEVATION
SCALE 1:150

0 3 6 9 15m
1:150

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-205EL

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS
FROM QARABAGH TO KANDAHAR
EAST
MOQOR SUBSTATION
ELEVATION

SHEET REFERENCE NUMBER:
E-205

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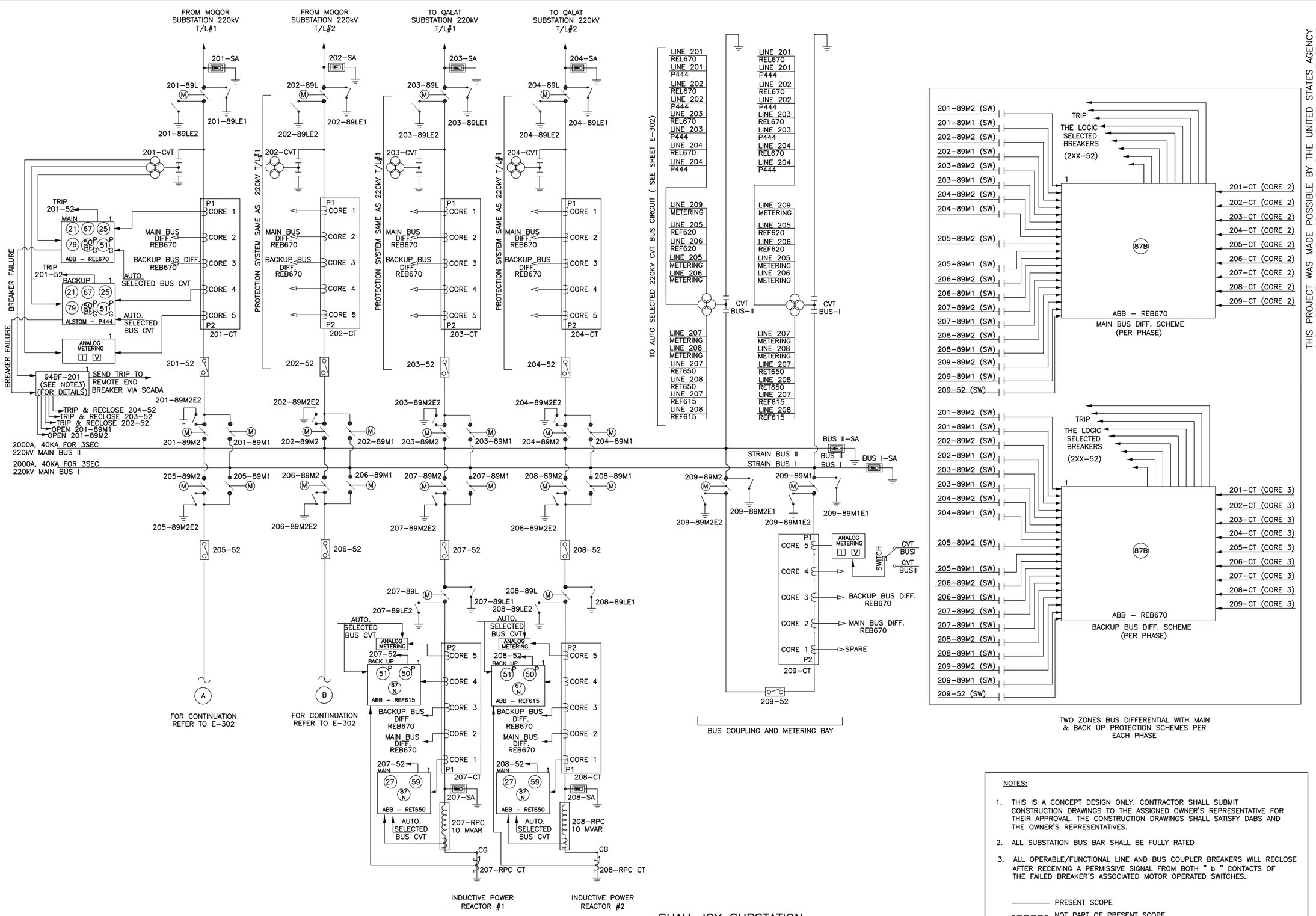

NOT FOR CONSTRUCTION

SHAH JOY SUBSTATION
SINGLE LINE DIAGRAM–HV
N.T.S

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED
3. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RECLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.

——— PRESENT SCOPE
– – – – – – NOT PART OF PRESENT SCOPE
XXX INDICATE THE CORresponding CONTROLING BREAKER NUMBER ON THE LINE, FEEDER OR RPC BAY

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

STMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY — DATE: 9/26/14
DRAWN BY: WM — SUBMITTED BY: Tetra Tech
CHECKED BY: DJ — CAD FILE NAME: LT0048-E-301DI

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
SHAH JOY SUBSTATION
SINGLE LINE DIAGRAM – HV

SHEET REFERENCE NUMBER:
E–301

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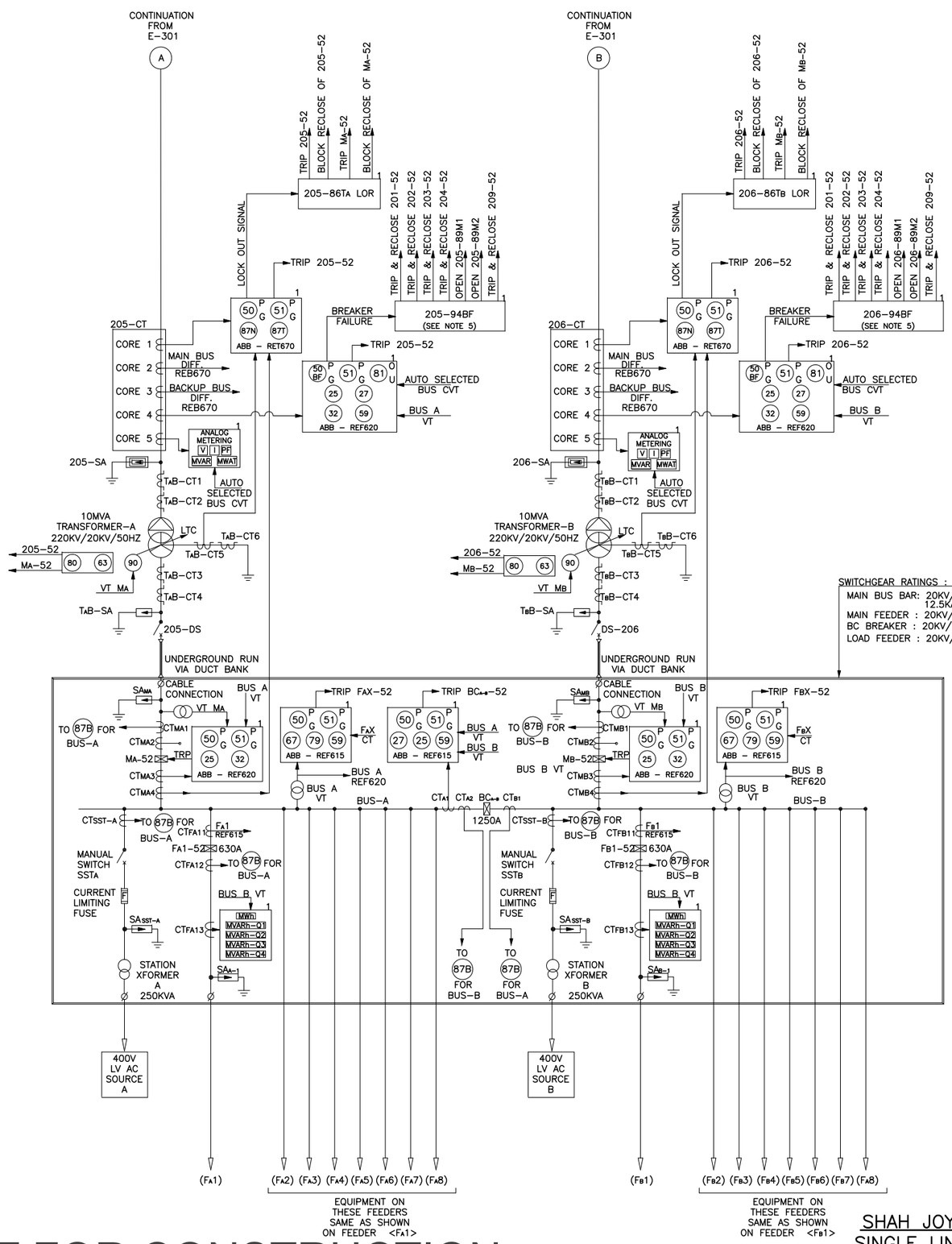
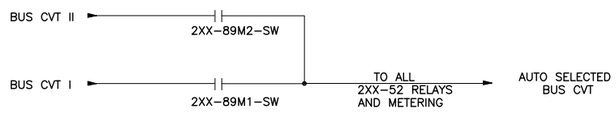
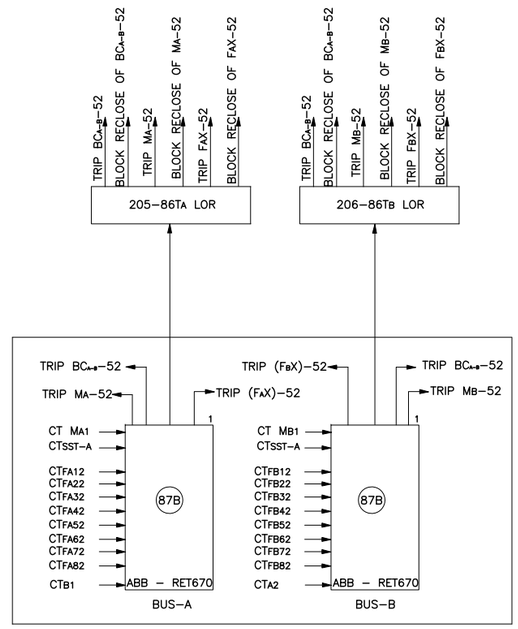


SWITCHGEAR RATINGS :

MAIN BUS BAR: 20KV/1250A/50HZ
12.5KA FOR 3 SEC.
MAIN FEEDER : 20KV/1250A/50HZ
BC BREAKER : 20KV/1250A/50HZ
LOAD FEEDER : 20KV/630A/50HZ (EACH)

TYPICAL AUTO SELECT 220KV BUS CVT





TYPICAL DIFFERENTIAL SCHEME PER PHASE FOR THE 20KV (MV) BUSES

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED.
3. ALL 20KV BUS TIE BREAKERS OPERATED AS NORMALLY OPEN.
4. (FAX) IS ONE OF THE 8 FEEDERS FROM BUS A .
5. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RECLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.

SHAH JOY SUBSTATION
SINGLE LINE DIAGRAM–MV
N.T.S

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-302DI

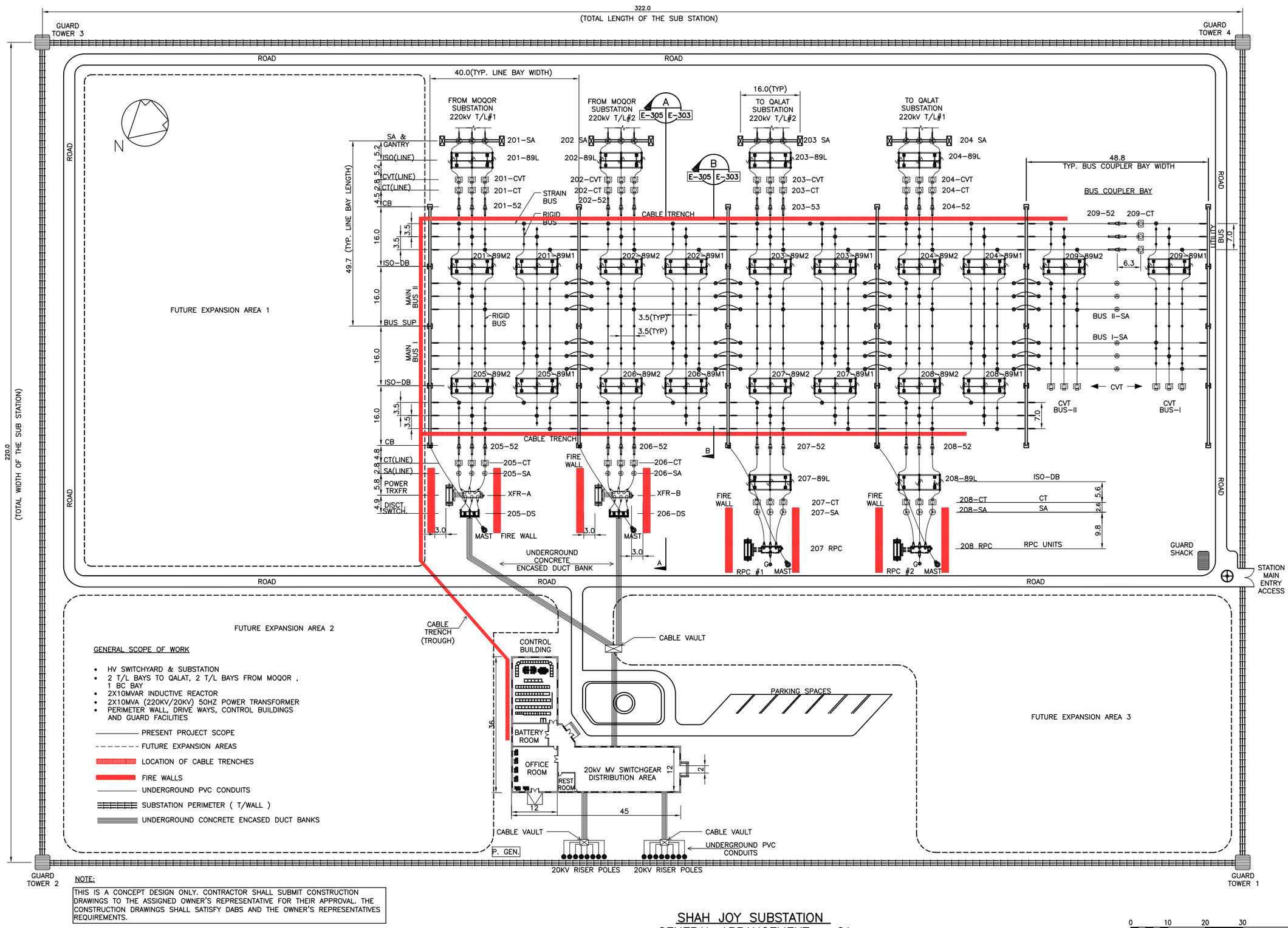
USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
SHAH JOY SUBSTATION SINGLE LINE DIAGRAM – MV

SHEET REFERENCE NUMBER:
E-302

P:\1298\Work Orders\WO-LT\WO-LT-0048 PTEC SOW Preparation\CAD\SheetFiles\141110_LT0048-AMD4 REVISED\SHAH JOY\CAD files\E-302.dwg 11/23/2014 9:44:21 AM Yarmand, Mohammad Arash



NOTE:
THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES REQUIREMENTS.

NOT FOR CONSTRUCTION

SHAH JOY SUBSTATION
GENERAL ARRANGEMENT – GA
SCALE: 2:1

0 10 20 30 50m
2:1

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAT
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-303PN

USAID FROM THE AMERICAN PEOPLE
A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
SHAH JOY SUBSTATION
GENERAL ARRANGEMENT – GA

SHEET REFERENCE NUMBER:
E-303

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SHAH JOY SUBSTATION
SITE LOCATION MAP
SCALE 1:2

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

STMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-304LS

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
SHAH JOY SUBSTATION SITE LOCATION MAP

SHEET REFERENCE NUMBER:
E-304

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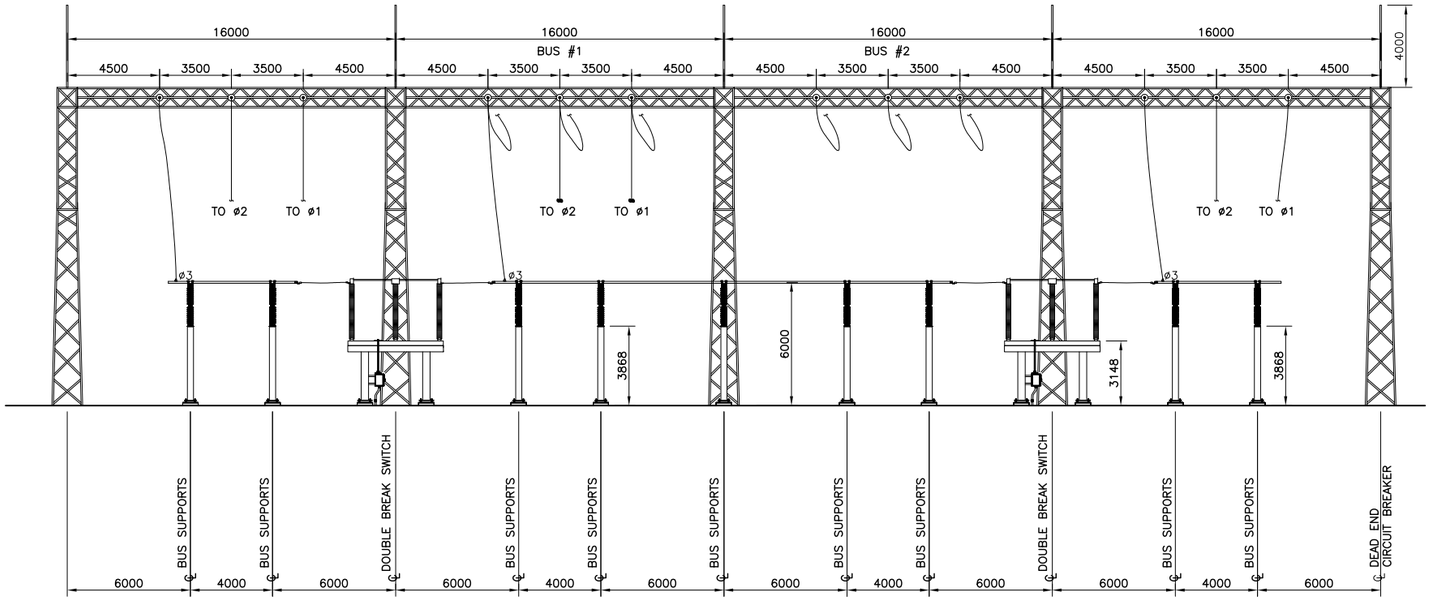
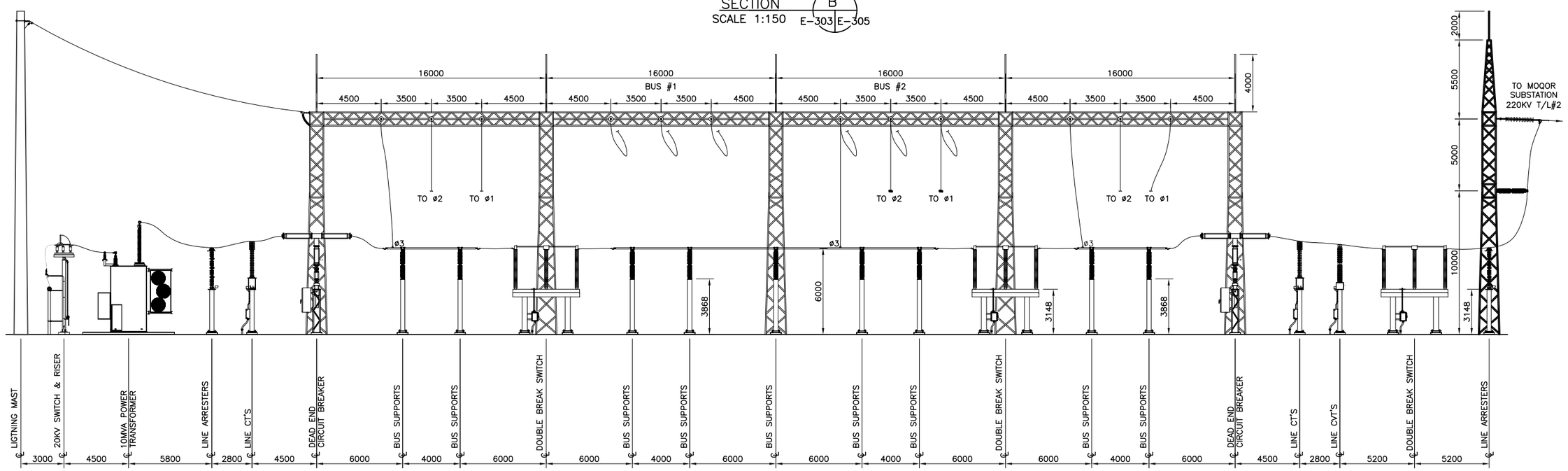
NOTES:

1. THIS IS A CONCEPT DESIGN ONLY,CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWING TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.

2. DISTANCE BETWEEN ELECTRICAL COMPONENTS ARE IN mm.



SECTION B E-303 E-305
SCALE 1:150



SECTION A E-303 E-305
SCALE 1:150

SHAH JOY SUBSTATION
ELEVATION
SCALE 1:150

0 3 6 9 15m
1:150

NOT FOR CONSTRUCTION

CONCEPT DESIGN SUBMITTAL

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-305EL

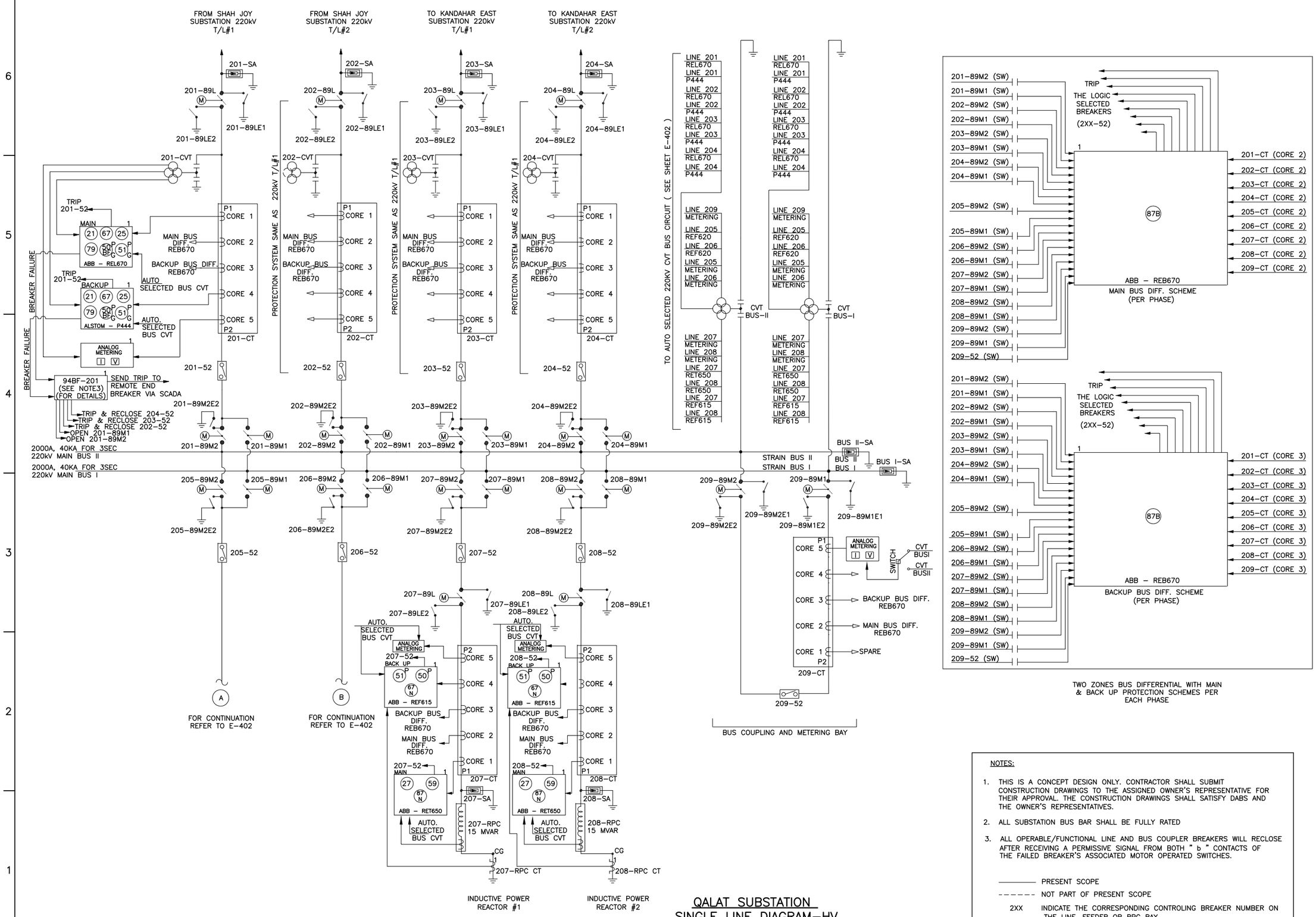
USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS
FROM QARABAGH TO KANDAHAR EAST
SHAH JOY SUBSTATION
ELEVATION

SHEET REFERENCE NUMBER:
E-305

P:\1298\Work Orders\WO-LT\WO-LT-0048 PTEC SOW Preparation\CAD\SheetFiles\141110_LT0048-AMD4 REVISED\SHAH JOY\CAD files\E-305.dwg 11/23/2014 9:41:57 AM Yarmand, Mohammad Arash



NOT FOR CONSTRUCTION

QALAT SUBSTATION
SINGLE LINE DIAGRAM–HV
N.T.S

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED
3. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RECLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.

——— PRESENT SCOPE
– – – – – – NOT PART OF PRESENT SCOPE
2XX INDICATE THE CORRESPONDING CONTROLING BREAKER NUMBER ON THE LINE, FEEDER OR RPC BAY

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-401DI

USAID FROM THE AMERICAN PEOPLE
A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
QALAT SUBSTATION
SINGLE LINE DIAGRAM – HV

SHEET REFERENCE NUMBER:
E-401

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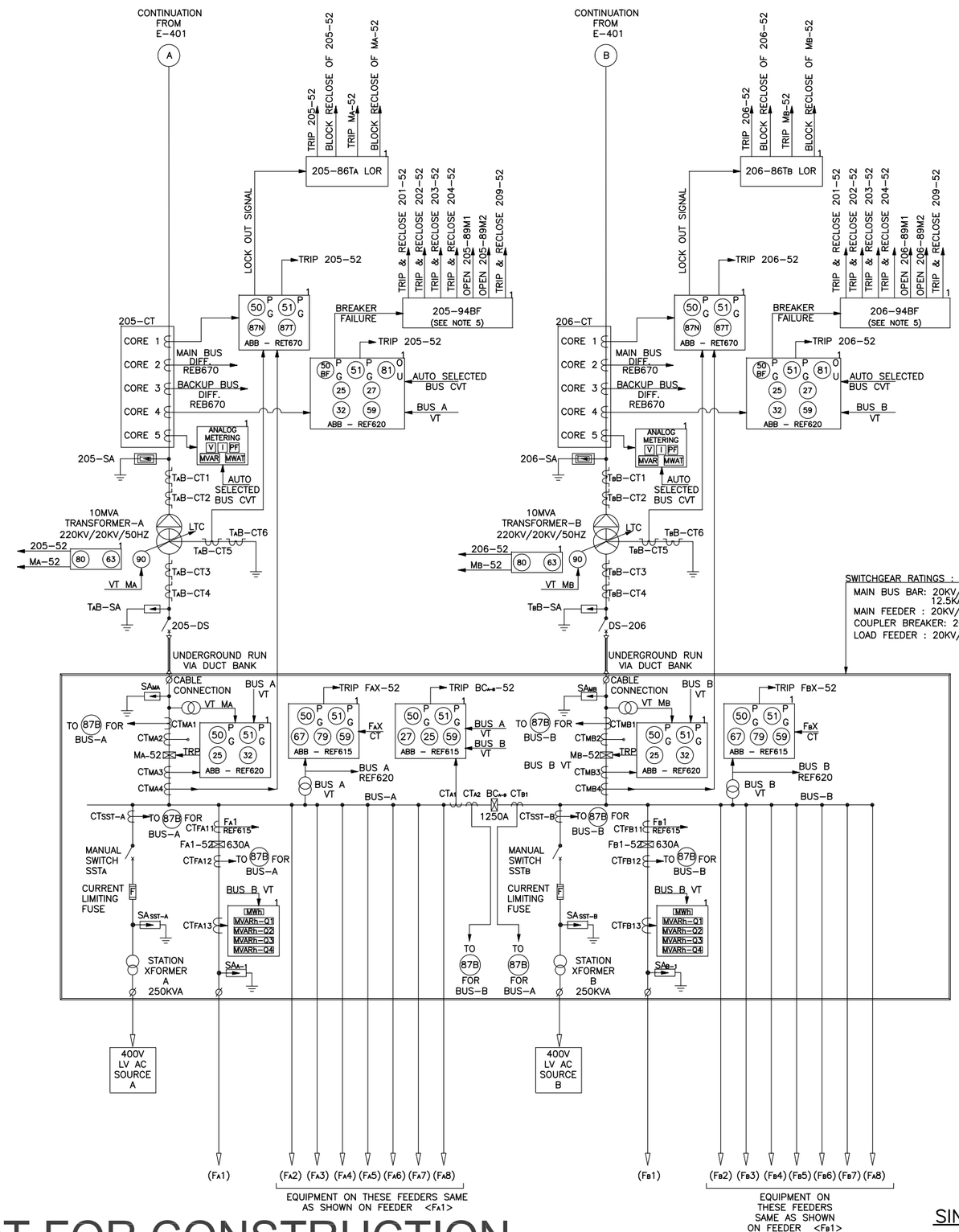
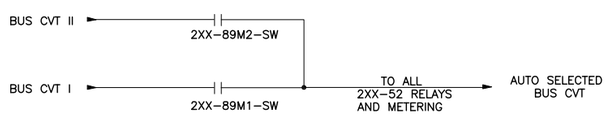
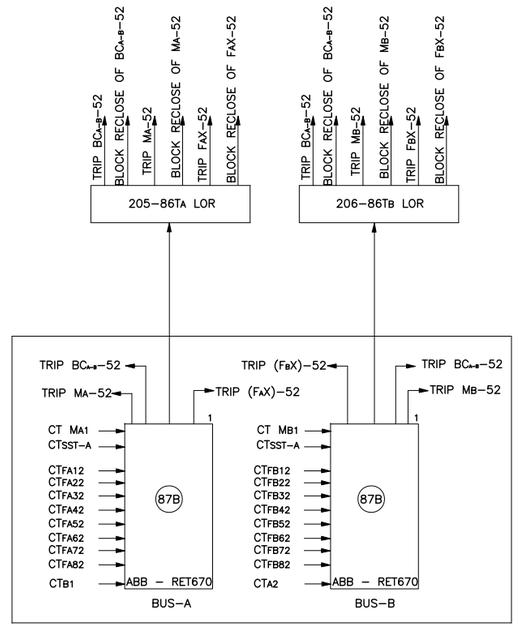


SWITCHGEAR RATINGS :
MAIN BUS BAR: 20KV/1250A/50HZ
12.5KA FOR 3 SEC.
MAIN FEEDER : 20KV/1250A/50HZ
COUPLER BREAKER: 20KV/1250A/50HZ
LOAD FEEDER : 20KV/630A/50HZ (EACH)

TYPICAL AUTO SELECT 220KV BUS CVT





TYPICAL DIFFERENTIAL SCHEME PER PHASE FOR THE 20KV (MV) BUSES

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED.
3. ALL 20KV BUS TIE BREAKERS OPERATED AS NORMALLY OPEN.
4. (FAX) IS ONE OF THE 8 FEEDERS FROM BUS A .
5. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RECLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.

QALAT SUBSTATION
SINGLE LINE DIAGRAM–MV
N.T.S

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-402DI

USAID FROM THE AMERICAN PEOPLE

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
QALAT SUBSTATION
SINGLE LINE DIAGRAM – MV

SHEET REFERENCE NUMBER:
E–402

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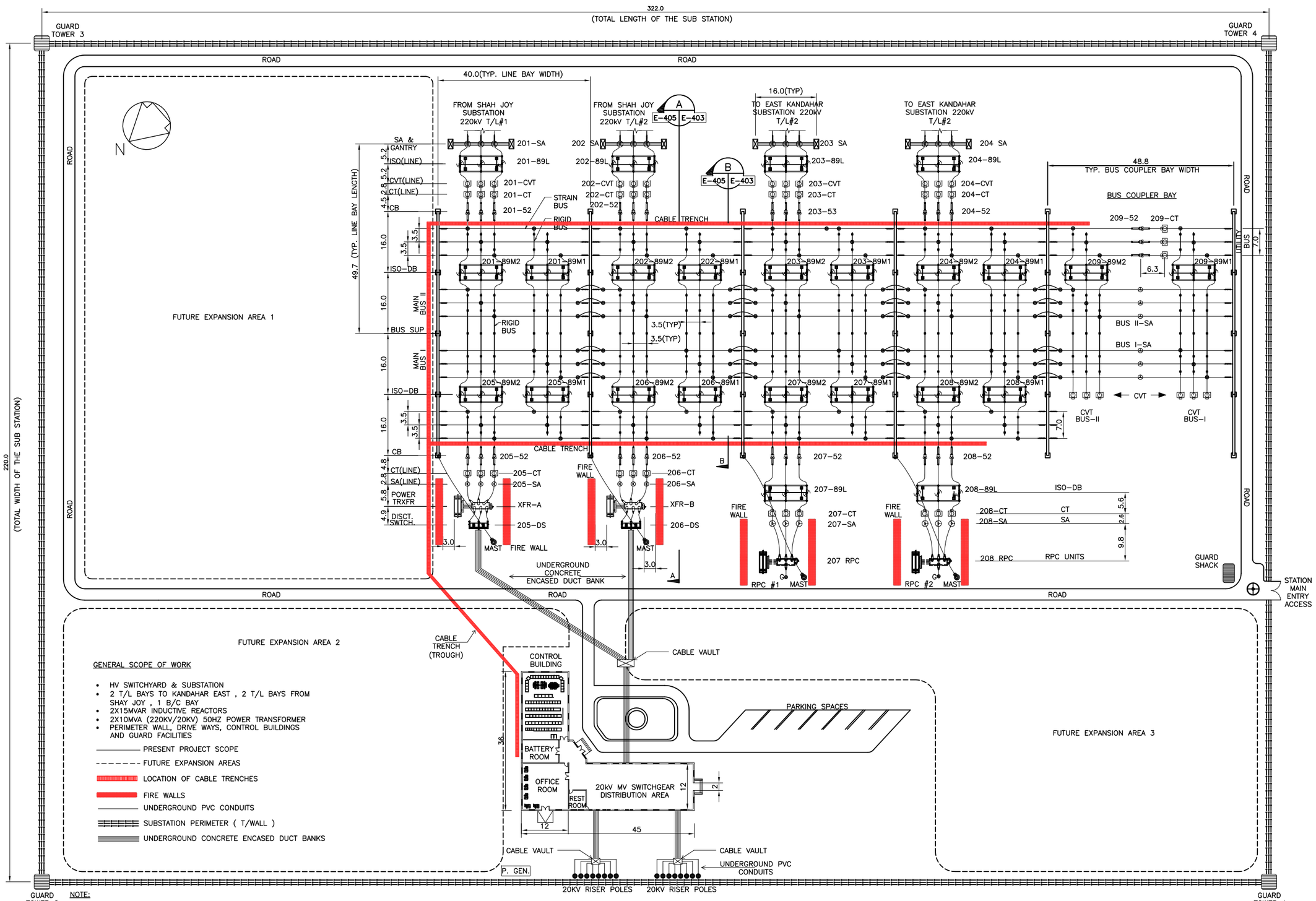


THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
1	LINE EARTHING SWITCHES REVISED	11/24/14	DJ
0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

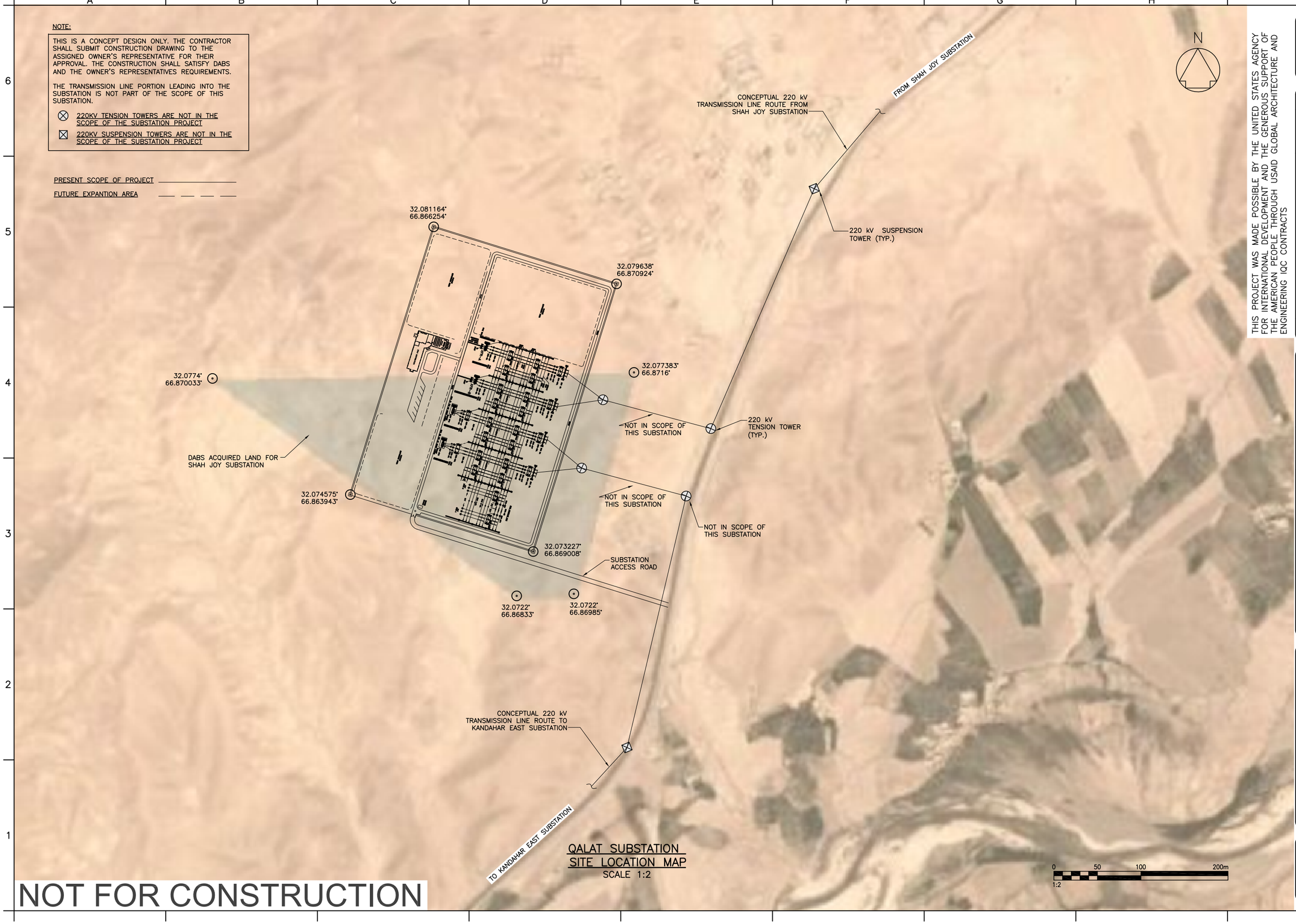
DESIGNED BY: MAYY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-403PN

USAID FROM THE AMERICAN PEOPLE
A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
QALAT SUBSTATION
GENERAL ARRANGEMENT – GA

SHEET REFERENCE NUMBER:
E-403

P:\1298\Work Orders\WO-LT\WO-LT-0048 PTEC SOW Preparation\CAD\SheetFiles\141110_LT0048-AMD4 REVISED\QALAT\CAD files\E-403.dwg 11/23/2014 9:35:58 AM Yarmand, Mohammad Arash



THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

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A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-404LS

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
QALAT SUBSTATION SITE LOCATION MAP

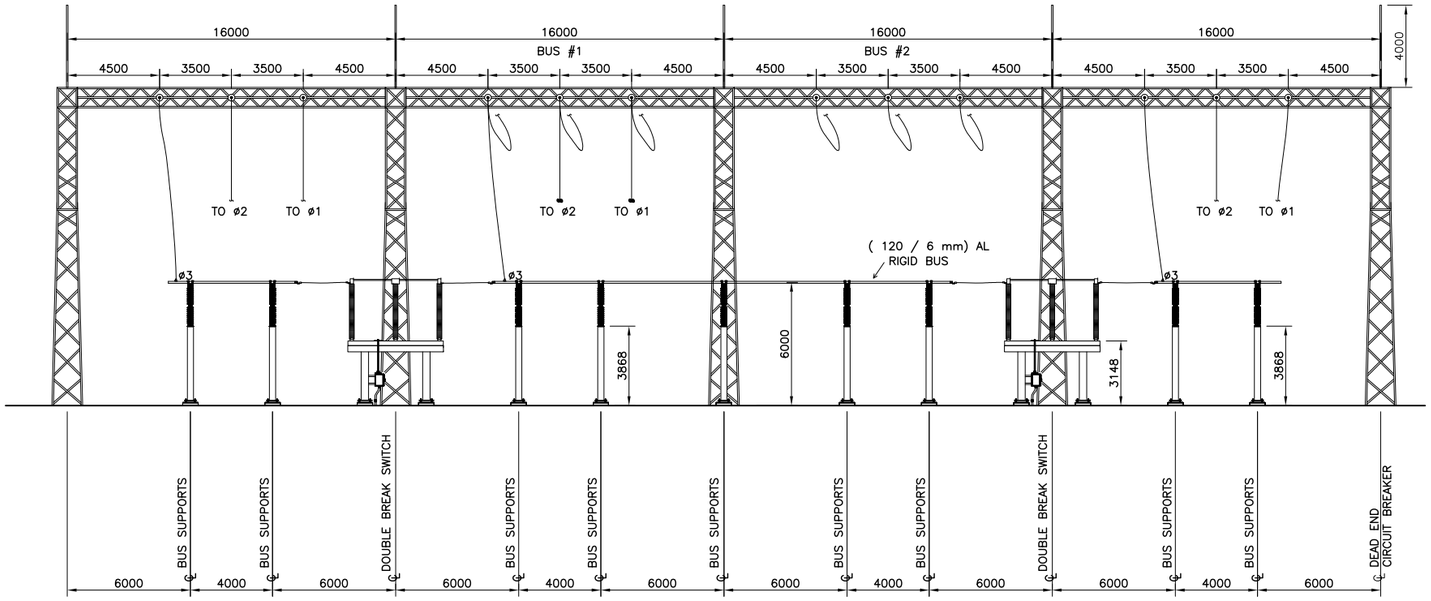
SHEET REFERENCE NUMBER:
E-404

P:\1298\Work Orders\WO-LT\WO-LT-0048 PTEC SOW Preparation\CAD\SheetFiles\141110_LT0048-AMD4 REVISED\QALAT\CAD files\E-404.dwg 11/23/2014 9:34:47 AM Yarmand, Mohammad Arash

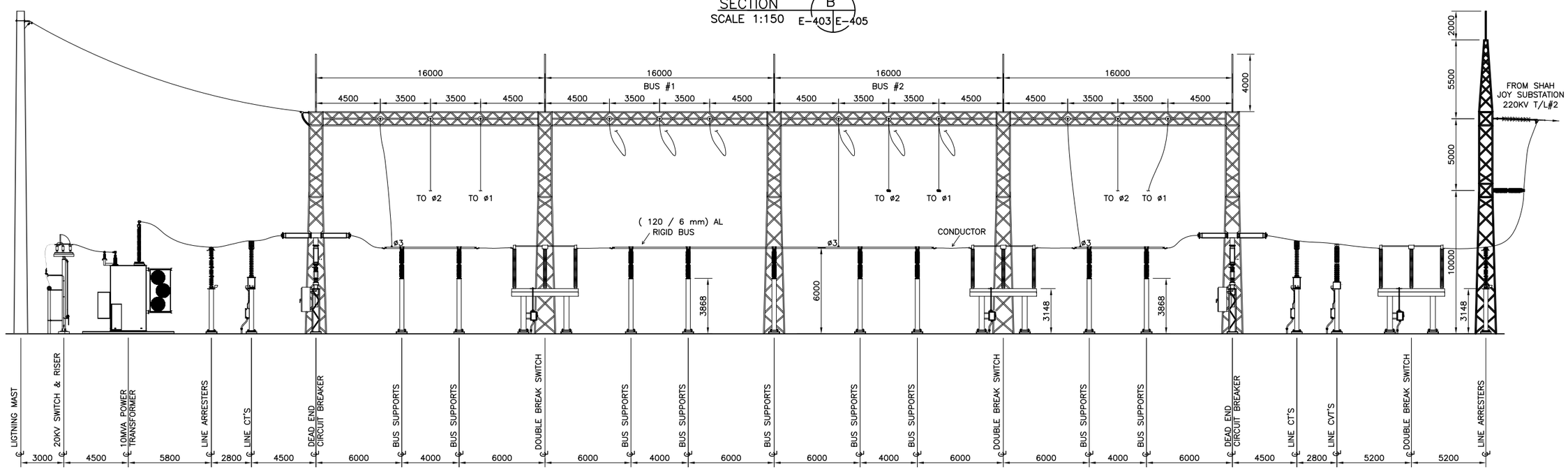
NOTES:

1. THIS IS A CONCEPT DESIGN ONLY,CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWING TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.

2. DISTANCE BETWEEN ELECTRICAL COMPONENTS ARE IN mm.



SECTION B
SCALE 1:150 E-403 E-405



SECTION A
SCALE 1:150 E-403 E-405

QALAT SUBSTATION
ELEVATION
SCALE 1:150

0 3 6 9 15m
1:150

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
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0	ISSUED FOR DESIGN/BUILD	26/09/14	DJ
A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-405EL

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USAID - OEGI
WOLT0048, AMD4 SUBSTATIONS
FROM QARABAGH TO KANDAHAR
EAST
QALAT SUBSTATION
ELEVATION

SHEET REFERENCE NUMBER:
E-405

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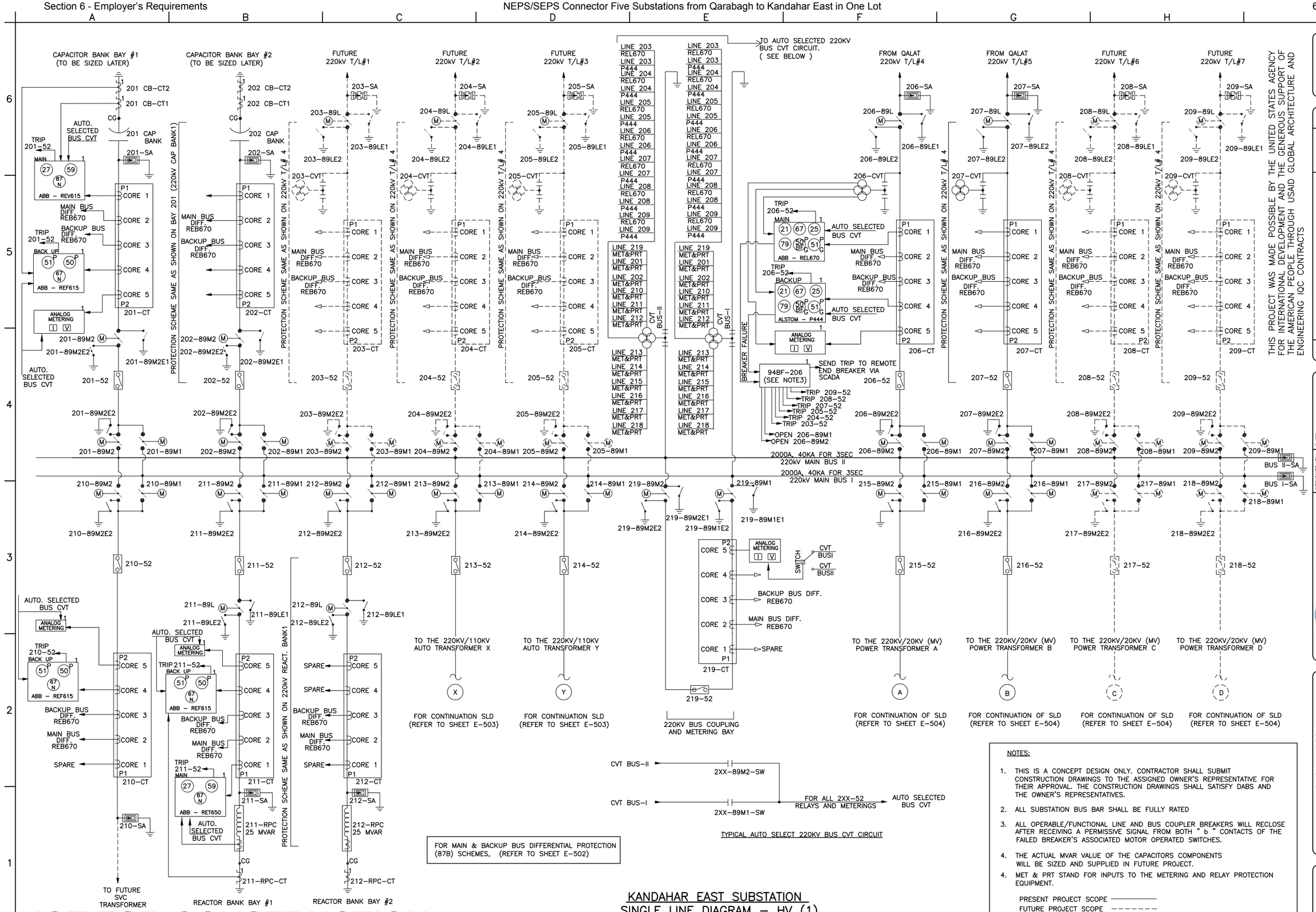

NOT FOR CONSTRUCTION

KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM – HV (1)

N.T.S

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED
3. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RECLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.
4. THE ACTUAL MVAR VALUE OF THE CAPACITORS COMPONENTS WILL BE SIZED AND SUPPLIED IN FUTURE PROJECT.
4. MET & PRT STAND FOR INPUTS TO THE METERING AND RELAY PROTECTION EQUIPMENT.

PRESENT PROJECT SCOPE ————
FUTURE PROJECT SCOPE - - - - - -

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A	CONCEPT DESIGN	02/06/14	DJ

DATE: 9/26/14
SUBMITTED BY: Tetra Tech
DESIGNED BY: MAY
DRAWN BY: MAY
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-501DI

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM – HV (1)

SHEET REFERENCE NUMBER:
E-501

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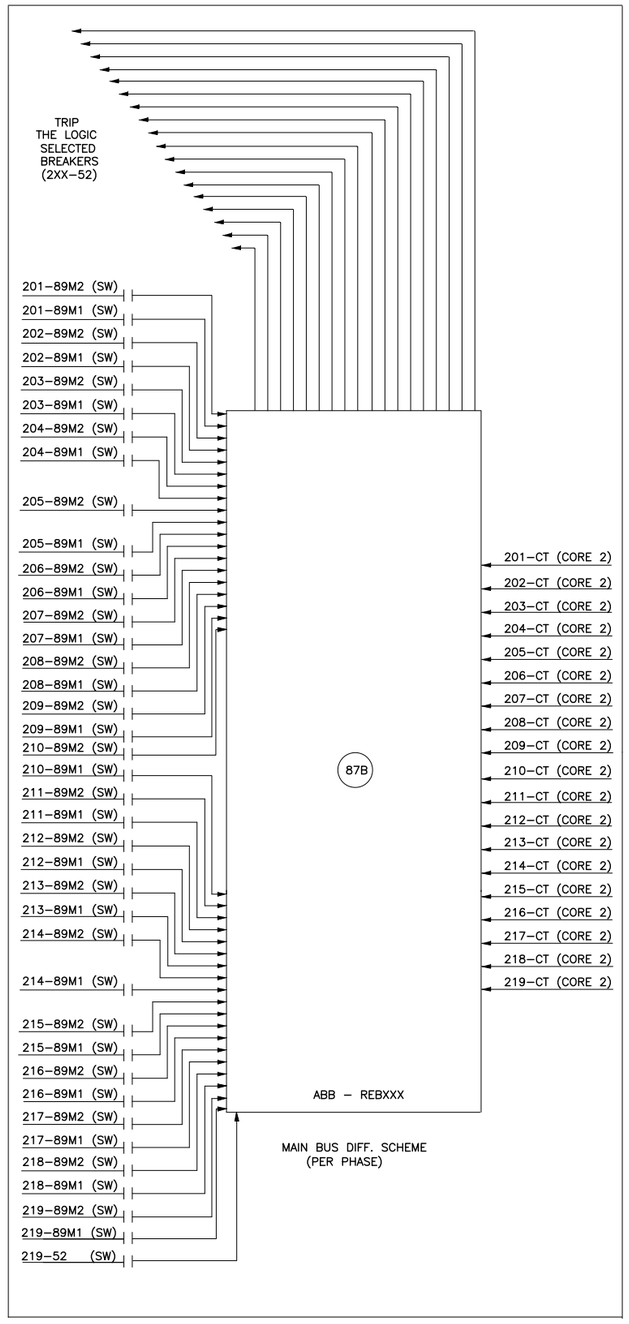
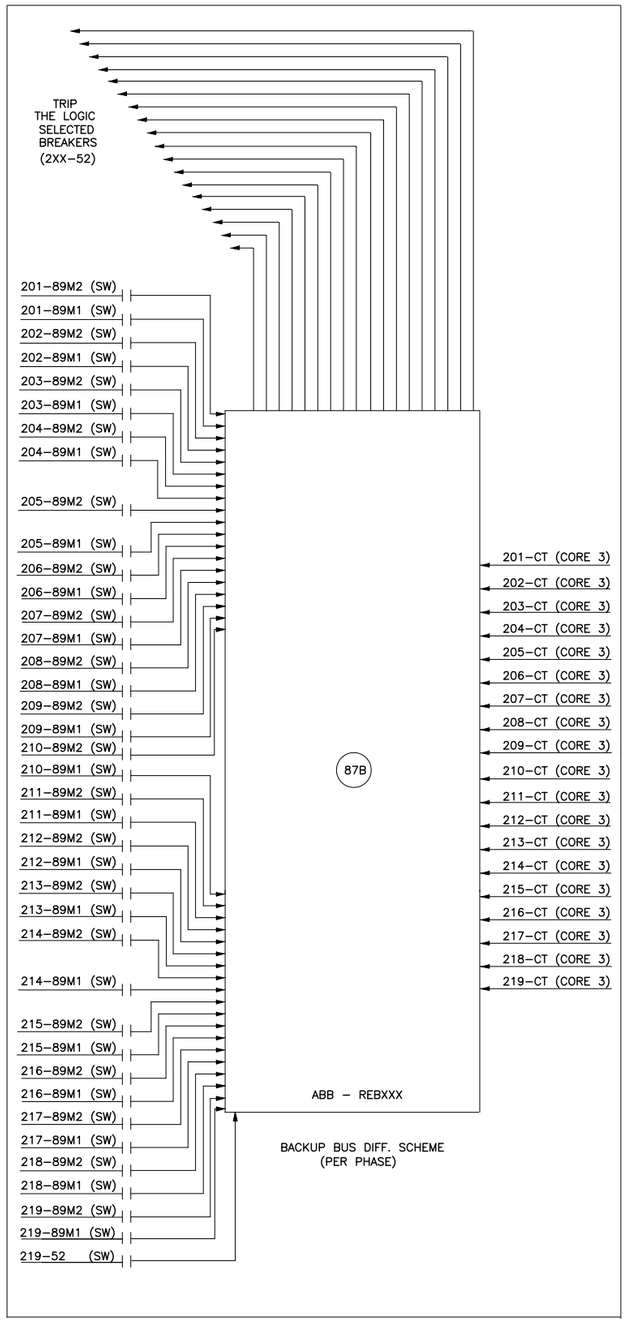


TWO ZONES BUS DIFFERENTIAL MAIN PROTECTION SCHEME PER PHASE
FOR THE 220KV BUS



TWO ZONES BUS DIFFERENTIAL BACKUP PROTECTION SCHEME PER PHASE
FOR THE 220KV BUS

KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – HV (2)
N.T.S

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A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048–E–502DI

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS
FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – HV (2)

SHEET REFERENCE NUMBER:
E–502

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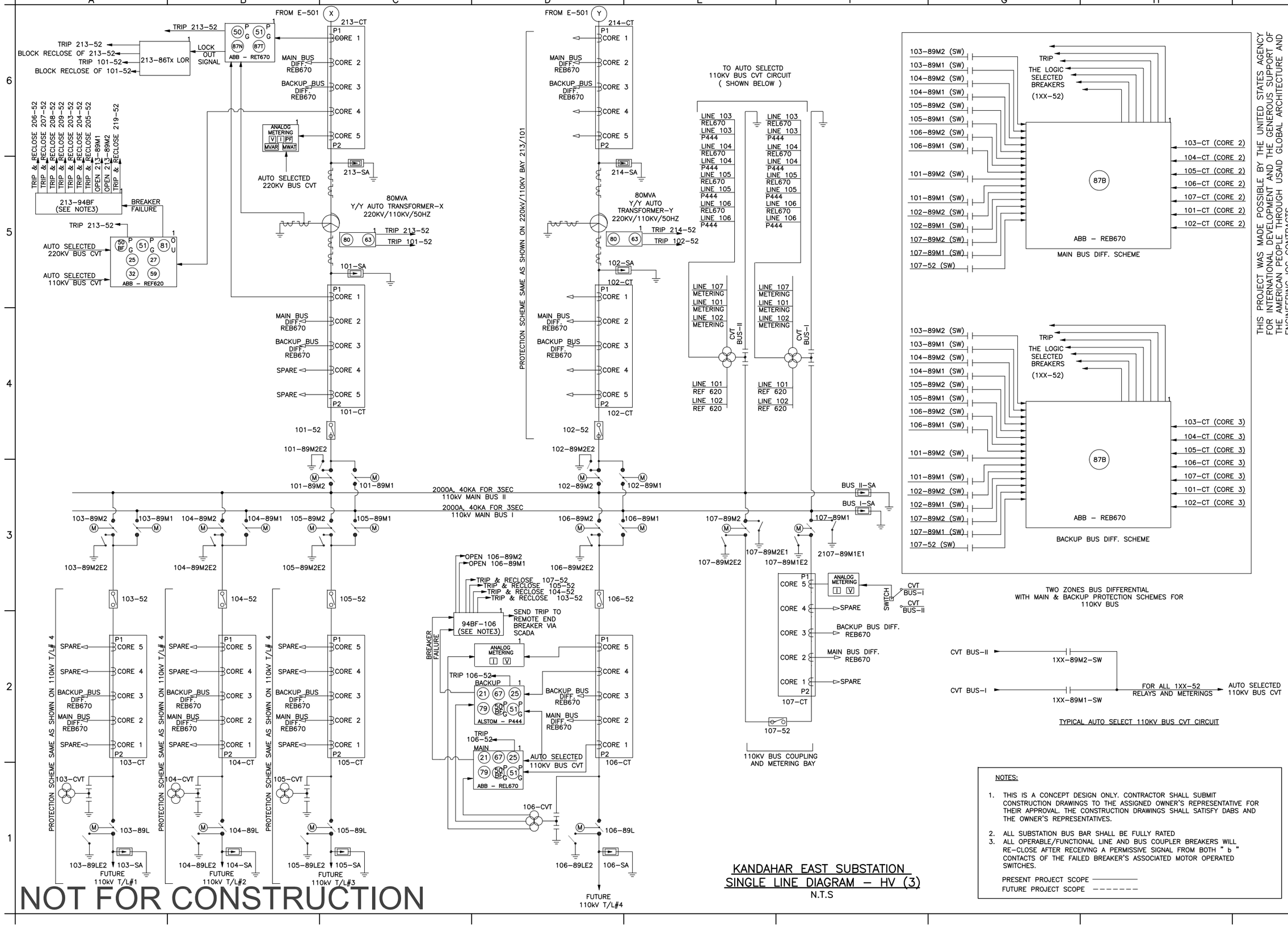

NOT FOR CONSTRUCTION

KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM – HV (3)

N.T.S

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED
3. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RE-CLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.

PRESENT PROJECT SCOPE ————
FUTURE PROJECT SCOPE - - - - - -

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A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-503DI

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM – HV (3)

SHEET REFERENCE NUMBER:
E-503

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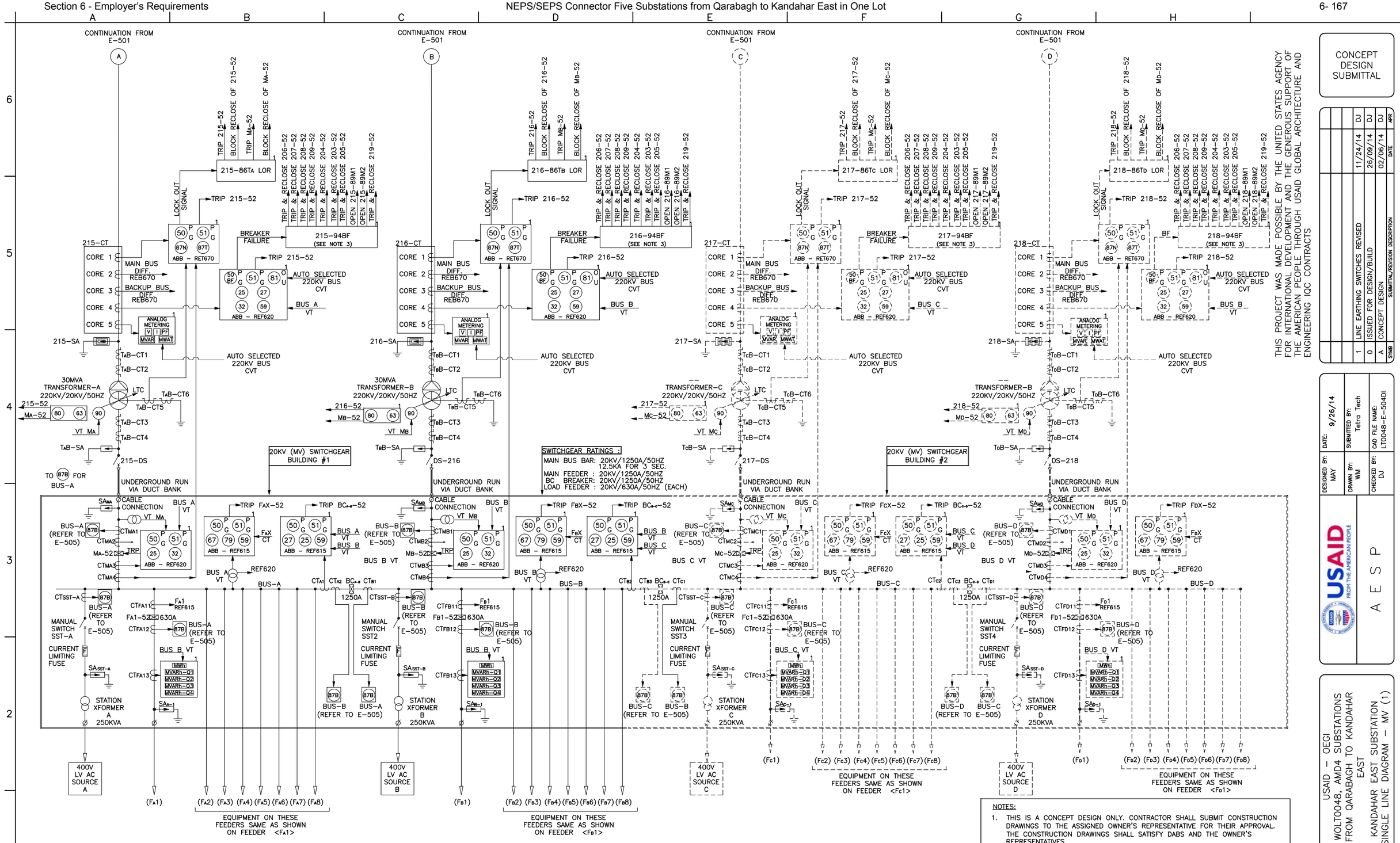

NOTES:

1. ALL 20KV BUS COUPLER BREAKERS OPERATED AS NORMALLY OPEN.
2. (FAX) IS ONE OF THE 8 FEEDERS FROM BUS A.
3. FOR THE 87B (BUS DIFFERENTIAL) PROTECTION SCHEME FOR THE MV, REFER TO SHEET E – 505

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED
3. ALL FUNCTIONAL/OPERABLE LINE AND BUS COUPLER BREAKERS WILL RE-CLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.
4. THE TWO SWITCHGEARS' MAIN BUSES ARE COUPLED VIA UNDER GROUND CONCRETE DUCT BANKS BETWEEN THE TWO MV BUILDINGS. SEE GENERAL ARRANGEMENT DRAWING (E-506) WHICH SHOWS THE LOCATION OF THE COUPLING UNDER GROUND DUCTS BETWEEN THE TWO MV BUILDINGS.
5. FOR AUTO SELECTED 220KV BUS CVT CIRCUIT, SEE E-505

PRESENT PROJECT SCOPE ————
FUTURE PROJECT SCOPE - - - - - -

KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – MV (1)
N.T.S

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A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAYT
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-504DI

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM – MV (1)

SHEET REFERENCE NUMBER:
E-504

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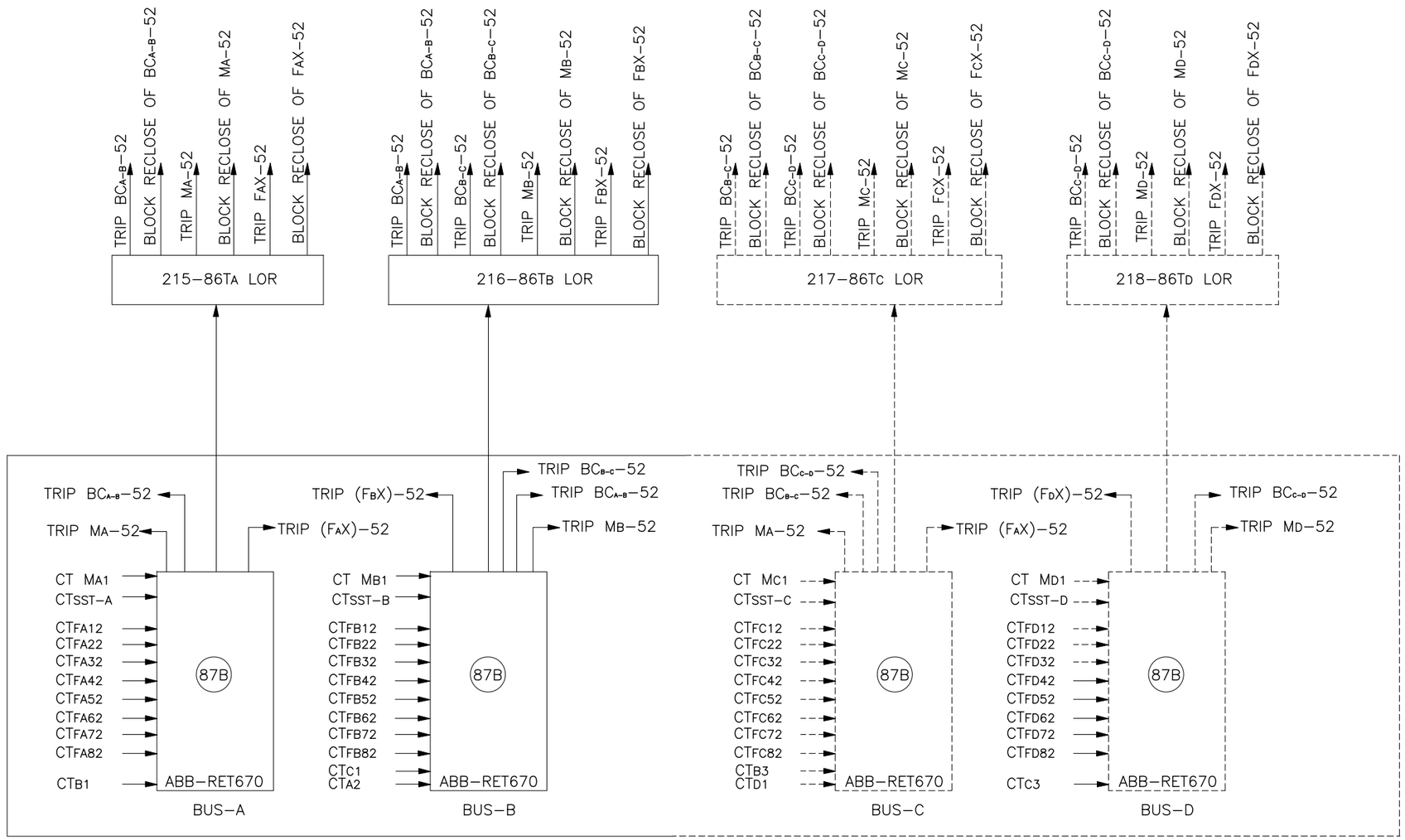

TYPICAL BUS DIFFERENTIAL SCHEME PER PHASE FOR 20KV (MV) SWITCHGEAR BUSES

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. (FAX) IS ONE OF THE 8 FEEDERS FROM BUS A
3. THE 87B (BUS RELAY) IS PER PHASE BASES. THEREFORE , (3) SUCH DEVICES , FOR EACH PHASE, ARE REQUIRED TO PERFORM THIS CONTROL FUNCTION.

PRESENT PROJECT SCOPE ————————

FUTURE PROJECT SCOPE - - - - - - - - - - -

KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM–MV (2)

N.T.S

NOT FOR CONSTRUCTION

CONCEPT DESIGN SUBMITTAL

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A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: WM
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-505DI

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM – MV (2)

SHEET REFERENCE NUMBER:
E–505

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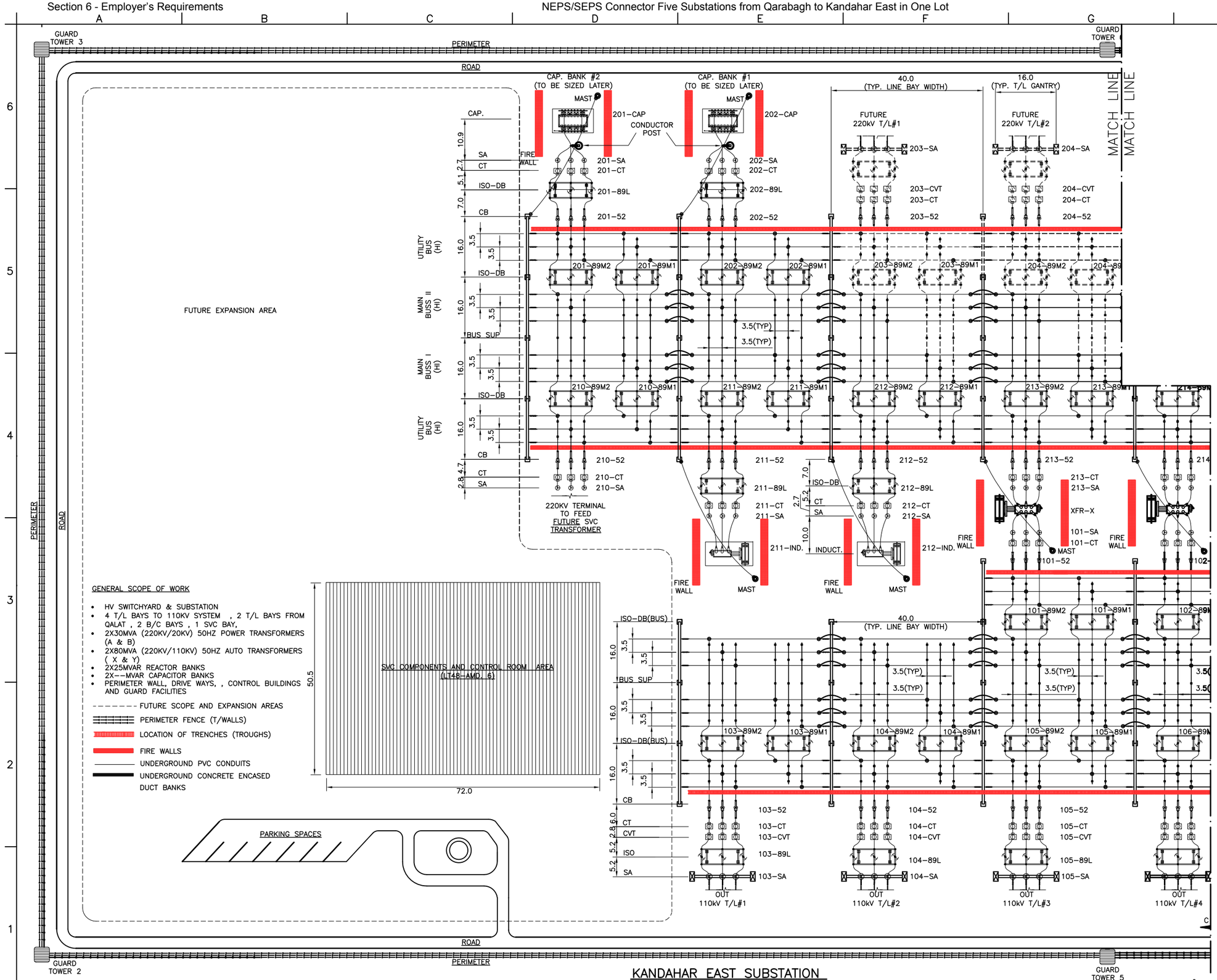

NOT FOR CONSTRUCTION

KANDAHAR EAST SUBSTATION
GENERAL ARRANGEMENT – GA
SCALE: 2:1

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS

CONCEPT DESIGN SUBMITTAL

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A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-506LS

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION GENERAL ARRANGEMENT – GA

SHEET REFERENCE NUMBER:
E-506

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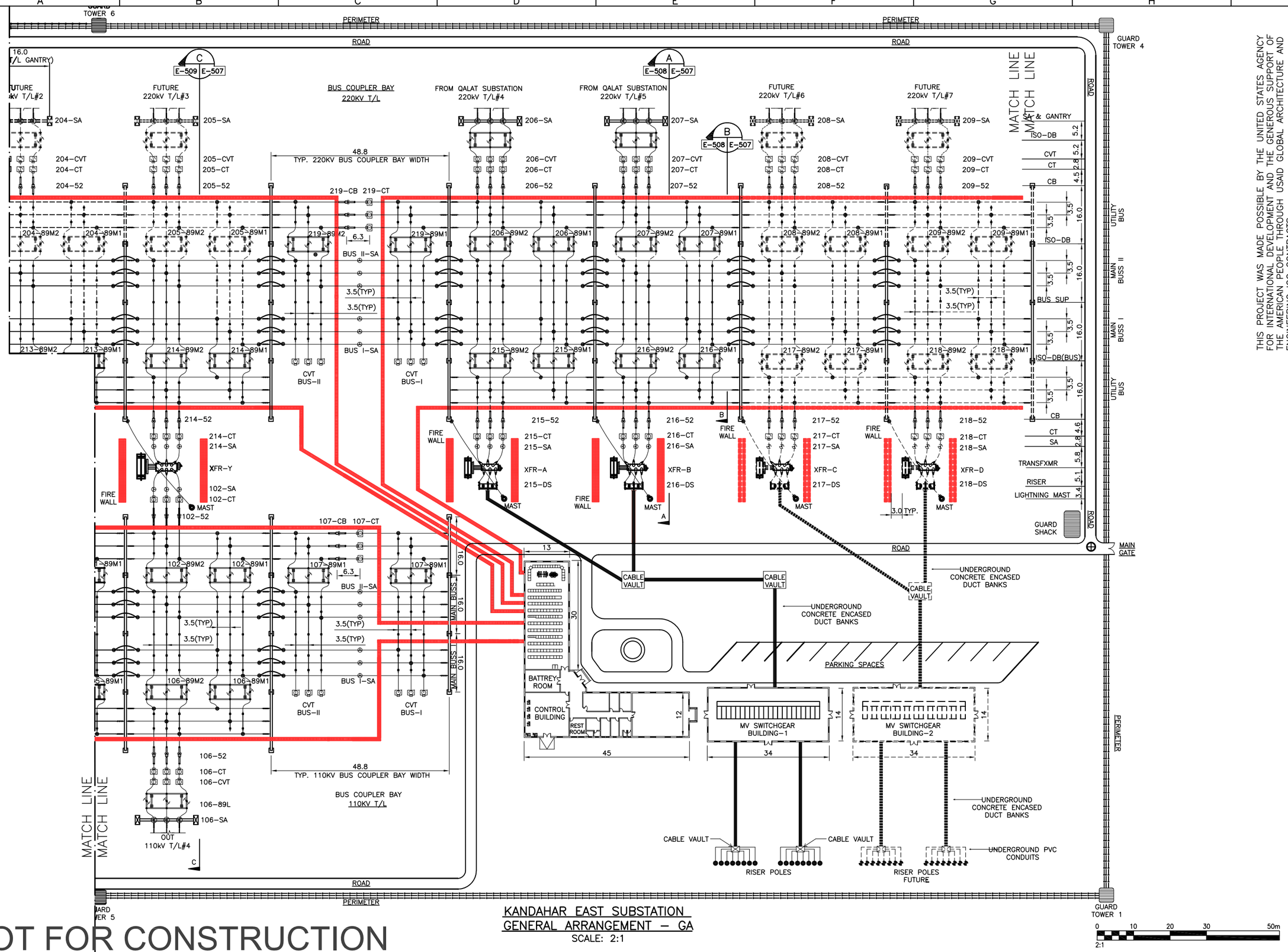

NOT FOR CONSTRUCTION

KANDAHAR EAST SUBSTATION
GENERAL ARRANGEMENT – GA
SCALE: 2:1

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A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-507LS

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS
FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION
GENERAL ARRANGEMENT – GA

SHEET REFERENCE NUMBER:
E-507

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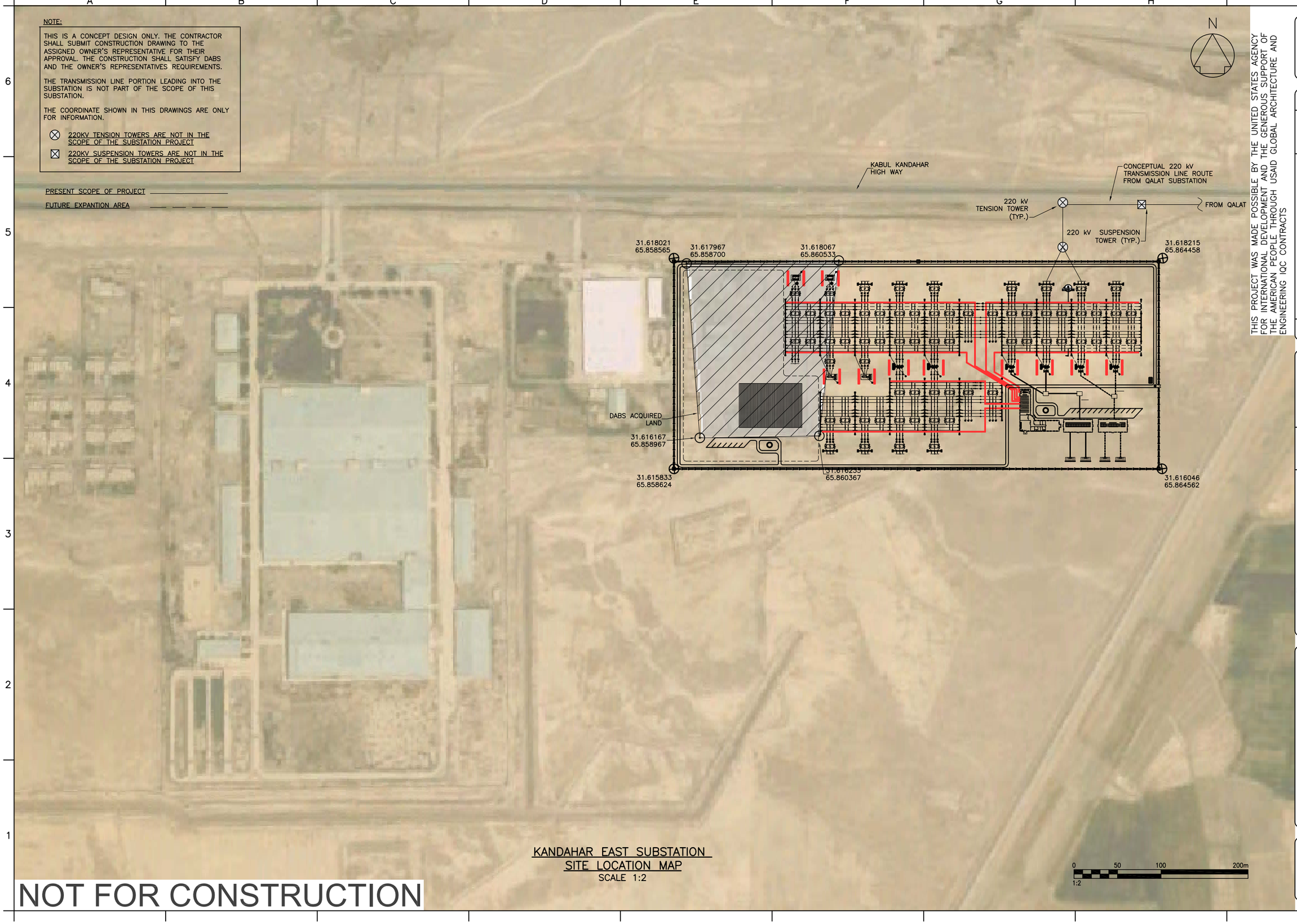

KANDAHAR EAST SUBSTATION
SITE LOCATION MAP
SCALE 1:2

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DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-508LS

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USAID – OEGI
WOLT0048, AMD4 SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION SITE LOCATION MAP

SHEET REFERENCE NUMBER:
E-508

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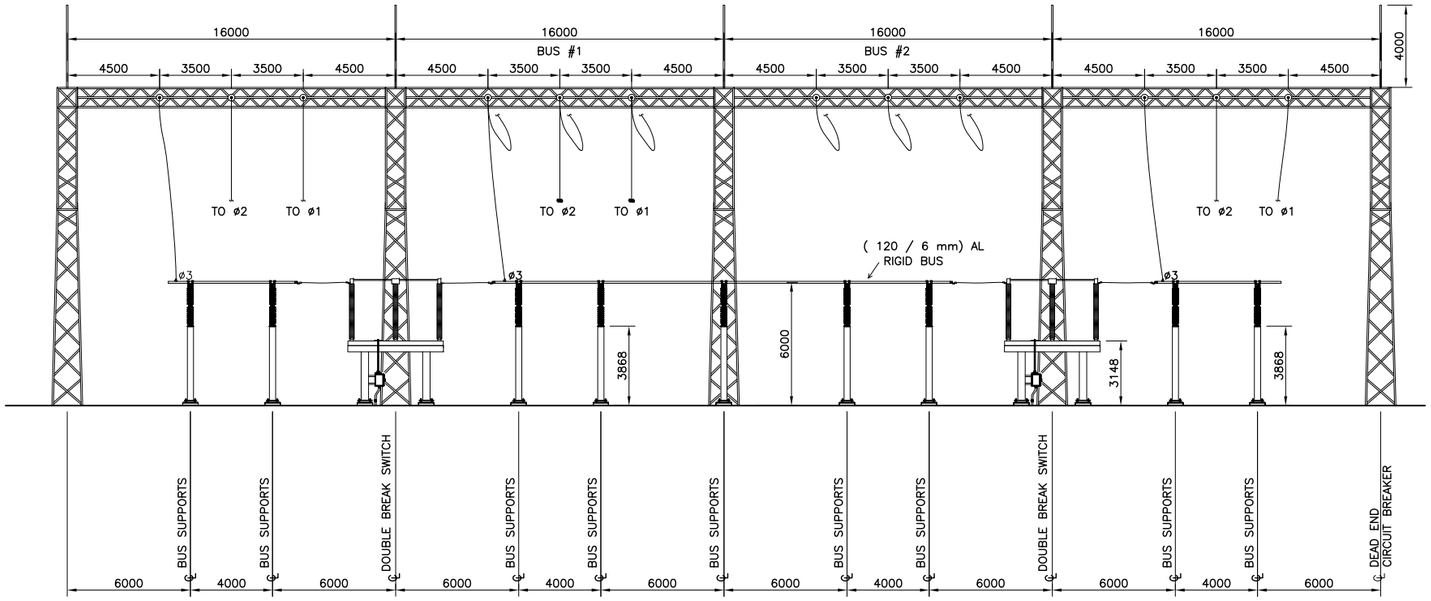
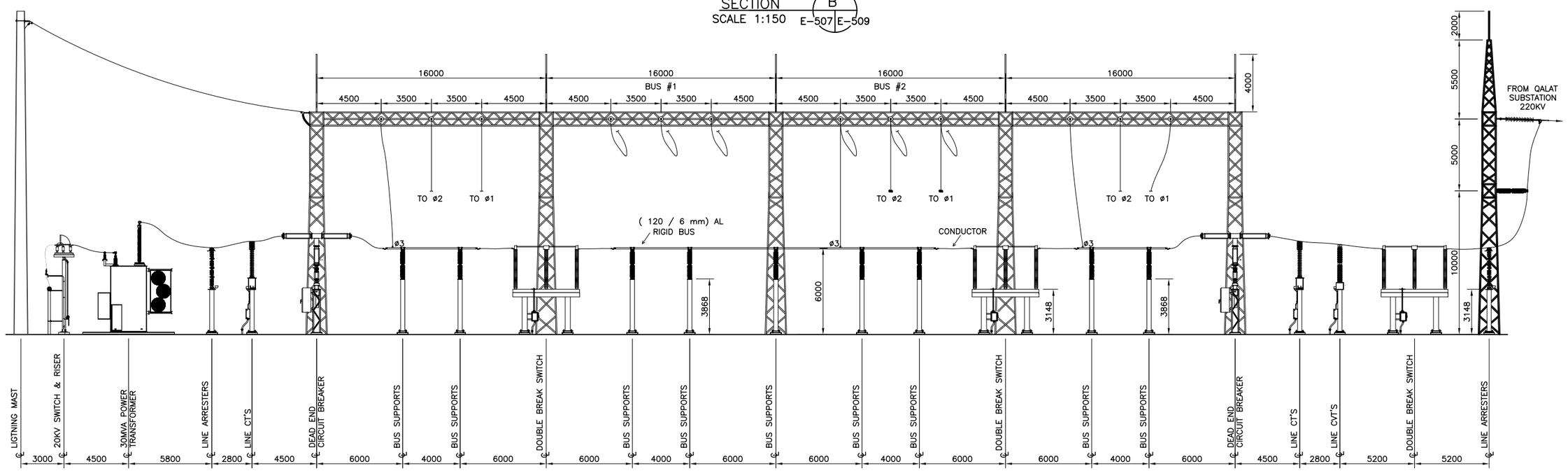
NOTES:

1. THIS IS A CONCEPT DESIGN ONLY,CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWING TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.

2. DISTANCE BETWEEN ELECTRICAL COMPONENTS ARE IN mm.



SECTION B
SCALE 1:150 E-507 E-509



SECTION A
SCALE 1:150 E-507 E-509

KANDAHAR EAST SUBSTATION
ELEVATION (1)
SCALE 1:150

0 3 6 9 15m
1:150

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A	CONCEPT DESIGN	02/06/14	DJ

DESIGNED BY: MAY
DATE: 9/26/14
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-509EL

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USAID - OEGI
WOLT0048, AMD4 SUBSTATIONS
FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION
ELEVATION (1)

SHEET REFERENCE NUMBER:
E-509

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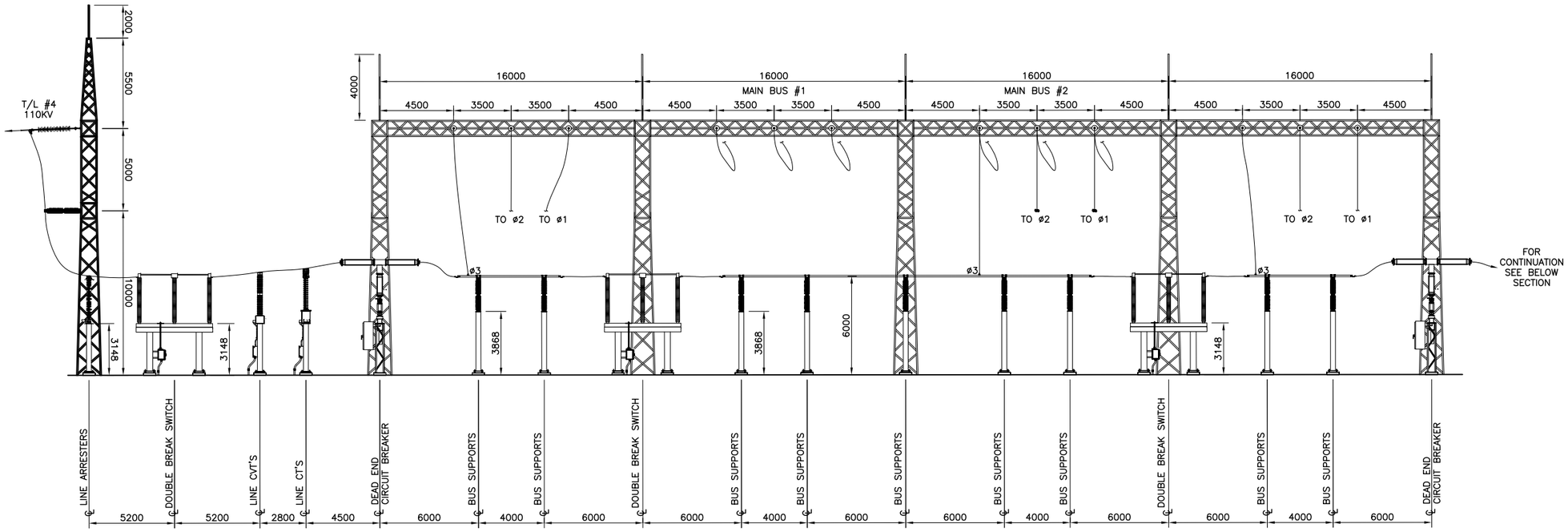
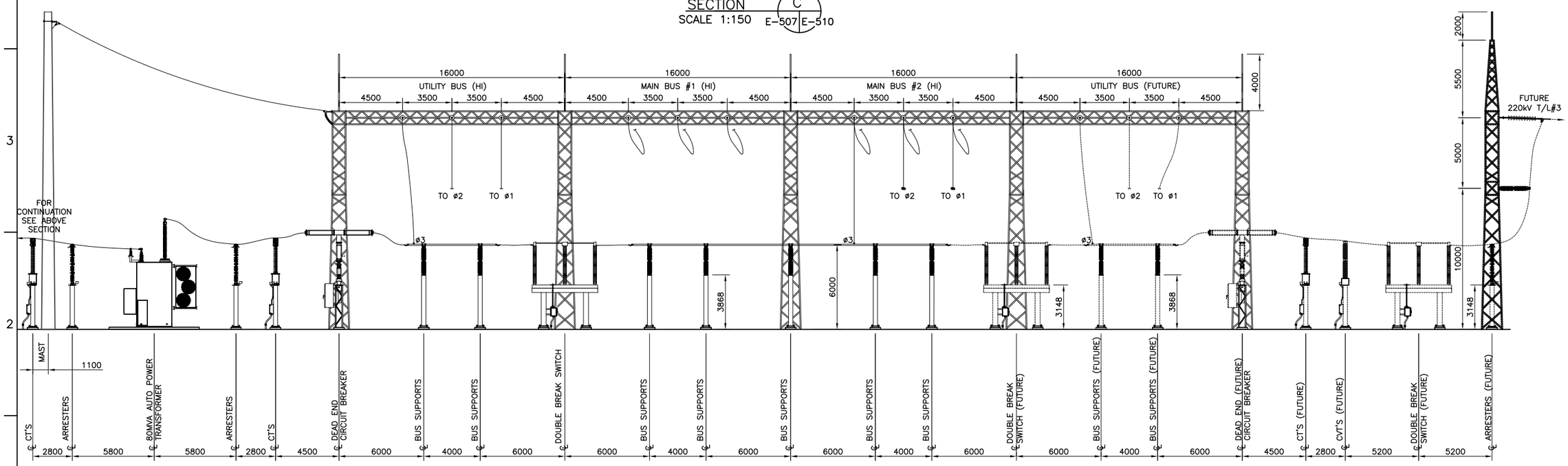


SECTION C
SCALE 1:150
E-507 E-510



SECTION C
SCALE 1:150
E-507 E-510

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY,CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWING TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.

2. DISTANCE BETWEEN ELECTRICAL COMPONENTS ARE IN mm.

NOT FOR CONSTRUCTION

KANDAHAR EAST SUBSTATION
ELEVATION (2)
SCALE 1:150

0 3 6 9 15m
1:150

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DESIGNED BY: MAY
DATE: 9/26/14
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SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-510EL

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USAID - OEGI
WOLT0048, AMD4 SUBSTATIONS
FROM QARABAGH TO KANDAHAR EAST
KANDAHAR EAST SUBSTATION
ELEVATION (2)

SHEET REFERENCE NUMBER:
E-510

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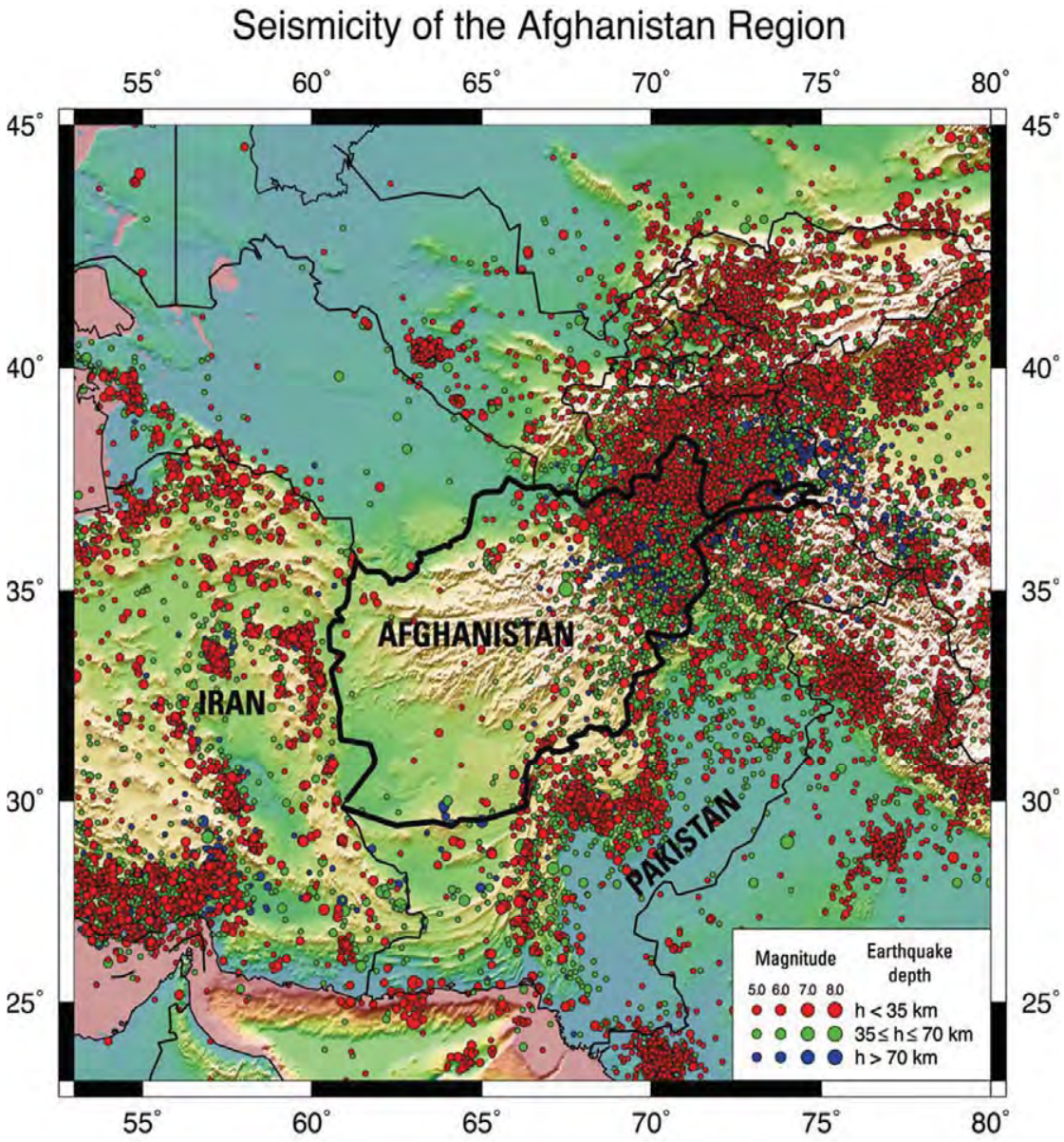
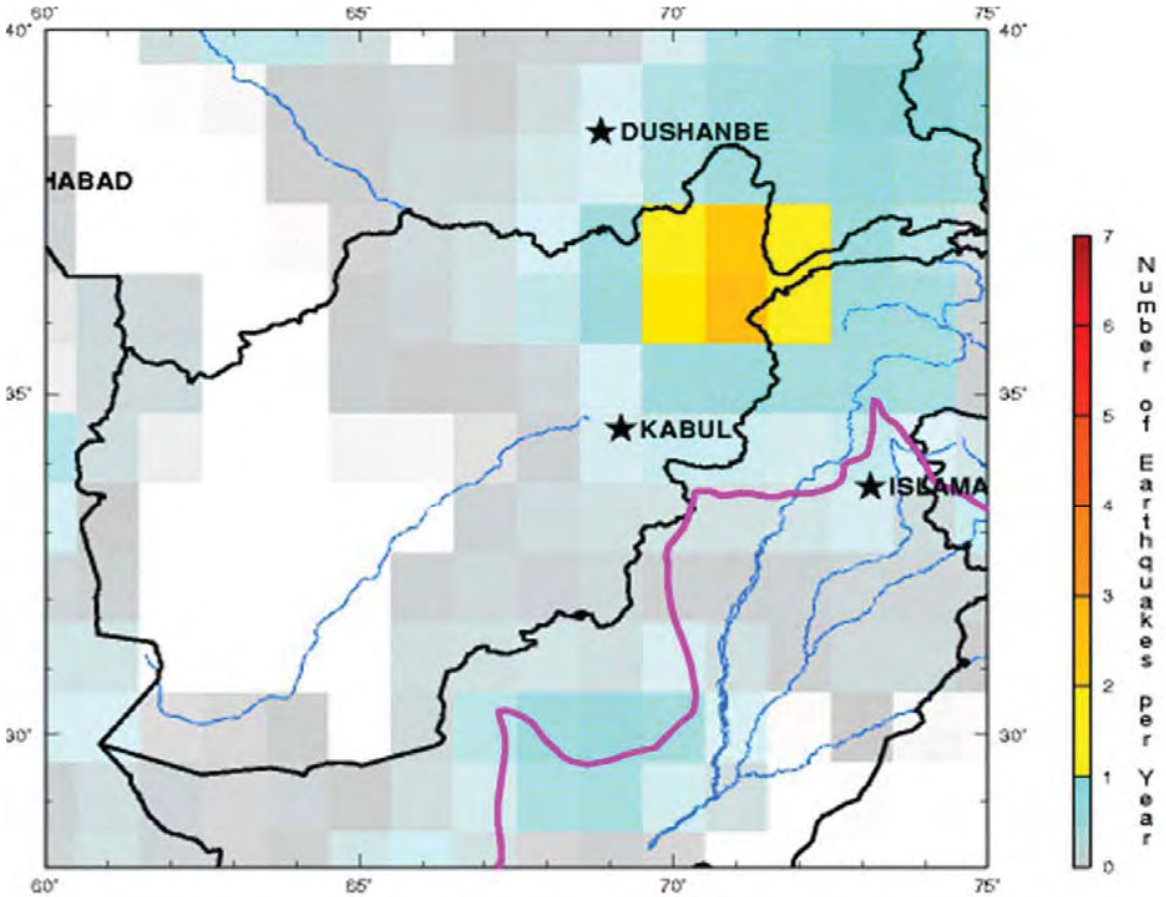
3.2 – Informative Earthquake Maps



MAP ESDIP TL 04 01

EARTHQUAKE DENSITY MAP

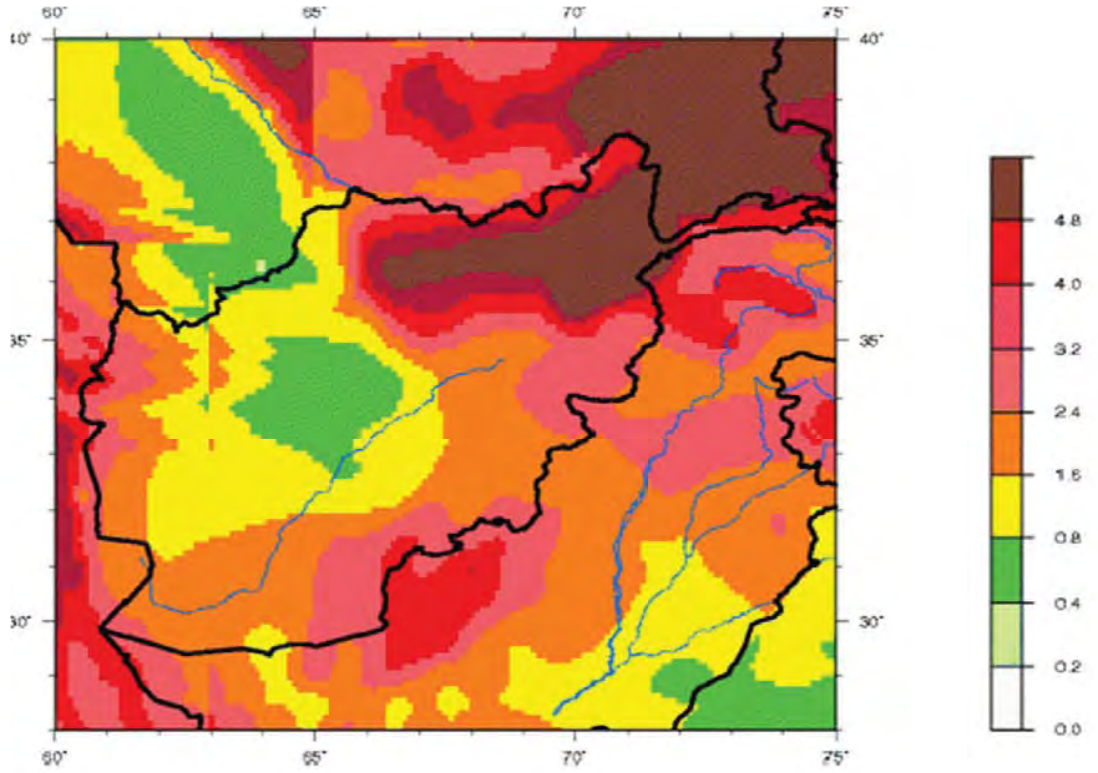


Number of Earthquakes per Year, Magnitude 5 and Greater, All Depths

Major Tectonic Boundaries: Subduction Zones -purple, Ridges -red and Transform Faults -green

MAP ESDIP TL 04 02

SEISMIC HAZARD MAP



Peak Ground Acceleration (m/s²) with 10% Probability of Exceedance in 50 Years

MAP ESDIP TL 04 03

Appendix A

SCADA, Telecom, RTU and NLCC Network Standard Technical Specifications

1. Description of Existing SCADA System and NLCC Operation

1.a Description of Existing SCADA National Load Control Center

The existing National Load Control Center (NLCC) in Kabul 100MW Power Plant Area is intended to eventually control/monitor all Afghanistan HV and MV Substations.

The system presently monitors and controls 17 HV and 1 MV Substation and has capacity to be expanded up to 200 RTUs as installed capacity. Further expansion is available by modularly adding servers into the system as well to add DMS functions on the same platform.

The system was installed by Uskom Komunikasyon A.S. , based on the Prism platform from Advanced Control Systems and operates in full redundancy.

There is as well a DLP based wall display to display the network status.

The communication ports are also redundant and each RTU communicates with SCADA Master with 2 FE ports with IEC60870-5-104 protocol.

There is also a Power Quality Analysis and metering Control Center which gathers metering information from all Substations and tie-in locations of Afghanistan Grid with other countries import power systems.

Please see existing SCADA system architecture as Attachment 1.

1.b Description of Existing Telecom Transmission, Management and Telephone System

The existing telecom transmission and telephone system was also installed by Uskom Komunikasyon A.S.

The telecom tranmission system is based on fiber optic SDH equipment. There are some MW links in addition to the SDH optical network. The SDH equipment is Sagem ADR 2500 eXtra and the MW Radio link is Sagem Link F. ADR2500 eXtra and Link F equipment are provided with Engineering Orderwire (EOW) at each Substation which provides a selective call based EOW between all Substations over SDH overhead.

Both SDH and MW radio Link equipment are fully redundant and provide redundant FE interfaces for RTU communication with NLCC. The optical system has redundant E1 ports for telephone network communication requirements.

SDH Optic and MW radio equipment are all connected to a Network Management System (NMS) and complete system is managed from NLCC IONOS-NMS system including provisioning and trail management capabilities. The NMS is expandable for up to 1000 Network Elements for the Afghanistan Electrical Network.

Please see existing telecom transmission system architecture as Attachment 2.

1. Description of Existing SCADA System and NLCC Operation

1.a Description of Existing SCADA National Load Control Center

The existing National Load Control Center (NLCC) in Kabul 100MW Power Plant Area is intended to eventually control/monitor all Afghanistan HV and MV Substations.

The system presently monitors and controls 17 HV and 1 MV Substation and has capacity to be expanded up to 200 RTUs as installed capacity. Further expansion is available by modularly adding servers into the system as well to add DMS functions on the same platform.

The system was installed by Uskom Komunikasyon A.S. , based on the Prism platform from Advanced Control Systems and operates in full redundancy.

There is as well a DLP based wall display to display the network status.

The communication ports are also redundant and each RTU communicates with SCADA Master with 2 FE ports with IEC60870-5-104 protocol.

There is also a Power Quality Analysis and metering Control Center which gathers metering information from all Substations and tie-in locations of Afghanistan Grid with other countries import power systems.

Please see existing SCADA system architecture as Attachment 1.

1.b Description of Existing Telecom Transmission, Management and Telephone System

The existing telecom transmission and telephone system was also installed by Uskom Komunikasyon A.S.

The telecom tranmission system is based on fiber optic SDH equipment. There are some MW links in addition to the SDH optical network. The SDH equipment is Sagem ADR 2500 eXtra and the MW Radio link is Sagem Link F. ADR2500 eXtra and Link F equipment are provided with Engineering Orderwire (EOW) at each Substation which provides a selective call based EOW between all Substations over SDH overhead.

Both SDH and MW radio Link equipment are fully redundant and provide redundant FE interfaces for RTU communication with NLCC. The optical system has redundant E1 ports for telephone network communication requirements.

SDH Optic and MW radio equipment are all connected to a Network Management System (NMS) and complete system is managed from NLCC IONOS-NMS system including provisioning and trail management capabilities. The NMS is expandable for up to 1000 Network Elements for the Afghanistan Electrical Network.

Please see existing telecom transmission system architecture as Attachment 2.

The telephone network is based on Selta SAM 4000 and SAM 8 PABX equipment. The NLCC SAM 4000 E is in full redundancy and includes as well a voice recording system.

The telphone network operates as a full homegeneous network and is interconnected with each other and NLCC via E1 links.

Please see existing telephone network architecture as Attachment 3.

1.c Description of Existing Substation RTU and Local SCADA System

At Substations connected to NLCC, there is a Selta STCE RTU operating with redundant CPU and redundant power supply. The RTU communicates with NLCC via SDH or MW communication equipment with dual FE interfaces based on IEC 60870-5-104 protocol.

The existing RTUs gathers all Substation signals either via parallel I/Os terminated over a Marshalling Cubicle or via serial interfaces based on Modbus or IEC 60870-5-103.

At some Substations where there has been existing Substation SCADA systems, interface over IEC 60870-5-101 has been utilized to the RTU and these exsting facilities have as well been connected to NLCC over the new RTU.

The RTU also provides a local SCADA system based on eXpert. eXpert HMI has the ability to monitor and control the Substation locally. The HMI has been standardized in all Substations regardless of the original Substation supplier abbreviations so that the maintenance and operation personnel has ease to have a standardized system management.

At Substations, energy meters with Power Quality Analysis (waveform recording) functionality have been installed. Energy meters have 64 samples/cycle waveform recording functionality with internal storage, class 0.2 accuracy, and both Ethernet and RS-485 connectivity.

RTU utilize the data for analog values received via RS485 ports over Modbus and NLCC utilizes centralized waveform recording and reporting sent over Ethernet ports separately. Installed units are Shark 200 V5 series and Nexus 1500 series from Elektro Industries / GaugeTech.

2. Addition of New Substations into NLCC Network (Substation Contractors Responsibility)

Every new Substation will be integrated into NLCC system.

The work will have components at Control Center and as well at Substations.

The work at control center and effected substations on the route will include the following works :

a. Integration of the new Substation into NLCC SCADA System and on wall display

b. Integration of the new communication equipment into NLCC NMS and channel routing along the nodes of the path from new Substation up to NLCC. Any additional optical modules to be inserted into existing Substation equipments are as well to be provided if required.
c. Integration of the new telephone exchange into NLCC PABX and as well reprogramming of existing exchanges along the route for numbering and routing for new Substation.
d. Integration of the energy meters of new substation to NLCC Power Quality Analysis (PQA) Control Center.

The work at the new Substation will include the following main headlines:

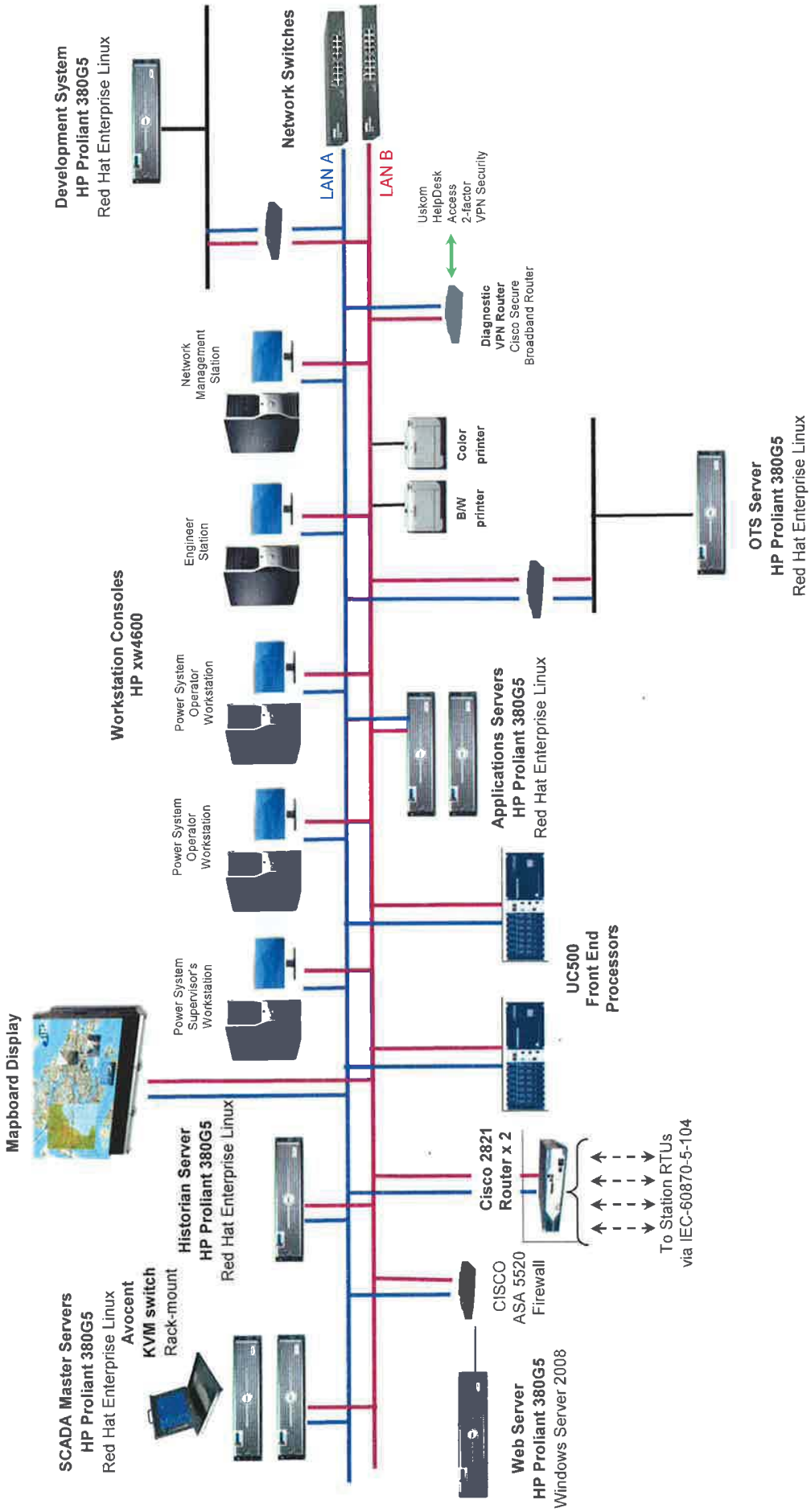
a. Provide an RTU compatible with NLCC SCADA system
b. Provide a local SCADA based on HMI as per NLCC system standardized display and abbreviations
c. Provide energy meters for connection to RTU and as well to NLCC PQA.
d. Provide a marshalling cubicle for termination of all S/S DI and DO parallel I/O
e. Provide protection relays to communicate with RTU either over IEC 60870-5-103, Modbus serial interfaces or IEC 61850 FE interface
f. Provide a redundant SDH optical equipment with remote ends integrated with NLCC telecom transmission system and NMS. Provide optical distribution frame, underground optical cable upto OPGW terminal joint box which will be provided within OHL scope. The connectivity is within the scope of the Contractor and if optical cables are not available, connectivity will be established by utilizing MW radio links. Route analysis and number of links needed to the nearest Substation will be within the scope of the contractor including all necessary infrastructure such as towers, antennas, shelters, power supplies, etc.
g. Provide a telephone exchange compatible with existing system with 2xE1 interfaces for connectivity with other telephone exchanges.
h. Provide EOW compatible with existing system.
i. Provide teleprotection equipment with remote ends to operate over each HV feeder of the Substation for providing distance and transfer trips.

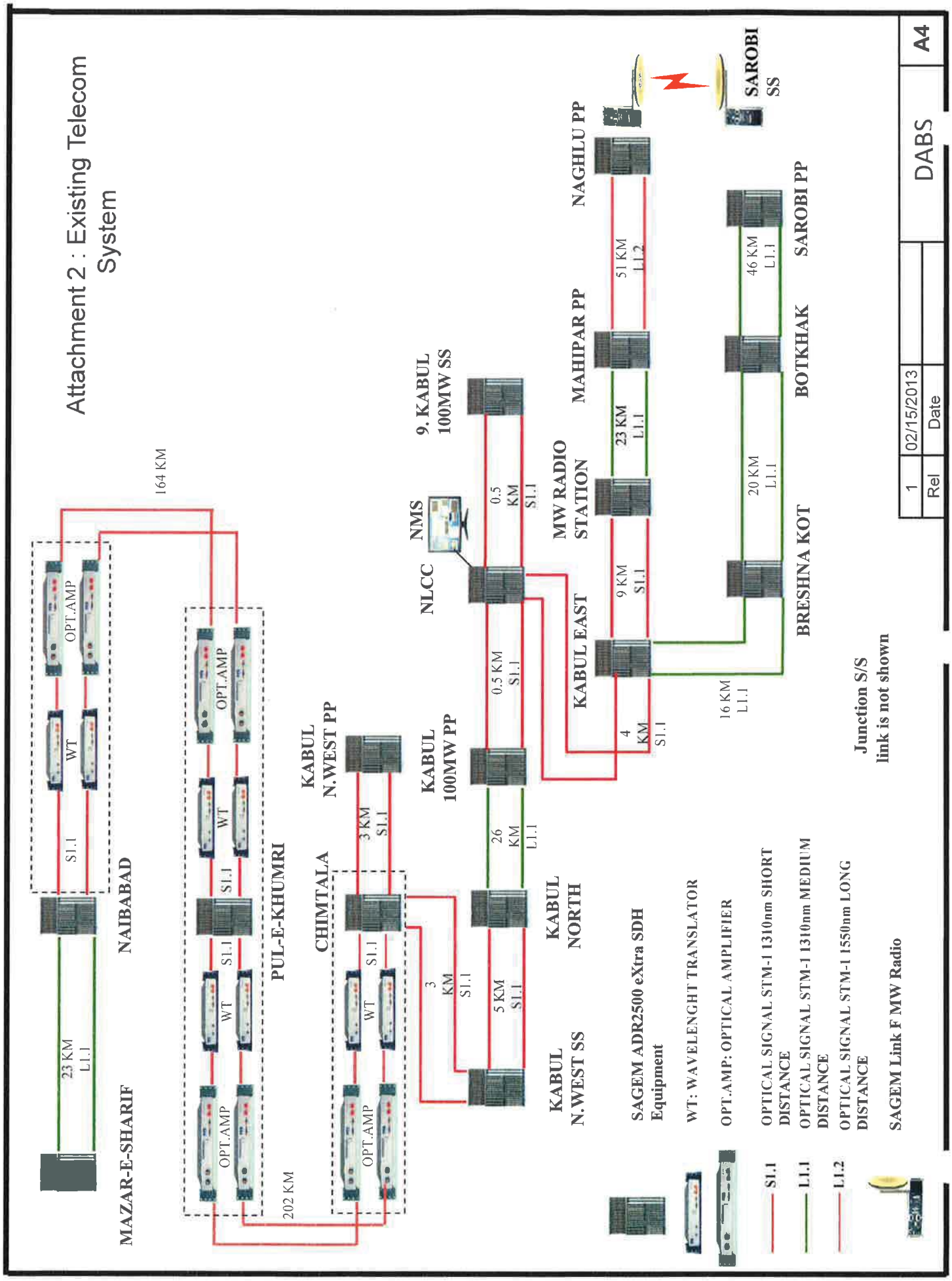
Please see a conceptual Substation Telecom and SCADA system layout as Attachment 4.

3. Bill of Quantity for Addition of a Substations into NLCC Network

Please see the Bill of Quantity as Attachment 5 defining the scope of work for each new or existing Substation to be interconnected with NLCC system.

Attachment 1 : Existing NLCC SCADA/EMS Master




Attachment 2 : Existing Telecom System
MAZAR-E-SHARIF
NAIBABAD
PUL-E-KHUMRI
CHIMTALA
KABUL N.WEST PP
KABUL N.WEST SS
KABUL 100MW PP
KABUL NORTH
NLCC
NMS
9. KABUL 100MW SS
KABUL EAST
MW RADIO STATION
MAHIPAR PP
NAGHLU PP
SAROBI SS
BRESHNA KOT
BOTKHAK
SAROBI PP
23 KM L1.1
S1.1
WT
OPT.AMP
164 KM
202 KM
3 KM S1.1
3 KM S1.1
5 KM S1.1
26 KM L1.1
0.5 KM S1.1
0.5 KM S1.1
9 KM S1.1
4 KM S1.1
23 KM L1.1
51 KM L1.2
20 KM L1.1
46 KM L1.1
16 KM L1.1
Junction S/S link is not shown
SAGEM ADR2500 eXtra SDH Equipment
WT: WAVELENGHT TRANSLATOR
OPT.AMP: OPTICAL AMPLIFIER
OPTICAL SIGNAL STM-1 1310nm SHORT DISTANCE
OPTICAL SIGNAL STM-1 1310nm MEDIUM DISTANCE
OPTICAL SIGNAL STM-1 1550nm LONG DISTANCE
SAGEM Link F MW Radio
S1.1
L1.1
L1.2
1
02/15/2013
Rel
Date
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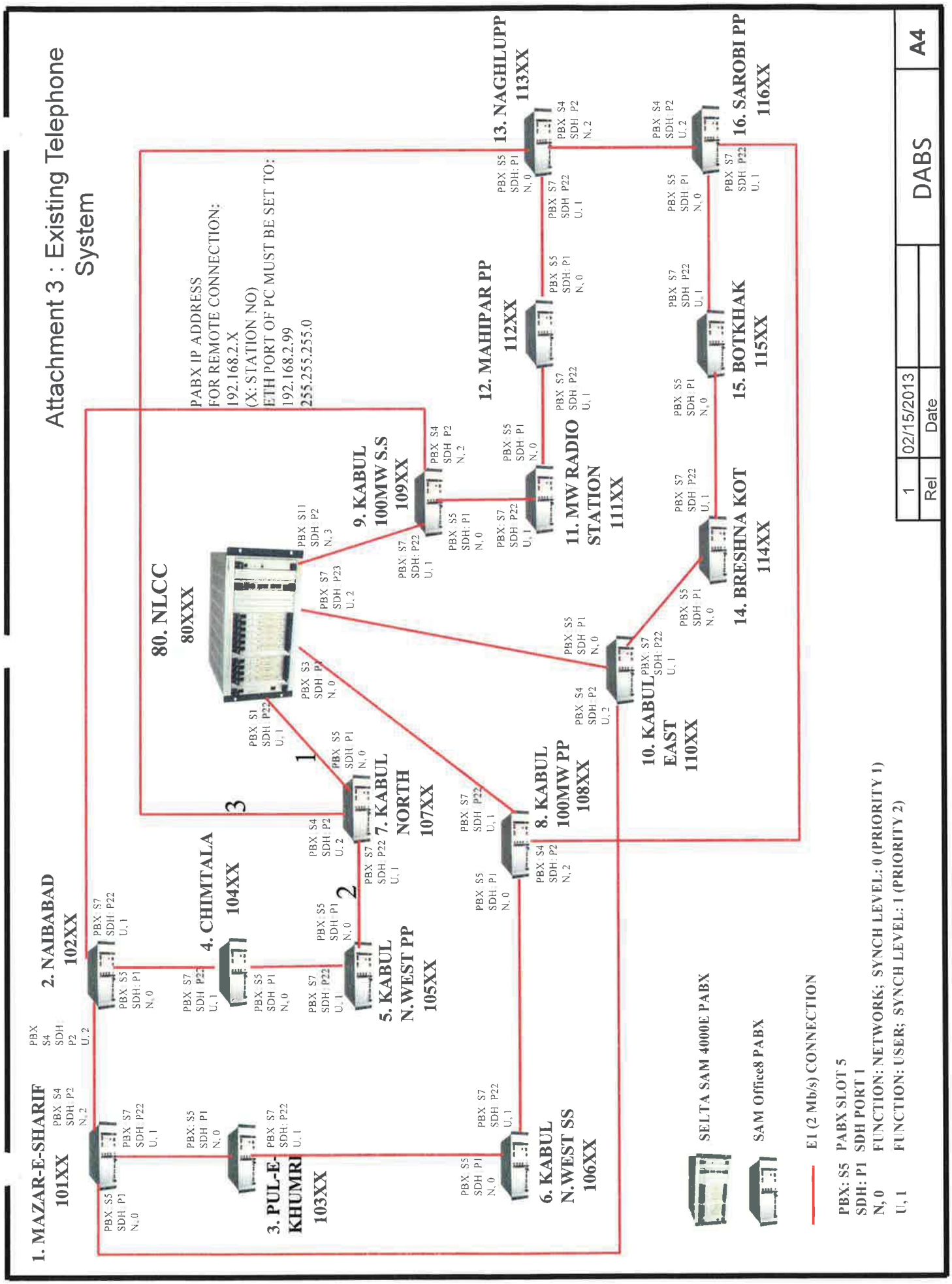
Attachment 3 : Existing Telephone System
PABX IP ADDRESS
FOR REMOTE CONNECTION:
192.168.2.X
(X: STATION NO)
ETH PORT OF PC MUST BE SET TO:
192.168.2.99
255.255.255.0
80. NLCC
80XXX
1. MAZAR-E-SHARIF
101XX
2. NAIBABAD
102XX
3. PUL-E-KHUMRI
103XX
4. CHIMTALA
104XX
5. KABUL N.WEST PP
105XX
6. KABUL N.WEST SS
106XX
7. KABUL NORTH
107XX
8. KABUL 100MW PP
108XX
9. KABUL 100MW S.S
109XX
10. KABUL EAST
110XX
11. MW RADIO STATION
111XX
12. MAHIPAR PP
112XX
13. NAGHLUPP
113XX
14. BRESHNA KOT
114XX
15. BOTKHAK
115XX
16. SAROBI PP
116XX
SELTA SAM 4000E PABX
SAM Office8 PABX
E1 (2 Mb/s) CONNECTION
PBX: S5 PABX SLOT 5
SDH: P1 SDH PORT 1
N, 0 FUNCTION: NETWORK; SYNCH LEVEL: 0 (PRIORITY 1)
U, 1 FUNCTION: USER; SYNCH LEVEL: 1 (PRIORITY 2)
1
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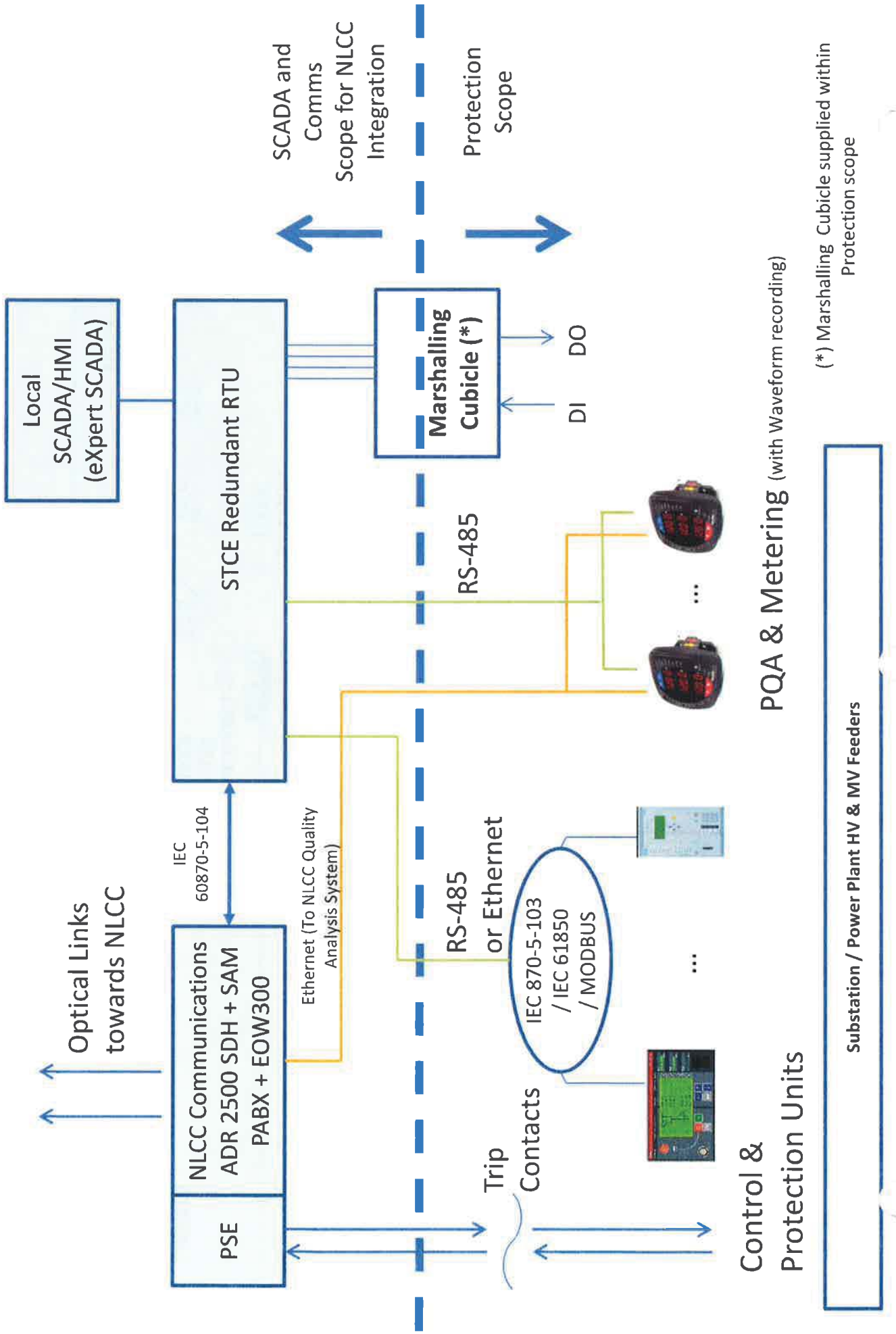
Attachment 4 - Substation Telecom and SCADA Conceptual Drawing



Attachment 5 : Bill of Quantity for Telecom and SCADA Scope per Substation

Item	Description	Qty	Unit	NLCC	Route	New S/S	PRICE
1	**Integration into NLCC Network**						
1.1	Integration of New S/S into NLCC SCADA Master and wall display	1	Lot	1			
1.2	Integration of New S/S meters into PQA Master	1	Lot	1			
1.3	Integration of New S/S comms links into telecom NMS system	1	Lot	1			
1.4	Integration of New S/S with NLCC PABX	1	Lot	1			
2	**Integration Works along the route**						
2.1	Route SDH equipment configurations and provide additional HW as may be required	1	Lot		1		
2.2	Reprogramming of Network PABXs and provide additional HW as may be required to insert new S/S PABX into NLCC network	1	Lot		1		
2.3	Provide any additional compatible communication equipment to complete the route between the new S/S and one of the existing NLCC communication system nodes if required	1	Lot		1		
3	**New S/S Works**						
3.1	**Remote Terminal Equipment**						
3.1.1	RTU cabinet	1	ea			1	
3.1.2	Base subrack	1	ea			1	
3.1.3	Extension subrack (Please add if required)	1	Lot			1	
3.1.4	48 Vdc Power Supply card	2	ea			2	
3.1.5	Central CPU and communication ports	2	ea			2	
3.1.6	Optoisolated DI card	1	Lot			1	
3.1.7	Control DO card and interposing relays	1	Lot			1	
3.1.8	Serial ports for Modbus or IEC 60870-5-103 connectivity on RS485	1	Lot			1	
3.1.9	Cables from RTU to marshalling cabinet	1	Lot			1	
3.1.10	Maintenance sw + PC	1	ea			1	
3.2	**HMI for S/S Gateway RTU**						
3.2.1	HMI and SCADA SW	1	ea			1	
3.2.2	SCADA PC	1	ea			1	
3.3	**SDH Equipment compatible with existing NLCC Network (If optic links will not be available, this item shall be replaced with a MW Radio system compatible with NLCC Network including all infrastructure including towers, power supply, antennas, shelters, etc.)**						
3.3.1	SDH equipment core	1	ea			1	
3.3.2	Redundant traffic effecting common units including power supply, matrix, etc.	1	ea			1	
3.3.3	STM-1 optic ports in 1+1 for each direction as applicable per design	1	Lot			1	
3.3.4	63E1 ports	1	ea			1	
3.3.5	Protection boards for 63 E1	1	ea			1	
3.3.6	8 port point to multipoint ethernet card	2	ea			2	
3.3.7	Selective call engineering orderwire (EOW) unit with up to 3 directions interface	1	ea			1	
3.3.8	19" cabinet for SDH and PABX equipment	1	ea			1	
3.3.9	Various installation materials	1	Lot			1	
3.3.10	LSA10 blocks for mounting in cabinet for termination of 63E1 ports	1	ea			1	
3.3.11	Dublex optic patch cord to ODF as applicable per design	1	Lot			1	

Attachment 5 : Bill of Quantity for Telecom and SCADA Scope per Substation

Item	Description	Qty	Unit	NLCC	Route	New S/S	PRICE
3.3.12	Approach cable from ODF to OPGW box outside of the S/S	1	Lot			1	
3.4	**PABX (Will be installed in SDH Equipment cabinet)**						
3.4.1	19" rack based PABX equipment core with common units	1	ea			1	
3.4.2	E1 interface	2	ea			2	
3.4.3	Analog extension port card (16 lines)	1	ea			1	
3.4.4	Digital extensions port card (8 lines)	1	ea			1	
3.4.5	Analog telephone set	12	ea			12	
3.4.6	Digital Telephone set	4	ea			4	
3.4.7	Outdoor IP66 based weather proof analog telephone set	4	ea			4	
3.4.8	Operator console	1	ea			1	
3.5	**Teleprotection Signaling Equipment**						
3.5.1	19" cabinet for teleprotection equipment for new S/S and each remote end	1	Lot			1	
3.5.2	Teleprotection signaling equipment with 4 trip commands and interconnected to SDH system over 2xE1 ports for each direction of HV lines including remote ends	1	Lot			1	
3.5.3	Installation materials	1	Lot			1	
3.6	**Rectifier and battery for 4 hours standby**						
3.6.1	48 Vdc positive grounded battery charger with single phase 220 Vac input operating in 1+1 or n+1 redundancy. Battery charger will consider the load + additional 30 % capacity and will be dimensioned to re-charge a fully discharged battery in 8 hours while supplying the load	1	ea			1	
3.6.2	48 Vdc sealed lead acid battery set for supplying the load + additional 30% spare capacity for 4 hours	1	ea			1	
3.6.3	DC system cabinet to house battery charger and batteries	1	ea			1	
4	**Spare Parts**						
4.1	Set of Spare Parts for 2 years	1	Lot			1	
5	**Services**						
5.1	Complete engineering and design	1	Lot			1	
5.2	System FAT at supplier premises out of Afghanistan						
5.3	Shipment and Insurance						
5.4	Installation, test & commissioning	1	Lot			1	
5.5	Warranty for 2 years with in country maintenance engineers and tools	1	Lot			1	
5.6	Practical Training in Afghanistan for 15 days including RTU, SDH, PABX and teleprotection equipment. In case there are more than 1 Substation in the project, this training will be common for all Substations.	1	Lot			1	
5.7	Training in Supplier Premises out of Afghanistan for 15 days including RTU, SDH, PABX and teleprotection equipment on the equipment after system FAT. In case there are more than 1 Substation in the project, this training will be common for all Substations.	1	Lot			1	
SUB-TOTAL Cost Per Substation (include in each Substation Base Bid)							

Addendum 1

NEPS/SEPS Connector

Reactive Power Compensation

Acronyms

ACSR	Aluminium Conductor Steel Reinforcement
ADB	Asian development Bank
ADM	Add/Drop Multiplexing
AFRM	Afghanistan Residence Mission
AIF	Afghanistan Infrastructure Fund
AMSL	Above Mean Sea Level
ANSI	Amercan National Standard institute
AP	Angle Point
ASA	American Standards Association (ANSI)
ASCE	American Society of Civil Engineers
ASTM	American Society of Testing Materials
BDS	Bid Data Sheet
BOQ	Bill of Quantity
BS	British Standard
BU	Bay Units
Cct-km	Circuit Kilometer (Double Circuit, 3Phase, Twin Conductor Per Phase)
COF	Contract Forms
CPA	Condtions of Particular Application
CSCS	Computerized Substation Control System
Cu.m, m^3	Cubic Meters
DA	Double Circuit Tower Type – A (Suspension)
DABS	Da Afghanistan Breshna Sherkat
DB	Double Circuit Tower Type – B (Tension)
DBPC	Di-tert-butyl-para-cresol
DC	Double Circuit Tower Type – C (Tension)
DCPT	Dynamic Cone Penetration Test
DD	Double Circuit Tower Type – D (Tension)
DDM/DDE	Double Circuit Tower Type – DDM/DDE (Tension/Dead End)
DDP	Delivery Duty Paid
DDU	Deliver Duty Unpaid
deg	Degree
DIN	Deutsches Institute für Normung e.V.
DNP	Distributed Network Protocol
DS	Direct selection
DXC	Digital Cross Connect
ELC	Eligible countries
EQC	Evaluation and Qualification criteria
EXW	Ex factory, ex works or ex warehouse
FAT	Factory Acceptance Testing
FC	Foreign Currency
FC/PC	Fiber Connector for Physical Contact
FDS	Functional design specification
FIDIC	Federation Internationale des Ingenieurs Conseils (International Federation of Consulting Engineers

FOB	Free on Board
g/m^2	Gram Per Meters Square
GCC	General Conditions of Contract
HMI	Human Machine Interface
HV	High Voltage
ICC	International Chamber of Commerce
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Devices
IEEE	Institute of Electrical and Electronics Engineers
IFB	Invition for Bids
ISO	International Standards Organization
ITB	Instruction to Bidders
ITU-T	International Telecommunication Union Standard T (ITU's Telecommunication Standardization Sector)
kA	kilo Amperes, 1000 A
kg	Kilogram
kg/cm^2	Kilogram Centimeter Square
kN	Kilo Newton
KV	Kilo Volt
kVArh	kilo Volt Amperes Reactive Hours
l.m, m	Linear Meters, Meters
L.S	Lump Sum
LARP	Land Acquisition and Resettlement Plan
LC	Local Currency
L/R	Slenderness ratio, length/radius
Lux	Light intensity measurment
m/sec	Meter per Second
m a.m.s.l.	meters above mean sea level
MCCB	Molded Case Circuit Breaker
MEW	Ministry of Energy and Water
MHz	mega Hertz
MMC	Man Machine Communications
MOF	Ministry of Finance
MOI	Ministry of Interior
MOSS	Minimum Operating Safety standards
MSC	Mechanically Switched Shunt Capacitor
MSR	Mechanically Switched Shunt Reactor
MVA	mega Volt Ampere
MVAr	mega Volt Ampere reactive
MW	mega Watt
N	Newton
NEPS	Northeast Power System
NLCC	National Load Control Center
NMS	Network Management System
No.	Number
NoC	Negotiation of Contract

N/mm^2	Newton per Milimeter Square
ODAF	Oil Directed Air Forced cooling
OLTC	On-load tap changer
ONAF	Oil Natural Air Forced cooling
OPGW	Optical Fiber Ground Wire
Employer	DABS
Employers Engineer	DABS Appointed/Selected Technical Representative(s)
PABX	Private Automatic Branch Exchange
PCC	Plain Cement Concrete
PCU	Project Coordination Unit
PDF	Proposal Forms
PDS	Proposal Data Sheet
PISU	Programme Implementation Support Unit
PMG	Permanent Magnet Generator
PMO	Project Management Office
PSTN	Public Switched Telephone Network
QSIG	Q signaling
RCC	Reinforced Cement Concrete
RFP	Request for Proposal
RF	Radio Frequency
RPC	Reactive Power Compensation
RTU	Remote Terminal Unit
RoW	Right of Way
SCADA	Supervisory Control and Data Acquisition
SCC	Special Conditions of Contract
SDH	Synchronous Digital Hierarchy
SEPS	Southeast Power System
SI	System International
SINAD	Signal to Noise and Distortion Ratio
SMEC	Snowy Mountains Engineering Corporation
SOH	Section Overhead
SPT	Standard Penetration Test
sq.m, m^2	Square Meters
sq.mm, mm^2	Square Milimeter
SVC	Static Var Compensator
TIF	Telephone Influence Factor
Ton	Metric Ton
UN	United Nation
Un	Nominal Voltage
Um	Design Voltage
Umax	Maximum Voltage
UNMACA	United Nations Mine Action Center, Afghanistan
UTM	Universal Transverse Mercator
UTS	Ultimate Tensile Strength
UXO	Unexploded Ordinance
VA	volt ampere

VAC	volt alternating current
VDE	Verband Der Electrotechnik Electronik Informationstechnik e.v
VF	Voice Frequency
VHF	Very High Frequency
XLPE	Cross-linked polyethylene
µm	micro meter (1 x 10-6 m)

1.0 Technical Specification

1.1 Project Description

1.1.1 Overview

The NEPS-SEPS connector is a double circuit 220 kV transmission line that will extend approximately 550 km from Arghandi Substation near Kabul to the Kandahar East Substation in Kandahar. It will provide an electrical connection from the Northeast Power System (NEPS) in Afghanistan to the Southeast Power System (SEPS) in Afghanistan. The NEPS-SEPS connector will serve load along the length of the NEPS-SEPs connector and at Kandahar.

The power source for the NEPS-SEPS connector is through existing double circuit 220 kV lines that extend approximately 450 km from generation sources in Uzbekistan and Tajikistan through northern Afghanistan, across the Hindu Kush mountains at Salang Pass and into the Kabul area at Chimtala Substation. Arghandi Substation is currently under construction approximately 27 km south of Chimtala Substation. A new 220 kV double circuit line will be constructed between Chimtala Substation and Arghandi Substation. The northern end of the NEPS-SEPS connector will terminate at Arghandi Substation.

This contract includes design, supply, installation, and commissioning of reactive power compensation (RPC) equipment plus operations and maintenance services for the equipment. The RPC equipment will include mechanically switched capacitors (MSCs), mechanically switched reactors (MSRs) and static VAr compensators (SVCs). RPC will be installed on the 220 kV buses at the Chimtala, Sayedabad Ghazni and Kandahar East substations.

The RPC systems at Chimtala and Kandahar East must be designed to operate together to manage 220 kV system voltages in conformance with the requirements of this specification. The objective of this contract is to stabilize voltage to permit energizing of the transmission line and serving load from the NEPS-SEPS connector. The RPC system will also increase the total import capacity from sources in Uzbekistan and Tajikistan, improve power quality in the Kabul area, and reduce the likelihood of outages caused by voltage excursions.

1.1.2 Design, Construct, and Commission RPC System

Design, procure, construct, and commission RPC system components at existing and newly constructed substation facilities including Chimtala, Sayedabad, Ghazni, and Kandahar East.

Supply a complete and operational RPC system, including the equipment specified in Table 1.1.1 for installation at Chimtala, Sayedabad, Ghazni, and Kandahar East substations. Perform final design of the RPC system including system modeling, dynamic analysis, and training of DABS personnel. The Contractor's analysis shall consider RPC equipment included in this specification, WO-LT-0048 AMD3, and WO-LT-0048 AMD4. New and existing RPC equipment at NEPS-SEPS substations including Chimtala, Sayedabad, Ghazni, Qarabagh, Moqor, Shah Joy, Qalat, and Kandahar East substations shall be addressed. See Drawings G-103/104 for elementary single line representation of the system.

PSS/E models of the existing NEPS system, including RPC components specified herein, will be provided to the Contractor for use in the system analysis. The PSS/E models are based on available data which may not be complete or accurate in all detail. Where specific information was not available, representative data was applied. The Contractor shall take potential imperfections in the PSS/E models into account in designing the RPC system to provide an RPC system that performs in accordance with requirements of this specification.

The Contractor shall perform final analysis of the RPC system and demonstrate coordination of the design with existing RPC in the NEPS system and RPC proposed for line segments to be constructed "by others" including the Kabul area to Gardez transmission line and the Kabul area to Kandahar East transmission line.

Monitoring and control for all components installed under this specification, including the SVC systems, shall be fully integrated into the National Load Control Center (NLCC) SCADA system. The Supervisory Control and Data Acquisition (SCADA) project scope shall include integration of RPC system control points, trip signals, analog values, and system indication (breaker trip, switch position, etc.) with the substation RTU where RPC is installed under this contract. If necessary a new RTU shall be installed. Programming of the SCADA Remote Terminal Units (RTUs) to accommodate the added functionality and programming of the SCADA master at the National Load Control Center (NLCC) shall also be included.

Chimtala

At Chimtala substation, design, procure, construct, and commission RPC including MSC, MSR, and SVC system components identified in Table 1.1.1 and the conceptual design drawings included in this specification.

Configure the Chimtala SVC controller to control all new and existing MSRs and MSCs (at both 110 kV and 220 kV) located in the Chimtala substation for steady state balancing of reactive power and voltage control. The SVC controller may apply all or part of the MSRs and MSCs at Chimtala substation to supplement the dynamic response provided by the SVC.

ADB is currently sponsoring work at the Chimtala site to extend the 220kV bus, adding line terminals and a connection point for the RPC system described in this specification. The project scope includes coordination of the Contractor's design with ongoing efforts (by others) to design and construct the Chimtala 220kV bus extension.

The substation modifications shall include 220 kV bus and structure modifications and additions as required to interface to the ADB sponsored bus extension and to support connection of the SVC and associated RPC equipment. The Contractor shall supply all breakers, switches, metering, relaying, RPC equipment, controls, control building, and civil works and all other associated work required to produce a functioning RPC system at the existing Chimtala substation.

The Contractor shall be responsible for final connections to existing and newly constructed substation facilities.

Design and construct the Chimtala RPC components in accordance with the technical requirements of this specification and Drawings XE-100 and XE-600.

Sayedabad

Design, procure, construct, and commission RPC consisting of MSR system components as identified in Table 1.1.1 and the conceptual design drawings including in this specification.

The substation modifications shall include all 220kV breakers, switches, metering, relaying, RPC equipment, controls, civil works, required buswork and structures, and all other associated work required to produce a functioning RPC system at the newly constructed Sayedabad substation.

The Contractor shall be responsible for final connections to existing and newly constructed substation facilities. The Sayedabad substation is in the design and construction phase of another USAID/DABS project.

Design and construct the Sayedabad RPC components in accordance with the technical requirements of this specification and Drawings XE-120 and XE-610.

Ghazni

Design, procure, construct, and commission RPC consisting of MSR system components as identified in Table 1.1.1 and the conceptual design drawings including in this specification.

The substation modifications shall include all 220kV breakers, switches, metering, relaying, RPC equipment, controls, civil works, required buswork and structures, and all other associated work required to produce a functioning RPC system at the newly constructed Ghazni substation. .

The Contractor shall be responsible for final connections to existing or and newly constructed substation facilities. The Ghazni substation is in the design and construction phase of another USAID/DABS project.

Design and construct the Ghazni RPC components in accordance with the technical requirements of this specification and Drawings XE-110 and XE-610.

Kandahar East

At Kandahar East, design, procure, construct, and commission RPC including MSC, MSR and SVC system components identified in Table 1.1.1 and the conceptual design drawings included in this specification.

Configure the Kandahar East SVC controller to switch all MSRs and MSCs located in the Kandahar East substation for steady state balancing of reactive power and voltage control. The SVC controller may apply all or part of the MSRs and MSCs at Kandahar East substation to supplement the dynamic response provided by the SVC.

The substation modifications shall include 220kV bus and structure modifications and additions as required to interface to the Kandahar East substation and to support connection of the SVC and associated RPC equipment. The Contractor shall supply all breakers, switches, metering, relaying, RPC equipment, controls, control building, civil works and all associated work required to produce a functioning RPC system at the existing Kandahar East substation.

The Contractor shall be responsible for final connections to existing or and newly constructed substation facilities. The Kandahar East substation is part of other bidding documents.

Design and construct the Kandahar East RPC components in accordance with the technical requirements of this specification and Drawings XE-130 and XE-610.

1.1.3 Operations and Maintenance

Provide a minimum of three staff on site for a period of three years following commissioning to lead the ongoing operation and maintenance of the RPC system. Staff duties and minimum staffing levels are:

- The SVC Engineer in Charge shall reside in Kabul to provide technical and administrative management of the RPC systems installed under this contract and to support the NLCC in operating the RPC systems
- A Field Engineer shall reside Kabul to support the SVC and associated equipment at Chimtala substation

- A Field Engineer shall reside in Kandahar to support the SVC and associated equipment at the Kandahar East substation.

This work is included in the base bid.

1.1.4 General

The RPC system includes all RPC system components, structures and all associated work required to produce a fully operational RPC system as specified in Table 1.1.1 and the conceptual design drawings included in this specification.

Table 1.1.1 RPC and Location, Type, and Rating

Location	RPC Type	Rating	Comments
Chimtala 220kV	MSC[1]	2 x 10 MVAr, 1 x 20 MVAr and 1 x 40 MVAr	1 x 60 MVAr, 1 x 40 MVAr and 1 x 20 MVAr existing on 110 kV bus
	MSR[1]	1 x 25 MVAr	1 x 25 MVAr existing[1]
	SVC	1 x +30/-140 MVAr minimum continuous at 220 kV[4]	
Sayedabad 220 kV	MSR	2 x 15 MVAr	
Ghazni 220 kV	MSR	2 x 15 MVAr	
Kandahar East 220 kV	MSC[3]	2 x 10 MVAr and 1 x 20 MVAr	
	MSR[3]	2 x 25 MVAr[2]	In substation contract, not included in this specification
	SVC	+40/-40 MVAr minimum continuous at 220 kV[3,4]	

Notes:
1. MSRs and MSCs installed in this contract and existing MSRs and 110 kV MSCs shall be controlled by the Chimtala SVC controller. The Contractor shall provide and install all necessary wiring and equipment to monitor switching configuration and status of the MSRs and MSCs.
2. The two 25 MVAr MSRs at Kandahar East are provided in other bidding documents.
3. MSCs installed in this contract and MSRs supplied under other bidding documents shall be controlled by the Kandahar East SVC controller. The Contractor shall provide and install all necessary wiring and equipment to control and monitor switching configuration and status of the MSRs and MSCs.
4. The SVC controller may control all or part of the MSRs and MSCs to supplement the dynamic response provided by the SVC. The MSRs and MSCs so controlled may be included in the SVC rating to the degree the effectiveness of including rapid switching of MSRs and MSCs is proven to the Employers satisfaction through dynamic analysis and simulation.

The scope of work comprises the design, supply and erection of all required substation equipment (circuit breakers, switches, etc.), control facilities, as well as installation of ancillary works, to provide a reliable RPC system to the satisfaction of the Employer.

Reference diagrams and substation plans are attached to this specification.

The bid hereinafter referred to as "the Works" shall be performed on a Turnkey basis. The Contractor shall execute all temporary and permanent works, whether particularized in these Specifications or not, necessary for a timely and successful Taking-Over of the Works.

This scope of work for the RPC system Design, Manufacture and Supply, Construction, Erection, Installation, Testing and Commissioning includes the following components:

- Perform analytical studies as defined in elsewhere within this specification to finalize RPC equipment ratings and design to meet the requirements of this specification. Final RPC design to use the substation locations and equipment locations identified in the representative design and to follow the approach to RPC deployment established in the representative design presented in this document. All aspects of performance of the RPC system shall meet or exceed the RPC equipment summarily described in Table 1.1.1.
- Document and present results of analytical studies for Employer review and approval. Include complete functional descriptions of the communication and control systems to be employed so that the completed RPC system will automatically function as single integrated system. Demonstrate that proposed RPC system meets this specification and meets or exceeds all aspects of performance of the representative system summarily described in Table 1.1.1. Include accommodations to be included in the design to assure operational compatibility between the SVCs installed at Chimtala and at Kandahar East.
- Prepare detailed design, construction, and commissioning services for new RPC included within the scope of this specification. Detailed designs shall conform to equipment types summarized in Table 1.1.1, ratings shall meet or exceed those detailed in Table 1.1.1and designs shall conform to the conceptual design drawings included in this specification. The analytical studies defined in this section above may define RPC equipment that varies from the RPC equipment listed in Table 1.1.1so long as the functional requirements of this specification are met and the equipment proposed meets or exceeds the performance of the RPC equipment specified in Table 1.1.1.
- Prepare final design deliverables including detailed substation drawings, specifications, and supporting analyses. Prepare shop drawings as required. Submit for Employer and Engineer review. Incorporate comments and resubmit as described in Section 1.1.13
- Transportation of all materials and facilities to site, proper storage and facilities preservation, including all services to be required at Customs (i.e., including unloading, loading, storing at site or Customs stores and other services).
- Provision and recommendation of spare parts as per the specification and price schedule for as further defined within this specification.
- Commissioning and acceptance testing including provision of necessary testing equipment, instruments, and devices.
- If necessary perform tests, control setting changes, or any other work or system modifications necessary to provide compatible operation with the SVC to be installed at Kandahar East substation.
- On-the-job training of the personnel authorized by the Employer.
- Strict implementation of Health, Safety, Environmental, and Social safeguards at site and as required as per the project specification and AIF guidelines.
- Construction and commissioning of RPC control buildings, life support features, communication systems, security features, and yard equipment.
- The contractor shall coordinate all outages with the Employer and shall minimize the occurrence and duration of outages associated with construction of the Works.
- Design, construct, and test hardware and software required to integrate all substations and related control and monitoring equipment constructed under this contract into the NLCC SCADA system.
- Provide services to integrate remote control and monitoring of the RPC system components constructed under this contract into the NLCC SCADA system.

- Operational on-site Operations and Maintenance services for a three year period.

The work shall be performed on a turnkey basis. The Contractor shall execute all temporary and permanent work, whether particularized in these Specifications or not, necessary for a timely and successful taking-over of a complete, functioning RPC system.

1.1.5 Coordination Activities

Contractor shall interface and coordinate with other parties to ensure proper connection of substations equipment constructed independently or by others. The interface points for work within substations are defined in the attached drawings.

1.1.6 Code, Standards, Specifications

All material used, facilities supplied and all workmanship and tests shall be in accordance with the latest editions of IEC and ISO Standards, or where International Standards are not applicable, with national standards such as ASA, ANSI, ASTM, BS or VDE + DIN, IEEE, ASCE. Where such standards and codes are national or relate to a particular country or region, other authoritative standards that ensure substantial equivalence to the standards and codes specified or in accordance with technical requirements of a Country where the site is located, will be acceptable. For any such standards which are not written in the English language, the Contractor shall make available copies of a certified English translation thereof.

Where no standards exist, as in the case of patent or special materials, all such materials and workmanship shall be of the best quality and full details of the material and any quality control tests to which they may be subjected shall be submitted to the Engineer for approval.

The Contractor shall deliver (soft copy and hard copy) at his own cost, one complete set of the selected and approved international code standards, and specifications to the Employer / Engineer within 28 days after commencement of the works.

The set shall contain codes, standards and specifications as referred to in the technical specifications or approved alternatives. One set shall be kept at the Contractor's site office and shall be accessible to the Employer or his representatives during working hours.

1.1.7 Facilities and Materials

All facilities and materials to be incorporated in the works must be new, unused, and of the most recent or current models, and must incorporate all recent improvements in design and materials unless provided for otherwise in the Contract. Where applicable, all facilities shall be of design suitable for adverse climatic conditions as experienced on site in Afghanistan. All facilities shall be inspected and tested in full, to prove compliance with the requirements of the Specifications to the satisfaction of the Engineer.

1.1.8 Workmanship

All work, method statements of work and workmanship, whether fully specified herein or not, shall be of the highest order. In all respects, the generally accepted requirements and commonly recognized good practice for first-class work of this nature are to be adhered to and the Contractor shall submit quality certificates for materials. Method statements shall be submitted for all works for review and approval before the work commences and shall be to the satisfaction and approval of the Engineer.

1.1.9 Design and Engineering

The Contractor shall design, manufacture, supply, erect, construct, install, test and commission all Facilities and Materials, items and components of the Works, and carry out all installation services and work necessary so that the Works described herein shall be satisfactory for their intended purpose.

The Contractor shall design the complete Works in accordance with the design criteria and specifications given in the Supply Requirements, and as shown in the Bid Drawings. All design carried out by the Contractor shall comply with these Specifications and shall take into account all requirements of the facilities and technical requirements of Afghanistan. The Contractor shall optimize the design of each component of the Works in order to achieve the most economic design. The Contractor shall be entirely responsible for all design carried out by him.

The Contractor shall inform themselves fully of the actual dimensions, levels, etc., of any other existing or proposed structures before commencing the manufacture of parts dependent on such data. The design calculations for each member forming part of the Facilities shall be based on the most unfavorable combination of all the loads which the said member or part is intended to support or assist in supporting either permanently or temporarily. All design calculations shall be subject to the review and approval of the Engineer.

Where appropriate design criteria or specifications are not indicated in the supply requirements or shown in the Bid Drawings, then the Contractor shall carry out the design work in accordance with generally accepted engineering design theories, principles and criteria, to the satisfaction of the Engineer.

The Contractor shall provide the Employer with fully detailed design drawings, detailed design reports and design calculations relating to the Works. All design work shall be subject to the approval of the Employer, pursuant to the Conditions of Contract. Design drawings, design reports and design calculations shall be prepared and submitted in accordance with chapter Documentation of the General Requirements.

1.1.10 System Characteristics and Climatic Conditions

All facilities shall be designed for efficient operation under Afghanistan's climatic conditions, which can be harsh with snow and ice in winter and hot and dusty conditions in the summer. The following system characteristics and climatic conditions data are provided for guidance in designing the facilities:

The information contained in this section is to be used in bid preparation only. Contractor must independently develop the information to be used in actual design, subject to review and approval of the Employer.

Specified clearances shall be considered minimums. The supplied values are elevation dependent and have been provided for information only. The designer shall consider elevation and adjust clearances tendered and applied to equipment design.

Table 1.1.2 Facilities Design Conditions

HV System	
Nominal Voltage (U_n)	220KV
Highest System Voltage (U_{max})	245KV
Design Voltage (U_m)	252KV
Minimum continuous ac system voltage, line to line	187KV (0.85 pu)

Maximum short-term ac system voltage, line to line	297KV (1.35 pu) (Max. duration 1 s)
Rated short time current	40kA/3sec
Minimum three-phase fault current	0.500kA
Earthing	Solidly Earthed
Insulation Coordination	IEC 60071-1
Rated lightning impulse withstand* :	
0m – 1,500m a.m.s.l.**	1,050kV$_{peak}$
1,501m – 2,500m a.m.s.l.**	1,050kV$_{peak}$
Rated 1 min power frequency withstand :	
0m – 1,500m a.m.s.l.**	460kV$_{rms}$
1,501m – 2,500m a.m.s.l.**	460kV$_{rms}$
Phase-to-earth air clearance :	
Minimum	2,000mm
0-750 m a.m.s.l.**	2,000mm
751-1,500 m a.m.s.l.**	2,100mm
1,501-2,500 m a.m.s.l.**	2,200mm
Phase-to-Phase air clearance :	
Minimum	2,200mm
0-750 m a.m.s.l.**	2,200mm
751-1,500 m a.m.s.l.**	2,300mm
1,501-2,500 m a.m.s.l.**	2,450mm
Creepage distance outdoor +	25mm/KV$_{PG}$
Frequency	
Standard frequency	50Hz
Maximum continuous ac system frequency	52.5Hz
Minimum continuous ac system frequency	47.5Hz
Maximum short-term ac system frequency	52.5Hz (Max. duration 900 s)
Maximum rate of change of frequency (df/dt)	0.2Hz/s
Minimum short-term ac system frequency	47.5Hz (Max. duration 1800 s)
LV Distribution System	
Nominal Voltage (Un)	400/230V
Design Voltage (Um)	0.6/1KV
Voltage Variation	±7.5%
Standard Frequency	50Hz
Rated Short Time Current	12.5kA/1 sec
Earthing	Solidly earthed

Climatic and Geographic Conditions	
Seismic Factor for design Data not available	High
Altitude (Project Area only)	
Chimtala	1,900 meters
Sayedabad	2,115 meters
Ghazni	2,185 meters
Kandahar East	1,029m
Dry Period	June to November
Rain Period	December to May
Annual Rainfall	327mm
Maximum Solar Radiation	1,200W/m2
Maximum Ground Snow Depth	1m
Maximum frost depth	1m
Air Temperatures:	
Average	12°C
Maximum	39°C
Minimum	-6°C
Humidity:	
Average humidity summer (June to September)	35%
Average humidity winter (October to May)	75%
Ground Resistivity of Soil:	
Average	2,000 Ohm-m Single soil layer
Wind:	
Maximum Wind Velocity	41m/s (148km/h)
Wind gust factor or maximum wind gust	1.5
Wind and Dust	Sand and dust storms in summer
Isokeraunic Level Thunderstorm	23 days/year

**a.m.s.l.: altitude mean sea level

1.1.11 Language

The English language shall be used in all Contract documents and in all correspondence between the Contractor and the Engineer, and between the Contractor and the Employer.

1.1.12 System of Units

In all correspondence, in all technical schedules and on all drawings, metric units of measurement, System International (SI) system of units, shall exclusively be used:

- Dimensions in meters and millimeters unless specified otherwise
- The unit of mass is the kilogram (kg)
- The unit of force is the Newton (N)
- Angular measurement shall be in degrees, with 90 degrees comprising one right angle

1.1.13 Documentation

1.1.13.1 General

The sizes of all documents and drawings shall conform to the ISO standard, and be of size A1, A2, A3 or A4. Larger sizes than A1 shall be avoided. All documents in size A3 and A4 shall be bound in hard covers. The schematic diagrams, apparatus and cable lists shall have a size of A3 or A4. The Contractor shall submit the hard copy and soft copy of the all documents as per the specification and price schedule.

All drawings shall be prepared and submitted in the latest version of AutoCAD or a similar computer aided drafting software package. Scales to be used on the drawings shall be 1:10, 1:20, 1:40, 1:50 and multiples of this series.

Operational and warning labels in the Afghan language shall also be indicated.

The Contractor shall, during the project duration, maintain a List of Documentation to be updated whenever needed. The List of Documentation shall include the date of the original issue of each document submitted as well as the dates of every revision. The List of Documentation shall also include a time schedule for the submittal of the documentation.

1.1.13.2 Documentation for Design and Manufacture

During the design period, full documentation on all equipment and material shall be supplied to the Engineer and Employer for review and approval. All drawings prepared by the Contractor shall be submitted in five (5) sets hard copy and two sets (2) of soft copy (CD) to the Employer for review and approval. All documentation shall have such information or instructions related to the drawings and the design as may be necessary.

Within twenty eight (28) days after receiving such drawings, calculations, samples, patterns and models, one copy of each document will be returned to the Contractor, dated, signed and marked by the Engineer and, where necessary, with proposed corrections indicated.

Any delay arising out of failure by the Contractor to rectify the design, calculations, drawings, etc. in good time should not alter Contract completion date.

Drawings marked **RETURNED FOR CORRECTION** shall be corrected by the Contractor and sent to the Engineer for further review.

When a drawing is marked **REVIEWED** or **REVIEWED AS AMENDED**, the Contractor will be allowed to use the drawing for manufacture and erection. The Contractor shall, however, make corrections according to the remarks given by the Employer, Engineer, expert and upon their approval, the Contractor could use the drawings. Manufacturing starting prior to receipt drawings marked REVIEWED or REVIEWED AS AMENDED is done at the Contractor's own responsibility.

The Engineer's approval does not however in any way relieve the Contractor of his full responsibility for the correctness of his documentation and the proper functioning, quality and compliance with the Specifications of all plant and equipment supplied by him.

The Engineer's approval shall not relieve the Contractor from full responsibility from mistakes or omissions therein or there from (including any resultant mistake or error in the Works) or for any discrepancy or deviation from the Technical Specification and other drawings.

Calculations, samples, patterns, models, etc., submitted to the Engineer for his review, shall be such as are called for herein or as may be necessary for proving compliance with the Contract.

1.1.13.3 Documentation for Installation

The Contract Price shall be deemed to include illustrated installation, operating, service and maintenance instructions for the Works, which shall be written in English. The installation, operation, service and maintenance manuals shall cover all aspects of the Works, including the civil works and structures, surface water drainage, sub-soil and under-structure drainage, etc., and all electrical equipment supplied. Hard copy and soft copy of the Method Statement with drawings/sketches shall be submitted for review and approval to Employer/Engineer for construction, erection, installation, etc. works.

The manuals shall include parts catalogues, and details of equipment installation, operation, maintenance and repair. If the manufacturer's standard bulletins are supplied, they shall be clearly marked to indicate the specifications applicable to the particular equipment that is supplied. Each manual shall include a full set of assembly drawings, including wiring diagrams, reduced to A3 size. The manual shall also contain a detailed service program adapted for each facility for all equipment explaining what action shall be done on which equipment and when.

Prior to the installation period the Contractor shall distribute copies of the REVIEWED documents and such other particulars, to the Employer in four (4) sets and to the Engineer in one (1) set.

The Contractor shall submit in due time but not less than one month before commissioning, two copies of preliminary Operation and Maintenance Instructions and Service handbooks to the Engineer for review and approval, following the same procedure as for the drawings.

The approved documentation shall be distributed in five (5) sets to the Employer two months before the start of commissioning.

If any descriptive brochures forming part of this documentation shall be provided in English versions, complete translations shall be enclosed.

The documentation shall continuously be updated during the installation and test period by the Contractor. During the initial period of operation, before receipt of As-built documentation at the site, one copy of the updated erection documentation, instructions, etc., shall be kept at the site.

1.1.13.4 Commissioning and Completion Report

Prior to the issue of the Taking-Over Certificate, the Contractor shall submit to the Employer's Representative one original and six copies of a Commissioning and Completion Report for each Section of the Works. The Works, or, if applicable, the Section, shall not be considered to be completed for the purposes of taking-over until such Commissioning and Completion Reports have been submitted to the Employer's Representative.

1.1.13.5 As-Built Documentation

General

Immediately after the Operational Acceptance of the Facilities, the Contractor shall update all final documents in accordance with the modifications made. When a document contains all modifications, it shall be marked As-built.

As-built documentation shall be submitted to the Employer in four (4) sets and to the Engineer in one set, at the latest two months after Operational Acceptance of the Facilities.

For drawings, A3 size and larger, one of the sets issued to the Employer, shall be of reproducible transparent material (PVC). In addition two soft copies, CD ROMS or similar computer storage media, shall be supplied for all As-Built drawings.

The supply of As-built documents shall comprise but not be limited to all AutoCAD drawings for construction and installation, calculations, instructions for operation, maintenance, repair and adjustment, apparatus lists, spare parts lists containing information needed for ordering for all equipment supplied under the Contract.

General Manuals

The following general manuals, covering the whole project, shall be delivered:

- A general description of the equipment in this contract
- Operating instructions, suitable for training of personnel
- General maintenance instructions, describing frequencies and methods for regular inspections, for planned maintenance and for regular part replacements. The instructions shall also include fault location guides.
- The manuals shall include spare part lists and description of any special tools needed for service of the equipment.
- All other drawings or manuals that are not mentioned, but are deemed necessary for a safe and proper handling of the delivered equipment.

Facilities Design Documentation

The following documents shall be delivered:

- All layouts, construction and installation drawings
- All design, calculations, regarding civil, electrical and mechanical design data and computations
- Design Drawings, Sag and Tension Chart, tower schedule, tower spotting data, etc.

Facilities Documentation

Documents for approval shall be delivered before the work is started but shall also be included in the as-built documentation as follows; in case of alterations agreed upon by all parties, new documents shall be issued:

- Type test certificates for important facilities; data specifications on other facilities
- Routine test certificates
- Data lists with Engineer required amendments incorporated. The contents of the lists shall correspond to the schedules of this document. Data lists will be regarded as binding for the manufacturer
- Dimension drawings. They shall be regarded as binding for the manufacturer and shall contain measures, weights and features of the facilities
- Detail drawings as required by the Engineer

1.1.14 Progress Reports

Work plans, monthly programs, and reports shall be provided by the Contractor. At the end of each month, the Contractor shall submit suitable written progress reports to the Employer and Engineer with the progress of design, manufacture, delivery, transport, erection, etc. If the progress of the Works does not conform to the approved Program, the Contractor shall indicate these deviations, with substantiating reasons.

1.1.15 Manufacture

Before commencing any construction of the facilities or manufacture of any apparatus provided within the scope of supply, the Contractor shall submit for the approval of the Engineer, the drawings of the manufacturers of the facilities.

After such approval has been given, the manufacture shall be planned and performed according to the Specifications and to the satisfaction of the Engineer.

The Engineer shall be afforded every opportunity to control and inspect the manufacture and testing of materials in the steelworks, rolling mills, foundries, factories etc., and their assembly in the workshops of the Contractor and his Subcontractors.

1.1.16 Site Regulations and Safety

The Employer and the Contractor shall establish Site regulations according to the General Conditions of Contract.

The Contractor shall provide appropriate training in handling facilities and machinery to the workers and laborers before the commencement of work. All workers employed by the Contractor shall be insured against any accident.

1.1.17 Notices and Permits

The Contractor shall give the requisite notice and obtain any necessary approvals from the Government or Authorities. Authorities' Inspectors may be required in the case of excavations, trenching and (in particular) blasting operations; the Contractor shall pay for all permits required prior to and during the execution of the Contract, including those required for all temporary works.

1.1.18 Verification of Dimensions

Before work is commenced on any structural element required to be fabricated, or provided under this Contract, the Contractor shall verify by measurement on site, the relevant dimensions of all work previously completed.

1.1.19 Site to be Kept Tidy

Throughout the progress of the Works, the Contractor shall keep the site and all working areas in a tidy and workmanlike condition, and free from rubbish and waste materials. Other items, which are not required for use by the Contractor at the present time, shall be dispersed about the site in an orderly fashion, or shall be properly and securely stored.

The Contractor shall not mobilize and demobilize of any construction facilities, materials, etc. from the site without the approval of the Employer or Engineer.

1.1.20 Site Supervisors

The Contractor shall provide the services of competent specialists to supervise the construction of the Works and erection / installation of Facilities at the Site. The Contractor's Site Supervisors shall be given full responsibility and authority to negotiate and agree points arising out of the Works, in order that the Works may proceed with a minimum of delay. Directions and instructions given by the Employer or the Engineer to the Site Supervisors shall be interpreted as having been given to the Contractor.

1.1.21 Safety of Personnel

The maximum safety, consistent with good erection/installation practices shall be afforded to personnel directly engaged on this Contract, or to persons who, in the normal course of their occupation, find it necessary to utilize temporary works erected by the Contractor to access the working area.

Once any section of the Works or Facilities has been energized, the Contractor shall establish a system for ensuring the safety of personnel and facilities. While the Works, Facilities are under the control of the Contractor, the Contractor shall be responsible for the safety precautions. While the Works, Facilities are under the control of the Employer, the Employer shall be primarily responsible for these precautions.

1.1.22 Packing and Transport Marking

All parts of the Facilities shall be well packed and protected against loss or damage during the transport by sea and land and whilst in storage under adverse climatic conditions. All packing shall be performed in such a way that the facilities will not be damaged by overturning of the packages or by weather. Dimensions of packages, crates, etc., shall be suitable for road transport. Instructions for handling shall be clearly marked on all parts, packages and crates.

All parts, packages and crates shall be adequately marked to enable identification. Each item contained in a package shall be clearly identified on the packing list by its description and part number and assembly drawing reference, and each item shall be marked or labeled to correspond with the packing list. The marking system to be used shall be as instructed by the Engineer.

All packages shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked with signs showing 'up' and 'down' on the sides of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit by sea or storage on land.

The cost of all facilities needed for the temporary fixing and supporting of the various parts of the Facilities and the various packages to crane hooks, etc., during handling, transport and storage and the cost of load distribution beams, etc., where they form part of the packing or crates, shall be included in the Contract Price.

The Contractor shall be entirely responsible for all packing and any loss or damage shall be made good by the Contractor and, except where otherwise provided, at the Contractor's own expense.

Identification, reinforcement or upgrading of roads/bridges for access to the site and for transport of facilities and materials shall be the responsibility of the Contractor. Any costs associated with identification, reinforcement and upgrading of roads and bridges shall be deemed to be included in the Contract Price.

1.1.23 Geotechnical Investigation

1.1.23.1 Scope of Work

The scope of work includes obtaining permits, licenses, obtaining underground utility clearances, performing soil borings, perform rock coring where appropriate, performing index, strength, and soil resistivity tests and providing the engineering report.

1.1.23.2 Definitions

ASTM – American Society of Testing and Materials specifications, latest revision.

Boring – Excavation four to eight inches in diameter made with a drill rig for the purposes of testing for engineering properties.

Drill Rig – A general term for portable machinery consisting of a derrick, power supply, draw works, hammer drop system, augers, drill-rod, bit, and other equipment necessary for geotechnical drilling and having the capability to advance borings to a depth of twenty five meters and perform SPT, thin-walled (Shelby tube), and rock core sampling.

Contractor – The company under contract to the Engineer or Employer to provide drilling, laboratory testing and other geotechnical engineering services for the project under the direction of its geotechnical engineer.

SPT – Standard Penetration Test, for driving a split-barrel sampler to obtain a representative soil sample and a measure of the penetration resistance of the soil as defined under ASTM D 1586.

USCS – Unified Soil Classification System

1.1.23.3 Right of Entry

The Employer or Engineer shall delineate the access and define the access restrictions to each boring location.

1.1.23.4 Environmental Protection

The Contractor shall comply with all applicable regulations pertaining to the protection and preservation of the environment. The Contractor shall get authorization from the Employer to clear any materials, or make any improvements whatsoever, to facilitate access to each boring.

The Contractor shall return the ground to as near original condition as possible and remove rubbish, unused materials, and other material belonging to him, or used under his direction during the performance of this work.

The Contractor shall avoid crossing, entering into or working in any environmentally sensitive areas.

1.1.23.5 Responsibility for Damages

The Contractor shall exercise due care in driving and in the execution of the work, on public and private property. The Contractor shall be responsible for all excess damages to property incurred by Contractor.

1.1.23.6 Locating Underground Utilities

The Engineer shall indicate the boring locations. The Contractor shall coordinate with all underground utilities to locate and mark any underground utility in the vicinity of each boring location prior to initiating any drilling activities. Minor offsets, as approved by the Engineer, are acceptable to provide a safe working clearance for any utility, whether underground or overhead.

1.1.23.7 Equipment and Procedure

The field testing programs shall consist of drilling the borings as shown on the Boring Location Plan, and obtaining suitable soil samples for laboratory analysis. The field testing program shall be performed with a truck-mounted Drill Rig, under the direction of the geotechnical engineer. Field work shall include penetration testing, split barrel and /or thin-walled tube (Shelby tube) sampling, and rock coring where applicable. Penetration testing and split barrel sampling shall conform to ASTM D 1586 using a two-inch (2") O.D. sampler. Thin-walled tube sampling shall conform to ASTM D 1587. Rock coring shall conform to ASTM D 2113 using a 2 to 2-1/2 inch I.D. "N" series core barrel. Rock core samples shall be prepared and transported to the soil/geotechnical testing laboratory in accordance with ASTM procedure D 5079.

Soil Samples shall be sealed in air/water tight containers, handled carefully to avoid disturbance, and delivered promptly to the soil/geotechnical testing laboratory.

All drill pipes, drilling tools, auger, etc. shall be free of potentially contaminating materials (i.e. oil, grease, paint, microbes, etc.). The rig shall be free of leaks, which could contaminate the holes or site (i.e. hydraulic fluids, oil, gas, loose paint, etc.).

1.1.23.8 Test Borings & Field Work

A minimum of four (4) borings are to be performed at each SVC site. Borings shall be drilled to a minimum depth of six (6) meters for shallow foundations, eleven (11) meters for standard drilled piers, and fifteen (15) meters for dead end drilled piers. Soil samples shall be obtained at intervals of one and a half (1.5) meters or less to allow accurate logging of the soil nature, thickness and characteristics and to obtain material for geotechnical testing. Sampling shall include penetration testing, split barrel and /or thin-walled tube (Shelby tube) sampling, and rock coring where applicable. Rock sampling shall be obtained on a continuous basis.

1.1.23.9 Soil

The Contractor shall log the borings on a continuous basis during drilling. Soil shall be visually classified in the field using the USCS in general accordance with ASTM D 2488. A record of SPT blow counts shall be made. The following characteristics shall be noted in the sequence presented below for each soil type encountered:

- Soil Type Primary, Secondary (i.e. LEAN CLAY, sandy)
- Color Primary colors only
- Consistency/Density Using blow count
- Plasticity Visual observation
- Moisture Visual observation
- Grain Size Distribution Note the presence of boulders
- Any Other Features Such as mineralization, organics, odor, lack of bedding or structure, etc.

1.1.23.10 Rock

If rock is encountered during field sampling, the Contractor shall be required to obtain rock core samples. Continuous cores shall be obtained, labeled, and shored in appropriate core boxes. The logs shall indicate size and type of coring equipment (coring bit and barrel). Rock materials shall be described by the Contractor in the sequence described below and in accordance with standard geologic nomenclature, including:

- Rock Type
- Relative Hardness

- Density
- Texture
- Color
- Weathering
- Bedding
- Fractures, Joints, Bedding Planes, and Cavities (including any filling material and whether open or closed)
- Rock Quality Designation (RQD)
- Percent Recovery
- Start and Stop Time of Core Run
- Length of Core Run
- Other Descriptive Features (fossils, pits, crystals, etc.)

1.1.23.11 Groundwater

Observations of groundwater shall be recorded on the boring log(s) by the Contractor. Logs shall identify the depth, date and time at which water is first encountered the depth to water at the completion of drilling and the stabilized depth to water. The logs shall indicate any and all observed seepages within the boring. If free groundwater is not observed within the boring, it shall be noted. The presence of surface waters including drainage ditches, canals, rivers, and/or lakes in the immediate vicinity of the boring location shall be recorded. Any evidence of artesian water, perched water, or loss of drilling water shall be reported.

Upon completion of each boring to the required depth, the groundwater level shall be recorded. The groundwater level shall be recorded again after twenty-four (24) hours. The Contractor shall fill each boring hole after performing the required work. After being filled, each boring locations shall be marked with a wooden stake, which shall give the boring number. Boring holes shall be covered until filled.

1.1.23.12 Resistivity Testing

Field in-situ soil resistivity measurements shall be conducted at the Chimtala and Kandahar East Substations. The testing will be carried-out using a high-impedance, earth resistivity meter and 18" stainless steel, non-polarizing electrodes (also known as "stakes" and "pins").

A total of two (2) test locations will be placed on site. The measurements will be conducted as outlined in Soil Resistivity Testing below:

Soil resistivity shall be measured using the "Wenner Four-Pin" Method in accordance with IEEE Standard 81, IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System. In the Wenner method, measurements are conducted at three equal spacings with four probes in a line or traverse. The four probes are designated as an input current probe C1 as the first pin, two internal probes, P1 and P2 which is a measure of the voltage for each spacing and the Second outside pin is C2, the return current probe.

Measurements shall be conducted up to a largest probe spacing that is equivalent to the maximum dimension of the substation if possible. If the largest spacing is not possible due to problems with adequate area or obstructions that interfere with the measurements, then a spacing should be chosen as close as possible to a distance which can be achieved. For example, if the maximum dimension of the substation is 750 feet but due to space restrictions, three equal spacings of 750 feet are not possible, it is decided that a maximum spacing of 500 feet can be measured. Then this becomes the largest spacing. The recommended probe spacings between one (1) and 200 feet are shown below. For probe spacings greater than 200 feet, the recommended incremental distances shall be fifty (50) feet up to 500 feet and 100 feet greater than 500 feet.

1.25, 2.5, 5.0, 7.5, 10, 15, 20, 25, 30, 40, 50, 60, 80, 100, 120, 140, 160, and 200 feet

After conducting a first measurement traverse as described in Step 2, a Second measurement should be performed perpendicular to the first traverse. The purpose of this second measurement is to make comparisons in the soil structure in two different directions within the area of the facilities. The second traverse should be conducted for the same probe spacings as the first traverse or as many as possible. In order to conduct the two perpendicular traverses, it is recommended that the potential probe designated as P1 is selected as the fixed probe for both traverses and the other probes are laid out from this pin. The perpendicular traverse would be performed with the three probes of the second traverse being laid out 90o from the first traverse at the P1 pin location.

The instrument selection is important for this measurement. The "Measuring Techniques" page identifies a Biddle Det2/2 which is a capable device for these measurements. If the measurements are to be conducted in high resistivity soils (such as the desert with dry sand or mountain terrain with a high concentration of rocks), or there is anticipation of large amount of 50 Hertz interference, another instrument may be required which is capable of transmitting a larger amount of power and is immune to the interference. This should be discussed with Engineer to determine which instrument is appropriate.

The measurement results shall be recorded in tabular form as illustrated in the table below. In order to determine the resistivity, for this table, it is necessary to calculate a conversion factor. The conversion factor is as follows:

$$p = 2 * \pi * a * R$$

where "a" is the measurement spacing (in meters) and "R" is the measured resistance value.

Test Point	Probe Spacing Meters	Resistance Reading (Ohms)	Resistivity (Ohm –Meters)
1			
2			
3			
4			
etc.			

On the datasheet, additional information that should be recorded includes; the date and time of the measurement, the persons conducting the measurements, the instrument that was used, and the weather conditions. A sketch of the area and the layout of the test probes should also be provided (see below).

The apparent soil resistivity will be plotted against the probe spacing during the actual field measurements to detect anomalies in the readings. This will allow corrective action to be taken immediately during the field measurements and will enhance the confidence factor in the recorded data.

One of problems with measurement values where resistance is too high (this becomes apparent when the instrument indicates a high resistance value or the measurements indicate an unusually high value abnormal from the trend in measurements). This can be corrected by two possible methods (but not limited to these methods); adding salt water (which should be included as one of the items for the measurement trip) to each probe, or adding additional pins connected to the C2 current probe or the P2 potential probe. This is done by connecting additional electrodes (pins) perpendicular to the existing C2 or P2 pin (where the resistance is high) until a satisfactory reading is obtained. Please confer with Engineer for additional information.

A sketch of the test layout, to include a North Arrow, and the test/site conditions will be recorded.

Resistivity Measurement Datasheet

Date:		Persons/Company Conducting Measurement:	
Instrumentation:			
Soil Conditions:			
Weather Conditions:			
Probe Spacing (Meters)	Potential Probe Depth (mm)	Current Probe Depth (mm)	Resistance or Resistivity Reading (Ohms/Ohm-meters)

1.1.23.13 Supervision and Records

All field testing shall be performed under the direction of the Contractor's registered geotechnical engineer. During field testing and sampling a continuous log shall be maintained as well as visually classifying the subsurface soil and/or rock. Logs shall show borehole and sample diameters and depths at which drillings or sampling methods or equipment change. Logs shall show total depth of penetration and sampling. The bottom of the hole shall be clearly identified on the log with notation "Bottom of Hole" or "Total Depth". Logs shall show drilling fluids, drilling equipment make and model, drilling method, date and time drilled, casing, any heaving conditions, loss of circulation, voids, or any other conditions observed during drilling.

Any special drilling or sampling problems shall be recorded on the logs, including resolutions. Any indications of contaminations (i.e. staining, odors, etc.) shall be noted.

1.1.23.14 Laboratory Testing Program/Procedure

All laboratory testing shall be performed in accordance with current applicable ASTM standards and procedures under the direction of the Contractor's registered geotechnical engineer. The laboratory shall have the general capability for soil and rock testing as indicated in ASTM D 3740, "Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction". Laboratory tests shall be made to provide data for the classification of the soil and rock encountered in the field and for the prediction of their engineering behavior when used as construction materials or for the support of the structures at the site. In general, the Contractor shall perform all of the laboratory tests that will be necessary to complete an engineering analysis performed by the registered geotechnical engineer.

Index Testing
Index testing including, but not limited to, dry density, moisture content, gradation, and Atterberg limits shall be performed as directed by the Contractor's geotechnical engineer to adequately classify the soil in accordance with ASTM D 2487 and evaluated subsurface conditions.

Strength Testing
Strength testing shall be performed on undisturbed and/or relatively undisturbed soil samples to determine cohesion, angle of internal friction, shear strength, soil modulus parameter, and stress-strain modulus. Shear strength testing may include, but not be limited to, Triaxial Compression Tests UU, CD, or CUPP, direct shear, and/or consolidation testing. Uniaxial compression of rock specimens for determination of uniaxial strength and shear modulus shall be performed as directed by the Contractor's geotechnical engineer to complete the engineering analysis and develop foundation design criteria.

Supervision and Records
All laboratory testing shall be performed under the direction of the Contractor's registered geotechnical engineer. Records shall be maintained of when samples were received and when testing was performed to assure that in-situ moisture conditions are maintained prior to testing.

Deliverables
Copies of the laboratory test data and final results shall be submitted to the Contractor's geotechnical engineer for analyses and report.

1.1.23.15 Engineering Analyses and Report

Deliverables
Based on the results of the field work and laboratory testing, the Contractor will prepare a formal written report which provides recommendations for site development and foundation design as well as any applicable construction procedural recommendations. Said report shall be certified by the Contractor's registered geotechnical engineer certified in the state in which the work was performed and shall include, but not limited to, the following recommendations:

- Site plan showing boring locations
- Detailed log of borings including N values and ground water levels.
- Summary of laboratory test data, including, but not limited to soil unit weight, in-situ moisture content, internal friction angle or cohesion, liquid limit, plastic limit and plasticity index.
- Discussion of surface and subsurface soil and groundwater conditions (if encountered)

- Recommendations for site preparation parameters
- Discussion shall be given to top soil stripping, cut and fill slopes, reuse as cut materials in fill, site drainage, structural fill material and compaction, shrink and swell factors.
- Recommendations for suitable foundation type(s)
- Recommended foundation design parameters including allowable soil bearing, anticipated settlement, active and passive soil pressures, coefficients of friction between soil and concrete foundations, and all necessary parameters to be used within a foundation design program.
- Feasibility of excavation techniques
- Suitability of on-site soils for use as compacted backfill
- Geologic characteristics of the site relevant to proposed construction
- Seismological data for the area of the site

Soil resistivity in ohm-meters to be provided as a separate report

Two (2) copies of the geotechnical report and resistivity test results shall be submitted along with all associated boring logs and tabular data to Employer and Engineer.

1.1.24 Corrosion Protection and Painting

1.1.24.1 General

All parts of the facilities shall be protected against corrosion under service conditions. The protection shall also prevent corrosion during transport, storage and erection. Because of the high humidity at the Site, the protection shall be carried out at the Contractor's workshop.

Damage to the protection during transport, erection, etc., and erection joints, shall be repaired to the same quality as specified for the facilities item.

1.1.24.2 Surface Protection

All steel and iron surfaces to be painted shall be prepared by means of sand or shot blasting or other approved methods. Before being blast-cleaned, the surfaces shall be cleaned of oil and grease. The surfaces shall be of clean metal and shall be dry and free from any foreign matter at the time of painting.

All surfaces to be painted shall be smooth, even and free from dirt, rubbish and shall be dry and protected from dampness; i.e., surfaces shall be free from anything that will adversely affect the adhesion or appearance of paint or galvanizing.

All defective concrete/cement plaster shall be cutout and trimmed, holes in internal plaster faces shall be made good with approved material. All dirt and powdery substrate shall be removed with slightly damp cloth.

All laitance shall be removed from concrete surfaces by wire brush or blasting. All holes, defects shall be filled and repaired by epoxy grouts. All dust and/or mill scale etc. shall - if necessary - be removed from new metal surfaces with a wire brush, chipping hammer or grinding.

The surface of the metal work shall then be primed with an approved metal primer before application of the undercoat.

Pre-treatment of the galvanized surfaces includes etch-cleaning, sweep blasting (preferred) or emery paper used to clean and roughen the surface, remove any matter detrimental to the adhesion and to achieve a better anchor pattern.

Wood surfaces shall have all ironwork removed prior to the preparation of surfaces and re-fixed upon completion of the paint. All knots and resinous parts in wood surfaces shall be treated by two coats of shellac varnish. Cracks and holes shall be treated by one coat of primer and filled with approved filler.

1.1.24.3 Painting

The painting shall be carried out in an efficient and professional manner to the satisfaction of the Engineer. The quality and colors as well as the application of the paints shall be approved by the Engineer and the Contractor shall submit detailed information, samples and the Manufacturer's recommendations for the paints for approval.

Emulsion paints shall be used for internal cement plastering and internal fair-faced concrete of walls and ceilings. All emulsion paints shall be washable consisting of:

- One coat of Acrylic primer sealer
- Two coats of filler based on alkaline resistant polyvinyl-acetate
- Two coats of polyvinyl-acetate emulsion flat finish

Oil paints shall be used for wood surface and internal cement plastering and internal fair faced concrete in confined humid areas such as bathrooms, consisting of:

- One coat of Acrylic primer sealer
- Two coats of filler, based on alkaline resistant polyvinyl-acetate
- Two finish coats, based on alkyd resins

Varnishes shall be used for wood surfaces and shall be of one of the following types:

- Polyurethane varnish
- Synthetic varnish of linseed oil alkyd resin

All un-galvanized external surfaces except nuts, bolts and washers which may be removed for maintenance purposes shall be painted at the manufacturer's works as follows:

- A primary coat of rust-inhibiting paint.
- Two coats of non-glossy oil and weather resisting paint, the second of which shall be applied on completion of work tests.
- One final coat of aluminum, oil and weather-resisting non-fading paint.

The total thickness of the above coatings shall be minimum 160 μm for outdoor surfaces and 120 μm for indoor surfaces.

Other paint systems:

- Epoxy paints for concrete shall be as per the specification.
- Oil resistant paints shall be epoxy paint resistant to all types of oil.

Paints for steel and galvanized surfaces are specified under "General Technical Requirements Mechanical".

Application of Paints (General)

All paint application shall be done in line with the paint manufacturer's instructions. Before applying any paint, all prepared surface shall be dry and clean. All priming paints shall be applied by brush except for etch primer which may be applied by brush or spray. Paints shall be applied as evenly as possible to provide a smooth coating of uniform thickness. Damaged areas of priming coats or undercoats shall be made good before further coats of paints are applied. The various coats of paint shall be distinguishable from each other by their shade.

The Contractor shall inform the Engineer in good time before starting to apply the next coat so that the Engineer shall have the opportunity of approving the previous coat. Painting systems shall not be carried out at temperature below 5°C or above 35°C. Trial coats shall be prepared at the request of the Engineer. The Contractor shall, upon completion remove all paint where it has been spilled, splashed or spattered on surfaces including sanitary fixtures, glass, and hardware. It shall be removed without marring the surface finish of the item being cleaned.

1.1.24.4 Galvanizing

Except where otherwise specified, all ferrous parts shall be galvanized. The dry film thickness or galvanization thickness on steel shall be measured by means of a magnetic or electrical thickness gauge such as "Microtester" or "Electrometer", and recorded in a tabulated form, indicating each layer of coat and the total dry film thickness. Contractor is responsible to provide such instrument without any charge to the Employer.

Galvanizing shall be applied, not less than 98% of which must be pure Zinc. The galvanizing procedure shall be started only after having finished all chipping, trimming, fitting and bending. Also, all drilling, punching, cutting and welding shall have been completed and all burrs removed.

All steel, including bolts, nuts and washers, shall be galvanized at the manufacturer's premises by means of hot dipping in accordance with internationally recognized standards such as ASTM A 239, or equivalent. The Zinc coat applied shall conform to ASTM A-123, minimum thickness grade 85 and higher (see Table 2, ASTM A 123-89a).

Galvanizing shall consist of a continuous coating to minimum weights (g/m^2) as follows:

Rolled steel exposed to the atmosphere only	600g/m^2
Rolled steel under the ground surface	1,500g/m^2
Cast iron and malleable iron	600g/m^2
Bolts, nuts and washers	375g/m^2

The zinc coating shall meet the requirements according to BS 729, ASTM, A123, A153, A239 and A385, DIN 50961, 50976, 50978 or other equivalent methods and international standards. All steel shall be fully fabricated before galvanizing, no machine or shop work, boring, punching, etc., will be allowed after galvanizing.

1.1.25 Structural Steel and Cast Iron

Structural steel shall be made by the open-hearth basic oxygen or electrical furnace process.

In order to reduce the risk for material confusions, only two strength classes may be used. Suitable classes are low tensile steel (yield point 220 - 260N/mm^2) and high tensile steel (yield point 300 - 350N/mm^2).

Steel shall comply with the requirements of ASTM A143 and embrittlement tests shall be made in accordance with that specification.

If the Contractor intends to use more than one quality of steel, they will be required to take every precaution to the satisfaction of the Engineer, against any possible intermixing of different qualities during transport, storing, handling manufacture and installation.

Cast iron shall have a tensile strength of at least 140N/mm². It shall be made from the best grey pig and scrap iron, and shall be close-grained, tough and uniform in character.

Malleable iron shall be of the black hearth type with a tensile strength of not less than 330 N/mm².

1.1.26 Copper, Aluminum Alloys and Clad Steel

Copper and aluminum stranded conductor material shall meet the requirements of IEC Standards. The specification of proposed aluminum alloys shall be submitted for approval.

The preferred aluminum-clad steel to be supplied is Alumoweld or substantially equivalent. The preferred copper-clad steel to be supplied is Copperweld or substantially equivalent.

1.1.27 Marking

A legible mark of origin shall be applied on all castings and forgings, particularly on conductor and overhead ground wire hardware, and on insulators and associated hardware. Insulators shall, in addition, be marked with the mechanical or electromechanical failing load or a corresponding code number. Each separate member of the structure shall be marked indicating tower/pole type and number and the piece corresponding to the shop drawings. These marks shall be embossed into the steel before galvanizing, or concrete as part of the casting, in such a manner as to be plainly visible after manufacture.

1.1.28 Concrete Works

1.1.28.1 General

In general, and except where otherwise specified, the Contractor shall supply all labor, materials and facilities required for the concrete work and all tests thereon and shall:

- Nominate the sources of materials, testing and mix design
- Mix, transport, place, compact, finish and cure all concrete
- Erect and dismantle all forms and formwork
- Produce and install all steel reinforcement
- Embed, as required, all items, whether supplied and erected directly or by other Contractors, in accordance with these specifications and drawings.

1.1.28.2 Cement

The type of cement to be used shall depend on the constructional circumstances and on the prevailing local conditions.

Ordinary Portland cement, ASTM C-Type I, may be used at places not exposed to chemical aggressiveness. Moderate sulphate resistant cement and highly sulphate resistant cement shall be used as per the recommendation of the soil investigation reports and written approval of Engineer and the Employer. No extra payment will be made to the Contractor for the use of sulphate resistant cement.

Cement shall be delivered to the site in bulk cement containers or in sealed bags clearly marked with the maker's name and shall be carefully stored in a waterproof shed with a raised floor or in a silo of approved design. Each consignment of cement shall be stored apart from earlier consignments and the cement shall be used in the order in which it is delivered.

The Contractor shall ensure that each consignment is accompanied by a certificate from the manufacturer certifying that the cement in that consignment is in accordance with the Specification. Weathered or congealed cement, or cement more than three (3) months old after production, shall not be permitted to be used unless otherwise approved by the Engineer after the quality test.

Cement shall be stored in a suitable weather-tight enclosure on a board platform raised off the ground. The enclosure should be such that free circulation of air around the bags of cement is kept to a minimum. Any cement that has become damp, caked or lumpy shall not be used. Concrete batching operations shall be organized so that cement that has been manufactured first is used first.

Each consignment of cement may, after delivery to the site and at the discretion of the Employer, be subjected to the whole of the tests and analyses required by the standard Specification.

The Employer may reject any cement as a result of any tests thereof, notwithstanding the manufacturer's certificate. The Contractor may also reject cement which has deteriorated owing to inadequate protection or other causes or in any other case where the cement is not to his satisfaction. The Contractor must remove all rejected cement from the site without delay and expenses for the Employer.

The Contractor shall arrange for these tests to be carried out at his own expense.

1.1.28.3 Aggregates

All aggregates to be used for the Works shall be crushed rock type complying with the requirements of BS 882 or equivalent in all respects and shall be subject to the tests laid down in BS 812 or equivalent. The Contractor shall furnish to the Engineer samples of both the proposed fine and the coarse aggregates, together with such full details as the Engineer may require. No aggregates may be used in the Works until approved by the Engineer.

During the work, the Engineer shall order such tests he may consider necessary on the aggregates; any aggregates found to have unsuitable characteristics at any time shall not be used in the Works and shall be removed from the Site. Aggregates are subject to the Employer's approval.

The various fractions of fine and coarse aggregates shall be stored separately and in such a manner as to avoid the admixture of dirt in the concrete. Aggregates shall be handled in such a way that separation is avoided.

Maximum size of aggregate used in concrete shall not be more than 20 mm. The combined aggregate shall be as coarse-grained and dense-graded as possible. Fine and coarse aggregates shall be stored so that they are kept clean and free from contamination and are not subjected to segregation. Where a clean hard surface is not available for the stockpiles, the bottom 150 mm of the aggregate piles that are in contact with the ground shall not be used.

1.1.28.4 Grading of Aggregates

The grading of the fine and coarse aggregates shall be such that when they are mixed in the proportions decided for each class of concrete, the grading of the combined aggregate shall be suitable for making dense concrete of appropriate workability, containing the proportions of cement and water prescribed.

The proportions of fine and coarse aggregates and the maximum size of the coarse aggregate to be used in each class of concrete shall be approved by the Engineer.

The Contractor shall be responsible for mixing the aggregates in the proportions approved by the Engineer for each class of concrete and each section of the work. He shall submit samples of the concrete material to the Engineer and the Employer well before starting any concrete work, and have test cubes made and tested from the aggregates and the cement which he intends to use. Concrete works must not begin until such samples and tests are to the Engineer's satisfaction.

Fine aggregate (sand) shall consist of clean material or manufactured sands and coarse aggregate shall consist of clean gravel, crushed gravel or crushed stone. Both the fine and coarse aggregates shall comply with ASTM C33. Sulphate and sulphide shall be in such quantities that the whole proportion, in sulphur trioxide, be less than 1 percent of the mass. Prohibited aggregates include:

- Feldspathic or schistose rock
- Aggregates containing charcoals or their residues such as coke, ashes, clinkers, finders.

1.1.28.5 Water

The water to be used for mixing and curing of concrete shall at all times be kept clean and free from deleterious materials such as oil, acid, alkali, silt, etc. which effects to the cement, aggregate or the steel reinforcement. Water chemical analysis tests shall be carried out before commencement of foundation works.

1.1.28.6 Admixtures

No admixtures shall be used without written approval of Engineer and the suitability of admixtures must be proven in trial mixes in presence of representative of Employer. If required to improve the quality of concrete (workability, finish and water tightness), water reducing and set retarding agents and plasticizers shall be used in accordance with ASTM C-494. Under no circumstances shall calcium chloride or any admixtures containing calcium chloride be permitted in the concrete.

Manufacturer's recommendations and instructions concerning overdosing of additives shall be strictly observed and mixture containing chlorides shall not be used under any circumstance.

1.1.28.7 Concrete Mixing, Placing and Compaction, Protection and Curing

Mix Design

Full details of the components forming the concrete mix proposed to be used by the Contractor shall be submitted to the Engineer for assessment least one (1) month before any concreting operations are commenced. Once the proposed mix has been approved by the Engineer, it shall not be varied by the Contractor unless the Engineer's prior approval has been obtained.
No concreting shall be commenced in any portion of the work until the preparations and the concrete mix design have been approved, and permission been granted by the Employer.

The required minimum concrete class is a C 25 as per BS standard. The mix design of the concrete has to be approved, and its suitability proven in trial mixes at site. In case of use of ready mixed concrete, trial mixes may be waived if an earlier proven mix design is used.

The concrete mix shall be designed and tested and their submission shall include the following information:

- Source, nature and grading of both the fine and coarse aggregates
- Type and supplier of the cement to be used
- Proportions by weight of both the fine and coarse aggregates
- Weight of cement per cubic meter of concrete
- Water-cement ratio by weight
- Estimated slump of the mix
- Arithmetic mean compression strength of the mix at 7 days and 28 days using cube compression test samples, plus the standard deviation of the test strengths and the number of cubes tested.

Any admixtures specified for inclusion in the concrete mixes or that the Contractor intends to use in his mixes (and they have had the prior approval of the Engineer) shall be included in these trial mixes. The ratio of the weight of fine aggregate (sand) to the total weight of aggregates shall be between 0.35 and 0.50. The minimum cement content shall be 350-400kg/m3 and the maximum water cement ratio by weight shall be 0.45.

The Contractor shall allow for the cost of all such testing in his Tender as well as any further testing and additional reporting that the Employer/Engineer may require.

Mixing of Concrete

All concrete shall be mixed in power driven mixers, approved by the Engineer. If required in some locations (i.e., a mixing machine transportation problem), volume basis will be allowed as long as careful controls are maintained and written approval from the Engineer has been received.
The concrete materials shall be accurately measured to ensure the production of uniform batches of concrete. The Contractor will be required to proportion the materials by weight at all times. If required, the materials may be measured by volume and the proportions in each batch adjusted to suit whole bags of cement after getting written approval from the Engineer. Only unbroken bags of cement may be used. Bags of cement that have partially set, contain any lumps, or have become wet at any stage shall not be used.

Volume measurement shall be carried out using well-proportioned gauge boxes. Under no circumstances will the volumes be proportioned by shovels. The gauge boxes shall be loose-filled with the material being measured then struck off level with a straight edge then discharged into the mixer. The required volume of mixing water shall be adjusted to allow for the free moisture contained in the aggregates. Personnel in charge of the concrete mixing operations shall be trained and experienced in this method of concrete production.

The batch mixture shall be rotated at a speed recommended by the manufacturer and all concrete shall be mixed for a minimum of 1½ minutes from the time the last of the materials have been placed in the mixing drum. The mixing shall continue until the materials are thoroughly and uniformly mixed and the concrete is uniform in color and texture. The entire batch must be discharged from the mixer before recharging commences. Each batch of concrete shall have a similar appearance. The slump of the concrete shall normally be between 25mm and 50mm corresponding to a stiff, plastic consistency.

All plant for mixing shall be cleaned and free from all dirt and debris. All mechanical equipment (mixture, vibrator, etc.) and the stock of construction material (cement, aggregate and sand) shall be checked before starting a concrete pour to ascertain whether or not it is in good operation condition and sufficient in quantity for the foundation work. The Contractor shall always have at least two vibrators in operating condition at the location of the concrete placement.

In hot weather conditions, various means should be employed to lower the temperature of concrete as:

- Using cold water; the use of ice is to be limited to chill the mixing water, but no ice is to be used during batching.
- Avoiding the use of the hot cement
- Insulating water supply lines and tanks
- Cooling coarse aggregate
- Shading and/or cooling mixer drums
- Adequately watering of sub-grade, formwork and reinforcement
- Avoid concreting around midday
- The temperature of fresh concrete must in no case exceed +30°C

Placing and Compaction of Concrete

Foundations shall normally be placed on virgin soil or well-compacted fill.

If excavation has been performed to greater depth than required, sand or gravel shall be placed at bottom of the pit to bring the excavation to the required elevation. Such material shall be placed and compacted in layers not exceeding 100 mm. Excavation pits shall be kept dry during construction and erection of foundations. Backfilling of the pits shall not be carried out until the Employer has inspected and approved the foundation.

Excavated soil may be used as backfill if it is suitable for compacting. Rock and soil not suitable for compacting shall be removed and replaced with a suitable backfill to the satisfaction of the Employer. Backfill shall be placed in layers approximately 150 mm thick. Each layer shall be carefully compacted by mechanical compactors to meet compaction specifications. .

Compact top 153mm of subgrade to 90% maximum density in accord with ASTM D3017 (Nuclear method), or ASTM D1557 Method A (5-layer method). Do not allow traffic over prepared subgrade. Uniformly moisten subgrade at time concrete is placed. Uniformly apply water ahead of concrete placement.

Concrete shall be conveyed from the mixer to moulds by a method that prevents segregation or loss of the ingredients. It shall be placed as nearly as practicable in its final position to avoid segregation due to re-handling or flowing.

The placement of concrete shall be at such a rate that the concrete is at all times plastic and flows smoothly, ensuring that the concrete in its final position shall be dense and homogeneous.

The placement of concrete in the moulds shall be completed within ½ hour after the introduction or the mixing water to the cement and the aggregates in the concrete mixer. Batches in excess of 30 minutes of mixing the concrete shall be rejected and replaced by fresh concrete without any extra cost to the Employer. Each formwork shall be filled with concrete as a continuous operation. The written approval is required for construction (working) joints, if required.

Concrete shall be placed and compacted/vibrated in horizontal layers of not more than 300 mm thickness each and vibrators and other compacting equipment shall be to the satisfaction of the Engineer.

An appropriate method must be adopted by the Contractor to prevent separation of concrete when placing concrete in the foundations with a fall over 1 meter. Acceptable methods include the use of an "elephant trunk" hose or hopper centered over the hole. The use of an inclined chute and "baffling device" (e.g. shovel) to direct the concrete downward is not acceptable.

Protection and Curing

Cement-based repairs may require some initial protection, because rapid drying could halt the hydration of the cement and lead to shrinkage cracking, de-lamination and weakness.

Careful curing is essential by covering with absorbent material that is kept damp, preferably covered in turn by polythene or similar sheets, which are sealed at the edges. Shading from the sun may be necessary. Importantly, alternate wetting and drying must be prevented because of the alternating stresses that it would cause.

If repairs are to be carried out during hot weather, it is advisable to shade the work from direct sunlight in order to prevent drying out of cement-based repairs or over-rapid stiffening of resin-based materials.

Requirements for curing large volume repairs are similar to those for new construction. Although they are less critical in this respect than thin patches, curing is important to a durable result. Normal curing methods are usable except that sprayed-on curing membranes are suitable if a surface coating is to be applied later.

During the initial stages of hardening, the concrete shall be protected from the direct rays of the sun and from drying winds. The formworks containing the hardened concrete shall not be disturbed or give external forces.

To ensure proper curing, all concrete shall be kept moist for a period of at least 10 days. Foundations shall not be backfilled before they have been cured and inspected. The foundations shall not be subjected to any loads in addition to those existing at the time of the placing of the foundation concrete until the curing period has elapsed. Curing compound membranes shall be applied uniformly by spray, leaving no pinholes or gaps, at a rate not to exceeding 4.91kg/m/liter. The curing compound shall be applied after finishing operations are completed and surface moisture has disappeared.

1.1.28.8 Ready-mixed Concrete

Ready-mixed concrete may be used in the Works, provided that adequate control is maintained of the supply, mixing, and placing of the concrete.

Concrete shall be placed and compacted in its final position within 90 minutes of the water being added to the mix. If the Bidder/Contractor proposes the use of pumps for the transporting and placing of concrete, he shall submit a detailed method statement.

The Contractor shall ensure that pumping shocks shall not be transferred from the pipeline to the form-work, to previously laid concrete or to the structure. The initial discharge of any pumped concrete shall be discarded completely.

1.1.28.9 Steel Reinforcement

The steel reinforcement shall consist of hot rolled deformed bars conforming to the requirements of BS 4449, Grade 460 or higher. The specific number, type and location of ridges on the deformed bars shall be approved by the Engineer and the Employer.

The number, placing and fixing of bars shall be in accordance with the drawings and approved bar bending schedules, or otherwise, as directed by the Engineer.

All reinforcing bars shall be bent in accordance with the relevant standard. In particular, no reinforcement shall be heated. All reinforcement shall be rigidly fixed in position to the concrete cover specified by an approved means.

All chairs, tie-wires or other devices used to connect, support, secure or fasten reinforcement shall be provided as per the requirement and as directed by the Engineer.

All reinforcing bars shall be stored in a clean, dry place on platforms off the ground. Grease, oil, paint or any other substance that will affect the bond of the reinforcement shall not be allowed to come in contact with the bars. All such substances shall be cleaned off the reinforcement before it is placed for concreting.

All reinforcing bars shall have a protective cover of not less than 100 mm at the bottom of footings and on any surface of concrete that will be exposed to salt water and 50 mm for concrete exposed to weather or soil.

1.1.28.10 Formwork

The Contractor shall be entirely responsible for the design and construction of the formwork to be used for concreting.

The formwork shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in position.

All form-works shall be of such tight construction that slurry cannot flow out at the joints during pouring and compaction. If required, joints shall be sealed with foam rubber strips.

No concrete shall be placed until the Engineer or his representative has examined and approved the formwork.

1.1.28.11 Surface Finish

Unless otherwise shown on the drawings, all permanently visible concrete surfaces shall have a regular finish of uniform texture free from holes, pins and formwork.

Should any section of the concrete present a rough, uneven, honeycombed discolored or imperfect appearance when the shuttering is removed, it shall be chiseled to such a depth and refilled and properly refaced with such class of concrete as the Employer may direct.

In the event of excessive porosity being discovered, the defective area shall be chiseled and make well as specified above, all at Contractor's cost. No plastering of such concrete areas will be permitted.

Concrete foundation edges above the ground level and 300mm below the ground level shall be beveled by inserting 25mm triangular edges in the formwork.

Concrete foundation tops shall be designed and finished to prevent the accumulation of water.

Concrete surfaces shall be wood float or steel trowel finished as specified on the Drawings or instructed by the Engineer. All finishing works shall be carried out in accordance with the relevant specification of British Standard and to the satisfaction of the Engineer.

All concrete foundations shall be treated with an asphaltic or equivalent coating in order to be acid-resistant. The surface to be covered must be perfectly clean. The coating shall be applied on the formed surface of the foundation with a layer at least 2mm thick.

The required protective painting of foundations shall not be executed until the end of the curing period to obtain a completely dry surface. Painting shall be done according to the specifications of the supplier.

1.1.28.12 Fixing of Steel Structures

Where shown on the drawings or as directed by the Engineer, steel items shall be embedded directly in correct positions in primary concrete. All brackets, anchor bolts and other steel items, for which recesses in concrete have been made, shall be fixed by secondary concrete after careful alignment to correct positions.

1.1.28.13 Testing of Concrete

The Contractor shall design and test concrete mixes, which have 28 days cubicle compressive strength of 25N/mm^2.

All testing of concrete shall be carried out in accordance with the requirements of BS 5328: Part 4 and BS 1881 or equivalent. During the placing of concrete for each section of the work and at such other times as directed by the Engineer and the Employer, quality certificates of all materials shall be submitted and 3 sets of test cubes, size 15cm x 15cm x 15cm, shall be taken, each set consisting of 6 cubes. From each set 3 cubes shall be tested after 7 days and the remaining 3 cubes after 28 days. The compressive strength of the cubes shall not be less than 25N/mm^2 after 28 days.

Consistency and bleeding test and such other preliminary tests as the Engineer may direct, shall be taken as often as directed by the Engineer or Employer. No concrete of any type or class shall be used in the Works before the preliminary tests have shown specified compressive strength and workability.

All test cubes shall be well marked and cured as specified.

1.1.28.14 Defective Concrete

Concrete will be deemed defective when:

- Tests on specimens fail to show specified test strengths.
- Not formed as indicated or detailed.
- Not plumb or level where so indicated.
- Not true to intended grades and levels.
- Cut, filled or resurfaced, unless under direction of Employer.
- Debris is embedded therein.
- Not fully in conformance with provision of Contract Documents.

Defective concrete shall be removed and replaced, at discretion of Employer or Engineer, or adequately strengthened and resurfaced in a manner acceptable to Employer or Engineer. Contractor shall bear all costs associated with such work.

1.1.28.15 Transformer Foundations

The foundation for the transformers shall be constructed in reinforced concrete, with containment for the entire volume of the transformer oil under the crushed aggregate and steel grating.

Transformers shall be separated by a fireproof wall.

1.1.28.16 Air Core Reactor Foundations

The foundation for air core reactors requires special consideration since these reactors induce current in adjacent metallic structures that can cause heating under normal conditions and mechanical forces under fault conditions in these structures. Use fiberglass reinforcement when foundation reinforcement distances are within ½ the diameter of the reactor and stainless anchor bolts for mounting reactor to insulators. Steel anchor bolts may be used if the distance is greater than ½ the diameter of the reactor. The manufacturer's recommendations should always be considered.

Closed metallic or conductive loops, i.e. chain link fence, metal structures connected to the earthing mat, metallic rebar, etc, should not be closer that one reactor diameter length from the reactor. Closed loops can be broken by taping the crossing parts with electrical or other nonconductive tapes or insulating spacers.

1.1.29 Maintenance Tools and Facilities

The Contractor shall include and supply all tools and facilities with latest calibration certifications that are required for the normal operation and maintenance of the equipment being supplied under the Contract. All tools and facilities shall be subject to the inspections and/or tests on the functions specified in the Supply Requirements and guaranteed in the approved drawings.

Instruction manuals of tools and facilities shall be submitted for approval in the same manner as the installation operation and maintenance manuals and when finally approved, one original and three copies shall be prepared and forwarded to the Employer.

Each tool and facilities item shall be clearly marked with its size and/or purpose and shall be packed in the appropriate box with three (3) sets of an operation and maintenance instruction book. All nameplates, duty labels and instruction plates on tools and appliances shall be marked in English.

1.1.30 Auxiliary Electrical Supply

The Contractor shall be entirely responsible for providing auxiliary electricity supplies needed on Site for construction and commissioning.

1.1.31 Temporary Site Installation

The Contractor shall be entirely responsible for providing all temporary site installations of every kind that may be required for carrying out the works including the facilities concerning office, living accommodation, fenced storage areas, lockable sheds, installations for supply of industrial water, power and compressed air, etc. The Contractor shall plan all temporary site installations required for the works to the approval of the Engineer. After completion of the work, such temporary installations are to be removed and the site left clean.

All costs for the construction and/or supervision and the removal or handing over to the Employer of all temporary site installations shall be deemed to have been included in the price schedules.

1.1.32 Running Costs

The Contractor shall be entirely responsible for the running and maintenance costs throughout the period when the site works are being carried out, including all temporary site installation works.

The costs for running and maintaining the temporary site installations together with other running costs necessary for the satisfactory execution of the works shall be deemed to have been included in the price schedules.

1.1.33 Social Safeguards

The Contractor shall minimize the locations of transmission towers in agricultural and populated areas. Where routing of transmission towers across agricultural and populated areas is unavoidable, the tower locations shall be positioned to completely avoid houses, structures, and interference with social and cultural assets. The Contractor's detailed line route design will be reviewed and approved by the Employer, in consultation with any affected people, after verification of its land acquisition impacts.

1.2 Technical Requirements – Substation Equipment

The substation designs shall conform to conceptual design drawings included in this specification.

1.2.1 220kV and 20kV Primary Equipment

1.2.1.1 General

All 220kV and 20kV primary equipment shall be designed and manufactured in accordance with the latest edition of IEC standards. This includes the following main applicable standards:

IEC 60044	Instrument transformers
IEC 60099	Surge arresters
IEC 60265	High voltage switches
IEC 60282	High voltage fuses
IEC 60694	Common specifications for high voltage switchgear and control gear standards
IEC 61166	High-voltage alternating current circuit-breakers - Guide for seismic qualification of high-voltage alternating current circuit-breakers
IEC 60071	Insulation Coordination
IEC 60255	Electrical relays
IEC 60273	Post Insulators
IEC 60502	Power Cables
IEC 62271	High-voltage switchgear and control gear
IEC 60815-1	Guide for the Selection of Insulators in Respect of Pollution Conditions

All 220kV primary equipment and accessories shall be air insulated and installed outdoors.

Specified clearances shall be considered minimums. The supplied values are elevation dependent and have been provided for information only. The designer shall consider elevation and adjust clearances tendered and applied to equipment design.

1.2.1.2 220kV Circuit Breakers and Disconnector/Earthing Switches

The circuit breakers and disconnector/earthing switches shall be rated in accordance with Section 2.0 Technical Data Sheets.

Circuit Breakers

The 220kV circuit breakers shall be of SF6 type. General electrical requirements shall comply with the parameters collected in Section 2.0 Technical Data Sheets.

Circuit breakers shall be equipped with motor-charged spring operated mechanism for 220VDC. The motor-charged spring-operated devices shall have a direct-on-line starter. It shall be possible to set the operating spring manually with a hand-crank. Motors shall be designed in accordance with valid IEC publication and operate correctly between 85% and 110% of rated voltage. The motors shall be effectively protected. The motor circuits shall be controlled 2-pole (Phase) from the motor-protection and end-position contacts. An auxiliary relay for alarm shall be connected to the motor-voltage and have a closed contact for no voltage, tripped motor-protection and unloaded spring.

The operating mechanism shall be provided with an anti-pumping device.

The circuit breaker shall have 220VDC shunt coils for closing and duplicate tripping. The coil and relays in the closing circuits shall operate correctly between 85% and 110% of the rated voltage. For tripping circuits the limits are 70% and 110%.

The operating devices shall be equipped with a selector switch for local and remote control.

Manual closing for maintenance work shall be possible. Manual tripping (mechanical) shall be possible even in the absence of supply voltage for emergency situations, unless the breaker is locked out.

One set of auxiliary contacts necessary for control purposes shall be mechanically linked to the circuit breaker. All contacts shall be wired and connected to terminals in the cubicle.

A switch shall be provided for the operating voltage for each circuit breaker. The switch shall, in the open position, prevent all electrical operations of circuit breakers. The switch shall have at least 10 contacts and be labeled OPERATION.

The mechanism shall be provided with an operation counter for at least 9999 CO-cycles.

Disconnectors

The disconnectors shall be of center break or center rotating type with horizontal operation. All disconnectors shall provide the possibility for a manual operation with a hand crank. General electrical requirements shall comply with Section 2.0 Technical Data Sheets.

Disconnectors with a manually operated earth switch shall be provided with a mechanical interlocking between the disconnector and the earth switch to prevent closing of the earth switch when the disconnector is in the closed position.

The disconnector and the earth switch shall be possible to lock with padlock in open and closed position. Earth switch shall have an earthing platform, suitably connected to the earthing grid at not less than 2 points of connection, of size not less than 3m x 3m installed under the switch handle mechanism for operator safety when operating the earthing switch manually.

Motor operated disconnectors shall be designed with three-pole operation and shall operate on 220VDC. The motor shall be designed in accordance with valid IEC publication and work correctly between 85% and 110% of rated voltage. The motor shall be effectively protected. Electric control shall always be two-pole to avoid mal-operation in case of earth faults.

Motor operated disconnectors shall be designed for control and position indication from remote. The operating device shall be equipped with a selector switch for local and remote control.

1.2.1.3 220kV Current Transformers

The current transformers shall be rated in accordance with Section 2.0 Technical Data Sheets.

Earthing of secondary windings shall be done through a disconnectable terminal inside the low-voltage cabinet. Unused cores shall be wired to terminals and short-circuited in the low-voltage cabinet.

A legible circuit-diagram plate showing the transformer connection and terminal markings shall be permanently fixed inside the low-voltage cabinet. The separate main data for the different cores shall be shown on the plate.

1.2.1.4 220kV Voltage Transformers

The voltage transformers shall be rated in accordance with the following in Section 2.0 Technical Data Sheets.

Rated voltage factor shall be as follows:

- Between phase and earth continuous 1.2
- Between phase and earth, 30 second 1.5

Earthing of secondary windings shall be done through a disconnectable terminal inside the low-voltage cabinet. Each secondary winding shall be protected with individual miniature circuit breakers (MCB) or fuses. To prevent mal-operation of relay protection, interlock system, etc. a supervision device for the MCBs or fuses shall be provided.

A legible circuit-diagram plate showing the transformer connection and terminal markings shall be permanently fixed inside the low-voltage cabinet. The separate main data for the different cores shall be shown on the plate.

1.2.1.5 220kVLightning Arresters

The lightning (surge) arrestors shall be rated in accordance with Section 2.0 Technical Data Sheets.

The surge arresters shall be of ZnO-type and heavy-duty station class. One common surge counter per three-phase group of arresters shall be provided.

1.2.1.6 High Voltage Terminals

Terminals shall normally be of module plate type. If the terminal is a direct extension of an internal conductor as for bushings or current transformers, pin type is accepted as an alternative.

Copper or copper alloy terminals shall be tinned to a thickness of minimum 50µm. Copper alloys shall not be sensitive to season cracking. Aluminum or aluminum alloy terminals shall not be treated. Aluminum alloys sensitive to layer or inter crystalline corrosion shall not be used.

1.2.2 Power Transformer

1.2.2.1 Reference Standards

All transformers shall be designed and manufactured in accordance with the latest edition of IEC standards. This includes the following main applicable standards:

IEC 60076	Power Transformers
IEC 60137	Insulating bushings for alternating voltages above 1000V
IEC 60214	Tap-changers
IEC 60296	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear
IEC 60354	Loading guide for oil-immersed transformers
IEC 60529	Degrees of protection provided by enclosures
IEC 60542	Application guide for on-load tap-changers

1.2.2.2 General Design

Power transformer banks serving the SVC shall consist of three single phase transformers plus an identical fourth transformer serving as a spare unit. Power transformers shall be single phase, oil immersed consisting of a complete independent unit with outdoor bushings, surge arrestors, cooling equipment, auxiliaries and accessories. All transformers supplied shall be installed outdoors and shall be required to operate under the system characteristics and climatic conditions specified in Section 1.1.10. Each transformer shall produce its full rated power at its designated substation after applying any derating factors due to climate and altitude. The transformers shall comply with IEC 60076. The transformers shall be rated for continuous operating at the maximum SVC output at an operating voltage between of 0.9 pu and 1.1 pu.

The transformers shall be capable of operating continuously at the specified output and at transmission level (220 kV nominal) voltages 10% higher than the rated voltages at any tap without undue heating, vibration, noise and other operating difficulties. All items, except for windings, shall be designed for continuous current of 120% of the rated current, without exceeding the temperature rises prescribed in the Standards.

The electrical supply for operation of electric motors required for the proper operation of the power transformer will be determined by the Contractor.

1.2.2.3 Losses

The losses shall be stated and guaranteed in the Bid schedules. The capitalized value of the guaranteed losses will be taken into account when comparing Bids and will be added to the Bid price. The losses will be capitalized at the rates as follow:

- No load loss: US$ 6,500 per kilowatt
- Load loss: US$ 1,500 per kilowatt applied to the total transformer capacity proposed by the Bidder.

The guaranteed losses are to be maximum values and shall not be exceeded. If the tested losses exceed the guaranteed losses but are within the tolerances allowed in IEC 60076 then losses in excess of the guarantees shall be capitalized at the evaluation rate and the amount deducted from the contract price. There will be no credit for losses under guarantee.

The values for losses stated by the Contractor in the Bid Documents shall be verified during the factory tests.

The Employer has the right to reject transformers that exceed the tolerances allowed by IEC 60076.

1.2.2.4 Cooling System

Transformers shall be capable of operating continuously at full load utilizing ONAN type cooling.

The coolers shall be of the fin type, fully hot-dip galvanized, detachable and equipped with lifting eyes, vent holes with plugs, plugs for filling and draining and with shutoff valves to permit the removal of any cooler without draining the oil from the transformer tank. The coolers shall be removable during operation of the transformer. All radiator isolating valves shall be fully oil tight and vacuum capable and shall be mounted to the transformer and radiator by bolted flanges.

Only transformers less than 10MVA shall have radiators mounted directly to the transformer tank, all other transformers shall be mounted via a manifold. ODAF designs shall have main and standby oil circulating pumps.

1.2.2.5 Temperature Rise

In continuous service, at the specified ratings, the top oil temperature rise above the ambient air shall not exceed 60° C .determined in accordance with applicable IEC standards.

For cores and other parts the rise in temperature shall, in no case, reach a value that will damage the core itself, metallic parts or adjacent materials.

1.2.2.6 Short-Circuit Withstand Capability

The transformer shall be designed and constructed to withstand, on any tapping, without damage:

- Thermal and mechanical effects of any short-circuit (three-phase short-circuits and solid line-to-ground short circuits, etc.) that can appear at the terminal of any winding
- Transportation or impact forces of 3g or greater.

1.2.2.7 Vibration and Noise Levels

Special attention shall be given in order to avoid undue vibrations and noise in the transformer.

1.2.2.8 Core

The core shall be made of high grade, un-aging, cold rolled grain oriented steel. Laminations shall have low losses and high permeability. Insulated packets of the core are to be connected so that no potential differences will exist between them. Flux distortion shall be minimized to reduce noise level.

The cores, framework, and clamping arrangements shall be capable of withstanding any shocks to which the equipment may be subjected during transport and operation.

Both the core and frames shall be earthed via a single point earthing design where each connection to either the frame or core is brought out through separate 2kV bushings complete with removable bolted shorting links that connect them to an earth stud on the transformer tank lid.

All components shall be rated for the maximum possible circulating current should the core or frame becomes inadvertently earthed. The bushings located on the transformer lid shall be protected from inadvertent physical damage by a removable cover or similar.

1.2.2.9 Windings

The turns in coils shall be thoroughly treated in such a way as to develop the full mechanical and electrical strength of the transformer. Oil from radiators shall be directed into the bottom of each winding.

All windings 220kV and above connected in star shall have graded insulation; and all windings rated less than 220kV shall be fully insulated.

The transferred voltage from one winding to any other winding when open circuited shall not exceed the impulse test voltage of that winding. Where windings do not meet this criteria then surge arrestors located in their own separate compartment located outside the main tank shall be used to restrict such transferred voltages to the specified impulse levels.

All winding conductors and connections shall be manufactured from burr free profiled high conductivity copper or aluminum. All electrical connections within the windings shall be fully brazed or welded and capable of withstanding all shocks encountered in service, transport, earthquakes etc. All connections from windings shall be mechanically sound and fully supported.

All cylinders and wraps shall be made from pre-compressed transformer board. All cylinder joints shall be fully scarfed with overlaps being made only on duct strips. Only fully molded caps and collars are acceptable; designs utilizing "Petal" collars or caps are not acceptable.

When used, enamel covered wires shall have a minimum radial thickness of 0.05mm and where cross-overs or transpositions occur they shall be mechanically and electrically protected.

No electrical out-of-balance turns will be acceptable between phase windings. All duct strips and spacers shall be full contoured and shall be of a solid construction, strips and spacers stacked together are not acceptable. All paper covered conductors shall use thermally upgraded paper. All continuously transposed conductors shall be fully epoxy bonded to withstand all free buckling and short circuit forces.

1.2.2.10 Tank

The tank shall be constructed of high-grade steel plate, suitable reinforced to withstand handling and pressure during faulty condition without any destruction. The tank shall be provided with manholes, valves and de-aerating cocks as may be required for the prescribed maintenance of the transformer. The tank shall be provided with earthing terminals for a wire of $95mm^2$ at two opposite sides of the tank.

1.2.2.11 Corrosion Protection

The corrosion protection shall be carried out as specified in Section 1.1.24.

1.2.2.12 Oil

All oil used during the manufacture of the transformer shall be free of all additives. Oil supplied for the filling of the transformer shall be new and shall contain at least 0.3 per cent by weight oxidation inhibitor of type di-tert-butyl-para cresol (DBPC) according to IEC 60296.

The oil shall not contain PCB. If oil samples taken from the transformer on delivery contain 2ppm or more PCB, the Employer shall have the right to refuse the delivery of the transformer.

1.2.2.13 Bushings

Bushings shall be of type stated in IEC 60137.

Connections from the windings to the bushings shall have the necessary flexibility. The bushings shall be installed so that they are easy to check and place, without removing the tank cover pipe work.

The star point of the winding shall be separately bought out through the tank lid by means of an outdoor bushing, located so that it cannot be associated with the main phase bushings. All bushings shall have permanent phase markings adjacent to the bushing flange.

1.2.2.14 Accessories

The following accessories shall be provided for the transformer:

- Oil temperature indicator for the top oil equipped with a maximum reading device individually insulated and a minimum of two separately adjustable contacts for alarm and tripping, with all immersed parts able to be removed without the need to interfere with the tank
- Winding temperature indicator shall be equipped with a maximum reading device individually insulated and a minimum of two separately adjustable contacts for alarm and tripping, with all immersed parts able to be removed without the need to interfere with the tank
- An aseismic Buchholtz relay for gas protection with a minimum of two non-mercury separate contacts for signal and tripping. A gas capture and test device shall be connected to the Buchholtz and located adjacent to the control cubicle
- Oil level indicator equipped with a minimum of two separately adjustable contacts for alarm and tripping
- Oil drying device, type Silica Gel breather
- Terminal box equipped with disconnect able terminals for signal cables to the auxiliary cubicle
- The on-load-circuit tap changer shall be provided with a mechanism for automatic operation. The operating mechanism shall be provided with a tap position indicator.

1.2.2.15 Routine and Type Tests

General
Full and complete testing of the transformer with accessories shall be carried out according to the relevant IEC Standards. The more important tests are listed below.

The Contractor shall give a complete description of the proposed test methods. The test methods and the performance of the test shall be subject to the approval of the Employer / Engineer. All instruments and equipment necessary for the testing shall be provided by the Contractor.

Test Particulars
Testing shall include but not be limited to the following:

- When a transformer is to be subject to a temperature rise test, dielectric test including an impulse test shall be carried out as soon as practicable after this test, that is whilst the transformer is still hot
- The no-load losses and the current of the transformer shall be measured at 90%, 100% and 110% of rated voltage before commencement of the dielectric test. The no-load losses and current measured after completion of the dielectric test shall be the values used in determining the performance of the transformer

- Impulse test shall be applied on all transformer terminals, including neutrals. Impulse test oscillography records shall be made
- Noise level measurements shall be carried out according to IEC 60076
- Bushings shall be fully tested according to IEC 60137
- Insulation power factor tests shall be performed with bushings in place

Type Tests
The following type tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Temperature rise test
- Zero sequence impedance
- Noise level
- Examination of harmonics
- Tests on bushings

Routine Tests
The following routine tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Winding resistance measurements on all windings
- Ratio tests on the rated voltage connection
- Polarity tests
- No-load loss at 90%, 100% and 110% of rated voltage
- Exciting current at 90%, 100% and 110% of rated voltage
- Impedance and load loss at rated current
- Separate source withstand tests
- Induced voltage tests
- Impulse voltage withstand tests on all windings. Full wave and chopped wave
- Pressure tests on tank and coolers for oil tightness. If a temperature test is made, the pressure test shall
- be made while the transformer is still hot
- Operational tests of all devices and wiring
- Insulation tests on auxiliary devices and wiring
- Test on bushings

1.2.3 Mechanically Switched Shunt Reactor

1.2.3.1 Standards

All shunt reactors shall be designed and manufactured in accordance with the latest edition of IEC standards. This includes the following main applicable standards:

IEC 60076	Power Transformers
IEC 60137	Insulating bushings for alternating voltages above 1000V
IEC 60296	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear
IEC 60529	Degrees of protection provided by enclosures
IEC 60099-1 and IEC 60099-4	Metal-oxide surge arresters without gaps for AC

systems

1.2.3.2 General

Shunt reactors shall be 3 phase, oil immersed consisting of a complete independent unit with outdoor bushings, surge arrestors, cooling equipment, auxiliaries and accessories.

All shunt reactors supplied shall be installed outdoors and shall be required to operate under the system characteristics and climatic conditions specified in Section 1.1.10. Each shunt reactor shall produce its full rated reactive power at its designated substation after applying any derating factors due to climate and altitude. The shunt reactors shall comply with guidelines established in IEC 60076.

The shunt reactors shall be rated in accordance with Table 2.1.7 of the Technical Data Sheets.

The shunt reactors shall be capable of operating continuously at the specified output and at voltages at 10% higher than the rated voltages without undue heating, vibration, noise and other operating difficulties.

Additional Requirements:

- Shunt Reactor shall be capable of controlling the dynamic over voltage occurring in the system due to load rejection.
- The reactor shall capable of withstanding switching surge overvoltage up to 2.5 p.u. followed by power frequency overvoltage up to 1.35 p.u. The reactor must withstand the stresses due to transient dynamic conditions which may cause additional current flow as a result of changed saturation characteristics.
- Reactor shall be completely shielded with no external stray flux.

An auxiliary electrical supply of 400/230VAC, 3-phase shall be available from the substation. This AC power is dedicated to operation of electric motors (fans, pumps, etc.) and AC control and protective devices required for the proper operation of the shunt reactor.

220VDC shall be available (from the substation) for Alarm and Protection and Control functionalities of the shunt reactor.

1.2.3.3 Cooling System

Shunt reactors shall be capable of operating continuously at full load utilizing ONAN type cooling.

The coolers shall be of the fin type, fully hot-dip galvanized, detachable and equipped with lifting eyes, vent holes with plugs, plugs for filling and draining and with shutoff valves to permit the removal of any cooler without draining the oil from the shunt reactor tank. The coolers shall be removable during operation or transportation of the shunt reactor. All radiator isolating valves shall be fully oil tight and vacuum capable and shall be mounted to the shunt reactor and radiator by bolted flanges.

Only shunt reactors less than 10MVA shall have radiators mounted directly to the tank, all other shunt reactors shall be mounted via a manifold.

1.2.3.4 Temperature Rise

In continuous service, at the specified ratings, the top oil temperature rise above the ambient air shall not exceed 60° C .determined in accordance with applicable IEC standards.

For cores and other parts the rise in temperature shall, in no case, reach a value that will damage the core itself, metallic parts or adjacent materials.

1.2.3.5 Short-Circuit Withstanding Capability

The shunt reactor shall be designed and constructed to withstand without damage:

- Three-phase short-circuits and solid line-to-ground short circuits that can appear at the winding terminal.
- Transportation or impact forces of 3g or greater.

1.2.3.6 Vibration and Noise Levels

Special attention shall be given in order to avoid undue vibrations and noise in the shunt reactor.

1.2.3.7 Core

The core shall be made of high grade, un-aging, cold rolled grain oriented steel. Laminations shall have low losses and high permeability. Insulated packets of the core are to be connected so that no potential differences will exist between them. Flux distortion shall be minimized to reduce noise level.

The cores, framework, clamping arrangements, shall be capable of withstanding any shocks to which the equipment may be subjected during transport and operation.

Both the core and frames shall be earthed via a single point earthing design where each connection to either the frame or core is brought out through separate 2KV bushings complete with removable bolted shorting links that connect them to an earth stud on the tank lid. All components shall be rated for the maximum possible circulating current should the core or the frame become inadvertently earthed. The bushings located on the lid shall be protected from inadvertent physical damage by a removable cover or similar.

1.2.3.8 Windings

The turns in coils shall be thoroughly treated in such a way as to develop the full mechanical and electrical strength of the shunt reactor. Oil from radiators shall be directed into the bottom of each winding.

All windings 220KV and above may have graded insulation; and all windings rated less than 220KV shall be fully insulated.

All winding conductors and connections shall be manufactured from burr free profiled high conductivity copper or aluminum. All electrical connections within the windings shall be fully brazed or welded and capable of withstanding all shocks encountered in service, transport, earthquakes etc. All connections from windings shall be mechanically sound and fully supported.

All cylinders and wraps shall be made from pre-compressed transformer board. All cylinder joints shall be fully scarfed with overlaps being made only on duct strips. Only fully molded caps and collars are acceptable; designs utilizing "Petal" collars or caps are not acceptable.

When used, enamel covered wires shall have a minimum radial thickness of 0.05mm and where cross-overs or transpositions occur they shall be mechanically and electrically protected.

No electrical out-of-balance turns will be acceptable between phase windings. All duct strips and spacers shall be full contoured and shall be of a solid construction, strips and spacers stacked together are not acceptable. All paper-covered conductors shall use thermally upgraded paper. All continuously transposed conductors shall be fully epoxy bonded to withstand all free buckling and short circuit forces.

1.2.3.9 Tank

The tank shall be constructed of high-grade steel plate, suitable reinforced to withstand handling and pressure during fault condition without any destruction.

The tank shall be provided with manholes, valves and de-aerating cocks as may be required for the prescribed maintenance of the shunt reactor. The tank shall be provided with earthing terminals for a wire of 95mm2 at two opposite sides of the tank.

1.2.3.10 Corrosion Protection

The corrosion protection shall be carried out as specified in Section 1.1.24.

1.2.3.11 Oil

All oil used during the manufacture of the shunt reactor shall be free of all additives. Oil supplied for the filling of the shunt reactor shall be new and shall contain at least 0.3% by weight oxidation inhibitor of type di-tert-butyl-para cresol (DBPC) according to IEC 60296.

The oil shall not contain PCB. If oil samples taken from the shunt reactor on delivery contain 2ppm or more PCB, the Employer shall have the right to refuse the delivery of the shunt reactor.

1.2.3.12 Bushings

Bushings shall be of type stated in IEC 60137.

The star point of the winding shall be separately bought out through the tank lid by means of an outdoor bushing, located so that it cannot be associated with the main phase bushings. All bushings shall have permanent phase markings adjacent to the bushing flange.

1.2.3.13 Accessories

The following accessories shall be provided for the shunt reactor:

- Oil temperature indicator for the top oil equipped with a maximum reading device individually insulated and a minimum of two separately adjustable contacts for alarm and tripping, with all immersed parts able to be removed without the need to interfere with the tank
- Winding temperature indicator shall be equipped with a maximum reading device individually insulated and a minimum of two separately adjustable contacts for alarm and tripping, with all immersed parts able to be removed without the need to interfere with the tank
- An aseismic Buchholtz relay for gas protection with a minimum of two non-mercury separate contacts for signal and tripping. A gas capture and test device shall be connected to the Buchholtz and located adjacent to the control cubicle

- Oil level indicator equipped with a minimum of two separately adjustable contacts for alarm and tripping
- Oil drying device, type Silica Gel breather
- Terminal box equipped with disconnect able terminals for signal cables to the auxiliary cubicle

1.2.3.14 Routine Type Tests

General
Full and complete testing of the shunt reactor with accessories shall be carried out according to the relevant IEC Standards. The more important tests are listed below.

The Contractor shall give a complete description of the proposed test methods. The test methods and the performance of the test shall be subject to the approval of the Project Manager. All instruments and equipment necessary for the testing shall be provided by the Contractor.

Test Particulars
Testing shall include but not be limited to the following:

- When a shunt reactor is to be subject to a temperature rise test, dielectric test including an impulse test shall be carried out as soon as practicable after this test, that is whilst the shunt reactor is still hot
- The no-load losses and the current of the shunt reactor shall be measured at 90%, 100% and 110% of rated voltage before commencement of the dielectric test. The no-load losses and current measured after completion of the dielectric test shall be the values used in determining the performance of the shunt reactor
- Impulse test shall be applied on all shunt reactor terminals, including neutrals. Impulse test oscillography records shall be made available
- Noise level measurements shall be carried out according to IEC 60076
- Bushings shall be fully tested according to IEC 60137
- Insulation power factor tests shall be performed with bushings in place

Type Tests
The following type tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Temperature rise test
- Noise level
- Examination of harmonics
- Tests on bushings

Routine Tests
The following routine tests shall be carried out. The tests shall be according to IEC 60076, except where otherwise specified.

- Winding resistance measurements
- Polarity tests
- No-load loss at 90%, 100% and 110% of rated voltage
- Exciting current at 90%, 100% and 110% of rated voltage
- Load loss at rated current

- Separate source withstand tests
- Induced voltage tests
- Impulse voltage withstand tests. Full wave and chopped wave
- Pressure tests on tank and coolers for oil tightness. If a temperature test is made, the pressure test shall be made while the shunt reactor is still hot
- Operational tests of all devices and wiring
- Insulation tests on auxiliary devices and wiring
- Test on bushings

1.2.4 Mechanically Switched Shunt Capacitor Banks

1.2.4.1 Reference Standards

All shunt capacitor banks shall be designed and manufactured in accordance with the latest edition of IEC standards. This includes the following main applicable standards:

IEC 60871	Shunt capacitors for a.c. power systems
IEC 60137	Insulating bushings for alternating voltages above 1000 V

1.2.4.2 General Design

This specification defines an outdoor shunt capacitor installation furnished in accordance with IEC standard 60871 and as further defined herein.

The shunt capacitor banks will be connected to a circuit breaker or circuit switcher for purposes of energizing, de-energizing and protection. The circuit switcher or circuit breaker, switches, and associated buswork is part of the capacitor bank installation and is to be provided by the Contractor. Each capacitor bank comprises: current limiting reactors, shunt capacitor bank (a number of units in an assembly), surge arrestors, protection and control along with associated racks, buswork and other equipment required for a complete and functioning installation.

Main design issues related to the operation of the shunt capacitor bank are size, layout, switching sequences and control strategies, and discharge time.

The surge arrestor between the capacitor and the current limiting reactor shall be rated to protect the capacitors against all possible switching overvoltages.

The capacitor banks shall be furnished complete with all racks, insulators, buswork, structures, grounding, instrument transformers, capacitor unit failure detection, and protection. The capacitor banks shall be mounted in racks of horizontally mounted capacitors ready for vertical mounting of the racks and any other equipment. Each phase shall be constructed identically to the other phases and each individual phase capacitance shall be balanced to within one percent of the average phase capacitance.

The capacitors shall be mounted to allow safe access to the capacitor area with the equipment energized or fenced and equipped with appropriate interlocks to prevent access until safely disconnected and grounded.

The capacitor banks shall be equipped with discharge devices such as wound potential transformers (PTs) as required to allow rapid restoration into service. The capacitors shall be designed, rated, and tested in accordance with the latest issue of applicable IEC standards.

The shunt capacitor banks shall be located and rated in accordance with Table 1.1.1 of this specification.

The shunt capacitor banks shall be capable of operating continuously at voltages at 10% higher than the rated voltages without undue heating, vibration, noise and other operating difficulties.

1.2.4.3 Capacitor Units

The individual capacitor units shall be of the all-film polypropylene dielectric type, in single bushing cases. The minimum sustained overvoltage rating shall be 120% of nominal voltage. The measured capacitance shall be stamped on the nameplate of each can.

The cases shall be designed to allow for expansion and contraction due to all ambient and loading conditions expected during the life of the unit, including short-term transient conditions. The capacitor design shall be such that it prevents rupture of the case.

The dielectric fluid used within the capacitor unit shall be environmentally safe and biodegradable. The capacitor units shall be completely impregnated with the dielectric fluid.

1.2.4.4 Capacitor Banks

Capacitor units shall be internally fused. Fuseless designs are not acceptable. Each individual bank shall not exceed 500 kVAr rating and shall not exceed 50 kg in weight.

Stacks shall be supplied complete with all auxiliary equipment and material necessary for a complete installation in the field, including all insulators capacitor units, and the neutral bus between the stacks.

Elevating structures shall be furnished complete with all necessary bracings and grounding pads. The structures and racks shall be aluminum or galvanized steel, pre-drilled with all suitable fasteners. All structural members shall be electrically connected to each other in order to ensure adequate grounding of the rack during maintenance and shall be connected to the ground mat. Steel rack components shall not be used as an electrical bus.

Provisions for mounting potential transformers and/or neutral current transformers shall be furnished with the structure. All bolted aluminum connections shall be flat washers with locknuts. Racks shall be furnished with lifting eyes for handling. Red warning signs shall be attached to all sides of all racks reading "WARNING - ENERGIZED FRAMES. Each rack shall be labeled with the maximum and minimum capacitor unit capacitances which may be substituted as spares.

The capacitor banks shall be designed, configured, and spaced so that each individual capacitor bank can be serviced, including the identification and changing of failed units, without requiring the adjacent banks to be taken out of service.

Individual capacitor cans shall be crated and shipped separately from the rack to avoid shipping damage. Cans shall be installed in the rack in the field.

1.2.4.5 Current Limiting Reactor

Each capacitor bank shall be equipped with an appropriately sized current limiting reactor. The current limiting reactor shall be sized so that the risk of resonances with the connecting grid is minimized and the inrush and outrush currents are controlled to conform with circuit breaker capability and applicable standards.

1.2.4.6 Testing

Capacitor banks shall be tested according to applicable IEC standards. All the necessary tests to assure adequate electrical, thermal and mechanical capabilities shall be performed. The Contractor shall submit for review by the Employer, a detailed program of design and production tests to be

performed on the capacitors. The Contractor shall specify the value and tolerances for tests to be performed.

1.2.4.7 Protection

The shunt capacitor bank shall be furnished with protection suitable to protect the bank against overvoltage, harmonics and resonances, in addition to detecting and responding to internal faults such as earth faults and short circuits.

The protection system must be able to function under N-1 conditions. This means that the protection system must be able to detect and clear a fault when any one component is out of service.

1.2.4.8 Surge Arrester Protection

Surge arrestors may be provided between the capacitor bank and the current limiting reactor if deemed necessary or desirable by the Contractor. The Contractor shall be responsible for selecting the appropriate rating for the arrestors in accordance with the system characteristics in Section 1.1.10.

1.2.4.9 Maintenance

The bank shall be designed so that all maintenance and field measurement activities can be accomplished on site. Individual capacitor cans shall be removable for maintenance, testing and replacement if necessary. Fixed or detachable pulley devices shall be supplied for all capacitor banks with cans weighing over 50 lbs.

1.2.4.10 Instrument Transformers

The supplier shall provide recommended maintenance procedures.

Ratings for current and voltage transformers will be specified by the Contractor as appropriate for the application.

1.2.5 Earthing System

1.2.5.1 General

The station earthing system shall be designed according to IEEE 80 Guide to Safety in Substation Grounding. The earthing system shall consist of buried conductor loops around the substation building and the transformer foundation. The loops shall be connected to an earth bar inside the building. Connections to the earth bar shall be possible to disconnect. The connections shall be clearly labeled. To reach the desired earth resistance, additional grounding rods shall be installed and connected to the earth bar.

Connections shall be made by compressed clamps or by an approved welding process. No bolted clamps may be used under the ground surface. Connections to steel structures (riser connections) shall be made by compressed lugs with two holes in the contact pad. Risers or earth conductors shall not touch cables.

1.2.5.2 Earthing Parameters

The earthing system shall comply with Section 2.0 Technical Data Sheets.

1.2.5.3 Earthing of Enclosures

An earthing conductor of a sufficient cross-sectional area shall be provided extending the whole length of the switchboards and control cabinets. All metal parts of the enclosure/cubicle shall be earthed by risers from the conductor loop.

1.2.5.4 Earthing of Other Types of Equipment

Earth terminals of LV equipment shall be earthed by wire designed for the actual earth fault current.

Connection and marshalling cubicles, etc. for LV or control equipment shall be connected to the earthing system irrespective of whether they are mounted on otherwise grounded structures or not. Cubicle doors, where electrical apparatuses or instruments are installed, shall be earthed by a flexible earthing cord.

1.2.5.5 Temporary Earthing Devices

Two three-phase sets of temporary earthing devices with leads of sufficient length and short circuit capacity, one for each winding, shall be delivered for each transformer. One three-phase set of temporary earthing device with leads of sufficient length and short circuit capacity shall be delivered for the 20kV switchgear.

The design and test methods for temporary devices are subject to approval of the Employer. Both the phase conductor and the steel structure shall always have fixed contacts.

Earthing devices shall be designed for 1-second duration of the specified fault current. Earthing switches in connection with disconnectors shall be designed for the same fault current as the disconnectors.

1.2.5.6 Corrosion Risks

The Contractor shall be observant of the risks for corrosion of buried galvanized steel structures if connected to copper.

1.2.5.7 Earth Resistivity Modeling

Soil resistivity measurements will be taken at each substation location. The Werner 4-point method described in IEEE Standard 80 shall be followed. A minimum of two layer soil model will be developed using an industry standard approved computer earthing analysis software to develop the soil model. Due to the limitation of IEEE Standard 80 using the uniform soil model, the industry standard computer earthing model shall be developed following IEEE standard 80 guidelines.

1.2.6 Medium Voltage Cable

1.2.6.1 Standards

The equipment supplied shall conform to the latest edition of the appropriate IEC specifications or other recognized international standards. In particular:

IEC 60028	Standard resistance for copper
IEC 60060	High voltage test techniques
IEC 60071	Insulation co-ordination
IEC 60228	Conductors of insulated cables
IEC 60229	Tests on cable oversheaths
IEC 60230	Impulse tests on cables and accessories

IEC 60287	Electric Cables - Calculation of the current rating
IEC 60502	Power cables with extruded insulation and their accessories for rated voltages from 1kV up to 30kV
IEC 60811	Common test methods for insulating and sheathing materials of electric cables
IEC 60885	Electrical test methods for electric cables
VDE 0278	Power cable accessories with rated voltages up to 30kV
ASTM D2303	Inclined plane non-tracking test method

1.2.6.2 Inspection and Testing

Tests shall be performed at the manufacturer's works in accordance with the relevant IEC standards supplemented by the specific requirements indicated below.

The tests will be divided into the following categories:

Routine and Special Tests

- Check for compliance with specifications herein and with the scheduled quantities.
- Conductor electrical resistance measurements
- Partial discharge test
- High-voltage test
- Conductor examination
- Check of dimensions
- Electrical test for 4 hours
- Hot set test

Type Tests
The Employer may call for type tests to be carried out at the Manufacturer's Works and witnessed by the Employer or representative. Such test would be on random samples at the discretion of the Employer and failure to meet the conditions of test could result in the rejection of a complete batch of cable.

When such tests are called for they will comprise the following:

- Partial discharge test
- Bending test, plus partial discharge test
- Dielectric power factor as function of voltage and capacitance measurement, and as a function of temperature
- Heating cycle test plus partial discharge test
- Impulse withstand test, followed by power frequency voltage test
- High voltage ac test
- Non-electrical tests as stated in IEC 60502.

After Installation Test
When the installation of the cable and its accessories has been completed, a voltage test will be made by the Employer with a dc voltage of 70% x 2.4 times the rated power-frequency voltage for which the cable is designed, applied for 15 minutes.

1.2.6.3 MV Terminating Kits

General
All high voltage terminations and joints shall be of a heat recoverable polymeric type. They shall be factory-engineered kits containing all the necessary components to reinstate the cable

insulation, metallic shielding of each core, together with the reinstatement of the sheath, equivalent to the cable being terminated.

The Contractor shall submit at bidding, and supply with contract, complete illustrated instructions describing the methods for terminating or jointing the cable.

Each terminating or jointing kit shall be in a separate package and a list of materials indicating quantities and weights in the kit, and an illustrated instruction sheet shall be included in the package.

Kits shall contain sufficient cleaning solvents and cleaning cloths for the proper making of the joint or termination.

Voltage stress relief shall be provided and this shall be inherent in the heat recoverable polymeric material.

The termination or joint shall be capable of tolerating any variances in the manufactured dimensions of the cable such as oval, out of round, sectored or oversize cable cores. The termination shall be capable of immediate energization once all components have been installed. The terminating or jointing materials shall not be subject to storage limitations such as controlled temperature or humidity restrictions, nor have shelf life limitations.

Standards
The equipment supplied shall conform to the latest edition of the appropriate IEC specifications or other recognized international standards. In particular:

IEC 60060	High voltage test techniques
IEC 60071	Insulation co-ordination
IEC 60230	Impulse tests on cables and accessories
VDE 0278	Power cable accessories with rated voltages up to 30kV

Inspection and Testing
Tests shall be performed at the manufacturer's works in accordance with the relevant IEC standards supplemented by the specific requirements indicated below.

Routine and Special Tests
Check for compliance with specifications herein and with the scheduled quantities.

Type Tests
The Employer may call for type tests to be carried out at the Manufacturer's Works and witnessed by the Employer or representative. Such test would be on random samples at the discretion of the Employer and failure to meet the conditions of test could result in the rejection of a complete batch of cable.

When such tests are called for they will comprise the following:

- AC voltage withstand test
- Loading cycle tests
- Partial discharge test
- Impulse voltage withstand test
- Thermal short circuit test
- DC voltage withstand test
- Humidity test (only for terminations)

- Non-tracking tests.
- Termination Materials

Termination materials for MV power cables shall provide for high permittivity electrical stress control, non-tracking exterior surfaces and complete environmental sealing. Electrical stresses shall be controlled by a high permittivity, high resistivity, heat shrinkable polymeric tubing.
Heat recoverable polymeric materials and terminations shall comply with requirements of IEC 60502, IEC 60446 Appendix C, IEC 60060 sub clause 3.3, IEC 60071, IEC 60507 Section 3, and VDE 0278.

The materials and the completed terminations shall be for the appropriate type of service, size and voltage and shall include ferrules, lugs and other materials necessary for the terminating of the conductor and clamps, braid, etc. necessary for the terminating of screen and sheath for earth continuity.

All heat shrinkable polymeric tubing and pre-molded materials shall be ultra violet stable, non-tracking (per ASTM D2303) and suitable for operation in the presence of severe external contamination and environmental pollution.

Three-core cable terminations shall use a heat shrinkable polymeric molded cable breakout to provide mechanical stress relief and sealing.

The entire termination or joint shall be environmentally sealed and capable of preventing the ingress of external moisture and contamination. Internal terminations shall fully insulate all bare metal adjacent to the termination.

MV Termination Kits
Termination kits shall be supplied for terminating the specified aluminum 20kV XLPE single and three core cables onto switchgear and transformer terminals. All 20kV terminations shall be of the fully shrouded type so that the terminations, when made, fully insulate the cable lug and the equipment terminal.

The termination kits shall comprise:

- Compression lugs
- Sealant tape
- Non-tracking lug sealing sleeve
- Non-tracking weather resistant exterior
- Stress control equipment
- Non-tracking three-way shed
- Non-tracking cable breakout
- Copper braid for earthing onto screen
- Jointing instructions
- All other items necessary to complete the kits

1.2.6.4 Tools

The following tools of well-proven design and performance shall be supplied for cable terminating and jointing and shall be handed over to the Employer at the end of the contract.

- Foot operated hydraulic 12 ton compressor complete with dies to fit all compression terminals and connectors as supplied with the terminating kits. One tool shall be suitable for all die sizes, and shall be complete with:

  - Recommended kit of spares, each kit to include at least three sets of all seals and other items required during normal servicing
  - Pressure test gauge including test blank dies
  - Complete set of repair and service tools
  - Maintenance and operating instructions
  - Service and repair manual
  - Strong metal box for protection of hydraulic compressor unit when not in use.
- Hand operated hydraulic compression tool
- Shear type cable cutters for cutting maximum cable size of 3 core 20kV 240mm2 cable
- Penciling tool for XLPE insulation for shaping all cables specified
- Electric hot air blower suitable for shrinking heat recoverable jointing and terminating materials, 230V ac
- Gas hot air blower suitable for shrinking heat recoverable jointing terminating materials including hoses, regulator and 3kg gas bottle

1.2.7 Cable Racks

A sufficient number of fittings, rack-joints and angles shall be included in the supply. Medium voltage, low voltage and control cables shall each be laid on separate cable racks. Cable racks and suspension fittings shall be dimensioned for a distributed load of at least 150kg/m.

Cable racks, accessories and suspension fittings shall be hot dip galvanized after manufacturing or be made of aluminum. Accessories shall be designed so pulling of cables can be done without damage. Diversion plates shall be used at junctions.

The cable racks shall be erected in a way so cables can be laid without threading. The distance between a horizontal rack and the wall shall exceed 50mm to allow cables to be pulled down between the rack and the wall. Sharp edges, screw-tips, etc., shall be removed from the rack before cable pulling. Expansion bolts used for suspension fittings shall have a diameter of at least 6 mm.

The cable racks shall be connected to the station earth wire system. An earth wire laid along the rack shall be tied underneath to the rack at every second step.

1.2.8 Marking of Equipment

All main parts of the facilities, including towers, gantries, busbars, apparatus, etc. shall be equipped with designation labels. All switchgear, distribution boards and control gear and units thereof, components mounted therein and wiring and cables, shall be labeled and marked according to IEC. The purpose of the labeling and marking is to facilitate the identification of switchgear and control gear and parts thereof and their relation to the relevant technical documentation in order to facilitate a rational and simple manner of installation, operation, troubleshooting, maintenance and repair.

All apparatus in the outdoor switchgear shall be labeled. Labels shall normally be placed adjacent to the middle phase. The main transformers shall be labeled with phase designations on all primary, secondary and tertiary bushings.

Designation system for text on designation labels will be provided by the Employer. Text on warning labels shall be approved by the Employer. The text on operational and safety labels shall be in both the English and the Afghan language.

Labels for outdoor use shall be of enameled sheet metal. Labels that are protected from solar radiation shall be made of fiberglass-reinforced polyester with embedded color layers. Labels shall be fixed by stainless steel screws or rivets. Enameled labels shall have stainless steel hole reinforcements.

Labels shall be white with red text and red frames. Phase designation labels shall be respectively colored red, yellow and blue for phases L1(R)-L2(Y)-L3(B). Sizes shall be chosen with regard to label location. Phase markings shall have the same height as designation labels at the same location, and shall be square.

Warning labels shall have a lightning bolt symbol in red at both ends. Warning labels shall be mounted on all dangerous parts of the installation. This means:

- A general warning label on low voltage distribution boards
- Special warnings shall be applied on all cubicles where back voltage can appear after switches are opened
- General warning labels outside all fences, gates or walls surrounding the substations. These shall be applied every 50 m along fences and walls. Completion with labels stating prohibitions against entrance, photographing, etc., shall be done at the Employer's request
- Labeling, as is deemed necessary to prevent dangers arising from mal-operation of equipment.

Inside the entrance doors to each building in the substation a large sign of poster type, of durable design, shall be set up. It shall show steps and methods to be taken and used in case of electrical accidents where persons are hurt, i.e. first aid principles and how to proceed.

Fire extinguishers shall be supplied and shall have a clearly readable sign applied to the wall above them, with notices about type and size.

In addition to the above, labeling and marking shall apply as follows:

- Each switchboard and control board shall have one label stating the make, the maker's identification data and rates, insulation voltage class and one label identifying the board in the facilities.
- Each unit of switchgear or control gear (such as a cell, panel, cubicle or box as well as remote located switching and control devices) shall have a label identifying the unit and stating its purpose in the facilities. The latter information is in more complicated cases suitably given in a mimic diagram.
- All apparatus or units of apparatus in the panels, cells, etc., shall have labels or markings identifying the apparatus or units thereof (normally the relevant apparatus designations used in the technical documents for the switchgear or control gear). In some cases this marking shall be completed with function marking in plain text. Apparatus labels shall be affixed by means of screw or reverts on the framework, so they remain in place when the apparatus is dismounted or changed.
- All terminals of apparatus or apparatus units shall be clearly marked. However, this marking may be omitted when the design and arrangement of the apparatus are such that a marking is obviously unnecessary.

- All electronic printed circuit boards shall have type marking. The electronic cubicles shall have item marking for each circuit board for identification of the circuit board in the schematic diagram.
- All instruments, indicating devices and control devices shall have identification marking in plain text or simple symbols or colors. Control devices shall in addition have marking of control positions in plain text, simple symbols or colors.
- Control cable terminals and, for small load circuits, also power terminals, shall be clearly marked for identification. The marking system shall be logically built up from letter and/or figures in one system consistently used within the switchgear or control gear.
- Internal wiring within switchgear, control gear or apparatus units shall have all wire ends marked, the marking to include as a minimum the same marking as has the terminal to which the wire end is connected. The marking shall be carried out with sleeves or similar. Tape is not permitted. Current and voltage circuits shall also have phase marking and, where necessary, polarity marking. Protective earth wires shall be marked with green-and-yellow.
- Cables connected to switchgear, control gear, external apparatus, etc., shall be marked with cable numbers according to the cable list and core number according to the external connection diagram. In addition, all cable cores shall have the same marking as the terminals to which cores are connected. Marking with glued tape is not permitted. The marking shall be indicated with ferrules.

  The ferrules shall be of white insulated material and be provided with a glossy finish preventing adhesion and dirt. They shall be clearly and durably marked in black and shall not be affected by damp or oil.
- Trenches with buried cables shall be marked with labels on walls where applicable or with labels on posts with one set up at each end of a road crossing, one set up for every point of change of direction of a cable trench, and one set up for each twentieth (20) meter of a cable trench. The cables shall be provided with warning tapes along all the trenches.
- All labels shall be of plastic or metal indoors and of enameled metal outdoors, and shall have the text or symbol engraved. Text and symbols shall be of dark color and the surface shall be light. All labels shall be permanently fixed to the switchboard and apparatus. Glued labels and marking tape are not acceptable.

Some of the above required markings and labeling may, subject to the Employer approval, be combined or omitted for uncomplicated parts of the equipment.

1.2.9 Optical Fiber Cables

Outdoor Optical Fiber Cable
Outdoor single mode and/or multi mode cable shall be used between buildings if there is more than one operational building on a site.

Outdoor optical fiber shall be of loose tube, gel filled construction and shall be installed in HDPE cable ducts or direct buried in plastic conduit. The cable shall have a non-metallic central core sheathed with black polyethylene. An armored layer shall surround the inner sheath made up of corrugated steel or aluminum tape at least 0.2mm thick followed by an outer polyethylene sheath.

Indoor Optical Fiber Cable
Single mode and/or multi mode indoor optical fiber cable will be used to interconnect equipment within the control buildings. Indoor optical fiber cable shall be of tight buffered construction and shall be installed in cable ducts or on cable ladder. The cable shall have a non-metallic central core

sheathed with black polyethylene. A non-metallic strength layer shall surround the inner sheath followed by an outer polyethylene sheath.

Table 1.2.1 Common Requirements for Optical Fiber Cables

Description	Specification
Number of fibers:	at least 12, but not less than the number of cores in any other cable to which the cable is joined
Spare fibers:	at least 4 for cables with up to 12 fibers and at least 6 for cables with over 12 fibers (counted after the system is commissioned)
Standard:	ITU-T G.652
Max. Tensile strength:	≥ 2700N
Cladding non-circularity:	≤ 2%
Covering material:	Polyethylene capable of resisting insects and rodents
Water proof capacity:	according to IEC 60794-1-F 5
Operating environment:	according to TCN- 68-149:1995
Environment temperature:	-5 to +65C

Single mode optical fibers shall be designed to optimize transmission of light at both the 1,310nm and 1,550nm wavelengths. The core/cladding diameters shall be 9/125μm.

Multi mode optical fibers shall be designed to optimize transmission of light at the 850 nm wavelength. The core/cladding diameters shall be 62.5/125μm.

Patch Leads/Pigtails

Fiber patch leads shall be used to connect between equipment within a cubicle, and may also be used between cubicles up to a distance of 10m. For lengths greater than this, indoor optical fiber cable shall be used with suitable breakout termination enclosures. When run externally between cubicles, the patch leads shall be suitably protected by being run in plastic conduit. Patch leads shall be Kevlar® (or aramide) reinforced and plastic coated optical fiber conforming to ITU-T Recommendation G.652, and be color coded depending on function (data, telecom, CCTV, protection etc.).

Where a termination enclosure is installed, all fibers of all cables are to be terminated on "pigtails" (or break-out cable) with a minimum length of 1m. The pigtail shall be a Kevlar® (or aramide) reinforced and plastic coated optical fiber conforming to ITU-T Recommendation G.652.

1.2.9.1 Fiber Optic Accessories

Junction (Splicing) Box

Outdoor junction boxes shall be provided as required. These junction boxes shall be used to house the fiber core splices which connect the trunk cable (e.g. OPGW) to the outdoor intermediate optical cable leading to the patch panel in the control room.

A fiber optic cable junction box shall provide the following:

- It shall support, organize, and protect the optical fibers and the fiber splices whilst ensuring that the optical fiber minimum-bending radius is not exceeded
- The splice tray shall not have any sharp edges or protrusions that may damage the optical fiber cable
- It shall provide entry for all cables
- Include number tags for tube and fiber identification
- The junction box shall be rated to IP65 in accordance with IEC 60529

- The enclosure shall be lockable.

The Junction box shall be mounted on a wall or pedestal at a conveniently accessible height.

Termination Patch Panels and Breakout Enclosures
Fiber optic cable patch panels shall be provided in the control room to patch the external optical fiber cable cores to the appropriate communications devices in the station.

Breakout enclosures shall be provided in cubicles to transition between optical fiber cable and individual fiber tails.

Sufficient connectors for all incoming and outgoing fibers, including spares, shall be provided in each enclosure.

A fiber optic cable termination patch panel shall provide the following:

- It shall support, organize, and protect the optical fibers and the fiber splices whilst ensuring that the optical fiber minimum-bending radius is not exceeded
- The splice tray shall not have any sharp edges or protrusions that may damage the optical fiber cable
- It shall provide entry for all cables
- Include number tags for tube and fiber identification
- It shall provide mounting positions for the bulkhead FC/PC type connectors on which the cable will be terminated
- It shall allow patching of fibers.

The patch panel shall have a fiber capacity equal to the total number of fibers (connected and spares) for all cables to be connected. Patch panels shall be designed for 19-inch rack mounting within a standard equipment cabinet.

All unused couplings shall have protective dust covers. The patch area shall be accessible behind a door or removable cover.

Sufficient factory manufactured patch cords with suitable color coding shall be provided.

Fiber Connectors
All optical connectors shall be field installable and perfectly matched to the cable used. The connectors shall provide tight fitting termination to the cladding and buffer coating.
Epoxy based or "hot melt" adhesives shall be used to bond the fiber and buffer to the connector ferrule and body prior to polishing the end face. No dry termination or "quick crimp" connectors are allowed.

After termination with connectors, the fiber ends must be visually inspected at a magnification of not less than 100 to check for cracks or pits in the end face of the fiber. If any irregularities found cannot be removed by further polishing, the entire process must be redone by cutting off and disposing the connector body.

Connectors shall have a maximum allowable connection loss of 0.3dB per mated pair, as measured per EA.-455-34, without use of index-matching gel (dry interfaces only). Single mode connectors shall be capable of field installation on 9/125 micron fibers with 900□m (OD) buffers.

Communications equipment shall use the industry standard FC/PC type connector, designed for single mode or multimode tolerances, and shall meet or exceed the applicable provisions of EA.-455-5, 455-2A, and 455-34, and shall be capable of 100 repeated matings with a maximum loss increase of 0.1dB. Substation equipment shall use either FC/PC type or ST type connectors. Connectors shall incorporate a key-way design and shall have a zirconium ceramic ferrule.

Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials, such as nickel plated zinc, designed to operate in humid environments without degradation of surface finishes.

Where a termination enclosure is installed, all fibers of all cables are to be terminated on "pigtails" with a minimum length of 1 m. The connector shall be inserted on the cable side of the bulkhead (feed-through) connector in the termination enclosure. All connectors shall be supplied with a removable cap to protect against moisture and dust ingress when not connected.

1.2.10 Control, Relay and Auxiliary Power Equipment

1.2.10.1 Control, Relay and Auxiliary General

The control panels in the SVC and substation control buildings shall include control and indication of all 220kV circuit breakers and disconnectors. The control panel shall be integrated with the relay panel. The control switches for the circuit breakers and disconnectors and indicating instruments shall be installed directly on the front of the control panel. The manual control features do not replace HMI functionality.

The panel front shall also include a mimic diagram, reflecting the actual layout of the complete 220kV and 20kV switchgear. The mimic diagram shall have different colors for different voltages and symbols for the main apparatus.

1.2.10.2 Design Data

Voltages shall be as indicated in Table 1.2.2.

Table 1.2.2 Control, Relay and Auxiliary Voltages

Description	Specification
Auxiliary power	400/230V AC three-phase, 4/5 wire with system earthing TN-C-S
General auxiliary voltage supply	220V DC 2-wire insulated system
Tolerances	are +10% - 15% measured at the consuming objects

1.2.10.3 Control, Relay, Metering and Alarm Boards

The boards shall be made of sheet steel of at least 2 mm thickness and be of vermin-proof design IP 43 according to IEC 60529. Boards shall be wired at the Contractor's workshop before delivery to Site. To facilitate transportation, the boards should be assembled in convenient sections before delivery.

All boards shall have a maximum height of 2,300mm. The boards shall be equipped with a master key-locking system. Each board shall have lighting that is switched on when the door of the cubicle is opened. Humidity controlled heaters shall be provided.

Terminal blocks for cable termination shall be mounted on the sides inside the boards and all cable entrances be supplied with glands. Terminal blocks for CT circuits shall be equipped with

testing plugs for commissioning purpose. All boards shall be connected to the general earthing system. Each board shall be labeled.

1.2.10.4 Operation and Indication, Control Systems

General
All control and indication circuits shall be designed for 220V DC. Fuses for various DC circuits for control, relay protection, indication, etc., shall be mounted in separate boards. Each circuit shall be supervised by voltage relays giving alarm in case of lost voltage or tripped fuse.

Interlocking System
A complete interlocking system shall be incorporated in the operating circuits for motor-operated disconnectors. The purpose of the interlocking system is to prevent opening of disconnectors while circuits are still loaded. An earth switch shall be mechanically interlocked to the disconnector to which it is attached.

Indicating Instruments
The indication instruments shall have dimensions 96 mm x 96 mm and be flush-mounted. The indication instruments shall be of angle type with 240° scales, indication errors shall not exceed ±1.5% of the full-scale value. The instrument scales shall have a white background and the same design of figures and gradation. The indicated values shall be given directly without constants such as x10 and the like. Panel instruments shall be provided as indicated in Section 2.0 Technical Data Sheets.

1.2.10.5 Control Panel Logic

The front panel mimic diagram shall be provided on panels. Mimic diagram shall be screwed onto the panels and shall be made of anodized aluminum or plastic of approved color. The mimic shall be 10mm wide for horizontal run and 5mm wide for vertical run. Mimic shall match the one-line diagrams indicated on the drawings and as specified herein.

Semaphore indicators (push-to-test type) shall be provided for the Operator and indications.

Each breaker control switch shall be paired with a control switch selector. The selector will place related breaker switch into local (control panel) control or remote (SCADA or breaker local) control. All necessary interface wiring to SCADA equipment to supply this function shall be provided.

Blue indicators shall be provided for energized indication of bus or line sections. The indicators shall be located in the related section of the mimic bus. Any mimic bus section over 500mm in length shall have multiple indicators evenly placed in mimic section.

Control Panel wiring logic shall be provided to inhibit all operations (open and/or close control signals) of disconnectors when respective breaker is closed.

Control Panel wiring logic shall be provided to inhibit simultaneous closure of paired (common line or load connection) bus-select disconnectors.

Control Panel wiring (or internal programming of 87 relay) logic shall be provided to automatically select proper current transformers and breaker operation for bus differential zone relaying during all possible switching schemes provided through the disconnect switch positions.

Each 87B shall be capable of monitoring two zones (Bus I & Bus II), and tripping only breakers associated with given zone for a bus fault.

Control Panel wiring logic shall be provided to automatically select proper voltage transformers for sync check (25) relaying and metering during all possible switching schemes provided through the above disconnect switch positions. Typical selection schematic is shown in drawings.

The system shall provide breaker failure protection for the 220KV system. Typical sequence: During a fault breaker #A fails to open when receiving an overcurrent trip command. Breaker #A REL670 and/or P444 relays detect breaker failure and issue failure command to related 94 relay. The 94 relay will issue trip commands to all substation power source breakers, issue a command via SCADA to open the far substation source breaker (with lock out), Send "open" commands to failed breaker motor operated bus disconnects. This de-energizes the bus and isolates the failed breaker #A. Upon receiving "b" contacts signals of both breaker #A disconnects, a re-close command is sent to all substation line breakers, restoring bus power.

The colors for various voltages in the mimic diagram shall be as below.

Voltage Level	Mimic Color
Medium Voltage	Canary Yellow
220KV	Signal Red

1.2.10.6 Alarm Equipment

An alarm annunciator shall audibly and visually identify the source and type of alarm. There is no requirement for a remote fault signal system.

1.2.10.7 Relay Protection

The proposed relay protection is listed in Section 2.0 Technical Data Sheets. The Contractor shall add all additional protection as necessary for their nominated facilities and equipment:

The relay protection shall consist of numerical type relays with self-supervision.

Each relay protection shall have test facilities of a type enabling testing of the entire relay combination while the protected part is in service. It shall be possible to block all tripping impulses by means of switches.

The setting ranges of the relays shall be selected to fit into the existing selectivity plan. All ranges will be settled at a later stage. All relay protection shall have individual indicating devices and be designed for easy resetting both by local and remote operation.

Possible influence from induced voltage in a control cable shall be taken into account, e.g. introducing barrier relays between relay protection and outgoing cables to switchgear, etc. Tripping outputs shall be of high-speed type. Tripping contacts shall be of heavy-duty design to obtain required contact duty for breaking.

1.2.10.8 Metering Equipment

Energy meters shall be provided as indicated in Section 2.0 Technical Data Sheets

Meters installed for monitoring of energy consumption shall be kWh delivered and kWh received for kWh (MWh) and four quadrant for KVArh (MVArh). Accuracy class for meters shall be 0.2 for active energy and 0.5 minimum for reactive energy. Meters shall have the facility for remote

interrogation via modem and the SCADA/CSCS and shall provide pulsed outputs to the metering data processors. Two data processors (main and backup) shall be supplied for recording and totaling metering pulses, with programmable 20 or 30-minute printout facilities and 20 inputs minimum for each processor.

Each meter shall be provided with a testing terminal block enabling the meter to be switched off in a simple manner.

1.2.10.9 Control Cables and Earth Wires for Control Systems

Control Cables
Control cables shall be of multi-core type, PVC insulated, with screen and copper conductors. Cables shall be termite-proof in an approved manner. All cables shall be laid in plastic pipes of a suitable size and standard. Medium voltage, low voltage and control cables shall be laid in separate pipes.

For low level signals, e.g. outputs from transducers, cables shall have conductors of tin coated stranded copper wires and screen of aluminum foil and copper wires (Electronic cables). Cables containing more than 10 cores shall be so dimensioned that at least 25% of the cores will serve as standby cores.

The cables shall comply with design criteria detailed in Table 1.2.3.

Table 1.2.3 Design Criteria – Control and Electronic Cables

Cable	Control	Electronic
Nominal voltage	230V	0V - 220V
Maximum current	10A	2A
Insulation level	0.6/1kV	0.6/1kV
Frequency	DC or 50Hz	0Hz-1000Hz

As a protective jacket the cable shall have an extruded sheath of grey or white PVC in waterproof color marked with:

- Name of manufacturer
- Year of manufacture
- Cross-section area of phase-conductors and number of cores.

The cables shall be delivered in full lengths and, consequently, no joints are permitted. Cable terminations are normally not needed for these types of cables, however all cable terminations shall be provided with cable glands.

Earth Wires for Control Systems
All control boards, relay boards, marshalling boxes, transformers, apparatus, etc., shall be connected to the main earthing system.

An earth bar shall be installed in the control building for transition of earth wires in the different rooms. The earth wires shall be separated from control cables, etc. The earth wire system shall be of stranded copper wire designed for the maximum prospective fault current.

Secondary Circuits
Auxiliary cables shall be PVC-insulated for a test voltage of 2KV, 50Hz and shall be screened or metal-sheathed. The conductors, screens and metal sheaths shall be made of copper.

The following minimum areas shall be applicable:

Current circuits for protection relays:	$2.5mm^2$
Instrument, voltage and control circuits:	$1.5mm^2$

The auxiliary cables shall be designed for a maximum voltage drop from voltage transformers to instrument and meters of 0.1%, and to relays 1.0%.

Total burden shall not load the secondary winding of voltage transformer more than 75% of rated burden. Total burden shall load the secondary winding of a current transformer between 25% and 75% of rated burden.

The screen of control cables in connection with the outdoor switchgear shall generally be earthed at both ends. All other cables shall generally be earthed at one end only. In case of earthing at one end only, the location of the earthing shall be indicated on the diagrams.

Auxiliary conductors in apparatus cubicles such as control and relay cubicles, etc. shall be stranded PVC cables with a minimum area of $1.5mm^2$.

Conductors within cubicles and between terminal blocks and apparatus shall be laid in plastic ducts or covered with plastic bands. Conductor ends not connected to compression-type terminal blocks shall be provided with approved claw washers, which neatly retain all strands. Wiring shall be arranged to give easy access to the terminal of relays and other apparatus. All jointing and tying of wires shall be carried out only at the terminal points.

Spare cores, if any, shall be connected to terminal blocks in cubicles and marshalling boxes.

Boards and Marshalling Boxes for Control Systems

Boards and marshalling boxes shall be made of steel and designed for adverse conditions and be vermin-proof. The doors shall be of the lift-off and hinged type. Boards and boxes for indoor installation shall fulfill Degree of Protection IP 43 according to IEC 60529. Boards and boxes for outdoor installation shall fulfill Degree of Protection IP 54.

The cables shall be mounted so that they are protected against damage and vibrations. The cables shall enter through glands, which shall properly be above the gland plate to prevent moisture from entering the cables.

Boards and marshalling boxes located outdoors or in damp surroundings shall have ventilation and drainage openings as well as connection for a 230V, 50Hz heater. They shall also be provided with lighting equipment. Boards and marshalling boxes and equipment installed in them shall be of satisfactory corrosion-proof design. All box openings shall be screened for protection against vermin, and be so arranged that entry of water is prevented. For screening of the holes, netting with at least one mesh per mm shall be used.

All marshalling boxes shall be placed at normal working height and shall be sufficiently spacious to facilitate the connection of leads. They shall be so designed as to make markings easily legible.

Not more than two cores shall be connected to each side of a terminal block. Each board and box, etc., shall be connected to the station earth system by a copper wire with a minimum area of $25mm^2$.

Terminal Blocks

All terminal blocks shall be equipped with visible isolating arrangements for testing purposes. They shall be provided with sockets for banana plugs, at both sides. The terminal blocks shall be

insulated for 500V and shall have provisions for marking. The terminal blocks shall be mounted to give easy access to wires, terminations and ferrules. The terminal blocks shall also give a clear view of the arrangement of the cable tails.

Terminals connected to 400/230V shall be properly protected and separated from control circuits.

1.2.10.10 Auxiliary Power Transformers

General
The auxiliary power transformers shall be 3 phase oil immersed. The design shall comply with IEC 60076 and be rated in accordance with Section 2.0 Technical Data Sheets.

The auxiliary power transformers shall be of a suitable type for service under the specified ambient conditions.

The transformers shall be capable of withstanding continuous operation at the rated power and at a voltage 10% higher than the rated voltage without causing dangerously high temperatures or abnormal vibration.

The transformers shall be designed with cable entry boxes for direct cable connection on the medium voltage and low voltage side. Oil or compound filled cable boxes are not permitted.

Oil
The oil shall contain at least 0.3 per cent by weight oxidation inhibitor of type diterbutyl paracresol (DBPC) according to IEC 60296. The oil shall not contain PCBs. If oil samples taken from the transformer on delivery contain 2 ppm or more of PCB, the Employer has the right to refuse the delivery of the transformer.

Accessories
The following accessories shall be provided for the transformer:

- Bushings for HV side
- Cable entrance boxes for LV side
- Marshalling box including terminal blocks for connection of external cables to the transformer accessories
- Oil temperature indicator
- Valves for filling and draining the oil
- Lifting devices such as eyes or hooks for lifting the complete transformer with oil and for lifting the coil and core assembly alone.

1.2.10.11 Auxiliary Power Equipment

Motors
Electrical motors shall fulfill the following requirements:

- Insulation Class F
- Enclosure Degree of Protection IP 54
- Cooling design IC 4

They shall have protected drainage holes, and be capable of operating continuously under equal service conditions without exceeding the specified temperature rises. All motors required to operate in damp or humid conditions or located outdoors shall be supplied with electrical heating equipment in order to protect the windings against moisture.

Low Voltage Boards
The requirements for boards are where applicable also valid for boxes for separately mounted apparatus. Boxes outdoors shall fulfill Degree of Protection IP 54 according to IEC 60529 and have thermostat-controlled heaters, ventilation and drainage.

All cables shall be connected to the boards with terminal blocks of approved type located near the cable entry. Cables with large cross-section areas are permitted to be connected directly to the apparatus.

All auxiliary circuits shall be connected to terminals with isolating arrangements having 4 mm banana plug sockets on both sides. All boards shall have 10% spare terminals for power circuits and 10% for auxiliary circuits. All distribution boards shall have 20% spare space for future extension.

The boards shall be complete with terminal block marking, full set of circuit breakers, switches and fuses as well as with other components required. The boards shall be designed for erection on wall without rear access. The operation devices for switches and control switches shall be operated from the front of the board without the doors being opened. The expanding gases developed in case of a short-circuit shall be directed in a safe direction in order to prevent injury to persons being near the board.

AC Boards
Boards for 400 VAC shall be of metal-enclosed panel type and vermin-proof designed; Degree of Protection shall be IP 43 according to IEC 60529.

The boards shall have Cu busbars for phases, neutral (N) and protective earth (PE). The neutral busbar shall also have full insulation against earth and be connected to earth with one link in the board only (power system TN-C-S). The earth busbar shall preferably be located near the outgoing cable terminals.

DC Boards
Main and battery boards for 220 VDC shall be of plastic-enclosed panel type and vermin proof designed; Degree of Protection shall be IP 43 according to IEC 60529.

Distribution boards for DC may be metal-enclosed but shall fulfill all requirements as for the main board. The battery boards shall have separate enclosures and shall be mounted as near the batteries as possible.

Circuit Breakers
Circuit breakers shall be capable of interrupting the available short-circuit energy. Miniature circuit breakers shall be used for all loads 430V / 80A and below.

Air Break Switches
The low voltage switches for the AC boards shall be of Utilization Category AC 23 and DC 23 respectively. The switches shall be front-operated and have distinct ON-OFF markings and have provision for locking. Switches on the main boards shall be of plug-in type.

Switch Disconnectors
Switch disconnectors shall be of utilization category AC 23 (DC 23). Switch disconnectors shall be operated from the front of the box and have distinct OFF-ON markings with possibility for locking with padlock in OFF position.

Fuses
Power fuses shall be of blade type according to IEC 60269 - 2A Section I. Fuses maximum 25A may be of screw type DII (IEC 60341). The fuses shall have a visible indication device. For small apparatuses, miniature fuses 5x20mm (IEC 60127) may be used.

Control Switches
Control switches shall be designed for 10A and be marked OFF-AUTO-ON, etc. Control switches shall be operated from the front of the cubicles.

Current Transformers
Current transformers shall be of the dry type for mounting on busbars or cores. Secondary current shall be 1A.

Measuring Instruments
Voltmeters and ammeters shall have dimensions 96mm x 96mm and be flush-mounted. The indication instruments shall be of square type with 240° scales, indication errors shall not exceed ±1.5% of the full-scale value. The instrument scales shall have a white background and the same design of figures and gradation. The indicated values shall be given directly without constants.

1.2.10.12 Back-up Diesel Generator

Refer to Section 1.3.16.7 Station Service of the SVC specification.

1.2.10.13 Solar Electric System

Solar electric system design is beyond the scope of this specification.

1.2.10.14 Lighting, Fittings and Accessories

General
Lighting fittings shall be of fluorescent type with electronic type ballast and have power factor compensation. All fittings shall be delivered complete with lamps.

Indoor Lighting
The lighting fixtures shall be surface mounted. Fittings for indoor lighting shall be IP 23 according to IEC 60529.

Outdoor Lighting
Fittings for outdoor lighting shall be splash-proof IP54 according to IEC 60529. The outdoor lighting shall be operated by means of a photocell relay, connected to a changeover switch, mounted in the lighting board, with three positions: ON; PHOTOCELL RELAY; OFF.

Socket Outlets
Single phase socket outlets shall be Shucko (CEE 7/4), 16A. Three phase socket outlets shall be splash-proof, 3P+N+PE according to IEC 60309. Outlets shall have a load breaker mechanically interlocked with the male device.

Socket outlets shall be provided as indicated in Table 1.2.4.

Table 1.2.4 Socket Outlets

Description	Specification
SVC Control room	three 16A, 230VAC, one three phase, 16A, 400VAC
Auxiliary room	three 16A, 230VAC, one three phase, 16A, 400VAC
Office	three 16A, 230VAC
Store room and workshop	two 16A, 230VAC
Kitchen	two 16A, 230VAC
WC- bathroom	one 16A, 230VAC
Adjacent to outdoor power transformers	one 125A, three phase outlet for oil treatment

	facilities

Lighting Intensity and Socket Details
The intensity of the lighting installation shall be as detailed in Table 1.2.5.

Table 1.2.5 Lighting Intensity

Description	Specification
Control, battery and auxiliary rooms	300 lux
Office and kitchen	300 lux
WC/bathroom	200 lux
Store room and workshop	200 lux
Outdoor, entrance and gate	50 lux
Transformer cells	50 lux
Switchyard, in general	10 lux
Emergency lighting in control room (design for 90 minutes minimum)	50 lux

1.2.10.15 Auxiliary DC Systems

General
The 220 V DC systems shall consist of two 220 V batteries banks, two rectifiers, one main battery board and DC distribution board. The 48 V DC systems shall consist of one 48 V battery bank, two rectifiers, one main battery board and DC distribution board. Battery supervision shall be included for each. For discharge test of batteries, a portable enclosed resistor and a fused test outlet at the DC board shall be supplied. It shall be possible to adjust the resistor for different load currents.

The DC systems shall be designed for the power demand of the connected loads and a future extension of at least 30%, taking into account the load diversity factor and the maximum voltage drop.

The battery shall have a sufficient capacity for maintaining the power supply of the connected systems for a period of six hours in the event of failure of the AC supply, without the terminal voltage falling below the nominal value by more than 10%. Furthermore, the battery must be dimensioned for a secure and selective operation of the short circuit protection devices (fuses).

The rectifiers shall be designed to recharge the battery, up to 90% of rated C10-capacity within 12 hours after a six-hour discharge, whilst supplying the connected loads at the same time.

The voltage at individual components when the system is at no load must not exceed the nominal voltage by more than 10%, and must not fall below the nominal voltage by more than 15% when the system is at full load.

Batteries
The batteries shall have main design data per Section 2.0 Technical Data Sheets.

The Contractor shall design the capacity of the battery system, using appropriate temperature correction factor, design margin and ageing factor, in accordance with IEEE 485 *Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations*. The batteries shall be erected on non-corrosive stands and totally insulated from frames and earthed equipment. The batteries shall be of a type with transparent containers and be installed in

maximum two layers in order to enable the observation of the acid level through the container walls.

The batteries must be erected in such a way that maintenance and service can easily be carried out. Acid resistant vessels under the batteries shall be included. Each battery cell shall be equipped with explosive retarding valves.

Rectifiers
The rectifiers shall be of solid-state constant voltage charge type and have an automatic current limitation. The rectifiers shall be equipped with volt- and ammeters (accuracy class 1,5) indication lamps, main switch and a selector switch for automatic recuperative recharging (Float/Quick charge with locking device) as well as alarm indicators for AC supply failure, and quick charging. Test outlets for 4 mm banana-plugs shall be provided.

Auxiliary contacts for above-mentioned alarms shall be provided for remote alarms, including a no-voltage relay for AC-voltage. The rectifiers shall be enclosed in painted steel chassis with a Degree of Protection of IP 43 according to IEC 60529.

DC-Supervision
DC-supervision of the battery systems shall be provided and shall, as a minimum, consist of:

- Over- and under-voltage supervision in two steps for each function of the floating voltage level
- Earth fault supervision
- Battery circuit supervision
- Fuse supervision for all fuses

If the DC-supervision is mounted in the rectifier it shall be connected at the external side of the rectifier fuse to prevent maloperation if the fuse will trip. Auxiliary contacts for the above mentioned alarms shall be provided for remote alarms.

1.2.10.16 Auxiliary Power Cables AC/DC, Wires and Earthing

General
The cables and wires with accessories shall be continuously rated and suitable for service under the actual climatic conditions. The cables shall withstand all electrical, thermal and mechanical stresses under the stated service conditions, and at a voltage of 10% above the rated value. The insulation level shall be 1kV. Special mechanical protection of the cables shall be provided where required. The cables shall be protected against the short circuit current and earth fault current by fuses, with exception of use in current measuring circuits. Cables shall be protected against direct sunshine. Cables shall be marked with designation according to the cable list.

Design
The cables to be used shall be PVC-insulated, PVC-sheathed with copper conductors and copper screen. The neutral conductor shall be of the same cross-section as the phase-conductors. The surface of the sheath shall be marked as follows in English:

- Name of manufacturer
- Year of manufacture
- Cross-section area of phase-conductors and number of cores

Cable Accessories

The minimum requirement for cable joints and cable terminations are that they after installation shall withstand the environmental and climatic conditions as the cable itself. They shall also fulfill the same electrical standards as the cables regarding insulation and current rating.

Cable Joints
Jointing shall be avoided. If jointing is anyway deemed necessary by the Contractor, he shall obtain the approval of the Employer. The jointing of conductor ends shall be done by pressing or screwing technique. The insulation may be restored by taping, molding or shrinking techniques.

Cable Terminations
Connection of low voltage cables to distribution boards, contactor cubicles, motors, etc., shall be carried out by removal of the insulation to the required length of the conductors and by connecting the ends to the terminals. The terminals shall be of screw-joint type. Special cable terminations are thus not needed.

Earth Wires
All switchboards, transformers, apparatus, etc., shall be connected to the main earthing system.

1.2.10.17 SDH Network

General
The utility furnished primary optical network connecting substations with the National Load Control Center (NLCC) near Tarakhil and shall be based on Synchronous Digital Hierarchy (SDH) equipment using multiplexed channels on STM-1 (155Mbit/s) links for data, telephony and protection signaling. The SDH equipment at each site shall be linked via optical fiber cable on the transmission lines (generally OPGW) or via microwave radio where specified.

The SDH equipment is required eventually to fit in to a system wide communications network so the scope of supply shall include provision of equipment for future fiber optic links. In addition multiplex and sub-network connection protection is also required so some duplication is specified.

Network Services
The SDH network shall provide the following services:

- Telephone Network
  - The telephone exchanges (PABX) at each substation shall be linked over the SDH network by 2 Mbit/s G.703 E1 circuits.
- SCADA Data
  - Digital communications shall be provided to connect the Remote Terminal Unit (RTU) of the CSCS at each site with the Network Control Center (National or Area Load Control Center) at Tarakhil. 10 Mbit/s IEEE 802.3 Ethernet data links shall be provided over the SDH. In addition, asynchronous serial links shall be provided for other equipment that may need interconnection.
- Teleprotection
  - Digital teleprotection circuits shall be provided on the SDH network for all transmission line protection as described above.
- Performance
  - The technical requirements of the equipment specified for the communications network are based on ITU-T Recommendations and other international standards. Error performance objectives shall comply with ITU-T Recommendation G.826.
- Redundancy
  - Each SDH terminal shall communicate via two separate fiber circuits in an actual ring or flat ring configuration. Where possible, these circuits shall be connected by separate transmission lines to form a true ring.

1.2.10.18 SDH Multiplex Equipment

General

Digital multiplex equipment shall be provided to perform the necessary multiplexing between 2 Mbit/s and 34 Mbit/s tributaries at each site. The digital multiplex equipment shall also provide the optical interfaces to the fiber optic cables between the various sites. The digital multiplex equipment shall be in accordance with the latest ITU-T Recommendations for SDH equipment, namely: G.703, G.707, G.708, G.709, G.781, G.782, G.783, G.784, G.803, G.811, G.823, G.825, G.957 and G.958.

Interfaces

The types of interfaces required are:

- STM-1 Optical
- n x 2 Mbit/s
- The characteristics of the multiplex interface shall conform to the ITU-T Recommendations for systems operating at 155 Mbit/s or 52 Mbit/s, namely:
- G.709 for mapping and de-mapping
- G.708, G.783 for MSOH and RSOH insertion and extraction
- G.708 and G.709 for POH generation and termination
- G.709, G.783 for Pointer generation and interpretation
- G.708 for multiplexing
- G.709 for scrambling and de-scrambling

STM-1 Optical Interface

Optical interfaces shall be provided for connection to the fiber optic cable between the various sites. In addition to the general requirements listed above, the STM-1 Optical Interface shall conform to the requirements listed in ITUT Recommendation G.957.

The interface shall operate at a nominal optical wavelength of 1550nm and be suitable for operation over the required distances. The optical fiber on these routes shall conform to the ITU-T Recommendation G.652. For each link, the optical interface with the lowest transmitter output power that still meets the performance objective shall be supplied.

The STM-1 Optical Interface card shall include flexible patch cords to connect the optical interface to the patch panel. The patch cords shall be terminated at the patch panel end in Type FC/PC connectors. These connectors are also preferred for the STM-1 Optical Interface.

n x 2Mbit/s Interface

2 Mbit/s interfaces are required at each site to connect to primary multiplex equipment. Each interface card should accommodate at least 4 x 2Mbit/s interfaces to provide the immediate requirement together with spare capacity for future growth. All 2Mbit/s interfaces shall conform to the ITU-T Recommendations:

- G.703 Section 6 for electrical characteristics. The 120Ω balanced pair option shall be used.
- G.704 for functional characteristics
- G.823 and G.783 for output jitter and jitter tolerance

The 2Mbit/s interfaces termination shall be 120Ω balanced.

Synchronizing
If a Primary Reference Clock for the synchronization of the SDH equipment is required, it shall be installed at the same location as the network management system and comply with ITU-T Recommendation G.811.

Each multiplexer shall have the ability to choose the timing source between external timing, incoming STM-1 signal (155 Mbit/s) or incoming 2Mbit/s. The order of priority in which these sources are chosen shall be programmable by the Employer.

The synchronization architecture shall conform to the recommendations in ITU-T Recommendation G.803 Section 6. Where required according to G.803, the Contractor shall provide slave clocks compliant with ITU/T Recommendation G.812. Also, the synchronization using the ring shall be configured in such a way that synchronization is not lost to any loop node with any single break in the ring.

The SOH (Section Overhead) bits Z1 (b5-b8) shall be used to carry synchronization status messages as defined in the ITU-T Recommendation G.708. These status messages shall determine the source of the clock during normal and abnormal operation and shall be used to provide a robust synchronization network as described in ITU-T Recommendation G.803 Section 6.2.7.

Each multiplexer shall be provided with a synchronization output interface conforming to ITU-T Recommendation G.703 Section 10.

Jitter and Wander
The jitter tolerance on the STM-1 interfaces (155 Mbit/s) shall be in accordance with the ITU-T Recommendations G.825 and G.958. The output jitter shall be in accordance with ITU-T Recommendations G.783, G.825 and G.958. The jitter transfer function shall be in accordance with ITU-T Recommendations G.783 and G.958.

Channel Assignment
The multiplex supplied in the Contract shall be configured by the Contractor to provide the specified reliability for the various types of services.

The Contractor shall submit detailed multiplex design / channel assignment information to the Employer's Representative for approval prior to commencement of manufacture.

Installation
The multiplex equipment supplied in the Contract shall be installed and tested by the Contractor. Following this testing, the equipment shall be subjected to an availability test to prove compliance with the ITU-T Recommendation G.826.

1.2.10.19 Management and Maintenance

Network Management
A Network Management System (NMS) based on Open Systems architecture conforming to the ITU-T Recommendations M.3010 and G.784 shall be provided for the SDH network. This shall be provided as portable system incorporating the NMS software installed on a notebook/laptop PC together with appropriate interfaces and leads to allow the system to be easily moved between the areas covered by this Contract. Local interfaces shall be provided at each site to allow connection of the NMS.

The individual network elements (i.e. DXC and ADM units) supplied to this Specification shall be interconnected as a managed SDH sub-network according to the architecture of Figure 3.4 of ITU-T Recommendation G.784.

In connecting the network elements to form this sub-network, the data channels used shall be configured in a ring-protected arrangement so that no network management capability is lost in the event of failure of any part of the ring.

The interface to each network element shall be a Q3 interface as defined in the ITU-T Recommendation G.773.

Maintenance Functions
The Bidder shall provide details of alarms and parameters monitored in the multiplex equipment and presented to the network management interface. As a minimum, these parameters shall include those listed in Section 4 ITU-T Recommendation G.736.

In addition to signaling external alarms, these fault conditions shall generate consequent actions as listed in Table 1 of ITU-T Recommendation G.736.

Control or Service Terminal
Each network element shall be provided with an 'F' interface to allow maintenance staff to locally interface to the network element with a hand held terminal or portable computer.

The maintenance technician shall be able to access locally all the information on alarms, settings and statistical information from each network element at the site. He shall also be able to change all software settings. The procedure for updating these software settings shall be designed to minimize the risk of the maintenance technician causing an inadvertent malfunction of the equipment.

The Bidder shall also provide details of measurements and settings that can be controlled on the radio with this terminal.

1.2.10.20 Telephone System

General
A modern digital Private Automatic Branch Exchange (PABX) shall be provided for each substation and switching station. Each PABX shall be inter-connected via 2Mbit/s G.703 E1 digital trunks over the SDH network. A telephone handset connected to this system shall be provided in the SVC control house.

The PABX shall be fitted with a 4-wire + E&M trunk to allow it to be connected to the local PSTN trunk at some time in the future, however for this project the Contractor shall supply and install two optical isolators and connect two incoming PSTN extension circuits, which will be arranged by the Employer. One PSTN extension shall be connected to a tele-facsimile (fax) machine and one to a telephone.

Telephones and Faxes
The requirements for telephones and faxes at each site are:

- Digital operator's console: 1
- Analogue telephones: At least 6 (one connected to a PSTN line)
- Fax machines: 2 (one on an internal extension and one on a PSTN line)

Telephones shall be installed at suitable locations within each station including in each office (if provided) and at the main operator's desk. A fax machine shall be installed beside the main operator's desk.

The digital operator's console for the PABX shall be located on the main operator's desk.

A structured cabling system shall be provided for the telephone network throughout the station and telephones shall be connected via suitable plug-in wall sockets located in convenient positions.

Administrative software for the PABX shall be provided and installed on the NMS PC. The necessary connection cables shall be provided. The administrative software shall allow easy configuration (adds, moves and changes) by the operator and provide an ability to collect and display error messages, traffic statistics, billing information etc.

PABX Facilities
The PABX shall have the following facilities:

- Subscriber interface
  - 16 x Analogue ports, expandable to 32 ports
  - 1 x Digital port.
- Trunk interface
  - 1 x Trunk 4-wire + E&M port, expandable to 2 ports
  - 1 x Trunk FXS-FXS (hot-line)
  - 1 x Trunk 2Mbps port expandable to 2 ports
- 1 x RS232 local maintenance communication port
- Cable as required
- Power supply: 230V AC station UPS supply, 220V DC battery supply or 48V DC communications supply

Requirements for the PABX:
Hardware
The PABX shall be of the Stored Program Control type constructed on modular principles. It shall be designed for full availability and be of the non-blocking type. It shall be constructed from components that require no routine maintenance.

The specified line and trunk expansion shall be achieved by no more than plugging in additional cards.

Software
The operating software and PABX configuration shall be stored in non-volatile memory. When new system firmware is available it shall be possible to upgrade the unit locally with the support of the configuration system supplied.

The PABX configuration software shall be supplied and installed on the computer as specified above.

Numbering Principle
The numbering capability of the system shall be flexible with at least four digit numbers being used for internal extensions and four or five digit numbers for dialing other subscribers on the telephone network.

The numbering plan shall be agreed with the Employer before implementation.

Features
The PABX equipment shall provide the following:

- Automatic connection by dialing between all internal subscribers

- Time billing for trunk calls
- Direct dial in
- Local extension to/from remote extension dialing
- QSIG (PSS1) support
- Conference call (up to 8 parties).

The operator console shall be an LCD screen based system and shall provide the following functions:

- Call hold
- Call transfer (internal and external calls)
- Break-in (intrusion)
- Call release
- Hands-free operation
- Delayed ringing
- Ability to connect hotline with telephone extensions
- Display call status information on the LCD screen

For subscribers, the following functions shall be supported:

- Personal access code for dialing outside line (PSTN network), (or otherwise external trunk access shall be provided via the operator)
- Call park/hold (camp on)
- Call forward/divert
- Call waiting
- Recall
- Direction select (call pickup)
- Speed Dialing
- Last number redial
- Hotline

1.2.10.21 Very High Frequency (VHF) Communications Systems

A VHF communication system is required for voice communications in the SVC control building. The system allocated frequencies are 163.425MHz and 163.325MHz.

The scope of supply shall include, but not be limited to, the following:

- VHF transceiver with code calling facility
- Power supply unit for base sets
- Antenna tower, Minimum 18m, including guys, line traps, coupling devices, foundations, etc.

The transceivers shall conform to the following specifications:

- RF output power: 30 Watts nominal
- Nº of switchable channels: 6 Frequencies matching with the existing system
- Channel separation: 25kHz
- Frequency control: Synthesized
- Display: Digital LED/LCD
- Audio output: 2 Watts with less than 10% distortion

- Controls: Power, volume, channel selection, code calling, operator selectable channel scan function, etc.

The Contractor shall ascertain the height of the VHF antenna tower at all substations and switching stations after carrying out a VHF survey. The minimum height of the antenna tower, however, shall be 18m as specified above. The RF output power shall be ascertained by the Contractor after carrying out survey and design according to ITU standards.

The VHF mast shall be of galvanized steel. Aviation obstruction lights to be provided on VHF mast shall conform to the requirements of the Employer. The design wind velocity is 185km/hr.

The base antenna shall be an omni-directional ground-plane antenna. Maximum power input shall be 100 Watts with VSWR on tuned frequencies of 1.2.

The base antenna coaxial cable shall be of copper conductor polyethylene foam insulated type. The attenuation shall not exceed 1.5dB per 100 meters at 40MHz. The characteristic impedance shall be 50 ohms.

1.2.10.22 Computerized Substation Control System

General

This section applies to the SCADA RTU and related systems that monitor control the 220 and 20 kV equipment and monitor electrical system parameters. Existing or new RTUs being installed on other contracts may be used to provide these functions so long as the functionality described is provided. It is anticipated that a new RTU will be required in each SVC control room.

This covers the interface, manufacture, supply, installation, testing, commissioning and handing over of a microcomputer-based substation Remote Terminal Unit suitable for operation and data recording of the SVC and related RPC systems included in this contract. All materials and parts that are not specifically mentioned hereinafter but are necessary for erection, assembly and operation of the equipment shall be furnished and are deemed to be included in the scope for this sub-section.

The Computerized Substation Control System (CSCS) is a microcomputer-based control and monitoring system and include protection functions.

Design and Operation

The arrangement shall follow the latest engineering practice, ensuring optimum continuity and reliability of supply and ensure the safety of equipment and the operating staff. The highest degree of uniformity and interchangeability shall be provided.

All components shall be suitable for the local climate; storage of equipment shall be possible in closed rooms without air conditioning at a maximum ambient temperature of 55°C. The system offered shall be suitable for operation under electrical conditions (including electrical discharge and disturbance levels) existing in high voltage substations.

The equipment shall be pre-assembled and pre-programmed at the Contractor's works. It is understood that all auxiliary facilities/devices and services necessary are to be provided, i.e. for generation of database of displays programming and testing, adjustments, parameter setting etc.

The design of the system shall be such that personnel without any computer background shall be able to operate the system with ease and shall incorporate user-friendly features without causing undue operational delay.

The design of the hardware and software shall be suitable for 220/20kV voltage levels used by the Employer to enable a standardized layout.

The RTU shall be designed for easy modification of hardware and software and for easy extension of the substation to the local control center. Maintenance, modifications or extension of components shall not require a shutdown of the CSCS. Self-monitoring of single components, modules and data transfer channels shall increase the availability and reliability of the equipment and minimize maintenance requirements. Failure of individual components shall not force a total system failure.

It shall not be possible to control the 220KVbays at the same time from the station and individual bay level.

The bay units shall be independent of each other and the operation shall not be affected by any fault occurring at the station level or in other bay units of the substation.

Each substation control system shall consist of the following main parts:

- Man Machine Communications (MMC)
- Serial high speed bus for data transmission between the different components via fiber optic links
- Bay Units (BU) for local control and protection
- 10Mbps Ethernet interface for remote communication over the SDH network

The MMC system shall only contain information that is related to presentation and control of the SVC facilities.

Control Supervision Functions
All control and monitoring functions have to provide for a secure and reliable operation of the SVC facilities, the following are the minimum functional requirements:

- Input of binary and analogue values
- Control, interlocking, protection and supervision of the bays of the substation
- Alarm handling in the bay computers and in the station computer
- Analogue value processing
- Indication of the bay and substation status
- Indication of measured and processed analogue values
- Station control via a monitor system
- Automatic chronological control of standard switching routines
- All hardware, software and telecommunication facilities for future remote control and supervision of the substation from a future Network Control Center.
- Emergency control of each bay from the related control panels
- Synchro-check functions for all breakers
- Display of trend values
- Fault indication
- Event recording
- Evaluation and archiving of historical data

A DC/AC converter suitable for connection to the station battery shall supply the AC power for the MMC computer, monitor and printers.

Bay Computers

The bay computers shall be based on a microprocessor technology and a real time operating system.

The bay computers shall perform all bay internal programs, command sequences, collection of signals and information, outputs of commands and signal processing including the processing of the signals from the protection system required for the different switchgear units of the corresponding bays.

Generally the following tasks shall be performed:

- Signal acquisition including signals from protection systems
- Acquisition of measured and counted values
- Monitoring of execution of commands
- Data pre-processing
- Data communication to the station computer and connected subsystems
- Calculation of derived operational measured values
- Generation of group signals
- Self-monitoring routines

Power supply to the computers shall come from the station battery. The bay computers are placed together with all necessary input/output equipment in panels in the relay room of the substation control building.

Emergency control is defined as control without electronic assistance. In this status other control of this bay is without interlocking. The emergency control requires a special key. Normal control of the bay from the station computer shall be disabled, if the emergency select key is in the emergency operation position.

The electronic system shall be provided with functions for self-supervision and test. Each circuit board shall contain circuits for automatic testing of its own function. These circuits shall interact with a test and diagnostic program controlled by the central unit.

Faults in a unit have to be indicated by the illumination of a red LED on the front edge of the unit. The time for fault tracing and replacement of a faulty unit shall be reduced to a minimum. The supervision shall also comprise the power supply system, the internal system bus and the ability of the central unit to communicate with different circuit boards.

The power supply system shall have test terminals for all voltages used in the system.

The function and design of the switchgear interlocking systems shall be extremely reliable and safe. Perfect collection and processing of all switchgear position of the whole substation must be ensured at all times and unclear information, such as intermediate switchgear positions, switchgear faults, faulty data transfer etc., must never allow switching operations. Control regulation and synchronizing functions shall require perfect collection and processing of all substation information. The information must be up to date and valid. Mal-operation of control and regulation facilities such as on-load switching of an isolator, switching on in an asynchronous state etc. shall be avoided. When the station level control and indication facilities fail, back up control shall be possible.

Station Diagrams and Station Control

The operational status of the substation, measured values of currents, voltages, active and reactive power flows are to be presented on the displays. The station displays shall present diagrams for each substation voltage level.

One display shall be able to show a single line with all the relevant data. The displays shall not take longer than 2 seconds to be updated, after selection by the operator. Layouts of the displays are subject to the approval by the Employer; the Employer's Personnel shall also be trained so that they can reconfigure the single line diagram.

To ensure a high degree of security against unwanted operations, a special operation procedure requiring "select before execution" shall be provided. After "selection" the operator shall be able to recognize the selected device on the screen and all other switching devices shall be blocked.

The computer shall check the interlocking conditions. The operator can only execute the command if the device is not blocked and interlocking conditions are not violated. After command execution the operator shall receive a message, either about the new switching position or that the switching operation has been unsuccessful or has been refused.

An integrated voltage-check and synchro-check function shall also be provided (separate from that used for auto-reclosing) for manual closing of the circuit breakers. The voltage-check function shall include live-bus/dead-line conditions, dead-bus/live line conditions and dead-bus/dead-line conditions.

It shall be possible to set or sect any combinations of these conditions that will allow closing. For live-bus/live-line conditions the synchro-check function shall take precedence.

The synchro check function shall allow circuit breaker closing only if the voltages on both sides of the breaker fulfill the pre-set conditions as to magnitude, phase and frequency difference. The voltages shall be considered in synchronism when their phase angles are measured to with the angle adjustable from 20 to 60 degrees. During synchronizing a closing order shall only be accepted, if the synchronizing conditions are fulfilled.

Alarm List

Faults and errors which may occur in the substation have to be tabulated in the substation alarm list and have to be processed in order to allow them to be transmitted in future to the Network Control Center. The alarm list shall replace a conventional alarm table. The alarm list shall constitute an actual evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults.

Date and time of occurrence shall be indicated. The time shall be displayed beside each alarm.

The operator shall be able to select pictures which contain only a section or subsection of the substation overall alarm list. The operator shall be able to acknowledge alarms at the keyboard. Acknowledged alarms shall be marked in the list.

Faults that appear and disappear without being acknowledged shall be specially marked in the alarm list. The alarm list shall be presented on the display screen. It shall be possible obtain hardcopy on the printer.

CSCS Internal Alarm List

The CSCS shall constitute an actual evaluation of internal CSCS alarms, e.g. of defective CSCS input/outputs or defective CSCS communication nodes. It shall contain unacknowledged alarms and persisting faults.

System Status List
The system status list shall show the CSCS configuration and the status of all devices in CSCS system.

Event List
The substation event list shall contain events that are important for the control of the substation, e.g. "Circuit Breaker Closed". The time has to be displayed before each event. The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it. A printout of each display shall be possible on the hardcopy printer.

The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. The latest 600 events shall be stored in the computer. Previous information shall be obtainable from the printed event log. The chronological event list shall contain:

- Control operations initiated by the operator
- Indication of change of position of circuit breakers, disconnectors and earthing devices
- Indication of protective relay operations
- Fault signals from the switchgear
- Changes in the upper/lower limits of analogue measured values

Event and Alarm Log
The event and alarm log shall consist of the spontaneous listing of events and alarms on the event printer. This log shall contain the same events as mentioned above, but chronologically printed as soon as they occur. Additionally, the event log shall contain all alarms, with the time of each occurrence. Each alarm shall be configurable, so that a second alarm message can be printed if the alarm disappears. Events which occur when the printer is off-line (e.g. because of being out of paper) shall be queued in the computer until the printer is again available.

Quantity of Input and Outputs
The signals to be primarily handled are at the 220kV and 20kV level, as indicated by the station single line diagram.

The following signals shall be considered as a minimum:

- Binary inputs (single indications):
  - 8 per circuit breaker
  - 5 per disconnector
  - 4 per earthing switch
  - 16 per line feeder from protection
  - 6 from busbar protection; (220kV only)
  - 50 general auxiliaries for the whole substation
- Binary outputs (single commands):
  - 2 per circuit breaker
  - 2 per disconnector
  - 2 per earthing switch
- Analogue inputs (8 bit measurement):
  - 3 voltages per respective busbar sections
  - 3 voltages per line feeder
  - 3 voltages per transformer feeder
  - 3 currents per line feeder or bus-coupler
  - 1 active power per line feeder

- 1 active energy counter per line feeder
- 1 reactive power per line feeder
- 1 reactive energy counter per line feeder
- 3 currents per transformer winding
- 1 active power per transformer
- 1 active energy counter per transformer
- 1 reactive power per transformer
- 1 reactive energy counter per transformer

The measurement transducers shall be integrated in the CSCS at the bay level. In place of transducers, analogue values may be obtained via serial data link from protection relays, intelligent power monitors or other Intelligent Electronic Devices (IEDs).

Power Transformer
All the status indications, binary outputs and analogues supplied with the power transformer and on-load tap changer shall be made available to the CSCS and allowed for when sizing the CSCS, including:

- Temperature alarms and trip signals
- Oil temperature alarms and trip signals
- Buchholtz trip
- Group alarms from MCB in the local control cubicle
- Status of the cooling fan groups etc.
- Tap position of the tap changer
- Commands for raising and lowering the tap position etc.
- Local/remote

The measurement transducers shall be integrated in the RTU at the bay level, e.g. in the relay panel associated with the bay. The CSCS shall be capable of continuously trending a minimum of 20 data items selectable by the operator.

Servicing, Testing and Programming Equipment
Three portable servicing, testing and programming units shall be supplied. They shall be based on a standard laptop computer and portable printer. The portable servicing units shall be used for application programming, documentation, testing and commissioning. The portable servicing units shall be supplied with a CD ROM burner, 1000 CD ROM blank discs, and three 56 KBPS Modems. Any specialist software required shall be supplied free of charge, the specialist software shall include any future upgrades, user fees, support fees and license fees.

The laptop-based portable servicing units shall be used for the following purpose:

- Program entry
- Program testing
- Fault tracing
- Program amendment
- Graphical program documentation
- Uploading and downloading of programs including CMOS etc.
- Commissioning
- Reading of values in the data base
- Changing peripheral parameters
- Programming/reprogramming of RTUs if software configurable

The portable servicing units shall permit the user to study changes in the substation. The units shall be able to monitor data in the CSCS while the system is in use and to present changing variables on the display screen, selectable in a tabular or graphical format. The portable servicing units shall be supplied at the beginning of the commissioning period and be available for training of the Employer's personnel.

The programming entry procedure shall be based on a graphical user interface that provides the operator with visual control of the work.

The portable servicing units shall deliver alphanumeric and full graphical documentation of the work such as printouts of the application program in graphical form.

The engineering ports of all IEDs (protection relays, fault recorders, voltage regulators, RTUs, CSCS etc.) shall be connected via a serial network so they can be remotely interrogated from the Network Control Center when it is commissioned. A suitable interface with the SDH communications equipment shall be provided for this purpose. For example, one or more Terminal Servers may be provided on the Ethernet LAN.

Software Capabilities

The software shall consist of basic software modules and standardized supplementary function modules, the parameters of which can be changed depending on the layout and operational concept of the substation, as the operation and configuration of the substation may change over time. The software shall be either UNIX or LINUX based; or alternatively, MS windows operating system, with Windows 7 Professional 64 bit or latest Windows Server.

Security of control selections is of paramount importance and every precaution shall be taken in the software and hardware design to ensure that spurious control operations are rejected by the system and cannot occur. Failure of communication (partial, total, intermittent or permanent) shall not lead to erroneous control actions. Noise, either spuriously occurring or injected manually into any communication link, shall not lead to a false control action.

The system software shall be standard software that has been in use by other customers.

The system shall restart automatically after failure or loss of supply voltage, and no real time data collected up to the time of power failure shall be lost. After restart, the system shall automatically boot up into operational mode. It shall be possible to test the CSCS while the substation is live and being controlled by the CSCS. The testing shall not present any hazards to the safe operation of the substation. Test facilities shall include functional and data tests.

The following software programming shall be deemed to be included in the scope of supply of the equipment and services as a minimum:

- Design of the data base including entering all substation data
- Design of one overall display representing the substation
- Design of the displays for each voltage level
- Design of a detailed display for each individual bay
- Design of a display for station auxiliaries.

Station Interlocking and Control Sequence

The control program shall make it easy to reconfigure the system by adding new feeders (lines, transformers etc.) and future modification and extension of the station shall be possible without interference with the operation of other parts of the installation (e.g. moving of existing feeders including all parameters and settings to enable installation of new feeders).

The interlocking concept shall be as follows:

- The disconnector shall be operable only when the relevant circuit breaker is in the off position and the relevant grounding switch has been removed. Busbar change over shall be possible with the busbar isolators and bus coupler in the closed position without power supply interruptions
- The earthing switch is operable only when the disconnectors have been opened and the circuit is dead (i.e. no voltage)
- Closing of circuit breakers shall only be possible when the relevant grounding switches have been removed and the protective relays and corresponding lock-out relays are not actuated or if they are actuated, the faults have been cleared and the respective lockout relays have been reset
- When a pressure drop signal is received from gas monitoring devices for SF6 circuit breakers, the tripping and closing signal shall be locked out
- The interlocking system is to be designed in such a way that testing is possible during normal operation of the CSCS

Station Metering
The CSCS shall be connected to the digital outputs of the station metering equipment. The station computer software shall include the same software used in the laptop PC supplied for metering analysis. In future the automatic transmission of metering data to the Network Control Center as well as remote setting of meter parameters shall be possible.

Program for the Delivery of Hardware and Software
Before starting the manufacture of the CSCS equipment complying with this specification, the following shall be supplied as early as possible to the Employer:

- A functional design specification (FDS) which describes in detail the equipment and the functions of the system to be installed
- A program for FAT (Factory Acceptance Testing)

Both these documents shall be supplied for approval by the Engineer. Their purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes testing to the degree required before the equipment leaves the factory.

In addition to the above, further documents shall be submitted to the Engineer for approval (e.g. the layout of all the station displays, the data base list and the documentation of the software) in the form of graphical diagrams. No factory acceptance tests shall be allowed without the approval of the FDS and the FAT.

Documentation
The hardware and software documentation shall comprise of but not be limited to hard copies and soft copies of the following:

- Front view and side view of all different cubicles (front and side elevations)
- Circuit diagrams for cubicles
- Apparatus lists for cubicles
- Connection tables for cubicles
- Data base listings
- Manuals for the MMC

- Manuals for the station and bay computers
- Programming manuals

All system hardware and software documentation and all the application hardware and software documentation shall be supplied in the English language.

Time Synchronization
Accurate time synchronization shall be provided for all IED internal clocks including the CSCS, the HMI workstation, the Bay level controllers, fault recorder, protection relays and any metering clocks.

The real-time clock or clocks within each device shall be synchronized to within 1mSec of Afghani time (UTC + 04:30:00.000) by a GPS clock provided at each substation and switching station. The GPS clock shall be connected to a suitable GPS antenna installed on the roof of the control building or at another suitable location providing adequate visibility to GPS satellites.

The GPS clocks shall also provide both unmodulated and amplitude modulated IRIG-B signal outputs which can be used for time synchronization. If necessary, a Network Time Protocol server (NTP server) is to be provided to synchronize devices on the substation LAN.

Proof of Quality
Only experienced and technically capable manufacturers of Control and Protection Systems will be accepted. In order to establish their capabilities, the Bidder is required to present the following documents with their bid:

- Block and functional diagrams showing the proposed control scheme
- Technical specifications and descriptions of systems, catalogues of equipment and devices to be used
- Brochures and references of the manufacturer supplying the CSCS
- A list of references of similar CSCS systems installed in the last 5 years

1.2.10.23 Remote Control

Philosophy
New substations and power stations shall be supplied with a built in SCADA interface, Synchronous Digital Hierarchy (SDH) communications equipment, and telephone equipment. The SDH equipment shall be connected to outgoing fiber optic cable and commissioned to communicate with other substations being supplied under the same contract. The stations shall be configured so they integrate with the overall NLCC SCADA and communications systems.

Interface to the Network Control Center
An interface shall be provided to connect to the Network Control Center (National Load Control Center). This shall be achieved by either providing a physical RTU or by providing a virtual RTU within the Computerized Substation Control System (CSCS). Connection to the Network Control Center will be by 10 Mbps Ethernet over the SDH communications system or via serial data communication over Power Line Carrier if provided.

It shall be possible to fully remotely control and monitor each substation from the future Network Control Center. All control and supervision signals available to the local CSCS HMI workstation shall potentially be available to the remote control center interface, and selection of the required signals shall be by no more than configuration of a mapping table or equivalent within the CSCS.

The CSCS shall support both, and be equipped with at least one of the following data communications protocols for the remote interface:

- IEC 60870-5-101/104
- DNP 3.0 (Level 3 implementation)

Note that the NLCC will be responsible for the 220kV and 110kV HV system, going down to the 20kV MV circuit breaker/disconnector of the HV/MV transformer.

Minimum SCADA Interface Signals

The following remote interface signals shall be provided as a minimum:

- Digital inputs:
  - 8 per circuit breaker (status - 2 bits, remote control available, alarms) – HV CBs and MV incomer CB only
  - 3 per disconnector (status - 2 bits, remote control available) – HV DISs and MV incomer DIS only
  - 2 per earth switch (status - 2 bits)
  - 16 per line feeder from line protection
  - 5 per transformer from transformer protection
  - 6 from busbar protection (220kV only)
  - 20 communication system status and alarms
  - 50 general auxiliaries for the whole substation (typically auxiliary AC and DC system status and alarms, fire alarm, intruder alarm etc.)
- Digital outputs (commands):
  - Open/close per circuit breaker – HV CBs and MV incomer CB
  - Open/close per disconnector – HV CBs and MV incomer CB
- Analogue inputs:
  - 3 voltages per respective busbar sections
  - 3 voltages per line feeder
  - 3 voltages per transformer feeder
  - 3 currents per line feeder or bus-coupler
  - 1 frequency per busbar section
  - 1 active power per line feeder
  - 1 active energy counter per line feeder
  - 1 reactive power per line feeder
  - 1 reactive energy counter per line feeder
  - 3 currents per transformer winding
  - 1 active power per transformer
  - 1 active energy counter per transformer
  - 1 reactive power per transformer
  - 1 reactive energy counter per transformer.

All the status indications, binary outputs and analogues supplied with the power transformer and on-load tap changer shall be made available to SCADA including:

- Winding temperature and temperature alarms and trip signals
- Oil temperature and temperature alarms and trip signals
- Buchholtz trip
- Group alarms from MCB in the local control cubicle
- Status of the cooling fan groups etc.
- Tap position of the tap changer
- Commands for raising and lowering the tap position etc.
- Local/remote status
- Master/Follower status

1.2.11 Civil Works

1.2.11.1 Execution of Works

The civil works shall include all necessary supply of equipment and materials, design, construction, excavating, refilling, etc. to complete a functioning substation. The civil works shall include the following main parts:

- Forming of the site to ensure correct surface drainage
- Leveling and compacting of substation area
- Excavation and backfilling as required
- Gravelling of the complete substation area
- Install drainage system for the complete substation area
- Construct new internal roads
- Install control building, battery room
- Install air conditioning and heating equipment for the control building
- Construct fences and gates
- Construct new oil interceptor tanks for all RPC equipment
- Construct concrete foundation for all apparatus
- Construct steel structures and apparatus supports as required
- Construct concrete fire protection walls each side of oil filled reactors and transformers

Leveling of Site
A removal of top soil shall be carried out down to a minimum depth of 0.5m.

The Contractor shall level the area by excavating the high areas and filling with materials obtained by selective stockpiling of excavated soils. Stockpile only materials acceptable to Employer. Such materials shall be free of all vegetation, roots, and organic matter, root mat, muck, rocks larger than 4 inches in diameter and debris.

After placing appropriate fill, compact the low areas. Any soft soil or other material unsatisfactory for the leveling work shall be excavated and removed from the Site.

After the bulk excavation, filling, and compacting works have been carried out, the Contractor shall remove any remaining high spots and fill in any depressions so that before the commencement of any construction work, the whole of the area has been leveled to the requisite ground level to the satisfaction of the Employer.

All necessary retaining walls shall be included in the contract.

Setting Out
Before any excavation of filling work begins, the Contractor shall set out accurately all excavation and filling lines according to the drawings and shall satisfy himself as to the correctness of all site levels shown on the drawings. During the work, the Contractor shall ensure that the excavation and filling follow the said lines and the Contractor shall set out as necessarily as the works precede profiles and other markers for leveling purposes and he shall be in agreement with the Employer about the levels of the said profiles and markers.

Locate existing underground utilities in the area of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult with the utility owner immediately for directions. Cooperate with owner in keeping respective services and facilities in operation.

Repair damaged utilities to satisfaction of utility owner. Do not interrupt existing utilities serving facilities occupied and used by Employer or others, except when permitted in writing by the Employer, and then only after acceptable temporary utility services have been provided.

Excavation

The Contractor shall excavate the ground to the lengths and widths and exact depths as indicated on the drawings required for the construction of the works. In cases where the bearing capacity of the subsoil under foundations or roads is insufficient, the excavation shall be continued to such greater depth as may be necessary. Based on the existing ground water level, the foundations shall not be deeper than necessary. All excavation may be carried out mechanically, but the final shaping and trimming of the sub-grade below foundations, etc. shall be done by hand. The Contractor shall handle and remove as necessary all water from a whatsoever source which may come into the excavations and he shall provide, maintain, and remove on completion all planking, strutting, shoring or piling required to support the sides of the excavation.

The Contractor shall report all cases of unsuitable or weak ground to the Employer and shall follow the instructions given by the Project Manger during the excavation works. If due to negligence or mistakes on the part of the Contractor any excavations be taken to a level lower than that shown on the drawings or stated in the specification or required for the works, the Contractor shall at his own cost fill in the voids so formed to the proper level with approved fill material well compacted or, if necessary, under foundations and the like with approved blinding concrete.

Filling and Compacting

Filling of areas and around foundations and backfilling of trenches shall be executed in such a way and to such extra depths as will ensure that final surface after settlement and compacting conforms to the specified levels. All filling material shall be free from cinders, ashes, refuse vegetation or organic material, boulders and other unsuitable material.

All fill material shall be well compacted by mechanical means until a high degree of compacting is obtained. The filling material shall be placed in even layers of a depth not greater than 0.4 m and each layer shall be thoroughly compacted. A suitable power-driven roller of at least 5 tons weight, making at least 10 passes for each layer shall be used. For backfilling of narrow and steep sections, the thickness of each layer shall be maximum 150 mm, each layer being compacted to required density by using a vibrating plate compactor. Filling and compacting around any pipes, cables or ducts shall be done by hand using selected materials for a depth of at least 0.5 m above such pipes, cables or ducts.

The Employer's instructions regarding the addition of water to improve compacting of fill must be adhered to. For fill under roads and foundations every effort shall be made to compact the fill material at its optimum moisture content for compacting. In any case, the dry density of the compacted soil shall not be less than 95% of the maximum density according to ASSHTO T180.

The complete substation area shall be surfaced with a 100 mm layer of crushed aggregate, size 32mm-64mm.

Leveling

Depending on the ground socket level, leveling to the surroundings might be needed. The slope of such shall be between 1:100 and 1:50.

Disposal of Surplus

The Contractor shall remove from the Site all surplus soil or other excavated material not required or not suitable as fill material. Such material shall be transported to spoil dumps located as agreed upon with the Employer.

1.2.11.2 Drainage

The Contractor shall install an adequate drainage system for the new substation area. Building down pipes shall be connected to the drainage system. Open ditches are not allowed within the substation area.

The drainage system shall be designed for the relevant local climatic conditions.

1.2.11.3 Roads

The Contractor shall arrange for roads in the new switchyard for transport of the transformer to the transformer cell and for passage of a car to the control building. The roads shall be about 6 m wide and shall be surfaced with asphalt or concrete.

Irrespective of the type of bituminous surfacing proposed, a prime coat of at least 0.8 liter/m^2 shall be uniformly sprayed to penetrate and seal the surface of the base course.

Concerning the wearing course, the Contractor may propose a double seal coat or premixed asphaltic concrete. The proposal shall account for rates and types of bitumen and aggregates, plant and method of application.

The allowable tolerances are as specified in Table 1.2.6.

Table 1.2.6 Substation Road Tolerances

Description	Specification
Thickness	+6mm - 0mm
Level	±20mm
Maximum deviation	-6mm from a 4m straight edge

1.2.11.4 Foundations

The foundation for the transformers shall be constructed in reinforced concrete, with space for the whole oil volume of the transformer under the crushed aggregate and steel grating.
Transformers shall be separated by a fireproof wall.

Foundations shall normally be placed on virgin soil or well-compacted fill.

If excavation has been performed to greater depth than required, sand or gravel shall be placed at bottom of the pit to bring the excavation to the required elevation. Such material shall be placed and compacted in layers not exceeding 100mm. Excavation pits shall be kept dry during construction and erection of foundations. Backfilling of the pits shall not be carried out until the Employer has inspected and approved the foundation.

Excavated soil may be used as backfill if it is suitable for compacting. Rock and soil that is not suitable for compacting shall be removed and replaced with a suitable backfill to the satisfaction of the Employer. Backfill shall be placed in layers approximately 150mm thick. Each layer shall be carefully compacted by means of a suitable plant.

1.2.11.5 Buildings

General

The rooms shall have painted concrete floor with a sufficient extent of cable channels for installation of control and auxiliary power cables.

All cable penetrations in floor and walls shall be sealed with fire resistance material. All cable penetrations in outer walls shall be protected against the ingress of water.

Design

The substation building shall be constructed of reinforced concrete for beams and pillars with brick walls. The construction shall have good thermal isolation to minimize the need of air cooling. Internal walls shall have a fire resistance for 60 minutes.

The penetration seals between these rooms shall also meet this requirement. All air inlets and outlets shall be provided with applicable filters to avoid pollution of the rooms. The outer doors and windows shall be sealed. The design shall provide enough space for erection, operation, service and maintenance of the substation as well as for the future expansion of the control equipment with 100%.

The floors shall be steel toweled and painted in an approved manner with resistant epoxy paint. The internal wall and roof surfaces shall be painted in an approved manner with suitable plastic paint. The external walls shall be painted in an approved manner with suitable plastic paint. Walls below ground surfaces shall be painted with bituminous coat. The quality and colors as well as the application of the paints shall be approved by the Employer. The Contractor shall submit detailed information, samples and the manufacturer's recommendations for the paints for approval. The painting shall be carried out in an efficient and professional manner to the satisfaction of the Project Manager.

Down pipes shall be provided to lead the rain water from the roof to drainage which shall be adequate to prevent water from entering the building and from the formation of pools on the ground near the building.

Lockable doors, complete with frames, shall be provided. They shall have the same fire resistance as the walls. The doors shall be dimensioned for transport of goods even after the completion of works.

Installations

In order to maintain a temperature in the building below +25°C, air conditioning of wall unit type shall be installed in the control room. The air-conditioning units shall be divided into several units to provide redundancy.

The floor in the battery room shall be provided with a gully made of stainless steel, connected to the sewage pipe.

The floor surface shall have adequate sloping towards the gully and to be covered by tiles. The battery room shall be provided with one exhaust fan with jalousie (louvers) and air inlet with grill and filter.

1.2.11.6 Fire Protection Walls

Fire protection walls are protection against heat radiation, which means they prevent the NARPad of fire and damage of facilities and equipment in the neighborhood. The fire protection walls shall be designed according DIN VDE 0101 or equivalent.

1.2.11.7 Fences and Gates

Fences

The Contractor shall design, furnish and install a masonry fence and gates around the whole substation area. Masonry fences will not be required for areas already contained within masonry perimeter fencing.

Masonry walls, 600mm thick, shall be constructed around the perimeter of the site.

Any roads inside the compound shall be at a standoff distance of no less than 3.0m from the inside face of the perimeter wall.

The walls shall be reinforced with rebar.

The walls shall be concrete reinforced with native stone masonry veneer.

The height of the walls shall measure at least 2.2m from the inside grade. Inside grade shall in all cases be higher than outside grade.

The wall shall be capped with a cast-in-place concrete capping.

Outriggers shall be installed to support barbed wires and 2 strands of concertina style razor wire.

The ground grade shall slope away from the wall for at least 5m and shall be kept a minimum of 2.2m below the top of wall for a minimum distance of 10m.

The wall shall be designed to prevent visual access to the inside of compound by all pedestrian and vehicular traffic outside the compound which may require the wall to be built at a higher level in some locations.

Any penetrations through the Perimeter Security Wall shall only be for site drainage purposes and shall have force protection such as a welded bar grill, welded grating, or other pre-engineered barrier.

Details of any penetrations shall be produced by the Contractor and provided in the design drawings.

Optional Chain Link Fencing

At the option of the Employer, chain link fencing and gates may be substituted for masonry walls and steel sliding gates. Chain link fencing shall be used as necessary to separate areas within the Perimeter Security Wall. Chain link shall be design as follows:

The Contractor shall design, furnish and install a chain link fence and gates around the whole substation area including three numbers of 4-point galvanized barbed wire at the top. A bottom tension wire shall be provided. All parts of the fence shall be corrosion resistant, galvanized or aluminum.

The chain link shall have a mesh width of maximum $50mm^2$ and each wire shall have a minimum failure load of 2,000 N. Straight line posts shall have a minimum bending failure load, applied horizontally on the top, in the most unfavorable direction, of 600N. Top and bottom tension wires shall have a minimum failure load of 5,000N. In case of 2.5m or higher chain link, the top wire shall be substituted by a top rail. Barbed wires shall have a minimum failure load of 3,000N.

There shall be one main gate with one smaller gate for personnel passage. The main gate shall allow for passage of a truck, both gates shall have provision for securing by padlock. Fence posts and gates shall be set in concrete foundations of adequate strength.

Straight line posts shall have a spacing not exceeding 3m. Guyed tension posts shall be inserted each 50m along straight lines. End and corner posts shall be adequately braced. Straight line posts shall have 800mm – 1,000mm deep foundations, either a 6 inch concrete tube filled with concrete, or a directly cast foundation, at least 200mm wide.

Foundations for corner or end posts shall extend minimum 1,000mm below surface and consist of either a filled 9 inch concrete pipe, or be a directly cast foundation, at least 300mm wide. The main gate shall be designed with a reinforced concrete foundation connecting both posts.

To prevent small animals from entering the substation, the space between the bottom of the chain link and the ground surface shall be filled in by a concrete curb, either consisting of prefabricated slabs or cast at site.

To prevent dangerous touch voltages, a 35mm^2 copper wire shall be buried 1 m outside the fence and 0.5 m deep. Connections between the fence and the encircling earth wire shall be made each 15m. All corner and gateposts shall be separately connected. The encircling earth wire shall be connected to the station grounding grid.

In case of an insulated (plastic coated) fence, the encircling earth wire may be omitted. Only gateposts will be connected to the station grounding grid. The top and bottom wires (or top rails) will be divided in 50m sections fully insulated from each other.

Special SVC TCR reactor area fencing shall be designed so as to have separation and grounding compatible with this high magnetic field area. The SVC TCR area fencing shall be designed to eliminate ground loops and fence fabric heating shall be prevented with proper design procedures.

1.2.11.8 220kV Switchyards

The Contractor shall design and mount steel gantries with supported rigid tubular busbars of a suitable design for the 220kV switchyards. The 220kV rigid tubular busbars shall be supplied with steel supports, conductor, insulators and accessories

The gantries and busbars shall be designed to ensure adequate clearance to other equipment, transmission lines, distribution lines, vehicles and personnel inside and outside the substation area.

1.2.11.9 Lightning Protection

The RPC equipment and bus shall be protected against lightning by providing earth wires or lightning rods on the strain portals for the busbars and the overhead lines. The protected zone shall include all switchgear and transformers.

The earthing facilities necessary for lightning protection shall conform to DIN VDE 0141 or equivalent, with particular attention paid to the requirements for lightning protection in outdoor switching stations (e.g. back flashover). Lightning conductor wires and lightning rods shall be corrosion resistant.

1.2.11.10 Control Building

The control building shall include one room for the relay panel and the AC/DC equipment, a battery room, a storeroom and workshop, and an office. There shall be spare space to extend the

control relay panels by up to 50%. The entrance into the store and the battery room could also be from outside. The SVC control building may be integrated into the SVC equipment building.

A desk, a chair and a bookshelf shall be placed in the control room as well as in the office room.

1.2.11.11 SVC Building

The Contractor shall provide all labor, material and equipment necessary to complete the building required to house the SVC equipment and controls. The SVC building shall provide adequate space for all Contractor supplied equipment requiring indoor installation.

The control room shall house all control and protection facilities except local controls integral with the equipment or separately mounted near the corresponding equipment. The layout of equipment in the control room shall allow a minimum clearance of 1000 mm to adjacent walls and 1200 mm between rows of equipment.

Viewing windows of approximately 10,000 cm2 in size shall be provided for all areas of the facility where access is not allowed while the SVC is in operation. Such viewing windows shall be located on inside walls, preferably between the control room and such equipment. The glass used within the viewing windows shall be a laminated safety glass. Viewing windows shall include a port with the ability to be opened for thermal imaging inspection or the glass shall allow thermal imaging inspection.

Areas where battery banks are located shall be designed in accordance with applicable IEC standards.

Design Requirements

Building construction and materials shall be consistent with those specified in Sections 1.2.11.5 and 1.2.11.10. A steel skinned modular structure may be substituted subject to approval of the Employer.

The building and foundation shall be designed in accordance with all applicable provisions of local building codes, as modified herein. The building and foundation shall be in accordance with the Contractor's geotechnical investigations. The building shall be designed so that ice and snow sliding off the roof will not damage any equipment or bus and will not unload onto the main entrance area.

In addition to environmental loads, the roof shall support a collateral dead load. The collateral dead load shall be determined by the Contractor considering items such as pipe supports, cable tray, etc. This load shall be included in all load cases.

Insulation shall be provided as appropriate for the structure type. Insulation shall be as required to provide minimum R-values for walls and roof as required by by the International Building Code or for efficient operation of the HVAC system.

Erection

A concrete entranceway or walkway shall be provided and shall have a broom finish with tooled edges. Concrete floor slabs shall be steel troweled to a hard surface and perfectly level (unless given a specified slope), without bumps, pits, or trowel marks. A suitable hardener shall be used.

The Contractor shall make an effective connection from the ground grid through the SVC building to all equipment, control panels, each instrument rack, several points on cable tray support steel, and each conduit that shall be used to pull conductors into the building. The Contractor shall be responsible for a complete and effective ground system.

All work shall be well braced, closely fitted, thoroughly connected, accurately set, and rigidly secured in place. The structure shall be constructed in conformance with the best workmanship practices and building codes, making it square, straight, level, and properly installed on the foundation.

Sealants shall be installed at all joints as required to achieve a wind and water tight condition. All sealant work shall be done in a neat manner. Excess sealant shall be removed from exposed surfaces.

1.2.11.12 Doors and Hardware

All doorways and openings shall be sized for convenient passage of personnel, equipment and materials. Transom panels are not acceptable. Exterior doors shall be 18 gauge steel, swinging out, flush designs filled with mineral fiber insulation. Where required, doors shall be one-hour fire rated. Hinges shall be bronze butt. Hinge pins shall be non-removable type when door is closed by means of a set screw in barrel.

Overhead or roll-up equipment doors shall be insulated, and shall be provided with an adequate bottom weather strip. Tracks for overhead doors shall be galvanized.

All hardware of each kind shall be a product of one manufacturer (i.e. all locks shall be product of one manufacturer, closers shall be product of on manufacturer, etc.) and shall be of a standard commercial quality suitable for its intended use. All locks shall be keyed alike and shall match the locks at the Chimtala Substation.

1.2.11.13 Painting and Finishes

All surfaces of the SVC building shall be painted except surfaces having a factory-applied coating or surfaces not designed to be painted. The Contractor shall submit a color scheme and list of materials for approval by the Employer. Protect nameplates, cover plates and other surfaces from paint and damage. Furnish drop cloths, shields, or protective equipment to prevent spraying or droppings from fouling surfaces not being painted.

Materials furnished for each coating system must be products from a single manufacturer and compatible with the substrate. When shop-painted surfaces are to be coated, determine whether finish material will be compatible with the shop coating.

Preparation of surfaces to be painted shall be in accordance with the manufacturer's instructions. If solvents are used, the surfaces shall be cleaned of all defective or damaged areas of existing paint and of all loose rust, mill scale, excess mortar, loose particles, and other foreign substances. Surfaces with gloss or semi-gloss paints shall be lightly sanded. Wood surfaces shall be sanded prior to painting. Nail holes, cracks and similar imperfections shall be filled.

1.2.11.14 Lighting and Fire Protection

Lighting and Electrical Systems

The Contractor shall design, furnish and install all material and equipment and perform all work necessary to complete, test, and make ready for operation the lighting and electrical systems for the SVC building. The design of the building lighting and electrical systems shall be in accordance with proven design methods, local codes and accepted industry standards.

The Contractor shall furnish and install all luminaries complete with all lamps, ballasts, fuses, wire, and cord, mounting hardware, and accessories necessary to complete the installation of the luminaries.

Minimum lighting levels for the control room shall be 970 lux. Minimum lighting levels for unfinished and equipment areas shall be 540 lux.

Emergency lighting units shall be self-contained units that operate automatically upon loss of station service power. Emergency lighting shall be installed at critical locations as required for safety of personnel and where required for restoration of the station lighting system.

Fire Protection and Alarm

The Contractor shall design and install a fire protection system that conforms to national and local codes. The fire protection system design and associated alarms shall take into account that the SVC will be unattended at most times. Selection and location of automatic detectors shall suit the application, and shall consider conditions such as high voltage fields, air velocity and environment to minimize nuisance alarms.

The system shall be electrically supervised against failure of the detection and alarm circuits. In case of failure of a detector or alarm circuit, a visual and audible alarm different from a fire detection alarm shall be initiated on the station fire alarm control panel. Detectors shall be capable of being tested, having maintenance performed on them or being replaced without impairing the operation of the SVC, except for detectors located in areas where personnel access is not allowed during SVC operation.

Operation of any manual alarm or automatic detector shall cause the initiation of the visual and audible alarm on the station fire alarm control panel, indicating the area of the location of the originating alarm. Alarms shall initiate automatic shutdown of the air-conditioning, ventilation and exhaust systems in the area of the fire. A manual override of this function shall be provided for exhaust systems that could be used for smoke removal. All alarms shall initiate audible signals and visible flashing indicators that shall continue until the system is reset. Operation of detectors in the valve hall shall trip the SVC.

The fire alarm control panel shall be located in the control room and shall include all devices necessary to permit the operation of the fire alarm system. All fire alarms shall be identifiable as to location. Standby power from an uninterruptible source shall be provided. The uninterruptible source shall be sufficient to provide electrical supervision and support of the normal system for a minimum of 24 hours.

The Contractor shall provide portable fire extinguishers in the control and equipment areas.

1.2.11.15 Heating, Ventilating and Air Conditioning

Air conditioning, heating, ventilation, and/or environmental controls systems shall be provided to ensure satisfactory operation of the station under the range of climatic conditions to which the station may be subject. A complete redundant package should be installed such that full SVC operation can be maintained with a single element failure of HVAC equipment.

The HVAC systems shall include energy conservation design features that can minimize station service energy, be economically justified, and suitable for the area served. In areas where environmental control is essential to ensure proper operation, back-up systems shall be installed. Heating and air conditioning temperatures shall be thermostatically controlled.

The design of the HVAC system shall be primarily based on the operation requirements of the SVC equipment installed. It shall be the sole responsibility of the Contractor to provide reliable systems that satisfy these requirements. Regardless of equipment requirements, supplemental heat will be required when the SVC is off line, workers are present, and outside temperatures are low. Air intakes shall incorporate snow and rain exclusion devices and filters for removal of airborne plant material, insects, and birds. If necessary, devices for controlling ambient noise shall be included.

As an alternative air conditioning of individual cabinets and/or equipment spaces may be proposed. The Contractor shall provide information regarding the alternative solution including vendor, detailed technical description of equipment and how it will be rated and applied, electrical power consumption, and a list of similar installations.

1.2.12 Testing

1.2.12.1 Workshop Testing

The type and routine tests described in the IEC recommendations shall be applied, but type tests may not be required if the Contractor can produce evidence of such tests having already been satisfactorily completed on similar equipment.

1.2.12.2 Tests on Completions

The procedures for the Tests on Completion shall be based on applicable standards and codes of practice and recommendations from manufacturers, and shall be specified by the Contractor in a separate document. The procedures are subject to the Employer's review. The extent of the Tests on Completion is tentatively summarized below.

A general check of the entire switchgear and ancillary equipment shall be made and shall include a check of the completeness, correctness and condition of earth connections, labeling, painted surfaces, cables, wiring, pipe work, valves, blanking plates and all other auxiliary and ancillary items.

Checks shall be made for oil and gas leaks and that insulators are clean and free from external damage. A check shall be made that loose items that are to be handed over to the Employer (e.g. blanking plates, tools, spares) are in order and are correctly stored or handed over. Shutters, earthing procedures and the interchangeability of components shall be checked. All interlocking arrangements both electrical and mechanical shall be fully checked and tested.

1.2.12.3 Power Transformers

After completed erection, the transformer shall be inspected and tested as follows:

- Visual inspection for oil leakage and correct erection
- Insulation test of high and low voltage windings, cables and accessories
- Functional check of all accessories, including transformers guards, level and temperature indicators, tap changer and heating elements
- Oil test
- Visual inspection of oil level, dehydrating breather, valves, control cabinet, electric clearances between live parts and earth, earthing connections

1.2.12.4 Switchgear and Controlgear

Circuit Breakers:

- Circuit breakers shall be visually inspected
- Contact resistance tests shall be carried out
- Operational tests will include local and remote trip/close
- For SF6 circuit breakers, testing is required on the gas system to prove the gas quantity, its dryness and its dielectric strength. The gas leakage shall also be measured

Disconnectors, Earthing Switches and Auto-Reclosers:

- Auto-reclosers, disconnectors and earthing switches shall be subject to operation tests to confirm contact pressures, contact resistance, simultaneous operation of all phases and the ease of operation
- Checks shall be made of the local and remote indications and operation of auxiliary contacts
- Checks shall be made of the interlock system, both electrical and mechanical, between the disconnectors and earthing switches

Voltage and Current Transformers:

- Insulation tests at 1,000 volts to earth and between windings
- All voltage transformers shall be checked for polarity phasing and for secondary output
- Burden, ratio and polarity check of all current transformers shall be carried out

Surge Arresters and Surge Counters:

- Surge arresters and surge counters shall be inspected including installation and earth connection tests

Conductors and Connections:

- Flexible connections shall be tested to ensure that the correct tensions, sags and clearances will be maintained over the range of environmental conditions and loads without stress to other equipment. If dynamometers are used to check the sags and tensions, they shall be checked both before and after use
- Conductivity tests are required without any exception on all connections and joints that are made on site
- The required torque shall be checked with a torque wrench for all bolts and nuts

Earthing System:

- Tests shall be made on the effectiveness of the bonding and earthing which will include conductivity tests on selected joints and at the connections to equipment and structures. Checks shall also be made and precautions taken to avoid corrosion on the earthing system
- The resistance of the earthing system to earth shall be tested and recorded including the method and equipment used to carry out the tests

Test of Wiring:

- Insulation resistance tests at 1,000V AC for one minute shall if possible be carried out on all AC and DC protection, control, alarm, and indication circuits to ensure that wiring is in satisfactory condition. Visual inspection shall be made on cable glands, cable jointing, fuse or circuit breaker ratings and small panel items such as indicating lamps
- Static equipment which may be damaged by the application of test voltages shall have the appropriate terminals short-circuited

- Inter-relay, inter-unit and cubicle wiring carried out at site is to be checked to the appropriate circuit and/or wiring diagram. This may be done by using bells or buzzers. DC supplied from the station battery may also be used.

  Where it is found necessary during pre-commissioning work to effect site modifications to the secondary wiring, site copies of the appropriate schematic and wiring diagrams shall be suitably marked as agreed with the Employer before the circuit is commissioned

- Loop resistance measurements are to be made on all current transformer circuits. Separate values are required for a current transformer and lead resistances and all measurements are to be recorded on lead resistance diagrams

Test of Relays:

- All relays are to be examined to ensure that they are in proper working condition and correctly adjusted, correctly labeled, and that the relay case, cover, glass. and gaskets are in good order and fit properly
- Secondary injection shall be carried out on all AC relays, using voltage and a current of sinusoidal wave form and rated power frequency. For circulating current protection employing high impedance voltage operated relays, the points of injection for relay voltage setting tests shall be across the relay and stabilizing resistance
- The operation setting for the type of protection is to be established by secondary injection where it is impractical to ascertain this value by primary injection. Injection is to be made across the appropriate relay bus wires with all associated relays, setting resistors, and intermediate current transformers connected
- Fault setting test to establish the value of current and voltage necessary to produce operation of the relays. These tests are to be carried out by secondary injection applied at the current transformer terminals

Test of DC Circuits:

- Tests are to be carried out to prove the correctness of all DC polarities, the operating level of DC relays and the correct function of DC relay schemes, selection and control switching, indications and alarm

Test of Instruments:

- Instruments and instrument transformer circuits shall be checked for polarity of direction and for calibration including any interposing transformers or transducers. These checks shall be made on all current transformer ratios where applicable

1.2.12.5 On-Load Tests

On-load tests are required but due to the hazards inherent, they shall be carried out under the direct supervision of the Employer. The following tests are required:

- An operation and stability test shall be carried out for on-load commissioning
- Tests for restraint shall be carried out to prove the characteristics of protective systems with directional characteristics
- On-load checks shall be made after the protective gear has been placed in service to ensure that all connections and test links have been replaced and test leads removed, as well as to confirm the integrity of the current transformer circuits. Where necessary, voltage readings shall be taken at the terminals on each relay to ensure that loop

connections between the relays are complete. Special attention shall be paid to broken delta voltages and residual current circuits where zero voltage or current respectively may not be a proof of the completeness of the circuit

1.2.12.6 Communications System Tests

All routine tests as specified in the applicable standards shall be carried out on the communication system equipment. Certificates of routine tests carried out on the equipment supplied shall be submitted for approval.

In addition, the following VHF transceiver tests shall be carried out:

- RF level
- Frequency accuracy
- Loss for speech frequency level
- Signal levels
- Nominal impedance and return loss-VF side
- Automatic gain control
- Transmit/ receive frequency difference
- Linearity
- Noise generated
- Sensitivity (SINAD value)

1.2.13 Performance

All works shall be executed according to the requirements and in the manner set out in the Contract Documents. The Contractor shall design, construct and supply all materials for manufacture, tests at the manufacturer's works, transport from the works and delivery to the site, erection, tests, carry out all completion works, put into operation, remedy defects during the defects liability period for the above Facilities as described in the Specifications and as shown on the Drawings. All components and accessories required for the satisfactory operation of the Facilities shall be supplied as necessary.

1.2.14 Training

During the manufacture of the 220kV circuit breakers, 220 kV transformers and 220 kV reactors, the Contractor shall arrange for factory visits for Employer's appointed personnel.

During each visit of 7 days, training shall be given to five Employer's appointed personnel on factory inspections and witnessing of performance tests. During the erection and test period, the Contractor's supervisor shall give 7 days of training, information and thorough instructions to the Employer's staff concerning the handling of the facilities and the use of the operation and maintenance manuals. The Employer's appointed personnel shall also have the opportunity of taking part in the testing and commissioning of the Facilities. Contractor shall provide translation services as required. Training sessions shall observe the traditional work schedules of the Employers staff.

The training shall be performed according to a program approved by the Employer in advance. The price for this training shall be regarded as included in the price for installation. Travel expenses for Employer's personnel shall be borne by the Employer.

1.3 Technical Requirements – Static VAR Compensator

1.3.1 Description of Work

The intent of this Specification is to have the Contractor furnish and install complete Static VAR Compensator (SVC) systems and any required harmonic filter/shunt capacitor banks. In addition, the SVCs should have a short-term overload rating for short durations, less than two minutes. It is anticipated that this short time rating will not increase the size of the main step-up transformer.

The main step-up transformer should be rated for the steady state rating of the associated SVC. One SVC system will be connected to a position in the existing Chimtala Substation 220kV bus. Another SVC system will be connected to the Kandahar East Substation 220 kV bus included in other bidding documents.

The Contractor shall provide with their proposal, project experience in providing SVC systems in developing countries. Information provided shall include location, rating, voltage, and references with names and contact information.

These specifications cover the design, manufacture of equipment, construction, installation, testing, commissioning, warranting, training, and placing into successful operation a complete SVC facility at two locations. The Contractor shall provide all necessary design, materials, equipment, and construction to provide complete "turnkey" installations. It is the intent of these specifications to describe the required features and performance requirements of the SVC systems and define the interconnection requirements to the Chimtala Substation and Kandahar East Substation. No attempt has been made to describe all details of the intended design. It is the responsibility of the selected Contractor to define, design, and construct all aspects of the turnkey installations whether or not specifically described in this specification. It is the intent to purchase the Contractor's standard system design and installation, to the extent possible, with such modifications required to provide the functions and performance specified herein.

The SVCs will be required to work successfully as part of an a Reactive Power Compensation (RPC) system that will consist of the Chimtala SVC; new and existing Mechanically Switched Shunt Capacitors (MSCs) at substations in the NEPS and SEPS; new and existing Mechanically Switched Shunt Reactors (MSRs) at substations within the NEPS and SEPS; and a new SVC at a new Kandahar East Substation.

The Chimtala SVC controller will be required to optimize and control the switching of all the MSRs and MSCs at the Chimtala Substations to manage steady reactive power balance of the SVC and bus voltage. The SVC may switch MSCs and MSRs at the Chimtala substation as part of the SVCs dynamic response to system events.

The Kandahar East SVC controller will be required to optimize and control the switching of all the MSRs and MSCs at the Kandahar East Substations to manage steady reactive power balance of the SVC and bus voltage. The SVC may switch MSCs and MSRs at the Kandahar East substation as part of the SVCs dynamic response to system events.

The SVCs shall be designed as part of this entire system without instability or negative interactions with any of the other components of the total RPC system. The SVC control system shall be capable of being reprogrammed in the future to allow the SVC to adapt to unanticipated changes in the Afghanistan electrical system.

The SVCs are important to the stability and integrity of the bulk transmission system in the area. Therefore, the Employer desires to pursue options to help ensure the availability of the SVC for its intended use. The location of the SVC and inexperience of the Employers operation and

maintenance personnel require a design that emphasizes reliability, simplicity and ease of maintenance. Of primary concern are single contingency failures that have the potential to cause the entire output of the SVC to be interrupted for significant periods of time, such as a failure of the main step-up transformer or require complex diagnostic and maintenance procedures. The SVC shall be designed so that the failure of any single component, except the main step-up transformer, 220 kV circuit breaker, 220 kV switches, and 220 kV buswork, will not affect the performance requirements described in Section 1.3 of these specifications. The Contractor shall provide a system with all necessary component redundancy to ensure rapid return to service in the event of any major component failure.

The Contractor shall provide with their proposal, information on the process required to add capacity to the SVC. This information shall include all modifications to or replacement of equipment and controls that may be required.

1.3.2 Material and Services Furnished by the Employer

Available system load flow and stability studies previously completed by the Employer or their contractors. In addition, the Employer will furnish to the selected Contractor electronic databases of the affected system in PSS/E format.

Geotechnical considerations shall be coordinated with the substation design specified in Section 1.1.23.

1.3.3 Material and Services Furnished by the Contractor

The Contractor shall furnish all materials and services required for completion of the work. This list shall not be construed to be a complete listing of requirements, but rather a general overview. The scope of supply for the SVC system shall include, is not limited to, the following:

- Engineering, design, fabrication, shipping, assembly, testing and supply of the components of the SVC, its assemblies, and accessories necessary for connection of the SVC to the Chimtala 220 kV bus and to the Kandahar East 220 kV bus.
- The high power semiconductor devices, as required, for reactor control and capacitor switching including their protection, control, monitoring and cooling systems.
- Harmonic filters as required to meet the specified harmonic performance levels.
- The SVCs main step-up transformer(s).
- All current transformers and voltage transformers required.
- All necessary equipment for the protection, control, indication and measurement of the SVCs including interfaces to the Employer's SCADA system.
- Sequence of events recorder and digital fault recorder to monitor the SVCs and associated substation equipment if required for trouble shooting of the SVCs.
- Building as required to house the SVC equipment, control and protection equipment, batteries, spare parts and cooling equipment, including HVAC and fire protection systems.
- SVC yards and associated substation civil work (i.e. site development, clearing, grading, retaining walls, drainage, fill, etc.), SVC site fencing, gates and site security during construction.
- All required foundations and structures for the SVC equipment.
- Outdoor lighting system.

- SVC yard grounding and connection to the existing substation ground grids.
- Surge protection and lightning shielding.
- AC and DC distribution, including protection, batteries and chargers, distribution panels, and transfer switches.
- Primary and back-up station power source, location to be determined by the Contractor.
- All special tools required for the assembly and maintenance of the SVCs.
- Wiring, connection and assembly of all equipment, apparatus, components, equipment frames, racks and switchboard panels.
- All drawings and instruction booklets necessary to construct, operate and maintain the SVCs and associated equipment.
- Sufficient training of Employer personnel to enable them to operate and maintain the SVCs without further assistance from the Contractor.
- Supervise and perform final checkout, startup and commissioning tests of all SVC apparatus and controls, and verify proper operation and functioning of same.
- A warranty for all SVC related equipment and substation components including the enclosure.
- Provide necessary post-construction landscaping to return the site to its original aesthetic state.
- UPS package for cooling system ride-thru protection, defined as 15 minutes at full reactive exchange (as defined in Table 1.1.1, and provide for orderly shutdown after this period has been exceeded. This requirement can also be met with the application of UMD technology (Uninterruptable Motor Drive) designed to cover the same 15 minute event, and provide for orderly shutdown, after this period has been exceeded.

1.3.4 Site Conditions

Refer to Section 1.1.10 for site conditions.

The information in Section 1.1.10 is to be used for bid preparation only. Contractor must independently develop the information to be used in actual design, subject to review and approval of the Employer.

1.3.5 Performance Requirements

1.3.5.1 System Electrical Characteristics

The power system characteristics for bidding purposes only can be found in Section 1.1.10.

1.3.6 Rating and Performance

The Contractor shall provide any capacitor banks required for SVC rating and harmonic filtering.

The Contractor shall provide a temporary dynamic rating for the SVCs for times less than 5 minutes. It is anticipated that the main step-up transformer will be designed for the continuous rating of the SVCs and will be allowed to overload for the dynamic swings.

The SVCs shall regulate the 220 kV bus voltages to a reference voltage continuously variable from 0.90 pu to 1.05 pu. Normal reference point of the SVCs will be 1.00 pu. This value is compatible with the area generation and bus voltage requirements.

The minimum continuous voltage for SVC operation shall be 0.20 per unit or lower as specified by the Contractor for the proposed design. Operation shall mean the SVC control system and the cooling system remains in service and thyristor valves are in the block mode ready to be deployed when voltage recovers to no more than 0.70 per unit.

The SVCs shall be capable of operation in both MVAr and voltage regulation modes. Normal operation is expected to be voltage regulation.

Slope of the SVC regulation system shall be continuously adjustable, or adjustable in steps not to exceed 0.5%, from 0 to 5% over the full continuously variable range of the SVCs.

The Contractor shall specify the temporary overvoltage capability of the proposed design and design the SVC controls to allow safe use of the temporary capability. SVC operating time in the temporary overvoltage region shall be specified by the Contractor. If the Contractor's design has additional short time (0.05 to 1 second) overvoltage capability this capability shall also be specified by the Contractor.

The SVCs shall continue to generate capacitive reactive power during temporary undervoltage down to its lowest operating limit (to be specified by the Contractor). The Contractor shall specify the temporary undervoltage capability of the SVC design.

If SVC compensation must be shutdown due to system undervoltage conditions that persist longer than the SVCs can safely continue compensation, the SVCs shall automatically block the thyristor valves, and stay in synchronism so that after stability in the voltage has occurred (no more than 0.7 pu) the SVCs will be available for controlled action following system voltage recovery above its continuous under voltage operating limit. The vendor shall specify the time required to restart the SVC compensation controls following a shutdown or blocked valve condition due to system undervoltage.

The control shall have provisions to enable and disable the automatic restart feature both locally and remotely via the Employer's SCADA system.

The SVCs shall continue to generate inductive reactive power for temporary overvoltages up to the Contractor specified overvoltage limit.

All SVC and filter bank components shall be rated to withstand the continuous and short-term system operation, including harmonics specified in the Power System Characteristics section of this specification and to withstand or be protected against voltage and currents stresses that exceed these characteristics.

The SVC transformers and all connected equipment shall be undamaged by any internal fault no matter what fault strength is available at the 220 kV high voltage SVC bus connections. Employer reserves the right to perform a 220 kV single line to ground staged fault test and a line to line low voltage staged fault test.

The vendor shall specify the magnitude and duration of fault current that the SVCs will contribute to system faults near the Chimtala Substation or the Kandahar East Substation. This may be significant for Chimtala or Kandahar East circuit breaker rating and protection considerations. If the SVC will not contribute to fault current, the vendor shall so state.

Torsional Interactions: The Contractor will provide suitable well documented system model compatible with PSS/E version 32.02 for future SSR/SSI studies.

1.3.7 SVC Control Concepts

The SVC shall be designed to regulate the 220 kV Chimtala and 220 kV Kandahar East bus voltages over a range of 0.90 to 1.05 pu. Normal operation will be to regulate the voltage to1.00 pu. The present application does not require power system swing damping from the SVC. However, damping capability shall be provided and activated, if necessary, to mitigate any destabilizing effects of the fast SVC voltage regulator or other system conditions that may develop. Damping control shall have its parameters and activation adjustable by the user. Capability shall be provided for both local and remote adjustment of the regulator set points and control parameters.

The control system shall be self-diagnosing for any circuit failures. The printed circuit cards shall have built-in test points and indicating lights to facilitate testing and maintenance.

- The SVCs shall be designed to regulate the voltage on the 220kV bus over a range of 0.90 pu to 1.05 pu. The reference voltage shall be continuously adjustable over this range.
- The slope (ratio of per unit reference bus voltage change to SVC per unit current change) over the linearly controlled range of the SVC shall be continuously adjustable from 0% to 5% in no greater than 0.5% steps on the nominal 220kV system.
- Maximum error in the controlled bus voltage provided by the SVC shall be +/- 1.0% of the theoretical value as calculated from the control reference voltage and slope settings at any possible operating point within the SVC operating range. This tolerance includes any error due to the 220kV voltage sensing transformers or other hardware.
- Response time is defined as the time required for the SVC to reach 90% of its final output level, in closed loop response to a step change in the 220kV system voltage reference. Desired SVC response time is 30 ms or less.
- Maximum overshoot shall not exceed 10% of the ordered change and the settling time shall not exceed 200 ms, after which the system voltage shall be within 2% of the ordered value.
- The Contractor shall specify the SVC response time which can be achieved between any two operating points within the SVC operating range, including fully capacitive to fully inductive, or vice versa, at the 220kV bus system impedances specified in the System Electrical Characteristics section of the specification. This shall be specified for a SVC slope of 0% and 5%. This closed loop response shall be continuously available and repeatable. Capability to adjust the response time is required. Response time adjustments shall not affect the slope characteristic of the SVCs.
- The Contractor shall provide a primary station service source for both the Chimtala and the Kandahar East SVC, either from the 220kV bus or the SVC secondary bus. The Contractor shall also provide one source of back-up service power to the SVCs for use as needed in the event of the loss of the primary station service power. In the event of the loss of both AC power sources, the SVCs shall transfer to a Contractor provided source of DC power capable of supplying the control system during the time required for a safe and orderly shutdown of the SVC systems. In the event of an emergency SVC shut down, the SVCs shall restart active compensation as quickly as possible after the system voltage recovers above the minimum SVC continuous operating voltage. The vendor shall specify the time required to restart the SVC compensation following an emergency shutdown.
- The gating scheme shall be designed to:
    - be immune to severe harmonic distortion of the voltage waveform
    - continue to operate during and following large voltage excursions
    - continue to operate during and following large frequency excursions

- minimize generation of characteristic, non-characteristic and non-integer harmonics
- be immune to misoperation when the 220 kV bus voltage amplitude and/or phase changes quickly (for example during system fault initiation and clearing)

1.3.8 Capacitor and Reactor Bank Control

The SVC controllers shall control capacitor Mechanically Switched Capacitors (MSCs) and Mechanically Switched Reactors (MSRs).

- Capacitor and reactor step sizes shall be no larger than specified in Table 1.1.1.
- The SVC controllers shall be capable of automatically operating the local MSRs and MSCs to allow the SVC to operate near the zero output point. Both existing and new MSCs and MSCs will be controlled from the SVC. Control of MSC and MSR banks shall be made directly from the SVC control system. The MSC and MSR bank status (open, closed, manual, automatic, local) shall be reported to the SVC controller. The new MSCs will be equipped with rapid discharge devices to facilitate higher speed automatic control of the MSCs. The SVC control shall include timing functions to avoid closing capacitors until time has elapsed to allow capacitors to discharge (if necessary) and shall include logic to balance switching duty on capacitor banks to the extent practical. MSCs may be included as part of the dynamic response of the SVC.
- Contractor shall coordinate with Employer and gain Employer approval of the proposed communication system design between the SVC controller and the existing Chimtala MSCs and MSR and coordinate any communication system outages or cut-overs of new equipment with Employer.
- Contractor shall coordinate with Employer and gain Employer approval of the proposed communication system design between the SVC controller and the existing Kandahar East MSRs and coordinate any communication system outages or cut-overs of new equipment with Employer.
- The capacitor and reactor banks shall also be capable of manual control remotely via the Employer's SCADA system or by operators within the station. The normal priority of control order is SVC control (automatic).

1.3.9 Insulation Coordination

The Contractor shall perform studies to determine that the SVC systems are adequately protected against high frequency transient and dynamic overvoltages and system interactions. The Contractor shall be responsible for the insulation coordination of all equipment within his scope of supply and shall furnish all necessary protection for the supplied equipment. Protection equipment shall include surge arresters, special control features and other forms of protection according to the contractors design. Backup protection shall be provided for overvoltages that could occur due to credible failures or malfunctions of the SVCs.

Contractor study reports shall document protection methods and show that insulation coordination of the SVC is adequate and that all Contractor supplied equipment is capable of withstanding steady state, dynamic and transient overvoltages to which it may be subjected. Overvoltages may be due to the SVC system, its component switching, normal SVC operation and abnormal SVC operation.

Insulation levels shall not be less than specified in Table 1.1.2.

1.3.10 Availability and Reliability

1.3.10.1 General

The Contractor shall provide, with the proposal, availability calculations for the base bid and all proposed options including all component failure rates.

1.3.10.2 Required Availability

The annual availability required of the SVCs shall be 98.0 percent. Failure or outages required for maintenance of auxiliary equipment and all other parts of the SVCs, including main step-up transformer, shall be included in the determination of availability.

The Contractor shall design and furnish equipment with the design objective of producing a system, that will meet or exceed stated guaranteed availability performance based on loss of capacity or the failure of equipment within his contract responsibility as measured at the 220 kV bus connection point.

1.3.10.3 Definitions

- Forced Outages: Outages caused by the SVC equipment which result in loss of part or all of the essential function of the SVC. These outages may be initiated by failure of components, the operation of protective devices, alarms or by manual action.

- Scheduled Outages: Outages necessary for preventive maintenance to assure continued and reliable operation of the SVCs.

1.3.10.4 Outage Duration

The elapsed time from the instant the SVC is out of service to the instant it is returned to service. If the SVC is available for service such time will not be included in the outage duration, should the Employer elect not to return the equipment to service. The following shall be included in outage duration:

- The time required to determine the cause of an outage or to determine which equipment or units of equipment must be repaired or replaced.
- The time required by system operators/technicians for disconnection and grounding of equipment in preparation for repair work, and for removal of grounds and reconnection of equipment after repairs are complete.
- Delays caused by unavailability of qualified Employer's personnel shall be excluded from the outage duration.

1.3.10.5 Partial Outage

If partial SVC output is available, the duration of equivalent outage shall be calculated as the product of the derated condition duration and the proportion of the nominal output range which cannot be achieved during this period.

1.3.10.6 Annual Availability

The annual equivalent availability for the combination of scheduled and forced outages in % is defined as:

$$\left[1-\sum\frac{\text{Duration of equivalent outage}}{8760}\right]*100$$

1.3.10.7 Required Availability

The annual equivalent availability for all outages (combined scheduled and forced outages) for the SVCs shall be at least 98.0%. There shall be less than three forced outages of the SVCs per year.

1.3.11 Interference

1.3.11.1 Broadband Interference

The Contractor shall take necessary precautionary measures to insure that there will be no misoperation, damage or danger to any equipment or system due to broadband interference and effects. The broadband interference includes: Power Line Carrier; radio and television; microwave; and wireless communications.

1.3.11.2 Compliance and Measurements

The Contractor shall perform ambient (before construction) and after commissioning measurements to document actual noise levels for the above types of communication and frequency bands used in the vicinity. Measurements taken after the SVC is placed into service shall include all operating modes and levels that will cause worst-case interference conditions. Based on these two different measurements, SVC system contribution and compliance will be determined. The measurement results and conclusions will be provided to the Employer.

1.3.12 Audible Noise

The maximum sound level generated from the SVC system and any associated equipment, including the main transformer, supplied by the Contractor under any output level within the SVC's operating range combined with the audible noise from the existing substation equipment shall not exceed sound levels allowed by local regulations at any point on the substation property line. This shall be measured on the "A" weighted scale. The ambient noise level inside the SVC control room shall not exceed 55 dBA.

The Contractor shall make ambient audible noise level measurements before and after SVC installation to verify compliance with this requirement. Any noncompliance shall be corrected by the Contractor to the Employer's satisfaction. The Contractor shall make these corrections at no cost to the Employer

1.3.13 Harmonics

The studies shall document acceptable filter performance for various system configurations and be supplied prior to SVC installation. Harmonic studies shall evaluate the maximum harmonic levels at the point of common coupling (PCC). In addition, these studies shall be used to demonstrate that the AC filters do not cause any resonance with the rest of the power system and that harmonic distortion limits can be met by the filters designed by the Contractor. Resonance problems related to the SVC filters, capacitor banks, and system impedances shall be avoided for all credible system conditions. The Contractor shall be required to meet IEEE 519 harmonics requirements at the PCC (the 220 kV substation bus) with all equipment installed. Harmonic performance and filter design shall consider characteristic, non-characteristic and non-integer harmonics from the 2nd to the 50th or higher if necessary. Actual compliance shall be based on field measurements performed by the Contractor after commissioning at all operating modes and output levels that may cause worst-case harmonic distortion

The Contractor is advised that no existing harmonic studies have been performed nor have measurements been made. The level of the existing network harmonics is unknown but may exceed IEEE 519 levels. The Contractor shall perform a Harmonic Impedance analysis using network power flow data and a reasonable set of network configuration & generation level assumptions. This static analysis shall be used to determine the base harmonic filter design and provide calculations that demonstrate that the harmonic absorption of the SVC filters and the generated harmonics will perform in accordance with the levels established in IEEE 519 during the worst firing angle of the TCR.

The Contractor shall size the filter components to absorb the SVC harmonics and an assumed margin of 10 % of additional unknown network generated harmonics without damage to any of the filter components. The Contractor shall make measurements before the SVC is energized to demonstrate the existing and the levels after the completion of the SVC to assure that the harmonic filter(s) are properly tuned and meeting the system harmonic target objectives where possible.

The following limits shall be applied:

Individual harmonic voltage distortion (Dn) (Target)	1.5% (24 hr. Average)
Total harmonic voltage distortion factor, THD (Target)	2.5% (24 hr. Average)
Telephone influence factor (TIF)	50
I*T product	10,000

Harmonic Definitions:

- Voltage distortion factor, $D_n = (E_n/E_l)*100$
  E_l = rated line-to-ground system voltage (rms)
  E_n = Line-to-ground voltage of the nth harmonic (rms)
- Total harmonic voltage distortion, $THD = (100 / E_l)*\sqrt{\sum E_n^2}$
  Summation from harmonic n = 2 to 50
- Telephone influence factor, $TIF = (1/ E_l)* \sqrt{\sum(E_n*W_f)^2}$
  Summation from n = 2 to 50
  W_f = weighting factor for n^{th} harmonic (see IEEE Std. 519-1992)
- I*T Product: $I*T = \sqrt{\sum(I_n* W_f)^2}$
  Summation from harmonic n = 2 to 50
  I_n = n^{th} harmonic current injected into the system (rms)

In meeting these requirements the design of the SVC shall take into account mistuning, failed power electronics, component tolerances due to manufacturing and temperature deviations in transformers, reactors, and capacitors, normal system frequency, SVC operating with redundant valves out of service, and component aging.

The SVC components shall be designed to carry the harmonic currents caused by the background harmonic distortion of the system as well as those produced by the SVC itself. The harmonic currents from the system and the SVC shall be added quadratically. At least a 20% safety margin shall be applied.

1.3.14 General

The Contractor shall guarantee that the total electrical losses for the SVC will not exceed those stated by the Contractor. The guaranteed total electrical losses stated will be used for evaluation of bids. If the guaranteed total station losses are exceeded, a corresponding penalty will be applied.

The guaranteed losses shall include all equipment within the Contractor's scope of supply, including building heating/cooling losses. Any filter loss shall be included. Where possible, the Contractor shall determine the electrical losses and power requirements of equipment by direct measurements. Calculated values provided by the Contractor may be used where direct measurement of losses and power requirements is not feasible.

For the purposes of calculating losses, it shall be assumed that the ambient temperature is 30° C, the Chimtala Substation bus is at 0.95 pu and the slope setting is 3.0%.

System auxiliary power requirements shall be based upon the total electrical power required by auxiliaries from the station service source.

1.3.15 Loss Evaluation

It is expected that the SVCs will be operating near 0 Mvar the majority of the time. The losses for the SVC shall be given at the operating points defined below, and these losses will be used in computing the evaluated cost for the SVCs. In addition, the Contractor shall provide a curve for the total operating losses over the entire steady state operating range of the SVCs.

Operating Point #1	+10 Mvar	Weighting Factor: 0.1
Operating Point #2	0 Mvar	Weighting Factor: 0.6
Operating Point #3	-10 Mvar	Weighting Factor: 0.3

The losses at each operating point will be multiplied by the associated weighting factor. The weighting factor is the approximate expected time of operation at a particular operating point. These losses will then be totaled and economically assessed using the value from Section 1.2.2.3

Should the actual total losses as determined by testing and calculation, where appropriate, exceed the guaranteed losses, the Contractor shall pay to the Employer an amount determined by the actual losses in excess of the guaranteed losses multiplied by the value from 1.2.2.3.

NO CREDIT WILL BE GIVEN FOR ACTUAL LOSSES WHICH ARE LESS THAN THE GUARANTEED LOSSES.

1.3.16 Equipment Specifications and Design Requirements

1.3.16.1 General Requirements

All equipment manufactured or purchased for this contract shall be in general conformance to these specifications. The equipment specifications are intended to describe the required features of each piece of equipment, but are not intended to limit the manufacturer's design to provide the best facility.

1.3.16.2 Transformers

General

The Contractor shall state in the proposal the proposed transformer manufacturer and the actual location of manufacture of the unit(s) that will be supplied under this contract. The Employer will review and approve the proposed transformer suppliers engineering and manufacturing & testing locations. The Contractor's manufacturer is required to submit the factory quality assurance program, or in lieu of a supplier provided custom program, can provide ISO 9001, 9002 certificates of conformance of the specific facilities to be used for this contract.

Refer to Section 1.2.2 for detailed transformer specifications.

Due to the location of the site, it is desired to use single-phase transformers with a 4th single phase transformer as a spare. The station shall be designed to allow efficient replacement of a failed transformer with the spare transformer as quickly as possible, without moving the transformer and, with the exception of jumpers to the transformer bushings, no addition or modification of bus work.

CT switching blocks, and quick connected control cables from the transformer control cabinet shall be supplied.

The transformer shall be designed to withstand the stress of all operating modes and system conditions as specified, including negative sequence currents and harmonics.

Losses
Losses are to be guaranteed and will be evaluated along with the complete SVC facility.

Maintenance Considerations
The recommendation for spare parts shall be included in the instruction book for the original equipment. This recommendation must include all spare parts that the Manufacturer recommends be carried in stock for these transformers plus all gaskets and other expendable items that may be reasonably required during the preliminary operating and adjusting period that often precedes normal operation. Vendor will identify spare parts with lead times in excess of six months.

1.3.16.3 High Power Semiconductor Devices

General
The high power semiconductor devices (valves) and all necessary accessories shall be designed to ensure satisfactory operation according to the overall performance requirements and to meet the specified reliability. The proposed valves shall be of a type in, or ready for, commercial production with fully proven characteristics. The Contractor shall state in the proposal significant departures from previous designs of valves in service in similar applications.

Any plastic components shall be of a type that is not degraded by corona discharges, and be fully compliant to UL94 flammability performance standards.

The valves, and all related components, shall be designed to withstand the stresses associated with steady state operation, transient operation and overload conditions as implied by this application. The Contractor shall be responsible to demonstrate that all relevant aspects of overvoltage and overcurrent stresses have been taken into account, including those due to malfunctions in the valves' firing system and faults occurring in various parts of the AC system.

Maintenance
The valve arrangements shall be designed to permit easy access for visual inspection, routine maintenance, removal, replacement, and handling of the valve modules or components. Such work shall result in minimal loss of coolant and the Contractor shall provide means of retaining any coolant lost. It shall be possible to carry out replacement of one module or component within 2 hours from shutdown to startup, excluding time for switching procedures, but including the time required for identification of the faulty module or component.

A continuous monitoring system shall be provided to detect failed valves and provide indication of each failure and its location within the valve assembly. This indication shall be made available in the control room. Contacts shall be provided for connection to a sequence of events recorder and a supervisory control status point so that valve failure events can be logged. The monitoring system shall be of fail-safe design such that failure of the monitoring system will be detected or appear as a valve failure.

The Contractor shall provide one complete set of tools and lifting and access equipment for valve maintenance.

Redundancy

The valve design shall be such that the SVC will continue to operate at full capacity with the loss of any one component, including a complete valve level (two thyristors, VE units and associated hardware. All performance and protection functions shall be met with any one failed component out of service. The Contractor shall take into account the availability requirements of the project when designing redundancy and maintenance procedures.

Guaranteed Failure Rate

The Contractor shall state the guaranteed failure rate of high power semiconductor devices. Device failures shall include those caused by a malfunction of the firing system and of all auxiliary components associated with such high power semiconductor devices. The failure rate of devices will be monitored by the Employer. The annual guaranteed failure rate of the devices shall be calculated for a one-year period and shall not include failures directly attributable to operating and maintenance error.

If the actual failure rate exceeds the guaranteed failure rate, the Contractor shall supply the actual number of components equal to the difference between the actual failure rate and the guaranteed failure rate over a 20-year period.

The Contractor shall agree to furnish new devices on a schedule determined by the Employer that will allow use of the devices prior to exceeding the device shelf life.

Valve Protection

The Contractor shall provide adequate overvoltage and overcurrent protection of the valves. The Contractor shall state in the proposal the methods of overvoltage and overcurrent protection of the valves and the levels at which these protections operate.

Valves shall be provided with means for individual emergency firing in the event of an overvoltage or failure of firing pulses to one or more individual valves.

The SVCs shall be automatically disconnected whenever the number of failed valve levels and associated electronics is more than the number of redundant valves.

The valve shall be protected against overcurrents (temperature). Emergency tripping of valves shall take into account pre-trip overcurrent magnitude and duration as well as decay of trapped charge in other components.

Testing

Factory tests on the valves shall be performed by the Contractor. The Contractor shall submit a detailed test program and test specification, including type tests and routine tests. All test circuits shall be such as to adequately test performance under realistic worst case stress conditions and shall demonstrate in a simple and conclusive manner the capability of the valve. All tests shall be in accordance with the applicable IEC standards.

Valve Cooling System

The purpose of the valve cooling system is to remove the heat produced by the valve operation and transfer this heat to the outside ambient air. The cooling system shall be furnished complete with all necessary equipment and facilities, including, but not limited to, interconnecting piping, ductwork, circulating pumps, blowers, heaters, make-up reservoirs, heat exchangers, filters, water treatment facilities, instrumentation, automatic controls, alarms and control power.

The cooling system shall be designed such that the failure of any single component will allow the SVC to continue to operate at full capacity. Single piping and tubing is acceptable provided the materials are stainless steel and all joints and gaskets are designed for high reliability. A single non-metallic piping manifold at the valve structure may be used.

The cooling system controls may be provided within a Individual Cabinet Climate Control Systems (ICCS) cabinet hardware, in lieu of room HVAC control provided the systems are supplied by proven suppliers such as Rittal chiller systems using R134a refrigerant and having world wide support including the host country.

These systems shall be designed to operate from the local distribution sources of 230 VAC 50 Hz, and be equipped with cabinet heating systems for operation during low temperature conditions. Each cabinet shall be equipped with high/low temperature alarms and automatic controls.

The cooling circuit shall provide full heat rejection and may be a closed loop de-ionized water recirculating system. Each loop and each branch shall have manual valves to allow draining for maintenance and isolate it from the rest of the system without disrupting the operating loop. The cooling system shall be designed to allow the SVC to maintain full capacity at the maximum ambient temperature and maximum reactive power output and shall be able to operate at the lowest ambient temperature with the SVC off-line.

Replacement or maintenance of cooling system components shall be possible without shutting down the system. If redundant pumps are provided, the cooling system shall be designed to cycle the pumps periodically.

The high purity (high resistivity) water in the primary closed loop system shall be circulated through the heat producing electrical equipment at a constant flow rate. A purifying loop to maintain the high purity in the closed system shall be provided. The Contractor shall specify the design resistivity of the system and shall describe the proposed methods of detecting and responding to abnormal conditions.

The quantity of de-ionizing material shall be sufficient for continuous operation for a period longer than the Contractor specified maintenance interval without replacement. De-ionizing materials shall be replaceable without shutting down the cooling system.

Provision for make-up water shall be provided by the Contractor. The system shall be designed so that the addition of make-up water shall not be required for a period longer than the Contractor specified maintenance interval. There is no domestic water available on site. Contractor shall provide adequate make-up water storage and any required treatment facilities required by the facility design and maintenance interval.

The secondary cooling circuit shall be a closed system using a water/glycol mixture to prevent freezing in the event of loss of station power. The heat transfer from the primary to secondary cooling circuits shall take place in a liquid-to-liquid heat exchanger. Such heat exchanger shall be of double wall construction to assure that the liquids in the primary and secondary systems do not mix.

No discharge of the primary or secondary loop cooling system water will be allowed. The heat transfer from the closed water system to the ambient air shall take place in a liquid to air heat exchanger.

Alternative Liquid Cooling: As an alternative, the Bidder may propose a single loop, water/glycol mixture cooling system for the valves. The Bidder must then provide a full detail of the cooling system and point out its cost and operational benefits over the primary/secondary water cooling system outlined above. This method of cooling may be preferred if it provides maintenance and operational advantages.

The cooling plant shall be equipped with power ride-through capabilities in the form of UPS or UMD systems as previously discussed backup sources to provide a minimum of 15 minutes of ride-through capabilities in the event of loss of station service power.

1.3.16.4 Instrument Transformers

General

The Contractor shall supply all voltage and current transformers necessary for control, protection and monitoring of the SVCs and shunt/filter capacitor banks.

The Contractor shall ensure that the accuracy, ratings and performance of all instrument transformers are adequate for its specific purpose.

Instrument transformers shall be designed, manufactured and tested according to applicable IEC standards. The Contractor shall provide the description, rating, performance, dimension and proposed tests for all instrument transformers provided.

Voltage Transformers

The voltage transformers shall be designed to avoid saturation at voltages up to at least 1.2 pu continuous and 2.3 pu for 1 cycle. Further, no ferroresonance conditions shall occur between voltage transformers and capacitors including stray capacitances.

Current Transformers

The current transformers shall be provided with the appropriate number of windings as required by the Contractor's design. Each winding of the current transformer shall be provided with an individual core.

The current transformers shall be capable of withstanding, with the secondary short circuited, a fully offset primary current having an AC component with an rms value equal to the maximum fault levels specified.

1.3.16.5 Filters and Shunt Capacitors

General

Shunt capacitor banks shall be provided as required by this specification for harmonic filter requirements and SVC rating.

The capacitor banks shall be furnished complete with all racks, insulators, buswork, structures, grounding, instrument transformers, capacitor unit failure detection, and protection. The capacitor banks shall be mounted in racks of horizontally mounted capacitors ready for vertical mounting of the racks and any other equipment. Capacitors shall not be shipped mounted in racks. The capacitors shall be mounted to allow safe access to the capacitor/filter area with the equipment energized or fenced and equipped with appropriate interlocks to prevent access until safely disconnected and grounded.

The capacitor banks shall be equipped with discharge devices as required to allow rapid restoration into service. The capacitors shall be designed, rated, and tested in accordance with the latest issue of applicable IEC standards.

Capacitor Units

The individual capacitor units shall be of the all-film polypropylene dielectric type, in single bushing cases. The minimum sustained overvoltage rating shall be 120% of nominal voltage. The measured capacitance shall be stamped on the nameplate of each can.

The cases shall be designed to allow for expansion and contraction due to all ambient and loading conditions expected during the life of the unit, including short-term transient conditions. The capacitor design shall be such that it prevents rupture of the case.

The dielectric fluid used within the capacitor unit shall be environmentally safe and biodegradable. The capacitor units shall be completely impregnated with the dielectric fluid.

Capacitor units shall be internally fused. Fuseless designs are not acceptable.

Individual capacitor cans shall be crated and shipped separately from the rack for field installation in the rack to avoid shipping damage.

Capacitor Banks
Stacks shall be supplied complete with all auxiliary equipment and material necessary for a complete installation in the field, including all insulators capacitor units, and the neutral bus between the stacks.

Elevating structures shall be furnished complete with all necessary bracings and grounding pads. The structures and racks shall be aluminum or galvanized steel, pre-drilled with all suitable fasteners. All structural members shall be electrically connected to each other in order to ensure adequate grounding of the rack during maintenance and shall be connected to the ground mat. Steel rack components shall not be used as an electrical bus.

Provisions for mounting potential transformers and/or neutral current transformers shall be furnished with the structure. All bolted aluminum connections shall be flat washers with locknuts. Racks shall be furnished with lifting eyes for handling. Red warning signs shall be attached to all sides of all racks reading "WARNING - ENERGIZED FRAMES. Each rack shall be labeled with the maximum and minimum capacitor unit capacitances which may be substituted as spares.

The capacitor banks shall be designed, configured, and spaced so that each individual capacitor bank can be serviced, including the identification and changing of failed units, without requiring the adjacent banks to be taken out of service.

Testing
Capacitor banks shall be tested according to applicable IEC standards. All the necessary tests to assure adequate electrical, thermal and mechanical capabilities shall be performed. The Contractor shall submit for review by the Employer, a detailed program of design and production tests to be performed on the capacitors. The Contractor shall specify the value and tolerances for tests to be performed.

1.3.16.6 Switching and Interrupting Devices

General
As required by the design, the Contractor shall provide switching and interrupting devices to control and protect the SVC equipment. Switching and interrupting devices furnished under these specifications shall be in accordance with all the requirements of applicable IEC standards, and shall be designed to operate under the conditions listed in this specification.

The switching and interrupting devices shall be properly rated for capacitor switching and fault interruption duties where used on filter or switched capacitor banks or reactors. All switching and interrupting devices shall be furnished in accordance with the material supply portions of the specification.

1.3.16.7 Station Service

General
The Contractor shall furnish all required AC and DC distribution systems to supply all loads in the SVC facilities. The primary AC station service source will come from the adjacent substation. The Contractor shall provide all duct banks, cabling and pull boxes required to connect the Contractor

furnished station service transformers and secondary equipment; or, if available and of adequate capacity, existing substation station service transformers.

The auxiliaries shall be capable of riding through all frequency and voltage conditions as specified in Section 1.3 without loss of SVC capacity or shutdown of auxiliary systems. The Contractor shall provide all protective relays or other systems required for protection of the station service system and shall be responsible for coordination of all such protection.

Back-up Source
The SVCs, including auxiliaries, will be required to operate under the conditions set forth in Section 1.1.10of these specifications. The SVCs will be required to be capable of operating in the event of the loss of the primary station service source. In addition, the SVCs will be required to shut down in a safe and orderly manner in the event of the loss of all station service sources. The Contractor shall provide for a back-up station service source sized to allow full operation of the SVCs. This may be a source from the low voltage side of the SVC step-up transformer.

Back-up Diesel Generation
Back-up diesel generation shall be provided for emergency operation. Generation shall be sized to power critical SVC loads including but not limited to main cooling system, DC battery charging system, control space HVAC, and emergency lighting. The system shall include fuel storage adequate for a minimum of eight hours to maintain the readiness of the SVCs during extended outages.

Automatic Transfer Equipment
The Contractor shall provide automatic transfer equipment for the SVC AC station services to switch to the secondary power source in the event of primary source failure. The equipment shall switch back to the primary source upon restoration of the primary source.

DC Power System
If required for the Contractor's design, station battery systems shall be compatible with and of the same type as the battery systems in the existing substations and shall include a battery charging system.

The battery shall consist of cells of proven technology designed for the type of service required. For the purposes of this specification, proven technology shall be defined as cells that have been in successful commercial service in similar type applications for a period of time sufficient to establish a service life and maintenance history.

1.3.17 Controls, Metering, Instrumentation and Protection

1.3.17.1 Control Requirements

The SVC control system shall be designed to provide for automatic, unattended operation of the facility. However, the control system design also shall provide for local manual operation and remote operation of the SVC from the Employer's SCADA system. The SVC shall include provisions for an orderly and safe shutdown, even in the absence of utility power.

An HMI shall be provided in the SVC building for local control and troubleshooting. Control shall also be provided through a SCADA HMI located in the substation control building. The SCADA HMI shall be provided with fully functioned control and monitoring capability for the SVC.

Communication with the National Load Control Center (NLCC) in Kabul shall be over existing optical fibers, all or part of which is contained in optical ground wires (OPGW) on transmission structures. Contractor will provide all terminal equipment, installation, and commissioning

necessary to connect with and use the existing optical fibers. Contractor shall coordinate with Employer and gain Employer approval of the proposed communication system design and coordinate any communication system outages or cut-overs of new equipment with Employer. The Contractor shall provide commissioning assistance to ensure proper communications between the control and the Employers SCADA system control center.

One purpose of the SVC is to assist the Employer in responding to abnormal utility system conditions.

Therefore, the Contractor shall design the control system, including its power supplies and connections to sensors, to be immune from utility voltage and/or frequency excursions, transients and similar events. The control system shall meet or exceed the surge withstand capability requirements of applicable IEC standards.

The control system shall provide for setting the operating mode and changing set points from a SVC operator console and by signals from the Employer's SCADA system. Initiation and continued operation in any of the modes shall be as allowed by the set operating state.

All local and remote control and monitoring system components shall be housed in a separate control room in the SVC building. The control system components shall be housed in freestanding, indoor metal-clad cabinets. The equipment shall be designed to operate properly at the maximum allowable temperature and humidity determined by the building HVAC design. Supplemental cooling for the control room may be provided if necessary.

The control system shall be of digital design. The design shall be such as to prevent externally supplied, control panel or local signals from causing the SVCs to operate in an unsafe manner or in a manner that may damage the SVCs, equipment, or the connected utility system equipment.

The SVC control shall include, as a minimum, the states and operating modes as outlined below.

Shutdown

The shutdown state shall be defined as 220kV circuit breaker(s) open; non-critical power supplies de-energized; control system power may remain energized. This mode includes both normal shutdown and system trips requiring reset.

The control system shall initiate shutdown under the following conditions and remain in the shutdown state until a reset signal, either local or remote, is initiated:

- Emergency shutdown operation
- Loss of station service (Simultaneous loss of both sources)
- Loss of cooling system
- 220kV circuit breaker trips that isolate the SVC
- Door interlock - initiate shutdown when the door to the valve room is opened. A "defeat" feature shall allow for maintenance. Interlocks shall be self-resetting.
- Smoke/fire alarm
- Fire Suppression operation
- Control logic trouble
- Failure to restart from disconnect state after automatic restart attempts
- Remote disable (no reset required)

Disconnect
The disconnect state shall be defined as 220kV circuit breaker(s) open; non-critical power supplies and control system power energized.

Some faults or failures are expected to be transient in nature. Normal faults should be cleared in about six (6) cycles by primary protection or 35 cycles by back-up protection. The SVCs shall stay on line for these cases.

The control system shall open protective devices upon fault occurrence and shall attempt to automatically start-up after a Contractor specified adjustable time delay without requiring a manual reset. The control system shall go to the disconnect state under the following conditions:

- Synchronization Error – The SVC is unable to synchronize with the utility grid.
- Grid transient conditions (i.e., line switching or reclosure action)
- Utility voltage out of emergency operating range for a length of time as defined in this specification.
- Utility line frequency out of emergency operating range as defined in this specification (field adjustable in 0.1 Hertz increments)
- Over-temperature on the SVC equipment, controls or other equipment.

Operate
The Operate state shall be defined as all circuit breakers closed and reactive power available to flow to or from the SVC and transformer systems to the utility systems. Normal operation shall include all operating scenarios as described herein. It also may include additional modes and sequences deemed necessary by the Contractor. The SVCs are operating normally and automatically, with no faults detected or alarms.

1.3.17.2 Operator Interface

The Contractor shall provide all the operator control, indication, alarm, and metering functions that are necessary for operating the SVC, either locally from the operator console in the SVC control rooms or remotely through supervisory control. The Contractor shall provide an interface to the Employer's SCADA system master station.

Local Control
Local control of the functions and set points for the SVCs shall be accomplished through an operator interface console located in the SVC control rooms. The operator console shall be equipped with a minimum of a 19-inch color LCD type monitor and a read/write compact disk/DVD drive. The PC for the operator interface shall be server quality and shall be equipped with redundant power supplies and hard disk drives. The Contractor shall provide remote access from Contractor's manufacturing offices to the operator interface to facilitate remote trouble shooting by factory personnel. Such remote access shall be coordinated with the Employer to address security concerns.

The operator console shall be designed so that alarms shall not be able to be deleted while they are active. The audible alarm signal shall be able to be silenced with a single keystroke or mouse click, but shall reset itself with the addition of a new alarm. The audible alarm shall have the capability of being defeated from the local control, as the site will be primarily unmanned. The operator shall be able to call up an alarm summary display with a single keystroke. The display shall enter the newest alarms at the top and if the display is full, delete the oldest alarms. The system shall log all alarms, control actions, and system abnormalities to a hard disk and shall send all alarms and other activities

directly to a local log printer furnished by the Contractor. The system shall have the capability to enable and disable the local printer from the local control console.

All control commands shall be of a select before operate (SBO) format. First, the component to be operated is selected then a clear selection of the control function to be performed is chosen (i.e. close or open) with "operate" and "cancel" commands. The state indication shall be shown with logical signs. The color of each equipment or function shall show the state of the equipment or function. Colors shall be designed to comply with the Employer's standard color scheme. Information on the standard color scheme will be provided to the successful Contractor.

The intermediate position or missing position of equipment such as motor-operated switches shall also be presented clearly.

The SVCs shall include a local control panel or console within the SVC buildings. The local control panel may consist of manual control switches, or, if fully redundant, may utilize control actions initiated by digital signals through a local control console. Emergency trip push buttons shall be manually operated and not require action from the digital control, as described elsewhere in these specifications. As a minimum, the following operator controls shall be located on the local control panel:

- Trip/close for the 220kV circuit breaker(s) connected to the main step-up transformer.
- SVC Start/Stop
- Reset toggle or push-button. When reset is initiated, the control system shall resume control and proceed to the appropriate operating mode
- Reset cut-out selector switch to disable remote or local reset signals
- A selector switch to manually set the operating state (i.e., shutdown, disconnect and operate) and to have the control systems set the operating state automatically
- A selector switch to manually set the operating mode and to have the control system set the operating mode automatically
- An emergency trip pushbutton shall be located near the control panel and be suitably protected to prevent accidental operation. Operation shall be as described elsewhere in these specifications.

Supervisory Control

The SVCs will be controlled by the Employer's system control center. The Contractor shall furnish all necessary equipment and functions to facilitate control from a remote location. The SVC controls shall have the equipment and capability to communicate directly with the Employer's SCADA system master station using a protocol compatible with the Employer's SCADA system. All functions necessary to operate and monitor the SVCs remotely will be available via the communications link. The Contractor shall ensure complete compatibility with the Employer's master station communications system.

The Contractor may provide remote control through a Contractor supplied RTU (Remote Terminal Unit). The RTU shall be interfaced to the SVC control using standard dry contacts and digital inputs/outputs or Employer approved digital protocols. All functions necessary to operate and monitor the SVCs remotely will be interfaced into the Contractor supplied RTU.

The Contractor shall provide a master supervisory/local control selector switch to be located on the SVC control enclosure or RTU. This switch shall disable all remote control functions, but shall not disable remote instrumentation, status and alarms functions. The control circuits shall be arranged to

ensure that when the selector switch is in the "supervisory" position, the associated controls on the operator control console in the SVC control room shall not be capable of affecting the device or function. Similarly, when the selector switch is in the "local" position, the associated remote controls shall not be capable of affecting the device or function.

SCADA Remote Terminal Unit
If required by the Contractor's design, a SCADA RTU will be provided by the Contractor that complies with the Employer's specifications for the monitoring and control of all equipment normally used for such control and monitoring by a power dispatch center. The RTU shall simultaneously communicate with the Employer's SCADA system and the local control system in the SVC control room via a communications link compatible with the Employer's SCADA system.

1.3.17.3 Monitoring and Instrumentation Requirements

The control equipment shall contain monitoring functions needed for safe and reliable operation of the SVCs. All protective functions and diagnostic monitoring shall be included. Two levels of alarm signals, namely warning and shutdown, shall be incorporated. Each alarm shall be annunciated to the SVC controls, logged by an events printer and annunciated remotely via SCADA.

Station Alarm System
The alarm and event system shall be capable of continuous monitoring of all points simultaneously and shall have a resolution of better than 10 ms.

The alarms and events shall be presented in chronological order with the status of the alarm shown in different color or text. The alarms shall be connected and synchronized to a GPS clock.

Each alarm on the system shall be categorized into levels of criticality such as critical and non-critical. Alarm processing shall be provided to filter system events on specific screens to ensure the operator is notified of primary events and is not inundated with lower level events which were created by other primary events. Each lower level alarm shall have the capability of being automatically upgraded to a critical alarm after a specified delay. A tabular screen shall be provided that lists a summary of all abnormal alarms.

A continuous monitoring system shall be provided to detect failures in the high power semiconductor devices and provide indication of each failure and its location within the valve. This indication shall be made available in the SVC control room. Indication shall also be made to a sequence of events recorder and a supervisory control status point so that valve failure events can be logged. The monitoring system shall be of fail-safe design such that failure of the monitoring system will be detected and appear as a valve monitor failure.

A complete monitoring system for the cooling system including warning, trouble, leaks and shutdown alarms shall be furnished. All warning alarms shall be annunciated on the SCADA system. Separate sensing devices (flow indicators, pressure switches, etc.) shall be used for SCADA indication and local indication.

The Contractor shall provide, at a minimum individual alarms and/or status change reports for the following types of events. It is possible that multiple levels of some alarms may be necessary to indicate warning and critical levels.

- Operation of any main and backup protection circuits
- Operation of control limits
- Operation of local/supervisory switch
- Operation of automatic/manual switch
- Loss of redundant equipment, including controls or operator interface

- Change in status of circuit breakers
- Circuit breaker trouble alarms
- Transformer trouble alarms
- Building door(s) and/or gate open
- AC & DC station service supply failure
- Cooling system fan or pump failure
- Cooling system trouble as specified in Section 1.3.16.3
- Capacitor unit failure
- Depleted demineralizer (de-ionizing) cell
- Low water resistivity
- Low water tank level
- Abnormal water or air flow
- High coolant or exhaust temperature
- High differential pressure across filter
- Relay or protection failure
- Loss of cooling system rated capacity
- Loss of synchronism with system voltage
- Excessive number of capacitor unit failures
- Excessive overcurrent in the high power semiconductor devices
- High power semiconductor device failure
- Fire detection/suppression system status and trouble alarms
- Battery charger trouble
- Battery voltage alarms
- Control PC trouble alarms
- Time synchronization status and alarms
- UMD or UPS status and critical alarms

Fault Recording System

The Contractor shall provide high speed, analog and digital fault recording of significant quantities, including but not limited to, AC and DC voltages, current harmonics to the 25th order, THD, and selected control and protection signals. The fault recording system shall be capable of communication with the Employer's control center via an Employer specified communications link. This system will be part of the communications system provided by the Contractor.

The event channels shall be designed with dry, potential free, contacts. The sampling rate shall be at least 96 samples per cycle. Each record shall include at least 0.2 seconds of pre-fault quantities and at least 1.8 seconds of post fault recording. The recorded values shall be retained in the case of a failure in the auxiliary power supply system. The fault recorder shall be synchronized with the GPS clock.

The event channels shall provide sequence of event time tags with a one-millisecond resolution and shall be time correlated to the analog portion within 1 millisecond. All time tagging shall be performed at the recorder. The output shall list the chronological sequence of occurrence of changes of state of each input, indicating the time of occurrence.

GPS Clock

The Contractor shall provide a GPS (Global Positioning Satellite) clock. The antenna shall be furnished and installed outdoors as recommended by the manufacturer. The GPS clock shall be connected to all alarm, monitoring, protection, and control system within the SVC. All time tagged alarms shall receive the time from the GPS clock. A redundant GPS clock shall be provided.

Metering and Instrumentation

All metering, sensors and test points in the SVC shall be easily and safely accessible for calibration, maintenance and troubleshooting by the Employer. The Contractor shall provide and install current and voltage test switches for each protective relay and for each set of metering within a CT circuit. The Contractor shall also install test switches for each protective relay input and output used.

The Contractor shall provide a complete metering system for the SVC, including any required current and voltage transformers, to measure all required parameters near the 220kV terminals of the SVC main step-up transformer.

The required SVC metering points are listed below. The metering shall have capabilities for local indication, local recording and remote supervisory indication. These are minimum requirements. The Contractor shall specify any additional metering needs.

- Total SVC MW/MVAr (reactive and capacitive)
- SVC line currents (each phase)
- Harmonic filter phase current (each phase)
- 220kV bus voltage (each phase and three phase)
- 220kV bus voltage (average)
- SVC AC bus voltage (each phase and three phase)
- Zero sequence voltage

1.3.17.4 Protection Requirements

The Contractor shall provide a complete protective relaying system based on prudent industry practices and local utility requirements. The protective relaying shall be integrated with the SVC control system. However, integration into the SVC control system shall not circumvent normal protective relaying functions.

All protective equipment and schemes shall be properly coordinated with the protection of the existing Substation.

The Contractor shall use microprocessor type protection equipment to the extent possible. All microprocessor relays used shall communicate to Employer's control center via an Employer approved communications link. This system will be part of the communications system provided by the Contractor. The Contractor shall provide a communications switch specifically designed for this purpose.

All protective relaying systems shall be redundant or otherwise provide back-up protective relaying functions. If the protective relay normally expected to operate fails or is out of service a second protective relay shall detect the fault and generate a trip signal to clear the faulted device or circuit element.

Two redundant high speed protective relays shall be provided for the SVC main transformer(s) and 220 kV busses. Each of the redundant relays shall have a separate CT core and if needed VT core. Breaker failure protection shall be provided on all 220 kV circuit breakers or 220 kV fault interrupting switches.

The low side bus and cable shall be protected by differential and overcurrent relays. Capacitor protection shall include, at a minimum, voltage unbalance protection with back-up overcurrent protection.

Low impedance differential relays shall provide 220 kV bus protection.

1.3.17.5 Communications Requirements

Telephones
The Contractor shall furnish all required permanent telephone(s) and the necessary equipment to interface with the local telephone company and all other devices required for a complete voice and data telephone communications system. The telephone(s) shall be located in the area of the operator's console. The Contractor shall provide any telephone communication circuits required during construction and for Contractor's remote access to the control system and other devices.

Remote Communications
The Contractor will provide digital communications to the control room area of the SVC buildings. The communications shall interface to the Employer's digital communications network. The Contractor shall provide the necessary communication cable from the existing Chimtala Substation to the SVC building and between the Kandahar East Substation and SVC building.

The Contractor shall be responsible for furnishing all Employer specified terminal equipment located in the SVC buildings. A specification on available communications and required equipment will be furnished to the successful Contractor.

SCADA functionality for the MSRs to be installed at Sayedabad and Ghazni may be provided by interconnection with the SCADA RTU supplied by the substation EPC contractor. Contractor is responsible for determining if the SCADA RTUs supplied by the substation contractor are adequate for the needs of this contract, and for all coordination necessary for design and installation.

Any unused digital ports shall be capped with an identifiable colored plug and electronically disabled from use. Contractor shall supply a list of all data ports, used and unused, for future audit purposes.

The Contractor shall provide communications for remote access from the Contractor's facilities to the SVC controls for the purposes of commissioning, troubleshooting and ongoing factory support. The remote access shall have full capability for all control indication and metering to allow the Contractor to assist in troubleshooting and maintenance of the SVCs after the contractor leaves the site and during the warranty period. These facilities may remain in place for the life of the SVCs. The Contractor shall propose a schedule of charges for assistance after the warranty period is complete. Any remote access for the purposes of Contractor use shall be coordinated with the Employer to address security concerns. Remote access may require the use of ground based or Satellite communications systems depending on the availability of telecommunications services at the site location.

1.3.18 Testing Requirements

The Contractor shall be responsible for compliance with all standard test procedures that shall progressively check the quality and performance of the SVC equipment.

The Contractor shall perform those design, production and commissioning tests specified below and in other sections of this specification.

The Bidder shall propose additional tests that will be conducted. The completeness of the proposed tests will be a factor in the bid evaluation. Where appropriate, tests shall conform to those contained in IEC standards and guides. Where standards are not suitable or applicable, other common industry procedures and mutually acceptable methods shall be used.

If certain design, production or commissioning tests are performed by manufacturers other than the Contractor, the Contractor has the responsibility to furnish the test reports and certify that the necessary testing has been performed.

If the SVC manufacturer will not be present for the field tests, the communications link between the SVC controls and the manufacturer's facilities shall be completely tested and operational prior to the start of any field operating tests.

1.3.18.1 Factory Testing

The Contractor shall develop and submit a factory test plan. As a minimum, sufficient tests shall be conducted to demonstrate that all controls, protective functions and instrumentation perform as designed and is in compliance with this specification. Successful tests performed on scale models or digital simulators will be deemed to meet the intent of this paragraph.

All equipment to be supplied by the Contractor shall be subjected to routine and design tests in the factory as required under the specifications for each piece of equipment.

Equipment with complex interfaces with other equipment, such as the SVC controls, shall be connected and tested as a system in the factory. The tests shall demonstrate full implementation and compatibility with the Employer's communication system and protocol.

The Contractor shall indicate in his proposal all the factory design and production tests which will be performed on all major components and parts. Standard tests previously performed on certain equipment may be acceptable. For standard items such as capacitors, and high power semiconductor devices, such reports on previously performed tests will generally be acceptable. However, for the major items such as the transformers, breakers, control system and cooling systems applicable specific performance tests will be required.

The test data shall be complete including drawings and shall clearly state the performance of the equipment subjected to the test. If the test data is for standard tests performed on equipment other than that being provided under this contract, the Contractor shall include a statement that equipment being furnished is identical in all respects to the equipment on which the particular test was performed.

1.3.18.2 Pre-Commissioning Field Tests

The Contractor shall perform pre-commissioning field tests on the fully assembled SVC facilities with the SVCs disconnected from the 220kV sources. The tests shall be performed on all equipment to ensure that no damage occurred in transit, all equipment has been properly installed, is correctly set, and is functioning correctly.

Pre-commissioning tests shall include, but not be limited to, the following:

- Dielectric and insulation resistance tests on all equipment connected to the 220kV system, consisting of power factor tests and hi-pot tests.
- Ratio and polarity tests on transformers and instrument transformers
- Insulating oil tests on transformers and other oil-insulated equipment
- Functional tests on auxiliaries
- Functional tests on control, protection and alarm circuits, including relay and control settings
- Functional tests of all interlock systems

- Wiring continuity and insulation resistance tests
- Diagnostic software functional demonstration
- Alignment and adjustment of all disconnect switches
- Verification and adjustment of cooling system
- Calibration and adjustment of all gauges, meters and instruments
- Measure grounding system resistance
- Capacitance test of capacitor cans
- All HVAC system components and overall operation
- All elements of the thyristor valve cooling system including the testing for redundancy and failover under "worst case" testing events

In addition to the above tests, the Contractor shall energize or start up all independent subsystems. These tests shall demonstrate the electrical and mechanical integrity of these subsystems.

During these tests, the Contractor shall make the initial adjustments to the equipment required for satisfactory operation.

Following the successful completion of the above tests, the Contractor shall perform system tests as required to demonstrate the proper functioning of the associated controls and protection. Such tests may include trial operation during which the Contractor shall make final adjustments to the equipment for satisfactory and proper operation.

1.3.18.3 Acceptance and Performance Tests

After successful completion of the pre-commissioning tests, the Contractor shall perform acceptance and performance tests to demonstrate that the SVCs perform as specified. All modes of operation as described in these specifications shall be tested. Prior to proceeding with acceptance and performance tests, the Contractor shall determine that the SVCs are fully operational and suitable for acceptance testing. Tests shall include verification of all sensors, meters, alarms, control functions, including automatic, local and remote control, and performance criteria.

The Contractor shall coordinate with the Employer for all tests where the SVCs are to be connected to the Employer's power systems. No such tests shall be performed unless permission by the Employer has been granted. The tests must be performed in a fashion to minimize unanticipated disturbances on the power system. These tests may have to be performed during the night or low load periods for certain types of tests.

The Contractor shall document all acceptance and performance tests performed. The Contractor shall submit documentation, analyses, and a summary in a test report for the Employer's records.

Function Tests

After the SVCs have been installed, the Contractor will perform comprehensive testing on the entire system to verify compliance with all requirements of this specification. Testing shall include, at a minimum, the following tests.

- Verify change of reference point and slope both locally and remotely
- Verify the automatic start-up and shutdown sequences, including restart following undervoltage trip. This includes both those that are initiated automatically by the SVC controller, and manually by a system operator from both local and remote locations.

- Verify the automatic sequences of blocking and unblocking the valves.
- Demonstrate the repeatability of control system functions such as voltage set-point changes.
- Operation of all control, protective relaying, and instrumentation circuits shall be demonstrated by direct test if feasible or by simulating operating states for all parameters that cannot be directly tested. Automatic, local, and remote operation will be demonstrated.

Performance Tests

The SVC performance verification shall include tests as determined by the Contractor to verify that the performance criteria specified in these specifications can be met or exceeded. Accordingly, the Contractor shall provide a total system performance verification plan to ensure correct SVC response to system disturbances and operating scenarios described in this specification. The total system performance verification plan shall be submitted to the Employer for review and approval 60 days prior to SVC performance tests.

At a minimum, the following performance tests shall be performed:

- Measurements of harmonic content at full and partial output levels.
- Measurement of losses to verify the factory loss target values were met in the field under actual conditions, at the full and no load set points.
- Interference measurements
- Tapchanger control (if provided)
- Operating mode transfers
- Performance under system disturbances and faults including the performance of staged system faults.
- AC and DC auxiliary supply changeover or failure
- Demonstrate and measure the SVC system operation and performance under prevailing system condition for a continuous 48 hour period.

The Employer will not accept the SVC until all acceptance tests have been successfully completed.

Actual Operating Experience

It may not be possible due to system constraints to test all facets of the SVC function as part of the performance verification tests specified above. The actual operating experience of the SVC system through the warranty period shall be deemed an extension of the performance verification tests.

Actual operating experience will be documented through Contractor furnished sequence of event recorders, digital fault recorders and other system monitoring equipment capable of identifying system disturbances and associated SVC performance.

Documented failure or malfunctions of any SVC component during the warranty period shall be deemed as a failure of the system commissioning test. The Contractor shall, at no cost to the Employer, make the necessary repairs, replacements, modification or adjustment to prevent the same failure or malfunction from occurring again. The replacement of certain SVC components in response to a system failure may necessitate, at the discretion of the Employer, the duplication of certain performance verification tests which shall be performed at the Contractor's expense.

1.3.19 Training

The Contractor shall provide training for the SVC facilities as specified below. The Contractor shall determine the content and duration for each training session. The Contractor shall provide all material and equipment, as well as qualified fluent Dari speaking instructors, to conduct the training program. It is preferred that as much of the training as practical be held at the SVC site. Classroom sessions may be held in a convenient location close to the site with site visits to supplement the training. Preliminary information on the content of each training session shall be submitted with the proposal.

Training manuals shall be provided to each trainee attending each course. At the completion of each course, the training manuals and any other training aids shall become the property of the Employer.

The suggested class durations in this specification are meant to illustrate the level of training expected. In preparation of the course material, the Contractor shall consider that the Employer's personnel are familiar with substation equipment, including control, protection and communications. The Employer's personnel are not familiar with power electronics and associated systems.

Training shall be conducted in Dari in Afghanistan.

Training shall be videotaped, edited and indexed by the contractor, and provided to Employer for reference in the future.

1.3.19.1 Orientation Training

The Contractor shall provide one Orientation training session. It is anticipated that the Orientation training will be held over a two-day period with one 4-hour session per day. These sessions shall be suitable for managers, supervisors, professional and technical personnel. Each session will be limited to a maximum of 12 people.

The orientation training session shall be scheduled before commencing SVC performance verification tests. An outline for this orientation training shall be submitted to the Employer 90 days ahead of the actual date of training. Approval of this outline shall be obtained from the Employer. The Employer will provide comments and/or approval 30 days before the scheduled training date.

1.3.19.2 Operator Training

The Contractor shall provide the necessary training in proper operation of the SVC and related equipment. This training shall be conducted after completion of the SVC performance verification testing, but before system commissioning. The training shall thoroughly familiarize the operating personnel with the various aspects of the SVCs including operation from a SCADA system so that at the completion of the training they will be able to completely and properly operate the SVC equipment without Contractor assistance. Emphasis shall be placed on hands-on operating experience interspersed with the critical background as necessary, including switching procedures and emergency response training.

The Contractor shall provide two Operator training sessions to accommodate a rotating shift schedule. It is anticipated that this session will last 1-2 days. Each session will be limited to a maximum of 12 people.

1.3.19.3 Emergency Procedures Training

The Contractor shall provide the necessary training in emergency procedures to allow the Employer's personnel to respond to emergencies at the SVCs. Such training shall include

emergency shutdown procedures, switching to isolate the SVCs, fire procedures, and any other procedures the Employers maintenance personnel may be required to respond to.

The Contractor shall provide one Emergency Procedures training session. It is anticipated that emergency procedures training will last 1 day. Each session will be limited to a maximum of 12 people.

1.3.19.4 Maintenance Training

The Contractor shall provide necessary training in maintenance of the SVCs and related equipment. The maintenance training shall be scheduled after successful commissioning of the SVCs. The training shall thoroughly familiarize the maintenance personnel with the various aspects of the SVCs. Maintenance training shall include preventative maintenance as well as troubleshooting. Maintenance of digital controls and microprocessor control systems used in the SVCs shall be emphasized. At the completion of training, the maintenance personnel should be able to completely and properly maintain the SVC facilities without Contractor assistance. The maintenance training shall include, but not be limited to:

- Normal maintenance methods
- Repairs and replacement
- Diagnostic procedures
- Equipment calibration
- Re-energization
- Special tests
- Special tools
- Safety and grounding procedures

The Contractor shall provide two Maintenance training sessions. It is anticipated that maintenance training will last 1-2 days. Each session will be limited to a maximum of 6 people.

The Maintenance Training shall be recorded by the Contractor and provided to the Employer on DVD for use in training new personnel and as a refresher course.

1.3.20 Maintenance and Spare Parts

The SVCs shall be designed so that regular maintenance may be carried out by either the Contractor (under a separate contract) or by the Employer. Failure rates and duration of resupply (production delays) should be used to calculate and show the Employer that the appropriate level of spare parts is provided. Usage rates, and causes of failures during the warranty and/or the field engineering periods shall be maintained and reported by the contractor, and at the end of all warranty and engineering/maintenance service periods and exact inventory and status report shall be provided to the Employer with a priced option list of spares, tools and other equipment which should be place on order to assure that the next yearly period will be adequately supplied.

1.3.20.1 Maintenance by Contractor

The Contractor shall assist with Operations and Maintenance of the RPC system. The scope these services is described in Section1.3.23.

1.3.20.2 Maintenance by Employer

The Employer may elect to operate and maintain all equipment for the SVCs with its own personnel. To support this, the Contractor shall design and supply equipment with commercially available, "off the shelf" parts to the extent possible.

The Contractor with the assistance of its major equipment suppliers shall conduct training classes for Employer maintenance personnel at the site.

The Contractor shall remain available by telephone, e-mail or fax and provide consultation and required repairs for the Employer if the system malfunctions during the warranty period.

In its proposal, the Contractor shall supply a description of all major maintenance activities, including estimated man hours and frequencies of occurrence for each activity.

1.3.20.3 Spare Parts

The Contractor shall evaluate its design with regard to failure rates, effects and SVC reliability and availability. The Contractor shall provide a recommended spare parts list, including prices and availability, as part of his proposal. Spare parts that are readily available from stock and available within sufficient time to meet the required availability shall be considered off-the-shelf items and not required as spare parts in stock at the site. These parts shall be listed and so noted on the spare parts list. The Employer will determine the need for and purchase separately all spare parts.

All spare parts for equipment covered by this specification shall be interchangeable with the original equipment and shall comply in all aspects with the requirements of this specification. This includes documentation identical in kind and format to that required for the original equipment or material.

The Contractor shall update the electronic spares prior to the end of warranty to assure proper operation in the future. The Contractor shall provide updated programmable memory components to the end of the warranty period. There shall be two sets of programmed memory elements available at both SVC stations at all times.

1.3.20.4 Tools and Equipment

The Contractor shall provide all "special tools and equipment" for maintenance and operation which are not normally or readily available.

The Contractor shall submit, with the proposal a complete list of tools and equipment needed for erection/installation and maintenance and a list of special tools and equipment that will be provided, including prices. Special tools and equipment shall become the property of the Employer at the completion of the SVC installations. The Employer reserves the right to purchase additional quantities of tools if desired. Specifically include capacitor test set, electronic card extenders and any special cable assemblies and configured PC with operating system with a license prepaid for ten years.

The Employer will supply common tools and maintenance equipment. Common tools and maintenance equipment in this context shall mean tools and maintenance equipment available commercially from two or more independent suppliers. The Contractor will supply all common tools and maintenance equipment throughout the maintenance.

1.3.21 Documentation

1.3.21.1 Document Submittal Quantity and Procedures

The Contractor shall furnish complete documentation that will be used for determination of contract compliance, as well as, operation and maintenance of the SVCs. The documentation shall be in accordance with the documentation section of these specifications.

At a minimum, Contractor's documentation shall consist of the following:

- Construction and Installation Drawings
- Construction Materials Submittal
- Equipment Drawings and Specifications
- Operation and Maintenance Manual
- Maintenance Schedule
- Master Test Plan and Procedures
- Quality Assurance Manual
- Software Documentation
- Study Reports
- Test Reports
- Training Manuals

1.3.21.2 Maintenance Schedule

The Contractor shall prepare a comprehensive maintenance schedule listing required maintenance for all equipment based on specific maintenance triggers.

This schedule will cover the equipment design life and make direct reference to maintenance requirements listed in the Operation and Maintenance Manuals. The maintenance schedule shall include an estimate of the man-hours and equipment required to complete each task.

1.3.21.3 Master Test Plan and Procedures

The Contractor shall submit a Master Test Plan and Procedures indicating the order in which the tests will be conducted and the test method being used along with required instrumentation. The test plan shall include all types of tests required by these specifications and shall demonstrate that a complete testing plan is being proposed.

1.3.21.4 Study Reports

The Contractor shall submit all design study, simulation and field test reports to the Employer in a timely manner in accordance with the documentation requirements. These reports shall contain assumptions, study methods, results, significant findings and conclusions. The Contractor shall submit reports for all studies required by these specifications.

1.3.21.5 Test Reports

The Contractor shall prepare test reports. Formal test reports are required for all tests listed in the Master Test Plan and Procedures. The test reports will include the subject test plan, required data, test results and discrepancy reports or failure reports resulting from performance of the tests.

1.3.21.6 Training Manuals

The Contractor shall provide draft training manuals and course outlines for review 45 days prior to the start of training. The training manuals will include relevant portions of the Operation and Maintenance Manuals and Software Documentation and will be retained by the Employer. The Employer shall have the right to reproduce any training manuals for their own use.

1.3.21.7 Operation and Maintenance Manuals

The Contractor shall furnish operation and maintenance manuals for all the equipment as applicable. Clarity and readability shall be of the highest commercial standards. The books shall be oriented toward operation and maintenance of the equipment without the services of a manufacturer's representative. The portions devoted to descriptive matter and theory shall be limited to those that are essential to a proper understanding of the equipment for satisfactory operation and maintenance.

The Employer shall have the right to reproduce any Operation and Maintenance manuals for their own use.

The operation and maintenance manuals shall include, but are not limited to, the information specified below:

- Manufacturer's Definitions: All terminology peculiar to the Contractor's equipment shall be clearly explained by the Contractor in a supplementary section bearing the heading "Definitions."
- Factory Specification of the Equipment
- Shipping Instruction, Warehouse Storage, and Handling Instruction: List major components for warehouse inspection, and site receiving and storage instructions.
- Parts and Factory Service Instruction: Factory repair policy shall be provided. Describe in detail the procedure to obtain spare parts or factory service: (1) under normal conditions, (2) under emergency conditions. Specify the mailing address and telephone number(s) of the service department.
- Installation Instructions: Installation instructions and information to supplement the installation drawings shall be furnished. This information shall include power requirements, assembly procedures, safety precautions, grounding instructions, alignment instructions, installation test requirements, and details associated with equipment testing to verify proper performance.
- Preventive Maintenance Instructions: Preventive maintenance instructions shall be furnished for all subsystems indicating manufacturers' recommended maintenance intervals based on specific maintenance triggers. These instructions shall include required test procedures, alignment instructions, cleaning requirements and instruction for visual examinations.
- Maintenance Schedule: The maintenance schedule shall include maintenance trigger points for each type of equipment. Such trigger points shall identify monitored parameters that can be used to perform preventative maintenance when needed based on operating conditions rather than time based maintenance. The preventive maintenance instructions shall include a table indicating the average man-hours required to complete a maintenance action, outage time if required and on-line/off-line requirement for the maintenance action.
- Troubleshooting Instructions: Troubleshooting instructions shall be to the spare parts level with adequate details for quick and efficient location of cause for equipment malfunction. Include adjustment limits, timing diagrams, troubleshooting and recommended corrective action steps, and resetting requirements before return to service. For mechanical items, information on tolerances, clearances, wear limits, and maximum bolt-down torques shall be supplied.
- Parts information: This section shall contain a complete parts list and subsections which include a breakdown to the smallest assembly considered a replacement part, showing name and description, catalog number, quantity used, and reference by item number on the applicable drawing. The description shall include electrical and mechanical ratings, settings, nameplate drawings, additional instructions or instruction books, testing requirements, wire list, curves, drawings, and inspection and installation instructions.
- Spare Parts: A list of spare parts as recommended by the manufacturer, including the descriptive information listed in the preceding paragraph.

- Tools Information: A list of all tools needed to install or maintain the equipment shall be provided in this section. Tools shall be identified by either the Contractor's part number or manufacturer's part number and cross-referenced where applicable. All special tools supplied with the equipment shall be identified as such on the tool list.
- Theory of Operation: Include a system overview and detailed information pertaining to the individual systems and subsystems that make up the SVC, as shown on a Contractor supplied outline, logic, schematic, and one-line diagrams. The SVC control and protective functions shall be numbered and cross-referenced to insure easy identification on the above diagrams. Specifically the Contractor is required to provide narrative describing the control and protective logic of each function such that the operating principles can be readily understood. Portions devoted to describing fundamental theory shall be limited to those that are essential to a proper understanding of the equipment operation.
- Controller User Interface: The instructions shall describe the Controller User Interface in detail and specifically include instructions and examples for calculating and setting all user controlled parameters. The description shall identify in detail exceptional system conditions (if any) where the conventional settings may have to be altered.

- Installation Procedure: This section shall include a detailed step-by-step instruction of the SVC test procedure and calibration. Additional information shall include power requirements, assembly procedures, safety precautions, grounding instructions, and installation test requirements.

1.3.21.8 Digital Controller Software Documentation

All controller software and any subsequent fixes, patches, or upgrades shall be fully documented. The Software Design Document shall detail the design of the controller software. This document will include the following types of information.

Software Overview
The Software Design Document shall provide an overview of the controller software. This overview shall include a list of controller algorithms and a description of how each of these algorithms interrelates with the others. This description shall either be provided as a narrative or as software control flow diagrams.

Documentation of Individual Modules
The Software Design Document shall include separate documentation for each controller module or algorithm. Information specific to individual modules or algorithms shall include:

- A functional description of the module.
- A Data Flow Diagram that depicts the interfaces between the module and other controller software routines.
- A Module Interaction Summary that narrates the information presented in the Data Flow Diagrams.
- A list of GLOBAL data elements used within the module, including a full description of each data element, its type, how it is used, and its range of values.
- A list of LOCAL data elements used within the module, including a full description of each data element, its type, how it is used, and its range of values.
- A list of control inputs required by the module.
- A list of outputs directly affected by the module.
- Pseudo code (structured English) description of the algorithm's high level design.
- Other information required for an understanding of the function of the algorithm.
- PLC code, logic diagrams and/or ladder logic diagrams.

Data Dictionary
The Data Dictionary shall be an alphabetically arranged source of information on each data element used in the controller software system. The Data Dictionary shall provide a description of each data element used in the controller software, including descriptions of:

- Data element type.
- Data element use by the Applications Software.
- The acceptable range of values for the data element.
- The program modules in which the data element is used.

Error Messages List

The Error Messages List shall be a source of information on error messages issued by the controller. This information shall include a description of the type and meaning of each error message, how it is used, and what corrective action is required to solve the problem. The Error Message List shall include information on:

- Error messages generated by the Operating System
- Error messages generated by the Hardware Diagnostics
- Error messages generated by the Applications Program

1.3.21.9 Digital Controller Hardware Documentation

The contractor shall provide manufacturer standard specifications and model numbers of all controller hardware.

1.3.21.10 Relay and Control Settings

The contractor shall provide complete documentation of all protective relay and SVC control settings. Such documentation shall include all calculations and coordination curves used in the development of the settings.

1.3.21.11 Drawings

Drawings shall be provided in electronic form compliant with A/E/C CAD Standard Release 4.0, July 2009. AutoCAD 2012 shall be used.

1.3.22 Warranty

1.3.22.1 Twenty Four Month Construction Warranty

Contractor warrants that all Work performed under this Contract shall be in accordance with the Contract documents and specification and all applicable national and local laws and regulations in existence at the time of execution of the Contract. Contractor makes all such warranties for a period of twenty four (24) months after the date of final acceptance of the project by the Employer. Contractor shall provide an option for extending the warranty for an additional 12 months in his proposal.

If it is demonstrated within the warranty period the Work fails to meet the provisions of this warranty, Contractor shall promptly correct any defects, including, nonconformance with the specification, either, at its option, by adjustment, modification, repair, or replacement of all defective parts or materials (Correction Measure), including adjustment, repair or replacement of any portion, component, part and/or assembly.

Contractor shall be required, at its expense, to take any or all of the Corrective Measures to correct any defects and deficiencies in the Work before and during the warranty period, including without limitation, transportation expenses of equipment and personnel to and from the job site, and in and out expenses.

All Corrective Measures taken by the Contractor shall be subject to Warranty for twelve (12) months from the date of the Corrective Measure for the corrected portions. If Contractor, after written notice from Employer, fails to proceed to correct defective Work or otherwise to comply with the terms of Contractor's Warranties, Employer may have the Work corrected as it deems appropriate and Contractor shall be liable for all expenses incurred to correct the defective Work by Employer to include without limitation Employer's overhead costs.

Contractor does not warrant the Work or any required repairs or replacement under this provision against normal wear and tear including those due to operation or environment. The Work must be operated and maintained in accordance with Contractor's instructions and prudent utility practices.

The liability of Contractor under this warranty (except as to title) shall constitute the exclusive remedy for all equipment damage claims based on failure of, or defect in, goods or services sold hereunder, whether the failure or defect arises before or during the warranty period, and whether such claim, however instituted, is based on Contract, indemnity, guarantee, tort, (including negligence), strict liability or otherwise. The foregoing warranty is exclusive and is in lieu of all other warranties whether written, oral, implied, or statutory. As to all goods sold, no implied statutory warranty of merchantability or of fitness for particular purpose shall apply.

1.3.23 Operations and Maintenance Services

This service commences at the beginning of commercial operation and terminates three years thereafter.

A minimum of three qualified people who are technically qualified and are fluent in written and spoken Dari or are accompanied by a full time translator will be required. Contractor's O&M staff will work the customary work schedule for Employer's personnel (normal duty shift) and be available on-site within two hours on an on-call basis after a normal duty shift. The SVC Engineer in Charge will normally work at the National Load Control Center (NLCC). The SVC Engineer in Charge will provide support as further described below as well as liaison with the SVC OEM technical expert staff. One of two on-site Field Engineers will work at Chimtala Substation and one at Kandahar East Substation. The Field Engineer will be the principle party to train and assist with the physical O&M of the SVC(s) and associated MSRs and MSCs. The SVC Engineer in Charge will rotate to cover activities at the SVC sites when a Field Engineer is unavailable to do so. The SVC Engineer in Charge and the on-site Field Engineers will be available on-site within two hours of notice when not on a normal duty shift.

The Employer will provide security. The Contractor may provide his own security measures in addition to those provided by the Employer.

Dispatcher communications, Switching Operations, Outage Clearance Requests, and Clearance "Holders" will be appropriate Employer's Operations and Maintenance staff.

Any SVC work conducted by the Contractor will be coordinated with and require the approval of the appropriate Employer's on-site Operations and Maintenance Supervisor.

All Employer Health and Safety Provisions will apply to the subject work.

The following general activities are envisioned but may be expanded by the Contractor:

1.3.23.1 On Site Field Engineer (O&M)

- Develop and document (with SVC supplier) routine maintenance and inspection program that is in concert with the SVC supplier Master Maintenance Procedures and Schedule.
- Manage and lead routine inspection and maintenance with emphasis on training DABS personnel on proper procedures and providing DABS personnel with hands on experience.
- Respond to forced outages and other unplanned events by restoring plant to service, making repairs and/or acquiring additional parts or equipment to restore plant to pre-event

level of readiness, and using the event as an opportunity for on the job training during event response and lessons learned training after event is resolved.

- Develop and implement a transition plan to turn O&M over to DABS personnel at the termination of the contract
- Manage and procure replacement spares and consumable parts through the SVC supplier and approved secondary suppliers, as well as the management of any maintenance subcontractors or other site activities related to the SVC projects, including the semi-annual scheduled inspection and repair periods.
- As time permits, conduct classroom and practical training to DABS staff

1.3.23.2 Power System Operations – SVC Engineer in Charge

- Provide local management of the O&M contract and supervision of the On-Site Field Engineers
- Manage the Field Engineer's Maintenance and Repair schedules, field maintenance training performance, and during the Field Engineer's absence provide coverage for the Field Engineers activities, including first responder support.
- Provide liaison with the SVC supplier's home office commercial and technical staff for both day to day support and to improve the performance and reliability of the SVCs
- Work primarily with staff at the NLCC
- Perform power flow and dynamic analysis of the system for actual system operating conditions and contingencies from those operating conditions to better support and train the NLCC staff in system level operation of the SVCs and associated MSRs and MSCs.
- Develop and train DABS NLCC staff on switching procedures such as system energization after outages, response to specific events (e.g. permanent fault on one circuit of PeK to Chimtala line), deployment of MSCs and MSRs for different loading and system configuration scenarios, operating point and operating mode selection for SVCs and so on.
- Manage NLCC staff response to system contingencies as it pertains to the operation of the SVCs and associated MSCs and MSRs.
- Manage NLCC staff response to changing load and power supply situations as it pertains to the operation of the SVCs and associated MSCs and MSRs.
- Develop and implement a transition plan to turn these responsibilities over to DABS personnel at the termination of the contract
- As time permits conduct classroom and practical training on more general topics related to power system operation as it pertains to SVCs and their associated MSCs and MSRs
- Conduct post-event analysis and lessons learned training after system outages or unplanned events
- Conduct post-event maintenance procedures and corrective actions to improve maintenance procedures, improve reliability, and to participate with the OEM's technical center of excellence in the improvement of the delivered SVC systems.

1.3.24 SVC and Overall System Studies

Engineering and performance studies shall be performed within the scope of supply. The Contractor shall perform design and simulation verification studies at its own facilities to ensure proper design

and operation of the RPC system, which includes mechanically switched reactors (MSRs), mechanically switched capacitor (MSCs) and Static VAr Compensators (SVCs).

The studies shall demonstrate that the RPC will perform together as a complete system and that the proposed design will meet the requirements of this specification as well as in all aspects perform equal to or better than the representative design summarized by the equipment list in Table 1.1.1These studies are in addition to the actual SVC design studies and performance tests. Final RPC design shall use the substation locations and equipment locations identified in the representative design and follow the approach to RPC deployment established in the representative design presented in this document. MSC and MSR sizes and locations specified in Table 1.1.1 shall be used in the design. The SVC dynamic range shall be at least the range specified in Table 1.1.1.

The Contractor shall allow the Employer, his engineer or designated representative to witness, review and provide comment on such studies and simulations.

The Contractor shall document and present results of analytical studies for Employer review and approval. Documentation shall include complete functional descriptions of the communication and control systems to be employed so that the completed RPC system will automatically function as single integrated system. Documentation shall demonstrate that proposed RPC system meets this specification and meets or exceeds all aspects of performance of the representative system summarily described in Table 1.1.1.

The study shall take into account that the SVC control will be capable of automatically operating the MSCs and MSRs. The Chimtala SVC will control MSRs and MSCs at Chimtala and the Kandahar East SVC will control MSRs and MSCs at Kandahar East. The SVC controlers will switch MSRs and MSCs to allow the SVCS to operate near the zero output point. Both existing and new MSCs and MSRs will be controlled from the SVCS. Rapid switching of MSCs and MSRs may be used as part of the dynamic response of the SVC.

Steady state voltages on all transmission buses shall be with 0.95 and 1.05 per unit for the base cases provided for study. Post-disturbance steady state voltages for design contingencies measured ten seconds from disturbance initiation shall be within 0.9 to 1.1 per unit at the Chimtala 220 kV bus. Design contingencies shall include:

- Loss of 60 MVAR Chimtala Substation 110 kV MSC
- A three-phase line fault followed by loss of both 220 kV circuits between the Qalat and Kandahar East substations. This contingency determined the amount of reactive power that must be absorbed by the Chimtala SVC. This is Scenario 5 in the "ADD TITLE" which supports this specification.
- A three-phase line fault followed by loss of one 220 kV circuit between the Pul-e-Khumri and Chimtala substations. This contingency determined the amount of reactive power that must be provided by the Chimtala SVC. This is Scenario 11 in the "ADD TITLE" which supports this specification.
- A three-phase bus fault followed by loss of 60 MW of load at the Kandahar East 110 kV bus. This contingency determined the amount of reactive power that must be absorbed by the Kandahar SVC. This is Scenario 16 in the "ADD TITLE" which supports this specification.
- Applying load to the largest transformer at Kandahar East with the remainder of the NEPS-SEPS connector loaded to RPC design levels. This is a sudden increase in load of 35.3 MVA (30 MW at 0.85 power factor) with the rest of the NEPS-SEPS connector

loaded to 176.5 MVA (150 MW at 0.85 power factor). This contingency determined the amount of reactive power that must be provided by the Kandahar SVC. This is Scenario 14 in the "ADD TITLE" which supports this specification.

Studies will be performed using up to five different Employer provided databases which will define controlling system conditions for RPC design. Studies will include the SVC controlled switching of MSCs and MSRs. Studies to be performed for each of these databases include:

- Steady state power flow for the intact systems with and without the NEPS-SEPS Connector in Service
- Sensitivity cases to determine steady state 220 kV voltage change when capacitor steps are switched
- Systematic dynamic simulation of single line to ground and three phase faults on 110 kV and 220 kV transmission system lines and buses between:
  - The Pul-e-Khumri 220 kV bus and the Kabul North 110 kV bus, including the Kabul 110 KV bus, with and without the NEPS-SEPS connector in service.
  - The Chimtala 220 kV bus and the Kandahar East 220 kV bus.

Bus faults will result in the bus tripping off line. Transmission line faults will be modeled as permanent and temporary. Permanent transmission faults will be simulated with one reclose attempt followed by line tripping. Temporary transmission line faults will be simulated with one successful reclose after the fault has been cleared followed by the line being restored to service. The purpose of these simulations is to create a record of expected RPC and system response to disturbances for operator training and system planning. They will also illustrate the operation of MSCs and MSRs under SVC control. Some cases may not meet the 0.9 to 1.1 per unit post-disturbance steady state voltage criteria. Contractor shall separately tabulate such cases in their report to the Employer.

Dynamic simulations to validate performance for the design contingency cases with and without the NEPS-SEPS Connector (which includes an SVC at Kandahar East Substation) in service. The NEPS-SEPS Connector will be modeled at two different load levels.

The Employer will make available the fundamental frequency power flow and dynamic stability data bases in Siemens/PTI PSS/E format. The Contractor shall sign a release specifying that the data base is for the Contractor's in-house use for this project only before the data bases will be made available. The data bases shall not be used for any purpose other than this project shall not be disclosed to any third party without written consent of the Employer.

Contractor studies shall be based on models and data that accurately represent the SVC, voltage regulator function, capacitor and reactor bank controls, timing, logic and limits to be supplied. The SVC model and data used for the Employer's study were based on assumed data that may not represent the contractors SVC. It is expected that performance of the Contractor's actual SVC model will more accurately represent the physical SVC to be supplied than the Employer's assumed model and data.

1.3.24.1 Step Response Study

A simulation analysis of 1% step reference changes for system pre and post fault system conditions shall demonstrate the SVC's linear response time under the pre and post fault system conditions.

1.3.24.2 Control Interactions

Studies shall confirm satisfactory operation of the SVC voltage regulator functions. In addition, these studies shall demonstrate satisfactory operation of any supplementary controls included in the SVCs. The study shall demonstrate that there is no unfavorable interaction with other nearby control systems or equipment.

1.3.24.3 SVC Model

For the purpose of the above system studies, the Contractor shall develop and deliver to the Employer an accurate power flow and dynamic simulation models of the supplied SVCs compatible with Siemens/PTI PSS/E Version 32.02.03. The Employer will use this model for future system studies. The model shall provide, as a minimum, the following features:

- Accurately represent the as-built operation and performance of the SVC for a time frame up to 60 seconds.
- Model shall provide the Employer with appropriate feedback on the various aspects of SVC operation during a simulation. The following are deemed minimum display requirements: SVC limit operation, SVC blocking, SVC restarting, and others deemed to be of interest by the Contractor.
- Clear and accurate documentation of the theory and modeling techniques (including assumptions) used for the model. Include examples for calculating and setting all Employer controlled parameters and data.
- Clearly documented model code throughout the model (liberal use of comments)
- Model documentation shall include a narrative description of model operation, model assumptions, model approximations, user instructions for the model, transfer functions and block diagrams illustrating model functions, logic diagrams, equations describing SVC relationships, and other items to clearly document the model.

1.3.24.4 Employer Provided System Model

While a good faith effort has been made to provide an accurate representation of the system, the Siemens/PTI PSS/E models will, of necessity, be based in part upon representative or estimated data. The Contractor shall evaluate the impact of possible errors in the accuracy of model parameters and, following consultation with the Employer and/or Employer's representative, perform sensitivity analyses to evaluate the impact of changes in the most critical parameters. The Employer will provide a report and review the results of these sensitivity studies with the Employer and/or Employer's representative to determine if changes in design will be requested to account for the impact of potential errors in the model input parameters.

1.3.24.5 System Effects

Valve firing circuits shall be designed to be immune to rapid changes in the 220 kV bus voltage amplitude and/or phase as may occur due to fault and clearing disturbances in the power system. This immunity shall be demonstrated by simulation tests of the SVC firing system and/or by high frequency (delta T equal to 50 μs or less) simulation modeling of the SVC.

1.4 Schedule of Supply

1.4.1 Chimtala SVC and RPC Schedule of Supply

Schedule No. 1 Chimtala SVC and RPC: Supply of Major Plant and Equipment

Item No.	Description	Units	QTY

1.1	Supply of 220kV Feeder Bays	EA	0
1.2	Supply of 220kV Future Feeder Bay	EA	0
1.3	Supply of 220kV Transformer Bay	EA	0
1.4	Supply of 220kV Future Transformer Bay	EA	0
1.5	Supply of 220/110kV Autotransformer Bay	EA	0
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	0
1.7	Supply of Auto Capacitor Bank Bay	EA	4
1.8	Supply of Future Auto Capacitor Bay	EA	0
1.9	Supply of 220kV SVC Feeder Bay	EA	2
1.10	Supply of SVC System (with 24 month warranty & spares)	LS	1
1.11	Supply of Reactor Bay	EA	1
1.12	Supply of Future Reactor Bay	EA	0
1.13	Supply of 20kV Switchgear & Station Battery	LS	0
1.14	Supply of Control/Relay/Metering Panels	LS	1

Schedule No. 2 Chimtala SVC and RPC: Supply of 110kV Plant and Equipment

Item No.	Description	Units	QTY
2.1	Supply of 110kV Feeder Bays	EA	0
2.2	Supply of 110kV Future Feeder Bay	EA	0
2.3	Supply of 110kV Source Bay	EA	0
2.4	Supply of 110kV Future Source Bay	EA	0
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0

Schedule No. 3 Chimtala SVC and RPC: Supply of General Plant and Equipment

Item No.	Description	Units	QTY
3.1	Supply of Substation Fence & Gates	LS	1
3.2	Supply of Control and Other Buildings	LS	0
3.3	Supply of 400V Building Power Distribution	LS	1
3.4	Supply of Utility Systems & Connections	LS	1
3.5	Supply of General Area Ground Grid System	LS	1
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1
3.7	Supply of Concrete Wireway Trenches	LS	1
3.8	Supply of Emergency Generator & Fuel System (housed)	LS	1

Schedule No. 4 Chimtala SVC and RPC: Mandatory Spare Parts

Item No.	Description	Units	QTY
4.1	Protection System	LS	1
4.2	HV Control Equipment	LS	1
4.3	LV AC System	LS	1
4.4	DC Distribution System	LS	1
4.5	HV Equipment (SVC spares priced in SVC materials)	LS	1
4.6	20kV Metal Clad Switchgear	LS	0
4.7	Power Transformers	LS	0

Schedule No. 5 Chimtala SVC and RPC: Standard Tools

Item No.	Description	Units	QTY
5.1	Substation Maintenance Tools & Appliances	LS	1
5.2	20kV MV Cables	LS	0
5.3	20kV Metal Clad Switchgear	LS	0

Schedule No. 6 Chimtala SVC and RPC: Design, Drawings, and Documentation

Item No.	Description	Units	QTY
6.1	Structural Design And General Arrangement Drawings	LS	1
6.2	Site Civil Design Drawings	LS	1
6.3	Building and Structure Design Drawings	LS	1
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1
6.5	Control Circuits & Wiring Drawings	LS	1
6.6	Coordination Study & Relay Settings Instructions	LS	1
6.7	General Construction Drawings	LS	1
6.8	As Built Drawings	LS	1
6.9	Maintenance Manual And Completion Report	LS	1

Schedule No. 7 Chimtala SVC and RPC: Installation and Other Charges

Item No.	Description	Units	QTY
7.1	Project Management	LS	1
7.2	Project Reporting	LS	1
7.3	Project Insurance	LS	1
7.4	Compliance with MOSS	LS	1
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1
7.6	Pavement of Road & Parking Areas	LS	1
7.7	Security Wall, Towers, & Gates	LS	0
7.8	Installation of 220kV Feeder Bays	EA	0
7.9	Installation of 220kV Future Feeder Bay	EA	0
7.10	Installation of 220kV Transformer Bay	EA	0
7.11	Installation of 220kV Future Transformer Bay	EA	0
7.12	Installation of Auto Capacitor Bank Bay	EA	4
7.13	Installation of Future Auto Capacitor Bay	EA	0
7.14	Installation of 220/110kV Autotransformer Bay	EA	0
7.15	Installation of 220kV Bus Coupler & Metering Bay	EA	0
7.16	Installation of 220kV SVC Feeder Bay	EA	2
7.17	Installation of SVC System	LS	1
7.18	Installation of Reactor Bay	EA	1
7.19	Installation of Future Reactor Bay	EA	0
7.20	Installation of 20kV Switchgear	LS	0
7.21	Installation of Control/Relay/Metering Panels	LS	1
7.22	Installation of 110kV Feeder Bays	EA	0
7.23	Installation of 110kV Future Feeder Bay	EA	0
7.24	Installation of 110kV Source Bay	EA	0
7.25	Installation of 110kV Future Source Bay	EA	0
7.26	Installation of 110kV Bus Coupler & Metering Bay	EA	0
7.27	Installation of Substation Fence & Gates	LS	1
7.28	Installation of Control and Other Buildings	LS	1
7.29	Installation of 400V Building Power Distribution	LS	1
7.30	Installation of Utility Systems & Connections	LS	1
7.31	Installation of General Area Ground Grid System	LS	1
7.32	Installation of Underground Conduit, Control & Power Cables	LS	1
7.33	Installation of Concrete Wireway Trenches	LS	1
7.34	Installation of Emergency Generator & Fuel System	LS	1
7.35	Testing and Commissioning	LS	1

Schedule No. 8 Chimtala SVC and RPC: Transfer of Knowledge

Item No.	Description	Units	QTY
8.1	Training of Operation & Maintenance Management Staff	LS	1
8.2	On-Site training during construction and commissioning	LS	1
8.3	Training of Operation & Maintenance General Staff	LS	1
8.4	On-Going Training & Operation Assistance	LS	1

1.4.2 Sayedabad RPC

Schedule No. 1 Sayedabad RPC: Supply of Major Plant and Equipment

Item No.	Description	Units	QTY
1.1	Supply of 220kV Feeder Bays	EA	0
1.2	Supply of 220kV Future Feeder Bay	EA	0
1.3	Supply of 220kV Transformer Bay	EA	0
1.4	Supply of 220kV Future Transformer Bay	EA	0
1.5	Supply of 220/110kV Autotransformer Bay	EA	0
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	0
1.7	Supply of Auto Capacitor Bank Bay	EA	0
1.8	Supply of Future Auto Capacitor Bay	EA	0
1.9	Supply of 220kV SVC Feeder Bay	EA	0
1.10	Supply of SVC System	LS	0
1.11	Supply of Reactor Bay	EA	2
1.12	Supply of Future Reactor Bay	EA	0
1.13	Supply of 20kV Switchgear & Station Battery	LS	0
1.14	Supply of Control/Relay/Metering Panels	LS	1

Schedule No. 2 Sayedabad RPC: Supply of 110kV Plant and Equipment

Item No.	Description	Units	QTY
2.1	Supply of 110kV Feeder Bays	EA	0
2.2	Supply of 110kV Future Feeder Bay	EA	0
2.3	Supply of 110kV Source Bay	EA	0
2.4	Supply of 110kV Future Source Bay	EA	0
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0

Schedule No. 3 Sayedabad RPC: Supply of General Plant and Equipment

Item No.	Description	Units	QTY
3.1	Supply of Substation Fence & Gates	LS	0
3.2	Supply of Control and Other Buildings	LS	0
3.3	Supply of 400V Building Power Distribution	LS	0
3.4	Supply of Utility Systems & Connections	LS	0
3.5	Supply of General Area Ground Grid System	LS	1
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1
3.7	Supply of Concrete Wireway Trenches	LS	0
3.8	Supply of Emergency Generator & Fuel System	LS	0

Schedule No. 4 Sayedabad RPC: Mandatory Spare Parts

Item No.	Description	Units	QTY
4.1	Protection System	LS	1
4.2	HV Control Equipment	LS	1
4.3	LV AC System	LS	0
4.4	DC Distribution System	LS	0
4.5	HV Equipment	LS	1
4.6	20kV Metal Clad Switchgear	LS	0
4.7	Power Transformers	LS	0

Schedule No. 5 Sayedabad RPC: Standard Tools

Item No.	Description	Units	QTY
5.1	Substation Maintenance Tools & Appliances	LS	1
5.2	20kV MV Cables	LS	0
5.3	20kV Metal Clad Switchgear	LS	0

Schedule No. 6 Sayedabad RPC: Design, Drawings, and Documentation

Item No.	Description	Units	QTY
6.1	Structural Design And General Arrangement Drawings	LS	1
6.2	Site Civil Design Drawings	LS	1
6.3	Building and Structure Design Drawings	LS	0
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1
6.5	Control Circuits & Wiring Drawings	LS	1
6.6	Coordination Study & Relay Settings Instructions	LS	1
6.7	General Construction Drawings	LS	1
6.8	As Built Drawings	LS	1
6.9	Maintenance Manual And Completion Report	LS	1

Schedule No. 7 Sayedabad RPC: Installation and Other Charges

Item No.	Description	Units	QTY
7.1	Project Management	LS	1
7.2	Project Reporting	LS	1
7.3	Project Insurance	LS	1
7.4	Compliance with MOSS	LS	1
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1
7.6	Pavement of Road & Parking Areas	LS	0
7.7	Security Wall, Towers, & Gates	LS	0
7.8	Installation of 220kV Feeder Bays	EA	0
7.9	Installation of 220kV Future Feeder Bay	EA	0
7.10	Installation of 220kV Transformer Bay	EA	0
7.11	Installation of 220kV Future Transformer Bay	EA	0
7.12	Installation of Auto Capacitor Bank Bay	EA	0
7.13	Installation of Future Auto Capacitor Bay	EA	0
7.14	Installation of 220/110kV Autotransformer Bay	EA	0
7.15	Installation of 220kV Bus Coupler & Metering Bay	EA	0
7.16	Installation of 220kV SVC Feeder Bay	EA	0
7.17	Installation of SVC System	LS	0
7.18	Installation of Reactor Bay	EA	2
7.19	Installation of Future Reactor Bay	EA	0
7.20	Installation of 20kV Switchgear	LS	0
7.21	Installation of Control/Relay/Metering Panels	LS	1
7.22	Installation of 110kV Feeder Bays	EA	0
7.23	Installation of 110kV Future Feeder Bay	EA	0
7.24	Installation of 110kV Source Bay	EA	0
7.25	Installation of 110kV Future Source Bay	EA	0
7.26	Installation of 110kV Bus Coupler & Metering Bay	EA	0
7.27	Installation of Substation Fence & Gates	LS	0
7.28	Installation of Control and Other Buildings	LS	0
7.29	Installation of 400V Building Power Distribution	LS	0
7.30	Installation of Utility Systems & Connections	LS	0
7.31	Installation of General Area Ground Grid System	LS	1
7.32	Installation of Underground Conduit, Control & Power Cables	LS	1
7.33	Installation of Concrete Wireway Trenches	LS	0
7.34	Installation of Emergency Generator & Fuel System	LS	0
7.35	Testing and Commissioning	LS	1

Schedule No. 8 Sayedabad RPC: Transfer of Knowledge

Item No.	Description	Units	QTY
8.1	Training of Operation & Maintenance Management Staff	LS	1
8.2	On-Site training during construction and commissioning	LS	1
8.3	Training of Operation & Maintenance General Staff	LS	1
8.4	On-Going Training & Operation Assistance	LS	0

1.4.3 Ghazni RPC

Schedule No. 1 Ghazni RPC: Supply of Major Plant and Equipment

Item No.	Description	Units	QTY
1.1	Supply of 220kV Feeder Bays	EA	0
1.2	Supply of 220kV Future Feeder Bay	EA	0
1.3	Supply of 220kV Transformer Bay	EA	0
1.4	Supply of 220kV Future Transformer Bay	EA	0
1.5	Supply of 220/110kV Autotransformer Bay	EA	0
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	0
1.7	Supply of Auto Capacitor Bank Bay	EA	0
1.8	Supply of Future Auto Capacitor Bay	EA	0
1.9	Supply of 220kV SVC Feeder Bay	EA	0
1.10	Supply of SVC System	LS	0
1.11	Supply of Reactor Bay	EA	2
1.12	Supply of Future Reactor Bay	EA	0
1.13	Supply of 20kV Switchgear & Station Battery	LS	0
1.14	Supply of Control/Relay/Metering Panels	LS	1

Schedule No. 2 Ghazni RPC: Supply of 110kV Plant and Equipment

Item No.	Description	Units	QTY
2.1	Supply of 110kV Feeder Bays	EA	0
2.2	Supply of 110kV Future Feeder Bay	EA	0
2.3	Supply of 110kV Source Bay	EA	0
2.4	Supply of 110kV Future Source Bay	EA	0
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0

Schedule No. 3 Ghazni RPC: Supply of General Plant and Equipment

Item No.	Description	Units	QTY
3.1	Supply of Substation Fence & Gates	LS	0
3.2	Supply of Control and Other Buildings	LS	0
3.3	Supply of 400V Building Power Distribution	LS	0
3.4	Supply of Utility Systems & Connections	LS	0
3.5	Supply of General Area Ground Grid System	LS	1
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1
3.7	Supply of Concrete Wireway Trenches	LS	0
3.8	Supply of Emergency Generator & Fuel System	LS	0

Schedule No. 4 Ghazni RPC: Mandatory Spare Parts

Item No.	Description	Units	QTY
4.1	Protection System	LS	1
4.2	HV Control Equipment	LS	1
4.3	LV AC System	LS	0
4.4	DC Distribution System	LS	0
4.5	HV Equipment	LS	1
4.6	20kV Metal Clad Switchgear	LS	0
4.7	Power Transformers	LS	0

Schedule No. 5 Ghazni RPC: Standard Tools

Item No.	Description	Units	QTY
5.1	Substation Maintenance Tools & Appliances	LS	1
5.2	20kV MV Cables	LS	0
5.3	20kV Metal Clad Switchgear	LS	0

Schedule No. 6 Ghazni RPC: Design, Drawings, and Documentation

Item No.	Description	Units	QTY
6.1	Structural Design And General Arrangement Drawings	LS	1
6.2	Site Civil Design Drawings	LS	1
6.3	Building and Structure Design Drawings	LS	0
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1
6.5	Control Circuits & Wiring Drawings	LS	1
6.6	Coordination Study & Relay Settings Instructions	LS	1
6.7	General Construction Drawings	LS	1
6.8	As Built Drawings	LS	1
6.9	Maintenance Manual And Completion Report	LS	1

Schedule No. 7 Ghazni RPC: Installation and Other Charges

Item No.	Description	Units	QTY
7.1	Project Management	LS	1
7.2	Project Reporting	LS	1
7.3	Project Insurance	LS	1
7.4	Compliance with MOSS	LS	1
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1
7.6	Pavement of Road & Parking Areas	LS	0
7.7	Security Wall, Towers, & Gates	LS	0
7.8	Installation of 220kV Feeder Bays	EA	0
7.9	Installation of 220kV Future Feeder Bay	EA	0
7.10	Installation of 220kV Transformer Bay	EA	0
7.11	Installation of 220kV Future Transformer Bay	EA	0
7.12	Installation of Auto Capacitor Bank Bay	EA	0
7.13	Installation of Future Auto Capacitor Bay	EA	0
7.14	Installation of 220/110kV Autotransformer Bay	EA	0
7.15	Installation of 220kV Bus Coupler & Metering Bay	EA	0
7.16	Installation of 220kV SVC Feeder Bay	EA	0
7.17	Installation of SVC System	LS	0
7.18	Installation of Reactor Bay	EA	2
7.19	Installation of Future Reactor Bay	EA	0
7.20	Installation of 20kV Switchgear	LS	0
7.21	Installation of Control/Relay/Metering Panels	LS	1
7.22	Installation of 110kV Feeder Bays	EA	0
7.23	Installation of 110kV Future Feeder Bay	EA	0
7.24	Installation of 110kV Source Bay	EA	0
7.25	Installation of 110kV Future Source Bay	EA	0
7.26	Installation of 110kV Bus Coupler & Metering Bay	EA	0
7.27	Installation of Substation Fence & Gates	LS	0
7.28	Installation of Control and Other Buildings	LS	0
7.29	Installation of 400V Building Power Distribution	LS	0
7.30	Installation of Utility Systems & Connections	LS	0
7.31	Installation of General Area Ground Grid System	LS	1
7.32	Installation of Underground Conduit, Control & Power Cables	LS	1
7.33	Installation of Concrete Wireway Trenches	LS	0
7.34	Installation of Emergency Generator & Fuel System	LS	0
7.35	Testing and Commissioning	LS	1

Schedule No. 8 Ghazni RPC: Transfer of Knowledge

Item No.	Description	Units	QTY
8.1	Training of Operation & Maintenance Management Staff	LS	1
8.2	On-Site training during construction and commissioning	LS	1
8.3	Training of Operation & Maintenance General Staff	LS	1
8.4	On-Going Training & Operation Assistance	LS	0

1.4.4 Kandahar East SVC

Schedule No. 1 Kandahar East SVC: Supply of Major Plant and Equipment

Item No.	Description	Units	QTY
1.1	Supply of 220kV Feeder Bays	EA	0
1.2	Supply of 220kV Future Feeder Bay	EA	0
1.3	Supply of 220kV Transformer Bay	EA	0
1.4	Supply of 220kV Future Transformer Bay	EA	0
1.5	Supply of 220/110kV Autotransformer Bay	EA	0
1.6	Supply of 220kV Bus Coupler & Metering Bay	EA	0
1.7	Supply of Auto Capacitor Bank Bay	EA	3
1.8	Supply of Future Auto Capacitor Bay	EA	0
1.9	Supply of 220kV SVC Feeder Bay	EA	1
1.10	Supply of SVC System (with 24 month warranty & spares)	LS	1
1.11	Supply of Reactor Bay	EA	0
1.12	Supply of Future Reactor Bay	EA	0
1.13	Supply of 20kV Switchgear & Station Battery	LS	0
1.14	Supply of Control/Relay/Metering Panels	LS	1

Schedule No. 2 Kandahar East SVC: Supply of 110kV Plant and Equipment

Item No.	Description	Units	QTY
2.1	Supply of 110kV Feeder Bays	EA	0
2.2	Supply of 110kV Future Feeder Bay	EA	0
2.3	Supply of 110kV Source Bay	EA	0
2.4	Supply of 110kV Future Source Bay	EA	0
2.5	Supply of 110kV Bus Coupler & Metering Bay	EA	0

Schedule No. 3 Kandahar East SVC: Supply of General Plant and Equipment

Item No.	Description	Units	QTY
3.1	Supply of Substation Fence & Gates	LS	1
3.2	Supply of Control and Other Buildings	LS	0
3.3	Supply of 400V Building Power Distribution	LS	0
3.4	Supply of Utility Systems & Connections	LS	0
3.5	Supply of General Area Ground Grid System	LS	1
3.6	Supply of Underground Conduit, Control & Power Cables	LS	1
3.7	Supply of Concrete Wireway Trenches	LS	0
3.8	Supply of Emergency Generator & Fuel System	LS	0

Schedule No. 4 Kandahar East SVC: Mandatory Spare Parts

Item No.	Description	Units	QTY
4.1	Protection System	LS	1
4.2	HV Control Equipment	LS	1
4.3	LV AC System	LS	0
4.4	DC Distribution System	LS	0
4.5	HV Equipment (SVC spares priced in SVC materials)	LS	1
4.6	20kV Metal Clad Switchgear	LS	0
4.7	Power Transformers	LS	0

Schedule No. 5 Kandahar East SVC: Standard Tools

Item No.	Description	Units	QTY
5.1	Substation Maintenance Tools & Appliances	LS	1
5.2	20kV MV Cables	LS	0
5.3	20kV Metal Clad Switchgear	LS	0

Schedule No. 6 Kandahar East SVC: Design, Drawings, and Documentation

Item No.	Description	Units	QTY
6.1	Structural Design And General Arrangement Drawings	LS	1
6.2	Site Civil Design Drawings	LS	1
6.3	Building and Structure Design Drawings	LS	0
6.4	Single & 3 Line Drawings with Protective Relay Equipment	LS	1
6.5	Control Circuits & Wiring Drawings	LS	1
6.6	Coordination Study & Relay Settings Instructions	LS	1
6.7	General Construction Drawings	LS	1
6.8	As Built Drawings	LS	1
6.9	Maintenance Manual And Completion Report	LS	1

Schedule No. 7 Kandahar East SVC: Installation and Other Charges

Item No.	Description	Units	QTY
7.1	Project Management	LS	1
7.2	Project Reporting	LS	1
7.3	Project Insurance	LS	1
7.4	Compliance with MOSS	LS	1
7.5	Surveying, Grading, Roads, Site Perpetration & Finish	LS	1
7.6	Pavement of Road & Parking Areas	LS	0
7.7	Security Wall, Towers, & Gates	LS	0
7.8	Installation of 220kV Feeder Bays	EA	0
7.9	Installation of 220kV Future Feeder Bay	EA	0
7.10	Installation of 220kV Transformer Bay	EA	0
7.11	Installation of 220kV Future Transformer Bay	EA	0
7.12	Installation of Auto Capacitor Bank Bay	EA	3
7.13	Installation of Future Auto Capacitor Bay	EA	0
7.14	Installation of 220/110kV Autotransformer Bay	EA	0
7.15	Installation of 220kV Bus Coupler & Metering Bay	EA	0
7.16	Installation of 220kV SVC Feeder Bay	EA	1
7.17	Installation of SVC System	LS	1
7.18	Installation of Reactor Bay	EA	0
7.19	Installation of Future Reactor Bay	EA	0
7.20	Installation of 20kV Switchgear	LS	0
7.21	Installation of Control/Relay/Metering Panels	LS	1
7.22	Installation of 110kV Feeder Bays	EA	0
7.23	Installation of 110kV Future Feeder Bay	EA	0
7.24	Installation of 110kV Source Bay	EA	0
7.25	Installation of 110kV Future Source Bay	EA	0
7.26	Installation of 110kV Bus Coupler & Metering Bay	EA	0
7.27	Installation of Substation Fence & Gates	LS	1
7.28	Installation of Control and Other Buildings	LS	0
7.29	Installation of 400V Building Power Distribution	LS	0
7.30	Installation of Utility Systems & Connections	LS	0
7.31	Installation of General Area Ground Grid System	LS	1
7.32	Installation of Underground Conduit, Control & Power Cables	LS	1
7.33	Installation of Concrete Wireway Trenches	LS	0
7.34	Installation of Emergency Generator & Fuel System	LS	0
7.35	Testing and Commissioning	LS	1

Schedule No. 8 Kandahar East SVC: Transfer of Knowledge

Item No.	Description	Units	QTY
8.1	Training of Operation & Maintenance Management Staff	LS	1
8.2	On-Site training during construction and commissioning	LS	1
8.3	Training of Operation & Maintenance General Staff	LS	1
8.4	On-Going Training & Operation Assistance	LS	1

1.4.5 Schedule of Supply Glossary

Item No.	Description
1.1	Supply of 220kV Feeder Bays: Supply of all the 220KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.2	Supply of 220kV Future Feeder Bay: Supply of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.3	Supply of 220kV Transformer Bay: Supply of all the 220KV/20KV power transformers with OLTC (if specified), all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.4	Supply of 220kV Future Transformer Bay: Supply of all the structures, foundations, and related area ground grid system required for 220kV Future Transformer Bay(s) as shown and detailed in drawing package.
1.5	Supply of 220/110kV Autotransformer Bay: Supply of all the 220KV/110KV power transformers, all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.6	Supply of 220kV Bus Coupler & Metering Bay: Supply of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system. Couplers and metering equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.7	Supply of Auto Capacitor Bank Bay: Supply of all the capacitors, breakers, manual/motorized switches, associated equipment, accessories, and related area ground grid system as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.8	Supply of Future Auto Capacitor Bay: Supply of all the structures, foundations, and related area ground grid system required for Future Auto Capacitor Bay(s) as shown and detailed in drawing package.
1.9	Supply of 220kV SVC Feeder Bay: Supply of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV SVC Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.10	Supply of SVC System: Supply of all the buildings, structures, foundations, and related area ground grid system required for a complete automated SVC system as shown and detailed in drawing package. Includes all transformers, reactors, filters, bus work, electronic switching, controls, and cabling.
1.11	Supply of Reactor Bay: Supply of all the substation dead end Gantry structures, station steel, manual motorized switches, breakers, buses, insulators, RPC, and related area ground grid system as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.

1.12	Supply of Future Reactor Bay: Supply of all the substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for future Reactor Bay(s) as shown and detailed in drawing package.
1.13	Supply of 20kV Switchgear & Station Battery: Supply of all the switchgear equipment, station batteries, conduit stubs, concrete ducting, insulators, surge arrestors, connectors, and the associated termination hardware kits. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
1.14	Supply of Control/Relay/Metering Panels: Supply of all the panels, breakers, relays, contactors, conductors, indicator lights, labeling, starters, meters, associated equipment and accessories. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
2.1	Supply of 110kV Feeder Bays Supply of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
2.2	Supply of 110kV Future Feeder Bay Supply of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
2.3	Supply of 110kV Source Bay Supply of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
2.4	Supply of 110kV Future Source Bay Supply of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
2.5	Supply of 110kV Bus Coupler & Metering Bay Supply of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system. Couplers and metering equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
3.1	Supply of Substation Fence & Gates: Supply of all suitable and appropriate fencing materials, posts, gates, and warning labels. Equipment shall be designed and manufactured IAW rated performance specifications.
3.2	Supply of Control and Other Buildings: Supply of all the equipment and materials necessary for completion of Control and Other Buildings along with their necessary water, sewer and HVAC systems.
3.3	Supply of 400V Building Power Distribution: Supply of all panels, breakers, wiring, outlets, switches, lights, and other equipment required for 400V Building Power Distribution.
3.4	Supply of Utility Systems & Connections: Supply of all the equipment necessary for complete connection of all the sewer, water, and 230/400V electrical mains to the Utility system at the location shown on the Drawings.
3.5	Supply of General Area Ground Grid System: Supply of all the ground rods and ground conductors required for a complete Ground Grid System. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications. This item is for grounding systems external to HV Bays; each bay price includes its ground grid system.
3.6	Supply of Underground Conduit, Control & Power Cables: Supply of all conduit (PVC or steel), control, and power cables required for a complete substation as shown in the Drawings and performance specifications such that wiring can be completed without splicing of cables.
3.7	Supply of Concrete Wireway Trenches: Supply of pre-fabricated concrete wireway trenches and any associated equipment and accessories. All material shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.

3.8	Supply of Emergency Generator & Fuel System: Supply of a generator, fuel, and fuel storage. Equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
4.1	Protection System: The Supply of all the spare relays, SCADA spare parts, optical fiber cables, and fuses.
4.2	220kV Control Equipment: The Supply of spare relays, fuses, and control panels.
4.3	LV AC System: The supply of all the spares for power distribution boards, breakers, backup generator, lights, outlets, wires, conduits, back diesel generator and automatic transfer switches.
4.4	DC Distribution System: Parts for the batteries, associated cables, charger / supply system, DC loads, and distribution power boards.
4.5	HV Equipment: The supply of power transformers parts, parts for switches, breakers, insulators, jumpers, and connectors.
4.6	20kV Metal Clad Switchgear: The switchgear equipment parts, surge arrestors, connectors, and the associated termination hardware kits. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
4.7	Power Transformers: All the associated spare parts and accessories for such transformer.
5.1	Substation Maintenance Tools & Appliances: All the necessary tools required to install, test, inspect and maintain the substation equipment.
5.2	20kV MV Cables: All the tools that are necessary to install, test, maintain and replace such cables.
5.3	20kV Metal Clad Switchgear: All the tools necessary to install, test inspect and maintain this equipment class.
6.1	Structural Design And General Arrangement Drawings: Structural steel calculations, and general arrangement drawings for the equipment and support facilities in the new substation. Design calculations, detailed design drawings, final design deliverables including detailed supporting analyses, survey drawings, soil resistivity measurements, and geological investigation works.
6.2	Site Civil Design Drawings: All civil work drawings for excavating, grading, refilling, forming of the site, leveling and compacting, graveling, control buildings, office, workshop, storage room, battery room, water well, wastewater, drainage system, internal roads, fences, gates, oil interceptor tanks, concrete foundations.
6.3	Building and Structure Design Drawings: All the drawings and any structural calculations and documentations for the control buildings, office, workshop, storage room, battery room and concrete fire protection separation walls.
6.4	Single & 3 Line Drawings with Protective Relay Equipment: All the single and three lines drawings showing the power flow into and out of the substation along with all the control and protective relays functions, protective meters, and panel names where the relays units will be located.
6.5	Control Circuits & Wiring Drawings: The control panels and the wirings connections drawings showing all the control wirings from the control panels to substation yard equipment.
6.6	Coordination Study & Relay Settings Instructions: All the coordination studies for fault zone isolation along with the required settings for the relays determined by the coordination studies with the complete instructions to perform these settings.
6.7	General Construction Drawings: Construction Drawings of all the civil and steel structures showing the construction sequencing for all these structures in the substation.
6.8	As Built Drawings: Updated final documents and design drawings showing all the modifications made on the designs in the field, all CAD drawings for design, construction and installation.
6.9	Maintenance Manual And Completion Report: All the equipment maintenance, repair and adjustments manuals, and full set of assembly drawings including wiring diagrams. Completion report for each section of the works showing the acceptable testing and proper operations of all the installed equipment. Complete instructions for operations, apparatus lists, and spare parts lists containing information needed for ordering all equipment supplied under the contract. The delivery of the following manuals: general description of the equipment, operating instructions that are suitable for training of personnel, general maintenance instructions, spare parts manuals, all layout, and installation drawings.

7.1	Project Management: Planning, execution, monitoring and closing all the design, procurement, construction, testing and commissioning activities and ensuring they are carried out IAW the relevant technical standards and design specifications.
7.2	Project Reporting: The set up of a reporting system from the beginning until the end of the project in which the frequency, format, contents, and the level of details for these reports will be maintained throughout the life cycle of the project.
7.3	Project Insurance: Coverage for any bodily injury or property damage during the performance of the work. Coverage for faulty workmanship. Coverage for error and omission in the design of the project. Coverage for damage caused by hazard materials. Coverage for damage caused by non-excusable delay. The Coverages should cover damages to project during and after construction.
7.4	Compliance with MOSS (Minimum Operating Safety Standards): Strict implementation and compliance with all of the relevant and applicable codes dealing with health, safety, environmental and social safe guards at the site as required per project and the AIF. Site regulations, security plan procedures for the staff, the employer, visiting missions from employer and AIF and the equipment. Implementation of an effective Earthing system at the new substation IAW the latest pertinent standards. Operational and safety labels in both English and local language.
7.5	Surveying, Grading, Roads, Site Perpetration & Finish: Marking and staking the selected location of the substation. Determination of the suitability of the selected site. Testing the soil condition of the site to ensure its ability to support the facility's size and construction requirements. Testing the soil for any toxic contamination of the site. Surveying the wildlife, vegetation, and archeological or historic resources of the site. A development of a detailed site preparation work plan to include measures for any wetlands and endangered species. The marking of any wetlands and special habitats. The consideration of annual breeding and hibernation cycles of certain species in creating the construction schedules. Briefing procedures for the crews on special care while working in sensitive areas, including limiting ground disturbances. The installation of erosion and sedimentation controls at the outer limits of the construction area. The laying of access roads to the site in preparation for the construction activities. Clearing any existing structures and vegetation present in the access roads and the site of the substation. The grading of the site with all the required fill/cut in accordance with the specifications. The finishing of the ground inside of the substation site with a layer of suitable gravel as determined in the design specifications to ensure proper drainage and provide crews with safe work surface.
7.6	Pavement of Road & Parking Areas: Paving and marking of road and parking areas and materials included. Marking of the roads and parking areas shall be durable paint and/or signs.
7.7	Security Wall, Towers, & Gates: Installation of suitable and appropriate walls, towers, and gates and materials included around the complete substation site.
7.8	Installation of 220kV Feeder Bays: Installation of all the 220KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
7.9	Installation of 220kV Future Feeder Bay: Installation of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV Future Feeder Bay(s) as shown and detailed in drawing package.
7.10	Installation of 220kV Transformer Bay: Installation of all the 220K/20K power transformers with OLTC (if specified), all associated equipment and accessories, and related area ground grid system.
7.11	Installation of 220kV Future Transformer Bay: Installation of all the structures, foundations, and related area ground grid system required for 220kV Future Transformer Bay(s) as shown and detailed in drawing package.
7.12	Installation of 220/110kV Autotransformer Bay: Installation of all the 220KV/110KV power transformers, all associated equipment and accessories, and related area ground grid system. Transformers shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
7.13	Installation of 220kV Bus Coupler & Metering Bay: Installation of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system.
7.14	Installation of Auto Capacitor Bank Bay: Installation of all the capacitors, breakers, manual/motorized switches, associated equipment, accessories, and related area ground grid system.

7.15	Installation of 220kV SVC Feeder Bay: Supply of all the 220KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 220KV SVC Feeder Bay(s) as shown and detailed in drawing package. All equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
7.16	Installation of SVC System: Supply of all the buildings, structures, foundations, and related area ground grid system required for a complete automated SVC system as shown and detailed in drawing package. Includes all transformers, reactors, filters, bus work, electronic switching, controls, and cabling.
7.17	Installation of Future Auto Capacitor Bay: Supply of all the structures, foundations, and related area ground grid system required for Future Auto Capacitor Bay(s) as shown and detailed in drawing package.
7.18	Installation of Reactor Bay: Installation of all the substation dead end Gantry structures, station steel, manual motorized switches, breakers, buses, insulators, RPC, and related area ground grid system.
7.19	Installation of Future Reactor Bay: Installation of all the substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for future Reactor Bay(s) as shown and detailed in drawing package.
7.20	Installation of 20kV Switchgear: Installation of all the switchgear equipment, conduit stubs, concrete ducting, insulators, surge arrestors, connectors, and the associated termination hardware kits.
7.21	Installation of Control/Relay/Metering Panels: Installation of all the panels, breakers, relays, contactors, conductors, indicator lights, labeling, starters, meters, associated equipment and accessories.
7.22	Installation of 110kV Feeder Bays Installation of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
7.23	Installation of 110kV Future Feeder Bay Installation of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Feeder Bay(s) as shown and detailed in drawing package.
7.24	Installation of 110kV Source Bay Installation of all the 110KV substation dead end Gantry structures, manual/motorized switches, buses, breakers, tuners, line trap, surge arrestors, station steel, insulators, connectors, jumpers, conductors, and related area ground grid system.
7.25	Installation of 110kV Future Source Bay Installation of all the 110KV substation dead end Gantry structures, station steel, foundations, and related area ground grid system required for 110KV Future Source Bay(s) as shown and detailed in drawing package.
7.26	Installation of 110kV Bus Coupler & Metering Bay Installation of all the CVTs, CTs, metering, bus coupling breakers, and related area ground grid system.
7.27	Installation of Substation Fence & Gates: The installation of a suitable and appropriate fence around the substation side with the required access gates with warning signs in the local language.
7.28	Installation of Control and Other Buildings: Installation of all the equipment and materials necessary for completion of Control and Other Buildings along with their necessary water, sewer and HVAC systems.
7.29	Installation of 400V Building Power Distribution: Installation of all panels, breakers, wiring, outlets, switches, lights, and other equipment required for 400V Building Power Distribution.
7.30	Installation of Utility Systems & Connections: The permitting and proper connection of all the sewer, water and 230/400V electrical mains to the utilities and the testing of these systems to ensure their proper operations.
7.31	Installation of General Area Ground Grid System: Installation of all the ground rods and ground conductors required for a complete General Area Ground Grid System.
7.32	Installation of Underground Conduit, Control & Power Cables: Installation of all conduit (PVC or steel), control, and power cables and materials included required for a complete substation as shown in the Drawings and performance specifications such that wiring can be completed without splicing of cables.
7.33	Installation of Concrete Wireway Trenches: Digging of trenches and installation of pre-fabricated concrete wireway trenches and any associated equipment and accessories (materials included).

7.34	Installation of Emergency Generator & Fuel System: Installation of a generator, fuel, and fuel storage. Equipment shall be designed and manufactured IAW latest edition of the IEC standards and the rated performance specifications.
7.35	Testing and Commissioning: Completion and full documentation of testing and commissioning for all substation equipment to the satisfaction or the Employer's Engineer.
8.1	Training of Operation & Maintenance Management Staff: Training of the maintenance management personnel on the general operation and maintenance schedules of the substation. Furnishing of all detailed operation, service, maintenance manuals, and complete spare parts list for the substation equipment.
8.2	On-Site training during construction and commissioning: Training of personnel, workers, and laborers to handle the installation, testing and commissioning of the substation equipment. Training for six Employer's appointed personnel on factory inspections and witnessing performance tests for the substation equipment.
8.3	Training of Operation & Maintenance General Staff: Providing the maintenance general personnel a complete and detailed O&M training program on how to operate and perform the periodical maintenance procedures.
8.4	On-Going Training & Operation Assistance: Provide long-term of operation & training assistance for the SVC system per Technical Section requirements.

2.0 Technical Data Sheets

The contractor shall provide the transmission lines and substations using the following specification tables for basis of design. The data listed is the minimum requirements for all equipment and designs.

2.1 Substations and Components

Table 2.1.1 220KV Breaker

Item	Description/Details	Unit	Specified
1	220KV Circuit Breaker		
1.1	Manufacturer's type and reference	Each	
1.2	Number of poles	#	3
1.3	Class	class	Outdoor
1.4	Rated lightning impulse withstand voltage between terminals and earth	KV_{pk}	1,050
1.5	Rated 1 minute power-frequency withstand voltage to earth	KV_{rms}	460
1.6	Rated System Voltage	KV_{ll}	245
1.9	Rated normal current – RPC Leg, SVC, Capacitor and Reactor Bays	A	1,250
1.13	Rated short-circuit breaking current	kA	40
1.15	Rated operation sequence	Sequence order	O-0.3s-CO-3m-CO
1.16	Maximum tripping time	s	1
1.17	Rated total breaking time	ms	50
1.18	Rated total closing time	ms	60
1.19	Type of arc quenching medium	Gas	SF6
1.20	Type of stored energy medium	Technology	Motor spring
1.21	Voltage for operation device	VDC	220
1.22	Rated System Frequency	Hz	50

Table 2.1.2 220KV Disconnector

Item	Description/Details	Unit	Specified
1	220KV Disconnector		
1.1	Manufacturer's type and reference	Each	Contractor to nominate
1.2	Rated voltage	KV_{rms}	245
1.3	Rated short-circuit withstand current, 3s	kA	40
1.4	Rated peak withstand current	kA	50
1.5	Rated lightning impulse withstand voltage		
1.5.1	• common value	KV_{pk}	1,050
1.5.2	• across the isolating distance	KV_{pk}	1,200
1.6	Rated short-duration power-frequency withstand voltage		
1.6.1	• across the isolating distance	KV_{rms}	530
1.6.2	• common value	KV_{rms}	460
1.7	Rated normal current- RPC, capacitor, reactor and SVC bays	A	1,250
1.8	Creepage distance	mm/KVll	25
1.9	Voltage for operation device	VDC	220
2	Earthing switch		
2.1	Rated 1 minute 50 Hz Withstand	KV_{rms}	530
2.2	Rated voltage	KV_{ll}	245
2.3	Rated short-circuit withstand current, 1s	kA	20
2.4	Rated peak withstand current	kA	50
2.5	Rated lightning impulse withstand voltage		
2.5.1	• to earth and between poles	KV_{pk}	1,050
2.5.2	• across open pole	KV_{pk}	1,200
2.6	Rated short-duration power-frequency withstand voltage		
2.6.1	• common value	KV_{rms}	460
2.6.2	• across the isolating distance	KV_{rms}	530

Table 2.1.3 220KV Current Transformers

Item	Description/Details		Unit	Specified
1	220KV Current Transformers: Line, Bus Coupler and RPC Leg Bays			
1.1	Rated voltage		KVII	245
1.2	Core 1, 2, 3 & 4 characteristics, each multi-ratio	Ratios	Turns	750/1500A/1A
1.3		Continuous Thermal Current (min)	I(cth)	200%
1.4		Accuracy	Class	5P
1.5		Winding Power	VA	30
1.6	Core 5 characteristics, multi-ratio	Ratios	Turns	200/750/1500A/1A
1.7		Continuous Thermal Current (min)	I(cth)	200%
1.8		Accuracy	Class	0.2
1.9		Winding Power	VA	30
2	220KV Current Transformer: Transformer, Reactor and Cap Bays			
2.1	Manufacturer's type and reference		Each	TBD
2.2	Rated voltage		KVII	245
2.3	Core 1 & 4 characteristics, each multi-ratio	Ratios	Turns	50/100/200A / 1A
2.4		Continuous Thermal Current (min)	I(cth)	200%
2.5		Accuracy	Class	5P
2.6		Winding Power	VA	30
2.7	Core 2 & 3 characteristics, each multi-ratio	Ratios	Turns	750/1500A/1A
2.8		Continuous Thermal Current (min)	I(cth)	200%
2.9		Accuracy	Class	5P
2.10		Winding Power	VA	30
2.11	Core 5 characteristics, multi-ratio	Ratios	Turns	20/50/100/200A / 1A
2.12		Continuous Thermal Current (min)	I(cth)	200%
2.13		Accuracy	Class	0.2
2.14		Winding Power	VA	30

*Note: One set of Bus Coupler CT's only requires a single (Core Type 2) winding.
Single secondary, or 5 secondary type may be supplied.

Table 2.1.4 220KV Voltage Transformers

Item	Description/Details	Unit	Specified
1	220KV Voltage Transformers		
1.1	Primary Voltage	KVII	220KV/√3,
1.2	Secondary Voltages (Dual Voltages per winding)	V	110V/√3, 110V/√3
1.3	Rated Output, Metering/Protection	VA	100/100
1.4	Accuracy, Metering/Protection	CLASS	0.2/3P
1.5	Type	circuit	Capacitive
1.6	Minimum Creepage	mm/KV	25

Table 2.1.5 220KV Surge Arrestors

Item	Description/Details	Unit	Specified
1	220KV Surge Arresters		
1.1	System Voltage (Um)	KVll	245
1.2	Rated Voltage (Ur IEC 60099-4)	KV Rms	198
1.3	Line Discharge Class /Material Type	Class/Material	3/ ZnO
1.4	Pressure relief class	kA	10
1.5	Minimum Creepage	mm/KVll	25
1.6	MCOV (minimum)	KVlN	160

Table 2.1.6 220 KV SVC Main Transformers

Item	Description/Details	Unit	Specified
1	Transformer 220/Medium Voltage		
1.1	Windings (Pri/Sec)		Contractor to nominate
1.2	Type		Single Phase Two Winding
1.3	Rated power		Contractor to nominate
1.4	Rated voltage, primary winding	KV	220
1.5	Rated voltage, secondary winding	KV	Contractor to nominate
1.6	Top oil temperature rise	°C	60
1.7	Average winding temperature rise	°C	65
1.8	Lightning Impulse withstand voltage, primary winding	KV	1,050
1.9	Cooling Type		ONAN
1.10	Impulse withstand voltage, secondary winding	KV	Contractor to nominate
1.11	Power frequency withstand voltage, primary winding	KV	Contractor to nominate
1.12	Power frequency withstand voltage, secondary winding	KV	Contractor to nominate
1.13	Vector Group		Contractor to nominate
2	Off-load tap changer (220KV)		
2.1	Number of Steps		Contractor to nominate
2.2	Taps		Contractor to nominate
3	Bushings – Primary		
3.1	Type		IEC 60137
3.2	Lightning impulse level	KV	1,050
3.3	Minimum creepage distance	mm/KV	25
4	Bushings – Secondary		
4.1	Type		IEC 60137
4.2	Lightning impulse level	KV	Contractor to nominate
4.3	Minimum creepage distance	mm/KV	25
5	220KV Bushing Current Transformers		
5.1	Current Ratio		Contractor to nominate
5.2	Thermal Rating Factor	%	Contractor to nominate
5.3	Accuracy Class		Contractor to nominate
5.4	Location		High Voltage bushing
5.5	Quantity	qty	Contractor to nominate
6	Medium Voltage Bushing Current Transformers		
6.1	Current Ratio		Contractor to nominate
6.2	Thermal Rating Factor	%	Contractor to nominate
6.3	Accuracy Class		Contractor to nominate
6.4	Location		Medium Voltage bushing
6.5	Quantity	qty	Contractor to nominate

Table 2.1.7 Shunt Reactors

Item	Description/Details	Units	Specified
1	Reactor Power Ratings		
1.1	Chimtala Substation	MVAR	25 x 1
1.2	Sayedabad Substation	MVAR	15 x 2
1.3	Ghazni Substation	MVAR	15x 2
2	Rated voltage	KV	220
3	Rated Frequency	Hz	50
4	Rated fault level	kA	40
5	Lighting Impulse withstand voltage	KV_{pk}	1050
6	Switching Impulse withstand voltage	KV_{pk}	850
7	One minute power frequency withstand Voltage	KV_{rms}	460
8	Cooling system		Natural oil circulation (ONAN)
9	Neutral Connection		Star, Directly Earthed
10	Range of constant impedance	ohms	Up to 1.35 p.u. voltage
11	Tolerance on current at rated voltage		0 to +5% of rated current
12	Bushing minimum creepage distance	mm/KV	25
13	Total real power loss at rated voltage and frequency as a percentage of rated MVAR	%	<= 0.5

Table 2.1.8 Station Service Transformer 20/0.4KV

Item	Description/Details	Unit	Specified
1	Auxiliary Power Transformer 20/0.4KV		
1.1	No. of phases	number	3
1.2	Design Standard	IEC	IEC 60076
1.3	Impedance	%	Contractor to Nominate
1.4	Continuous rated power	KVA	Contractor to Nominate
1.5	Vector group	Shift angle	Contractor to Nominate
1.6	Rated frequency	Hz	50
1.7	Voltage Ratio	turns	20,000/440
1.8	Type of tap-changer	type	Off-voltage
1.9	Taps (on 20KV)	%	+5% +2.5% 0% -2.5% -5%
1.10	Design fault levels, HV winding	MVA	500
1.11	Impulse withstand voltage of HV winding	KV_{pk}	125
1.12	Transformer type	(Indoor / Outdoor)	outdoor
1.13	Type of Cooling		ONAN
1.14	Hermetically sealed		Yes
1.15	MV bushing type	style	Dead front Plug in 200A
1.16	LV bushing type	style	Live Front (Palm)
1.17	Top oil temperature rise	°C	60
1.18	Average winding temperature rise	°C	65
1.19	Exterior Finish		Painted or Hot Dip Galvanized

Table 2.1.9 Proposed Relay Protection

Item	Description/Details	Specified
1	220 kV Reactor Bays	One multi-function transformer differential relay and one multi-function over current, UV and OV relay. Each relay served from a dedicated CT core.
2	220KV Bus	Two multi-function low impedance bus differential relays each served from a dedicated CT core. If necessary it is permissible for one of the bus differential relays to share CT cores with a multi-function over current, UV, and OV relay.
3	220 KV/MV SVC Transformer Bays	One multi-function over current, UV and OV relay on same CT core with one multi-function differential transformer relay. Second multi-function differential transformer relay on dedicated CT core. Transformer mounted protection including winding and oil temperature low level alarm, winding and oil temperature high level trip, oil level alarm, gas relay (Buchholz relay) and sudden pressure relay
4	220 kV Capacitor Bays	One multi-function over current relay UV, OV relay and one multi-function voltage differential relay. Each relay with their own dedicated CT core.

Table 2.1.10 Energy Meters

Item	Panel	220KV
1	RPC Leg, SVC, Capacitor and Reactor Bays	kWh delivered, kWh received Four-quadrant KVARh with data access facilities and pulse output, class0.2

Table 2.1.11 Batteries and Rectifiers

Item	Description/Details	Unit	Specified
1	220 V Batteries		
1.1	Manufacturer's type and reference		Refer to Section 1.2.10.14
1.2	Capacity, 10 h discharge	Ah	Refer to Section 1.2.10.14
1.3	Capacity, 1 h discharge	Ah	Refer to Section 1.2.10.14
1.4	Maximum charging current	A	Refer to Section 1.2.10.14
1.5	Number of cells	number	110
1.6	Floating charge voltage	V	100% x U_N
1.7	Lowest Voltage, discharged battery	V	90% x Un
1.8	Discharging Time (100% of C10)	H	6
1.9	Quick charge 1 voltage	V	Refer to Section 1.2.10.14
1.10	Quick charge 2 voltage	V	Refer to Section 1.2.10.14
1.11	Maximum fuse tripping time	sec	5
2	220 V Rectifiers		
2.1	Manufacturer's type and reference		Refer to Section 1.3.8.14
2.2	Minimum current DC	A	50
2.3	Charging time (to 90% of C10)	H	12

Table 2.1.12 Earthing System

Item	Description/Details	Unit	Specified
1	Minimum Sizes of Copper Conductors		
1.1	Grounding loops	mm^2	120
1.2	Riser	mm^2	120
1.3	Connection of live neutrals	mm^2	50
1.4	Connection of other steelworks not part of high-voltage structures	mm^2	25
2	Maximum Permissible Fault Current Density for Connection of		
2.1	System neutrals	A/mm^2	100
2.2	HV-equipment	A/mm^2	200
2.3	LV-equipment auxiliary power transformers, etc.	A/mm^2	150
3	Grounding Rods		
3.1	Diameter	mm	16
3.2	Length, minimum	m	3m
3.3	Material	material	Copper-clad steel
4	Assumption for Calculations of Step Voltages, According to IEEE-80		
4.1	Maximum grid potential rise	KV_{rms}	5
4.2	Step	m	1
4.3	Body resistance	Ω	1000
4.4	Fault clearing time	s	1
5	Assumption for Soil Resistivity for Use, According to IEEE-80		
5.1	Common Soil resistivity	Ω-m	3,000

Table 2.1.13 Low Voltage Cables

Item	Description/Details	Unit	Specified
1	Cables		
1.1	Manufacturer's type and reference		Refer to Section 1.3.8.16

Table 2.1.14 MV Cable

Item	Description/Details	Unit	Specified
1	Nominal voltage rating	KV	11.5/20KV (24KV)
2	Number and nominal size of core	mm^2	3x240 1x400
3	Stranding type	material	Aluminum
4	Thickness of conductor shield	mm	1.0
5	Thickness of XLPE insulation	mm	5.5
6	Size of insulation shield		
6.1	- semi-conducting thickness	mm	0.8
6.2	Stranding-armour	mm	0.85
6.3	Maximum Conductor temp. rating	°C	90
7	Short circuit rating		
7.1	t = 0.1 seconds	kA	16
7.2	t = 0.2 seconds	kA	17
7.3	t = 0.5 seconds	kA	11
7.4	t = 1.0 seconds	kA	8
7.5	Minimum bending radius	mm	8 x diameter
7.6	Maximum drum wound lengths	m	>500
7.7	Maximum Pulling Tension	kN	3,000
8	Environmental Conditions		
8.1	Ground Temperature	°C	25
8.2	Maximum Conductor Temperature	°C	90
8.3	Thermal Resistivity of Soil	°C m/W	1.2
8.4	Depth of Burial	m	0.8

Table 2.1.15 MV Cable Termination Kits

Item	Description/Details	Unit	Specified
1	Nominal voltage rating	KV	20/24
2	Nominal size of cable	mm^2	240 400
3	Number of cores	number	3 1
4	Type of conductor	type	AAC

Table 2.1.16 Panel Instrumentation

Item	Description/Details	220 kV
1	Reactor and Capacitor Bays	3 x Ammeters
2	SVC and RPC Leg Bays	3 x Ammeter PF Meter 3 x Voltmeters

3.0 Drawings, Schedules, Maps

3.1 Conceptual Design Drawings

36. G-100 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System Cover Sheet
37. G-101 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System Drawings Index
38. G-102 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System General Notes, Legend Symbols, and Abbreviations
39. G-104 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System 220kV System Schematic Diagram Sheet 1
40. G-105 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System 220kV System Schematic Diagram Sheet 2
41. XE-100 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System Chimtala Substation – Partial General Arrangement Plan – RPC
42. XE-110 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System Ghazni Substation – Partial General Arrangement Plan – RPC
43. XE-120 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System Sayedabad Substation – Partial General Arrangement Plan – RPC
44. XE-130 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System Kandahar East Substation – Partial General Arrangement Plan – RPC
45. XE-500 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System SVC/Capacitor Bank Connection Bus Elevation
46. XE-501 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System Typical Single Line and Protection Scheme Details
47. XE-600 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System Chimtala Substation – Partial Single Line Diagram – RPC
48. XE-610 Chimtala, Sayedabad, Ghazni and Kandahar East RPC System Kandahar East, Ghazni, Sayedabad Substation Partial Single Line Diagram – RPC

3.2 Reference Drawing Set

1. Afghan Energy Information Center (AEIC) The Northwest Power System (SLD)
2. E-200 RFP for EPC 220kV T/L from Arghandi to Ghazni Ghazni Substation General Arrangement Plan – Contract 1-B
3. E-202 RFP for EPC 220kV T/L from Arghandi to Ghazni Sayedabad Substation General Arrangement Plan – Contract 1-B
4. E-300 RFP for EPC 220kV T/L from Arghandi to Ghazni Ghazni Substation One-Line Diagram 220kV – Contract 1-B
5. E-301 RFP for EPC 220kV T/L from Arghandi to Ghazni Ghazni Substation One-Line Diagram 220/20kV – Contract 1-B
6. E-302 RFP for EPC 220kV T/L from Arghandi to Ghazni Ghazni Substation One-Line Diagram 220/110kV – Contract 1-B
7. E-303 RFP for EPC 220kV T/L from Arghandi to Ghazni Sayedabad Substation One-Line Diagram 220kV – Contract 1-B
8. E-304 RFP for EPC 220kV T/L from Arghandi to Ghazni Sayedabad Substation One-Line Diagram 220/20kV – Contract 1-B
9. E-305 RFP for EPC 220kV T/L from Arghandi to Ghazni Sayedabad Substation One-Line Diagram 220/110kV – Contact 1-B
10. E-501 WOLT0048 AMD4 Substations from Qarabagh to Kandahar East Kandahar East Substation Single Line Diagram – HV (1)
11. E-502 WOLT0048 AMD4 Substations from Qarabagh to Kandahar East Kandahar East Substation Single Line Diagram – HV (2)

12. E-503 WOLT0048 AMD4 Substations from Qarabagh to Kandahar East Kandahar East Substation Single Line Diagram – HV (3)
13. E-504 WOLT0048 AMD4 Substations from Qarabagh to Kandahar East Kandahar East Substation Single Line Diagram – MV (1)
14. E-505 WOLT0048 AMD4 Substations from Qarabagh to Kandahar East Kandahar East Substation Single Line Diagram – MV (2)
15. E-506 WOLT0048 AMD4 Substations from Qarabagh to Kandahar East Kandahar East Substation General Arrangement – GA
16. E-507 WOLT0048 AMD4 Substations from Qarabagh to Kandahar East Kandahar East Substation General Arrangement – GA

3.1 – Conceptual Design Drawings

ISLAMIC REPUBLIC OF AFGHANISTAN
AFGHANISTAN ENGINEERING SUPPORT PROGRAM (AESP)

CHIMTALA, SAYEDABAD, GHAZNI, AND KANDAHAR EAST RPC SYSTEM

CONCEPT DESIGN
DATE: DECEMBER 4, 2014

NOT FOR CONSTRUCTION

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COVER SHEET

SHEET REFERENCE NUMBER:
G–100

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DRAWING REF. NUMBER	ISSUE DATE	ISSUE STATUTES	DRAWING TITLE
GENERAL DRAWINGS			
G–100	12/04/14	CONCEPT DESIGN	COVER SHEET
G–101	12/04/14	CONCEPT DESIGN	DRAWINGS INDEX
G–102	12/04/14	CONCEPT DESIGN	GENERAL NOTES, LEGEND SYMBOLS & ABBREVATIONS
G–103	12/04/14	CONCEPT DESIGN	220kV SYSTEM SCHEMATIC DIAGRAM SHEET 1
G–104	12/04/14	CONCEPT DESIGN	220kV SYSTEM SCHEMATIC DIAGRAM SHEET 2
CHIMTALA SUBSTATION			
XE–100	12/04/14	CONCEPT DESIGN	CHIMTALA SUBSTATION – PARTIAL GENERAL ARRANGEMENT PLAN – RPC
XE–600	12/04/14	CONCEPT DESIGN	CHIMTALA SUBSTATION – PARTIAL SINGLE LINE DIAGRAM – RPC
GHAZNI SUBSTATION			
XE–110	12/04/14	CONCEPT DESIGN	GHAZNI SUBSTATION – PARTIAL GENERAL ARRANGEMENT PLAN – RPC
SAYEDABAD SUBSTATION			
XE–120	12/04/14	CONCEPT DESIGN	SAYEDABAD SUBSTATION – PARTIAL GENERAL ARRANGEMENT PLAN – RPC
KANDAHAR EAST SUBSTATION			
XE–130	12/04/14	CONCEPT DESIGN	KANDAHAR EAST SUBSTATION – PARTIAL GENERAL ARRANGEMENT PLAN – RPC
XE–610	12/04/14	CONCEPT DESIGN	KANDAHAR EAST, GHAZNI, SAYEDABAD SUBSTATIONS – PARTIAL SINGLE LINE DIAGRAM – RPC
ELEVATIONS & PROTECTION SCHEMES			
XE–500	12/04/14	CONCEPT DESIGN	SVC/CAPACITOR BANK CONNECTION BUS ELEVATION
XE–501	12/04/14	CONCEPT DESIGN	TYPICAL SINGLE LINE AND PROTECTION SCHEME DETAILS

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DRAWING INDEX
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DRAWINGS INDEX

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PLAN LEGEND (SINGLE LINE DIAGRAM–HIGH VOLTAGE)

SYMBOL	DESCRIPTION
	HV(220KV) SURGE ARRESTER (SA) X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	HV(110KV) SURGE ARRESTER (SA) X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	HV CAPACITIVE VOLTAGE TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	HV AC CIRCUIT BREAKER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	HV MOTORIZED, DOUBLE END BREAK DISCONNECT (ISOLATOR) SWITCH
	HV MOTORIZED, HORIZONTAL MOVEMENT, DOUBLE END BREAK DISCONNECT (ISOLATOR) SWITCH WITH SINGLE END MANUAL EARTHING SWITCH. X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	HV MOTORIZED, HORIZONTAL MOVEMENT, DOUBLE END BREAK DISCONNECT (ISOLATOR) SWITCH WITH DOUBLE END MANUAL EARTHING SWITCH. X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	HV 3 PHASE BUS
	HV 3 PHASE AUTO TRANSFORMER
FF P G FF FF FF CCC – MMM	PROTECTIVE ELECTRONIC RELAY/METERING RELAY FF–DEDICATED RELAY FUNCTION (IEEE) X –EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE CCC –MAKER COMPANY OF THE RELAY MMM –MODEL OF THE RELAY
	HV 3 PHASE CAPACITIVE REACTOR
	HV 3 PHASE INDUCTIVE REACTOR
	HV 3 PHASE INDUCTIVE REACTOR WITH NEUTRAL CT
	HV MULTI CORE/MULTI RATIO CURRENT TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	HV BUSHING CURRENT TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	GROUND COMMON POINT (GC)

PLAN LEGEND (SINGLE LINE DIAGRAM–MEDIUM VOLTAGE)

SYMBOL	DESCRIPTION
	MV MANUAL OPERATED FUSED 3 PHASE DISCONNECT SWITCH
	POWER TRANSFORMER 3 PHASE DELTA/WYE WINDING
	SURGE ARRESTOR (SA) X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
FF P G FF FF FF CCC – MMM	PROTECTIVE ELECTRONIC RELAY/METERING RELAY FF–DEDICATED RELAY FUNCTION (IEEE) X –EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE CCC –MAKER COMPANY OF THE RELAY MMM –MODEL OF THE RELAY
	LV 3 PHASE STATION SERVICE TRANSFORMER
	MV SWITCHGEAR CIRCUIT BREAKER X –EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	MV CURRENT TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	MV POTENTIAL TRANSFORMER X – EQUIPMENT QUANTITY, 3 OF EACH UNLESS NOTED OTHERWISE
	MV 3 PHASE INSULATED / UNDERGROUND CONDUCTORS
	MV 3 PHASE INSULATED CONDUCTOR CONNECTIONS
1 2 3 4 5 6 7 . . .	MV SWITCHGEAR LINE UP

PLAN LEGEND (GENERAL ARRANGEMENT–GA)

SYMBOL	DESCRIPTION
	HIGH VOLTAGE SURGE ARRESTER– SA
	HIGH VOLTAGE CAPACITIVE VOLTAGE TRANSFORMER–CVT
	HIGH VOLTAGE TENSION INSULATOR
	HIGH VOLTAGE TENSION GANTRY
	HIGH VOLTAGE DOUBLE END BREAK (ISOLATOR–ISO) SWITCH WITH SINGLE OR DOUBLE END EARTHLING SWITCH
	HIGH VOLTAGE CURRENT TRANSFORMER–CT
	HIGH VOLTAGE CIRCUIT BREAKER–CB
	HV INDUCTIVE REACTOR
	HIGH VOLTAGE POWER TRANSFORMER
	HV CAPACITIVE REACTOR
	MV TRANSFORMER RISER
	CONDUCTOR POST
	SUPPORT POST
	20kV RISER POLE
	STEEL MAST

ABBREVIATIONS

SYMBOL	DESCRIPTION
A	AMPERE
AFF	ABOVE FINISHED FLOOR
BLDG	BUILDING
CT	CURRENT TRANSFORMER
CVT	CAPACITOR VOLTAGE TRANSFORMER
GEC	GROUNDING ELECTRODE CONDUCTOR
GES	GROUNDING ELECTRODE SYSTEM
GFE	GOVERNMENT FURNISHED EQUIPMENT, CONTRACTOR INSTALLED
HZ	HERTZ
kAIC	AMPERE INTERRUPTING CAPACITY IN THOUSANDS
kV	KILOVOLT
kVA	KILOVOLT–AMPERE
kW	KILOWATT
MVA	MEGAVOLTS–AMPERE
LA	LIGHTNING ARRESTER
M	METERS
mm	MILLIMETERS
MVA	MEGAVOLT–AMPERE
MVAR	MEGA–VAR
N	NEUTRAL
NIC	NOT IN CONTRACT
P	POLE
PH, ϕ	PHASE
PLC	PROGRAMMABLE LOGIC CONTROLLER
SA	SURGE ARRESTER
TYP	TYPICAL
UGE	UNDERGROUND ELECTRIC
UNO	UNLESS NOTED OTHERWISE
V	VOLT
W	WATT
W/	WITH
W/O	WITHOUT
XFMR,T	TRANSFORMER

RELAY LEGEND

27– UNDER VOLTAGE RELAY
25– SYNCHRONISM CHECK RELAY
32– DIRECTIONAL POWER RELAY
50– INSTANTANEOUS OVER CURRENT RELAY
51– INVERSE–TIME OVER CURRENT RELAY
52– AC CIRCUIT BREAKER RELAY
50BF–AC CIRCUIT BREAKER RELAY
59– OVER VOLTAGE RELAY
67N– NEUTRAL AC DIRECTIONAL OVERCURRENT RELAY
81– FREQUENCY RELAY
86– LOCK OUT RELAY
87B– BUS DIFFERENTIAL PROTECTIVE RELAY
87– DIFFERENTIAL PROTECTIVE RELAY
87T– TRANSFORMER DIFFERENTIAL PROTECTIVE RELAY
87N– RESISTIVE EARTH FAULT RELAY
89– LINE SWITCH RELAY
94– BREAKER FAILURE RELAY

GENERAL NOTES, LEGEND SYMBOLS & ABBREVATIONS

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GENERAL NOTES, LEGEND SYMBOLS & ABBREVATIONS

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G–102

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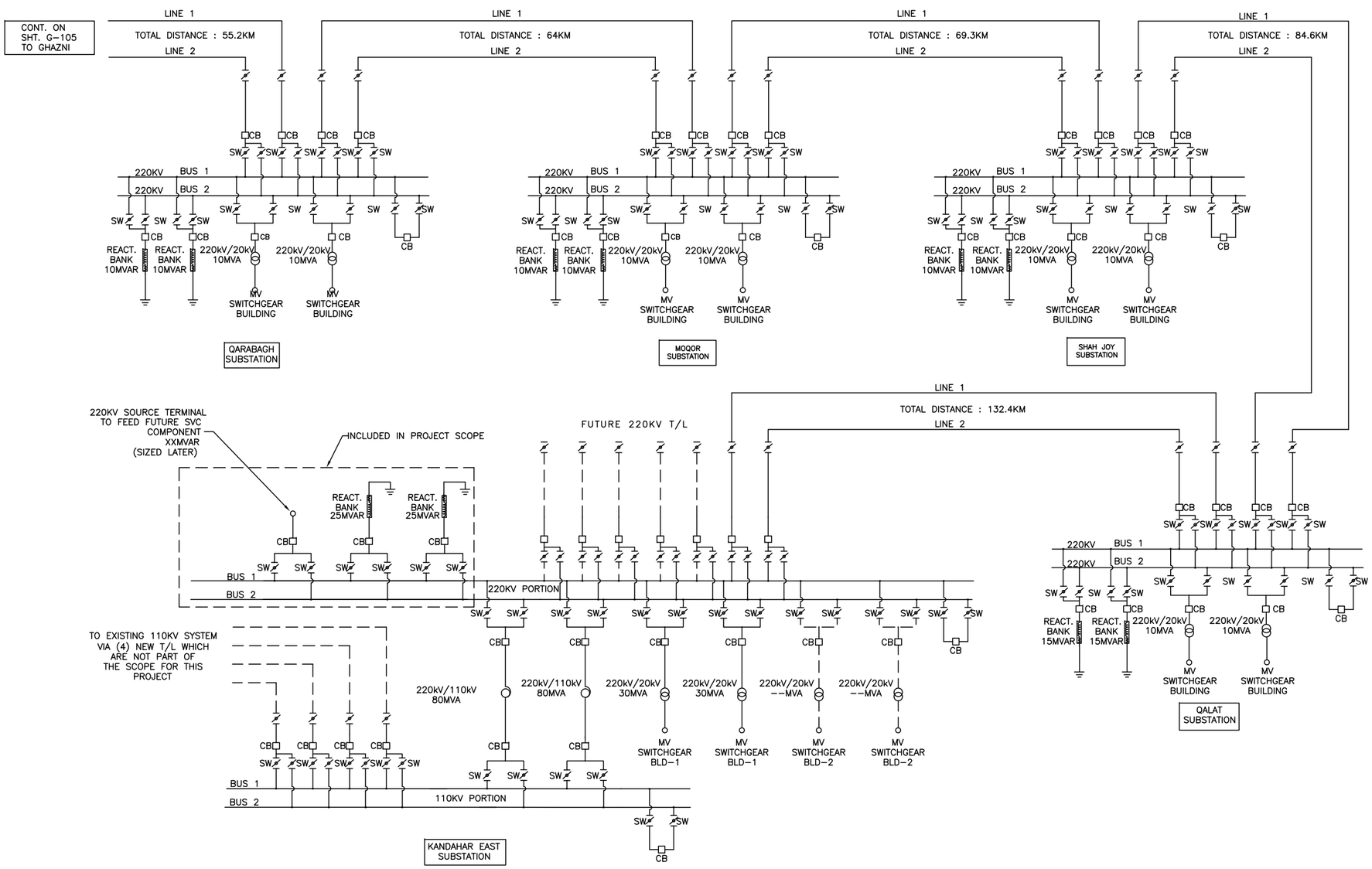
NOTES:

1. SIMPLIFIED SINGLE LINE DIAGRAM INTENDED TO ILLUSTRATE SYSTEM TOPOLOGY. THIS DRAWING IS NOT INTENDED TO INCLUDE ALL SYSTEM DETAILS.



220kV SYSTEM SCHEMATIC DIAGRAM

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220kV SYSTEM SINGLE LINE DIAGRAM SHEET 1

SHEET REFERENCE NUMBER:
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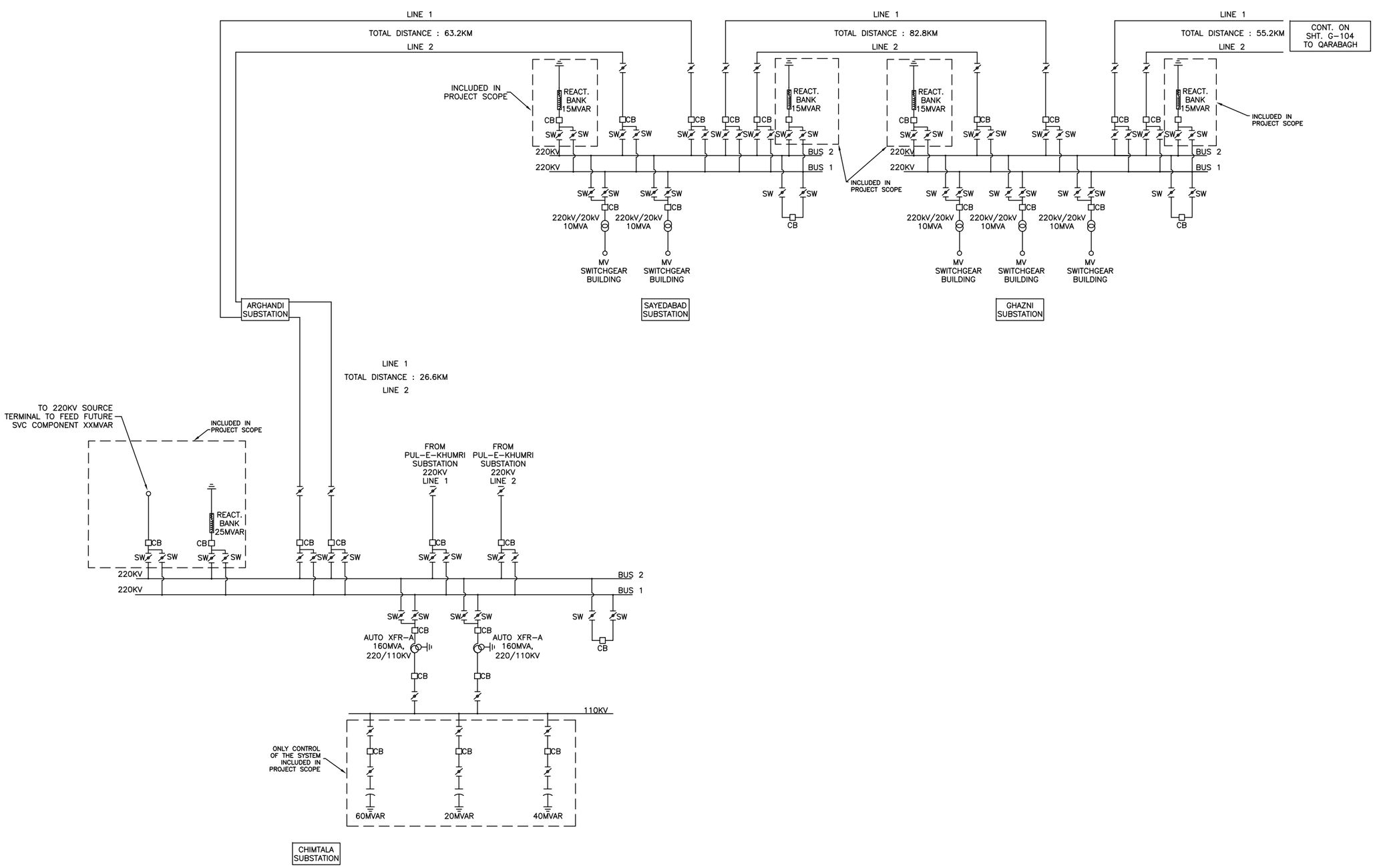
NOTES:

1. SIMPLIFIED SINGLE LINE DIAGRAM INTENDED TO ILLUSTRATE SYSTEM TOPOLOGY. THIS DRAWING IS NOT INTENDED TO INCLUDE ALL SYSTEM DETAILS.



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220kV SYSTEM SCHEMATIC DIAGRAM

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WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
220kV SYSTEM SINGLE LINE DIAGRAM SHEET 2

SHEET REFERENCE NUMBER:
G-104

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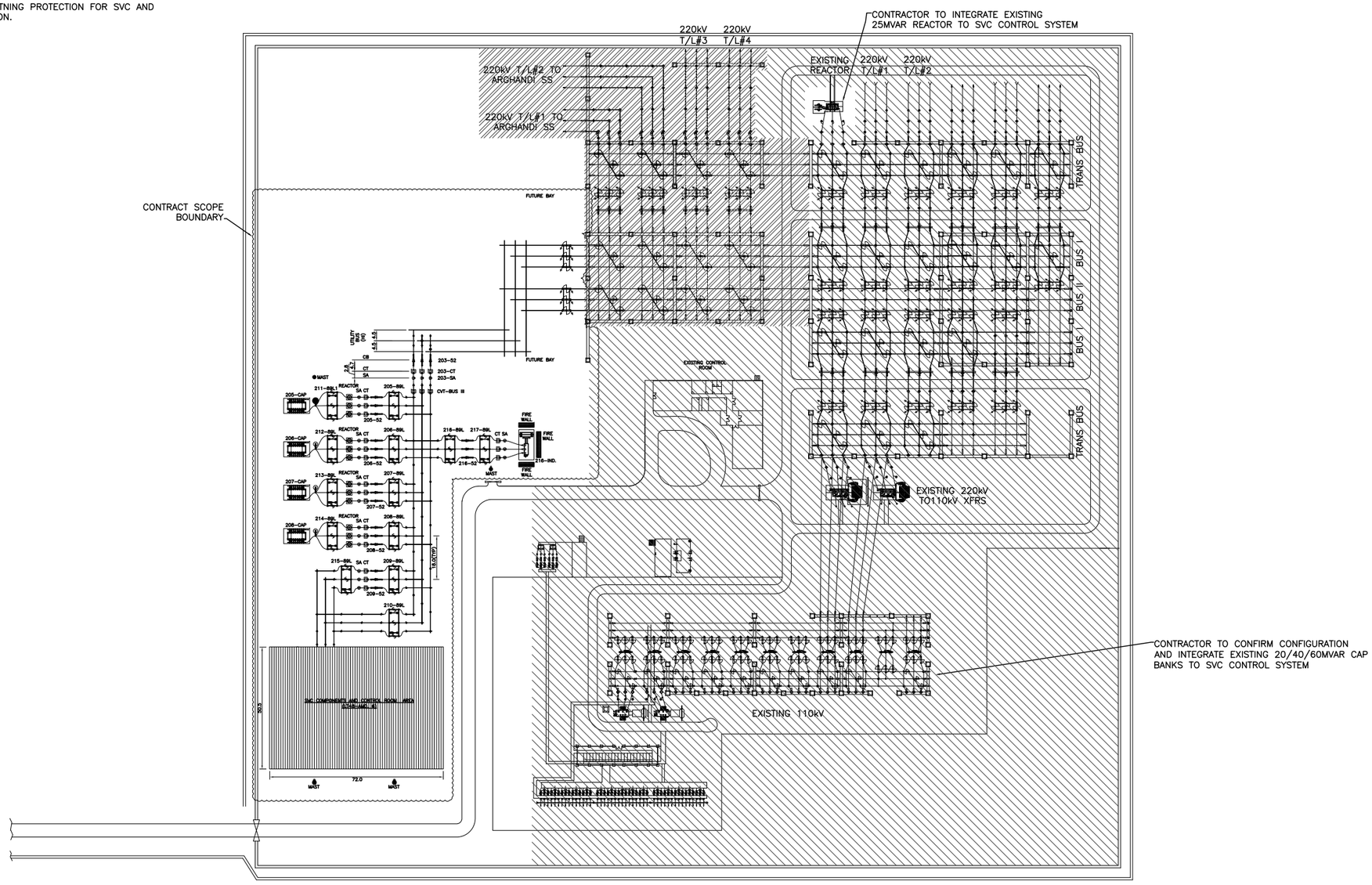
PART OF ADB CONTRACT

PART OF EXISTING INSTALLATION

NOTES:

1. TYPICAL GENERAL ARRANGEMENT PLAN SHOWN FOR INFORMATION ONLY CONTRACTOR SHALL PREPARE FINAL GENERAL ARRANGEMENT PLAN.
2. CONTRACTOR TO PROVIDE COMPLETE LIGHTNING PROTECTION FOR SVC AND NEW CAPACITOR AND REACTOR INSTALLATION.



CHIMTALA SUBSTATION RPC SYSTEM
INSTALLATION AND INTEGRATION
SCALE: 1:1

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WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
CHIMTALA SUBSTATION – PARTIAL GENERAL ARRANGEMENT PLAN – RPC

SHEET REFERENCE NUMBER:
XE-100

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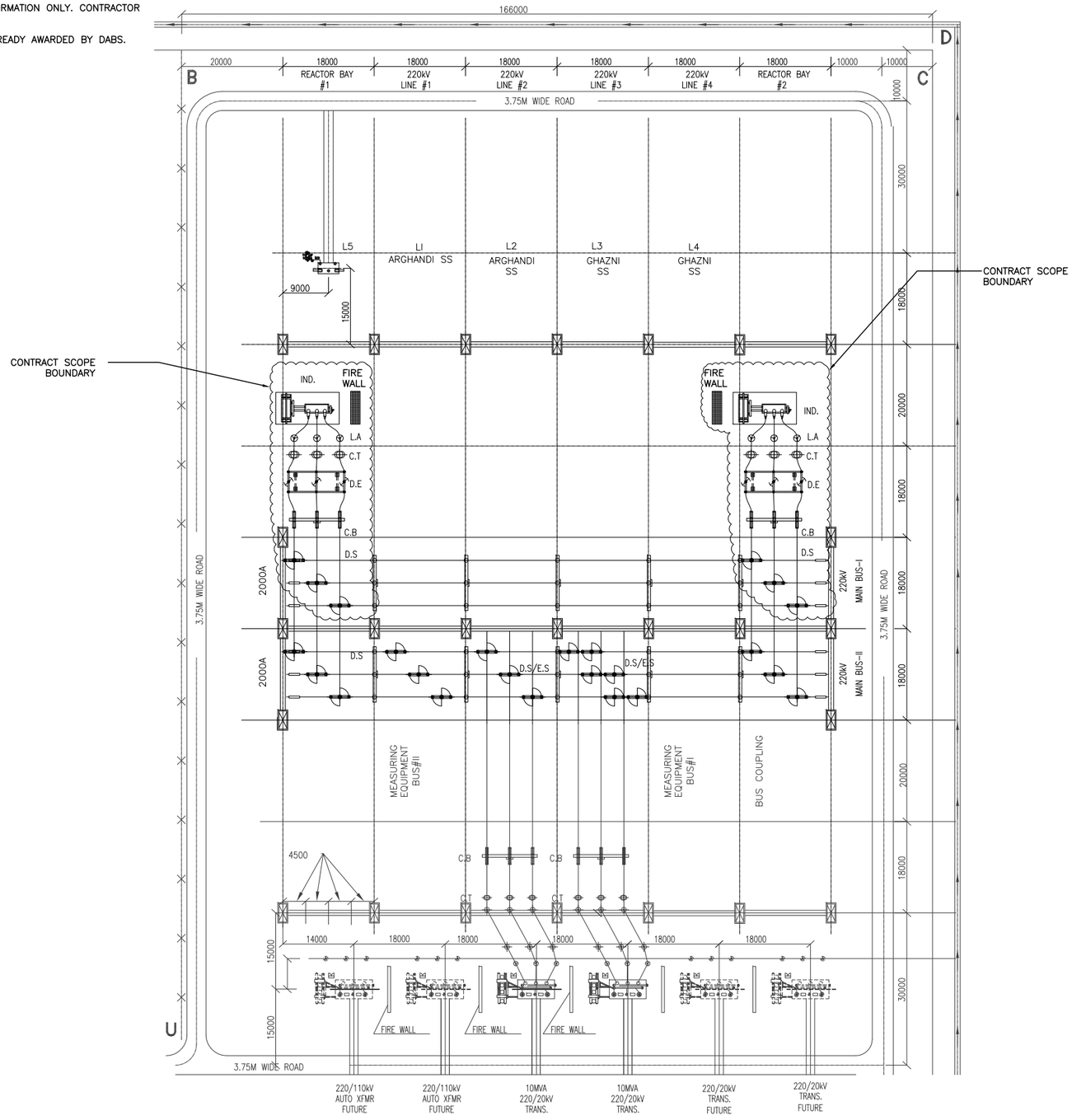
NOTES:

1. LINE BAY EQUIPMENT NOT SHOWN.
2. REFER TO "RFP FOR EPC, 220KV T/L FROM ARGHANDI TO GHAZNI, SAYEDABAD SUBSTATION GENERAL ARRANGEMENT PLAN – CONTRACT 1–B" DRAWING E–202 FOR SAYEDABAD SUBSTATION GENERAL ARRANGEMENT PLAN.
3. TYPICAL GENERAL ARRANGEMENT PLAN SHOWN FOR INFORMATION ONLY. CONTRACTOR SHALL PREPARE FINAL GENERAL ARRANGEMENT PLAN.
4. THE CONSTRUCTION BID FOR GHAZNI SUBSTATION IS ALREADY AWARDED BY DABS.



GHAZNI SUBSTATION RPC SYSTEM
INSTALLATION & INTEGRATION
SCALE:NTS

NOT FOR CONSTRUCTION

N

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DESIGN	12/04/2014	LLH

DESIGNED BY: LLH
DATE: 12/04/2014
DRAWN BY: SKL
SUBMITTED BY: Tetra Tech
CHECKED BY: PS
CAD FILE NAME: LT0048-E-501DI

USAID FROM THE AMERICAN PEOPLE

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USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
GHAZNI SUBSTATION – PARTIAL GENERAL ARRANGEMENT PLAN – RPC

SHEET REFERENCE NUMBER:
XE–110

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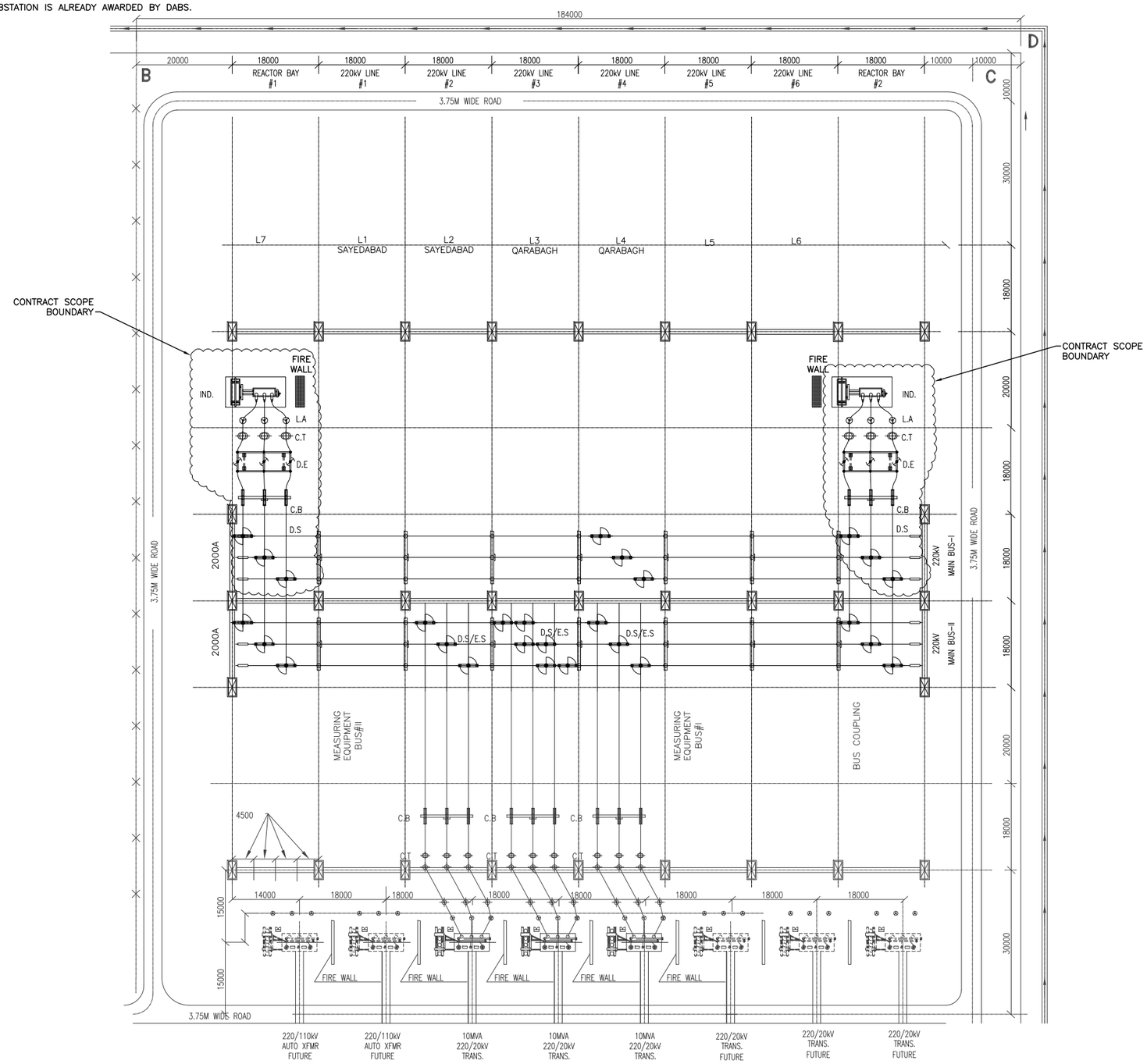
NOTES:

1. LINE BAY EQUIPMENT NOT SHOWN.
2. REFER TO "RFP FOR EPC, 220KV T/L FROM ARGHANDI TO GHAZNI, SAYEDABAD SUBSTATION GENERAL ARRANGEMENT PLAN – CONTRACT 1–B" DRAWING E–202 FOR SAYEDABAD SUBSTATION GENERAL ARRANGEMENT PLAN.
3. TYPICAL GENERAL ARRANGEMENT 1.25PLAN SHOWN FOR INFORMATION ONLY. CONTRACTOR SHALL PREPARE FINAL GENERAL ARRANGEMENT PLAN.
4. THE CONSTRUCTION BID FOR SAYEADBAD SUBSTATION IS ALREADY AWARDED BY DABS.



SAYEDABAD SUBSTATION RPC SYSTEM INSTALLATION & INTEGRATION

SCALE:NTS

NOT FOR CONSTRUCTION

N

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DESIGN	12/04/2014	LLH

DESIGNED BY: LLH
DATE: 12/04/2014
DRAWN BY: SKL
SUBMITTED BY: Tetra Tech
CHECKED BY: PS
CAD FILE NAME: LT0048–E–501DI

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USAID – OEGI
WOLT0048, AMD6 CHIMTALA,
SAYEDABAD, GHAZNI & KANDAHAR
EAST RPC SYSTEM

SAYEDABAD SUBSTATION – PARTIAL
GENERAL ARRANGEMENT PLAN – RPC

SHEET REFERENCE NUMBER:
XE–120

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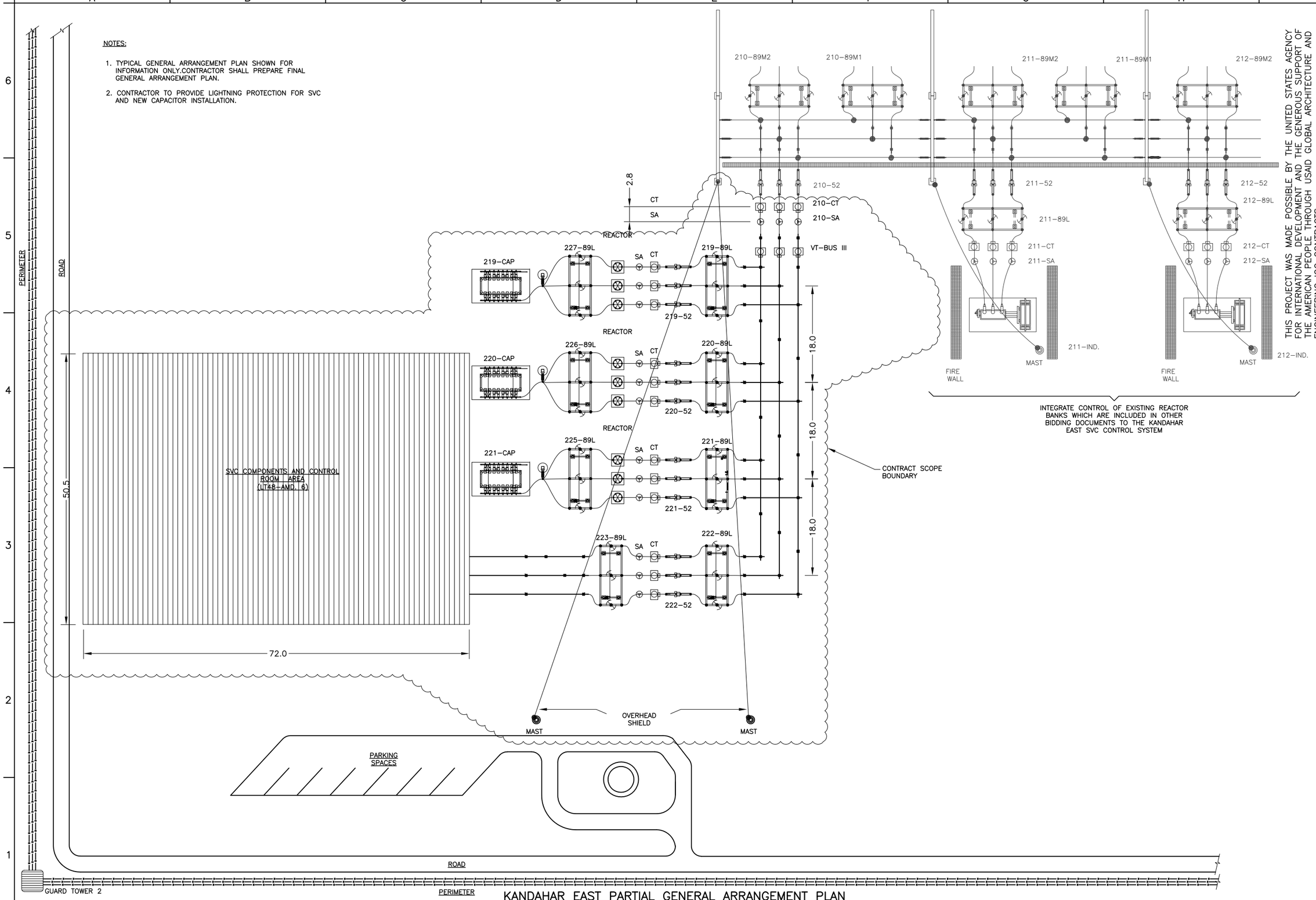
NOTES:

1. TYPICAL GENERAL ARRANGEMENT PLAN SHOWN FOR INFORMATION ONLY.CONTRACTOR SHALL PREPARE FINAL GENERAL ARRANGEMENT PLAN.
2. CONTRACTOR TO PROVIDE LIGHTNING PROTECTION FOR SVC AND NEW CAPACITOR INSTALLATION.



NOT FOR CONSTRUCTION

KANDAHAR EAST PARTIAL GENERAL ARRANGEMENT PLAN
RPC SYSTEM INSTALLATION
SCALE: 3:1

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DESIGN	12/04/2014	LLH

DESIGNED BY: LLH
DATE: 12/04/2014
DRAWN BY: SKL
SUBMITTED BY: Tetra Tech
CHECKED BY: PS
CAD FILE NAME: LT0048-E-501DI

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USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM

KANDAHAR EAST SUBSTATION-PARTIAL GENERAL ARRANGEMENT PLAN – RPC

SHEET REFERENCE NUMBER:
XE-130

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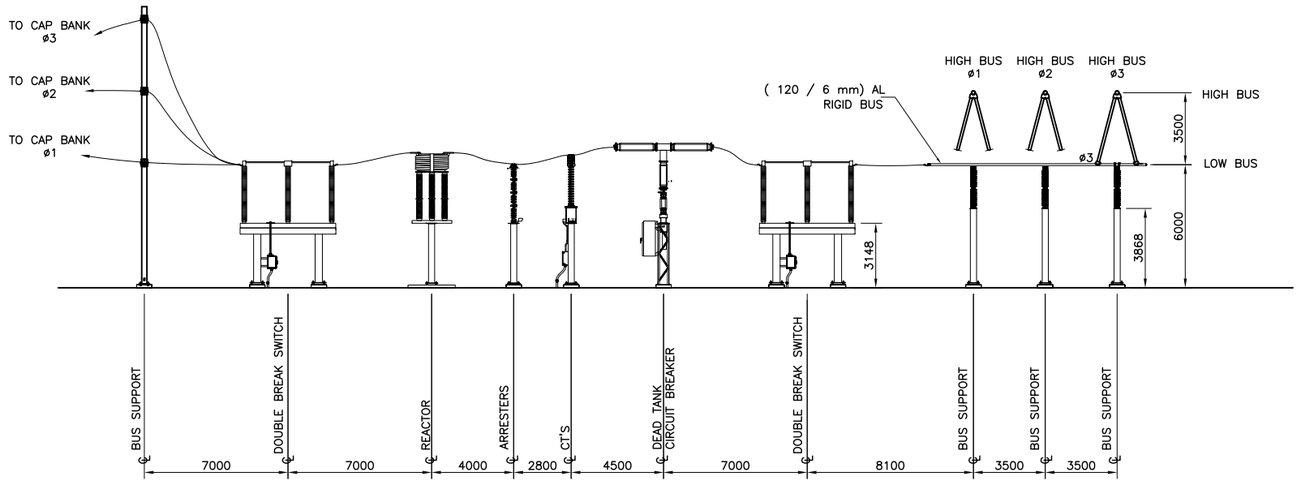
NOTES:

1. THIS IS A CONCEPT DESIGN ONLY, CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWING TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.



SVC/CAPACITOR BANK CONNECTION
TYPICAL BUS ARRANGEMENT
ELEVATION
SCALE 1:150

NOT FOR CONSTRUCTION

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CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DESIGN	12/04/2014	LLH

DESIGNED BY: LLH
DATE: 12/04/2014
DRAWN BY: SKL
SUBMITTED BY: Tetra Tech
CHECKED BY: PS
CAD FILE NAME: LT0048-E-501DI

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USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
SVC/CAPACITOR BANK CONNECTION BUS ELEVATION

SHEET REFERENCE NUMBER:
XE-500

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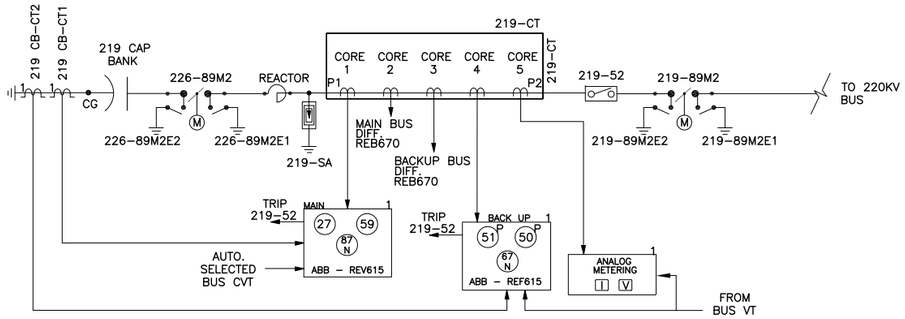
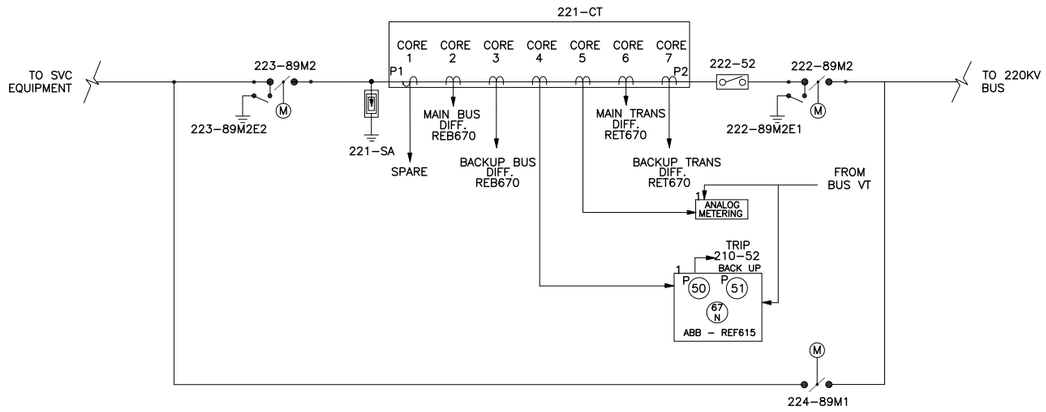
NOTES:

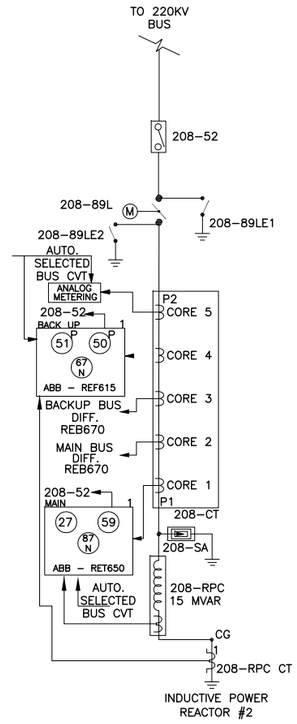
1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.



DETAIL 1
TYPICAL CAPACITOR SINGLE LINE AND PROTECTION SCHEME
SCALE: NTS



DETAIL 2
TYPICAL SVC SINGLE LINE AND PROTECTION SCHEME
SCALE: NTS



DETAIL 3
TYPICAL REACTOR SINGLE LINE AND PROTECTION SCHEME
SCALE: NTS

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CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DESIGN	12/04/2014	LLH

DESIGNED BY: MAY
DATE: 12/04/2014
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-501DI

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USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
TYPICAL SINGLE LINE AND PROTECTION SCHEME DETAILS

SHEET REFERENCE NUMBER:
XE-501

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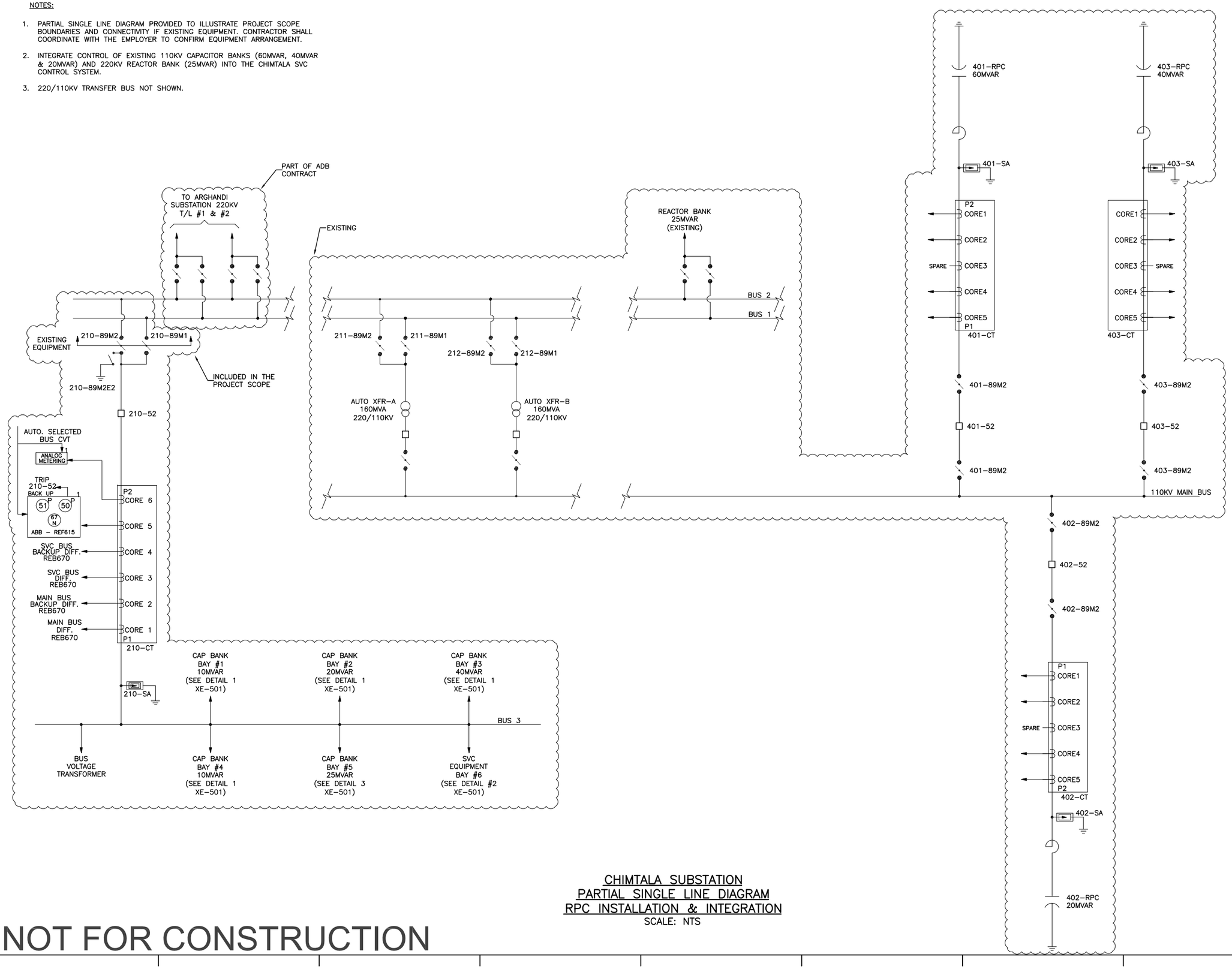
NOTES:

1. PARTIAL SINGLE LINE DIAGRAM PROVIDED TO ILLUSTRATE PROJECT SCOPE BOUNDARIES AND CONNECTIVITY IF EXISTING EQUIPMENT. CONTRACTOR SHALL COORDINATE WITH THE EMPLOYER TO CONFIRM EQUIPMENT ARRANGEMENT.
2. INTEGRATE CONTROL OF EXISTING 110KV CAPACITOR BANKS (60MVAR, 40MVAR & 20MVAR) AND 220KV REACTOR BANK (25MVAR) INTO THE CHIMTALA SVC CONTROL SYSTEM.
3. 220/110KV TRANSFER BUS NOT SHOWN.



CHIMTALA SUBSTATION
PARTIAL SINGLE LINE DIAGRAM
RPC INSTALLATION & INTEGRATION
SCALE: NTS

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DESIGN	12/04/2014	LLH

DESIGNED BY: MAY
DATE: 12/04/2014
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-501DI

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USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR
EAST RPC SYSTEM
CHIMTALA SUBSTATION – PARTIAL SINGLE LINE DIAGRAM – RPC

SHEET REFERENCE NUMBER:
XE-600

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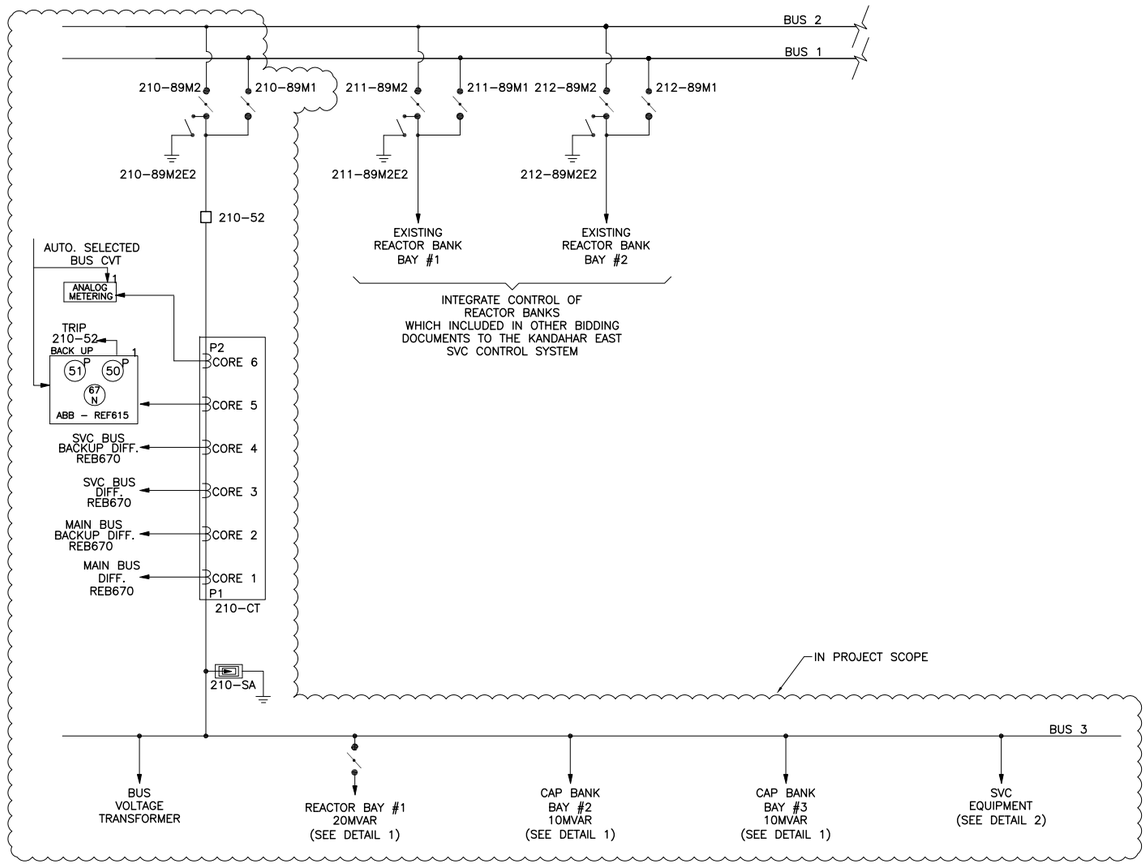
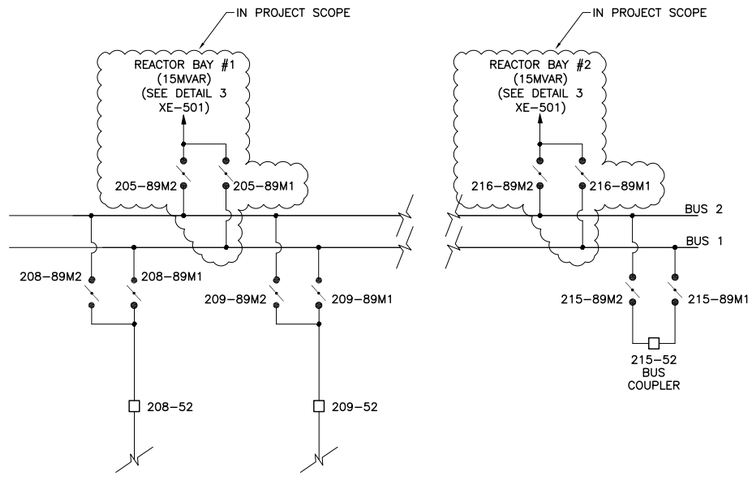
NOTES:

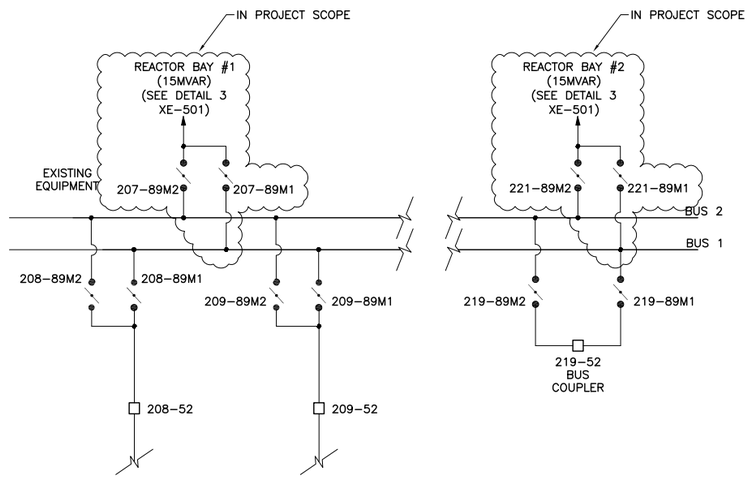
1. REFER TO WO-LT-0048 AMD4 DRAWING E-501, E-502 & E-503 FOR KANDAHAR EAST HV SLD.
2. INTEGRATE CONTROL OF EXISTING REACTOR BANKS #1 AND #2 INTO THE KANDAHAR EAST SVC CONTROL SYSTEM.
3. REFER TO "RFP FOR EPC, 220KV T/L FROM ARGHANDI TO GHAZNI, SAYEDABAD SUBSTATION ONE-LINE DIAGRAM 220KV – CONTRACT 1-B; DRAWING E-303" FOR SAYEDABAD SUBSTATION HV SLD.
4. REFER TO "RFP FOR EPC, 220KV T/L FROM ARGHANDI TO GHAZNI, GHAZNI SUBSTATION ONE-LINE DIAGRAM 220KV – CONTRACT 1-B; DRAWING E-300" FOR GHAZNI SUBSTATION HV SLD.



KANDAHAR EAST SUBSTATION
PARTIAL SINGLE LINE DIAGRAM
RPC SYSTEM INSTALLATION & INTEGRATION
SCALE: NTS



SAYEDABAD SUBSTATION
PARTIAL SINGLE LINE DIAGRAM
RPC INSTALLATION
SCALE: NTS



GHAZNI SUBSTATION
PARTIAL SINGLE LINE DIAGRAM
RPC INSTALLATION
SCALE: NTS

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

CONCEPT DESIGN SUBMITTAL

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DESIGN	12/04/2014	LLH

DESIGNED BY: MAY
DATE: 12/04/2014
DRAWN BY: MAY
SUBMITTED BY: Tetra Tech
CHECKED BY: DJ
CAD FILE NAME: LT0048-E-501DI

USAID FROM THE AMERICAN PEOPLE

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USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
KANDAHAR EAST, GHAZNI, SAYEDABAD SUBSTATION PARTIAL SINGLE LINE DIAGRAM – RPC

SHEET REFERENCE NUMBER:
XE-610

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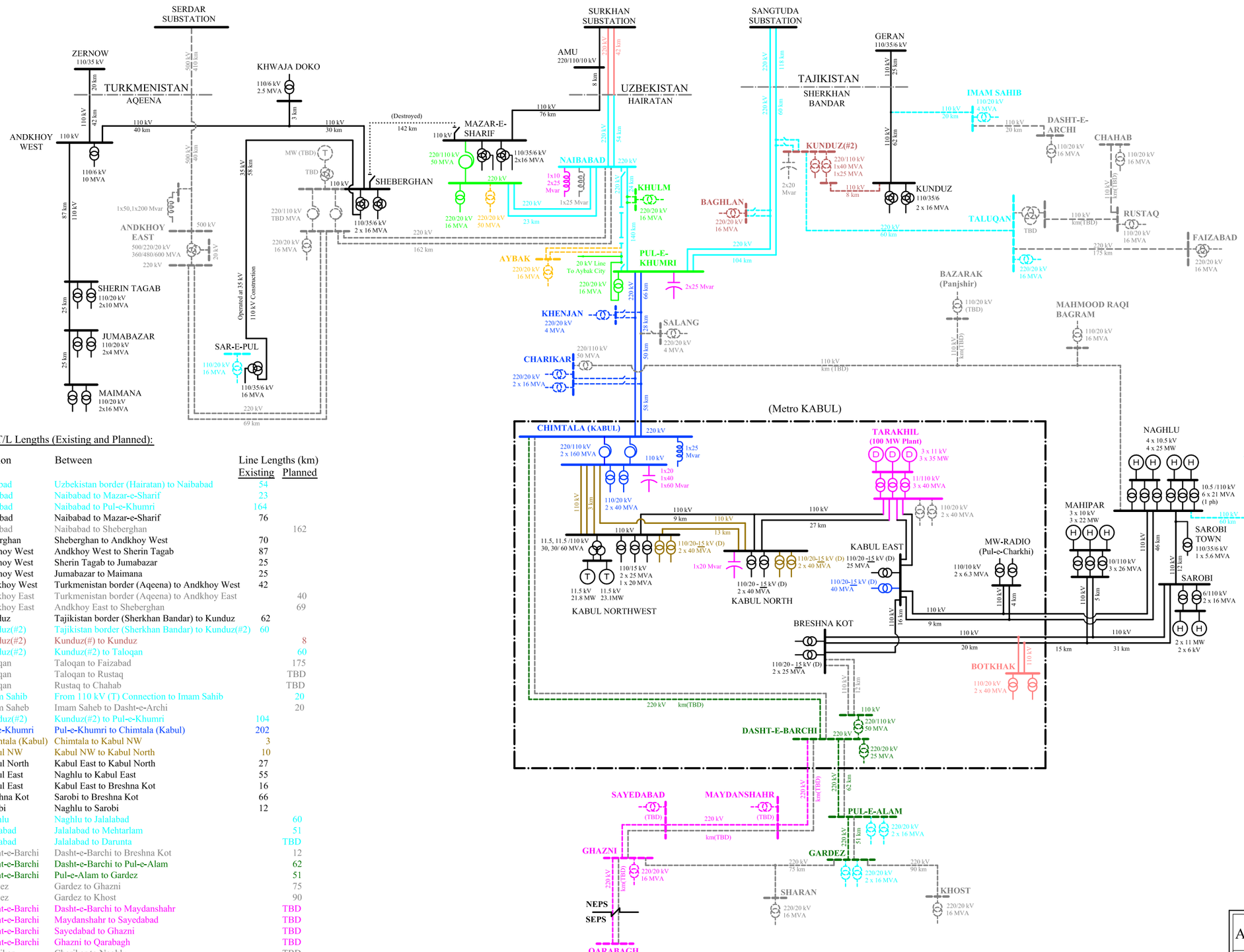
3.2 – Reference Drawing Set

USAID FROM THE AMERICAN PEOPLE

Afghan Energy Information Center
د افغان د انرژۍ معلوماتي مرکز
مرکز معلوماتی انرژی افغان

NORTHEAST POWER SYSTEM (NEPS) AFGHANISTAN

سیستم برق شمالشرق افغانستان



Donor Color Guide:

- Existing
- USAID
- WB
- GOI
- ADB
- KFW
- IsDB
- ARTF
- IRoA
- USACE
- Unfunded

Note :

1. Drawing is based on information from numerous sources, including donors, contractors, Inter-Ministerial Commission for Energy (ICE), MEW, and DABS.
2. While we have attempted to validate the information, the accuracy of the drawing is dependent on the reliability of the information provided by the sources.
3. For dual voltage transformers (D), the current operating voltage is underlined.
4. Not all destroyed T/L are shown.
5. Drawing believed to be accurate as of revision date.

LEGEND:

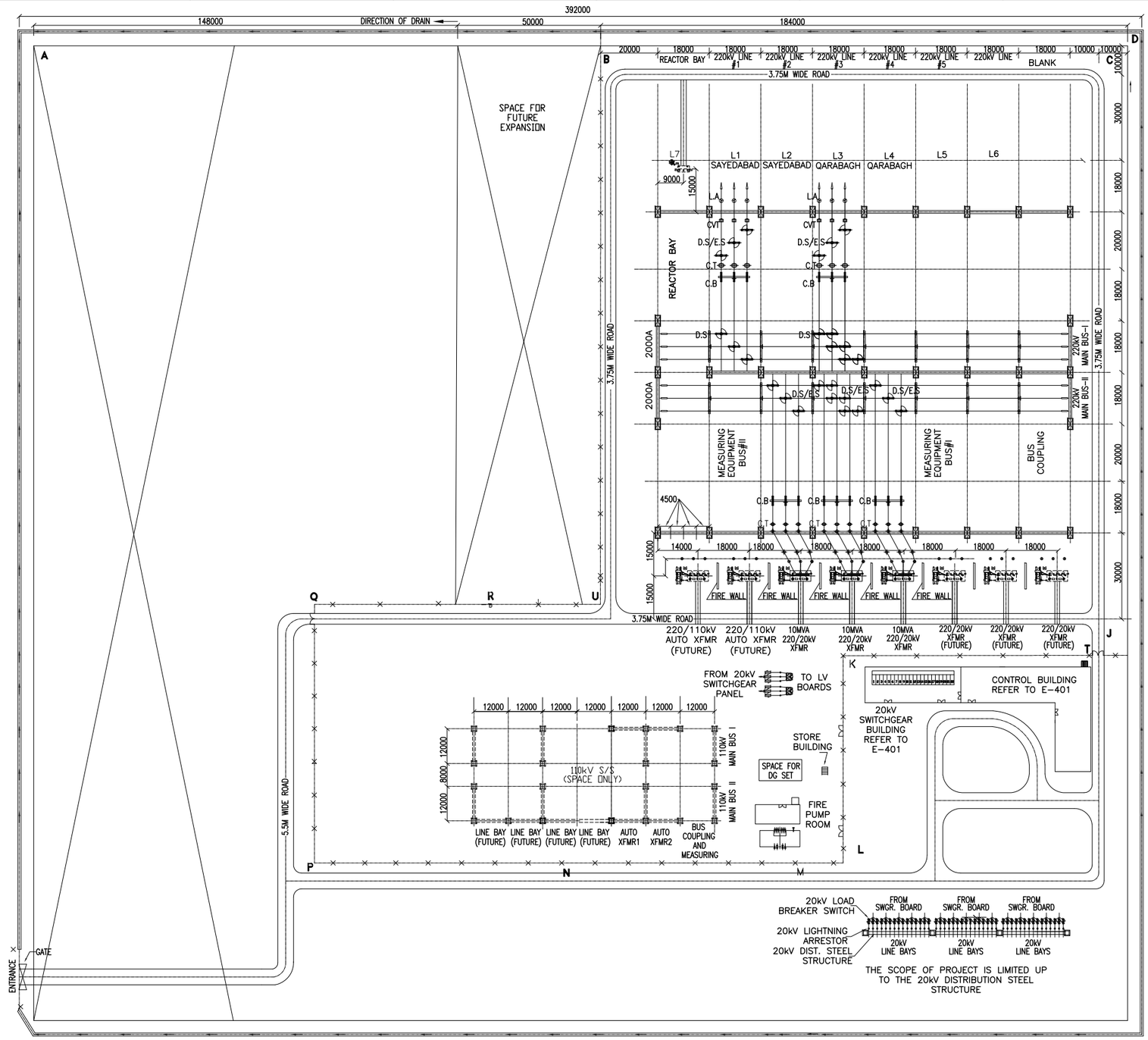
- Existing / Completed
- Planned / Under Construction
- Bus Bar
- Destroyed
- International Border
- Hydro Power Plant
- Diesel Generator
- Turbine Generator
- Transformer (2 Winding)
- Transformer (3 Winding)
- Auto Transformer
- Capacitor
- Reactor
- Switch
- Dual Voltage Transformer (D)
- To Be Determined (TBD)
- Common Name ( )
- Metro Kabul

NEPS T/L Lengths (Existing and Planned):

Substation	Between	Line Lengths (km) Existing	Planned
1- Naibabad	Uzbekistan border (Hairatan) to Naibabad	54	
2- Naibabad	Naibabad to Mazar-e-Sharif	23	
3- Naibabad	Naibabad to Pul-e-Khumri	164	
4- Naibabad	Naibabad to Mazar-e-Sharif	76	
5- Naibabad	Naibabad to Sheberghan		162
6- Sheberghan	Sheberghan to Andkhoy West	70	
7- Andkhoy West	Andkhoy West to Sherin Tagab	87	
8- Andkhoy West	Sherin Tagab to Jumabazar	25	
9- Andkhoy West	Jumabazar to Maimana	25	
10- Andkhoy West	Turkmenistan border (Aqeena) to Andkhoy West	42	
11- Andkhoy East	Turkmenistan border (Aqeena) to Andkhoy East		40
12- Andkhoy East	Andkhoy East to Sheberghan		69
13- Kunduz	Tajikistan border (Sherkhan Bandar) to Kunduz	62	
14- Kunduz(#2)	Tajikistan border (Sherkhan Bandar) to Kunduz(#2)	60	
15- Kunduz(#2)	Kunduz(#) to Kunduz		8
16- Kunduz(#2)	Kunduz(#2) to Taloqan		60
17- Taloqan	Taloqan to Faizabad		175
18- Taloqan	Taloqan to Rustaq		TBD
19- Taloqan	Rustaq to Chahab		TBD
20- Imam Sahib	From 110 kV (T) Connection to Imam Sahib		20
21- Imam Saheb	Imam Saheb to Dasht-e-Archi		20
22- Kunduz(#2)	Kunduz(#2) to Pul-e-Khumri	104	
23- Pul-e-Khumri	Pul-e-Khumri to Chimtala (Kabul)	202	
24- Chimtala (Kabul)	Chimtala to Kabul NW	3	
25- Kabul NW	Kabul NW to Kabul North	10	
26- Kabul North	Kabul East to Kabul North	27	
27- Kabul East	Naghlu to Kabul East	55	
28- Kabul East	Kabul East to Breshna Kot	16	
29- Breshna Kot	Sarobi to Breshna Kot	66	
30- Sarobi	Naghlu to Sarobi	12	
31- Naghlu	Naghlu to Jalalabad		60
32- Jalalabad	Jalalabad to Mehtarlam		51
33- Jalalabad	Jalalabad to Darunta		TBD
34- Dasht-e-Barchi	Dasht-e-Barchi to Breshna Kot		12
35- Dasht-e-Barchi	Dasht-e-Barchi to Pul-e-Alam		62
36- Dasht-e-Barchi	Pul-e-Alam to Gardez		51
37- Gardez	Gardez to Ghazni		75
38- Gardez	Gardez to Khost		90
39- Dasht-e-Barchi	Dasht-e-Barchi to Maydanshahr		TBD
40- Dasht-e-Barchi	Maydanshahr to Sayedabad		TBD
41- Dasht-e-Barchi	Sayedabad to Ghazni		TBD
42- Dasht-e-Barchi	Ghazni to Qarabagh		TBD
43- Charikar	Charikar to Naghlu		TBD
	Total Lengths :	1,183	955

DRAFT FOR PUBLICATION
www.AfghanEIC.org

AFGHAN ENERGY INFORMATION CENTER(AEIC)					
Title:	The Northeast Power System (SLD)				
Drawing No.	1 of 2	Origin Date:		December 13, 2004	
Rev Date:	**January 25, 2012**	Rev #:	039	Scale:	NTS



NOTES:

1. THIS IS A GENERAL ARRANGEMENT PLAN. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR APPROVAL. CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVE.
2. THE T/L CONTRACTOR (CONTRACT 1–A) SHALL TERMINATE WORK AT EACH DEAD–END T/L TOWER NEAREST TO THE SS. THE T/L CONTRACTOR SHALL SUPPLY SUFFICIENT SURPLUS CONDUCTORS (FOR POWER AND OPGW), LOOP IT, AND ATTACH IT AT THE DEAD–END TERMINAL TOWERS TO FACILITATE CONNECTIONS TO THE SUBSTATION. THE SS CONTRACTOR SHALL INSTALL AND CONNECT THESE SURPLUS CONDUCTORS TO EACH SS UNDER CONSTRUCTION FOR PURPOSE OF TESTING AND COMMISSIONING THE SS.
3. THE 20KV DISTRIBUTION LINES FOR OUTGOING FEEDERS SHALL BE TERMINATED AT THE 20KV LOAD BREAK SWITCHES THAT ARE TO BE INSTALLED AT THE 20KV STEEL STRUCTURE LOCATED IN THE SS SITE AS SHOWN IN THE PLAN. THE 20KV LOAD BREAK SWITCHES ARE TO BE SUPPLIED, INSTALLED, AND CONNECTED COMPLETELY BY THE SS CONTRACTOR. PROVIDE 20KV UNDERGROUND DUCT BANK SYSTEM BETWEEN THE 20KV SWITCHGEAR ROOM/BUILDING AND THE 20KV DISTRIBUTION STEEL STRUCTURE. THE SS CONTRACTOR IS TO PROVIDE AND INSTALL CONDUITS (OF SUFFICIENT SIZE AND QUANTITIES) FROM THAT UNDERGROUND DUCT BANK TO THE 20KV DISTRIBUTION STEEL STRUCTURE.
4. PROVIDE 20KV UNDERGROUND DUCT BANK SYSTEM BETWEEN 220/20kV TRANSFORMERS SWITCHYARD AND THE 20KV SWITCHGEAR ROOM/BUILDING. THE DUCK BANK SYSTEM SIZING SHALL INCLUDE ADEQUATE SPACE FOR FUTURE FEEDER NEEDS.
5. THE 20KV SWITCHGEAR ROOM/BUILDING SHALL BE COMBINED WITH OR ADJOINING THE CONTROL BUILDING. SUBMIT PROPOSED LAYOUTS FOR APPROVAL. THE PROPOSED LAYOUTS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES . THE 20KV SWITCHGEAR ROOM/BUILDING SHALL BE LARGE ENOUGH THAT ALL FUTURE 20KV SWITCHGEAR CAN BE LOCATED WITHIN THE SWITCHGEAR ROOM/BUILDING AND COMPLY WITH APPLICABLE CODES, ESPECIALLY SPACING REQUIREMENTS. THE LOCATION OF THE SWITCHGEAR ROOM/BUILDING IS TO BE LOCATED AS CLOSE AS POSSIBLE TO THE BOUNDARY WALL AT WHICH THE FIRST 20KV DISTRIBUTION STEEL STRUCTURE WILL BE LOCATED.
6. PROVIDE SUFFICIENT PROVISIONS FOR INCOMING AND OUTGOING MV, COMMUNICATION, AND LV CIRCUITS FOR EACH BUILDING.
7. PROPOSED SUBSTATION AREA TO BE LEVELED AND EARTH MAT TO BE LAID IS B,C,J,K,U, AND B.
8. ALL CIVIL FOUNDATION WORKS FOR FUTURE EQUIPMENT IN THE 220kV SWITCH AND 20kV SWITCH AREA (AUTO TRANSFORMERS, 220/20KV AND CB, DS, CT, PT, 20 KV SWITCHGEAR BUILDING/ROOM, ETC.) NEED TO BE COMPLETED AS PART OF THE BASE BID. PROVIDE ONLY ROUGH GRADING IN THE 110kV SWITCH YARD.
9. DABS WILL PROVIDE AVAILABLE LAND TO THE CONTRACTOR FOR THEIR STORAGE AND OTHER CONSTRUCTION NEEDS. THE REQUIRED AREA SHALL BE SPECIFIED BY THE CONTRACTOR IN THEIR BID RESPONSE.

LEGEND

DESCRIPTION	SYMBOL
CURRENT TRANSFORMER	
CAPACITIVE VOLTAGE TRANSFORMER	
SURGE ARRESTOR	
POST INSULATOR	
CIRCUIT BREAKERS (3 PH)	
DISCONNECTOR SWITCH–D.S DISCONNECTOR WITH EARTHING SWITCH–D.S/E.S	
20kV LOAD BREAKER SWITCH	
20kV LIGHTNING ARRESTOR	
NOT IN PRESENT SCOPE	
INDICATES 5.5 WIDE CONCRETE ROAD	
INDICATES FENCE	
INDICATES 3.75M WIDE CONCRETE ROAD	
INDICATES BOUNDARY WALL	
INDICATES DRAIN	

SUBSTATION	220kV YARD T/L BAYS		110kV YARD BAYS		220/20kV YARD BAYS		220/110kV YARD BAYS		220kV REACTOR BAYS	BID SCHED.
	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	SPACE	
GHAZNI	2	4	0	4	3	3	0	2	1	CONTRACT 1B
GHAZNI	2	0	0	0	0	0	0	0	0	OPTION 1B–1

900 9000 18000 36000 54000 72000

SCALE: 1:900

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

REFERENCE DRAWINGS

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DRAWINGS	12/04/2014	DJ

DESIGNED BY: SD
DATE: 12/04/2014
DRAWN BY: MAY
SUBMITTED BY:
CHECKED BY: MAL
CAD FILE NAME: E–200

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM

GHAZNI SUBSTATION GENERAL ARRANGEMENT PLAN– CONTRACT 1–B

SHEET REFERENCE NUMBER:

E–200

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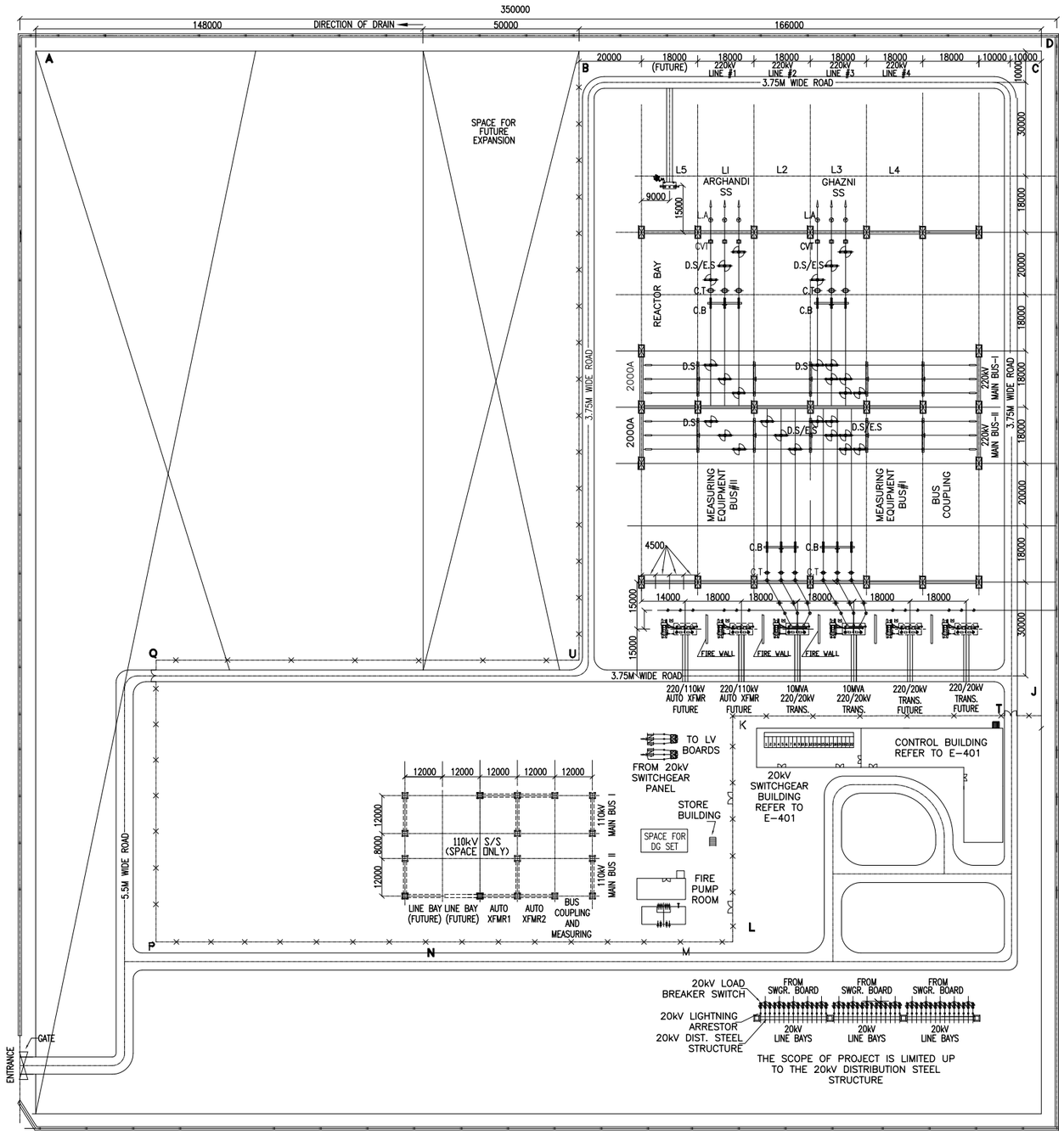

NOTES:

1. THIS IS A GENERAL ARRANGEMENT PLAN. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR APPROVAL. CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVE.
2. THE T/L CONTRACTOR (CONTRACT 1-A) SHALL TERMINATE WORK AT EACH DEAD-END T/L TOWER NEAREST TO THE SS. THE T/L CONTRACTOR SHALL SUPPLY SUFFICIENT SURPLUS CONDUCTORS (FOR POWER AND OPGW), LOOP IT, AND ATTACH IT AT THE DEAD-END TERMINAL TOWERS TO FACILITATE CONNECTIONS TO THE SUBSTATION. THE SS CONTRACTOR SHALL INSTALL AND CONNECT THESE SURPLUS CONDUCTORS TO EACH SS UNDER CONSTRUCTION FOR PURPOSE OF TESTING AND COMMISSIONING THE SS.
3. THE 20KV DISTRIBUTION LINES FOR OUTGOING FEEDERS SHALL BE TERMINATED AT THE 20KV LOAD BREAK SWITCHES THAT ARE TO BE INSTALLED AT THE 20KV STEEL STRUCTURE LOCATED IN THE SS SITE AS SHOWN IN THE PLAN. THE 20KV LOAD BREAK SWITCHES ARE TO BE SUPPLIED, INSTALLED, AND CONNECTED COMPLETELY BY THE SS CONTRACTOR. PROVIDE 20KV UNDERGROUND DUCT BANK SYSTEM BETWEEN THE 20KV SWITCHGEAR ROOM/BUILDING AND THE 20KV DISTRIBUTION STEEL STRUCTURE. THE SS CONTRACTOR IS TO PROVIDE AND INSTALL CONDUITS (OF SUFFICIENT SIZE AND QUANTITIES) FROM THAT UNDERGROUND DUCT BANK TO THE 20KV DISTRIBUTION STEEL STRUCTURE.
4. PROVIDE 20KV UNDERGROUND DUCT BANK SYSTEM BETWEEN 220/20kV TRANSFORMERS SWITCHYARD AND THE 20KV SWITCHGEAR ROOM/BUILDING. THE DUCK BANK SYSTEM SIZING SHALL INCLUDE ADEQUATE SPACE FOR FUTURE FEEDER NEEDS.
5. THE 20KV SWITCHGEAR ROOM/BUILDING SHALL BE COMBINED WITH OR ADJOINING THE CONTROL BUILDING. SUBMIT PROPOSED LAYOUTS FOR APPROVAL. THE PROPOSED LAYOUTS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES . THE 20KV SWITCHGEAR ROOM/BUILDING SHALL BE LARGE ENOUGH THAT ALL FUTURE 20KV SWITCHGEAR CAN BE LOCATED WITHIN THE SWITCHGEAR ROOM/BUILDING AND COMPLY WITH APPLICABLE CODES, ESPECIALLY SPACING REQUIREMENTS. THE LOCATION OF THE SWITCHGEAR ROOM/BUILDING IS TO BE LOCATED AS CLOSE AS POSSIBLE TO THE BOUNDARY WALL AT WHICH THE FIRST 20KV DISTRIBUTION STEEL STRUCTURE WILL BE LOCATED.
6. PROVIDE SUFFICIENT PROVISIONS FOR INCOMING AND OUTGOING MV, COMMUNICATION, AND LV CIRCUITS FOR EACH BUILDING.
7. PROPOSED SUBSTATION AREA TO BE LEVELED AND EARTH MAT TO BE LAID IS B,C,J,K,U, AND B.
8. ALL CIVIL FOUNDATION WORKS FOR FUTURE EQUIPMENT IN THE 220kV SWITCH AND 20kV SWITCH AREA (AUTO TRANSFORMERS, 220/20KV AND CB, DS, CT, PT, 20 KV SWITCHGEAR BUILDING/ROOM, ETC.) NEED TO BE COMPLETED AS PART OF THE BASE BID. PROVIDE ONLY ROUGH GRADING IN THE 110kV SWITCH YARD.
9. DABS WILL PROVIDE AVAILABLE LAND TO THE CONTRACTOR FOR THEIR STORAGE AND OTHER CONSTRUCTION NEEDS. THE REQUIRED AREA SHALL BE SPECIFIED BY THE CONTRACTOR IN THEIR BID RESPONSE.

LEGEND

DESCRIPTION	SYMBOL
CURRENT TRANSFORMER	
CAPACITIVE VOLTAGE TRANSFORMER	
SURGE ARRESTOR	
POST INSULATOR	
CIRCUIT BREAKERS (3 PH)	
DISCONNECTOR SWITCH-D.S DISCONNECTOR WITH EARTHING SWITCH-D.S/E.S	
20kV LOAD BREAKER SWITCH	
20kV LIGHTNING ARRESTOR	
NOT IN PRESENT SCOPE	
INDICATES 5.5 WIDE CONCRETE ROAD	
INDICATES FENCE	
INDICATES 3.75M WIDE CONCRETE ROAD	
INDICATES BOUNDARY WALL	
INDICATES DRAIN	

SUBSTATION	220kV YARD BAYS		110kV YARD BAYS		220/20kV YARD BAYS		220/110kV YARD BAYS		220kV REACTOR BAYS	BID SCHED.
	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	SPACE	
SAYEDABAD	2	2	0	2	2	2	0	2	1	CONTRACT 1B
SAYEDABAD	2	0	0	0	0	0	0	0	0	OPTION 1B-1

900 9000 18000 36000 54000 72000

SCALE: 1:900

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

REFERENCE DRAWINGS

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DRAWINGS	12/04/2014	DJ

DESIGNED BY: SD
DATE: 12/04/2014
DRAWN BY: MAY
SUBMITTED BY:
CHECKED BY: MAL
CAD FILE NAME: E-201

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
QARABAGH SUBSTATION GENERAL ARRANGEMENT PLAN– CONTRACT 1-B

SHEET REFERENCE NUMBER:
E-201

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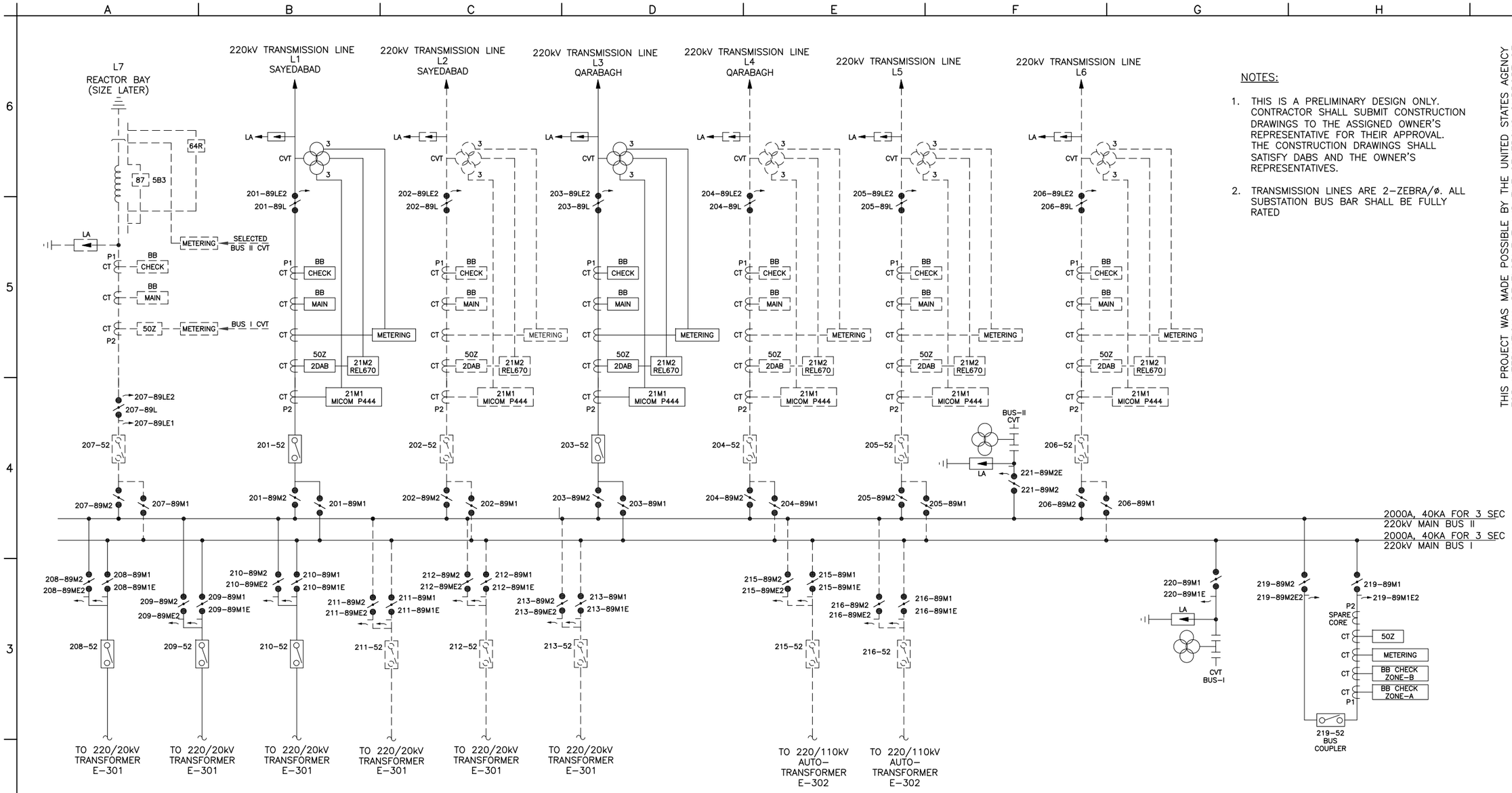

NOTES:

1. THIS IS A PRELIMINARY DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. TRANSMISSION LINES ARE 2-ZEBRA/ø. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

REFERENCE DRAWINGS

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DRAWINGS	12/04/2014	DJ

DESIGNED BY: SD
DATE: 12/04/2014
SUBMITTED BY:
DRAWN BY: MAY
CHECKED BY: MAL
CAD FILE NAME: E-300

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
GHANZI SUBSTATION ONE-LINE DIAGRAM 220kV-CONTRACT 1-B

SHEET REFERENCE NUMBER:
E-300

ONE-LINE LEGEND

CAPACITIVE VOLTAGE TRANSFORMER
CURRENT TRANSFORMER
DISCONNECT (ISOLATOR)
AC CIRCUIT BREAKER
DISCONNECT (ISOLATOR) WITH EARTHING SWITCH
DISCONNECT (ISOLATOR) WITH TWO EARTHING SWITCH
PRESENT SCOPE
NOT IN PRESET SCOPE UNLESS OTHERWISE NOTED
LIGHTING ARRESTOR (LA) SURGE ARRESTOR (SA)
PROTECTIVE RELAY/METERING/ELECTRONIC RELAY XX DEDICATED NUMBER
TRANSFORMER
AUTO TRANSFORMER
SWITCHGEAR CIRCUIT BREAKER
REACTOR

RELAY	21– DISTANCE RELAY
	50– INSTANTANEOUS OVERCURRENT RELAY
	52– AC CIRCUIT BREAKER
	64– GROUND DETECTOR RELAY
	67– AC DIRECTIONAL OVERCURRENT RELAY
	87– DIFFERENTIAL PROTECTIVE RELAY
	89– LINE SWITCH
	BB CHECK– BUS DIFFERENTIAL RELAY
ABBREVIATION	LA– LIGHTNING ARRESTOR
	CT– CURRENT TRANSFORMER
	Z– IMPEDANCE RELAY
	CVT– CAPACITOR VOLTAGE TRANSFORMER
	LT– STATION SERVICE
	SA– SURGE ARRESTOR
PRESENT SCOPE	
NOT IN PRESET SCOPE UNLESS OTHERWISE NOTED	

SUBSTATION	220kV YARD T/L BAYS		110kV YARD BAYS		220/20kV YARD BAYS		220/110kV YARD BAYS		220kV REACTOR BAYS	BID SCHED.
	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	SPACE	
GHAZNI	2	4	0	4	3	3	0	2	1	CONTRACT 1B
GHAZNI	2	0	0	0	0	0	0	0	0	OPTION 1B-1

NOT FOR CONSTRUCTION

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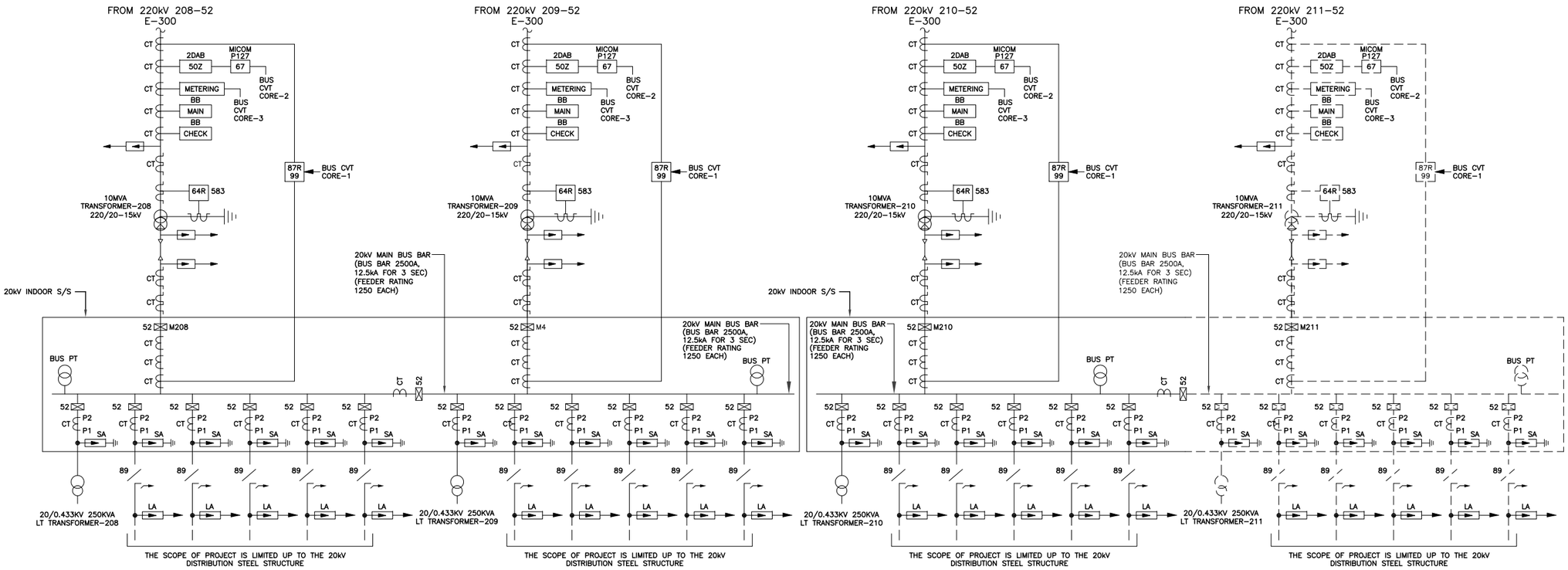


SUBSTATION	220kV YARD T/L BAYS		110kV YARD BAYS		220/20kV YARD BAYS		220/110kV YARD BAYS		220kV REACTOR BAYS	BID SCHED.
	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	SPACE	
GHAZNI	2	4	0	4	3	3	0	2	1	CONTRACT 1B
GHAZNI	2	0	0	0	0	0	0	0	0	OPTION 1B-1

LEGEND

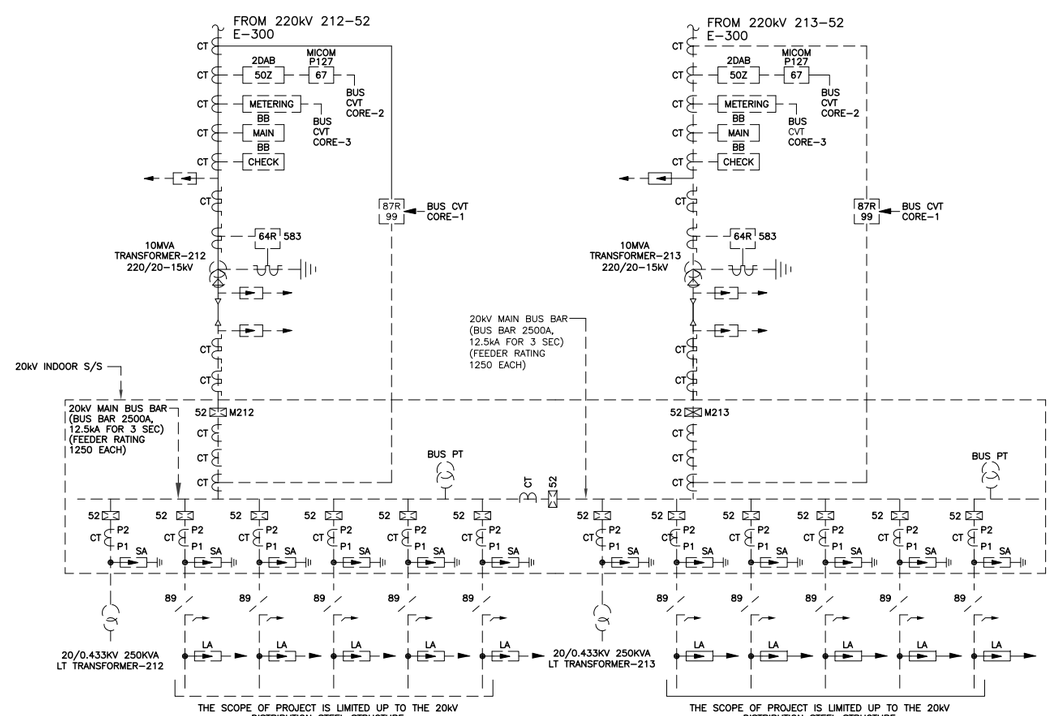
RELAY	21-	DISTANCE RELAY
	50-	INSTANTANEOUS OVERCURRENT RELAY
	52-	AC CIRCUIT BREAKER
	64-	GROUND DETECTOR RELAY
	67-	AC DIRECTIONAL OVERCURRENT RELAY
	87-	DIFFERENTIAL PROTECTIVE RELAY
	89-	LINE SWITCH
	BB CHECK-	BUS DIFFERENTIAL RELAY
ABBREVIATION	LA-	LIGHTNING ARRESTOR
	CT-	CURRENT TRANSFORMER
	Z-	IMPEDANCE RELAY
	CVT-	CAPACITOR VOLTAGE TRANSFORMER
	LT-	STATION SERVICE
	SA-	SURGE ARRESTOR

PRESENT SCOPE _____

NOT IN PRESENT SCOPE — — — —

NOTES:

1. THIS IS A PRELIMINARY DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. SEE DRAWING E-300 FOR ADDITIONAL LEGEND.



NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

REFERENCE DRAWINGS

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DRAWINGS	12/04/2014	DJ

DESIGNED BY: SD
DATE: 12/04/2014
DRAWN BY: MAY
SUBMITTED BY:
CHECKED BY: MAL
CAD FILE NAME: E-301

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
GHAZNI SUBSTATION ONE-LINE DIAGRAM 220/20kV-CONTRACT 1-B

SHEET REFERENCE NUMBER:

E-301

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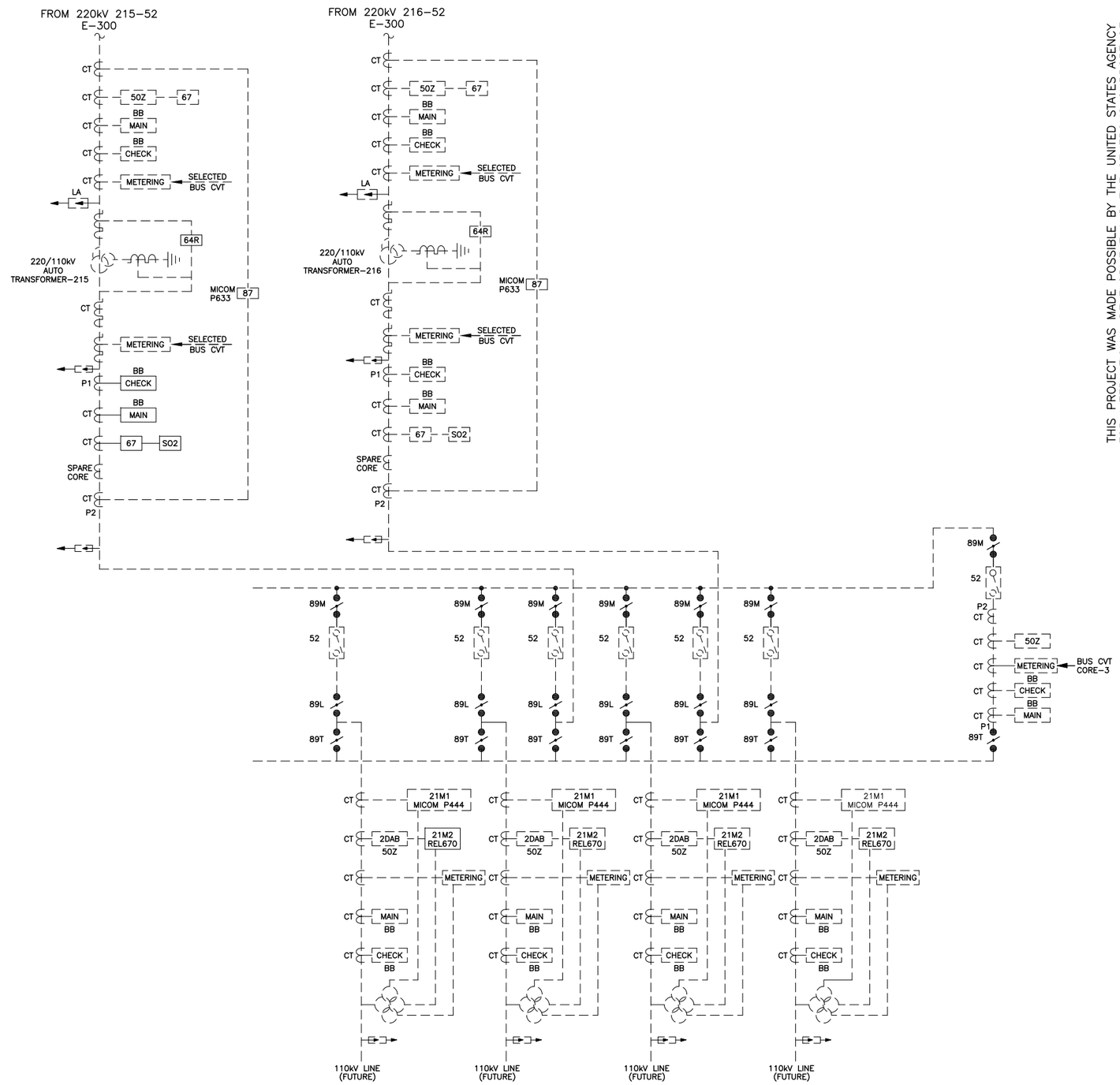
SUBSTATION	220kV YARD T/L BAYS		110kV YARD BAYS		220/20kV YARD BAYS		220/110kV YARD BAYS		220kV REACTOR BAYS	BID SCHED.
	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	SPACE	
GHAZNI	2	4	0	4	3	3	0	2	1	CONTRACT 1B
GHAZNI	2	0	0	0	0	0	0	0	0	OPTION 1B-1

LEGEND

RELAY	21– DISTANCE RELAY 50– INSTANTANEOUS OVERCURRENT RELAY 52– AC CIRCUIT BREAKER 64– GROUND DETECTOR RELAY 67– AC DIRECTIONAL OVERCURRENT RELAY 87– DIFFERENTIAL PROTECTIVE RELAY 89– LINE SWITCH BB CHECK– BUS DIFFERENTIAL RELAY
ABBREVIATION	LA– LIGHTNING ARRESTOR CT– CURRENT TRANSFORMER Z– IMPEDANCE RELAY CVT– CAPACITOR VOLTAGE TRANSFORMER LT– STATION SERVICE SA– SURGE ARRESTOR
PRESENT SCOPE ————	
NOT IN PRESENT SCOPE — — — —	

NOTES:

1. THIS IS A PRELIMINARY DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. SEE DRAWING E–300 FOR ADDITIONAL LEGEND.



THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

REFERENCE DRAWINGS

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DRAWINGS	12/04/2014	DJ

DESIGNED BY: SD
DATE: 12/04/2014
DRAWN BY: MAY
SUBMITTED BY:
CHECKED BY: MAL
CAD FILE NAME: E–302

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
GHAZNI SUBSTATION ONE–LINE DIAGRAM 220/110kV–CONTRACT 1–B

SHEET REFERENCE NUMBER:
E–302

NOT FOR CONSTRUCTION

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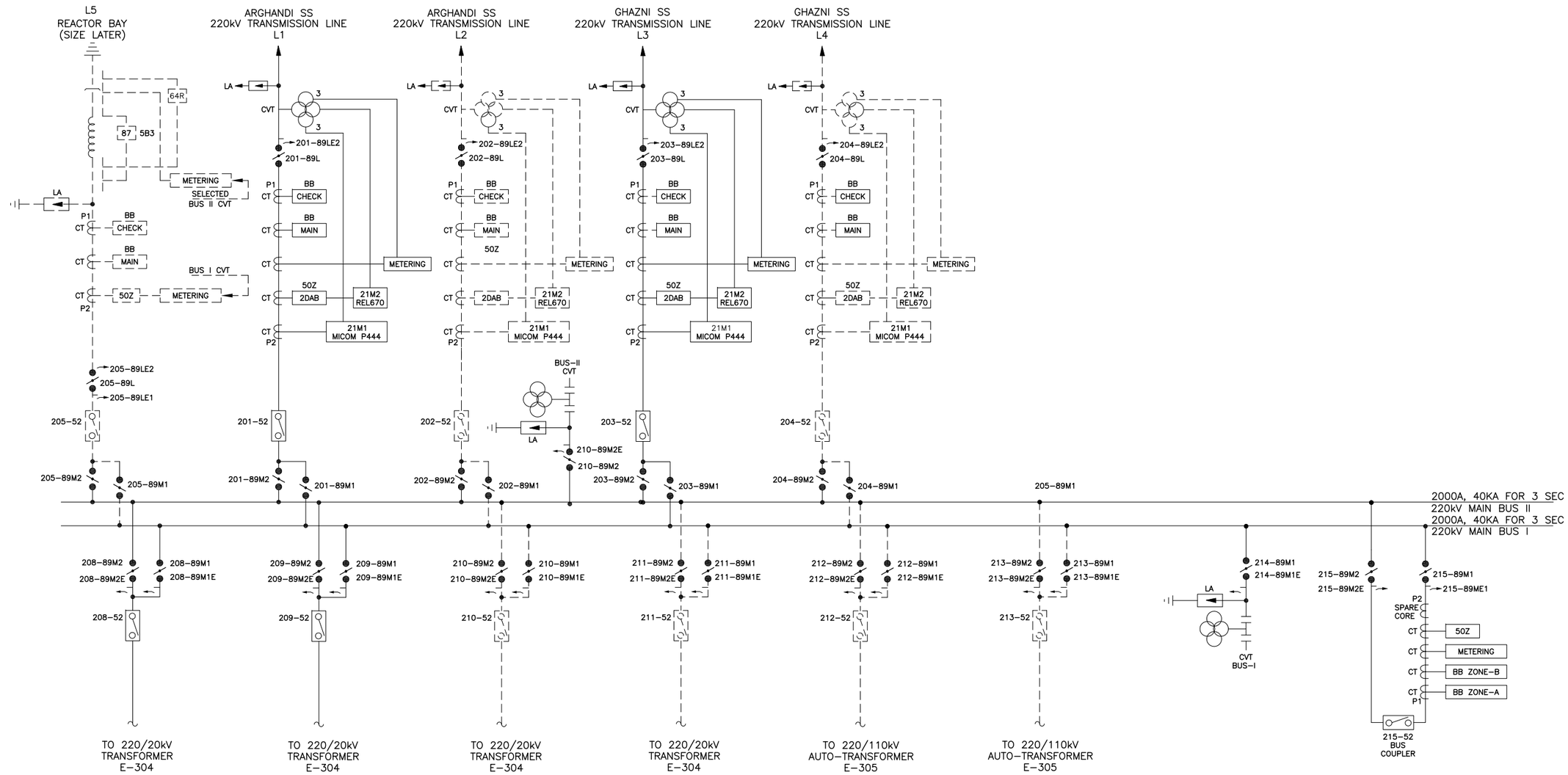

SUBSTATION	220kV YARD BAYS		110kV YARD BAYS		220/20kV YARD BAYS		220/110kV YARD BAYS		220kV REACTOR BAYS	BID SCHED.
	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	SPACE	
SAYEDABAD	2	2	0	2	2	2	0	2	1	CONTRACT 1B
SAYEDABAD	2	0	0	0	0	0	0	0	0	OPTION 1B-1

LEGEND

RELAY	21–	DISTANCE RELAY
	50–	INSTANTANEOUS OVERCURRENT RELAY
	52–	AC CIRCUIT BREAKER
	64–	GROUND DETECTOR RELAY
	67–	AC DIRECTIONAL OVERCURRENT RELAY
	87–	DIFFERENTIAL PROTECTIVE RELAY
	89–	LINE SWITCH
	BB CHECK–	BUS DIFFERENTIAL RELAY
ABBREVIATION	LA–	LIGHTNING ARRESTOR
	CT–	CURRENT TRANSFORMER
	Z–	IMPEDANCE RELAY
	CVT–	CAPACITOR VOLTAGE TRANSFORMER
	LT–	STATION SERVICE
	SA–	SURGE ARRESTOR

PRESENT SCOPE _____

NOT IN PRESET SCOPE UNLESS OTHERWISE NOTED _ _ _ _ _ _ _

NOTES:

1. THIS IS A PRELIMINARY DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. TRANSMISSION LINES ARE 2–ZEBRA/Ø. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED

ONE–LINE LEGEND

- CAPACITIVE VOLTAGE TRANSFORMER
- CURRENT TRANSFORMER
- DISCONNECT (ISOLATOR)
- AC CIRCUIT BREAKER
- DISCONNECT (ISOLATOR) WITH EARTHING SWITCH
- DISCONNECT (ISOLATOR) WITH TWO EARTHING SWITCH
- PRESENT SCOPE
- NOT IN PRESET SCOPE UNLESS OTHERWISE NOTED
- LIGHTING ARRESTOR (LA) SURGE ARRESTOR (SA)
- XX — PROTECTIVE RELAY/METERING/ELECTRONIC RELAY XX DEDICATED NUMBER
- TRANSFORMER
- AUTO TRANSFORMER
- SWITCHGEAR CIRCUIT BREAKER
- REACTOR

NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

REFERENCE DRAWINGS

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DRAWINGS	12/04/2014	DJ

DESIGNED BY: SD
DATE: 12/04/2014
DRAWN BY: MAY
SUBMITTED BY:
CHECKED BY: MAL
CAD FILE NAME: E-303

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR
EAST RPC SYSTEM
SAYEDABAD SUBSTATION ONE–LINE DIAGRAM 220kV–CONTRACT 1–B

SHEET REFERENCE NUMBER:
E–303

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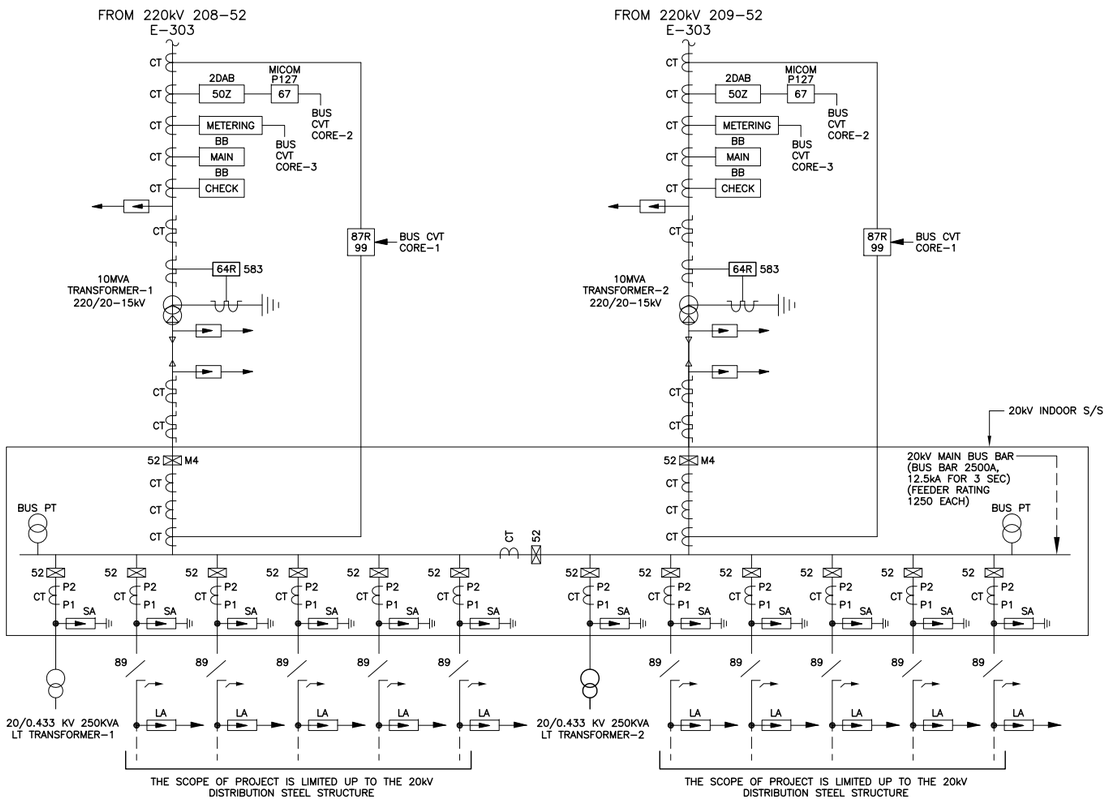


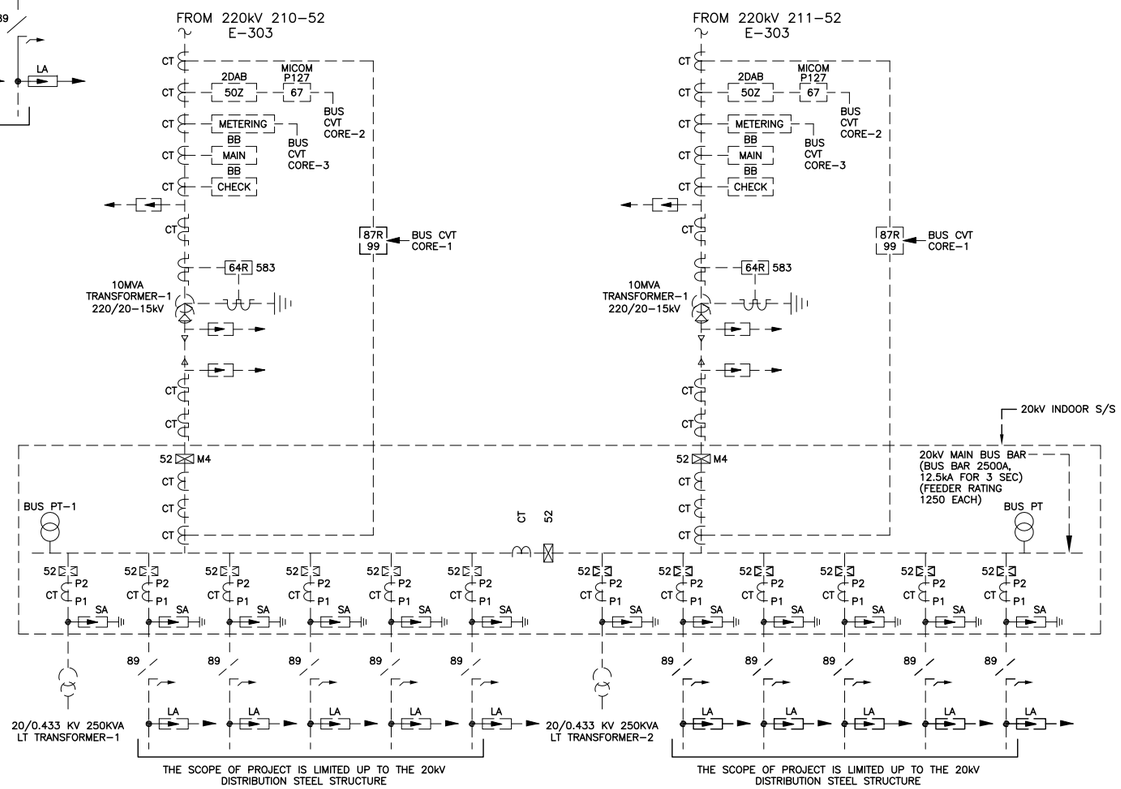
NOTES:

1. THIS IS A PRELIMINARY DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. SEE DRAWING E-303 FOR ADDITIONAL LEGEND.

SUBSTATION	220kV YARD BAYS		110kV YARD BAYS		220/20kV YARD BAYS		220/110kV YARD BAYS		220kV REACTOR BAYS	BID SCHED.
	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	SPACE	
SAYEDABAD	2	2	0	2	2	2	0	2	1	CONTRACT 1B
SAYEDABAD	2	0	0	0	0	0	0	0	0	OPTION 1B-1

LEGEND

RELAY	21- DISTANCE RELAY 50- INSTANTANEOUS OVERCURRENT RELAY 52- AC CIRCUIT BREAKER 64- GROUND DETECTOR RELAY 67- AC DIRECTIONAL OVERCURRENT RELAY 87- DIFFERENTIAL PROTECTIVE RELAY 89- LINE SWITCH BB CHECK- BUS DIFFERENTIAL RELAY
ABBREVIATION	LA- LIGHTNING ARRESTOR CT- CURRENT TRANSFORMER Z- IMPEDANCE RELAY CVT- CAPACITOR VOLTAGE TRANSFORMER LT- STATION SERVICE SA- SURGE ARRESTOR
PRESENT SCOPE	————
NOT IN PRESENT SCOPE	— — — — —



NOT FOR CONSTRUCTION

THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

REFERENCE DRAWINGS

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	
A	CONCEPT DRAWINGS	12/04/2014	DJ

APR

DESIGNED BY: SD
DATE: 12/04/2014
DRAWN BY: MAY
SUBMITTED BY:
CHECKED BY: MAL
CAD FILE NAME: E-304

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
SAYEDABAD SUBSTATION ONE-LINE DIAGRAM 220/20kV-CONTRACT 1-B

SHEET REFERENCE NUMBER:
E-304

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SUBSTATION	220kV YARD BAYS		110kV YARD BAYS		220/20kV YARD BAYS		220/110kV YARD BAYS		220kV REACTOR BAYS	BID SCHED.
	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	BUILD	SPACE	SPACE	
SAYEDABAD	2	2	0	2	2	2	0	2	1	CONTRACT 1B
SAYEDABAD	2	0	0	0	0	0	0	0	0	OPTION 1B-1

LEGEND

RELAY	21–	DISTANCE RELAY
	50–	INSTANTANEOUS OVERCURRENT RELAY
	52–	AC CIRCUIT BREAKER
	64–	GROUND DETECTOR RELAY
	67–	AC DIRECTIONAL OVERCURRENT RELAY
	87–	DIFFERENTIAL PROTECTIVE RELAY
	89–	LINE SWITCH
	BB CHECK–	BUS DIFFERENTIAL RELAY
ABBREVIATION	LA–	LIGHTNING ARRESTOR
	CT–	CURRENT TRANSFORMER
	Z–	IMPEDANCE RELAY
	CVT–	CAPACITOR VOLTAGE TRANSFORMER
	LT–	STATION SERVICE
	SA–	SURGE ARRESTOR

PRESENT SCOPE _____

NOT IN PRESENT SCOPE — — — — —

NOTES:

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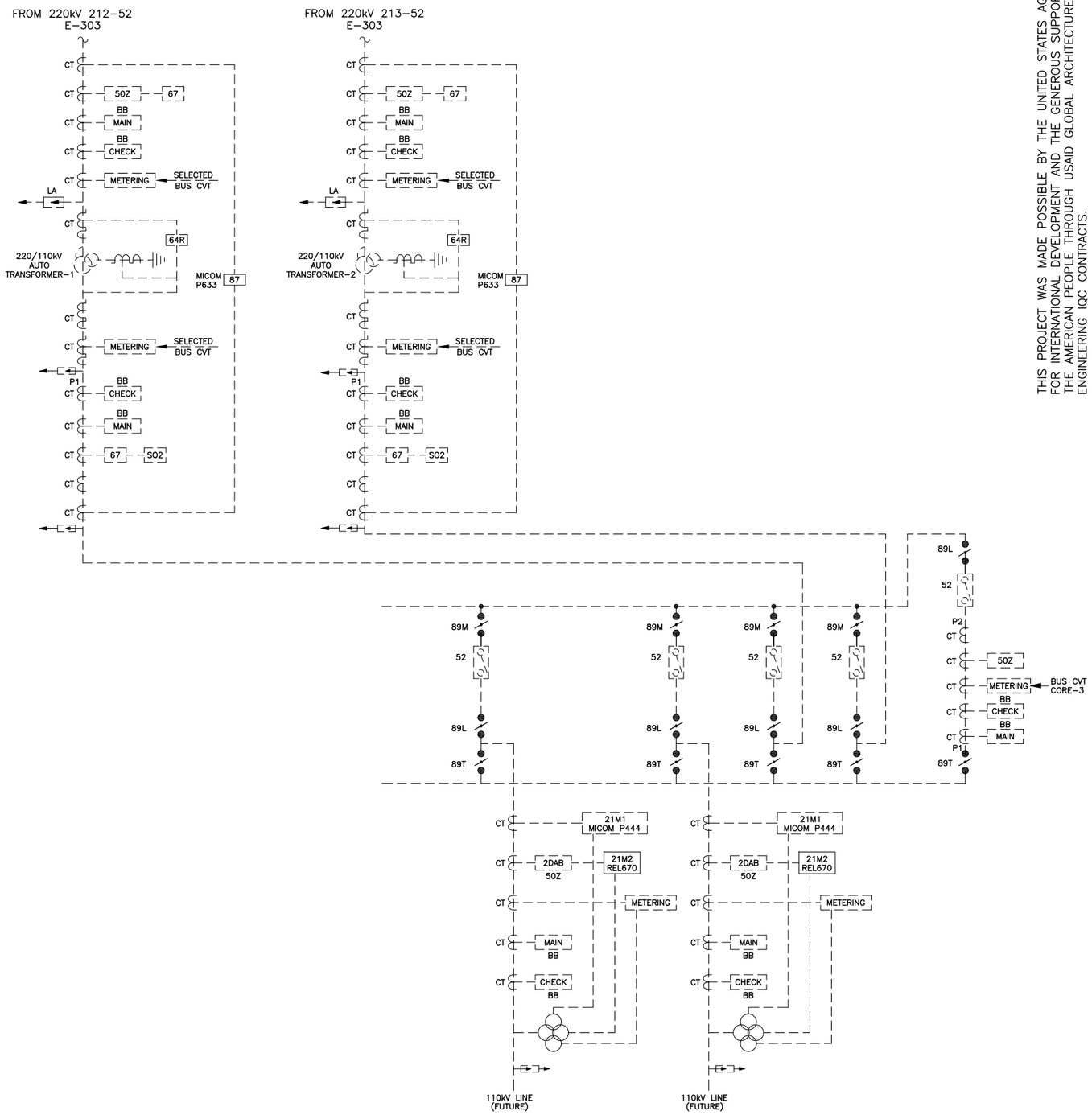
2. SEE DRAWING E–303 FOR ADDITIONAL LEGEND.



THIS PROJECT WAS MADE POSSIBLE BY THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT AND THE GENEROUS SUPPORT OF THE AMERICAN PEOPLE THROUGH USAID GLOBAL ARCHITECTURE AND ENGINEERING IQC CONTRACTS.

REFERENCE DRAWINGS

SYMB	SUBMITTAL/REVISION DESCRIPTION	DATE	APR
A	CONCEPT DRAWINGS	12/04/2014	DJ

DESIGNED BY: SD | DATE: 12/04/2014
DRAWN BY: MAY | SUBMITTED BY:
CHECKED BY: MAL | CAD FILE NAME: E–305

USAID FROM THE AMERICAN PEOPLE

A E S P

USAID – OEGI
WOLT0048, AMD6 CHIMTALA,
SAYEDABAD, GHAZNI & KANDAHAR
EAST RPC SYSTEM

SAYEDABAD SUBSTATION ONE–LINE
DIAGRAM 220/110kV–CONTRACT 1–B

SHEET REFERENCE NUMBER:

E–305

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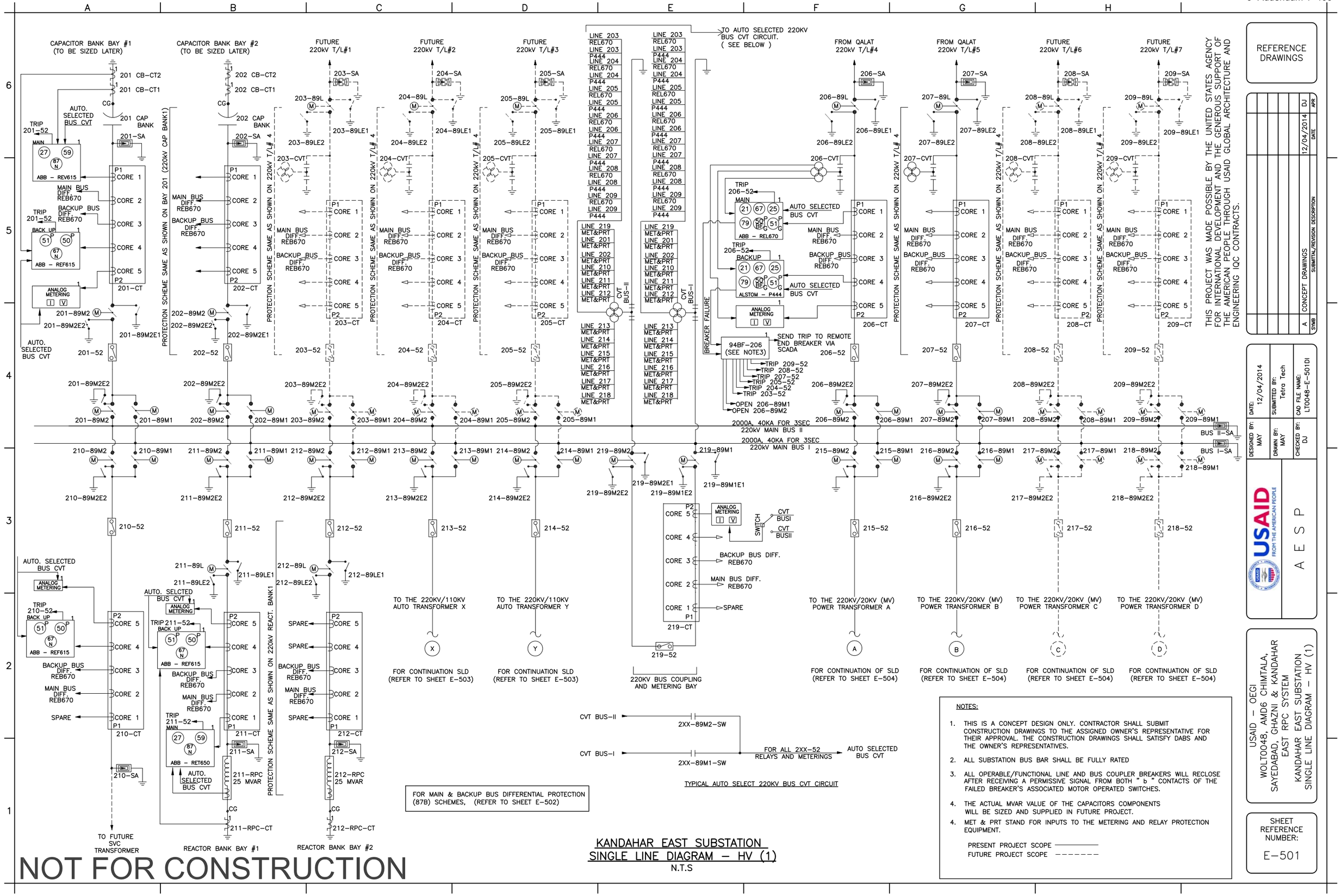
CAPACITOR BANK BAY #1 (TO BE SIZED LATER)
CAPACITOR BANK BAY #2 (TO BE SIZED LATER)
FUTURE 220kV T/L#1
FUTURE 220kV T/L#2
FUTURE 220kV T/L#3
FROM QALAT 220kV T/L#4
FROM QALAT 220kV T/L#5
FUTURE 220kV T/L#6
FUTURE 220kV T/L#7
TO AUTO SELECTED 220KV BUS CVT CIRCUIT. (SEE BELOW)
PROTECTION SCHEME SAME AS SHOWN ON BAY 201 (220kV CAP BANK1)
PROTECTION SCHEME SAME AS SHOWN ON 220kV T/L# 4
PROTECTION SCHEME SAME AS SHOWN ON 220kV REACT. BANK1
2000A, 40KA FOR 3SEC 220kV MAIN BUS II
2000A, 40KA FOR 3SEC 220kV MAIN BUS I
BUS II-SA
BUS I-SA
TO THE 220KV/110KV AUTO TRANSFORMER X
TO THE 220KV/110KV AUTO TRANSFORMER Y
220KV BUS COUPLING AND METERING BAY
TO THE 220KV/20KV (MV) POWER TRANSFORMER A
TO THE 220KV/20KV (MV) POWER TRANSFORMER B
TO THE 220KV/20KV (MV) POWER TRANSFORMER C
TO THE 220KV/20KV (MV) POWER TRANSFORMER D
FOR CONTINUATION SLD (REFER TO SHEET E-503)
FOR CONTINUATION OF SLD (REFER TO SHEET E-504)
TO FUTURE SVC TRANSFORMER
REACTOR BANK BAY #1
REACTOR BANK BAY #2
FOR MAIN & BACKUP BUS DIFFERENTIAL PROTECTION (87B) SCHEMES, (REFER TO SHEET E-502)
CVT BUS-II
CVT BUS-I
2XX-89M2-SW
2XX-89M1-SW
FOR ALL 2XX-52 RELAYS AND METERINGS
AUTO SELECTED BUS CVT
TYPICAL AUTO SELECT 220KV BUS CVT CIRCUIT
NOTES:
1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED
3. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RECLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.
4. THE ACTUAL MVAR VALUE OF THE CAPACITORS COMPONENTS WILL BE SIZED AND SUPPLIED IN FUTURE PROJECT.
4. MET & PRT STAND FOR INPUTS TO THE METERING AND RELAY PROTECTION EQUIPMENT.
PRESENT PROJECT SCOPE
FUTURE PROJECT SCOPE
KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – HV (1)
N.T.S
NOT FOR CONSTRUCTION
REFERENCE DRAWINGS
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WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – HV (1)
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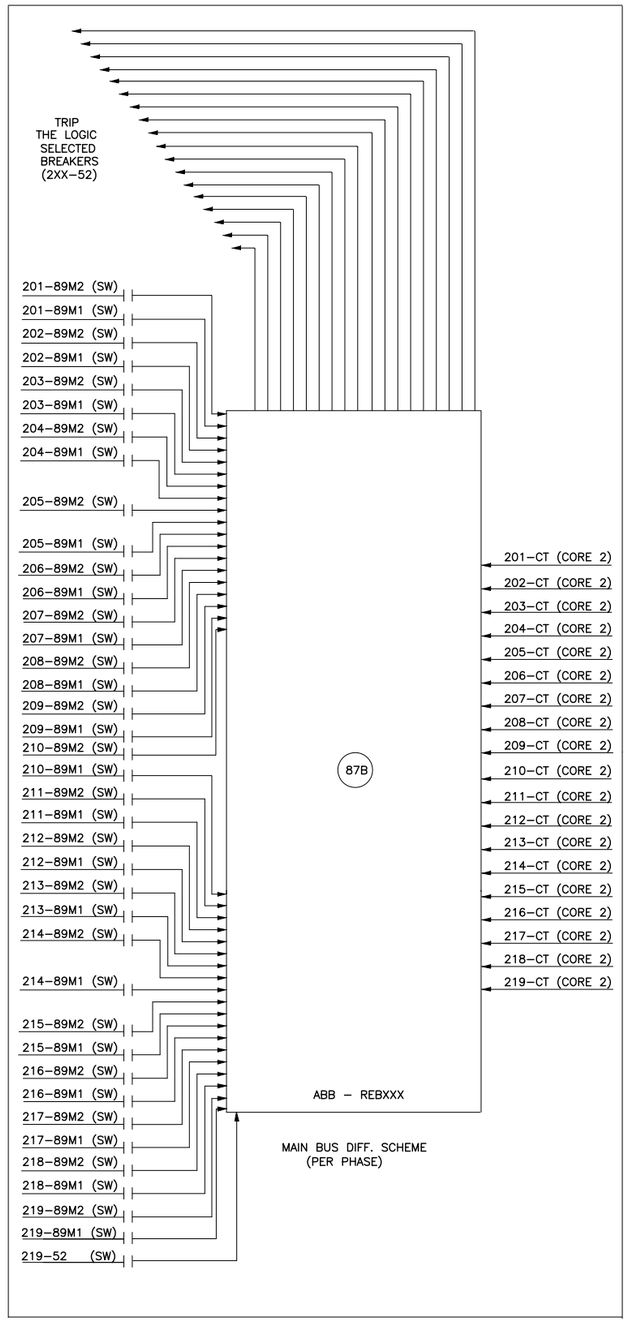
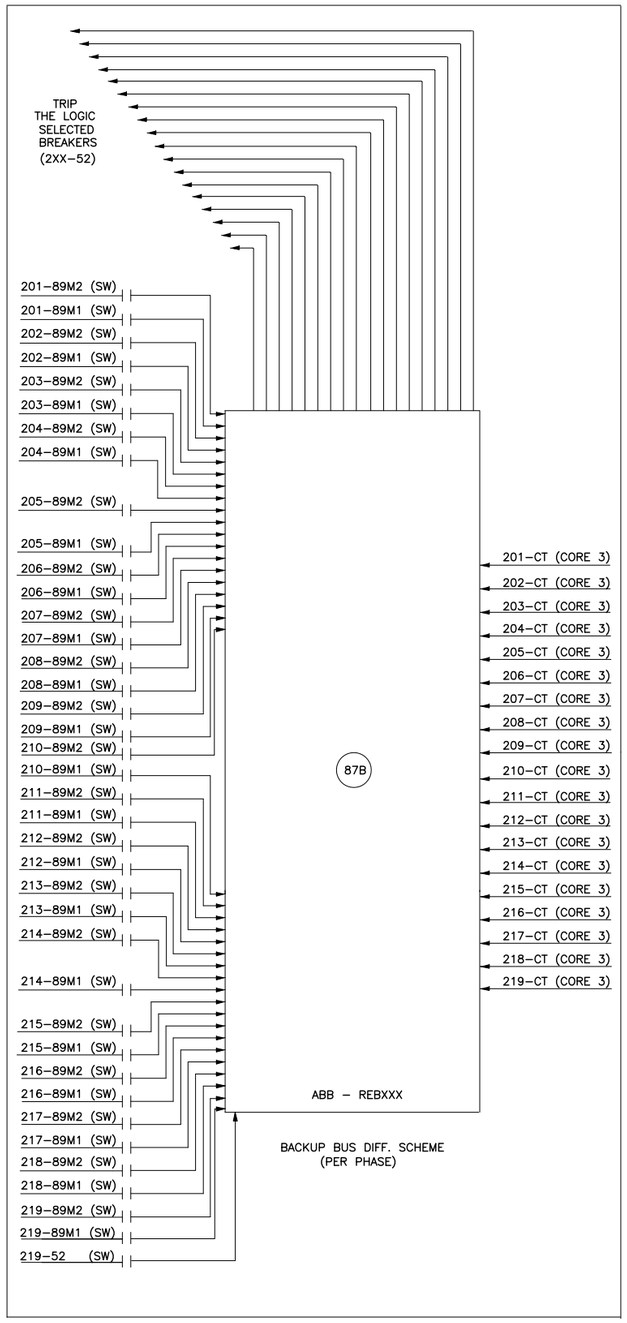


TWO ZONES BUS DIFFERENTIAL MAIN PROTECTION SCHEME PER PHASE
FOR THE 220KV BUS



TWO ZONES BUS DIFFERENTIAL BACKUP PROTECTION SCHEME PER PHASE
FOR THE 220KV BUS

KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – HV (2)
N.T.S

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KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – HV (2)

SHEET REFERENCE NUMBER:
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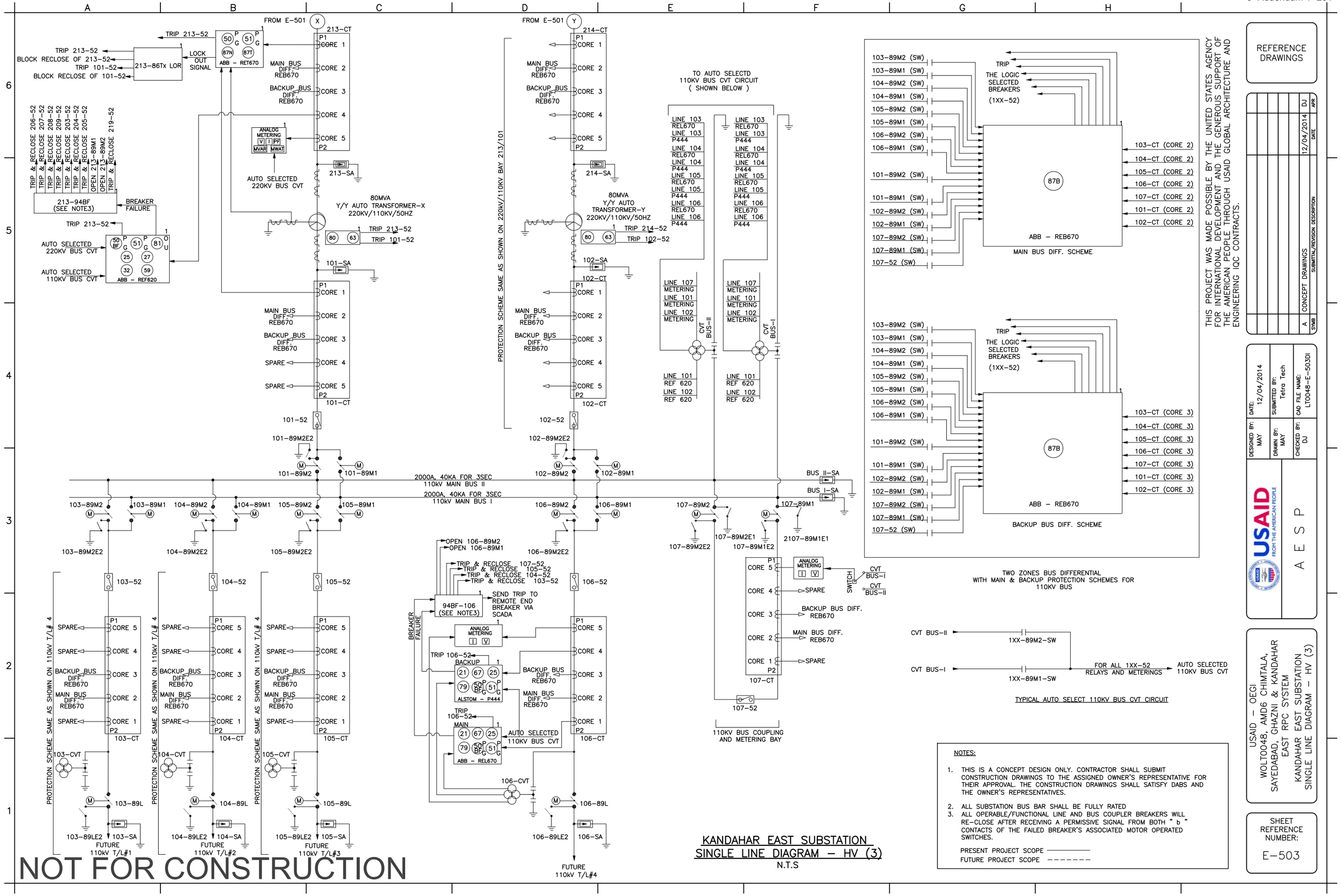
FROM E-501
213-CT
214-CT
101-CT
102-CT
103-CT
104-CT
105-CT
106-CT
107-CT
ABB – RET670
ABB – REF620
ABB – REB670
ALSTOM – P444
ABB – REL670
213-86Tx LOR
LOCK OUT SIGNAL
TRIP 213-52
BLOCK RECLOSE OF 213-52
TRIP 101-52
BLOCK RECLOSE OF 101-52
MAIN BUS DIFF. REB670
BACKUP BUS DIFF. REB670
ANALOG METERING
AUTO SELECTED 220KV BUS CVT
AUTO SELECTED 110KV BUS CVT
213-94BF (SEE NOTE3)
BREAKER FAILURE
80MVA Y/Y AUTO TRANSFORMER-X 220KV/110KV/50HZ
80MVA Y/Y AUTO TRANSFORMER-Y 220KV/110KV/50HZ
TRIP 213-52
TRIP 101-52
TRIP 214-52
TRIP 102-52
PROTECTION SCHEME SAME AS SHOWN ON 220kV/110kV BAY 213/101
TO AUTO SELECTD 110KV BUS CVT CIRCUIT (SHOWN BELOW)
LINE 103 REL670
LINE 103 P444
LINE 104 REL670
LINE 104 P444
LINE 105 REL670
LINE 105 P444
LINE 106 REL670
LINE 106 P444
LINE 107 METERING
LINE 101 METERING
LINE 102 METERING
CVT BUS-II
CVT BUS-I
LINE 101 REF 620
LINE 102 REF 620
2000A, 40KA FOR 3SEC 110kV MAIN BUS II
2000A, 40KA FOR 3SEC 110kV MAIN BUS I
BUS II-SA
BUS I-SA
OPEN 106-89M2
OPEN 106-89M1
TRIP & RECLOSE 107-52
TRIP & RECLOSE 105-52
TRIP & RECLOSE 104-52
TRIP & RECLOSE 103-52
94BF-106 (SEE NOTE3)
SEND TRIP TO REMOTE END BREAKER VIA SCADA
TRIP 106-52
AUTO SELECTED 110KV BUS CVT
SPARE
BACKUP BUS DIFF. REB670
MAIN BUS DIFF. REB670
SWITCH
110KV BUS COUPLING AND METERING BAY
FUTURE 110kV T/L#1
FUTURE 110kV T/L#2
FUTURE 110kV T/L#3
FUTURE 110kV T/L#4
PROTECTION SCHEME SAME AS SHOWN ON 110kV T/L# 4
NOT FOR CONSTRUCTION
TRIP THE LOGIC SELECTED BREAKERS (1XX-52)
MAIN BUS DIFF. SCHEME
BACKUP BUS DIFF. SCHEME
TWO ZONES BUS DIFFERENTIAL WITH MAIN & BACKUP PROTECTION SCHEMES FOR 110KV BUS
1XX-89M2-SW
1XX-89M1-SW
FOR ALL 1XX-52 RELAYS AND METERINGS
AUTO SELECTED 110KV BUS CVT
TYPICAL AUTO SELECT 110KV BUS CVT CIRCUIT
KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – HV (3)
N.T.S
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2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED
3. ALL OPERABLE/FUNCTIONAL LINE AND BUS COUPLER BREAKERS WILL RE-CLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.
PRESENT PROJECT SCOPE
FUTURE PROJECT SCOPE
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REFERENCE DRAWINGS
A CONCEPT DRAWINGS 12/04/2014 DJ
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KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – HV (3)
SHEET REFERENCE NUMBER:
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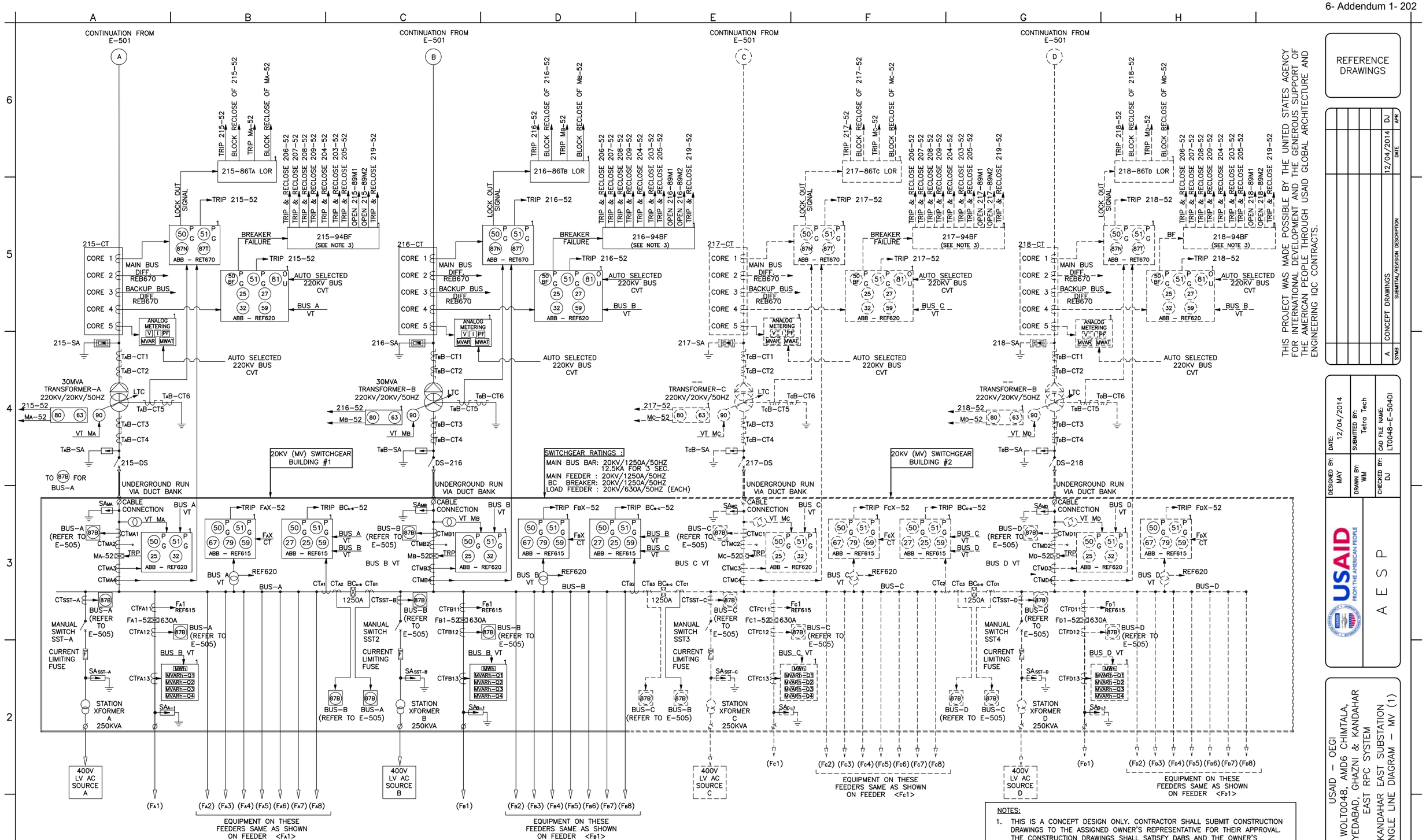

NOTES:

1. ALL 20KV BUS COUPLER BREAKERS OPERATED AS NORMALLY OPEN.
2. (FAX) IS ONE OF THE 8 FEEDERS FROM BUS A.
3. FOR THE 87B (BUS DIFFERENTIAL) PROTECTION SCHEME FOR THE MV, REFER TO SHEET E – 505

NOTES:

1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. ALL SUBSTATION BUS BAR SHALL BE FULLY RATED
3. ALL FUNCTIONAL/OPERABLE LINE AND BUS COUPLER BREAKERS WILL RE-CLOSE AFTER RECEIVING A PERMISSIVE SIGNAL FROM BOTH " b " CONTACTS OF THE FAILED BREAKER'S ASSOCIATED MOTOR OPERATED SWITCHES.
4. THE TWO SWITCHGEARS' MAIN BUSES ARE COUPLED VIA UNDER GROUND CONCRETE DUCT BANKS BETWEEN THE TWO MV BUILDINGS. SEE GENERAL ARRANGEMENT DRAWING (E-506) WHICH SHOWS THE LOCATION OF THE COUPLING UNDER GROUND DUCTS BETWEEN THE TWO MV BUILDINGS.
5. FOR AUTO SELECTED 220KV BUS CVT CIRCUIT, SEE E-505

PRESENT PROJECT SCOPE ————

FUTURE PROJECT SCOPE - - - - - - -

KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM – MV (1)

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EAST RPC SYSTEM
KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM – MV (1)

SHEET REFERENCE NUMBER:
E-504

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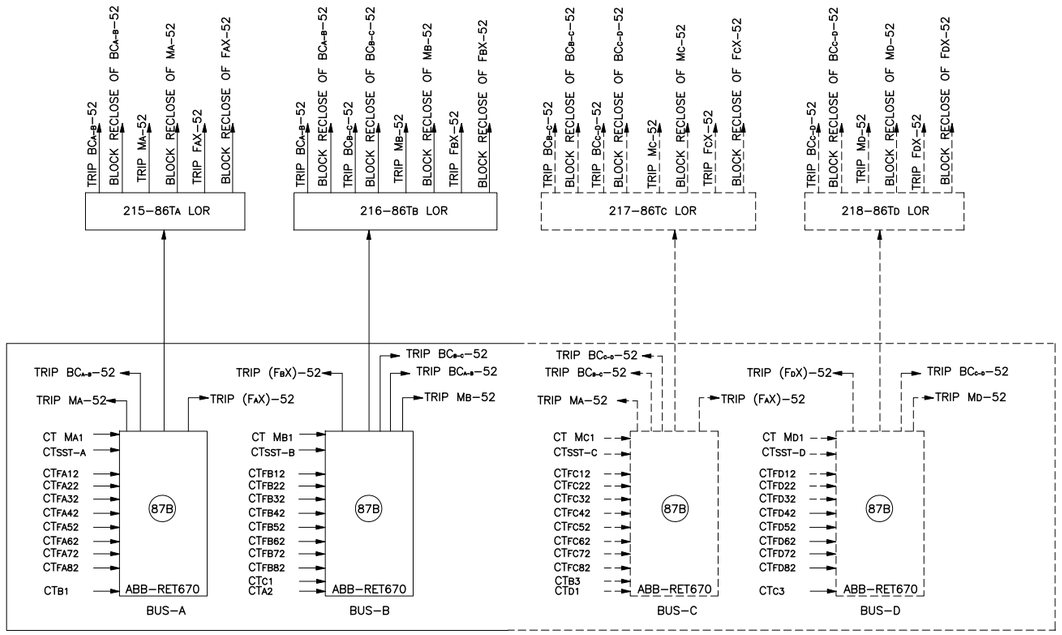

TYPICAL BUS DIFFERENTIAL SCHEME PER PHASE FOR 20KV (MV) SWITCHGEAR BUSES

NOTES:
1. THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES.
2. (FAX) IS ONE OF THE 8 FEEDERS FROM BUS A
3. THE 87B (BUS RELAY) IS PER PHASE BASES. THEREFORE , (3) SUCH DEVICES , FOR EACH PHASE, ARE REQUIRED TO PERFORM THIS CONTROL FUNCTION.

PRESENT PROJECT SCOPE ————
FUTURE PROJECT SCOPE - - - - - - -

KANDAHAR EAST SUBSTATION
SINGLE LINE DIAGRAM–MV (2)
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WOLT0048, AMD6 CHIMTALA, SAYEDABAD, GHAZNI & KANDAHAR EAST RPC SYSTEM
KANDAHAR EAST SUBSTATION SINGLE LINE DIAGRAM – MV (2)

SHEET REFERENCE NUMBER:
E–505

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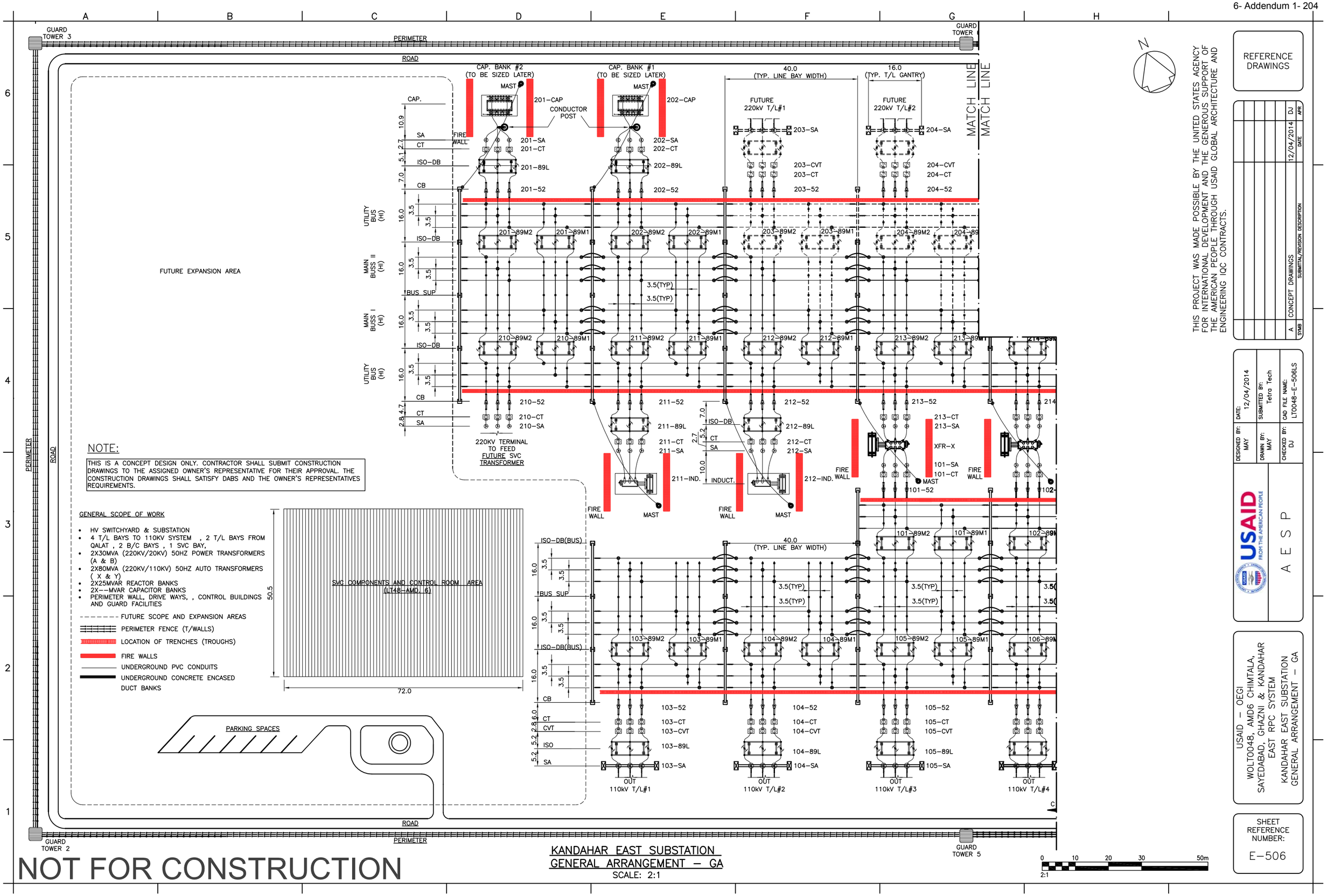
GUARD TOWER 3
PERIMETER
ROAD
CAP. BANK #2 (TO BE SIZED LATER)
CAP. BANK #1 (TO BE SIZED LATER)
MAST
201-CAP
202-CAP
CONDUCTOR POST
FIRE WALL
40.0 (TYP. LINE BAY WIDTH)
16.0 (TYP. T/L GANTRY)
FUTURE 220kV T/L#1
FUTURE 220kV T/L#2
MATCH LINE
CAP.
SA
CT
ISO-DB
CB
UTILITY BUS (HI)
MAIN BUSS II (HI)
BUS SUP
MAIN BUSS I (HI)
201-SA
201-CT
201-89L
201-52
202-SA
202-CT
202-89L
202-52
203-SA
203-CVT
203-CT
203-52
204-SA
204-CVT
204-CT
204-52
201-89M2
201-89M1
202-89M2
202-89M1
203-89M2
203-89M1
204-89M2
3.5(TYP)
210-89M2
210-89M1
211-89M2
211-89M1
212-89M2
212-89M1
213-89M2
210-52
211-52
212-52
213-52
210-CT
210-SA
211-89L
211-CT
211-SA
212-89L
212-CT
212-SA
213-CT
213-SA
220KV TERMINAL TO FEED FUTURE SVC TRANSFORMER
211-IND.
INDUCT.
212-IND.
XFR-X
101-SA
101-CT
101-52
FUTURE EXPANSION AREA
NOTE:
THIS IS A CONCEPT DESIGN ONLY. CONTRACTOR SHALL SUBMIT CONSTRUCTION DRAWINGS TO THE ASSIGNED OWNER'S REPRESENTATIVE FOR THEIR APPROVAL. THE CONSTRUCTION DRAWINGS SHALL SATISFY DABS AND THE OWNER'S REPRESENTATIVES REQUIREMENTS.
GENERAL SCOPE OF WORK
HV SWITCHYARD & SUBSTATION
4 T/L BAYS TO 110KV SYSTEM , 2 T/L BAYS FROM QALAT , 2 B/C BAYS , 1 SVC BAY,
2X30MVA (220KV/20KV) 50HZ POWER TRANSFORMERS (A & B)
2X80MVA (220KV/110KV) 50HZ AUTO TRANSFORMERS (X & Y)
2X25MVAR REACTOR BANKS
2X--MVAR CAPACITOR BANKS
PERIMETER WALL, DRIVE WAYS, , CONTROL BUILDINGS AND GUARD FACILITIES
FUTURE SCOPE AND EXPANSION AREAS
PERIMETER FENCE (T/WALLS)
LOCATION OF TRENCHES (TROUGHS)
FIRE WALLS
UNDERGROUND PVC CONDUITS
UNDERGROUND CONCRETE ENCASED DUCT BANKS
SVC COMPONENTS AND CONTROL ROOM AREA (LT48-AMD. 6)
50.5
72.0
PARKING SPACES
ISO-DB(BUS)
103-89M2
103-89M1
104-89M2
104-89M1
105-89M2
105-89M1
103-52
104-52
105-52
103-CT
103-CVT
103-89L
103-SA
104-CT
104-CVT
104-89L
104-SA
105-CT
105-CVT
105-89L
105-SA
OUT 110kV T/L#1
OUT 110kV T/L#2
OUT 110kV T/L#3
OUT 110kV T/L#4
GUARD TOWER 2
GUARD TOWER 5
KANDAHAR EAST SUBSTATION
GENERAL ARRANGEMENT – GA
SCALE: 2:1
NOT FOR CONSTRUCTION
REFERENCE DRAWINGS
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KANDAHAR EAST SUBSTATION GENERAL ARRANGEMENT – GA
SHEET REFERENCE NUMBER:
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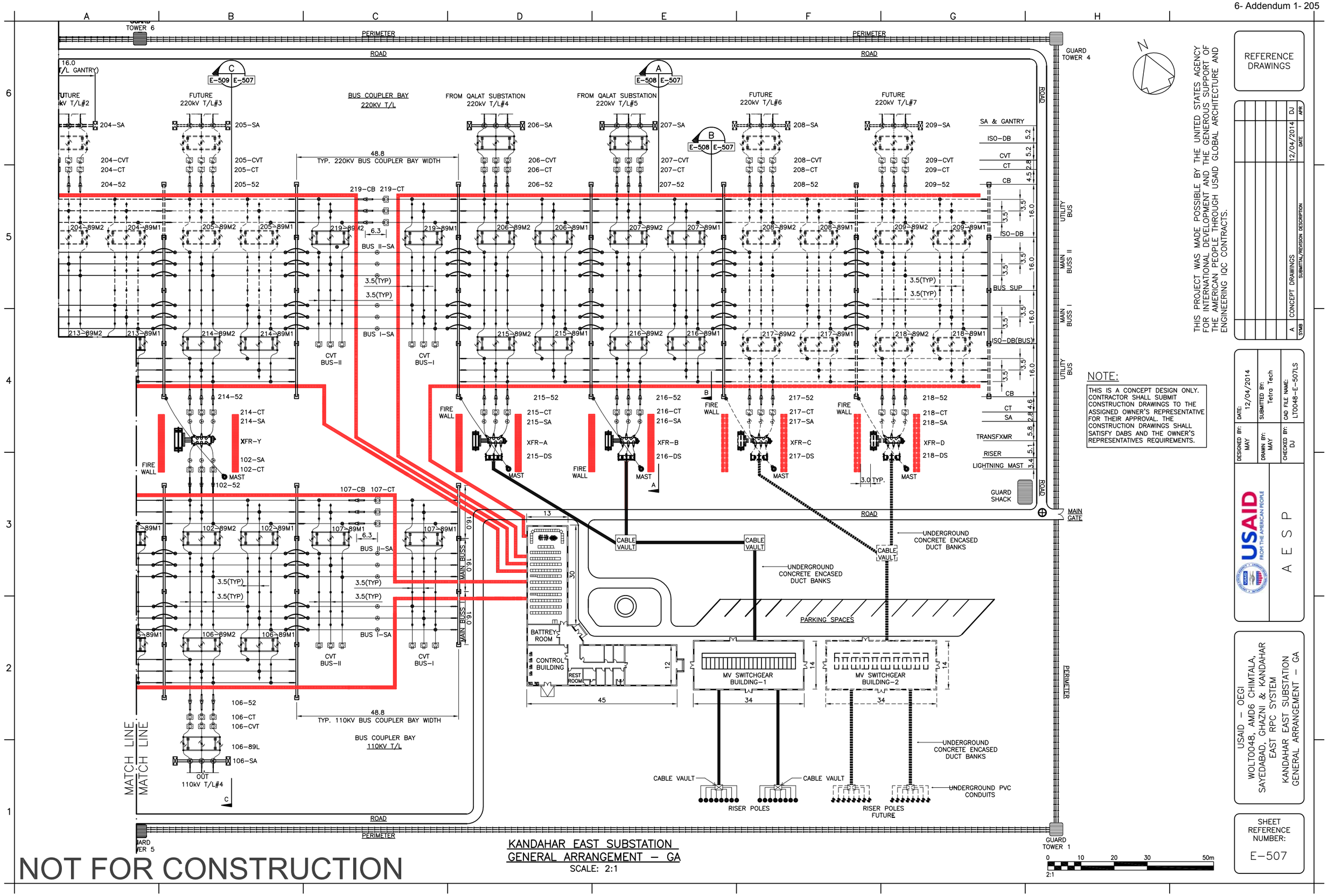

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EAST RPC SYSTEM
KANDAHAR EAST SUBSTATION
GENERAL ARRANGEMENT – GA

SHEET REFERENCE NUMBER:
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4.0 Attachments

4.1 WOLT-0048 AMD 6 Reactive Power Compensation for Kabul and Kandahar for NEPS-SEPS Connector Task 1 Rev 1 Final Technical Memo

4.2 PSS/E System Model (see zip file)

4.1 – Final Technical Memo Task 1 Rev 1

AFGHANISTAN ENGINEERING SUPPORT PROGRAM

WOLT-0048 AMD6 TASK 1 REV 1
REACTIVE POWER COMPENSATION FOR KABUL AND KANDAHAR FOR NEPS-SEPS CONNECTOR
FINAL TECHNICAL MEMO

December 04, 2014

DISCLAIMER

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Appendices

Appendix A Steady State Results
Appendix B Dynamic Results

1.0 Executive Summary and Results

1.1 Project Description

This work is being performed by Tetra Tech under AESP Work Order WO-LT-0048 AMD 6, which is limited to analysis of the proposed 578 km (approximate) 220 kV radial transmission line between Chimtala substation and Kandahar East substation and several intermediate 220 kV/20 kV distribution substations between Chimtala and Kandahar East. The analysis considers a maximum transmission line load of 211.8 MVA leaving Chimtala, as determined in previous WO-LT-0054 work. The focus of the analyses is to determine power system infrastructure necessary to minimize voltage fluctuations and system instability that may occur from normal power system operations, system switching, and fault-clearing events.

The scope of WO-LT-0048 AMD 6 includes electrical transmission system simulation, conceptual design, and specification of:

- Static VAR compensators (SVCs)
- Mechanically Switched Shunt Reactors (MSRs)
- Mechanically Switched Shunt Capacitors (MSCs)

This equipment is intended to provide reactive power compensation (RPC) for the NEPS-SEPS 220 kV Transmission Line system (the NEPS-SEPS connector).

This memo serves to describe the loading, electrical system configuration, system parameters, analysis techniques, RPC equipment conceptual dimensioning, predicted performance, and recommendations for equipment specifications as required for completion of WO-LT-0048 AMD 6 Task 1.

1.2 Electrical System Characteristics

The NEPS-SEPS connector is a long double-circuit transmission line serving load centers up to 1,000 km from the Uzbekistan and Tajikistan sources. The long transmission lines require the extensive use of RPC to control voltage fluctuations which can arise from normal system operation or system contingencies such as short circuits. RPC needs will be greatest when the load is maximum and when the weakest source is supplying the Afghanistan power system. The conditions expected to place the maximum credible stress on the RPC system performance were analyzed as described in the approved WO-LT-0048 AMD 6 Scope of Work (SOW). Specifically:

- Import power over existing transmission lines from Tajikistan alone
- Light load north of Kabul
- NEPS-SEPS connector substations loaded to levels established for RPC design; refer to Table 1
- Maximum load that can be served at Kabul without resulting in steady-state or dynamic performance violations

NEPS system characteristics based on information developed in WO-LT-0054 have been used in the analysis (with the exception that the 220 kV series capacitor banks on the lines north of Kabul have not been constructed). These system characteristics define a number of parameters that impact the RPC requirements, including SVC sizing.

The NEPS-SEPS connector characteristics and loading used in the RPC design are collected in Table 1.

Table 1 NEPS-SEPS Connector Substations			
Substation Location	Distance from Previous Substation	Substation Transformer Capacity	RPC Design Load**
Chimtala	NA	NA	NA
Arghandi*	26.60 km	1T x 60 MVA (220/20kV) 1T x 50 MVA (220/110 kV)	50.7 MVA
Sayedabad	63.20 km	2T x 10 MVA	9.2 MVA
Ghazni	82.75 km	3T x 10 MVA	13.8 MVA
Qarabagh	55.20 km	2T x 10 MVA	9.2 MVA
Moqor (previously Gelan)	63.95 km	2T x 10 MVA	9.2 MVA
Shah Joy	69.31 km	2T x 10 MVA	9.2 MVA
Qalat	84.63 km	2T x 10 MVA	9.2 MVA
Kandahar East	132.35 km	2T x 30 MVA (220/20kV) 2T x 80 MVA (220/110 kV)	101.3 MVA
Total	577.99 km	460 MVA	211.8 MVA

* *Initial transformer installation. A total of two 60 MVA 220-20kV transformers and two 50 MVA 220-110 kV transformers are planned for future.*

** *RPC design load was arrived at by allocating 211.8 MVA at 85% power factor in proportion to transformer capacity. 211.8 MVA at 85% power factor (180 MW) is the NEPS/SEPS loading used for RPC design in WO-LT-0054.*

Transmission line distances from Qarabagh to Kandahar East are subject to change due to route uncertainty but any changes are expected to be within +/- 10%. The transmission line from Chimtala to Kandahar East is a 220 kV double-circuit line with duplex ACSR ZEBRA conductors.

1.3 System Operating Limits

The electrical system operating limits used in the design of RPC, which includes SVCs, MSRs, and MSCs, have been based on those used in WO-LT-0054 and documented in Appendix B of the WO-LT-0054 Final Report dated August 31, 2012 as well as the associated PSS/E system models. Salient system operating limits that will guide RPC design include:

- Maximum steady-state voltage variation of +/- 5% of nominal 220 kV with normal, fully-intact transmission system
- Steady-state voltages after a non-catastrophic contingency remain within +/- 10% of nominal 220 kV. A non-catastrophic contingency is an event that the system can recover from and maintain service to customers unaffected by the event
- 220 kV voltages may fluctuate outside of the +/- 10% range momentarily while voltages stabilize after a contingency event
- Thermal limits for transmission lines will not be violated and will be consistent with those used in WO-LT-0054
- Angular stability will be maintained for selected contingency events. Angular stability will be analyzed for a 5-second interval following the contingency event
- Maximum frequency variation of +/- 2.5 Hz of nominal 50 Hz system

1.4 Analyses Performed

Two distinct types of analysis were required to establish RPC equipment requirements. These different types of analysis are most easily distinguished by the time frame for which they study. The two analyses types were:

- Steady-state power flow analysis
- Dynamic analysis

Steady-state power flow analysis was used for investigations that could be performed by modeling snapshots of a system under different operating conditions such as different system loading levels, the NEPS-SEPS connector operated with both circuits connected in parallel, and the NEPS-SEPS connector operated as a single-circuit. Analyses performed include:

- Evaluation of the NEPS-SEPS connector energization under normal, intact system configuration
- PQ (active power – reactive power)
- PV (active power – voltage)
- QV (reactive power – voltage) analysis
- Contingency analysis.

Each analysis serves a separate purpose in the selection of the RPC size and location, taking into consideration system operating conditions, limitations imposed by the diminishing effectiveness of RPC as greater levels of RPC are applied, RPC limits to provide maximum practical steady-state power flow to Kabul area while supporting the NEPS-SEPS connector load, and the amount of added load that can be imported from the north into Kabul.

Dynamic analysis was used for investigations that required modeling the response of the entire transmission system to disturbances with a time resolution of tens of milliseconds. This analysis tool builds upon the steady-state power database and was used to investigate the performance of Static VAR Compensators (SVCs) when the system was disturbed with events such as faults and loss of load or loss of network branches. System disturbances include those listed in Table 2.

Table 2 Dynamic Contingencies	
Location	Event Type
Kandahar	220 kV-110 kV Transformer Fault followed by loss of transformer's load
Kandahar	Connection of largest 220-110 kV transformer and its associated load at Kandahar East
Kandahar	Three-phase 220 kV-110 kV transformer fault followed by loss of transformer's load
Kandahar	Three-phase fault on 110 kV bus at Kandahar East followed by loss of all 110 kV load
Qalat	Three-phase fault followed by loss of 15 MVAR 220 kV MSR
Chimtala	Three-phase fault followed by loss of SVC
Chimtala	Three-phase 220 kV-110 kV transformer fault followed by loss of transformer's load
Chimtala	Three-phase Fault followed by loss of 60 MVAR 110 kV MSC
Kandahar to Qalat	Three-phase permanent line fault cleared by circuit breaker operation for both single-circuit faults and simultaneous faults on both circuits
Kandahar to Qalat	Three-phase line fault cleared by circuit breaker operation followed by a successful reclose
Chimtala to Arghandi	Three-phase permanent line fault cleared by circuit breaker operation for both single-circuit faults and simultaneous faults on both circuits
Chimtala to Arghandi	Three-phase line fault cleared by circuit breaker operation followed by a successful reclose
Sangtuda to Pul-E-Khumri	Three-phase permanent line fault cleared by circuit breaker operation
Sangtuda to Pul-E-Khumri	Three-phase line fault cleared by circuit breaker operation followed by a successful reclose
Pul-e-Khumri to Chimtala	Three-phase permanent line fault cleared by circuit breaker operation
Pul-e-Khumri to Chimtala	Three-phase line fault cleared by circuit breaker operation followed by a successful reclose

1.5 Performance of Recommended RPC System

The Reactive Power Compensation (RPC) equipment analyzed in these studies and defined by the associated Engineer Procure Construct (EPC) specifications will permit import levels that may load the existing North East Power System (NEPS) transmission system to its maximum thermal capacity.

In addition to high real power losses, there are risks inherent in operating any system at such relatively high power levels. In particular the system voltage may collapse or become high enough to require tripping loads off-line to protect equipment under some contingencies. These contingencies include faults on import transmission lines or faults on major substation buses.

The cost of real power losses and operational risks must be weighed against the benefits of providing more electrical power to Afghanistan. As discussed in the following paragraphs the RPC system is designed to provide practical but not complete mitigation of the operational risks.

The RPC system will allow management of voltage under intact power system conditions. It will provide automatic and continuously-variable adjustment of RPC through the action of SVCs. Under double-circuit operation of the NEPS-SEPS connector, the SVCs will maintain steady-state voltages within a preset bandwidth at the Chimtala 220 kV bus and at all NEPS-SEPS connector substation buses.

The RPC system will automatically and rapidly adjust reactive power compensation to ride through many events which would otherwise likely be catastrophic. Examples of these events are loss of the largest individual transformer under heavy load conditions, increases in load, loss of transmission line segments in the NEPS system, and loss of the largest MSC/MSR banks under heavy load conditions

For these types of events, the SVC portion of the RPC will enable the system to ride through disturbances without loss of service to loads and will result in rapid (less than a few seconds) restoration of steady-state voltage to between 0.9 and 1.1 per unit at all substations from Chimtala to Kandahar East.

After the initial disturbance reaches the new equilibrium point, the SVC will automatically perform limited MSR and MSC switching to rebalance the RPC system to be ready for another contingency event.

Operator-directed actions may be required to supplement the automatic switching performed by the SVCs to return the system voltage to pre-event levels.

The SVCs may use fast switching of local MSRs and MSCs to aid in maintaining system stability during a disturbance and thereby reduce the dynamic rating and cost of the SVCs. For example, the SVC controller at Chimtala may rapidly trip off one or more capacitors at the Chimtala substation to respond to the loss of both circuits of the NEPS-SEPS connector.

MSC and MSR sizes are chosen to coordinate with the SVC operation, and to provide small enough steps to allow system operators flexibility in operation of the system should the SVC be offline.

Without SVCs, the system is at very high risk of voltage instability, voltage-collapse, and loss of load due to excessively high or low system voltages; resulting in protective relay operation.

The SVCs at Chimtala and Kandahar East work together in responding to switching events and system contingencies. If only one of the two SVCs is installed, the single SVC will provide benefit, but will not operate as effectively as intended. The system may fail to maintain system voltage and stability for events that would be successfully mitigated if both SVCs were in service.

1.6 Kabul Area Load

The WO-LT-0048 AMD 6 RPC design analysis included 150 MVA of Kabul area load served from the Chimtala substation in addition to the 211.8 MVA NEPS-SEPS connector load. 150 MVA is a useful, representative value; however it is not an absolute limit. The RPC design analysis is based on a snapshot of system conditions and operating limits selected to arrive at a practical and effective RPC design.

The Kabul area load that could be served with import power at any time will vary depending on system parameters, including transmission system loading, switching configuration, power supply sources, and operating voltages.

If load on the NEPS-SEPS connector is less than the 211.8 MVA level used in the RPC design, then additional load could be served in the Kabul area from the import source. As an example, if the load on the NEPS-SEPS connector were negligible, a total of roughly 365 MVA (310 MW) could be served in the Kabul area with stable system voltages.

This approximate value was developed by combining the 211.8 MVA NEPS-SEPS connector design load and the 150 MVA Kabul area design load and rounding up.

1.7 NEPS-SEPS Connector Representative RPC System

A representative RPC system was designed for the NEPS-SEPS connector to demonstrate the effectiveness of RPC and to provide input to the EPC specification. The RPC equipment in the representative design is tabulated in Table 3.

The sizes for some of the MSCs and MSRs have been established as part of the substation design and are identified in Table 3.

The contracted EPC firm will perform its own analyses, subject to review of the Employer, to arrive at an RPC system design that will include any additional MSCs, MSRs, SVCs, and any ancillary equipment needed for a complete system.

The SVC sizes have been selected to survive system contingencies based on the NEPS-SEPS connector operated as a double-circuit line. When operated as a single-circuit line, the selected SVC sizes may not be large enough for the system to recover from the most catastrophic contingencies such as a line fault that results in the outage of a portion, or all, of the NEPS-SEPS line. SVC sizing is dependent on having both SVCs installed and in service. If only one SVC is in service, the RPC system will continue to assist in providing voltage stabilization but will not keep the system voltage stable and within design limits for all system contingencies.

The SOW for WO-LT-0048 AMD 6 defined a number of system contingencies to be considered in RPC design and two additional contingencies were added in the course of analysis. The four contingencies that follow resulted in the largest SVC size requirements:

- A three-phase line fault followed by loss of both 220 kV circuits between the Qalat and Kandahar East substations. This contingency determined the amount of reactive power that must be absorbed by the Chimtala SVC.
- A three-phase line fault followed by loss of one 220 kV circuit between the Pul-e-Khumri and Chimtala substations. This contingency determined the amount of reactive power that must be provided by the Chimtala SVC.
- A three-phase bus fault followed by loss of 60 MW of load at the Kandahar East 110 kV bus. This contingency determined the amount of reactive power that must be absorbed by the Kandahar SVC.
- Applying load to the largest transformer at Kandahar East with the remainder of the NEPS-SEPS connector loaded to RPC design levels. This is a sudden increase in load of 35.3 MVA (30 MW at 0.85 power factor) with the rest of the NEPS-SEPS connector loaded to 176.5 MVA (150 MW at 0.85 power factor). This contingency determined the amount of reactive power that must be provided by the Kandahar SVC.

Table 3 RPC Equipment to be added to the NEPS-SEPS Connector				
Location	Type	Qty	Rating (each)	Comments
Chimtala	MSC MSC MSC MSR SVC	2 1 1 1 1	10 MVAR[2] 20 MVAR[2] 40 MVAR[2] 25 MVAR[2] +30/-140 MVAR[3]	One (1) 60 MVAR MSC, One (1) 40 MVAR MSC and One (1) 20 MVAR MSC already exist on the 110 kV bus One (1) 25 MVAR MSR already exists at Chimtala + SVC provides reactive power (capacitive), - SVC absorbs reactive power (inductive)
Sayedabad	MSR	2	15 MVAR[2]	
Ghazni	MSR	2	15 MVAR[2]	
Quarabagh	MSR	2	10 MVAR[2]	
Moqor	MSR	2	10 MVAR[2]	
Shah Joy	MSR	2	10 MVAR[2]	
Qalat	MSR	2	15 MVAR[2]	
Kandahar East	MSC MSC MSR SVC	2 1 2 1	10 MVAR[2] 20 MVAR[2] 25 MVAR[2] +40/-40MVAR[3]	+ SVC provides reactive power (capacitive), - SVC absorbs reactive power (inductive)

Table Notes and Abbreviations:

1. *All devices applied on the 220 kV bus of the respective substations*
2. *Size fixed in substation design*
3. *SVC size required without using local Mechanically Switched Shunt RPC equipment including a +/- 10 MVAR margin for off-neutral operation*

2.0 System Design

The RPC system will be called upon to operate in varying transmission system environments. Load, import levels, import sources, and system configuration will vary daily, seasonally, and over years as the transmission system develops and electrification of Afghanistan continues.

The future of the transmission system cannot be foretold with certainty. To make specification of the RPC system practical it was necessary to select a limited number of the many possible future load, import, and circuit configuration scenarios for study. These cases were selected considering the existing transmission system configuration, available import sources and known plans for the 220 kV NEPS-SEPS Connector. The statement of work (SOW) also specifically directed a number of instances to consider when selecting cases to study.

A description of the cases selected for study follows below. They reflect credible "worst case" conditions that are likely to place maximum stress on the RPC system. Following the discussion of the cases selected for study is a list of the instances contained in the SOW with a brief discussion of how the cases studied either addressed them directly, or will result in a more capable RPC system than the instances would require.

2.1 NEPS Cases Selected for Study

Weak Source – Light Load – Tajikistan Import Only

This case is based upon 450 MW of generation imported from Tajikistan to service a lightly loaded NEPS system. With 180 MW (211.8 MVA at 85% power factor) of load served by the NEPS-SEPS Connector, up to 127 MW (150 MVA at 85% power factor) of load can be served in the Kabul area. These conditions provide the most stress on the SVC while maintaining system stability for most system events.

Tajikistan is limited to providing power during spring and summer when excess hydro generation is available. Summer rating for the Tajikistan import lines is estimated to be 390MW. A double-circuit 220 kV line serves the NEPS system from Tajikistan. With both circuits in service, no line thermal limits are violated.

In all cases load north of Kabul served from Tajikistan is minimized by serving Mazar-e-Sharif loads from the Uzbekistan generation at Surkhan. This delivers the maximum amount of power to the Chimtala 220 kV bus in Kabul. Sending the most power over the longest route requires the most RPC and requires the most capable RPC system.

NEPS-SEPS Single-Circuit

This case is based upon the Weak Source – Light Load – Tajikistan Import Only case with one circuit of the NEPS-SEPS Connector Circuit out of service. The NEPS-SEPS Connector load is 180 MW (211.8 MVA at 85% power factor) distributed throughout the line as detailed in Table 4 below.

NEPS-SEPS Double-Circuit

This case is based upon the Weak Source – Light Load – Tajikistan Import Only case with both circuits of the NEPS-SEPS Connector Circuit in service. The NEPS-SEPS Connector load is 180 MW (211.8 MVA at 85% power factor) distributed throughout the line as detailed in Table 4 below.

2.2 NEPS-SEPS Connector

The NEPS-SEPS Connector was modeled with two Zebra subconductors per phase. Both single- and double-circuit configurations were studied. Transformer and load information used in the full load case is tabulated in Table 4 below.

Table 4 Transformer and Load Information Used in Full-Load Case

Substation Location	Substation Transformer Capacity	RPC Design Load**
Chimtala	NA	NA
Arghandi*	1T x 60 MVA (220/20kV) 1T x 50 MVA (220/110 kV)	50.7 MVA
Sayedabad	2T x 10 MVA	9.2 MVA
Ghazni	3T x 10 MVA	13.8 MVA
Qarabagh	2T x 10 MVA	9.2 MVA
Moqor (previously Gelan)	2T x 10 MVA	9.2 MVA
Shah Joy	2T x 10 MVA	9.2 MVA
Qalat	2T x 10 MVA	9.2 MVA
Kandahar East	2T x 30 MVA (220/20kV) 2T x 80 MVA (220/110 kV)	101.3 MVA
Total	460 MVA	211.8 MVA

* *Initial transformer installation. A total of two 60 MVA 220-20kV transformers and two 50 MVA 220-110 kV transformers are planned for future.*

** *RPC design load was arrived at by allocating 211.8 MVA at 85% power factor in proportion to transformer capacity. 211.8 MVA at 85% power factor (180 MW) is the NEPS/SEPS loading used for RPC design in WO-LT-0054.*

When the NEPS-SEPS Connector was modeled at full load, 150 MW can be served to the Kabul area load, which for the controlling case limits the import to 450 MW from Tajikistan.

3.0 Equipment and System Operating Limits

3.1 Transmission System Voltages

These operating limits are based upon what is practical to achieve with well-applied RPC systems taking into account typical voltage limits from the North American transmission grid when possible to do so. These limits are used to design the RPC requirements in order to arrive at robust RPC that will give the system operators the means to improve overall system performance and increase imports. Given operational experience with the RPC system the system operators will define their own operating parameters and practices, including voltage limits.

- Steady-state Normal System – 0.95 to 1.05 per unit on 110 kV and 220 kV buses
- Steady-state Voltages After a Non-Catastrophic Contingency – 0.90 to 1.10 per unit on 110 kV and 220 kV buses
- Steady-state voltage change resulting from switching MSCs or MSRs - no greater than 3% increase or decrease (achievable through switching one or more MSCs in combination)

Definitions:

Per unit – Voltage expressed as a multiple of the nominal voltage. For example a 220 kV system operated at 1.10 per unit is operating at (1.10) x 220 = 242kV.

Normal System – No outages (generation, line, or transformer). All transmission and generation system components in service.

Non-Catastrophic Contingency – An event that the system can recover from and maintain service to customers unaffected by the event. Examples would be a short circuit resulting in the 60 MVAR capacitor bank at Chimtala tripping off line or a short circuit resulting in a heavily-loaded 40 MVA transformer at North Kabul Substation tripping off-line. After a non-catastrophic contingency, voltages need to be stabilized to allow operators time to reconfigure the system and establish a new stable operating situation without overloads, and with voltages within limits. SVC operation is essential to recovery from non-catastrophic contingencies and non-catastrophic contingencies are modeled dynamically to test SVC performance.

Catastrophic Contingency – An event that the system cannot recover from without losing service to customers in addition to those affected by the event. An example would be loss of the NEPS-SEPS Connector under heavily-loaded conditions. This contingency is likely to create overvoltages that will result in over-voltage protective relay operation causing outages in other parts of the system. Operation of the RPC system will mitigate effects of catastrophic contingencies but the RPC is not designed to allow recovery from catastrophic contingencies without loss of load.

4.0 Power Flow Analysis

Power flow analysis is used to determine RPC equipment size and placement required to maintain transmission-system bus voltages at desired values under projected import levels and power flows. RPC elements analyzed for WO-LT-0048 were:

- SVCs
- MSCs
- MSRs

The transmission system voltage limits defined in Section 3.1 were used in the study.

Possible RPC locations for the NEPS-SEPS Connector analysis included any substation along the NEPS-SEPS Connector, from Chimtala to Kandahar East. RPC design load was arrived at by allocating 211.8 MVA at 85% power factor in proportion to transformer capacity. 211.8 MVA at 85% power factor (180 MW) is the NEPS-SEPS loading used for RPC design in WO-LT-0054.

4.1 Brief Description of Analysis Technique

Steady-state power flow analysis was used for investigations that could be performed by modeling snapshots of a system under different operating conditions such as different system loading levels, the NEPS-SEPS connector operated with both circuits connected in parallel, and the NEPS-SEPS connector operated as a single-circuit. Analyses performed include:

- Evaluation of the NEPS-SEPS connector energization
- PQ (active power – reactive power)
- PV (active power – voltage)
- QV (reactive power – voltage) analysis
- Contingency analysis

Each analysis serves a separate purpose in the selection of the RPC size and location, taking into consideration system operating conditions, limitations imposed by the diminishing effectiveness of RPC as greater levels of RPC are applied, RPC limits to provide maximum practical steady-state power flow to Kabul area while supporting the NEPS-SEPS connector load, and the amount of added load that can be imported from the north into Kabul.

Multiple contingencies were evaluated to evaluate worst case system conditions, further define the amount of added load that can be imported from the north to Kabul, and to test the selected RPC for robustness. Contingencies were run on the system with the NEPS-SEPS Connector operated as a double-circuit and as a single-circuit. These contingencies include, but not limited to:

- Loss of 60 MVAR Chimtala substation 110 kV MSC
- Loss of one circuit of the Chimtala to Arghandi
- Loss of 110 kV load at the Kandahar East station
- Loss of one circuit of the Sangtuda to Pul-e-Khumri double-circuit line
- Loss of either Chimtala or Kandahar East SVC

For each system configuration, import level and applicable operating contingency power flow results were analyzed and MSC or MSR sizes were adjusted to correct voltage violations. Table 5, Table 6, and Table 7 show the resulting maximum MSC or MSR sizes required to keep bus voltages within the recommended steady-state range (0.95 to 1.05 per unit) for system-normal conditions.

For operating contingency conditions MSC or MSR sizes were adjusted to keep bus voltages within the recommended temporary range (0.90 to 1.10 per unit), if possible to do so, while system operators take action to restore bus voltages to the recommended steady-state levels.

For all system configurations analyzed the Kabul area and NEPS-SEPS Connector bus loads were modeled as ½ PQ loads and ½ Y-type loads. That mixed-load type was used for modeled Kabul loads in WO-LT-0054 in order to obtain a closer match between voltage drops in the model and voltage drops mentioned by DABS substation engineers. PQ loads are loads which are constant regardless of voltage, such as some motor loads. Y-type loads are resistance loads such as heaters electric cooking coils and incandescent light bulbs.

4.2 NEPS-SEPS Connector Analysis

The NEPS-SEPS Connector RPC system steady state performance was investigated using power flow analysis. The analyses performed and conclusions reached are discussed in the following sections. Appendix A contains power flow results of selected cases and contingencies.

Without the addition of RPC the voltage along the NEPS-SEPS Connector will rise unacceptably under light-load conditions. No load on the NEPS-SEPS Connector and 1.00 per unit voltage at the Chimtala 220 kV bus results in a 1.23 per unit (270 kV) steady state voltage on the Kandahar East 220 kV bus. These voltages must be controlled to permit use of the NEPS-SEPS Connector and avoid damage to electrical equipment on the NEPS-SEPS Connector. Refer to Appendix A for the power flow tabular data for this case.

4.2.1 Kabul Area Load

Evaluation of the PV and contingency analysis support that up to 150 MW of load can be imported to the Kabul area while maintaining system stability for non-catastrophic contingencies when the NEPS-SEPS Connector is operated as a double-circuit line. Should the NEPS-SEPS Connector be operated as a single-circuit line, then the Kabul area load level for system stability is reduced to 100 MW.

4.2.2 MSR and MSC Total Requirement, Location, and Size

The proposed 220 kV NEPS-SEPS Connector is modeled as a double-circuit line originating at Arghandi substation and terminating at Kandahar East substation with six intermediate substations along the 578-km line route. Each circuit is modeled as two 'Zebra' conductors per phase. Total modeled load on the NEPS-SEPS Connector is 180 MW, which is approximately the sum of all distribution substation transformer installed MVA capacity listed in WO-LT-0054 AMD1 and WO-LT-0048 AMD2 (130 MVA total) plus an additional 50 MVA of 110 kV load served from Kandahar East substation. The 180 MW loading level modeled is a representative future loading case. The RPC is designed to operate successfully for this representative future build-out case, and to provide flexibility in operation as the system grows and develops.

The approach used to determine the required NEPS-SEPS Connector RPC was to evaluate the NEPS-SEPS system during a no-load energization sequence and also under a full 180 MW load condition. For both loading conditions the import from Tajikistan was kept constant at 450 MW. Under no-load conditions, reactors were placed to absorb the reactive power generated through line charging. As load is added, the reactive power losses in the line and in the transformers, coupled with reactive power consumed by loads themselves, absorb some of the reactive power provided by the line and fewer reactors are needed, as shown in Table 6 and Table 7.

The steady-state criteria used for the RPC analysis were:

- Voltage along the NEPS-SEPS line from Chimtala to Kandahar East must be:
  - Between 0.9 and 1.1 per unit during a segment-by-segment line energization sequence, and
  - Between 0.95 and 1.05 per unit under intact system no-load and 180 MW loaded conditions.
- The reactive power flow between Chimtala and Arghandi must change less than 15 MVAR, measured at the Chimtala 220 kV bus, when switching unloaded line segments (including associated MSRs) in and out of service.

Steady-state power flow analyses, including QV analysis, were performed to determine recommended MSC locations, sizes and step size. Table 5 summarizes the NEPS-SEPS MSC and MSR recommended locations, maximum sizes and step size.

Table 5 MSC and MSR Recommendations for NEPS-SEPS

Location	Type	Qty	Rating (each)	Comments
Chimtala	MSC MSC MSC MSR	2 1 1 1	10 MVAR[2] 20 MVAR[2] 40 MVAR[2] 25 MVAR[2]	One (1) 60 MVAR MSC, One (1) 40 MVAR MSC and One (1) 20 MVAR MSC already exist on the 110 kV bus One (1) 25 MVAR MSR already exists at Chimtala
Sayedabad	MSR	2	15 MVAR[2]	
Ghazni	MSR	2	15 MVAR[2]	
Quarabagh	MSR	2	10 MVAR[2]	
Moqor	MSR	2	10 MVAR[2]	
Shah Joy	MSR	2	10 MVAR[2]	
Qalat	MSR	2	15 MVAR[2]	
Kandahar East	MSC MSC MSR	2 1 2	10 MVAR[2] 20 MVAR[2] 25 MVAR[2]	

The two 10 MVAR MSCs on the Chimtala distribution buses and the two 10 MVAR MSCs on the Kandahar East transmission buses (one capacitor on each bus) provide two benefits. First, they permit switching MSCs to allow the SVC to operate nearer zero reactive power, freeing up SVC capacity to better manage system disturbances. Secondly, the smaller steps provide system operators with the ability to better manage system voltages if the SVC should be out of service. The smaller steps allow switching MSCs without excessively large voltage swings. Changes in voltage of approximately 3% can be implemented providing system operators the flexibility to switch MSCs in smaller steps by switching one or a combination of MSCs.

Management of the reactive power flow between the NEPS-SEPS Connector and the Chimtala 220 kV bus is an important system operations consideration. If the SVC is out of service and the reactive power flow criteria between Chimtala and Arghandi is violated, the Chimtala substation voltage will be significantly impacted.

If the Chimtala SVC is in service and the reactive power flow criteria between Chimtala and Arghandi is violated, the SVC will be forced farther away from its desired near-neutral operating bandwidth.

This will force unnecessary MSC switching to bring the SVC output back into bandwidth and for a short time will keep the SVC from providing a full response to system disturbances. Proper design of the RPC and careful management of the reactive power flow between the NEPS-SEPS Connector and the Chimtala 220 kV bus during line switching will minimize these impacts.

Table 6 shows the double-circuit NEPS-SEPS Connector voltage profile and recommended MSR additions for both the line energization case and the fully-loaded case. The voltage profile listed is when the NEPS-SEPS Connector line is fully energized, all circuits are in service, no load is served to Kabul, and the MSRs noted in the "recommended MSR" column are in service.

Table 6 NEPS-SEPS Connector Double-Circuit MSR, MSC, and Voltages

Double-circuit NEPS-SEPS Final Voltage Profile	No Load		Full Load	
	Recommended MSR	Voltage	Recommended MSR	Voltage
Arghandi 220 kV	0	1.034	0	1.030
Sayedabad 220 kV	(2) 15 MVAR	1.031	0	1.036
Ghazni 220 kV	(2) 15 MVAR	1.027	0	1.040
Quarabagh 220 kV	(2) 10 MVAR	1.026	0	1.039
Moqor 220 kV	(2) 10 MVAR	1.023	(1) 10 MVAR	1.036
Shah Joy 220 kV	(2) 10 MVAR	1.020	(1) 10 MVAR	1.031
Qalat 220 kV	(2) 15 MVAR	1.014	(1) 15 MVAR	1.022
Kandahar 220 kV	(2) 25 MVAR	1.000	0	1.000

The same criteria and methodology were applied to evaluate the NEPS-SEPS Connector reactance with the line modeled as a single-circuit line. Table 7 shows the single-circuit NEPS-SEPS Connector voltage profile and recommended MSR and MSC additions for both the line energization case and the fully-loaded case. The voltage profile listed is when the NEPS-SEPS line is fully energized, all circuits are in service, and the MSRs and MSCs noted in the "recommended MSR and MSC" column are in service.

Table 7 NEPS-SEPS Connector Single-Circuit MSR, MSC, and Voltages

Single-circuit NEPS-SEPS Final Voltage Profile	No Load		Full Load	
	Recommended MSR and MSC	Voltage	Recommended MSR and MSC	Voltage
Arghandi 220 kV	0	1.034	0	1.007
Sayedabad 220 kV	(1) 15 MVAR	1.030	0	1.007
Ghazni 220 kV	(1) 15 MVAR	1.027	0	1.007
Quarabagh 220 kV	(1) 10 MVAR	1.025	0	1.009
Moqor 220 kV	(1) 10 MVAR	1.023	0	1.010
Shah Joy 220 kV	(1) 10 MVAR	1.020	0	1.010
Qalat 220 kV	(1) 15 MVAR	1.014	0	1.009
Kandahar 220 kV	(1) 25 MVAR	1.000	(1) 40 MVAR MSC	1.000

Switching of MSRs, and possibly MSCs for single-circuit operation, will be required to maintain voltages for most contingency conditions. The MSRs and MSCs, for single-circuit case only, at Kandahar East will be automatically controlled by the SVC at Kandahar East. The system voltages should be monitored closely, and the remaining reactors turned off or on as needed under operator direction in order to achieve acceptable bus voltages and reactive power flow. Contingency results are located in Appendix A.

4.2.3 NEPS-SEPS Connector SVC Location and Sizing for Steady-state Conditions

For the NEPS-SEPS Connector the recommended SVC locations are at the Chimtala and Kandahar East substation 220 kV buses because that is where the greatest voltage variation along the NEPS-SEPS Connector are experienced for varying power flows and reactive compensation levels. The Kandahar East SVC is recommended to be rated +/- 10 MVAR in addition to the required dynamic range discussed in Section 5.0. This margin will preserve the SVC's ability to respond to system disturbances while operating within an achievable bandwidth around zero reactive power output. Switching of MSCs and MSRs will be used to keep the SVC output as near to zero as possible, but the discrete step size of MSCs will prevent being assured of an exact zero reactive power output from the SVC.

5.0 Dynamic Analysis

5.1 Brief Description of Analysis Technique

Dynamic analysis was performed to determine the capacitive and reactive VAR requirements for the Chimtala and Kandahar East thyristor-based Static VAR Compensators (SVCs).

The SVCs provide voltage stabilization during normal operation by automatic, rapid, and continuous adjustment of the reactive power supplied or consumed by the SVCs. The SVCs are also needed to reduce transients and to stabilize voltages after system disturbances (post-disturbance voltages). The SVC size is primarily determined by the SVC response to system disturbances. This analysis investigated SVC response to selected system disturbances (also referred to as contingencies or events) to determine the minimum SVC size required at Chimtala and Kandahar East.

The SVCs will provide rapid and continuous adjustment of reactive power, up to the limit of its capacity, to reduce transients and stabilize voltage following a disturbance. After the disturbance the SVCs will attempt to return the voltage to as near the pre-disturbance level as its capacity permits. Post-disturbance voltages were held to between 0.9 per unit to 1.1 per unit in this analysis. Voltages in this range will permit continued operation of the system for an extended period. Once the initial disturbance transient is over (typically within 10 seconds), additional operation of mechanically switched capacitors and reactors will be able to reduce the dynamic VAR output of the SVCs to near-zero and possibly to further correct system voltages into the desired operating range of 0.95 to 1.05 per unit. Depending upon the event system operators may need to take additional action to adjust load or RPC to bring voltages to within acceptable limits.

SVC operation was studied under numerous disturbance events and transmission network topologies including the NEPS-SEPS Connector.

The Chimtala SVC is electrically located to control the voltage on the Chimtala 220 kV substation bus. The Kandahar SVC is connected to control the Kandahar 220 kV substation bus when the NEPS-SEPS Connector line is active.

Dynamic simulations simulate the control system interaction of the generators, power imports, and SVCs present in the network. By simulating for 10 seconds under the presence of a system disturbance, conclusions can be made about the network's dynamic response and whether the system can remain stable and return to steady-state operation. The dynamic analysis was performed for this project using Siemens-PTI PSS/E v32.1 software. Transmission, generation, and import topologies of the Afghanistan power grid were developed during the power flow analysis phase of this project, and used also for this dynamic simulation analysis.

The Chimtala and Kandahar SVCs were simulated using the generic model 'SVSM01U1', which is a thyristor-based, continuously-controlled shunt switchable element developed by the Western Electricity Coordinating Council (WECC) through the action of a task force, including vendor, utility, Electric Power Research Institute (EPRI) and consulting firm representatives. The control parameters were tuned to support the system voltage during disturbance events, and to minimize the capacitive and reactive VAR range necessary to assist in stabilizing the system. The SVSMO1U1 model has numerous features, but only some of the basic features were used in these simulations. The features used include:

- Undervoltage and overvoltage thresholds for modifying SVC behavior during very low voltage and very high voltage conditions. Low voltage features are used to reduce voltage overshoot following faults

- Main Proportional-Integral controller for minimizing the voltage error signal relative to the voltage set point
- Linear droop characteristic

Other features such as nonlinear droop, deadbands, and slow susceptance regulator were not modeled. The Mechanically Switched Shunt (MSS) control feature of the model is not being used directly but MSS control is analyzed by power flow studies. The parameters for the Chimtala and Kandahar SVC simulation models are listed in Appendix B, Figure 1.

The power flow studies used as the basis for the dynamic analysis contained some loads that were modeled at 50% constant MVA loads (PQ) and 50% constant admittance loads (Y-type). This mix of load models was used in an attempt to model operator descriptions of the Kabul area voltage behavior after load drop events and is documented in the report for LT-0053. As is typical for short-duration dynamic simulations, the constant MVA active power loads were converted to constant current, and constant MVA reactive power loads were converted to constant admittance, and the generators were converted to current injection models.

In the system studied, all loads in the NEPS and NEPS-SEPS Connector areas are being supplied by import generation sources. No local Afghan generators are synchronized with those import sources. This results in a network characterized by a very long radial transmission system exhibiting very high voltage sensitivity. The selection of controlling cases was discussed further in Section 1.7.

The dynamic contingencies selected for this study created a range of events which stressed the Chimtala and Kandahar East SVC VAR performance. The contingencies simulated were based on the power flows, which were derived in Section 4.0, and are relisted in Table 8. The SVC design approach used only N-1 (single-point of failure) contingencies to assess the SVC performance.

Table 8 Power Flow Base Conditions

Scenario	Location	Event Type
S1	Kandahar	220 kV-110 kV Transformer Fault followed by loss of transformer's load
S2	Chimtala	Three-phase fault followed by loss of SVC
S3	Chimtala	Three-phase 220 kV-110 kV transformer fault followed by loss of transformer's load
S4	Chimtala	Three-phase Fault followed by loss of 60 MVAR 110 kV MSC
S5	Kandahar to Qalat	Three-phase permanent line fault cleared by circuit breaker operation for both single-circuit faults and simultaneous faults on both circuits
S6	Kandahar to Qalat	Three-phase line fault cleared by circuit breaker operation followed by a successful reclose
S7	Chimtala to Arghandi	Three-phase permanent line fault cleared by circuit breaker operation for both single-circuit faults and simultaneous faults on both circuits
S8	Chimtala to Arghandi	Three-phase line fault cleared by circuit breaker operation followed by a successful reclose
S9	Sangtuda to Pul-E-Khumri	Three-phase permanent line fault cleared by circuit breaker operation
S10	Sangtuda to Pul-E-Khumri	Three-phase line fault cleared by circuit breaker operation followed by a successful reclose
S11	Pul-e-Khumri to Chimtala	Three-phase permanent line fault cleared by circuit breaker operation
S12	Pul-e-Khumri to Chimtala	Three-phase line fault cleared by circuit breaker operation followed by a successful reclose

Table 8 Power Flow Base Conditions		
Scenario	Location	Event Type
S13	Kandahar	Three-phase 220 kV-110 kV transformer fault followed by loss of transformer's load
S14	Kandahar	Connection of largest 220-110 kV transformer and its associated load at Kandahar East
S15	Qalat	Three-phase fault followed by loss of 15 MVAR 220 kV MSR
S16	Kandahar	Three-phase fault on 110 kV bus at Kandahar East followed by loss of all 110 kV load

Of the contingency combinations simulated, there are three main categories:

- Fault and Clear: Three-phase faults on either a transmission branch or bus. The faults are cleared, and all of the elements are returned to service. These contingencies resulted in the Chimtala and Kandahar SVCs supplying VARs to support the system, and then returning to nearly the SVC pre-fault VAR contribution value after the fault is cleared.
- Fault and Trip: Three-phase faults on either a transmission branch or bus. The faults are cleared by tripping a branch or bus out of service. These contingencies resulted in the Chimtala and Kandahar SVCs quickly adjusting to a new susceptance output level to support the new system configuration.
- Load or Shunt Device Loss/Addition: Change of a load or shunt VAR compensation bank, either MSC or MSR. Dropping a shunt VAR compensation bank or load resulted in the Chimtala and Kandahar SVC recovering toward the set point depending on the amount of shunt VARs or load MWs dropped/added from the transmission system and the size of the SVC components.

The fault used in all cases is a generic three-phase fault that lasts for 0.2 seconds (10 cycles) before being cleared. This fault clearing time may be longer than would actually occur in some cases but the intention is to provide a fairly large disturbance to expose the critical cases, rather than to provide a detailed modeling of protective equipment capability.

5.2 NEPS SVC Analysis

In these studies the Chimtala SVC was connected to the 220 kV bus in the Chimtala substation. The SVC includes a 220/20 kV transformer. The SVC equipment that provides continuously adjustable reactive power operates at 20 kV and is connected to the 220 kV bus through the 220/20 kV transformer. This configuration is typical for SVC designs. The SVC is configured to control the voltage of the Chimtala 220 kV bus.

A large number of studies, as described in Section 5.1, were run to determine the appropriate positive and negative (or capacitive and reactive) admittance size needed for the Chimtala SVC. The objective of the Chimtala SVC analysis was primarily to determine the appropriate size of the inductive and capacitive range of the SVC and also to determine the maximum voltage overshoot to expect at the Chimtala 220 kV bus.

The criteria used for sizing the dynamic range of the Chimtala SVC was to have the short-term post-contingency voltage at the controlled bus to fall between 0.9 and 1.1 per unit during the first 10 seconds after the disturbance initiation. The longer-term goal (5 to 10 minutes), however, is to have the SVC manage the mechanically switched shunt (MSS) devices to bring the post contingency voltage within the normal operation range of 0.95 to 1.05 per unit and also bring the dynamic

admittance of the SVC to near zero (between -5 and +5 MVAR). Balancing the transmission system to bring the SVC VAR contribution to near zero will ensure that the SVC will have the full range of designed operation to source and sink VARs in response to a system disturbance.

The sequence of actions can be divided into four steps:

1. Control the system transient voltages
2. Bring the post-contingency voltage to a stable operating point in order to avoid cascading outages
3. Prepare the SVC dynamic admittance for the next disturbance by reducing the dynamic portion of the admittance being utilized to near zero
4. Bring the controlled voltage and other system voltages into normal operating range of 0.95 to 1.05 per unit by switching available MSS devices, and other remedial action procedures such as load shedding, if equipment overloads are occurring

Steps 1 and 2 are accomplished by the SVC dynamic range during the first 1 to 10 seconds after the disturbance. These steps are studied using the dynamic analysis described in this section. Step 3 is accomplished by the MSS control logic of the SVC, depending on the SVC specifications. This occurs over a period of up to several minutes following the disturbance and is studied by power flow analysis as described in Section 4.0. Steps 1 and 2 are automatic functions of the SVC. Steps 3 and 4 are accomplished by system operators in the tens of minutes following the disturbance. This last step also falls into the analytical domain of power flow studies as described in Section 4.0. The power flow analysis did not attempt to model the almost innumerable number of combinations of switching and load shedding steps which could be taken, but instead focused on the most stressful critical cases. Analysis of the critical cases indicates that by providing MSCs which can be switched alone or in combination to provide VAR compensation in relatively small increments of 10 MVAR or less, the capability for the MSS controller to perform Step 3 and for the system operators to perform Step 4 will exist.

The critical cases which determine the sizing of the Chimtala SVC admittance for accomplishing steps 1 and 2 described above. Figure 1 and Figure 2 show dynamic plots of two contingencies listed in Table 8. SVC sizing is based on the NEPS-SEPS Connector operated as a double-circuit line. Should the line be operated as a single-circuit, additional RPC support may be required.

- A three-phase line fault followed by loss of both 220 kV circuits between the Qalat and Kandahar East substations. This contingency determined the amount of reactive power that must be absorbed by the Chimtala SVC. Scenario 5.
- A three-phase line fault followed by loss of one 220 kV circuit between the Pul-e-Khumri and Chimtala substations. This contingency determined the amount of reactive power that must be provided by the Chimtala SVC. Scenario 11.

Figure 1 Dynamic Scenario 5

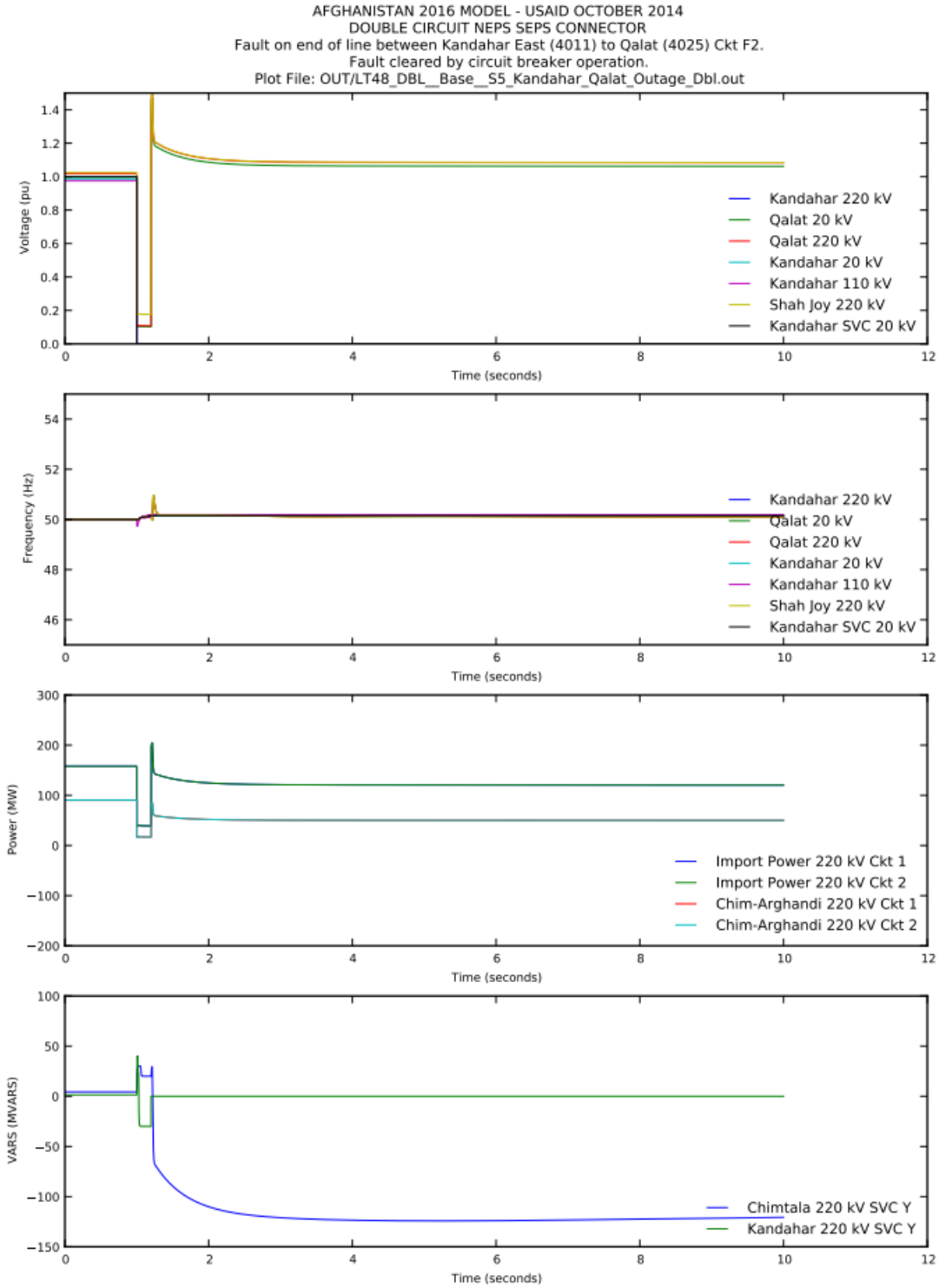
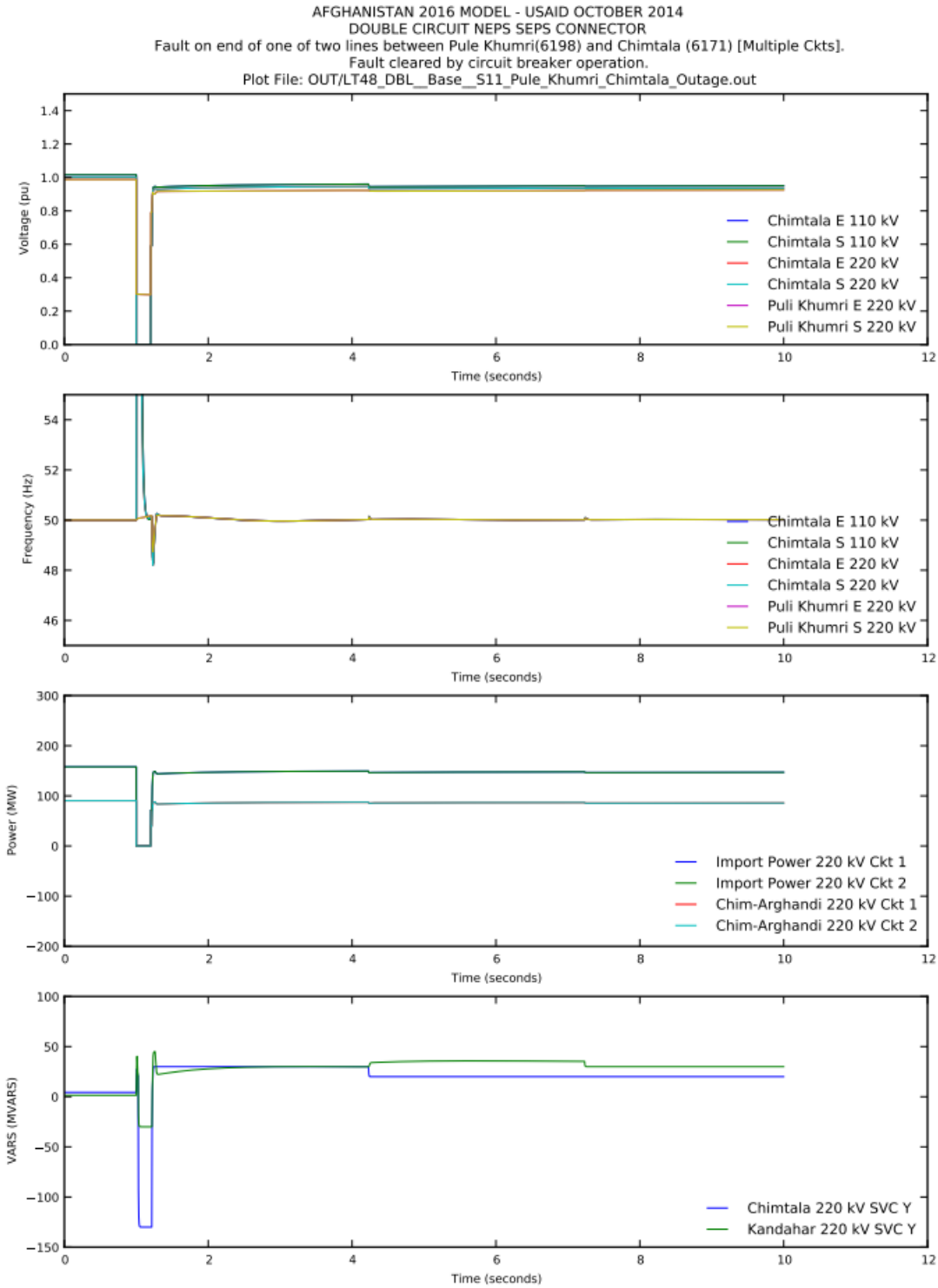


Figure 2 Dynamic Scenario 11



5.2.1 SVC Dynamic Rating and Switched MSCs and MSRs

This section summarizes the results of the power flow and dynamic analysis for the Chimtala SVC and the NEPS system. An SVC dynamic admittance range of -140 to + 30 MVAR is adequate to control the Chimtala 220 kV bus voltage within the range of 0.9 to 1.1 per unit for the worse case contingencies studied.

An additional +/- 10 MVAR or admittance should be available as a short-term rating (5 minutes maximum) to account for the portion of SVC output to be used for steady-state conditions and to complement the deployed MSRs and MSCs.

Properly applied high-speed switched MSCs and MSRs may result in a reduced dynamic range requirement of the SVC without degradation of performance. High-speed switched MSRs and MSCs, (if used) will need to be integrated into the overall SVC design taking into account the particular characteristics of the vendor's SVC equipment. The SVC vendor will be permitted to include high-speed switched MSCs and/or MSRs in the design if it can be shown that their use will be more cost-effective and result in acceptable SVC performance.

In addition the Chimtala SVC may have MSS control capability for switching the MSRs and MSCs at Pul-e-Khumri, Chimtala, and Kabul North substations. Optical fiber communication exists between these substations, providing a communication path.

Having the MSS controller operate the MSCs and MSRs will also extend automated voltage control through SVC response to maintain SVC output to near zero MVAR. This capability is necessary to provide system voltage stability at higher import levels under normal and post-disturbance conditions. At higher import levels operator-directed switching of MSCs and MSRs to meet changing load conditions is unworkable due to the high sensitivity of voltage to changes in load. Voltage control will become much more difficult at higher import levels.

5.3 SEPS SVC Analysis

The approach for analysis of the Kandahar SVC is essentially the same as that for the Chimtala SVC. The main difference is the location of the SVC at Kandahar which is located at the end of an additional long radial line from Chimtala to Kandahar. This puts the Kandahar SVC a very long distance from the import generation source. In all of the base power flow cases studied, the double-circuit NEPS-SEPS Connector is loaded below its surge impedance loading (or SIL) so that the transmission line is always generating more VARs than it is consuming. Thus the shunt devices for controlling the voltage profile of the line are MSRs. The Kandahar SVC is located on a 20 kV bus which is connected to the Kandahar 220 kV bus by a transformer. The Kandahar 220 kV bus voltage is the controlled voltage point for the Kandahar SVC.

The worst case scenario for the Kandahar SVC for accomplishing the dynamic voltage control of the Kandahar 220 kV bus are listed below. Figure 3 and Figure 4 show the dynamic plots for two contingencies listed in Table 8. SVC sizing is based on the NEPS-SEPS Connector operated as a double-circuit line. Should the line be operated as a single-circuit, additional RPC support will be required.

- A three-phase bus fault followed by loss of 60 MW of load at the Kandahar East 110 kV bus. This contingency determined the amount of reactive power that must be absorbed by the Kandahar SVC. Scenario 16
- Applying load to the largest transformer at Kandahar East with the remainder of the NEPS-SEPS connector loaded to RPC design levels. This is a sudden increase in load of 35.3 MVA (30 MW at 0.85 power factor) with the rest of the NEPS-SEPS connector loaded to 176.5 MVA (150 MW at 0.85 power factor). This contingency determined the amount of reactive power that must be provided by the Kandahar SVC. Scenario 14.

Figure 3 Dynamic Scenario 16

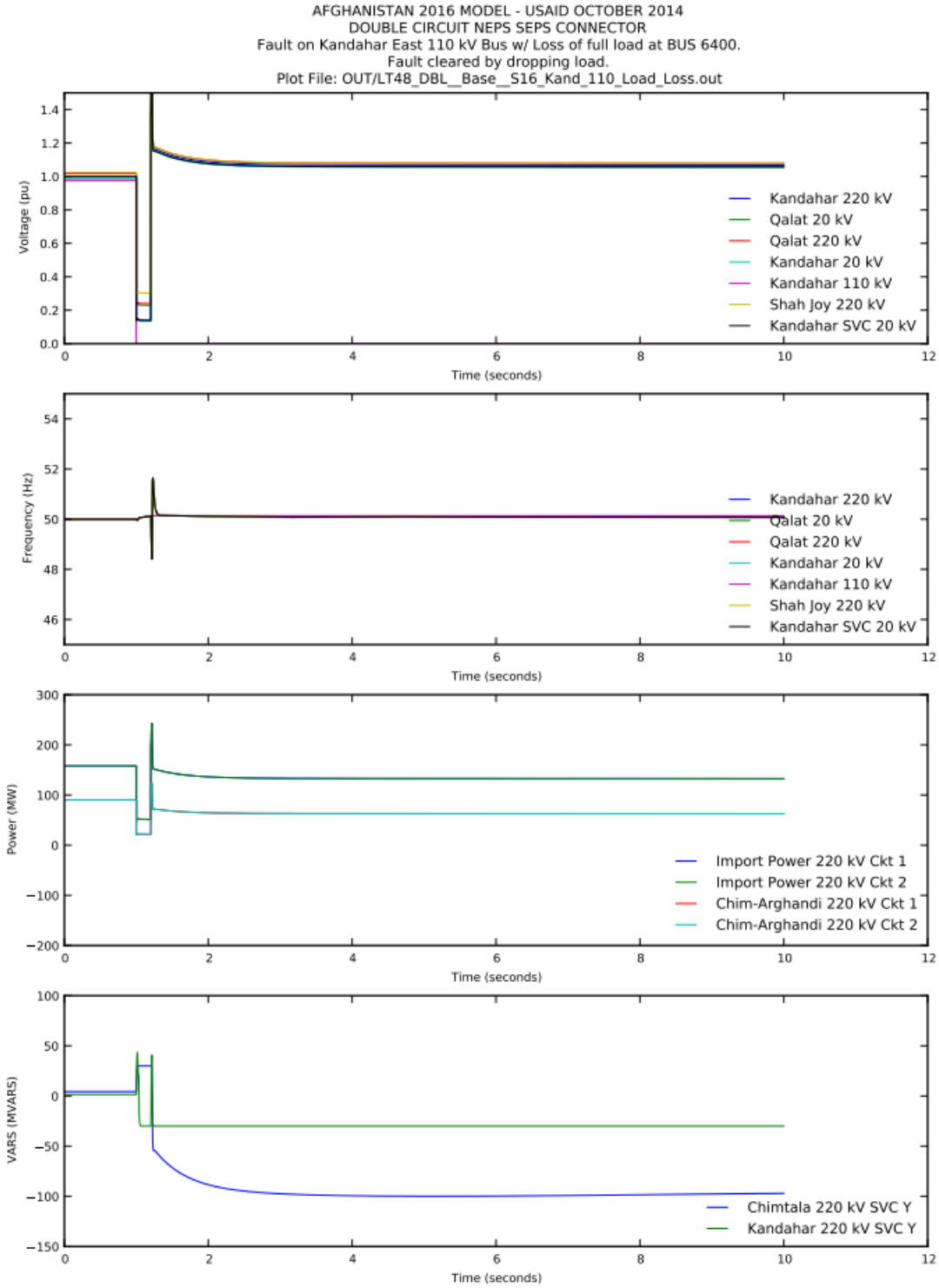
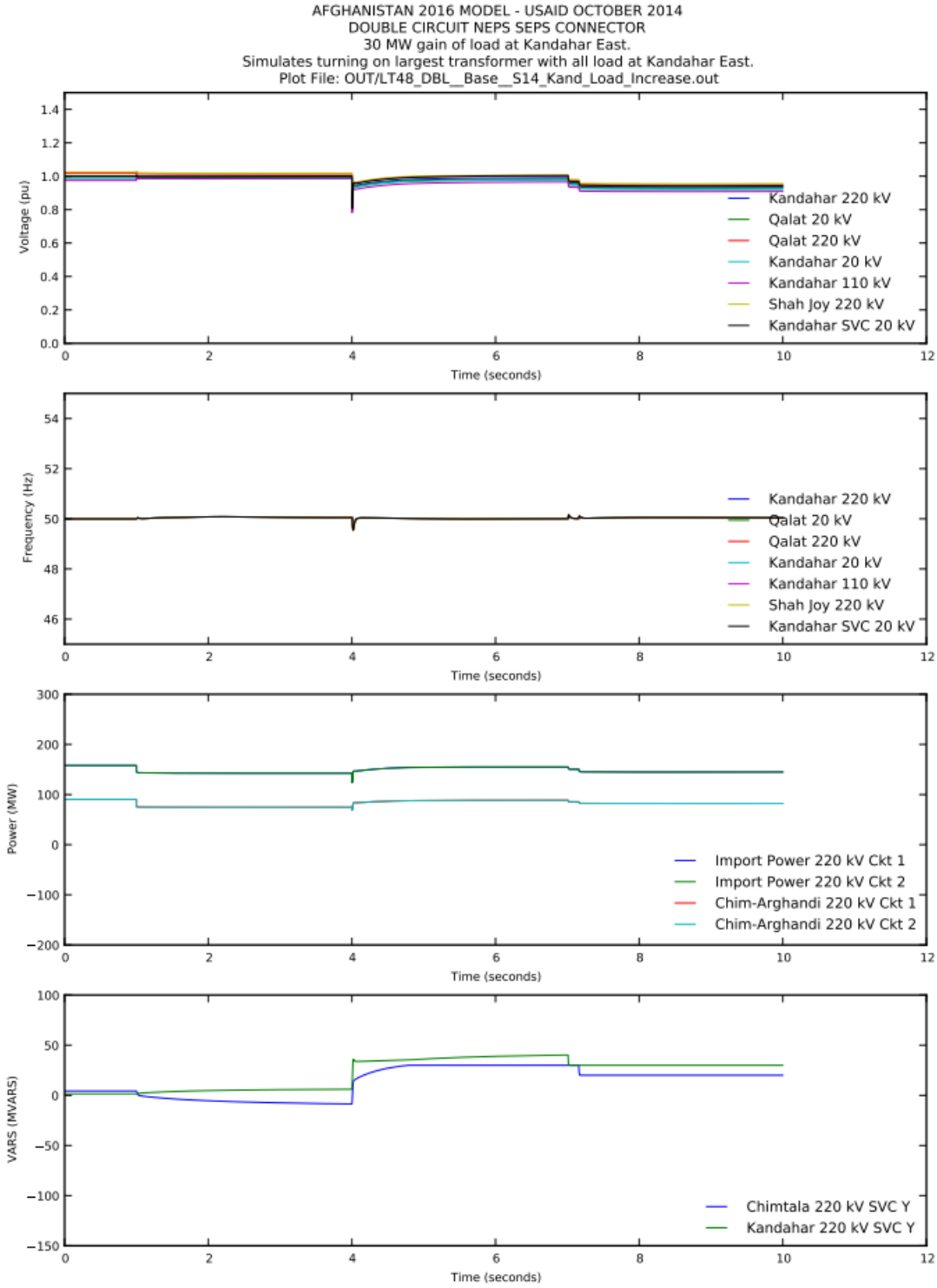


Figure 4 Dynamic Scenario 14



5.3.1 SVC Dynamic Rating and Switched MSCs and MSRs

This section summarizes the results of the power flow and dynamic analysis for the Kandahar SVC and the SEPS system. An SVC dynamic admittance range of -40 to + 40 MVAR is adequate to control the Kandahar 220 kV bus voltage within the range of 0.9 to 1.1 per unit for the worse case contingencies. In addition the Kandahar SVC should have MSS control capability for switching the MSRs and, if present, MSCs at Kandahar East. This function will automatically maintain the SVC reactive power output as near zero as possible to enable the SVC to remain prepared for a disturbance. After a disturbance the SVC will automatically adjust its reactive power output by switching MSRs and MSCs (if present) to be prepared for another disturbance.

5.4 SVC Conclusions

The power flows and contingencies selected for the dynamic simulation represent the extreme cases of high and low power import, under multiple transmission line topologies. The results of the Kabul and Kandahar SVC sizing are shown in Table 9.

Table 9 Representative Dynamic Ratings for Kabul and Kandahar SVCs

SVC Location	Admittance Range	
Chimtala	-140	+30
Kandahar	-40	+40

In addition to these dynamic ratings the SVC may have MSS control capability for switching the MSRs and MSCs. This function will automatically maintain the SVC reactive power output as near zero as possible to enable the SVC to remain prepared for a disturbance. After a disturbance the SVC will automatically adjust its reactive power output by switching MSRs and MSCs (if present) to be prepared for another disturbance.

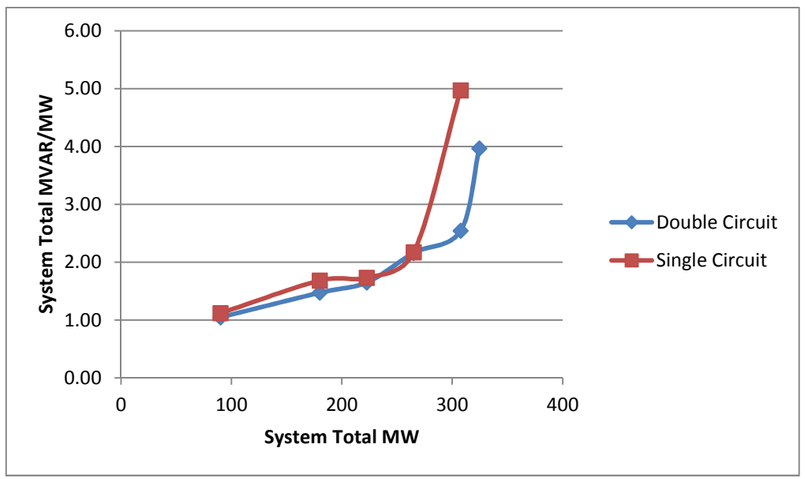
Appendix A
Steady State Results

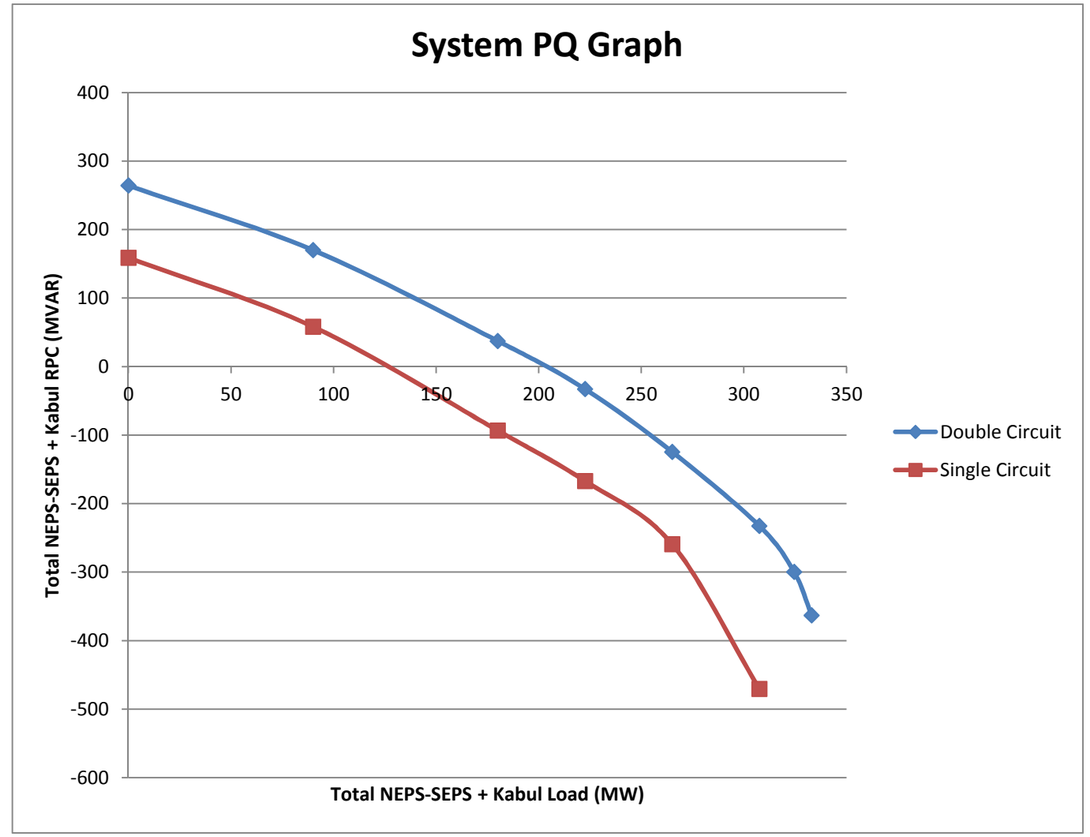
Results from 20141001 SVC post-contingency 1.1 to 0.9		Contingency 1a			Contingency 1b			Contingency 2			Contingency 3			Contingency 4			Contingency 5			Contingency 6		
		Single Circuit			Single Circuit			Single Circuit			Single Circuit			Single Circuit			Single Circuit			Single Circuit		
		Contingency 1a			Contingency 1b			Contingency 2-try2			Contingency 3 - try2			Contingency 4 - try3			Contingency 5 - try3			Contingency 6-try2		
Bus		Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load
Arghandi		0.999	1.000	25	0.995	0.995	51	0.995	0.993	51	0.995	1.053	51	0.995	0.996	51	0.995	1.006	51	0.995	0.997	51
Sayedabad		1.001	1.004	5	0.996	0.996	9	0.996	0.989	9	0.996	1.049	9	0.996	0.996	9	0.996	1.020	9	0.996	1.001	9
Ghazni		1.008	1.012	7	0.997	0.997	14	0.997	0.983	14	0.997	1.043	14	0.997	NA	14	0.997	1.034	14	0.997	1.006	0
Qarabagh		1.010	1.015	5	1.000	1.000	9	1.000	0.981	9	1.000	1.040	9	1.000	NA	9	1.000	1.042	9	1.000	1.007	9
Moqor		1.013	1.020	5	1.003	1.003	9	1.003	0.978	9	1.003	1.036	9	1.003	NA	9	1.003	1.049	9	1.003	1.009	9
Shah Joy		1.014	1.022	5	1.005	1.005	9	1.005	0.974	9	1.005	1.031	9	1.005	NA	9	1.005	1.054	9	1.005	1.010	9
Qalat		1.009	1.019	5	1.006	1.006	9	1.006	0.968	9	1.006	1.022	9	1.006	NA	9	1.006	1.055	9	1.006	1.008	9
Kandahar E		1.000	1.000	51	1.000	1.000	101	1.000	0.951	101	1.000	1.000	101	1.000	NA	101	1.000	NA	101	1.000	1.000	101
Additional Load into Kabul				**0**			**0**			**100**			**100**			**100**			**100**			**100**
Loads: MW & MVA @ .85 PF			90	106		180	212		265	312		265	312		265	312		265	312		253	298
T Import	MW	179			284			393			393			393			393			393		
Kabul Load	MW	49			50			135			153			135			135			135		
NSC Load	MW	91			182			182			182			182			182			182		
Puli Khumri	MSC - 2x25 MVAR			OUT			OUT	-25	-25	OUT	-25	-25	OUT	-25	-25	OUT	-25	-25	OUT	-25	-25	OUT
Chimtala 220 **(NEW)**	MSC 1- 40 MVAR			OUT			OUT	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT
Chimtala 220 **(NEW)**	MSC 2- 40 MVAR			OUT			OUT	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT
Chimtala 220	MSR 1 - 25 MVAR	25	25	IN			OUT			OUT			OUT			OUT			OUT			OUT
Chimtala 220 **(NEW)**	MSR 2 - 25 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Chimtala 110	MSC 1 - 60 MVAR			OUT	-60	-60	IN	-60	-60	IN	-60	-60	IN	-60	-60	IN	-60	-60	IN	-60	-60	IN
Chimtala 110	SC 2 - 20 + 40 MVA			OUT			OUT	-60	-60	IN	-60	-60	IN	-60	-60	IN	-60	-60	IN	-60	-60	IN
Sayedabad	MSR 1 - 15 MVAR	15	15	IN			OUT			OUT			OUT			OUT			OUT			OUT
Sayedabad	MSR 2 - 15 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Ghazni	MSR 1 - 15 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Ghazni	MSR 2 - 15 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Qarabagh	MSR 1 - 10 MVAR	10	10	IN			OUT			OUT			OUT			OUT			OUT			OUT
Qarabagh	MSR 2 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Moqor	MSR 1 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Moqor	MSR 2 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Shah Joy	MSR 1 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Shah Joy	MSR 2 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Qalat	MSR 1 - 15 MVAR	15	0	IN/OUT			OUT			OUT			OUT			OUT			OUT			OUT
Qalat	MSR 2 - 15 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Kandahar E	MSR 1 - 25 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Kandahar E	MSR 2 - 25 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Kandahar E **(NEW)**	MSC 1 - 40 MVAR			OUT	-40	-40	IN	-40		IN	-40	-40	IN	-40		IN	-40		OUT	-40	-40	IN
Kabul	SVC	13.2	16.7	Ind. (CAP)	17.7	17.7	Ind.	13.7	9.5	Ind.	13.7	0	Ind.	13.7	135.8	Ind.	13.7	137	Ind.	13.7	39.4	Ind.
Kandahar E	SVC	-10.8	1.3	Ind. (CAP)	-9.8	-9.8	Ind. (CAP)	-9.8	0	Ind.	-9.8	9.4	Ind.	-9.8	0	Ind. (CAP)	-9.8	0	Ind. (CAP)	-9.8	-6.1	Ind. (CAP)
Total RPC		67.4	68	Ind.	-92.1	-92.1	Ind.	-261.1	-215.5	Ind.	-261.1	-255.6	Ind.	-261.1	-89.2	Ind. (CAP)	-261.1	-88	Ind. (CAP)	-261.1	-231.7	Ind. (CAP)
Notes		PV Case 1, 50% Loading loss of RPC at Qalat			PV Case 2, 100% loading loss of RPC at Qalat			PV Case 4, 100% loading plus 100MW loss of Kandahar SVC			PV Case 4, 100% loading plus 100MW loss of Kabul SVC			PV Case 4, 100% loading plus 100MW loss of one circuit from Sayedabad to Ghazni.			PV Case 4, 100% loading plus 100MW loss of one circuit from Kandahar to Qalat.			PV Case 4, 100% loading plus 100MW loss of load at Ghanzi.		

Results from 20141001 SVC post-contingency 1.1 to 0.9		Contingency 7			Contingency 8			Contingency 9			Contingency 10			Contingency 11			Contingency 12			Contingency 13			Contingency 14		
		Single Circuit			Single Circuit			Single Circuit			Single Circuit			Single Circuit			Single Circuit			Single Circuit			Single Circuit		
		Contingency 7-try2			Contingency 8-try3			Contingency 9-try1			Contingency 10			Contingency 11 - Try2			Contingency 12 - Try3			Contingency 13			Contingency 14		
Bus		Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load	Pre Cont Voltage	Post Cont Voltage	Load
Arghandi		0.995	0.998	51/28	0.995	0.999	51	0.995	0.995	51	0.995	0.995	51	0.995	0.995	51	0.999	0.999	25	0.995	NA	51	0.995	0.995	51
Sayedabad		0.996	0.999	9	0.996	1.006	9	0.996	0.996	9	0.996	0.996	9	0.996	0.996	9	1.001	1.001	5	0.996	NA	9	0.996	NA	9
Ghazni		0.997	1.000	14	0.997	1.013	14	0.997	0.997	14	0.997	0.997	14	0.997	0.997	14	1.008	1.008	7	0.997	NA	14	0.997	NA	14
Qarabagh		1.000	1.002	9	1.000	1.017	9	1.000	1.000	9	1.000	1.000	9	1.000	1.000	9	1.010	1.010	5	1.000	NA	9	1.000	NA	9
Moqor		1.003	1.004	9	1.003	1.020	9	1.003	1.003	9	1.003	1.003	9	1.003	1.003	9	1.013	1.013	5	1.003	NA	9	1.003	NA	9
Shah Joy		1.005	1.006	9	1.005	1.021	9	1.005	1.005	9	1.005	1.005	9	1.005	1.005	9	1.014	1.014	5	1.005	NA	9	1.005	NA	9
Qalat		1.006	1.007	9	1.006	1.017	9	1.006	1.006	9	1.006	1.006	9	1.006	1.006	9	1.009	1.009	5	1.006	NA	9	1.006	NA	9
Kandahar E		1.000	1.000	101	1.000	1.000	101/23	1.000	1.000	101	1.000	1.000	101	1.000	1.000	101	1.000	1.000	51	1.000	NA	101	1.000	NA	101
Additional Load into Kabul				**100**			**100**			**100**			**100**			**0**			**0**			**100**			**100**
Loads: MW & MVA @ .85 PF			222	261		179	211		265	312		265	312		180	212		90	106		265	312		265	312
T Import	MW	393			393			393			393			284			179			393			393		
Kabul Load	MW	135			135			135			135			50			49			135			135		
NSC Load	MW	182			182			182			182			182			91			182			182		
Puli Khumri	MSC - 2x25 MVAR	-25	-25	OUT	-25	-25	OUT	-25	-25	OUT	-25	-25	OUT			OUT			OUT	-25	-25	OUT	-25	-25	OUT
Chimtala 220 **(NEW)**	MSC 1- 40 MVAR	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT			OUT			OUT	-40	-40	OUT	-40	-40	OUT
Chimtala 220 **(NEW)**	MSC 2- 40 MVAR	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT	-40	-40	OUT			OUT			OUT	-40	-40	OUT	-40	-40	OUT
Chimtala 220	MSR 1 - 25 MVAR			OUT			OUT			OUT			OUT			OUT	25	25	IN			OUT			OUT
Chimtala 220 **(NEW)**	MSR 2 - 25 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Chimtala 110	MSC 1 - 60 MVAR	-60	-60	IN	-60	-60	IN	-60	0	IN	-60	0	IN	-60	-60	IN			OUT	-60	0	IN	-60	0	IN
Chimtala 110	SC 2 - 20 + 40 MVA	-60	-60	IN	-60	-60	IN	-60	-60	IN	-60	-60	IN			OUT			OUT	-60	-60	IN	-60	-60	IN
Sayedabad	MSR 1 - 15 MVAR			OUT			OUT			OUT			OUT			OUT	15	15	IN			OUT			OUT
Sayedabad	MSR 2 - 15 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Ghazni	MSR 1 - 15 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Ghazni	MSR 2 - 15 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Qarabagh	MSR 1 - 10 MVAR			OUT			OUT			OUT			OUT			OUT	10	10	IN			OUT			OUT
Qarabagh	MSR 2 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Moqor	MSR 1 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Moqor	MSR 2 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Shah Joy	MSR 1 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Shah Joy	MSR 2 - 10 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Qalat	MSR 1 - 15 MVAR			OUT			OUT			OUT			OUT			OUT	15	15	IN/OUT			OUT			OUT
Qalat	MSR 2 - 15 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Kandahar E	MSR 1 - 25 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Kandahar E	MSR 2 - 25 MVAR			OUT			OUT			OUT			OUT			OUT			OUT			OUT			OUT
Kandahar E **(NEW)**	MSC 1 - 40 MVAR	-40	-40	IN	-40	-40	IN	-40	-40	IN	-40	-40	IN	-40	-40	IN			OUT	-40		OUT	-40		OUT
Kabul	SVC	13.7	61.4	Ind.	13.7	105.8	Ind.	13.7	-44.3	Ind.	13.7	5.1	Ind.	17.7	-68.6	Ind.	13.2	-29.3	Ind.	13.7	179	Ind.	13.7	134.7	Ind.
Kandahar E	SVC	-9.8	-8.8	Ind. (CAP)	-9.8	53.5	Ind.	-9.8	-9.8	Ind.	-9.8	-9.8	Ind.	-9.8	-9.8	Ind.	-10.8	-10.8	Ind.	-9.8	0	Ind.	-9.8	0	Ind.
Total RPC		-261.1	-212.4	Ind. (CAP)	-261.1	-105.7	Ind. (CAP)	-261.1	-259.1	Ind. (CAP)	-261.1	-209.7	Ind. (CAP)	-92.1	-178.4	Ind. (CAP)	67.4	24.9	Ind. (CAP)	-261.1	14	Ind. (CAP)	-261.1	-30.3	Ind. (CAP)
Notes		PV Case 4, 100% loading plus 100MW loss of load at Arghand			PV Case 4, 100% loading plus 100MW loss of load at Kandahar			PV Case 4, 100% loading plus 100MW loss of Chimtala 110 kV 60MVAR MSR			PV Case 4, 100% loading plus 100MW Loss of Chimtala 160 kV transformer			PV Case 2, 100% loading plus 0MW Loss of line segment from Pek to Chimtala			PV Case 1, 50% loading plus 0MW Loss of line segment from PeK to Sangtuda			PV Case 4, 100% loading plus 100MW Loss of line segment from Chimtala to Arghandi			PV Case 4, 100% loading plus 100MW Loss of line segment from Arghandi to Sayadebad		

	Double Circuit			Single Circuit	
	System Total (MW)	System Total (MVAR)		System Total (MW)	System Total (MVAR)
Base	0	264		0	159
Case1	90	170		90	58
Case2	180	37		180	-93
Case3	223	-33		223	-167
Case4	265	-124		265	-259
Case5	308	-232		308	-470
Case6	325	-300			
Case7	333	-363			

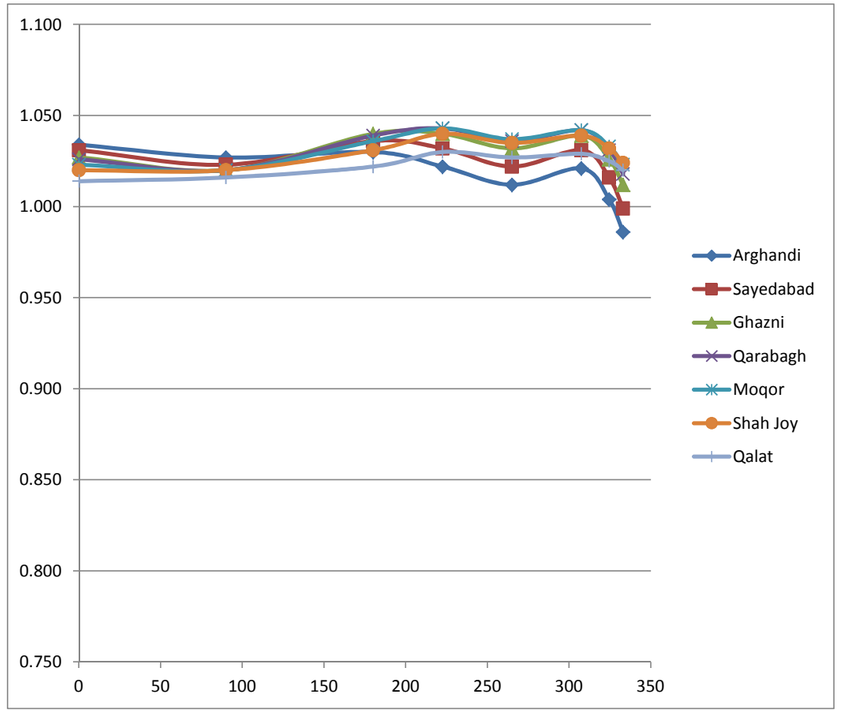
	Double Circuit			Single Circuit	
	System Total (MW)	System Total (MVAR/MW)		System Total (MW)	System Total (MVAR/MW)
Base to Case1	90	1.05		90	1.12
Case1	180	1.47		180	1.68
Case2	223	1.65		223	1.73
Case3	265	2.16		265	2.17
Case4	308	2.54		308	4.97
Case5	325	3.96			
Case6	333	7.45			





		Base		Case 1		Case 2		Case 3		Case 4		Case 5		Case 6		Case 7	
Bus		Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load
Arghandi		1.034	0	1.027	25	1.030	51	1.022	51	1.012	51	1.021	51	1.004	51	0.986	51
Sayedabad		1.031	0	1.023	5	1.036	9	1.032	9	1.022	9	1.031	9	1.016	9	0.999	9
Ghazni		1.027	0	1.020	7	1.040	14	1.040	14	1.032	14	1.039	14	1.026	14	1.012	14
Qarabagh		1.026	0	1.020	5	1.039	9	1.043	9	1.036	9	1.042	9	1.031	9	1.018	9
Moqor		1.023	0	1.020	5	1.036	9	1.043	9	1.037	9	1.042	9	1.033	9	1.023	9
Shah Joy		1.020	0	1.020	5	1.031	9	1.040	9	1.035	9	1.039	9	1.032	9	1.024	9
Qalat		1.014	0	1.016	5	1.022	9	1.030	9	1.027	9	1.029	9	1.025	9	1.020	9
Kandahar E		1.000	0	1.000	51	1.000	101	1.000	101	1.000	101	1.000	101	1.000	101	1.000	101
Additional Load into Kabul			0		0		0		50		100		150		170		180
Loads: MW & MVA @ .85 PF		0	0	90	106	180	212	223	262	265	312	308	362	325	382	333	392
T Import	MW	82		180		285		339		394		453		482		503	
Kabul Load	MW	50		50		50		94		136		178		195		203	
NSC Load	MW	0		92		183		183		182		182		181		180	
Puli Khumri	MSC - 2x25 MVAR		OUT		OUT		OUT		OUT	-25	IN	-50	IN	-50	IN	-50	IN
Chimtala 220 **(NEW)**	MSC 1- 40 MVAR		OUT		OUT		OUT		OUT		OUT	-40	IN	-40	IN	-40	IN
Chimtala 220 **(NEW)**	MSC 2- 40 MVAR		OUT		OUT		OUT		OUT		OUT	-40	IN	-40	IN	-40	IN
Chimtala 220	MSR 1 - 25 MVAR	25	IN	25	IN		OUT		OUT		OUT		OUT		OUT		OUT
Chimtala 220 **(NEW)**	MSR 2 - 25 MVAR	25	IN		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Chimtala 110	MSC 1 - 60 MVAR		OUT		OUT		OUT	-60	IN	-60	IN	-60	IN	-60	IN	-60	IN
Chimtala 110	MSC 2 - 20 + 40 MVAR		OUT		OUT		OUT		OUT	-60	IN	-60	IN	-60	IN	-60	IN
Sayedabad	MSR 1 - 15 MVAR	15	IN	15	IN		OUT		OUT		OUT		OUT		OUT		OUT
Sayedabad	MSR 2 - 15 MVAR	15	IN	15	IN		OUT		OUT		OUT		OUT		OUT		OUT
Ghazni	MSR 1 - 15 MVAR	15	IN	15	IN		OUT		OUT		OUT		OUT		OUT		OUT
Ghazni	MSR 2 - 15 MVAR	15	IN	15	IN		OUT		OUT		OUT		OUT		OUT		OUT
Qarabagh	MSR 1 - 10 MVAR	10	IN	10	IN		OUT		OUT		OUT		OUT		OUT		OUT
Qarabagh	MSR 2 - 10 MVAR	10	IN	10	IN		OUT		OUT		OUT		OUT		OUT		OUT
Moqor	MSR 1 - 10 MVAR	10	IN	10	IN	10	IN		OUT		OUT		OUT		OUT		OUT
Moqor	MSR 2 - 10 MVAR	10	IN	10	IN		OUT		OUT		OUT		OUT		OUT		OUT
Shah Joy	MSR 1 - 10 MVAR	10	IN	10	IN	10	IN		OUT		OUT		OUT		OUT		OUT
Shah Joy	MSR 2 - 10 MVAR	10	IN		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Qalat	MSR 1 - 15 MVAR	15	IN	15	IN	15	IN		OUT		OUT		OUT		OUT		OUT
Qalat	MSR 2 - 15 MVAR	15	IN		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Kandahar E	MSR 1 - 25 MVAR	25	IN	25	IN		OUT	25	IN	25	IN	25	IN		OUT		OUT
Kandahar E	MSR 2 - 25 MVAR	25	IN		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Kabul	SVC	7.37	Ind.	-8.38	Ind. (CAP)	-5.61	Ind. (CAP)	0.33	Ind.	0.18	Ind.	-8.6	Ind. (CAP)	-65.66	Ind. (CAP)	-117.65	Ind. (CAP)
Kandahar E	SVC	6.85	Ind.	3.36	Ind.	8.01	Ind.	1.97	Ind.	-4.64	Ind. (CAP)	1.14	Ind.	15.8	Ind.	4.43	Ind.
Total RPC		264.22	Ind.	169.98	Ind.	37.4	Ind.	-32.7	Ind.	-124.46	Ind. (CAP)	-232.46	Ind. (CAP)	-299.86	Ind. (CAP)	-363.22	Ind. (CAP)
Notes																**Last Valid Increase.** 190MVA increase at Kabul causes voltage collapse. Lack of reliable solution.	

	Values produced by PSS/E Case Results
	Values entered into PSS/E Model for Each Case

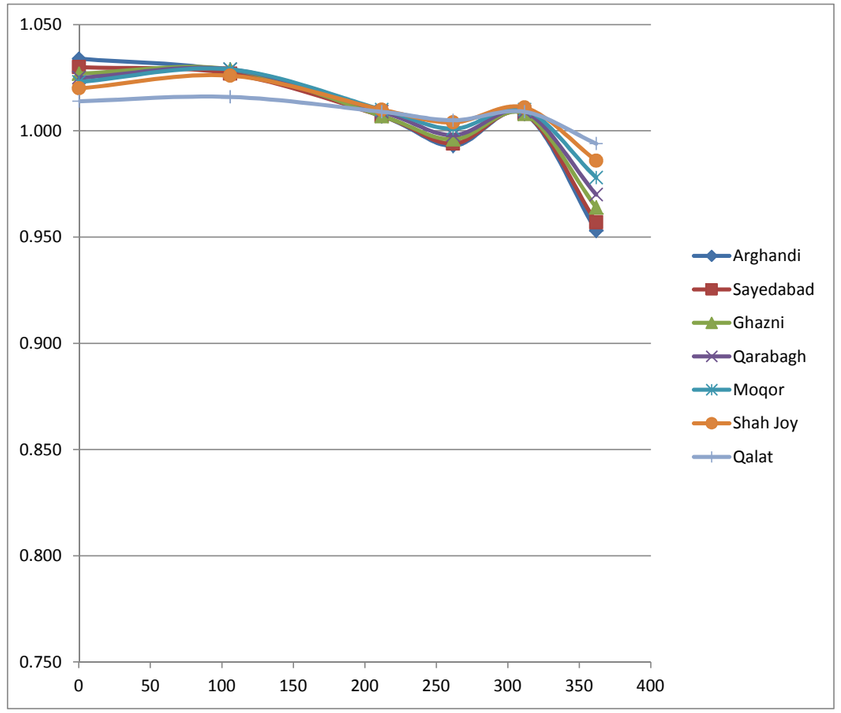


510 MW of transmission from Tajikistan is the apparent maximum power transfer before voltage instability.

Kabul loads increases occur at KABUL_NW_E bus 6034

Kabul loads served by Import source include Chimtala and Kabul NW.

		Single Circuit		Single Circuit		Single Circuit		Single Circuit		Single Circuit		Single Circuit		Single Circuit		Single Circuit	
		Base		Case 1		Case 2		Case 3		Case 4		Case 5		Case 6		Case 7	
Bus		Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load	Voltage	Load
Arghandi		1.034	0	1.028	25	1.007	51	0.993	51	1.008	51	0.953	51				
Sayedabad		1.030	0	1.027	5	1.007	9	0.994	9	1.008	9	0.957	9				
Ghazni		1.027	0	1.029	7	1.007	14	0.996	14	1.008	14	0.964	14				
Qarabagh		1.025	0	1.029	5	1.009	9	0.998	9	1.009	9	0.970	9				
Moqor		1.023	0	1.029	5	1.010	9	1.001	9	1.010	9	0.978	9				
Shah Joy		1.020	0	1.026	5	1.010	9	1.004	9	1.011	9	0.986	9				
Qalat		1.014	0	1.016	5	1.009	9	1.005	9	1.009	9	0.994	9				
Kandahar E		1.000	0	1.000	51	1.000	101	1.000	101	1.000	101	1.000	101				
Additional Load into Kabul			0		0		0		50		100		150		0		0
Loads: MW & MVA @ .85 PF		0	0	90	106	180	212	223	262	265	312	308	362	0	0	0	0
T Import	MW	82		181		286		339		395		469					
Kabul Load	MW	50		50		50		94		136		179					
NSC Load	MW	0		92		183		182		183		179					
Puli Khumri	MSC - 2x25 MVAR		OUT		OUT		OUT		OUT	-25	IN	-50	IN		OUT		OUT
Chimtala 220 **(NEW)**	MSC 1- 40 MVAR		OUT		OUT		OUT		OUT	-40	IN	-40	IN		OUT		OUT
Chimtala 220 **(NEW)**	MSC 2- 40 MVAR		OUT		OUT		OUT		OUT	-40	IN	-40	IN		OUT		OUT
Chimtala 220	MSR 1 - 25 MVAR	25	IN	25	IN		OUT		OUT		OUT		OUT		OUT		OUT
Chimtala 220 **(NEW)**	MSR 2 - 25 MVAR	25	IN		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Chimtala 110	MSC 1 - 60 MVAR		OUT		OUT	-60	IN	-60	IN	-60	IN	-60	IN		OUT		OUT
Chimtala 110	MSC 2 - 20 + 40 MVAR		OUT		OUT		OUT	-60	IN	-60	IN	-60	IN		OUT		OUT
Sayedabad	MSR 1 - 15 MVAR	15	IN	15	IN		OUT		OUT		OUT		OUT		OUT		OUT
Sayedabad	MSR 2 - 15 MVAR		OUT		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Ghazni	MSR 1 - 15 MVAR	15	IN		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Ghazni	MSR 2 - 15 MVAR		OUT		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Qarabagh	MSR 1 - 10 MVAR	10	IN	10	IN		OUT		OUT		OUT		OUT		OUT		OUT
Qarabagh	MSR 2 - 10 MVAR		OUT		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Moqor	MSR 1 - 10 MVAR	10	IN		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Moqor	MSR 2 - 10 MVAR		OUT		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Shah Joy	MSR 1 - 10 MVAR	10	IN		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Shah Joy	MSR 2 - 10 MVAR		OUT		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Qalat	MSR 1 - 15 MVAR	15	IN	15	IN		OUT		OUT		OUT		OUT		OUT		OUT
Qalat	MSR 2 - 15 MVAR		OUT		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Kandahar E	MSR 1 - 25 MVAR	25	IN		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Kandahar E	MSR 2 - 25 MVAR		OUT		OUT		OUT		OUT		OUT		OUT		OUT		OUT
Kandahar E **(NEW)**	MSC 1 - 40 MVAR		OUT		OUT	-40	IN	-40	IN	-40	IN	-40	IN				
Kabul	SVC	5.61	Ind.	-4.74	Ind. (CAP)	12.29	Ind.	3.52	Ind.	11.25	Ind.	-156.83	Ind. (CAP)		Ind. (CAP)		Ind. (CAP)
Kandahar E	SVC	3.23	Ind.	-2.07	Ind. (CAP)	-5.58	Ind. (CAP)	-10.47	Ind. (CAP)	-5.46	Ind. (CAP)	-23.63	Ind. (CAP)		Ind. (CAP)		Ind.
Total RPC		158.84	Ind.	58.19	Ind.	-93.29	Ind.	-166.95	Ind.	-259.21	Ind. (CAP)	-470.46	Ind. (CAP)	0	Ind. (CAP)	0	Ind. (CAP)
Notes												**Last Valid Increase**. 170MVA increase at Kabul causes voltage collapse. Lack of reliable solution.					



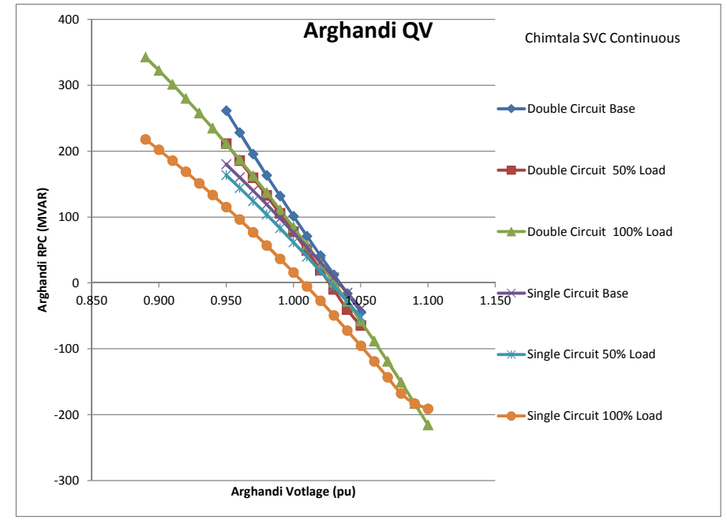
469 MW of transmission from Tajikistan is the apparent maximum power transfer before voltage instability.

Kabul loads increases occur at KABUL_NW_E bus 6034

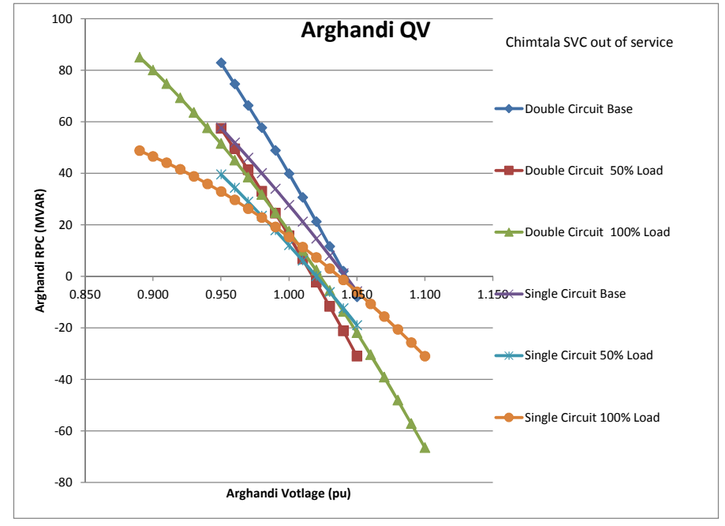
Kabul loads served by Import source include Chimtala and Kabul NW.

	Values produced by PSS/E Case Results
	Values entered into PSS/E Model for Each Case
	egative - values signify a capacitor, postiive values signify an induct

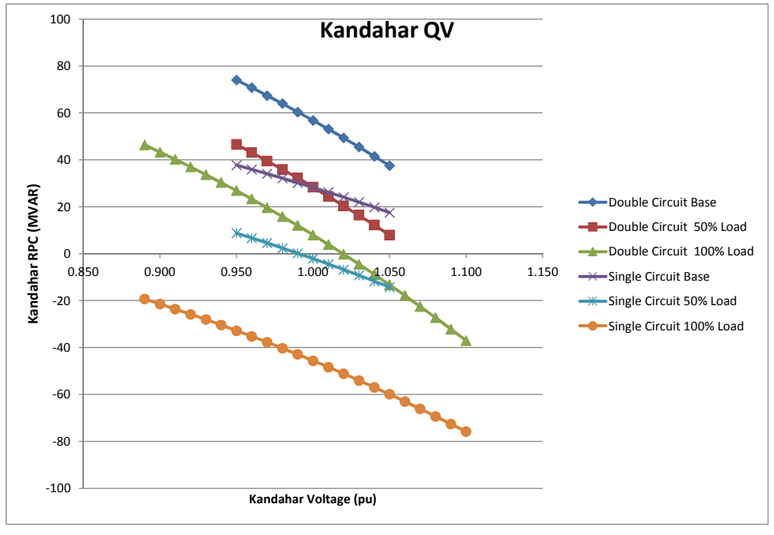
Chimtala SVC Continuous	Double Circuit			Double Circuit			Double Circuit			Single Circuit			Single Circuit			Single Circuit		
	Base			Case 1			Case 2			Base			Case 1			Case 2		
Bus	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load		Voltage	Load		Voltage	Load	
Arghandi	1.100	0		1.100	25		1.100	51	-216	1.100	0		1.100	25		1.100	51	-191
Arghandi	1.090	0		1.090	25		1.090	51	-183	1.090	0		1.090	25		1.090	51	-183
Arghandi	1.080	0		1.080	25		1.080	51	-151	1.080	0		1.080	25		1.080	51	-168
Arghandi	1.070	0		1.070	25		1.070	51	-119	1.070	0		1.070	25		1.070	51	-143
Arghandi	1.060	0		1.060	25		1.060	51	-88	1.060	0		1.060	25		1.060	51	-119
Arghandi	1.050	0	-44	1.050	25	-65	1.050	51	-58	1.050	0	-39	1.050	25	-52	1.050	51	-95
Arghandi	1.040	0	-16	1.040	25	-40	1.040	51	-28	1.040	0	-15	1.040	25	-28	1.040	51	-72
Arghandi	1.030	0	13	1.030	25	-10	1.030	51	1	1.030	0	9	1.030	25	-5	1.030	51	-49
Arghandi	1.020	0	42	1.020	25	20	1.020	51	29	1.020	0	32	1.020	25	18	1.020	51	-27
Arghandi	1.010	0	71	1.010	25	49	1.010	51	57	1.010	0	54	1.010	25	40	1.010	51	-5
Arghandi	1.000	0	101	1.000	25	78	1.000	51	84	1.000	0	76	1.000	25	62	1.000	51	16
Arghandi	0.990	0	132	0.990	25	106	0.990	51	111	0.990	0	98	0.990	25	83	0.990	51	37
Arghandi	0.980	0	164	0.980	25	133	0.980	51	137	0.980	0	119	0.980	25	104	0.980	51	57
Arghandi	0.970	0	196	0.970	25	160	0.970	51	162	0.970	0	140	0.970	25	124	0.970	51	77
Arghandi	0.960	0	228	0.960	25	186	0.960	51	187	0.960	0	160	0.960	25	144	0.960	51	96
Arghandi	0.950	0	262	0.950	25	211	0.950	51	211	0.950	0	180	0.950	25	164	0.950	51	115
Arghandi	0.940	0		0.940	25		0.940	51	235	0.940	0		0.940	25		0.940	51	133
Arghandi	0.930	0		0.930	25		0.930	51	258	0.930	0		0.930	25		0.930	51	151
Arghandi	0.920	0		0.920	25		0.920	51	280	0.920	0		0.920	25		0.920	51	169
Arghandi	0.910	0		0.910	25		0.910	51	302	0.910	0		0.910	25		0.910	51	186
Arghandi	0.900	0		0.900	25		0.900	51	323	0.900	0		0.900	25		0.900	51	202
Arghandi	0.890	0		0.890	25		0.890	51	343	0.890	0		0.890	25		0.890	51	218
Notes	Refer to PV for Case descriptions and details.			Refer to PV for Case descriptions and details.			Refer to PV for Case descriptions and details.											
	3% voltage change =		98.1			89.4			87.2			70.5			69.7			68.2
	6% voltage change =		190.46			173.3			168.9			136.9			135.1			132.1



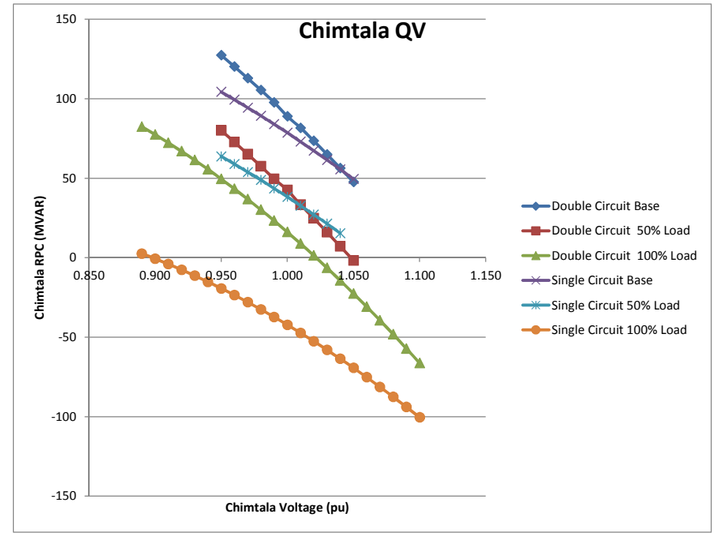
Chimtala SVC Out of Service	Double Circuit			Double Circuit			Double Circuit			Single Circuit			Single Circuit			Single Circuit		
	Base			Case 1			Case 2			Base			Case 1			Case 2		
Bus	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load		Voltage	Load		Voltage	Load	
Arghandi	1.100	0		1.100	25		1.100	51	-67	1.100	0		1.100	25		1.100	51	-31
Arghandi	1.090	0		1.090	25		1.090	51	-57	1.090	0		1.090	25		1.090	51	-26
Arghandi	1.080	0		1.080	25		1.080	51	-48	1.080	0		1.080	25		1.080	51	-21
Arghandi	1.070	0		1.070	25		1.070	51	-39	1.070	0		1.070	25		1.070	51	-16
Arghandi	1.060	0		1.060	25		1.060	51	-30	1.060	0		1.060	25		1.060	51	-11
Arghandi	1.050	0	-8	1.050	25	-31	1.050	51	-22	1.050	0	-6	1.050	25	-19	1.050	51	-6
Arghandi	1.040	0	2	1.040	25	-21	1.040	51	-14	1.040	0	1	1.040	25	-12	1.040	51	-1
Arghandi	1.030	0	12	1.030	25	-12	1.030	51	-6	1.030	0	8	1.030	25	-6	1.030	51	3
Arghandi	1.020	0	21	1.020	25	-2	1.020	51	2	1.020	0	15	1.020	25	0	1.020	51	7
Arghandi	1.010	0	31	1.010	25	7	1.010	51	10	1.010	0	21	1.010	25	6	1.010	51	11
Arghandi	1.000	0	40	1.000	25	16	1.000	51	18	1.000	0	28	1.000	25	12	1.000	51	15
Arghandi	0.990	0	49	0.990	25	25	0.990	51	25	0.990	0	34	0.990	25	18	0.990	51	19
Arghandi	0.980	0	58	0.980	25	33	0.980	51	32	0.980	0	40	0.980	25	24	0.980	51	23
Arghandi	0.970	0	66	0.970	25	41	0.970	51	39	0.970	0	46	0.970	25	29	0.970	51	26
Arghandi	0.960	0	75	0.960	25	50	0.960	51	45	0.960	0	52	0.960	25	34	0.960	51	30
Arghandi	0.950	0	83	0.950	25	57	0.950	51	52	0.950	0	58	0.950	25	40	0.950	51	33
Arghandi	0.940	0		0.940	25		0.940	51	58	0.940	0		0.940	25		0.940	51	36
Arghandi	0.930	0		0.930	25		0.930	51	64	0.930	0		0.930	25		0.930	51	39
Arghandi	0.920	0		0.920	25		0.920	51	69	0.920	0		0.920	25		0.920	51	42
Arghandi	0.910	0		0.910	25		0.910	51	75	0.910	0		0.910	25		0.910	51	44
Arghandi	0.900	0		0.900	25		0.900	51	80	0.900	0		0.900	25		0.900	51	47
Arghandi	0.890	0		0.890	25		0.890	51	85	0.890	0		0.890	25		0.890	51	49
Notes	Refer to PV for Case descriptions and details.			Refer to PV for Case descriptions and details.			Refer to PV for Case descriptions and details.											
	3% voltage change =		29.3			28.7			24.3			20.5			19			13.3
	6% voltage change =		56.9			55.5			46.6			39.8			36.8			25.2



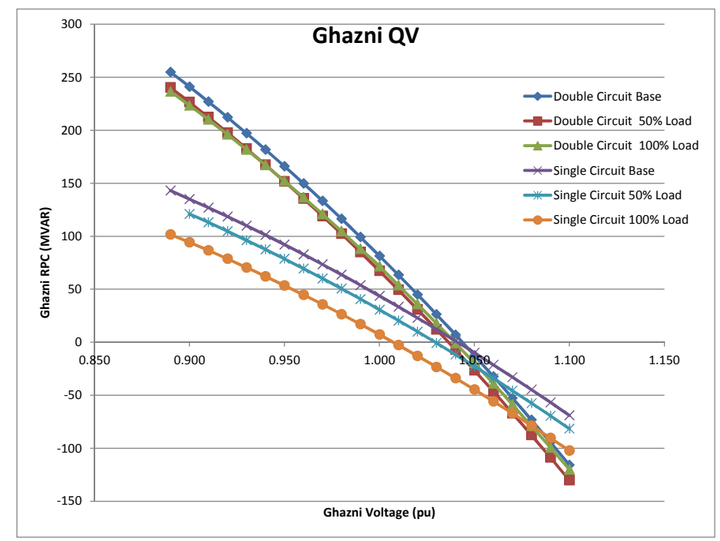
	Double Circuit			Double Circuit			Double Circuit			Single Circuit			Single Circuit			Single Circuit		
	Base			Case 1			Case 2			Base			Case 1			Case 2		
Bus	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load		Voltage	Load		Voltage	Load	
Kandahar	1.100	0		1.100	25		1.100	51	-37	1.100	0		1.100	25		1.100	51	-76
Kandahar	1.090	0		1.090	25		1.090	51	-32	1.090	0		1.090	25		1.090	51	-73
Kandahar	1.080	0		1.080	25		1.080	51	-27	1.080	0		1.080	25		1.080	51	-69
Kandahar	1.070	0		1.070	25		1.070	51	-23	1.070	0		1.070	25		1.070	51	-66
Kandahar	1.060	0		1.060	25		1.060	51	-18	1.060	0		1.060	25		1.060	51	-63
Kandahar	1.050	0	38	1.050	25	8	1.050	51	-13	1.050	0	18	1.050	25	-14	1.050	51	-60
Kandahar	1.040	0	42	1.040	25	12	1.040	51	-9	1.040	0	20	1.040	25	-12	1.040	51	-57
Kandahar	1.030	0	46	1.030	25	16	1.030	51	-5	1.030	0	22	1.030	25	-9	1.030	51	-54
Kandahar	1.020	0	49	1.020	25	20	1.020	51	0	1.020	0	24	1.020	25	-7	1.020	51	-51
Kandahar	1.010	0	53	1.010	25	24	1.010	51	4	1.010	0	26	1.010	25	-4	1.010	51	-48
Kandahar	1.000	0	57	1.000	25	28	1.000	51	8	1.000	0	28	1.000	25	-2	1.000	51	-46
Kandahar	0.990	0	60	0.990	25	32	0.990	51	12	0.990	0	30	0.990	25	0	0.990	51	-43
Kandahar	0.980	0	64	0.980	25	36	0.980	51	16	0.980	0	32	0.980	25	2	0.980	51	-40
Kandahar	0.970	0	67	0.970	25	40	0.970	51	20	0.970	0	34	0.970	25	5	0.970	51	-38
Kandahar	0.960	0	71	0.960	25	43	0.960	51	23	0.960	0	36	0.960	25	7	0.960	51	-35
Kandahar	0.950	0	74	0.950	25	47	0.950	51	27	0.950	0	38	0.950	25	9	0.950	51	-33
Kandahar	0.940	0		0.940	25		0.940	51	30	0.940	0		0.940	25		0.940	51	-30
Kandahar	0.930	0		0.930	25		0.930	51	34	0.930	0		0.930	25		0.930	51	-28
Kandahar	0.920	0		0.920	25		0.920	51	37	0.920	0		0.920	25		0.920	51	-26
Kandahar	0.910	0		0.910	25		0.910	51	40	0.910	0		0.910	25		0.910	51	-24
Kandahar	0.900	0		0.900	25		0.900	51	43	0.900	0		0.900	25		0.900	51	-21
Kandahar	0.890	0		0.890	25		0.890	51	46	0.890	0		0.890	25		0.890	51	-19
Notes	Refer to PV for Case descriptions and details.			Refer to PV for Case descriptions and details.			Refer to PV for Case descriptions and details.											
	3% voltage change =		11.9			12.5			13.1			6.6			7.4			8.8
	6% voltage change =		22.9			24.4			32.5			12.7			14.4			21.8



	Double Circuit			Double Circuit			Double Circuit			Single Circuit			Single Circuit			Single Circuit		
	Base			Case 1			Case 2			Base			Case 1			Case 2		
Bus	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load		Voltage	Load		Voltage	Load	
Chimtala 220kV	1.100	0		1.100	25		1.100	51	-66	1.100	0		1.100	25		1.100	51	-100
Chimtala 220kV	1.090	0		1.090	25		1.090	51	-57	1.090	0		1.090	25		1.090	51	-94
Chimtala 220kV	1.080	0		1.080	25		1.080	51	-48	1.080	0		1.080	25		1.080	51	-88
Chimtala 220kV	1.070	0		1.070	25		1.070	51	-39	1.070	0		1.070	25		1.070	51	-81
Chimtala 220kV	1.060	0		1.060	25		1.060	51	-31	1.060	0		1.060	25		1.060	51	-75
Chimtala 220kV	1.050	0	48	1.050	25	-2	1.050	51	-23	1.050	0	50	1.050	25		1.050	51	-69
Chimtala 220kV	1.040	0	56	1.040	25	7	1.040	51	-14	1.040	0	56	1.040	25	15	1.040	51	-64
Chimtala 220kV	1.030	0	65	1.030	25	16	1.030	51	-6	1.030	0	62	1.030	25	21	1.030	51	-58
Chimtala 220kV	1.020	0	74	1.020	25	25	1.020	51	1	1.020	0	67	1.020	25	27	1.020	51	-53
Chimtala 220kV	1.010	0	82	1.010	25	33	1.010	51	9	1.010	0	73	1.010	25	33	1.010	51	-47
Chimtala 220kV	1.000	0	89	1.000	25	43	1.000	51	16	1.000	0	79	1.000	25	38	1.000	51	-42
Chimtala 220kV	0.990	0	98	0.990	25	50	0.990	51	23	0.990	0	84	0.990	25	44	0.990	51	-37
Chimtala 220kV	0.980	0	105	0.980	25	58	0.980	51	30	0.980	0	89	0.980	25	49	0.980	51	-33
Chimtala 220kV	0.970	0	113	0.970	25	65	0.970	51	37	0.970	0	94	0.970	25	54	0.970	51	-28
Chimtala 220kV	0.960	0	120	0.960	25	73	0.960	51	43	0.960	0	99	0.960	25	59	0.960	51	-24
Chimtala 220kV	0.950	0	127	0.950	25	80	0.950	51	50	0.950	0	104	0.950	25	64	0.950	51	-19
Chimtala 220kV	0.940	0		0.940	25		0.940	51	56	0.940	0		0.940	25		0.940	51	-15
Chimtala 220kV	0.930	0		0.930	25		0.930	51	61	0.930	0		0.930	25		0.930	51	-11
Chimtala 220kV	0.920	0		0.920	25		0.920	51	67	0.920	0		0.920	25		0.920	51	-8
Chimtala 220kV	0.910	0		0.910	25		0.910	51	72	0.910	0		0.910	25		0.910	51	-4
Chimtala 220kV	0.900	0		0.900	25		0.900	51	78	0.900	0		0.900	25		0.900	51	-1
Chimtala 220kV	0.890	0		0.890	25		0.890	51	82	0.890	0		0.890	25		0.890	51	3
	3% voltage change =		25.9			26.6			23.9			17.8			27.1			16.7
	6% voltage change =		50.1			51.4			59.9			34.5			43.6			42.4



	Double Circuit			Double Circuit			Double Circuit			Single Circuit			Single Circuit			Single Circuit		
	Base			Case 1			Case 2			Base			Case 1			Case 2		
Bus	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load (MW)	RPC (MVAR)	Voltage	Load		Voltage	Load		Voltage	Load	
Ghazni	1.100	0	-116	1.100	25	-130	1.100	51	-120	1.100	0	-69	1.100	25	-82	1.100	51	-102
Ghazni	1.090	0	-94	1.090	25	-109	1.090	51	-99	1.090	0	-57	1.090	25	-69	1.090	51	-90
Ghazni	1.080	0	-73	1.080	25	-88	1.080	51	-79	1.080	0	-45	1.080	25	-57	1.080	51	-79
Ghazni	1.070	0	-53	1.070	25	-67	1.070	51	-59	1.070	0	-33	1.070	25	-46	1.070	51	-67
Ghazni	1.060	0	-32	1.060	25	-47	1.060	51	-39	1.060	0	-21	1.060	25	-34	1.060	51	-56
Ghazni	1.050	0	-12	1.050	25	-27	1.050	51	-20	1.050	0	-10	1.050	25	-23	1.050	51	-45
Ghazni	1.040	0	7	1.040	25	-7	1.040	51	-1	1.040	0	1	1.040	25	-12	1.040	51	-34
Ghazni	1.030	0	26	1.030	25	12	1.030	51	18	1.030	0	12	1.030	25	-1	1.030	51	-23
Ghazni	1.020	0	45	1.020	25	31	1.020	51	36	1.020	0	23	1.020	25	10	1.020	51	-13
Ghazni	1.010	0	64	1.010	25	49	1.010	51	54	1.010	0	34	1.010	25	21	1.010	51	-3
Ghazni	1.000	0	82	1.000	25	67	1.000	51	72	1.000	0	44	1.000	25	31	1.000	51	7
Ghazni	0.990	0	99	0.990	25	85	0.990	51	88	0.990	0	54	0.990	25	41	0.990	51	17
Ghazni	0.980	0	117	0.980	25	102	0.980	51	105	0.980	0	64	0.980	25	51	0.980	51	27
Ghazni	0.970	0	133	0.970	25	119	0.970	51	121	0.970	0	74	0.970	25	60	0.970	51	36
Ghazni	0.960	0	150	0.960	25	136	0.960	51	137	0.960	0	83	0.960	25	70	0.960	51	45
Ghazni	0.950	0	166	0.950	25	152	0.950	51	152	0.950	0	92	0.950	25	79	0.950	51	54
Ghazni	0.940	0	182	0.940	25	168	0.940	51	167	0.940	0	101	0.940	25	88	0.940	51	62
Ghazni	0.930	0	197	0.930	25	183	0.930	51	182	0.930	0	110	0.930	25	96	0.930	51	71
Ghazni	0.920	0	212	0.920	25	198	0.920	51	196	0.920	0	119	0.920	25	105	0.920	51	79
Ghazni	0.910	0	227	0.910	25	212	0.910	51	210	0.910	0	127	0.910	25	113	0.910	51	87
Ghazni	0.900	0	241	0.900	25	227	0.900	51	224	0.900	0	135	0.900	25	121	0.900	51	94
Ghazni	0.890	0	255	0.890	25	240	0.890	51	237	0.890	0	143	0.890	25	129	0.890	51	102
	3% voltage change =		57.5			57.6			55.7			32.9			32.7			31.8
	6% voltage change =		142.1			142.4			137.9			81.2			80.9			78.9



Appendix B
Dynamic Results

Appendix B.1 – Chimtala and Kandahar SVC Dynamic Model Parameters

Chimtala SVC

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BUS 8001 [KABUL-SVC   20.000] MODELS

 **SVSMO1U1**  BUS X-- NAME      --X BASEKV   C O N S      S T A T E S     V A R S    I C O N S
              8001     KABUL-SVC    20.000   2109-2155      744-748       747-775        63-76

ICONs:
+++++++++++ SVC REMOTE BUS ++++++++++++
        6171
+++++++++++ MSS BUS ++++++++++++
        8001
++++MSS SWITCH FLAG: 0 - NO SWITCH, 1 - SWITCH ON Q +++++
 1
++++DROOP FLAG: 0 - LINEAR DROOP, 1 - NON-LINEAR DROOP +++
 0
++++++++++FLAGS: ++++++++++
 0 0 0 0 0
 0 0 0 0 0

 CON(J   ) = UVSBmax, max cap U/V limit                     =      0.2000
 CON(J+ 1) = UV1,   undervoltage setting 1                  =      0.5000
 CON(J+ 2) = UV2,   undervoltage setting 2                  =      0.3000
 CON(J+ 3) = UVT,   undervoltage trip setting               =      0.5000
 CON(J+ 4) = OV1,   overvoltage setting 1                   =      1.3000
 CON(J+ 5) = OV2,   overvoltage setting 2                   =      1.5000
 CON(J+ 6) = UVtm1, undervoltage trip time 1                =      1.0000
 CON(J+ 7) = UVtm2, undervoltage trip time 2                =      5.0000
 CON(J+ 8) = OVtm1, overvoltage trip time 1                 =      1.0000
 CON(J+ 9) = OVtm2, overvoltage trip time 2                 =      0.5000
 CON(J+10) = Xs1, slope/droop                               =      0.0200
 CON(J+11) = Xs2, slope/droop                               =      0.0000
 CON(J+12) = Xs3, slope/droop                               =      0.0000
 CON(J+13) = Vup, up volt break-point for non-linear droop  =      1.1000
 CON(J+14) = Vlow,low volt break-point for non-linear droop =      0.0000
 CON(J+15) = Tc1, voltage measurment lead time constant     =      0.0000
 CON(J+16) = Tb1, voltage measurment lag time constant      =      0.0200
 CON(J+17) = Tc2, pre-controller lead time constant         =      0.0000
 CON(J+18) = Tb2, pre-controller lag time constant          =      0.0000
 CON(J+19) = Kpv, prop. gain of SVC PI-controller           =      5.0000
 CON(J+20) = Kiv, integral gain of SVC PI-controller        =     20.0000
 CON(J+21) = Vemax, voltage error max limit                 =      0.5000
 CON(J+22) = Vemin, voltage error min limit                 =     -0.5000
 CON(J+23) = T2, thyristor firing sequence control delay    =      0.0040
 CON(J+24) = Bshrt, short-term max. suceptance of SVC       =      0.3000
 CON(J+25) = Bmax, continuous max. suceptance of SVC        =      0.2000
 CON(J+26) = Bmin, min. suceptance of SVC                   =     -1.3000
 CON(J+27) = Tshrt, duration of short-term rating           =      3.0000
 CON(J+28) = Kps, prop. gain of SSC PI-controller           =      0.0000
 CON(J+29) = Kis, integral gain of SSC PI-controller        =      0.0000
 CON(J+30) = Vrmax, max. output of slow suceptance control  =      0.5000
 CON(J+31) = Vrmin, min. output of slow suceptance control  =     -0.5000
 CON(J+32) = Vdbd1, steady-state voltage deadband           =      0.0000
 CON(J+33) = Vdbd2, inner deadband                          =      0.0000
 CON(J+34) = Tdbd, recovery time to deadband                =      0.0000
 CON(J+35) = PLLdelay, PLL delay in voltage recovering      =      0.0000
 CON(J+36) = xeps, delta added to the susceptance bandwidth  =     0.0000
 CON(J+37) = Blcs, larger threshold for switching MSCs      =     40.0000
 CON(J+38) = Bscs, smaller threshold for switching MSCs     =     20.0000
 CON(J+39) = Blis, larger threshold for switching MSRs      =   -999.0000
 CON(J+40) = Bsis, smaller threshold for switching          =   -999.0000
 CON(J+41) = Tmssbrk, time for MSS breaker to operate       =      0.1000
 CON(J+42) = Tdelay1, time delay for larger threshold       =      0.5000
 CON(J+43) = Tdelay2, Time delay for smaller threshold      =      3.0000
 CON(J+44) = Tout, time MSC should be off before switch back=    300.0000
 CON(J+45) = Vrefmin, lower Vref limit                      =      0.9700
 CON(J+46) = Vrefmax, upper Vref limit                      =      1.0400
```

Kandahar SVC

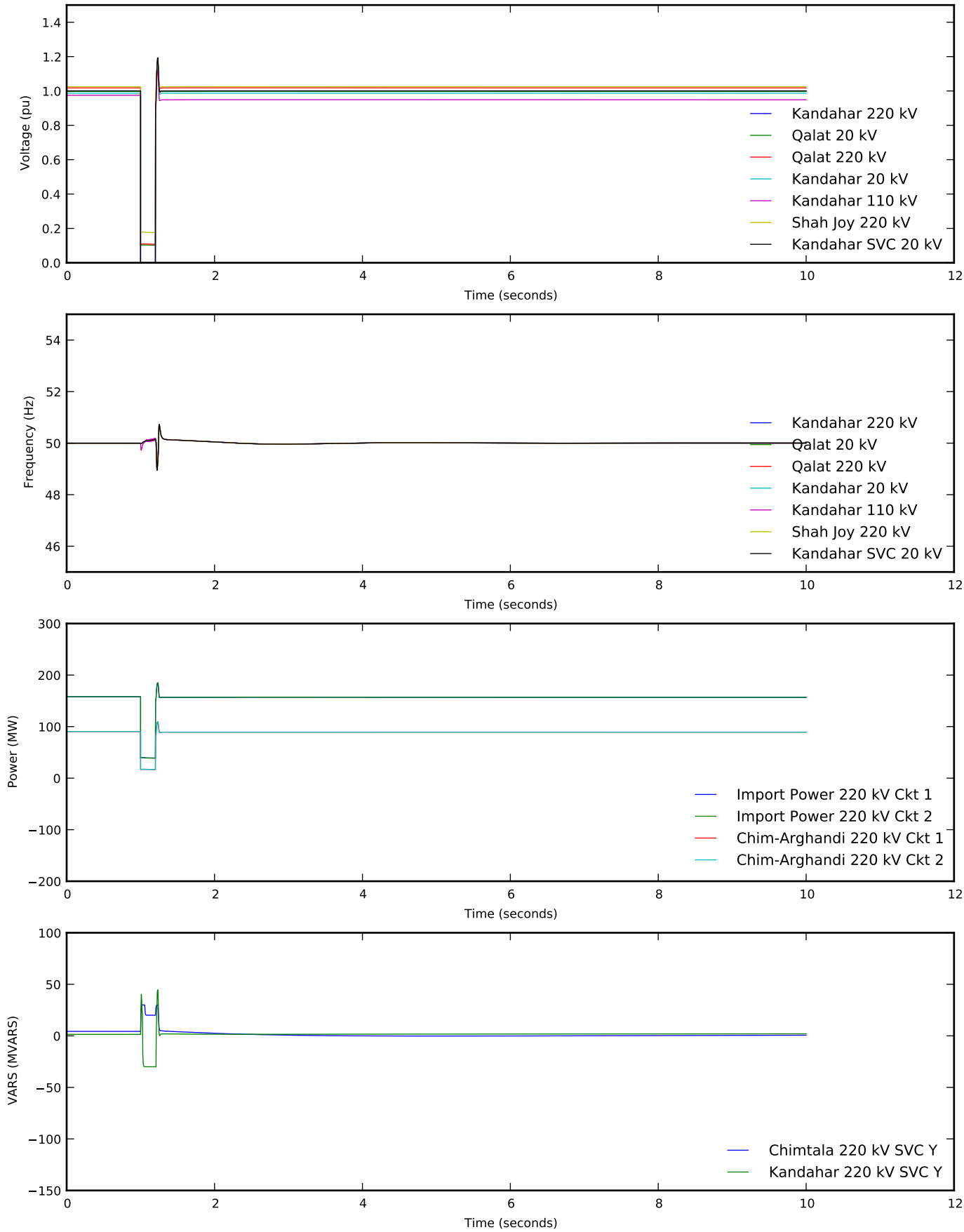
```
BUS 8010 [KAND-SVC    20.000] MODELS

 **SVSMO1U1**  BUS X-- NAME      --X BASEKV   C O N S      S T A T E S     V A R S    I C O N S
              8010     KAND-SVC     20.000   2156-2202      749-753       776-804        77-90

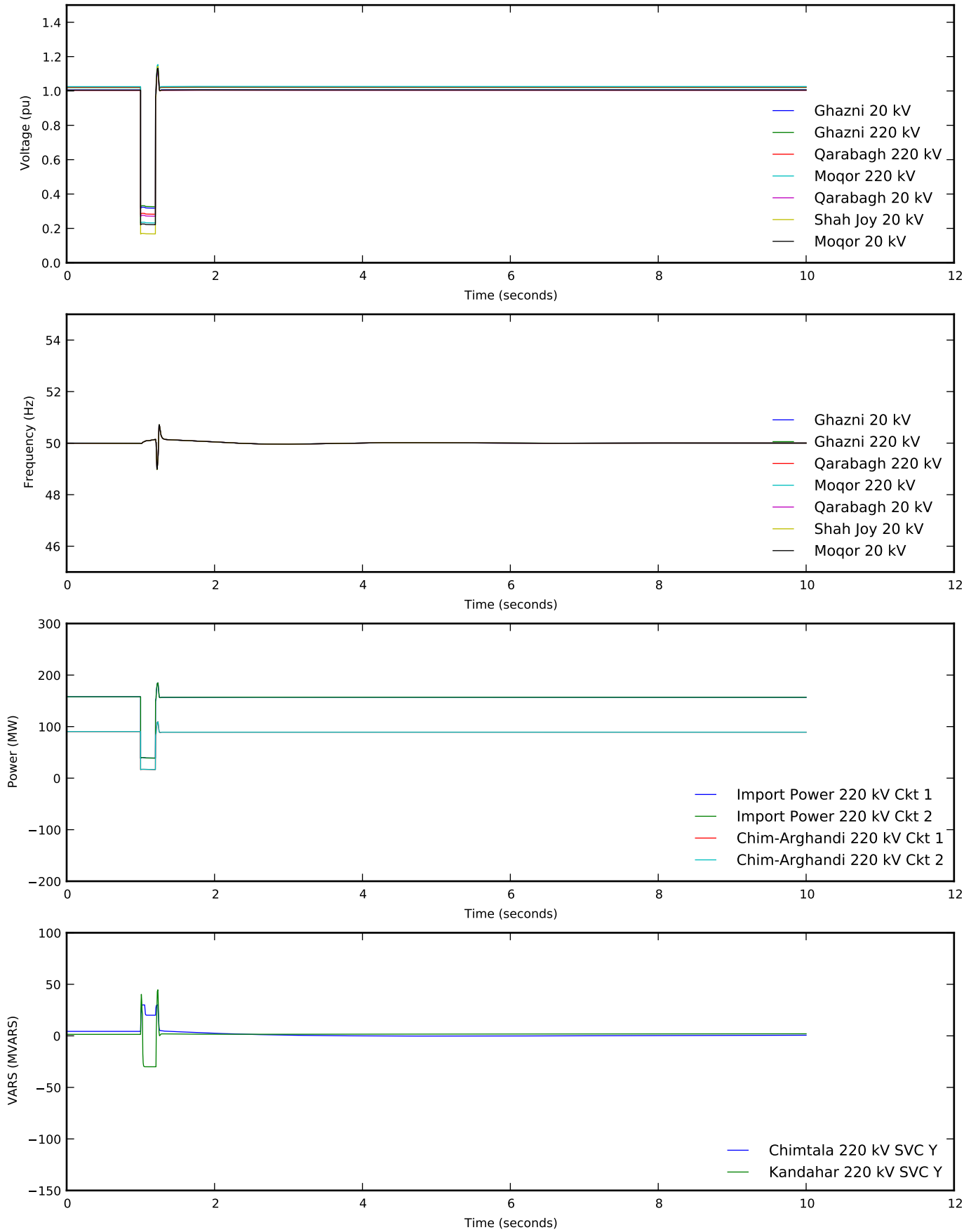
ICONs:
+++++++++++ SVC REMOTE BUS ++++++++++++
        4011
+++++++++++ MSS BUS ++++++++++++
        8010
++++MSS SWITCH FLAG: 0 - NO SWITCH, 1 - SWITCH ON Q +++++
 1
++++DROOP FLAG: 0 - LINEAR DROOP, 1 - NON-LINEAR DROOP +++
 0
++++++++++FLAGS: ++++++++++
 0 0 0 0 0
 0 0 0 0 0

 CON(J   ) = UVSBmax, max cap U/V limit                     =      0.2000
 CON(J+ 1) = UV1,   undervoltage setting 1                  =      0.5000
 CON(J+ 2) = UV2,   undervoltage setting 2                  =      0.3000
 CON(J+ 3) = UVT,   undervoltage trip setting               =      0.5000
 CON(J+ 4) = OV1,   overvoltage setting 1                   =      1.3000
 CON(J+ 5) = OV2,   overvoltage setting 2                   =      1.5000
 CON(J+ 6) = UVtm1, undervoltage trip time 1                =      1.0000
 CON(J+ 7) = UVtm2, undervoltage trip time 2                =      5.0000
 CON(J+ 8) = OVtm1, overvoltage trip time 1                 =      1.0000
 CON(J+ 9) = OVtm2, overvoltage trip time 2                 =      0.5000
 CON(J+10) = Xs1, slope/droop                               =      0.0200
 CON(J+11) = Xs2, slope/droop                               =      0.0000
 CON(J+12) = Xs3, slope/droop                               =      0.0000
 CON(J+13) = Vup, up volt break-point for non-linear droop  =      1.1000
 CON(J+14) = Vlow,low volt break-point for non-linear droop =      0.0000
 CON(J+15) = Tc1, voltage measurment lead time constant     =      0.0000
 CON(J+16) = Tb1, voltage measurment lag time constant      =      0.0200
 CON(J+17) = Tc2, pre-controller lead time constant         =      0.0000
 CON(J+18) = Tb2, pre-controller lag time constant          =      0.0000
 CON(J+19) = Kpv, prop. gain of SVC PI-controller           =      5.0000
 CON(J+20) = Kiv, integral gain of SVC PI-controller        =     10.0000
 CON(J+21) = Vemax, voltage error max limit                 =      0.5000
 CON(J+22) = Vemin, voltage error min limit                 =     -0.5000
 CON(J+23) = T2, thyristor firing sequence control delay    =      0.0040
 CON(J+24) = Bshrt, short-term max. suceptance of SVC       =      0.4500
 CON(J+25) = Bmax, continuous max. suceptance of SVC        =      0.3000
 CON(J+26) = Bmin, min. suceptance of SVC                   =     -0.3000
 CON(J+27) = Tshrt, duration of short-term rating           =      3.0000
 CON(J+28) = Kps, prop. gain of SSC PI-controller           =      0.0000
 CON(J+29) = Kis, integral gain of SSC PI-controller        =      0.0000
 CON(J+30) = Vrmax, max. output of slow suceptance control  =      0.5000
 CON(J+31) = Vrmin, min. output of slow suceptance control  =     -0.5000
 CON(J+32) = Vdbd1, steady-state voltage deadband           =      0.0000
 CON(J+33) = Vdbd2, inner deadband                          =      0.0000
 CON(J+34) = Tdbd, recovery time to deadband                =      0.0000
 CON(J+35) = PLLdelay, PLL delay in voltage recovering      =      0.0000
 CON(J+36) = xeps, delta added to the susceptance bandwidth  =     0.0000
 CON(J+37) = Blcs, larger threshold for switching MSCs      =     40.0000
 CON(J+38) = Bscs, smaller threshold for switching MSCs     =     20.0000
 CON(J+39) = Blis, larger threshold for switching MSRs      =   -999.0000
 CON(J+40) = Bsis, smaller threshold for switching          =   -999.0000
 CON(J+41) = Tmssbrk, time for MSS breaker to operate       =      0.1000
 CON(J+42) = Tdelay1, time delay for larger threshold       =      0.5000
 CON(J+43) = Tdelay2, Time delay for smaller threshold      =      3.0000
 CON(J+44) = Tout, time MSC should be off before switch back=    300.0000
 CON(J+45) = Vrefmin, lower Vref limit                      =      0.9700
 CON(J+46) = Vrefmax, upper Vref limit                      =      1.0400
```

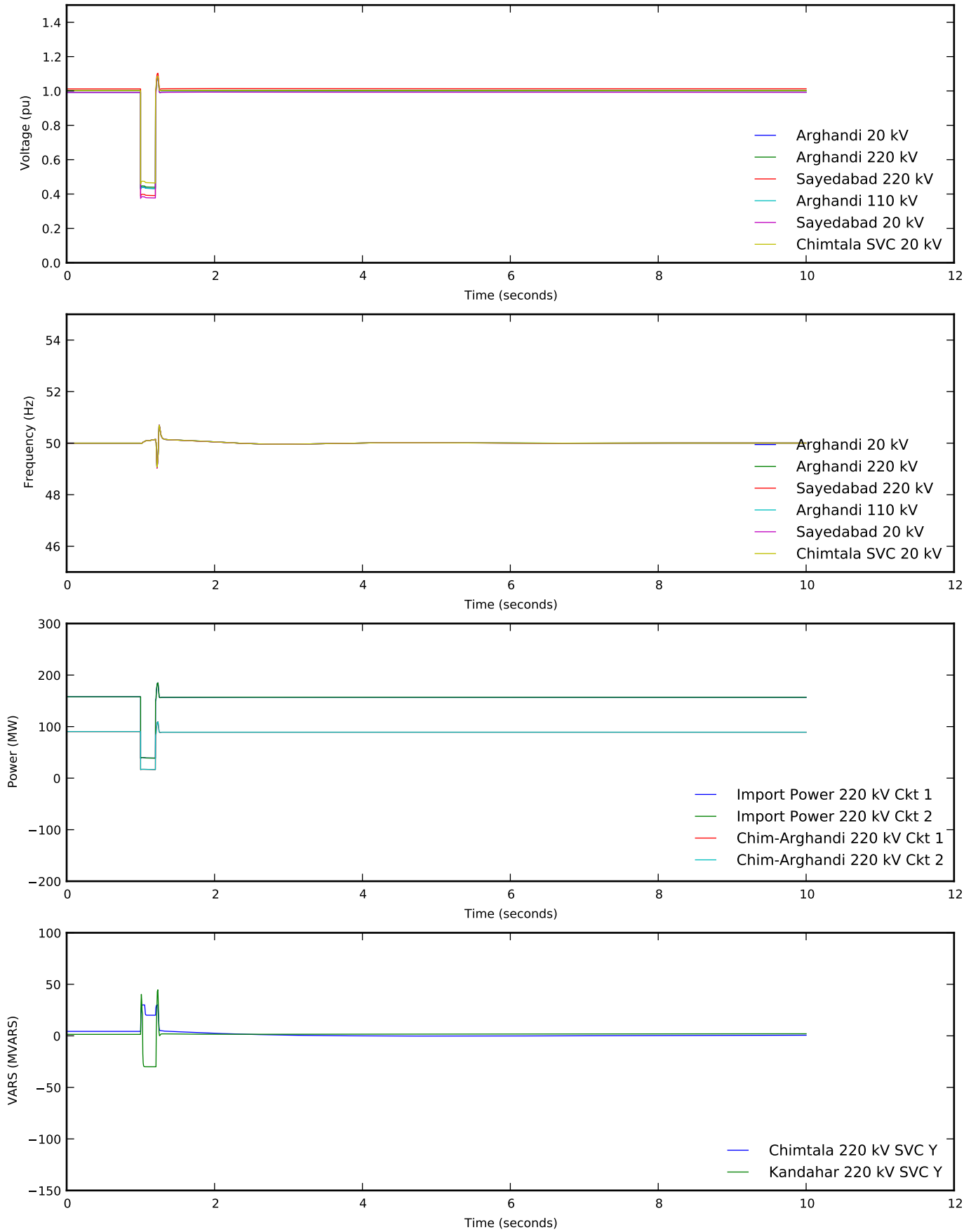
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Kandahar East.
Fault cleared by disconnecting transformer (FROM 4011 to 6400 ID=2).
Plot File: OUT/LT48_DBL__Base__S1_Kandahar_XF_Loss.out



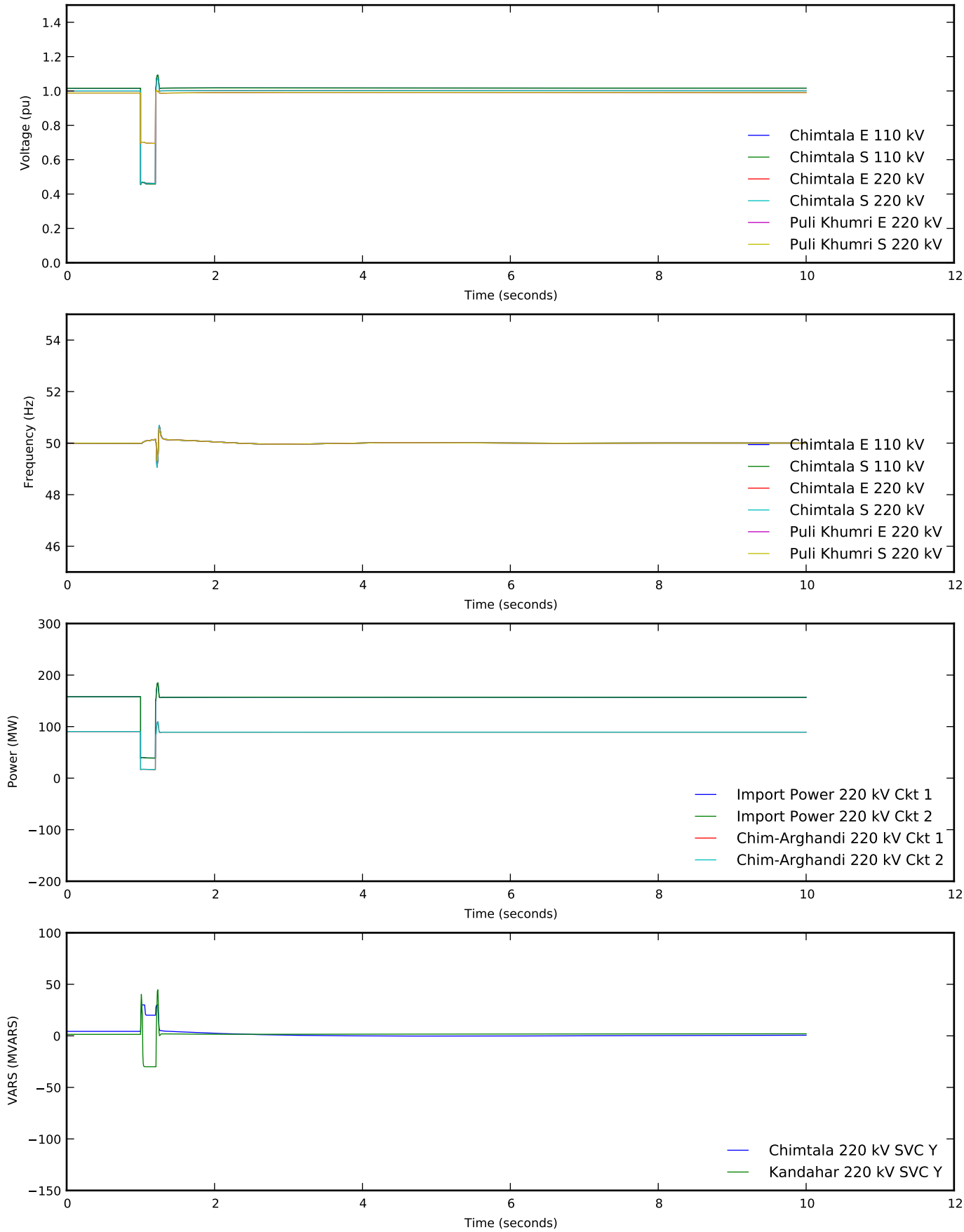
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Kandahar East.
Fault cleared by disconnecting transformer (FROM 4011 to 6400 ID=2).
Plot File: OUT/LT48_DBL__Base__S1_Kandahar_XF_Loss.out



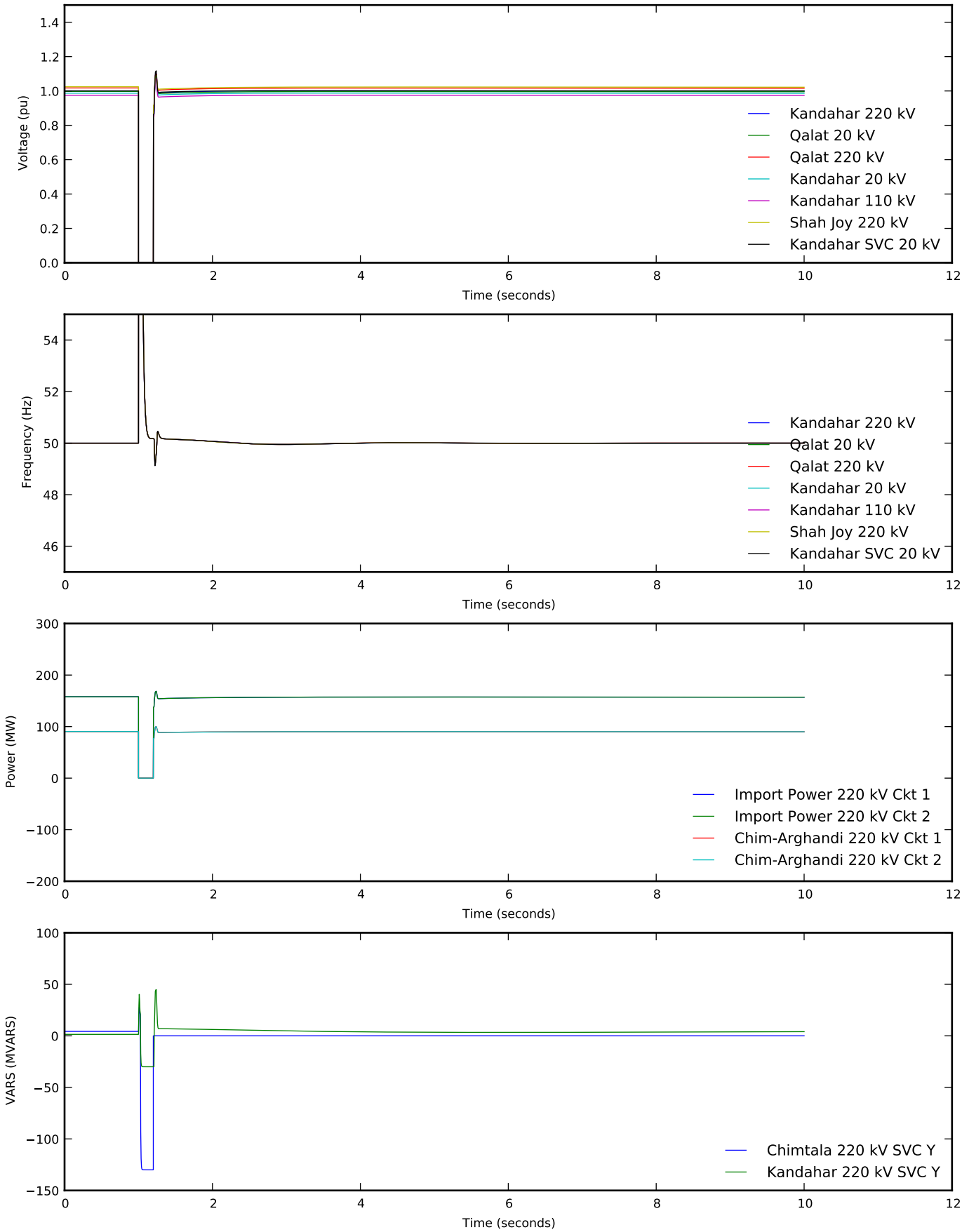
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Kandahar East.
Fault cleared by disconnecting transformer (FROM 4011 to 6400 ID=2).
Plot File: OUT/LT48_DBL__Base__S1_Kandahar_XF_Loss.out



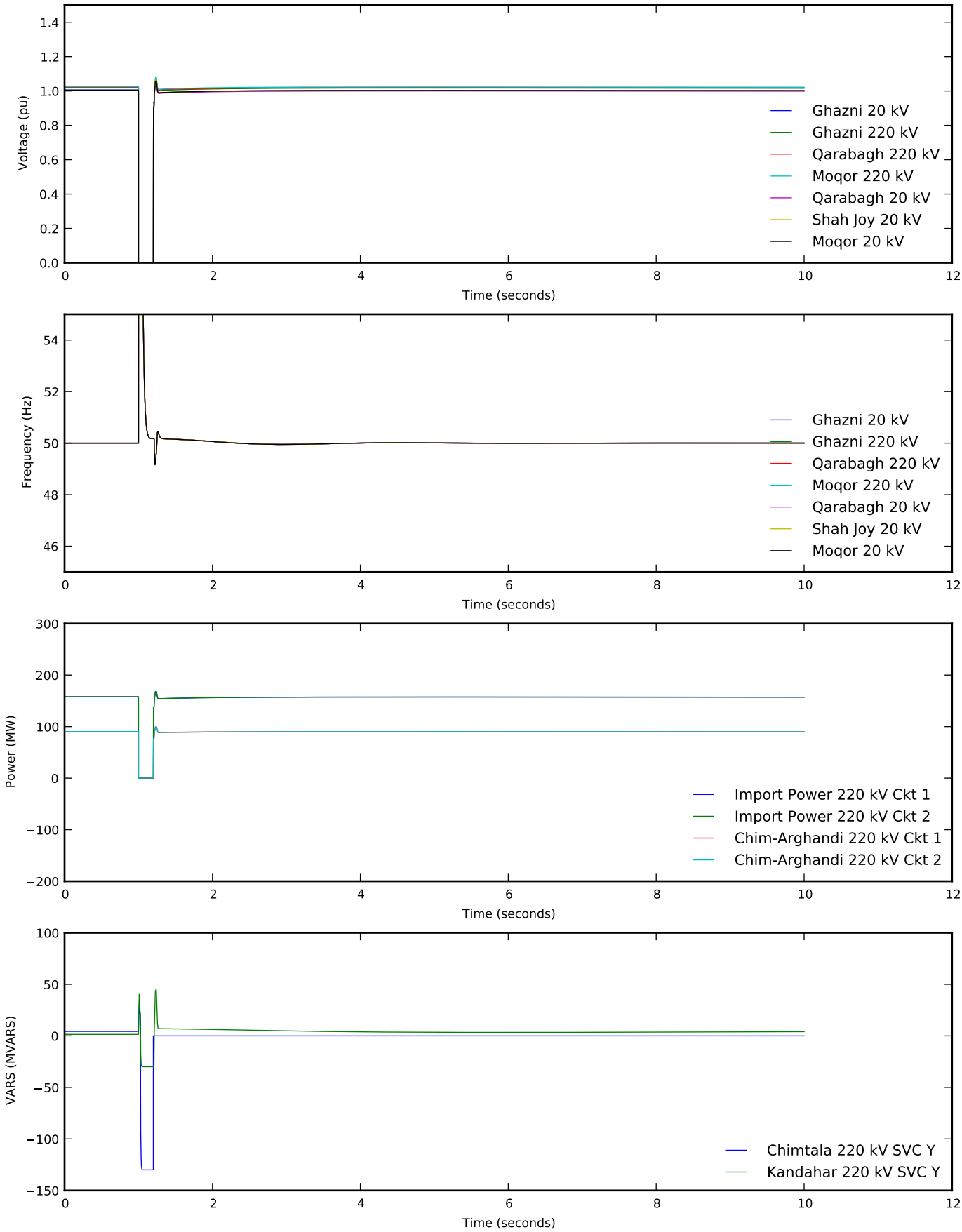
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Kandahar East.
Fault cleared by disconnecting transformer (FROM 4011 to 6400 ID=2).
Plot File: OUT/LT48_DBL__Base__S1_Kandahar_XF_Loss.out



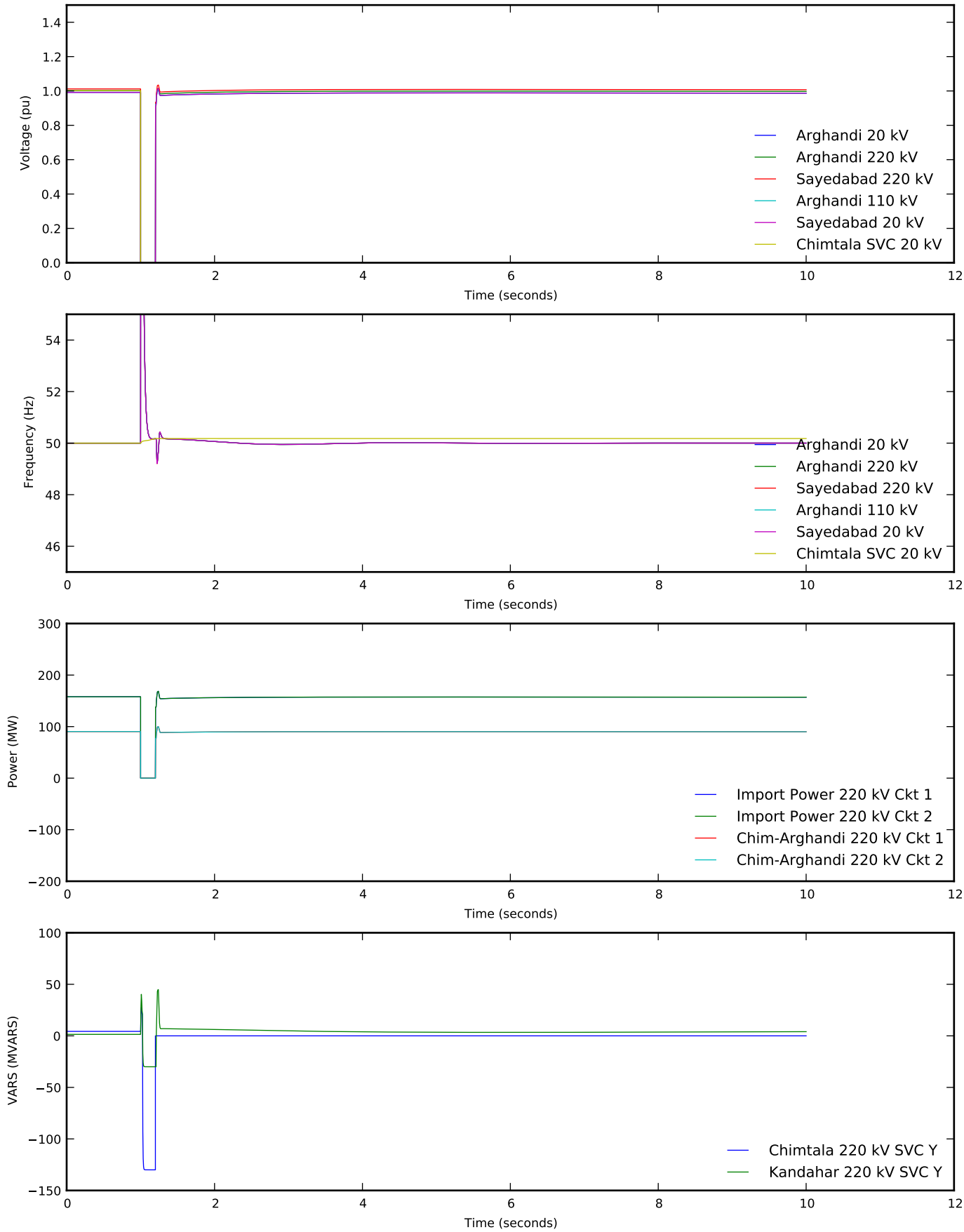
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault bus at Chimtala 220kV (6171).
Loss of Chimtala SVC (8001).
Plot File: OUT/LT48_DBL__Base__S2_Chimtala_Bus_Fault_SVC_Loss.out



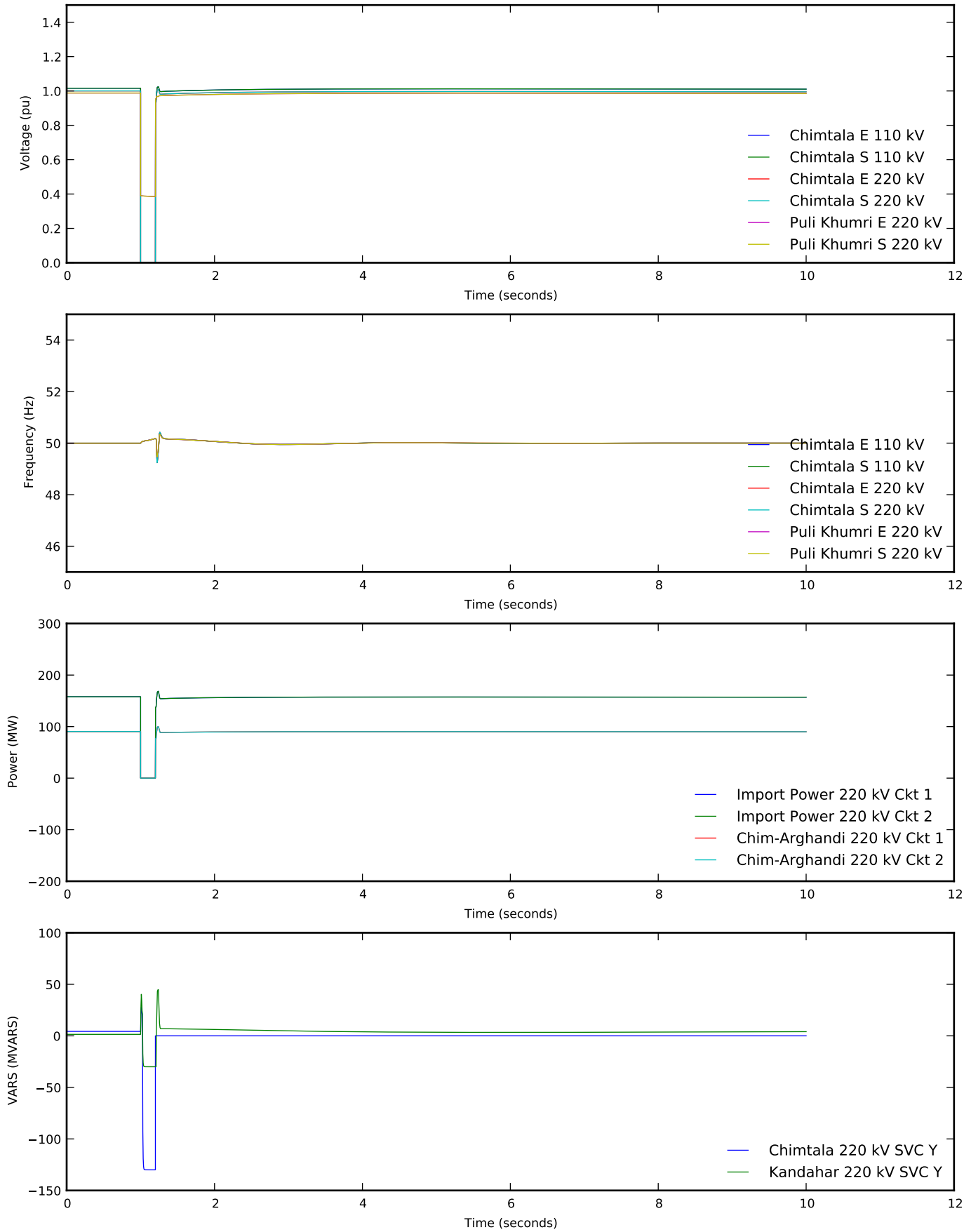
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault bus at Chimtala 220kV (6171).
Loss of Chimtala SVC (8001).
Plot File: OUT/LT48_DBL__Base__S2_Chimtala_Bus_Fault_SVC_Loss.out



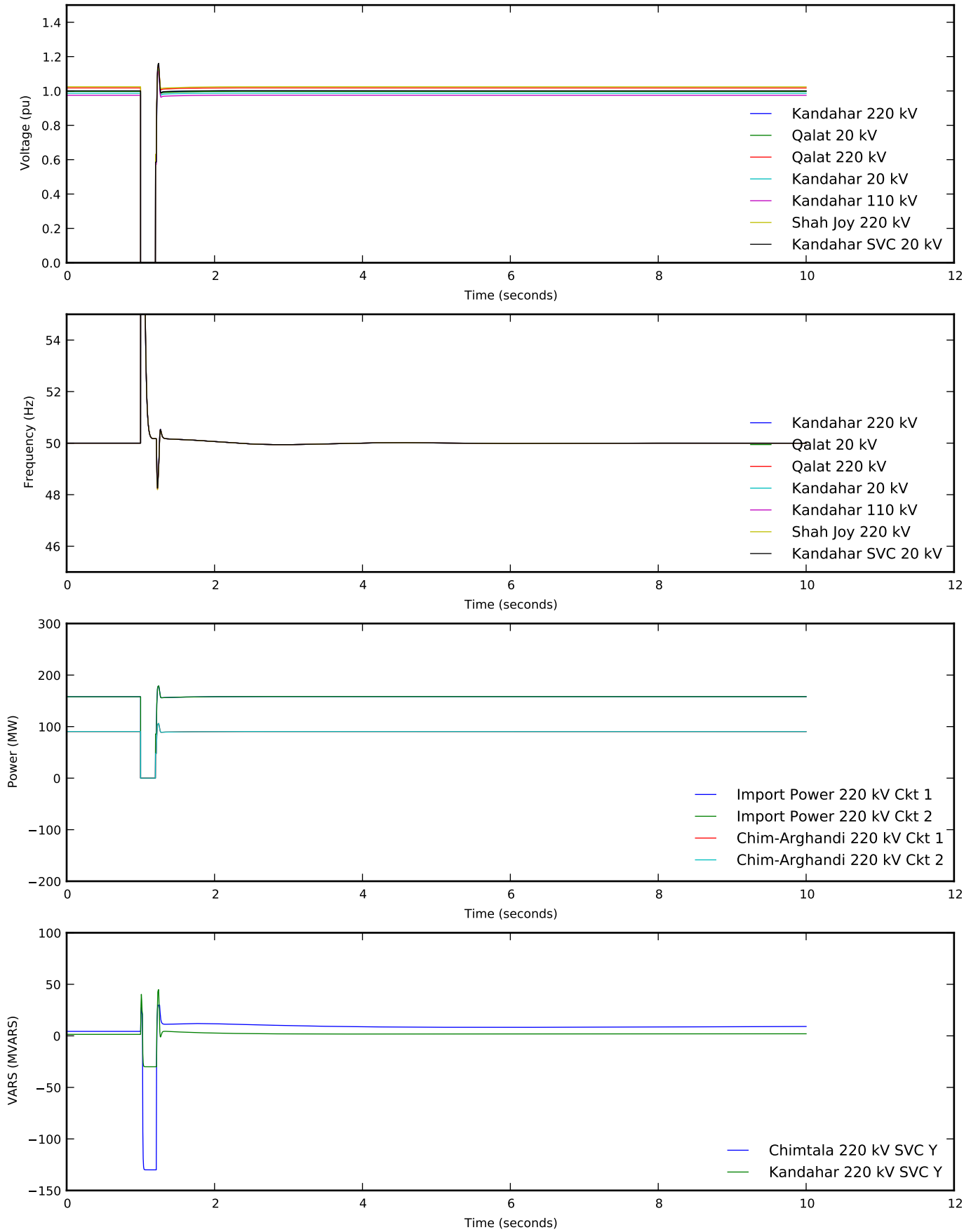
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault bus at Chimtala 220kV (6171).
Loss of Chimtala SVC (8001).
Plot File: OUT/LT48_DBL__Base__S2_Chimtala_Bus_Fault_SVC_Loss.out



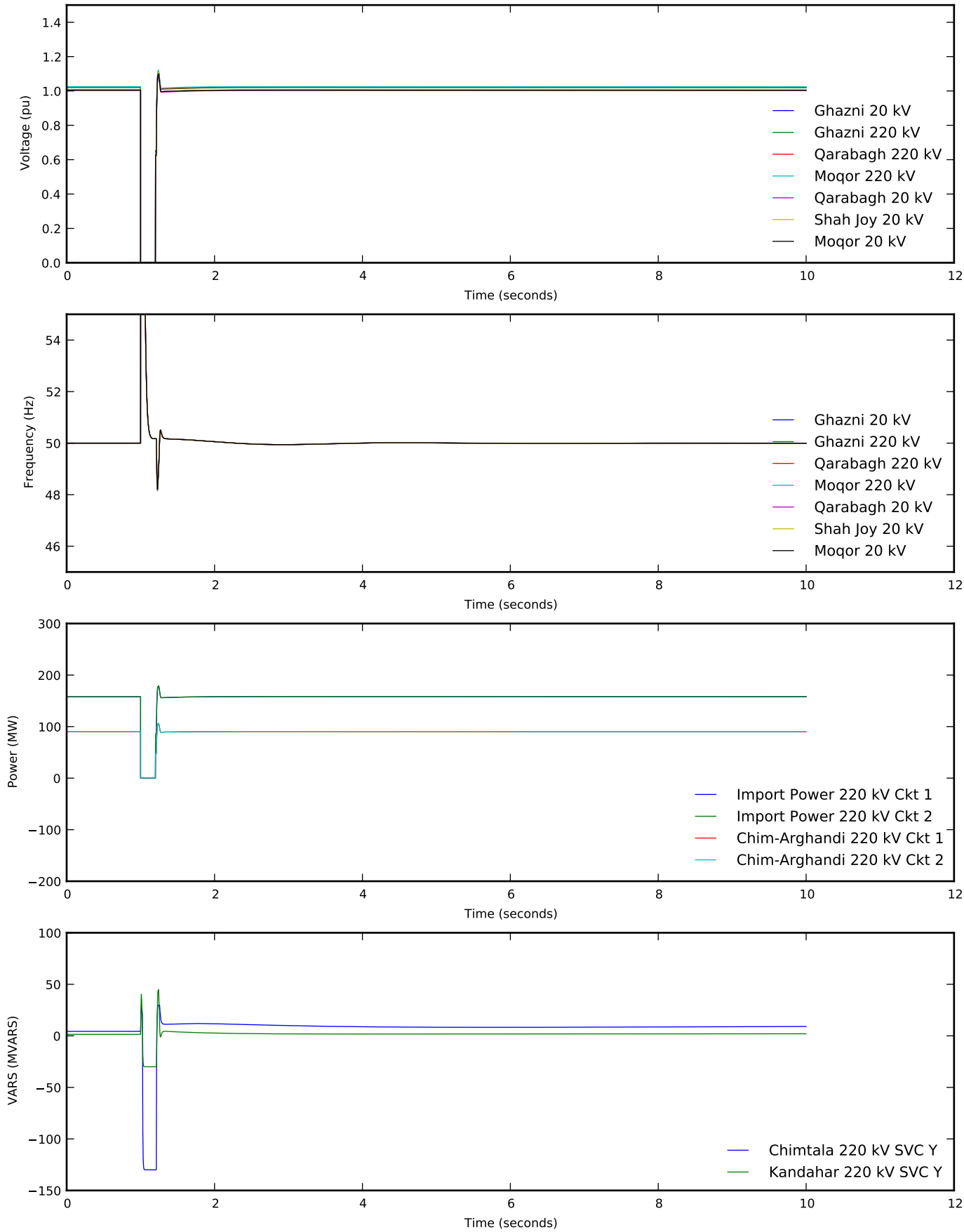
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault bus at Chimtala 220kV (6171).
Loss of Chimtala SVC (8001).
Plot File: OUT/LT48_DBL__Base__S2_Chimtala_Bus_Fault_SVC_Loss.out



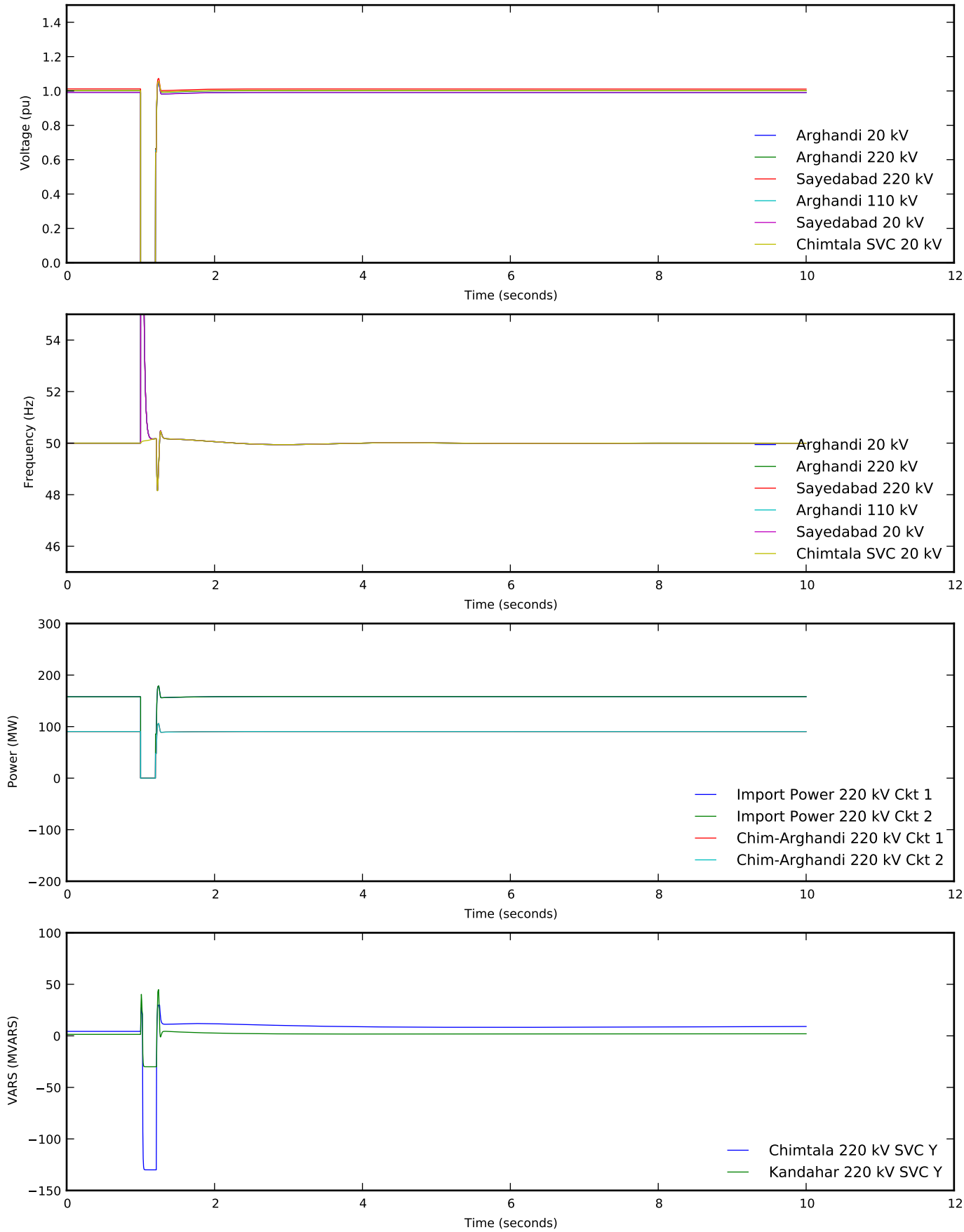
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Chimtala.
Drop load at Chimtala 20kV distribution bus 6022 & disconnect transformer.
Plot File: OUT/LT48_DBL__Base__S3_Chimtala_XF_Loss.out



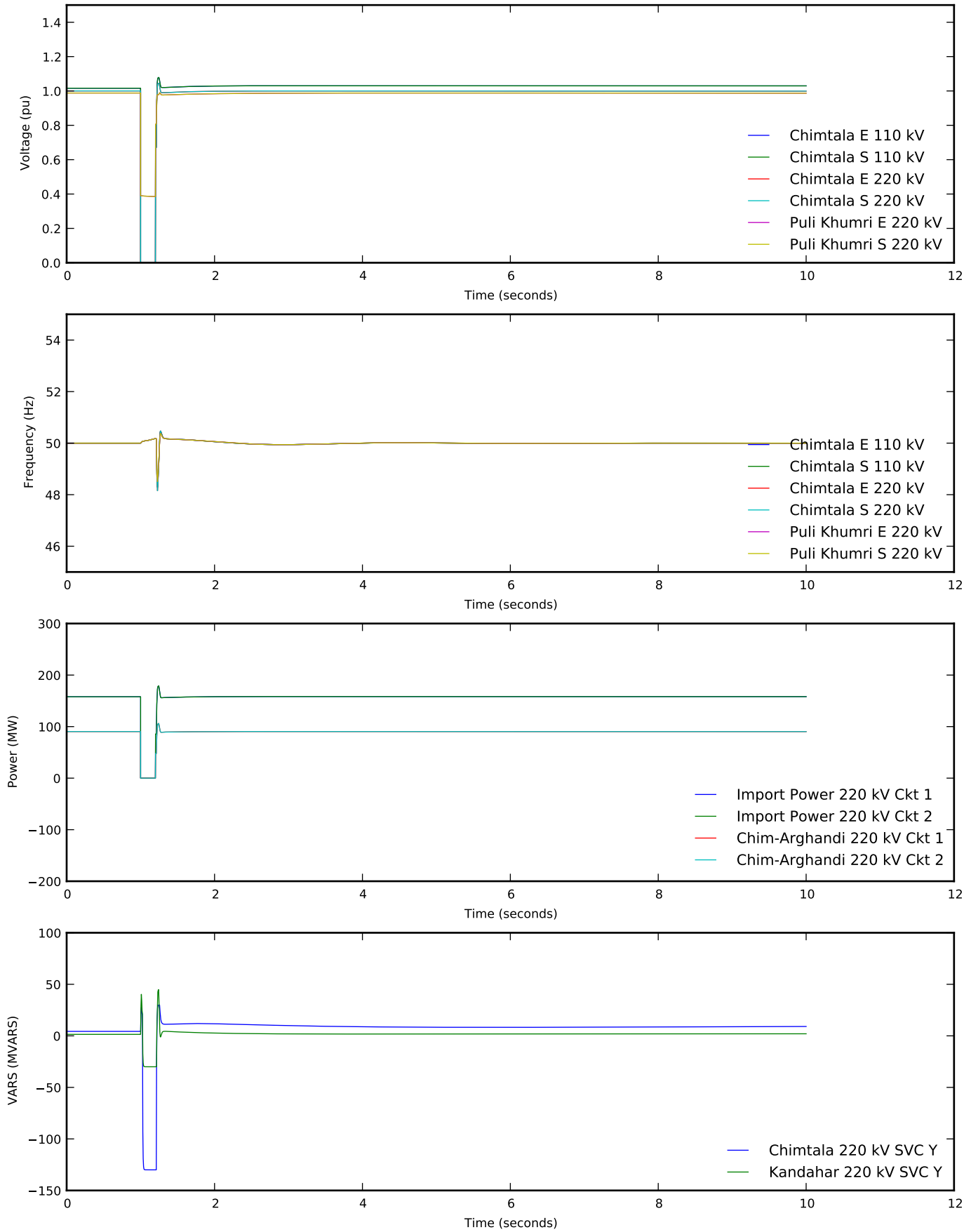
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Chimtala.
Drop load at Chimtala 20kV distribution bus 6022 & disconnect transformer.
Plot File: OUT/LT48_DBL__Base__S3_Chimtala_XF_Loss.out



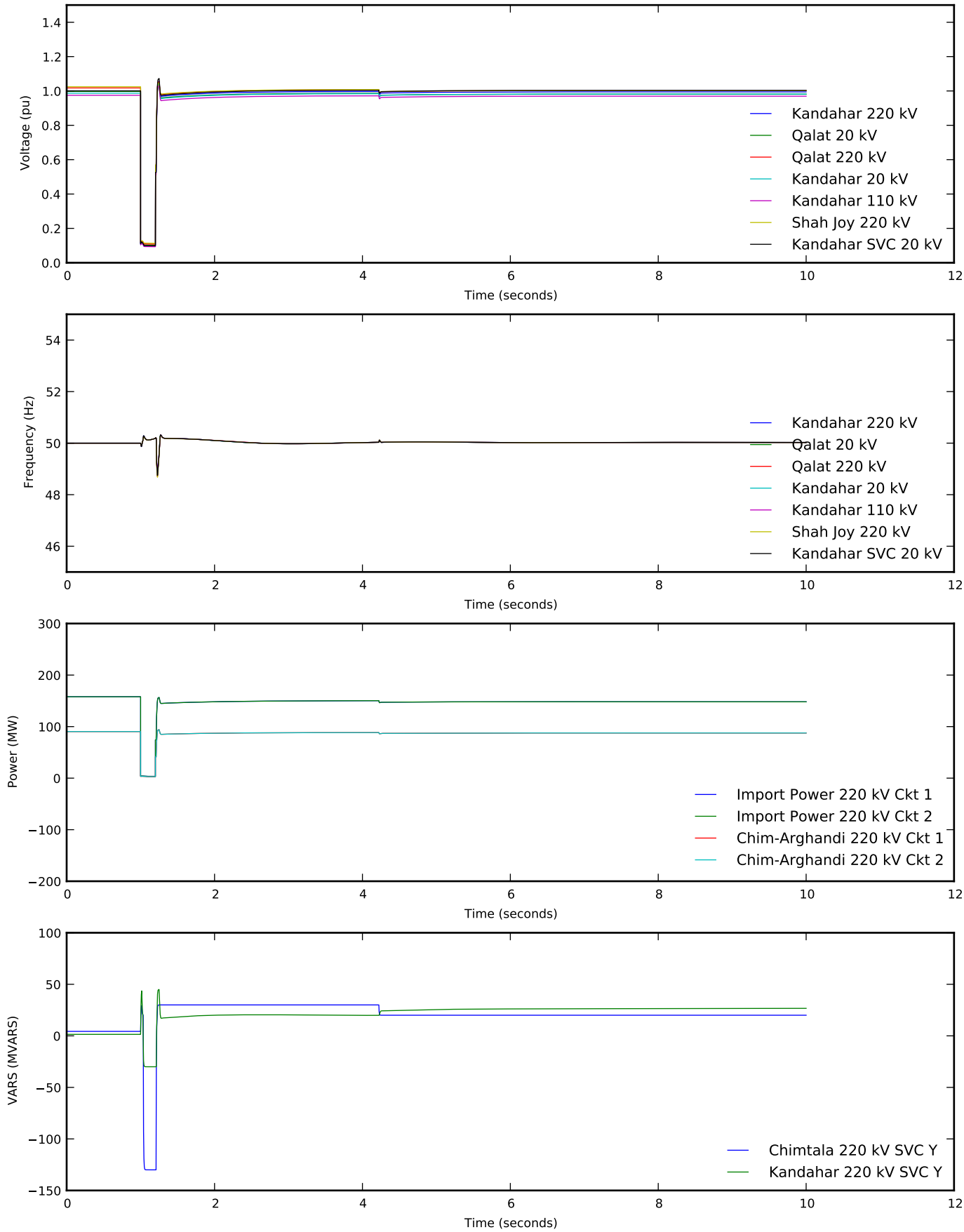
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Chimtala.
Drop load at Chimtala 20kV distribution bus 6022 & disconnect transformer.
Plot File: OUT/LT48_DBL__Base__S3_Chimtala_XF_Loss.out



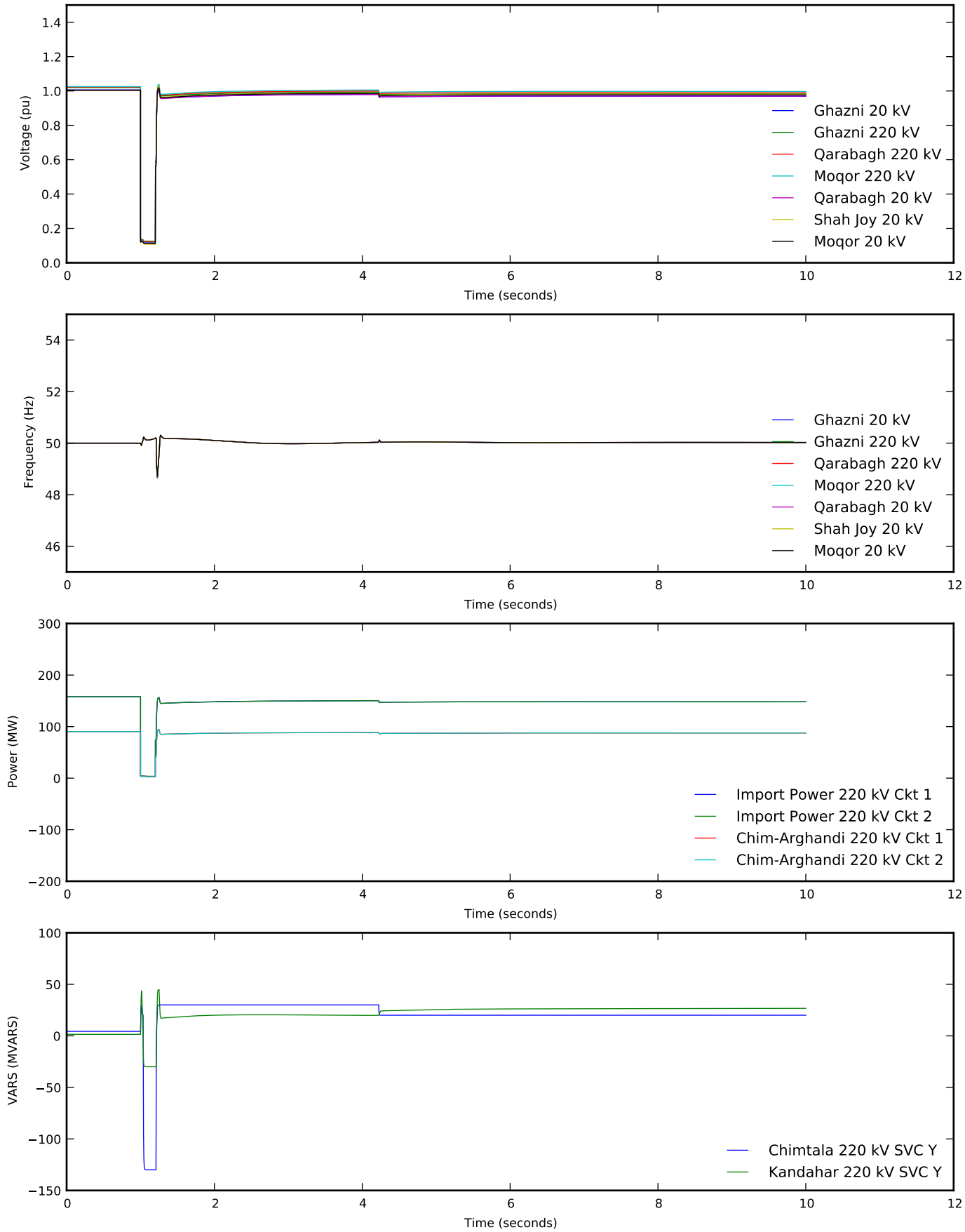
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Chimtala.
Drop load at Chimtala 20kV distribution bus 6022 & disconnect transformer.
Plot File: OUT/LT48_DBL__Base__S3_Chimtala_XF_Loss.out



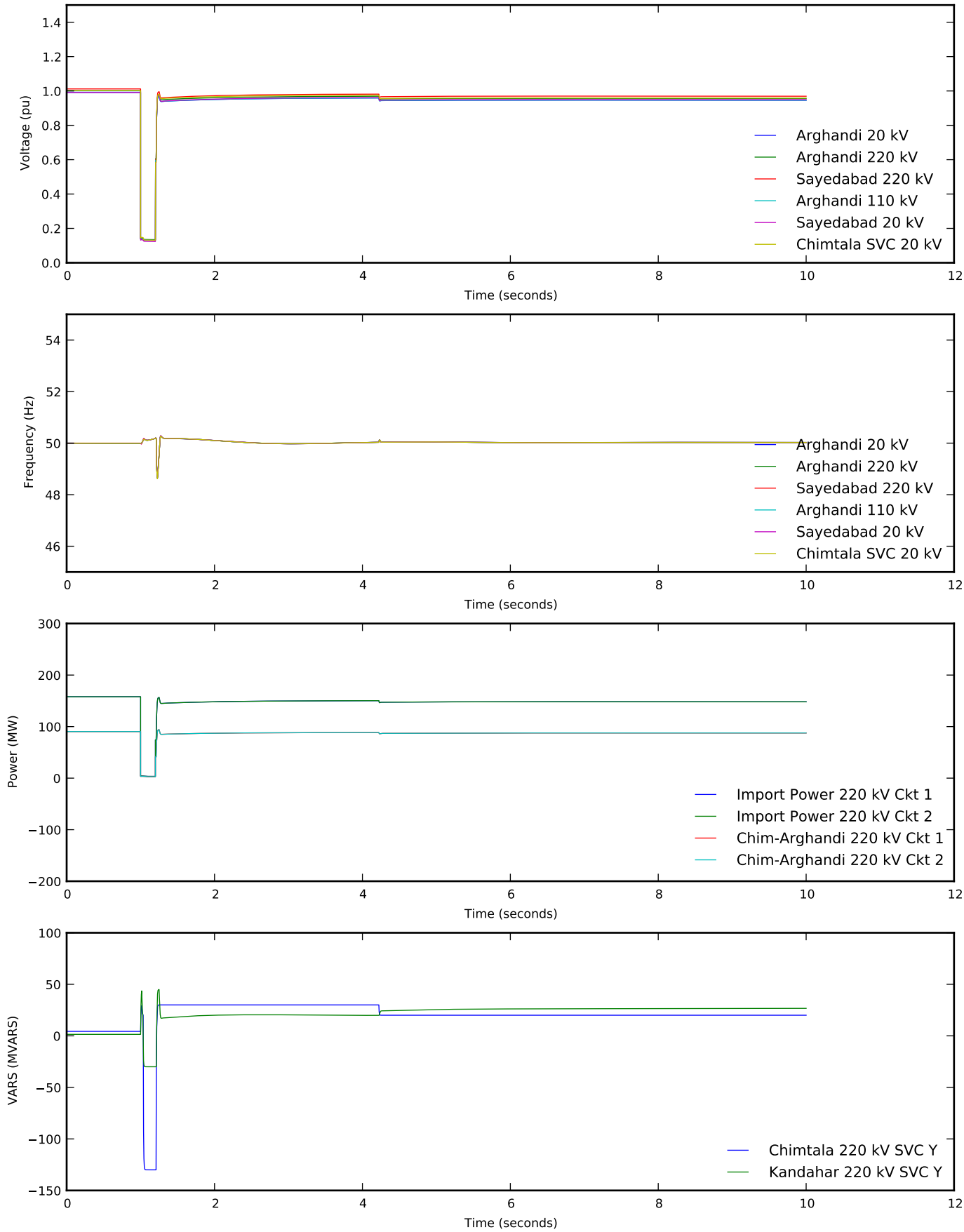
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault bus at Chimtala 110kV (6103).
Loss of Chimtala 110kV 60MVAR MSC (6103).
Plot File: OUT/LT48_DBL__Base__S4_Chimtala_Bus_Fault_MSC_Loss.out



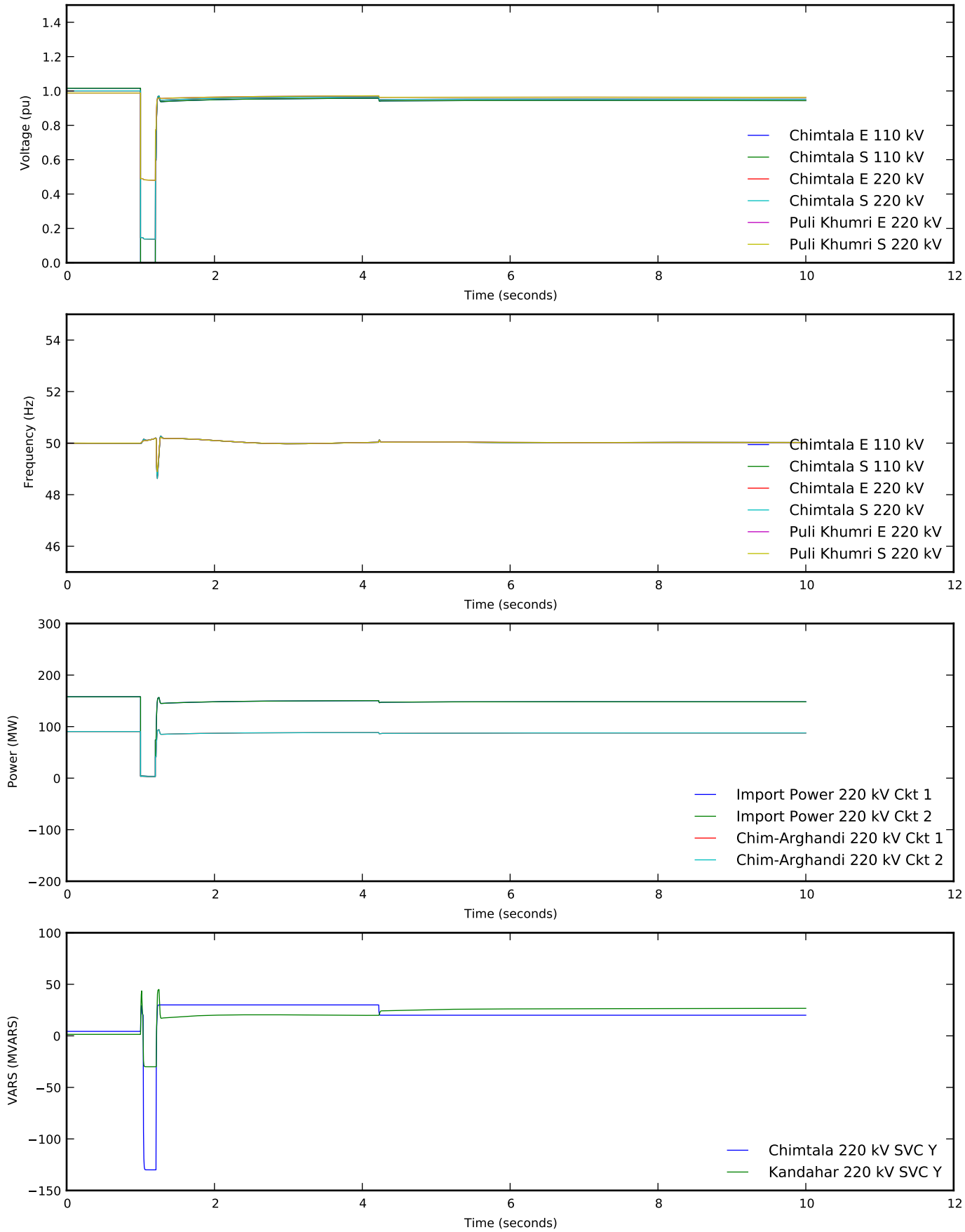
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault bus at Chimtala 110kV (6103).
Loss of Chimtala 110kV 60MVAR MSC (6103).
Plot File: OUT/LT48_DBL__Base__S4_Chimtala_Bus_Fault_MSC_Loss.out



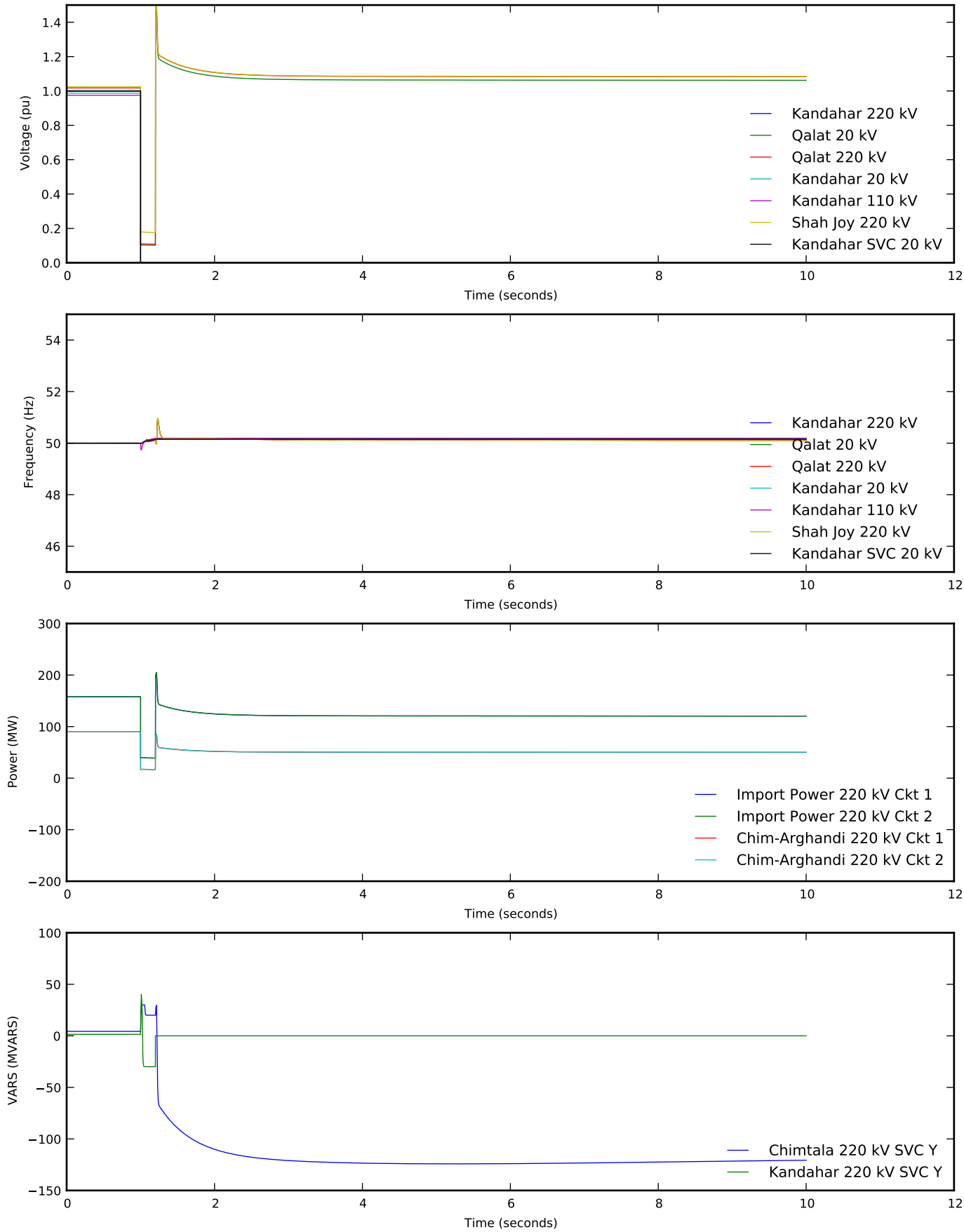
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault bus at Chimtala 110kV (6103).
Loss of Chimtala 110kV 60MVAR MSC (6103).
Plot File: OUT/LT48_DBL__Base__S4_Chimtala_Bus_Fault_MSC_Loss.out



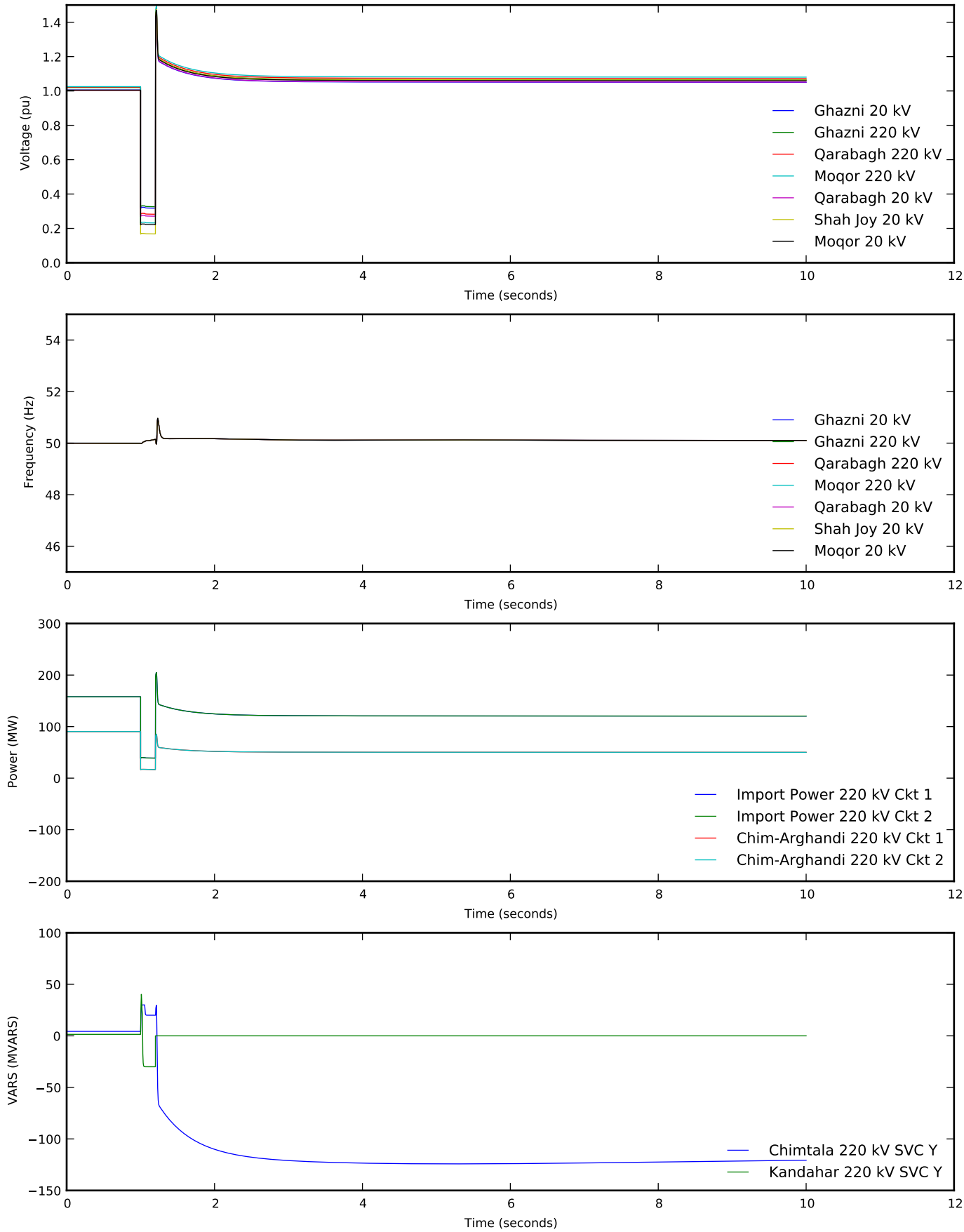
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault bus at Chimtala 110kV (6103).
Loss of Chimtala 110kV 60MVAR MSC (6103).
Plot File: OUT/LT48_DBL__Base__S4_Chimtala_Bus_Fault_MSC_Loss.out



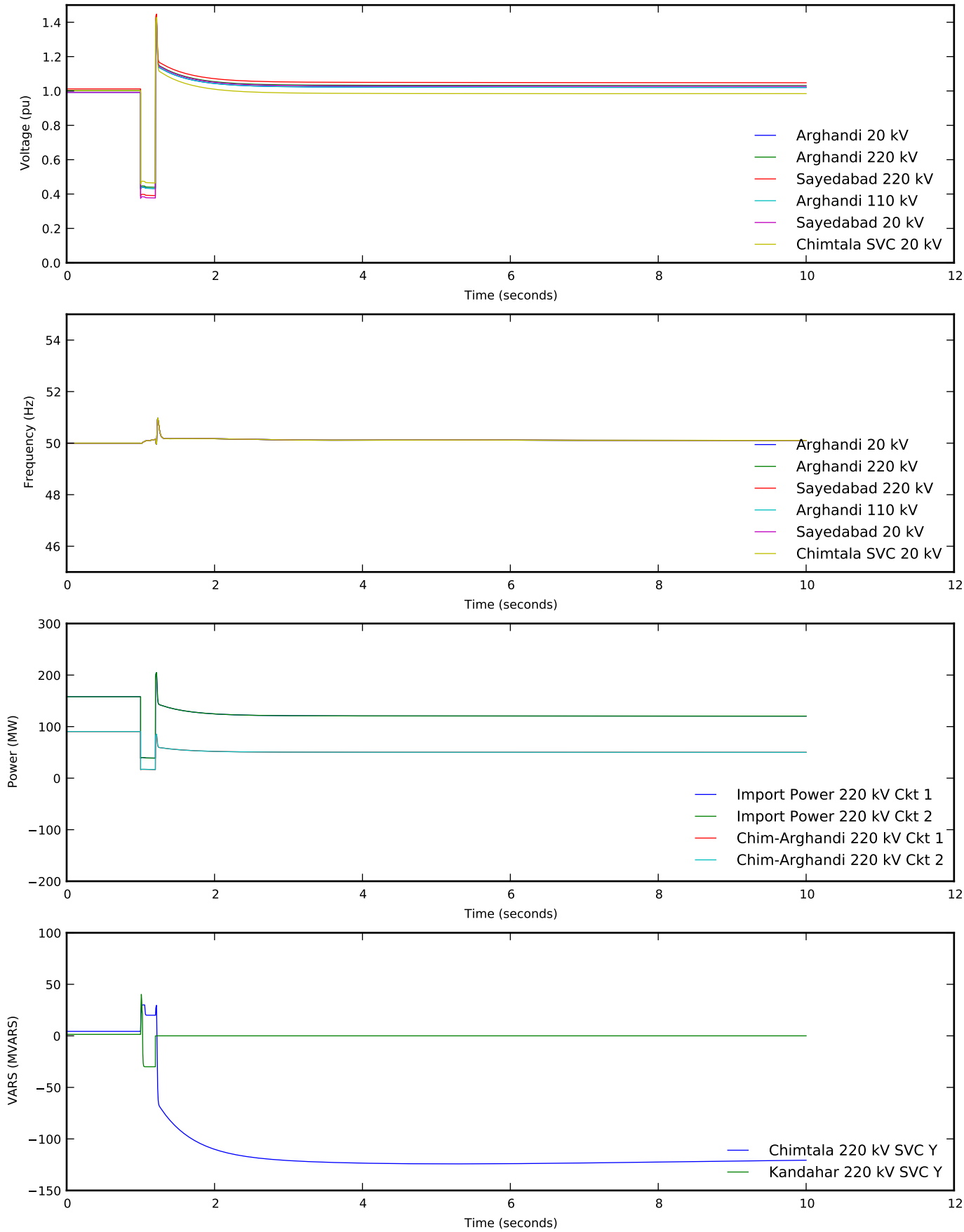
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Kandahar East (4011) to Qalat (4025) Ckt F2.
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S5_Kandahar_Qalat_Outage_Dbl.out



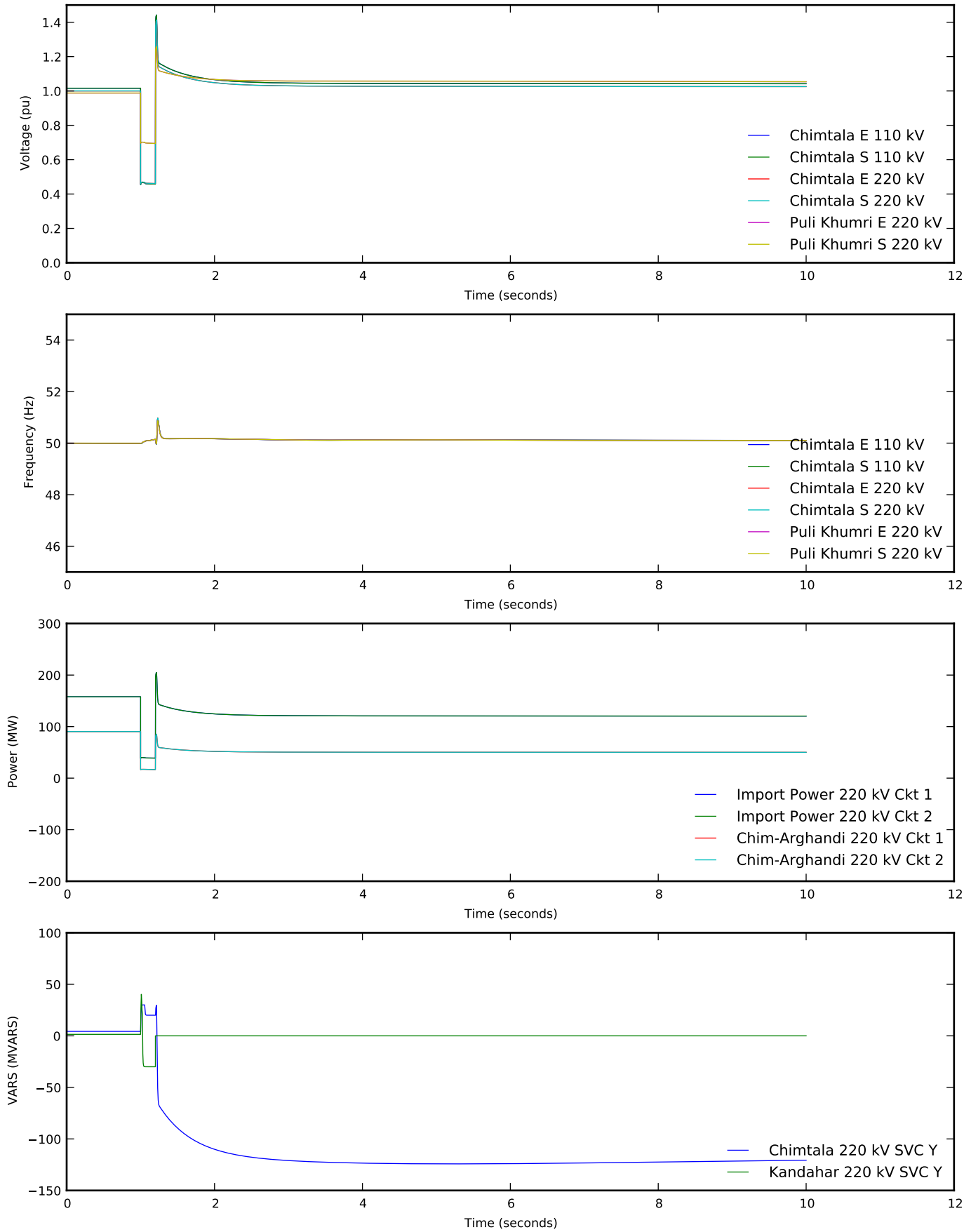
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Kandahar East (4011) to Qalat (4025) Ckt F2.
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S5_Kandahar_Qalat_Outage_Dbl.out



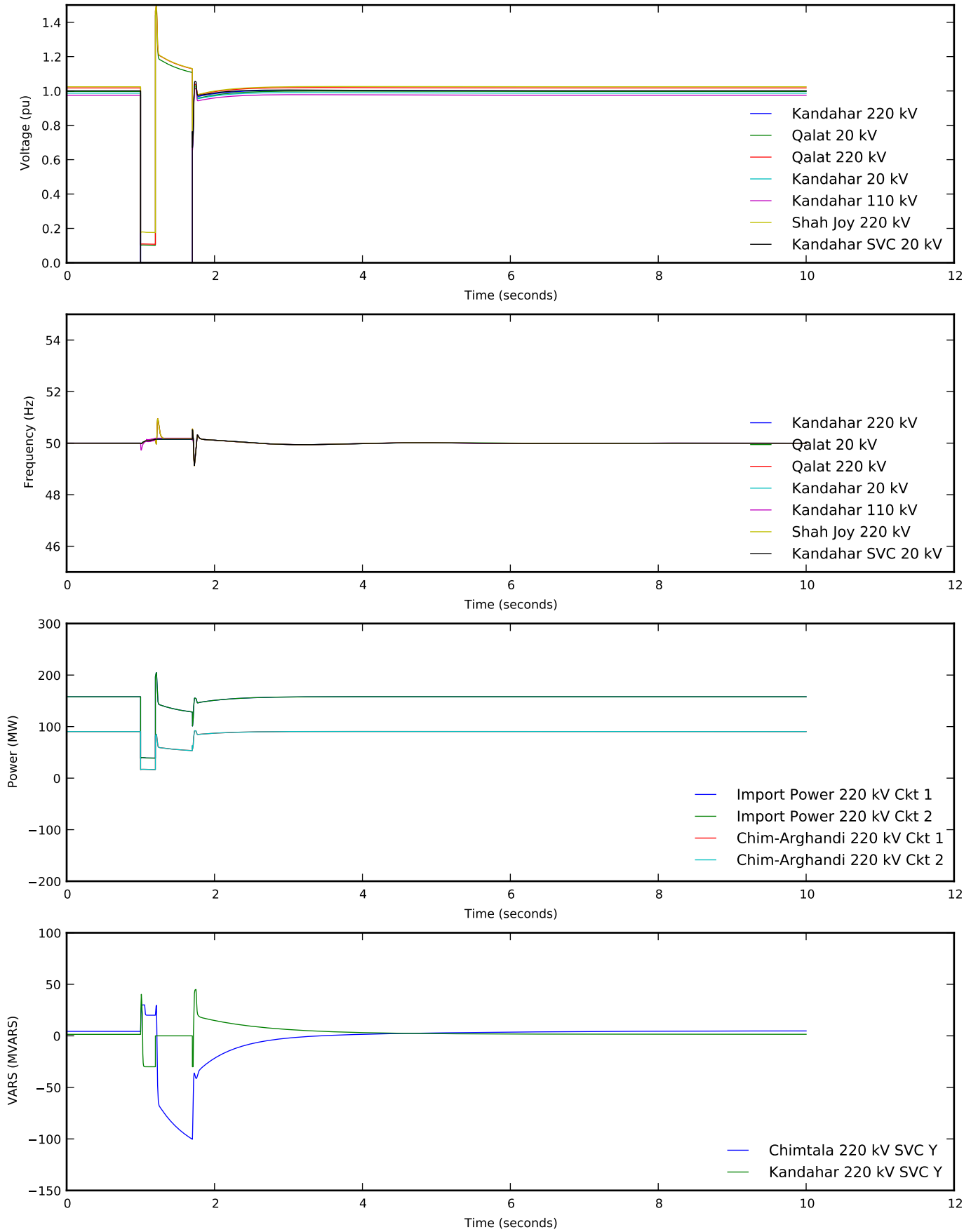
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Kandahar East (4011) to Qalat (4025) Ckt F2.
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S5_Kandahar_Qalat_Outage_Dbl.out



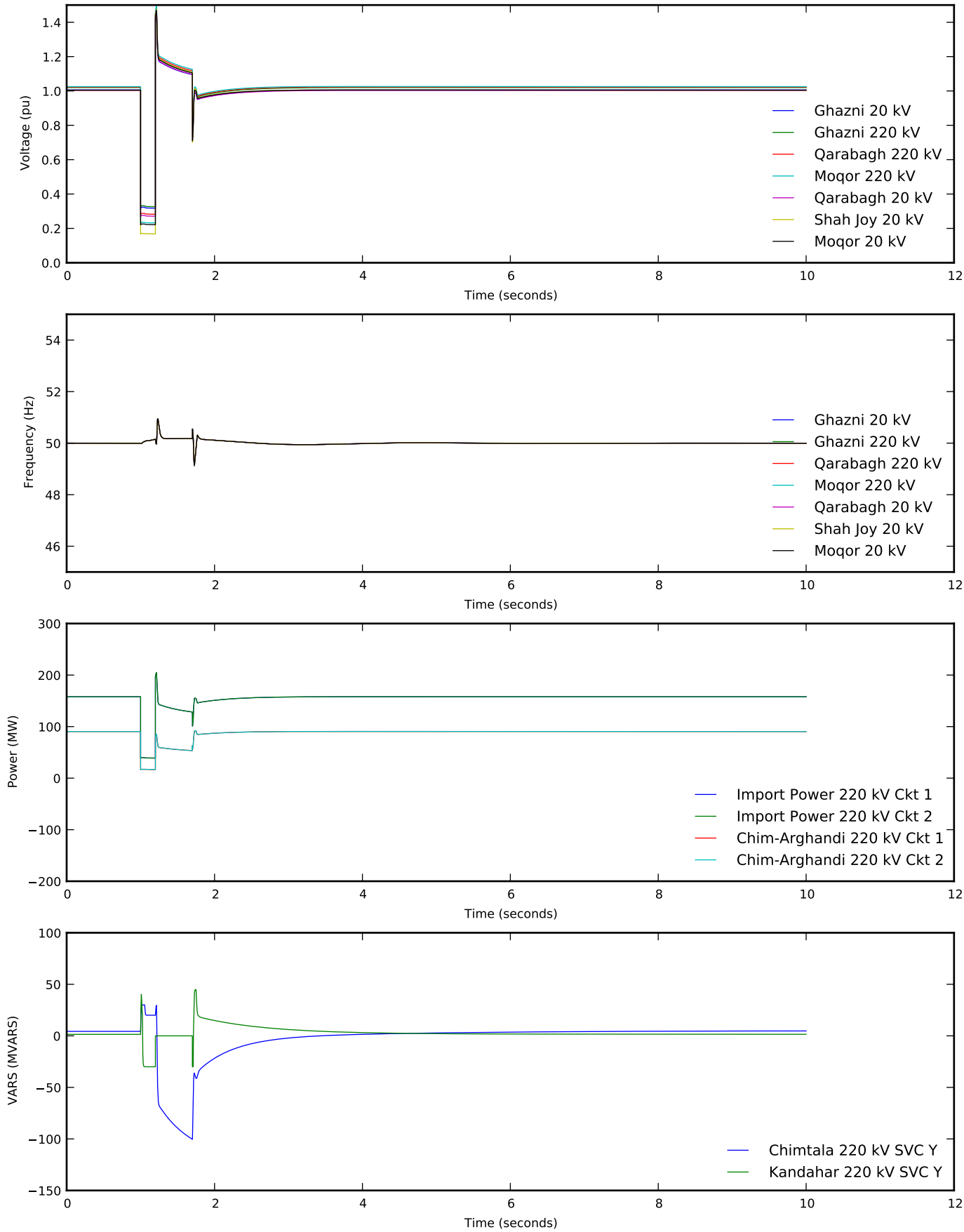
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Kandahar East (4011) to Qalat (4025) Ckt F2.
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S5_Kandahar_Qalat_Outage_Dbl.out



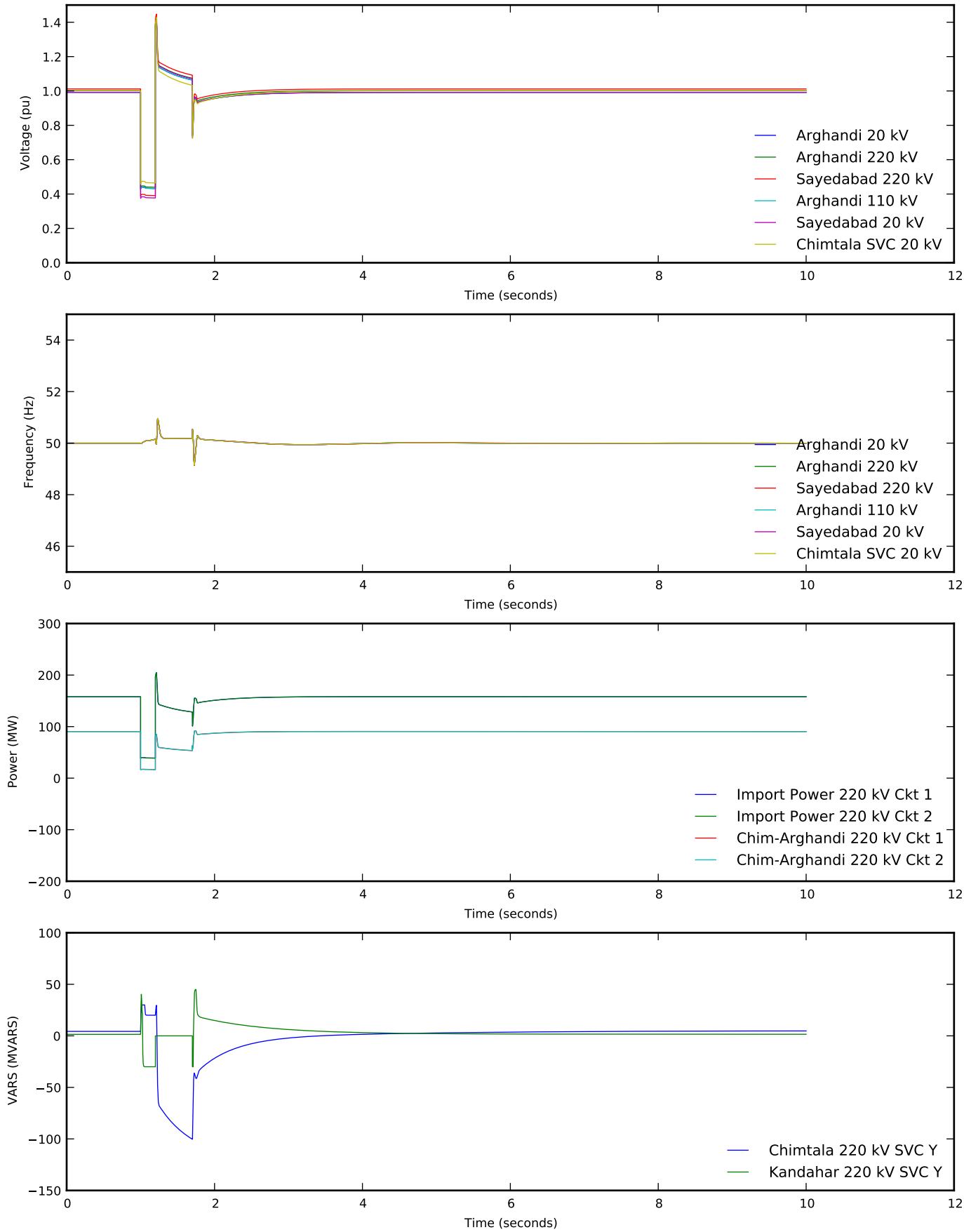
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Kandahar East (4011) to Qalat (4025) Ckt F2.
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S6_Kandahar_Qalat_Reclose_Dbl.out



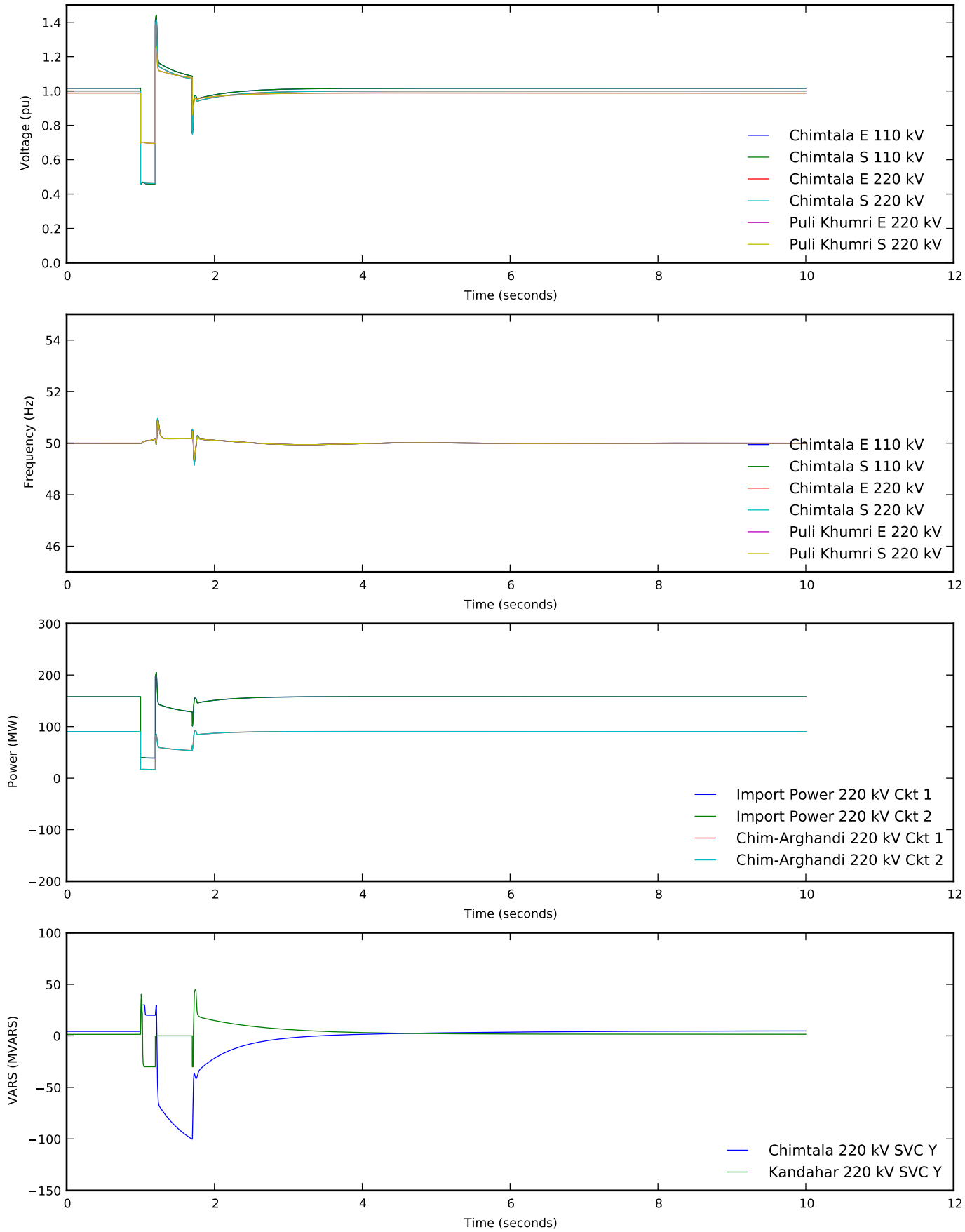
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Kandahar East (4011) to Qalat (4025) Ckt F2.
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S6_Kandahar_Qalat_Reclose_Dbl.out



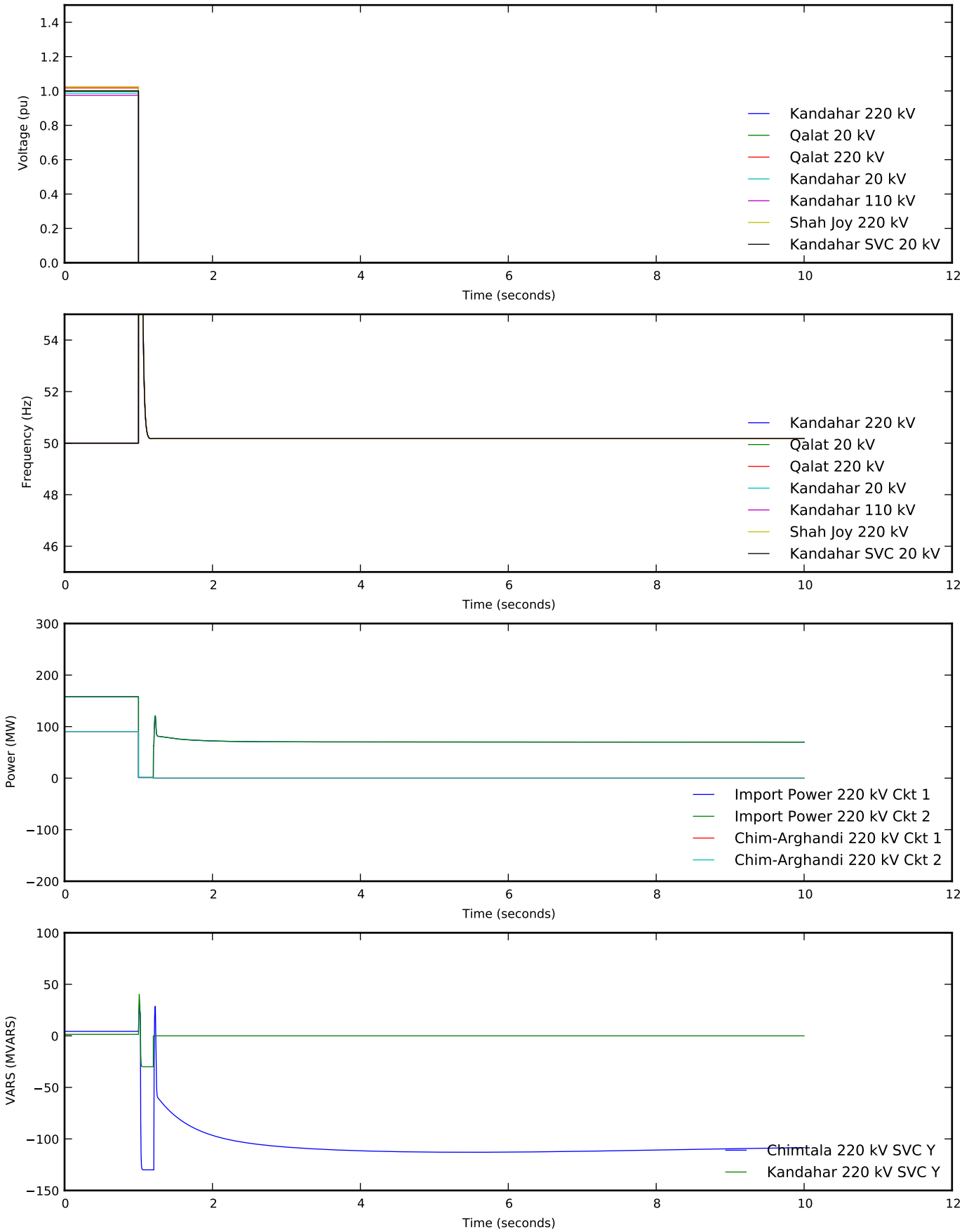
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Kandahar East (4011) to Qalat (4025) Ckt F2.
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S6_Kandahar_Qalat_Reclose_Dbl.out



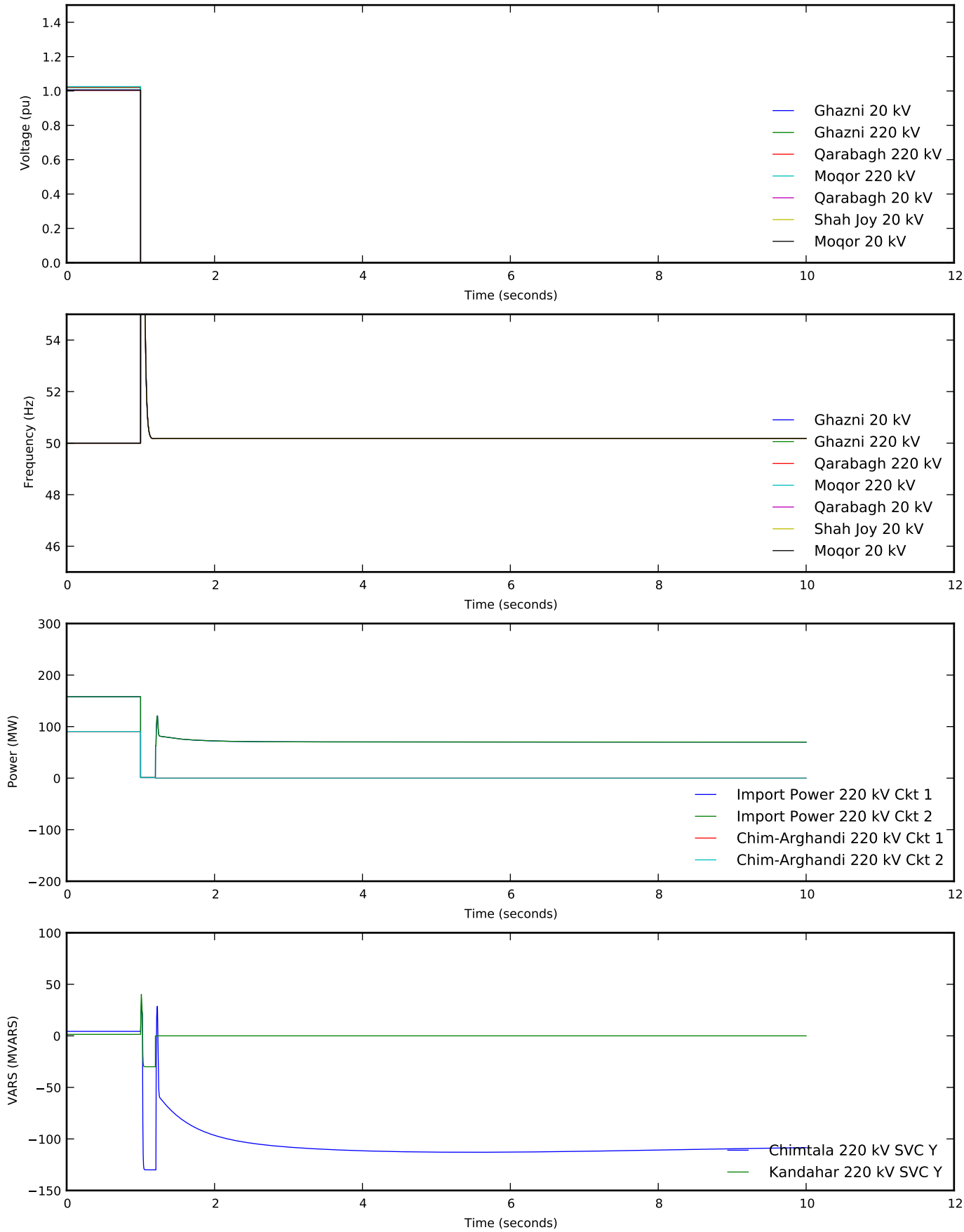
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Kandahar East (4011) to Qalat (4025) Ckt F2.
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S6_Kandahar_Qalat_Reclose_Dbl.out



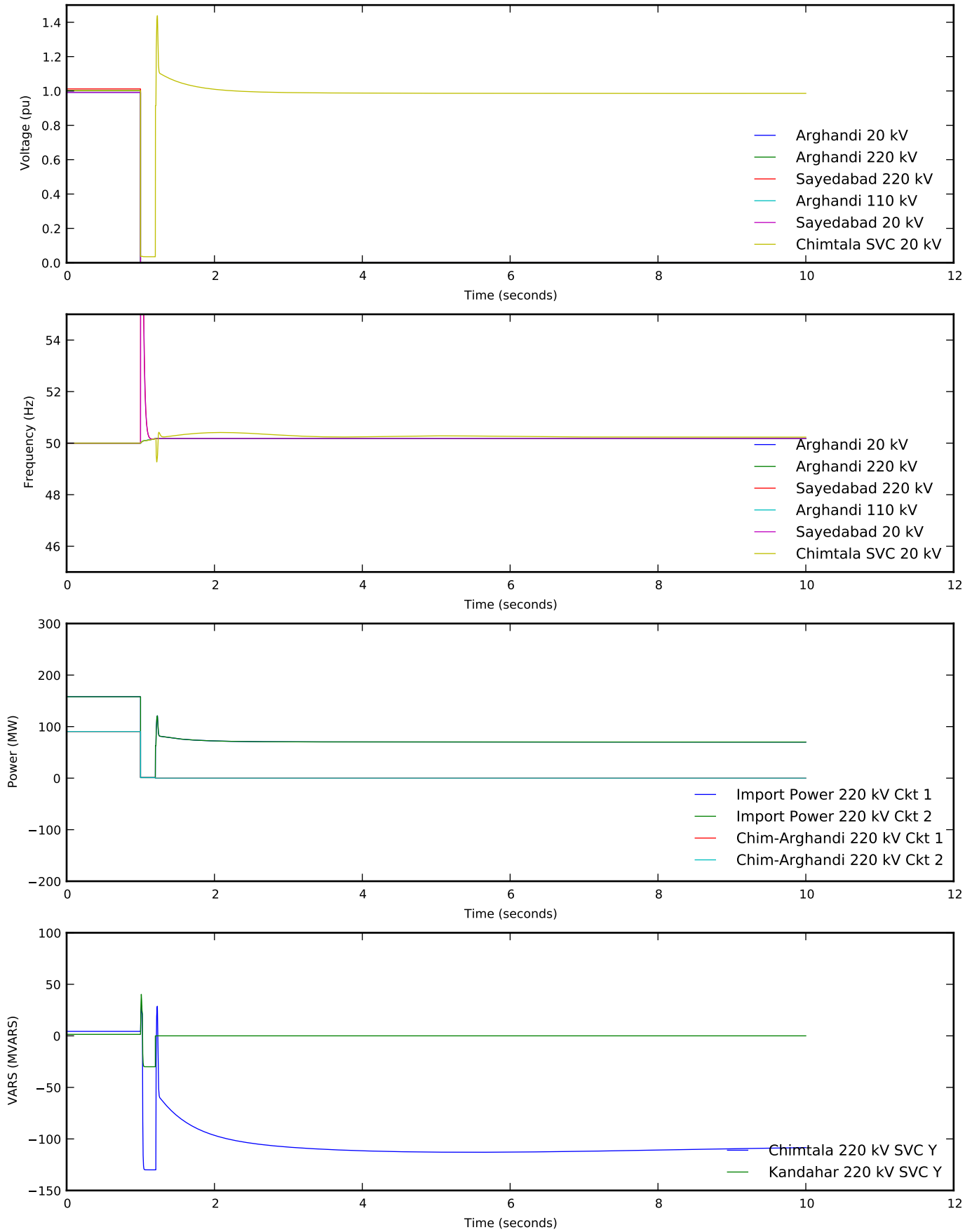
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Chimtala (6171) to Arghandi (6174) Ckt F2.
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S7_Chimtala_Arghandi_Outage_Dbl.out



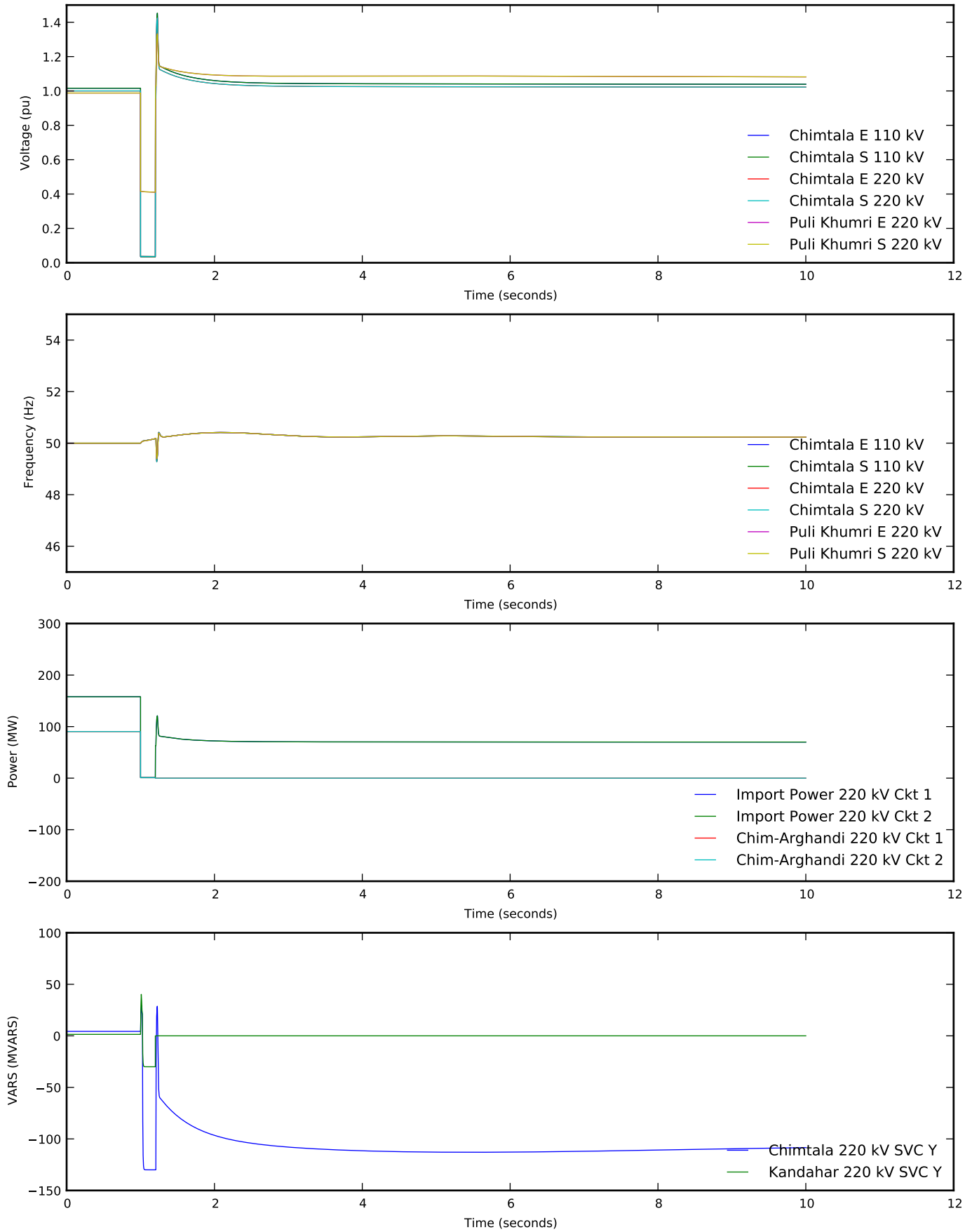
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Chimtala (6171) to Arghandi (6174) Ckt F2.
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S7_Chimtala_Arghandi_Outage_Dbl.out



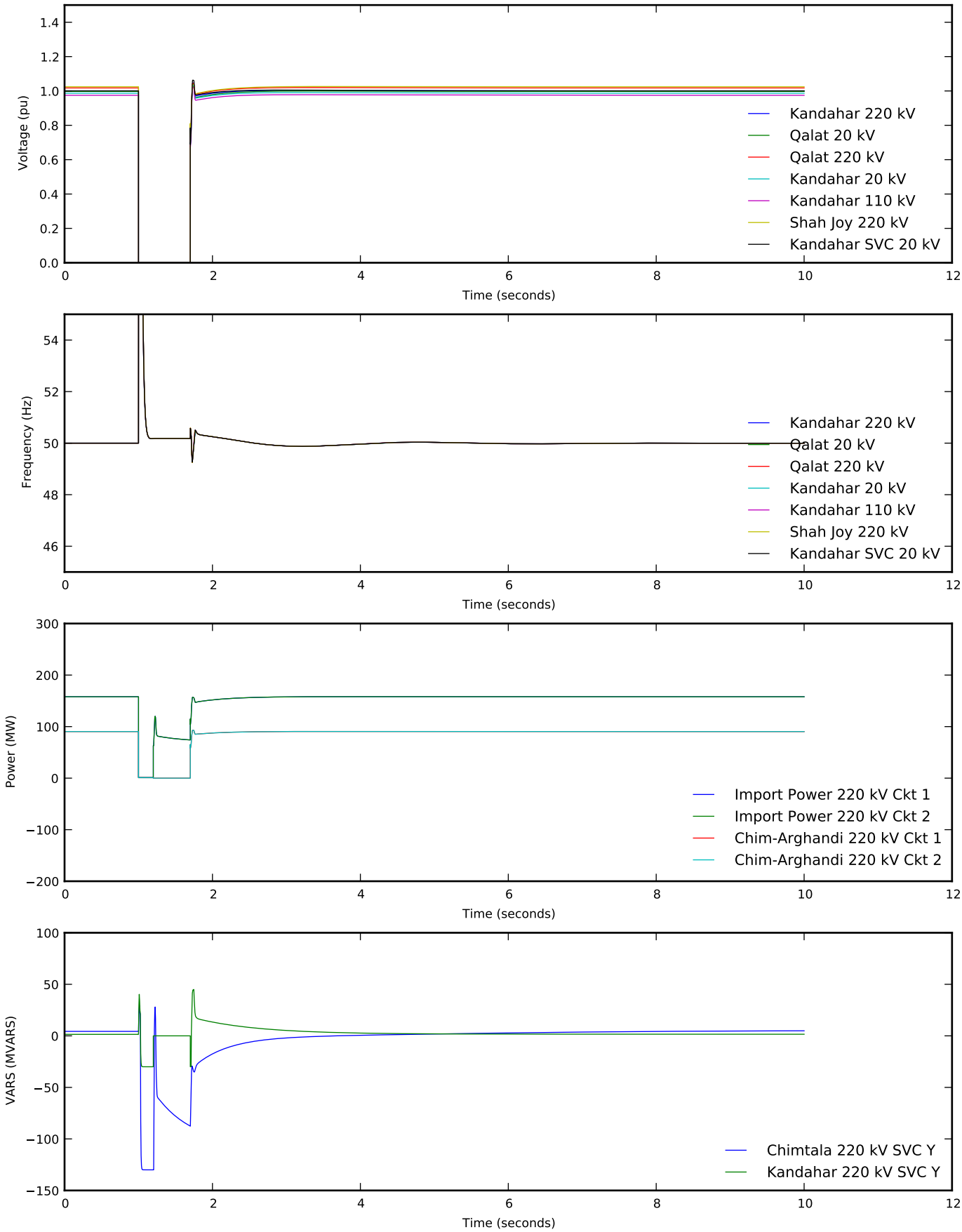
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Chimtala (6171) to Arghandi (6174) Ckt F2.
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S7_Chimtala_Arghandi_Outage_Dbl.out



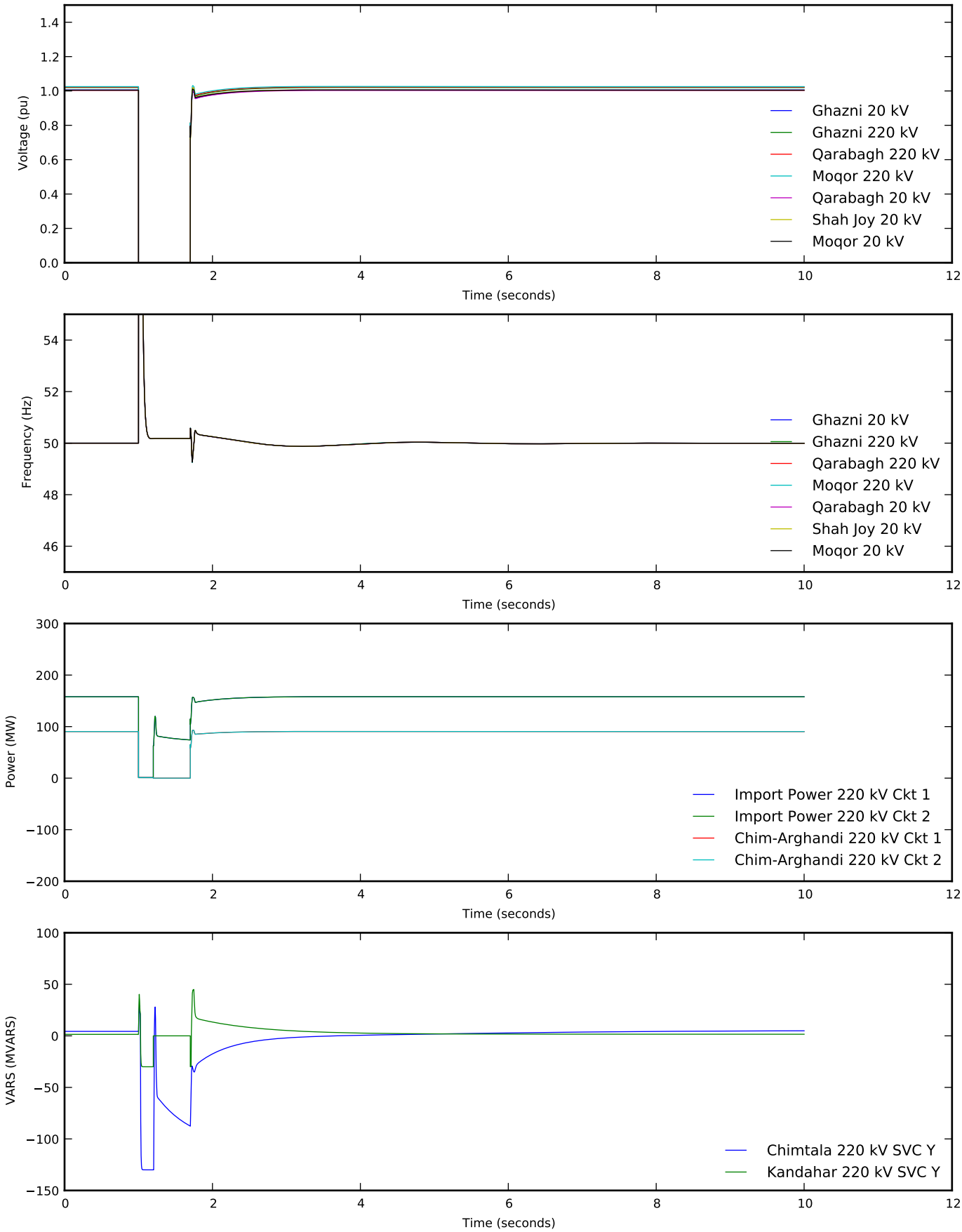
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Chimtala (6171) to Arghandi (6174) Ckt F2.
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S7_Chimtala_Arghandi_Outage_Dbl.out



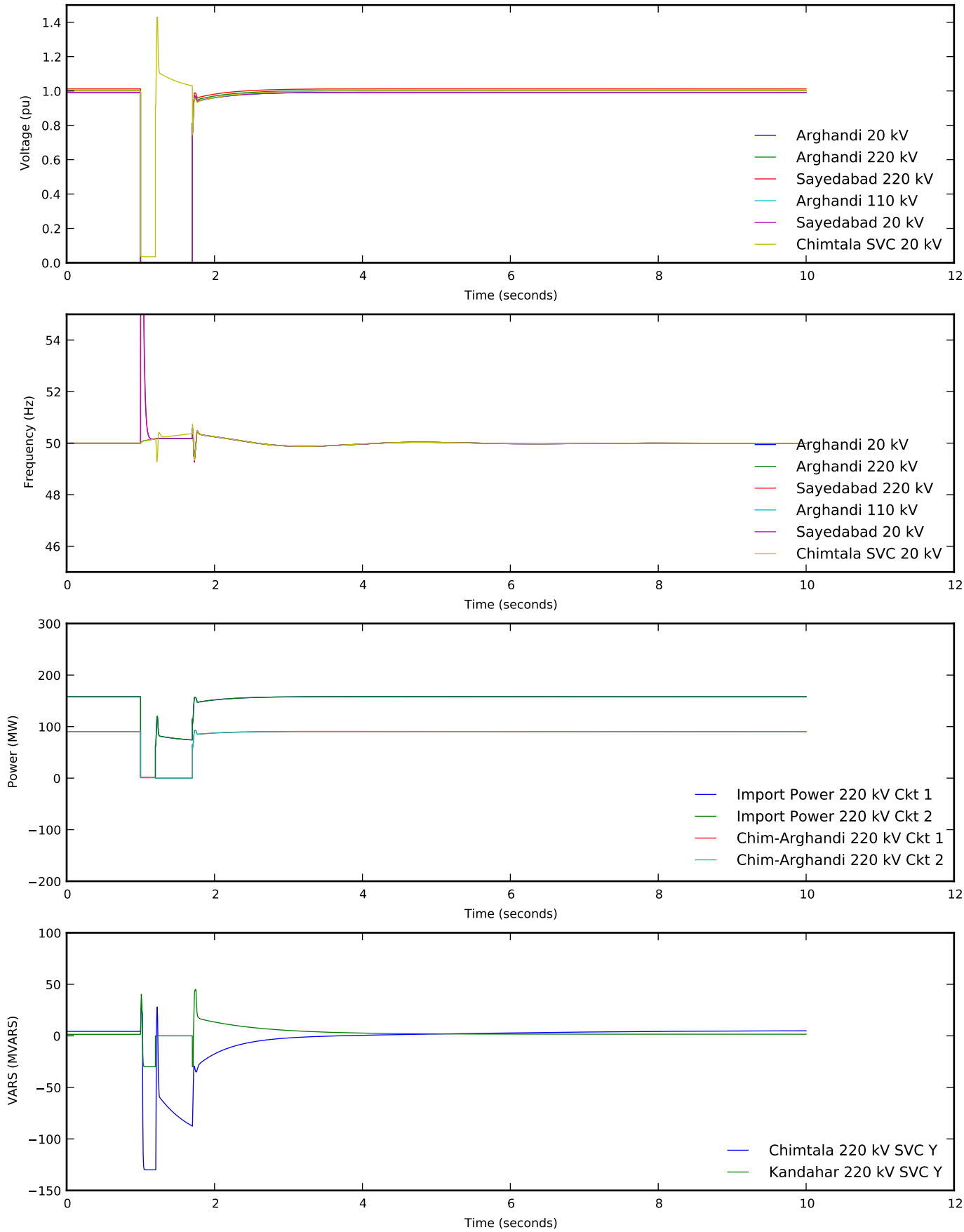
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Chimtala (6171) to Arghandi (6174) Ckt F2.
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S8_Chimtala_Arghandi_Reclose_Dbl.out



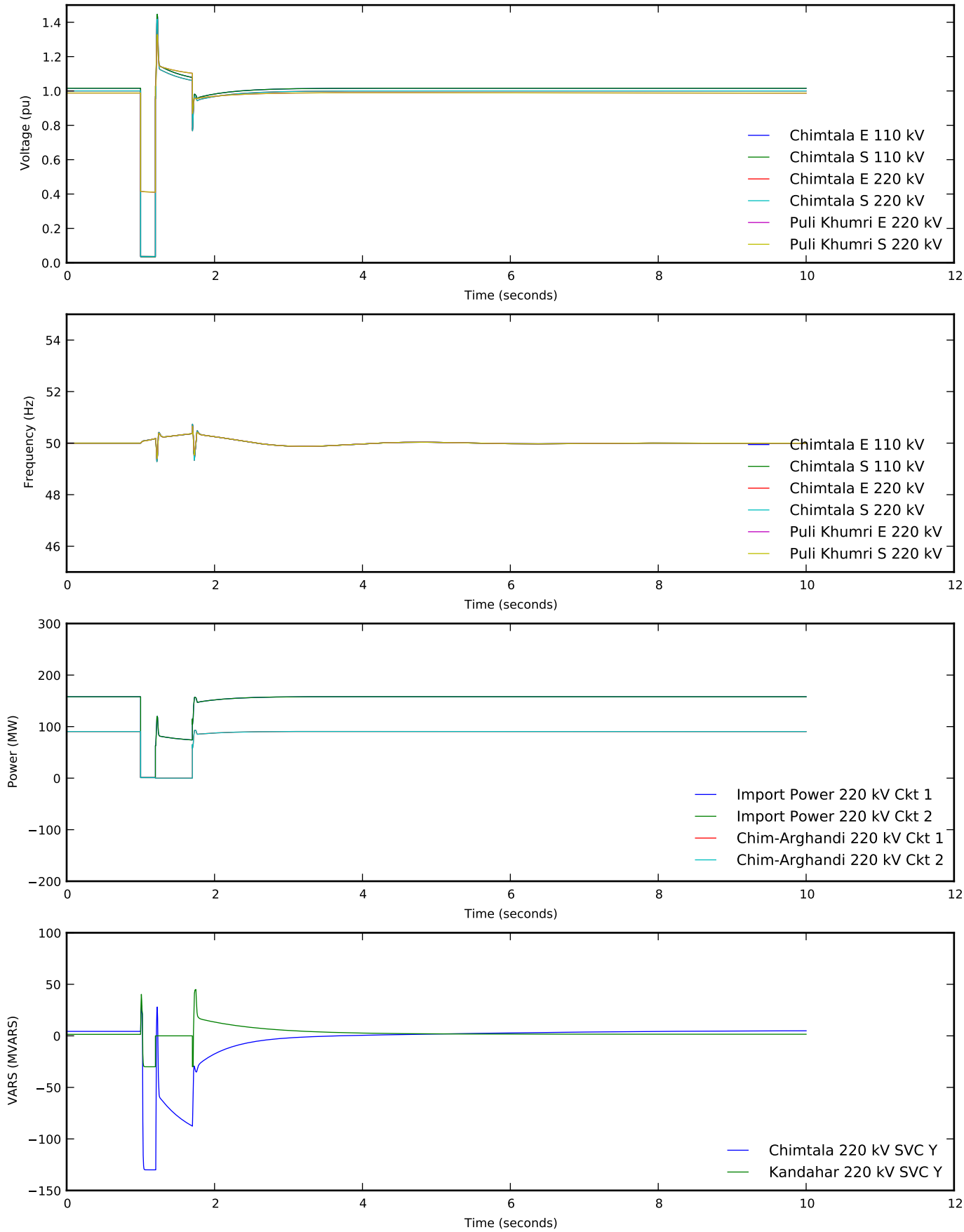
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Chimtala (6171) to Arghandi (6174) Ckt F2.
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S8_Chimtala_Arghandi_Reclose_Dbl.out



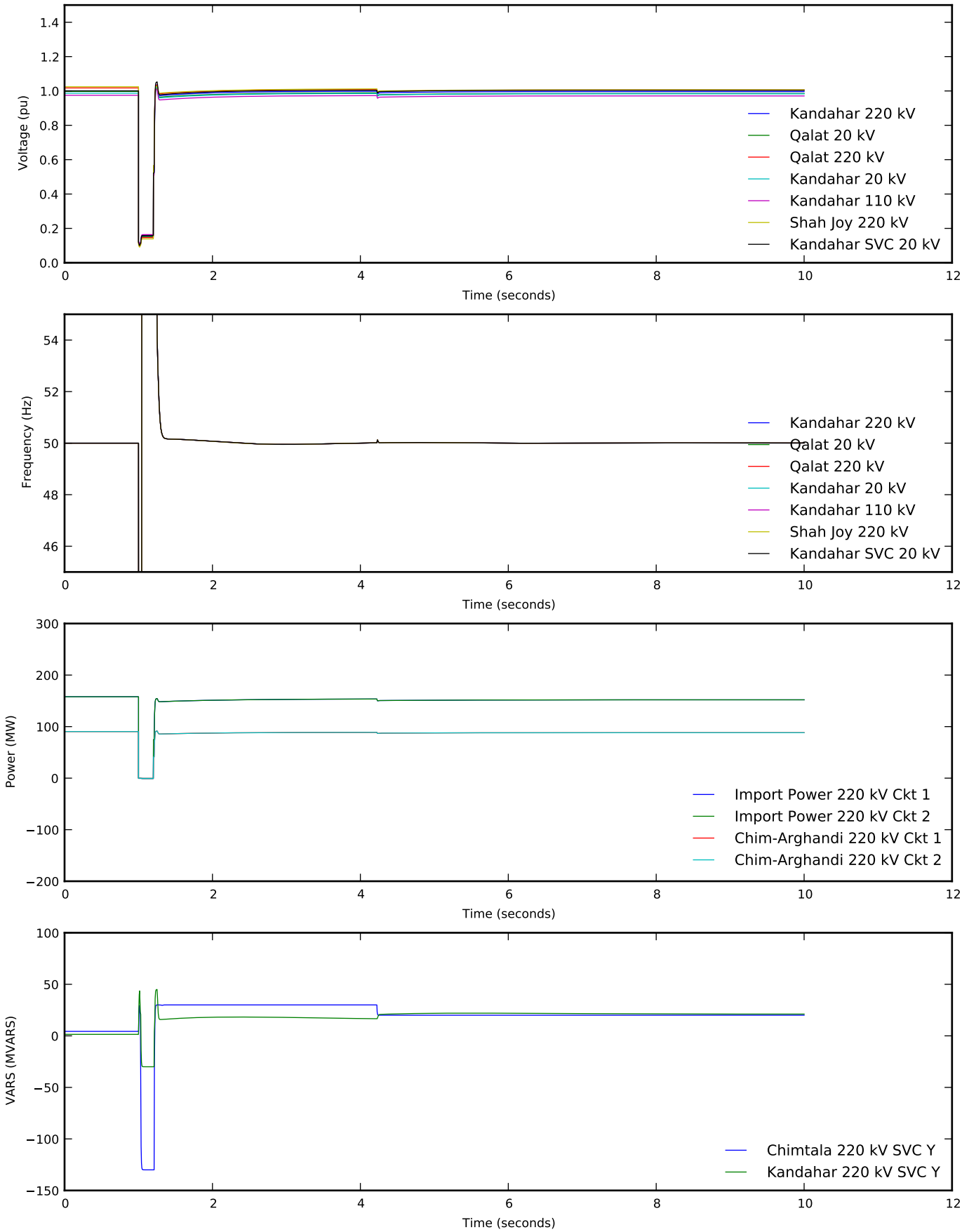
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Chimtala (6171) to Arghandi (6174) Ckt F2.
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S8_Chimtala_Arghandi_Reclose_Dbl.out



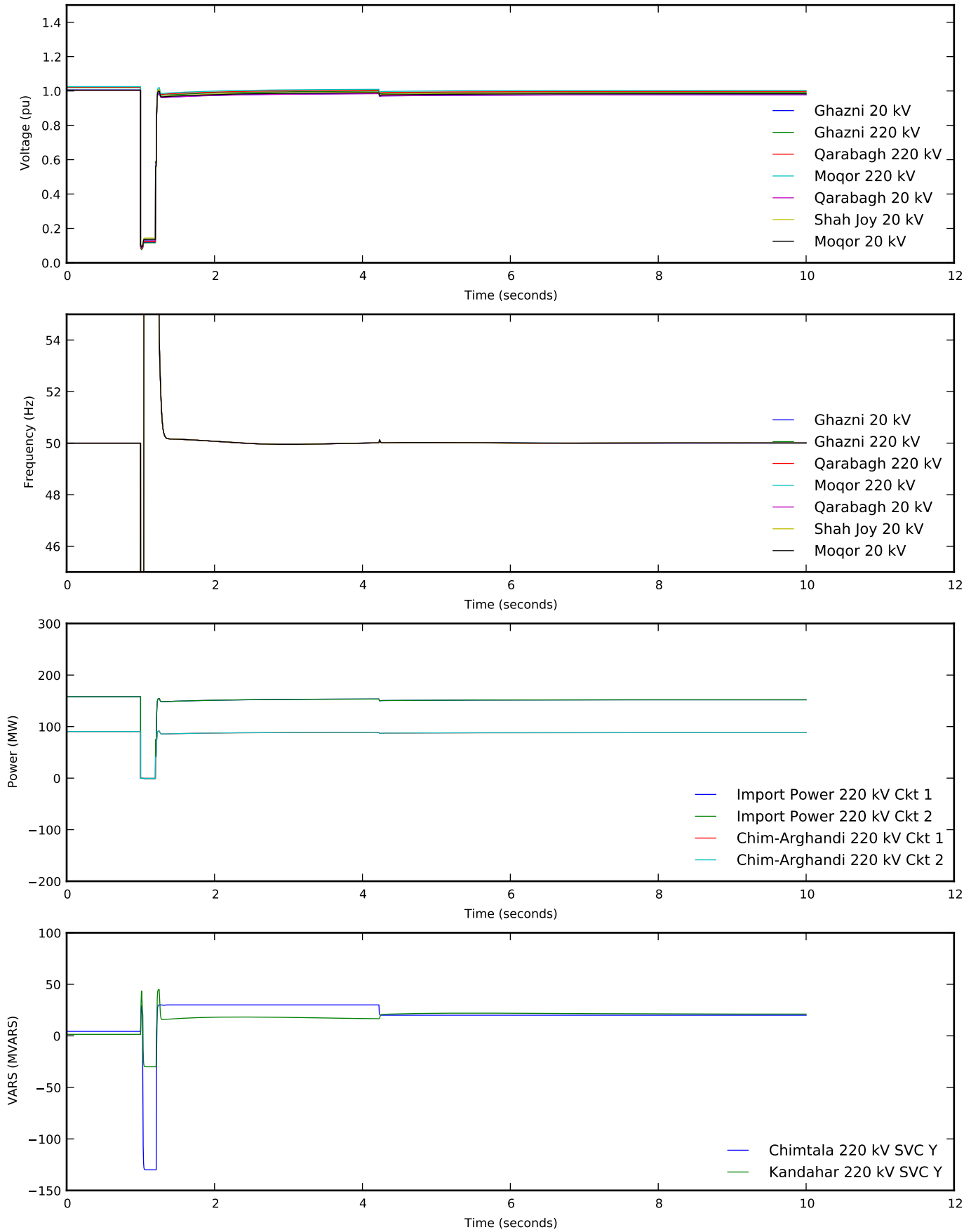
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of line between Chimtala (6171) to Arghandi (6174) Ckt F2.
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S8_Chimtala_Arghandi_Reclose_Dbl.out



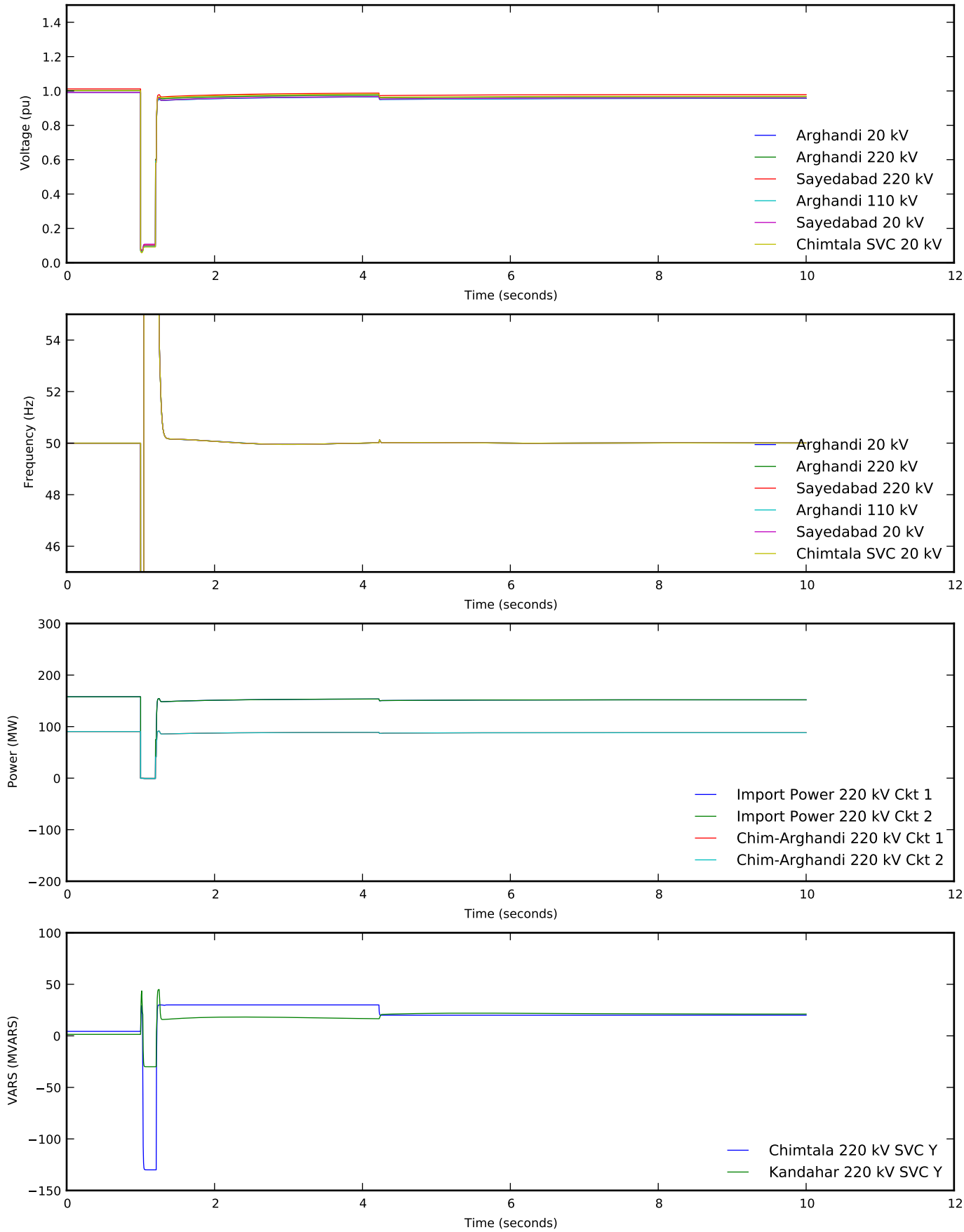
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Baghlan (6167) and Pule Khumri (6198).
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S9_Sangtuda_Pule_Khumri_Outage.out



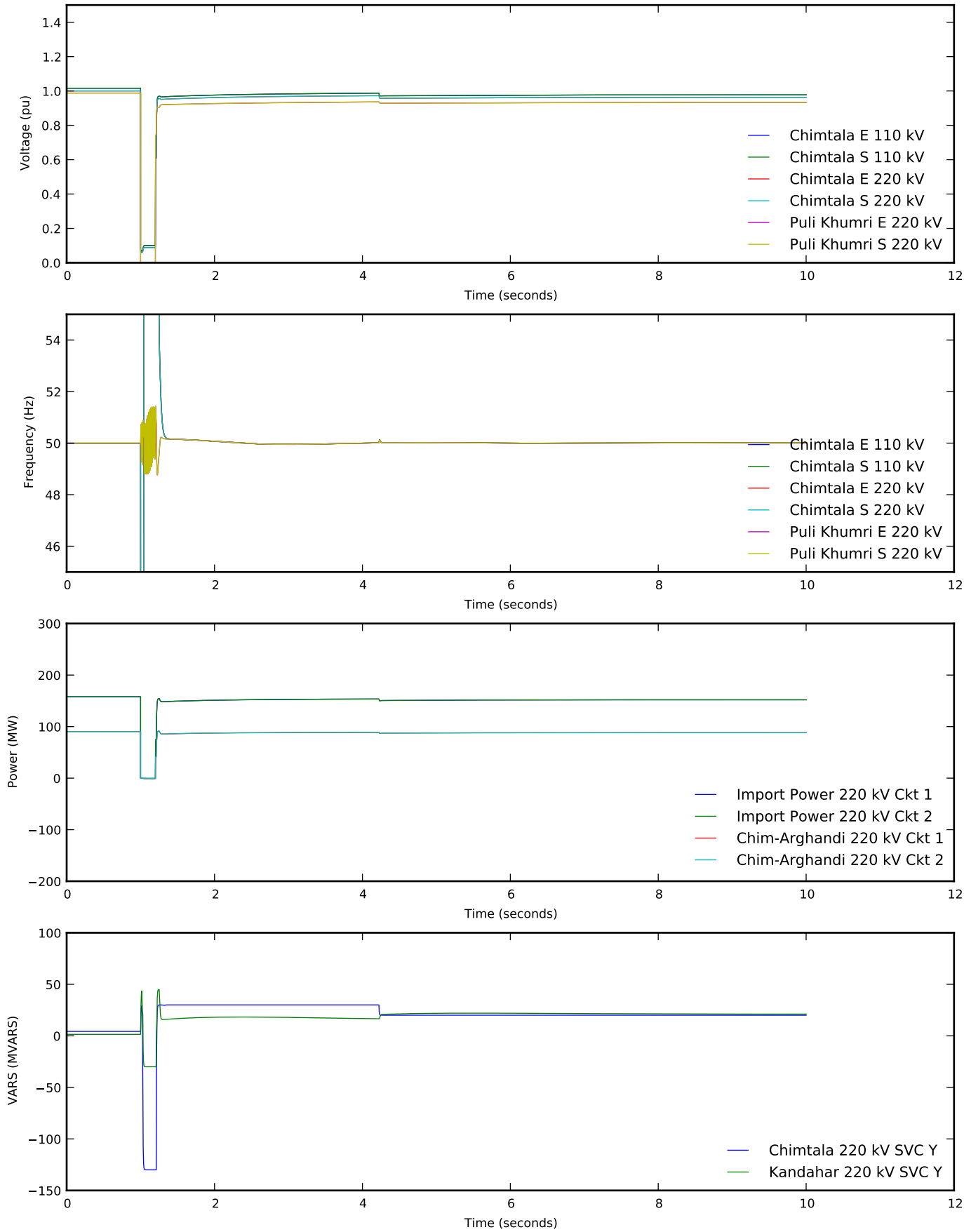
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Baghlan (6167) and Pule Khumri (6198).
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S9_Sangtuda_Pule_Khumri_Outage.out



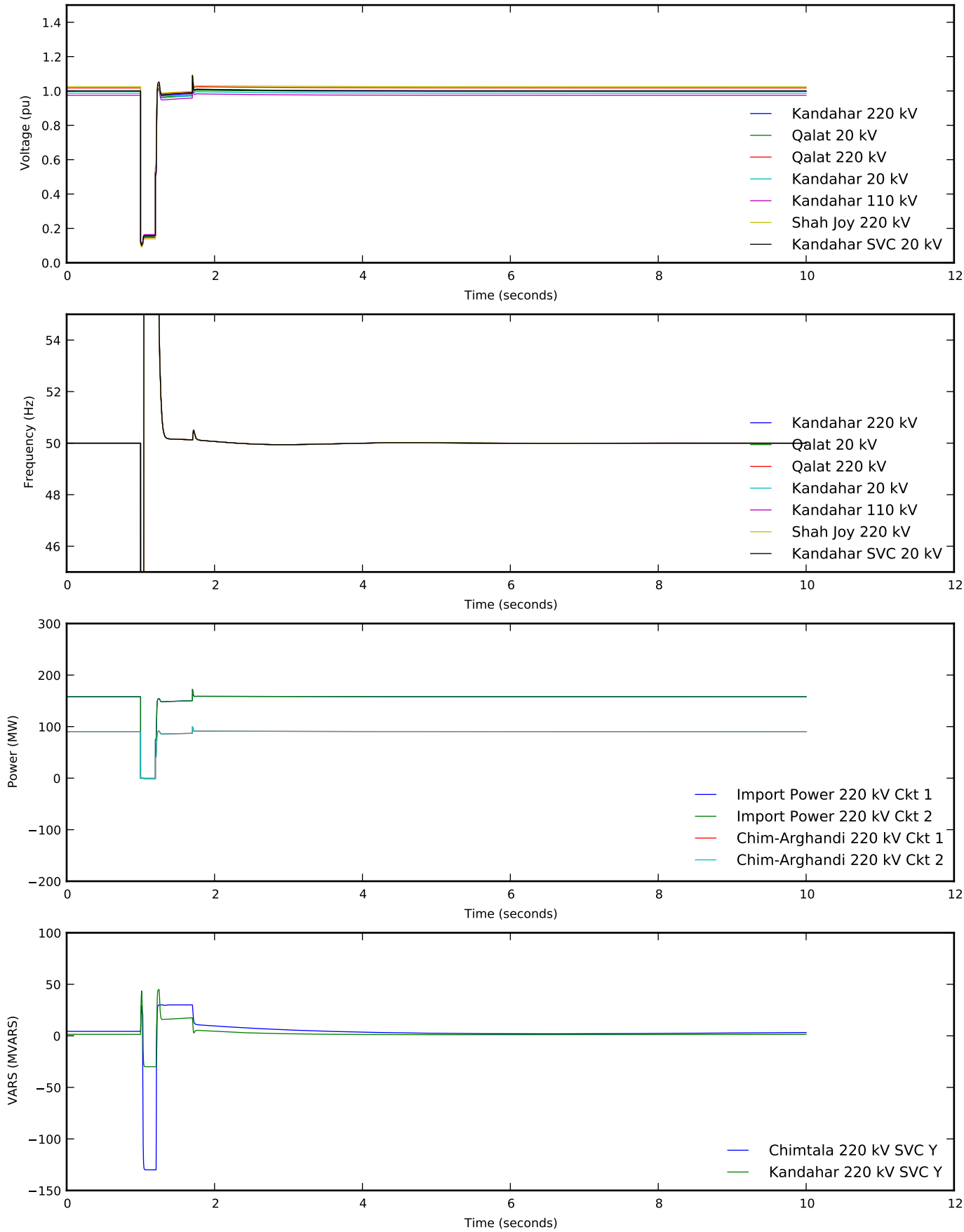
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Baghlan (6167) and Pule Khumri (6198).
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S9_Sangtuda_Pule_Khumri_Outage.out



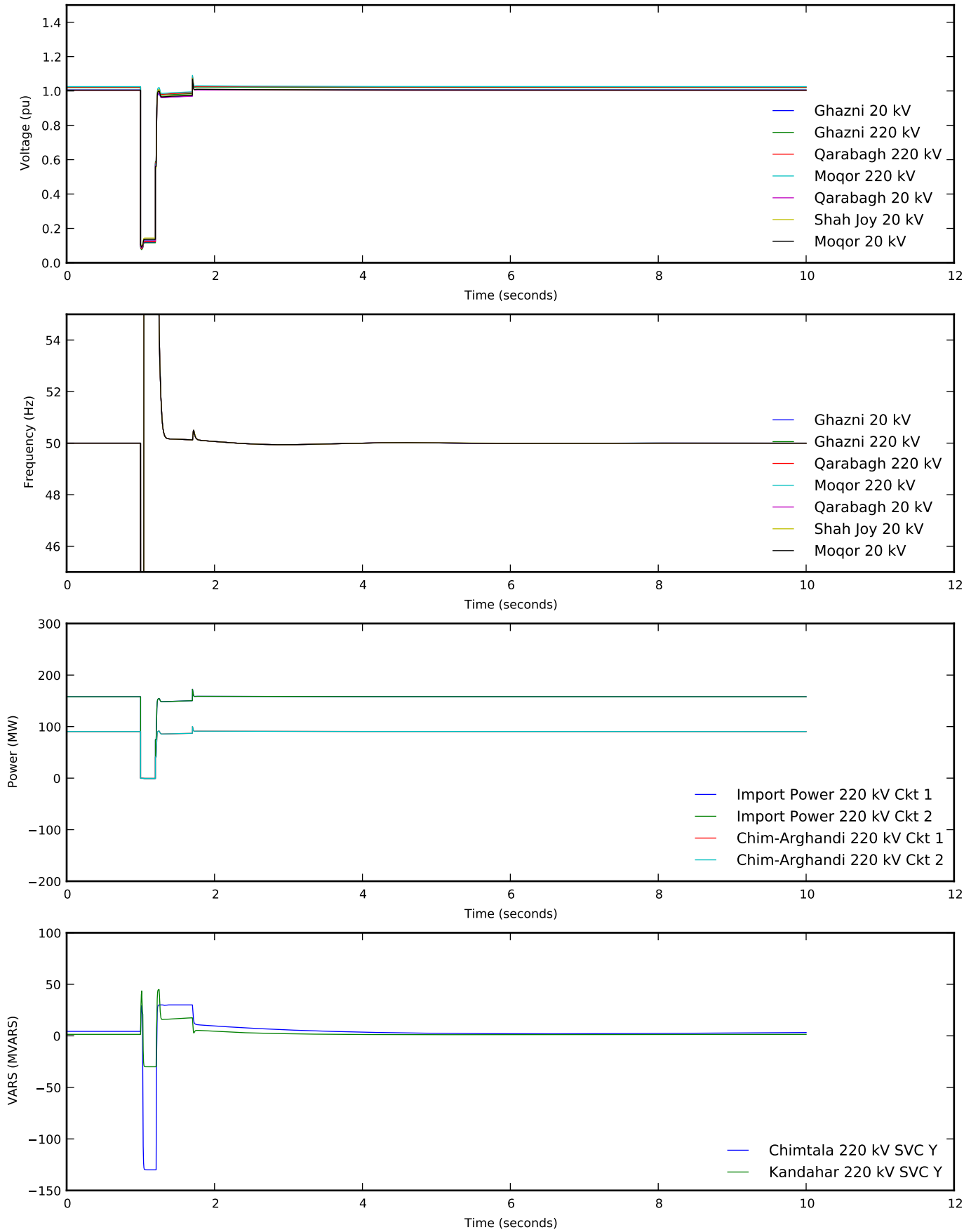
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Baghlan (6167) and Pule Khumri (6198).
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S9_Sangtuda_Pule_Khumri_Outage.out



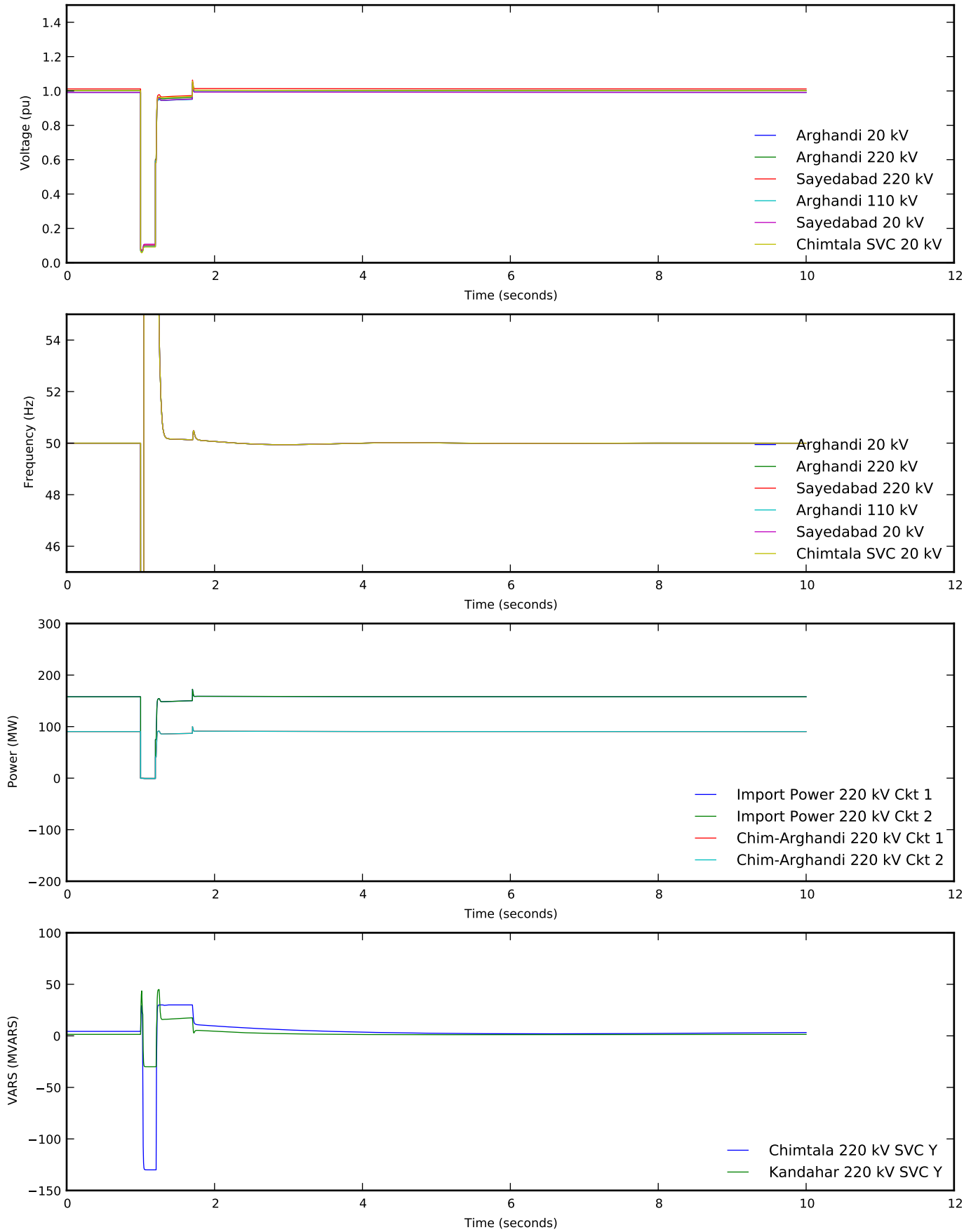
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Baghlan (6167) and Pule Khumri (6198).
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S10_Sangtuda_Pule_Khumri_Reclose.out



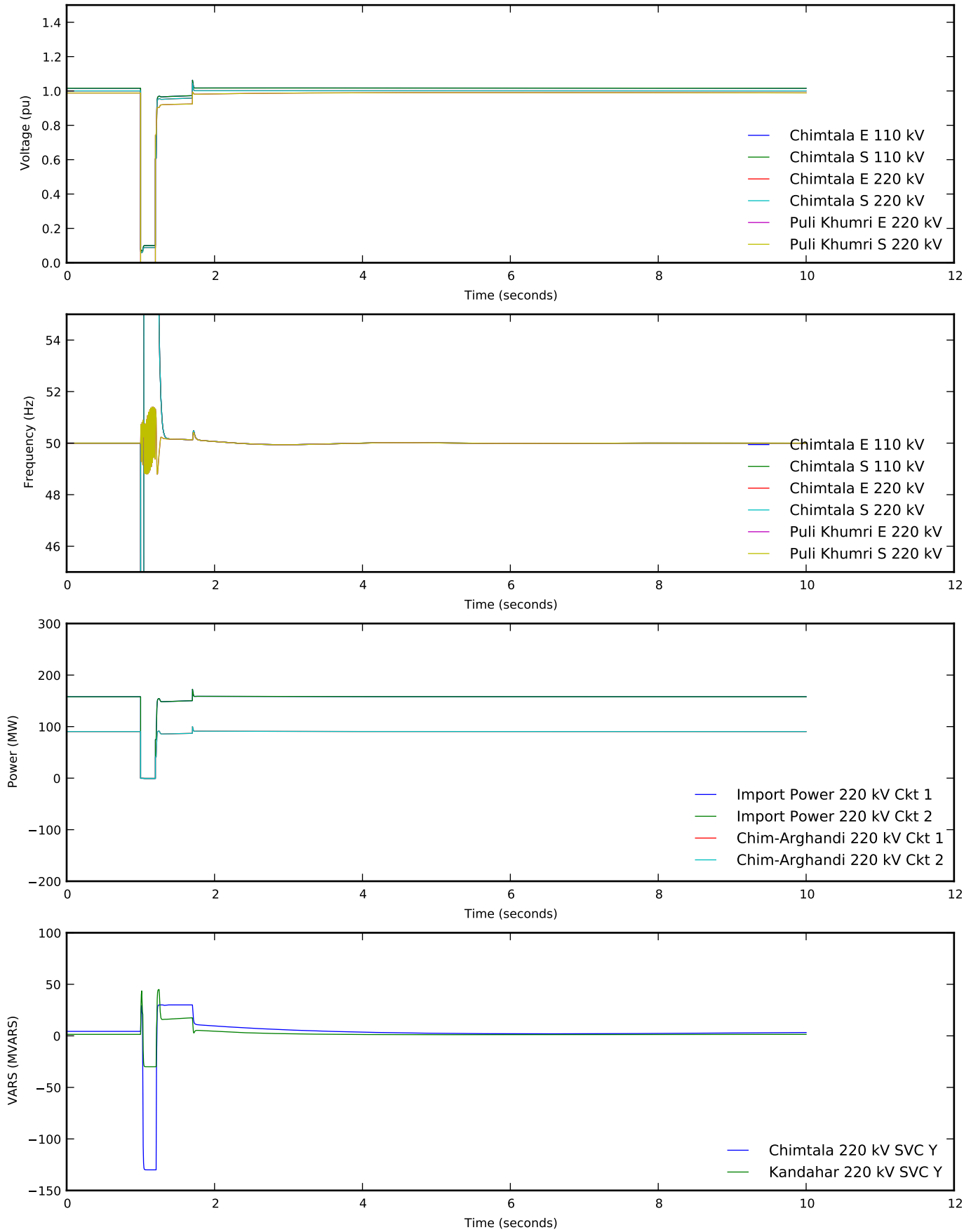
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Baghlan (6167) and Pule Khumri (6198).
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S10_Sangtuda_Pule_Khumri_Reclose.out



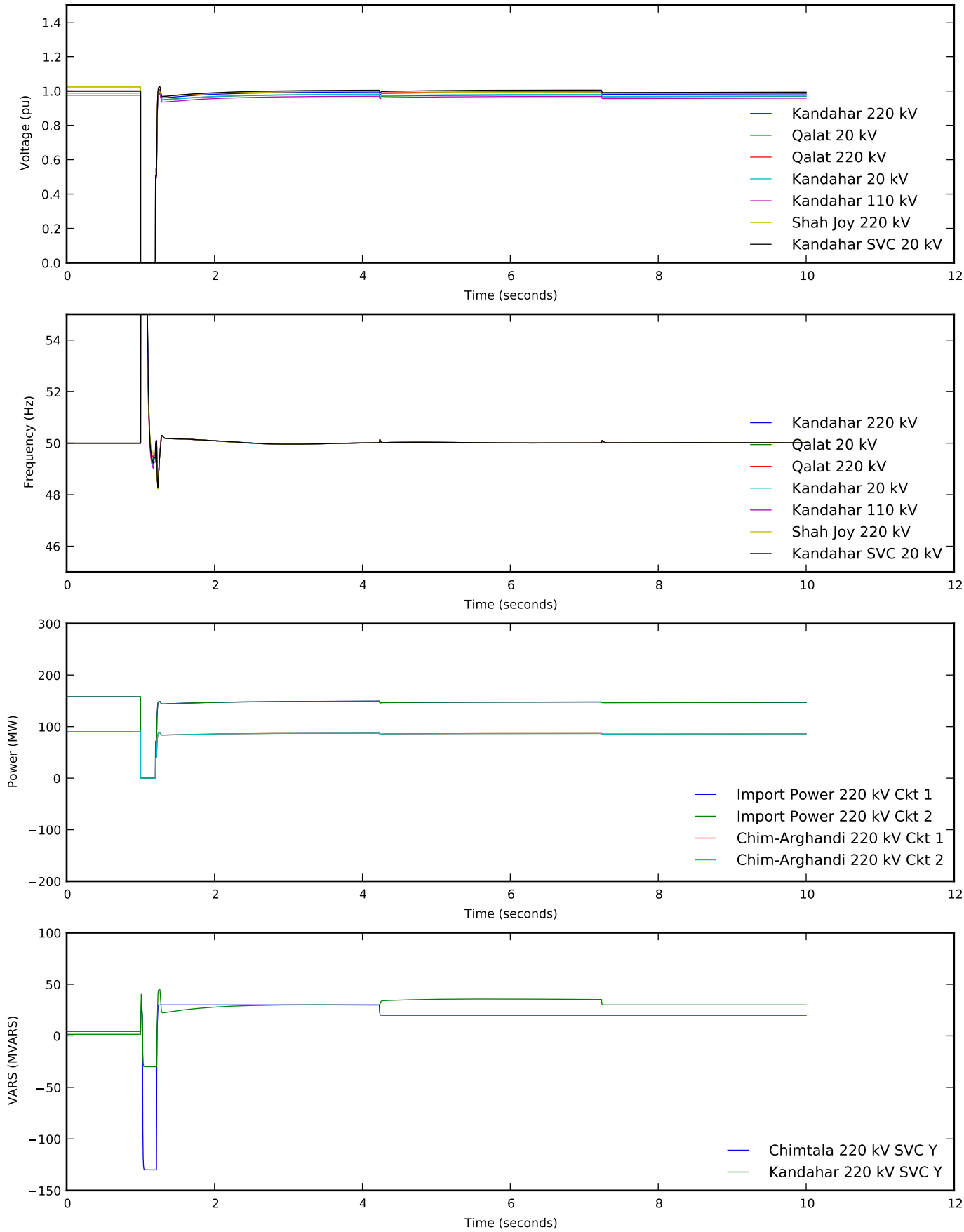
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Baghlan (6167) and Pule Khumri (6198).
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S10_Sangtuda_Pule_Khumri_Reclose.out



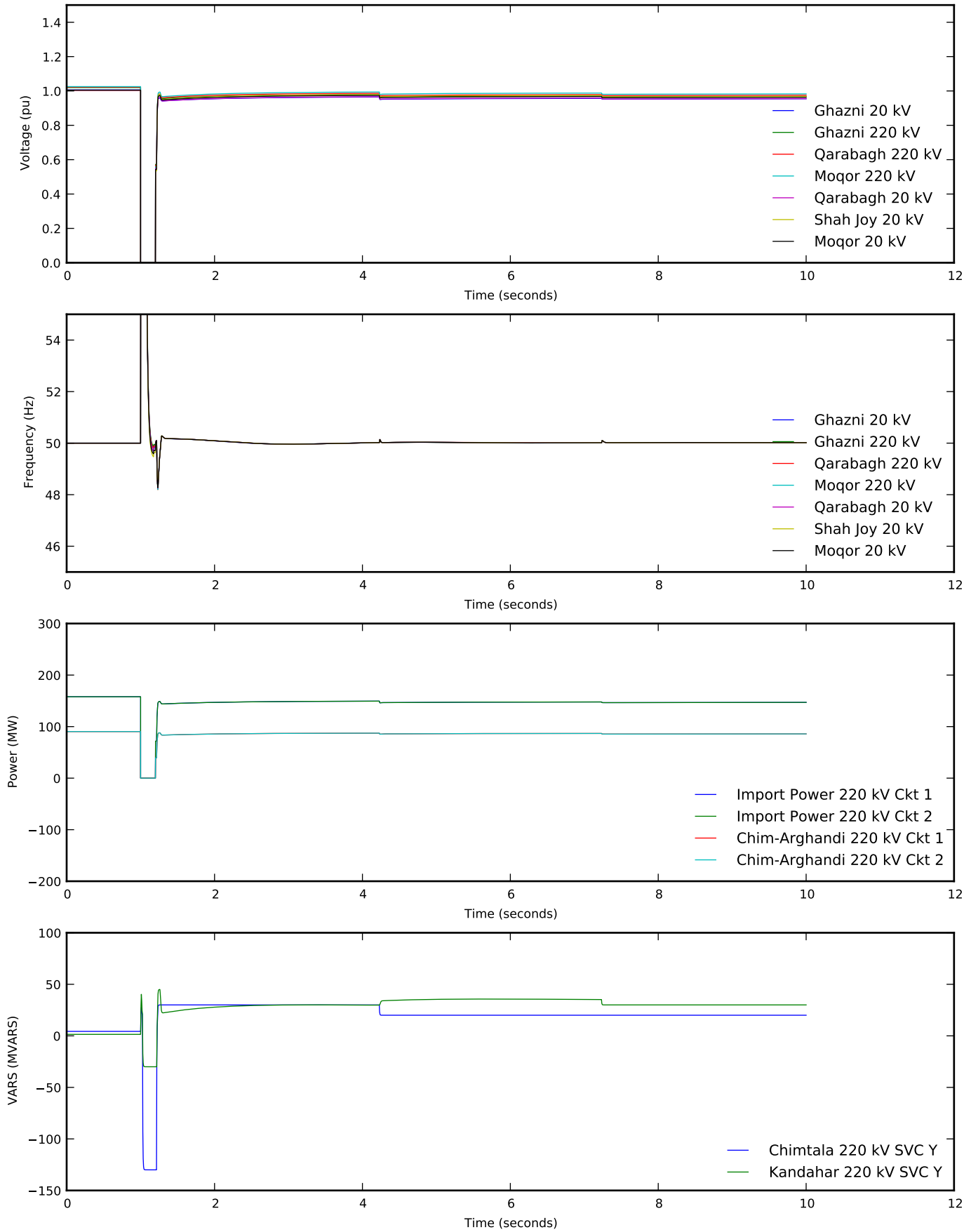
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Baghlan (6167) and Pule Khumri (6198).
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S10_Sangtuda_Pule_Khumri_Reclose.out



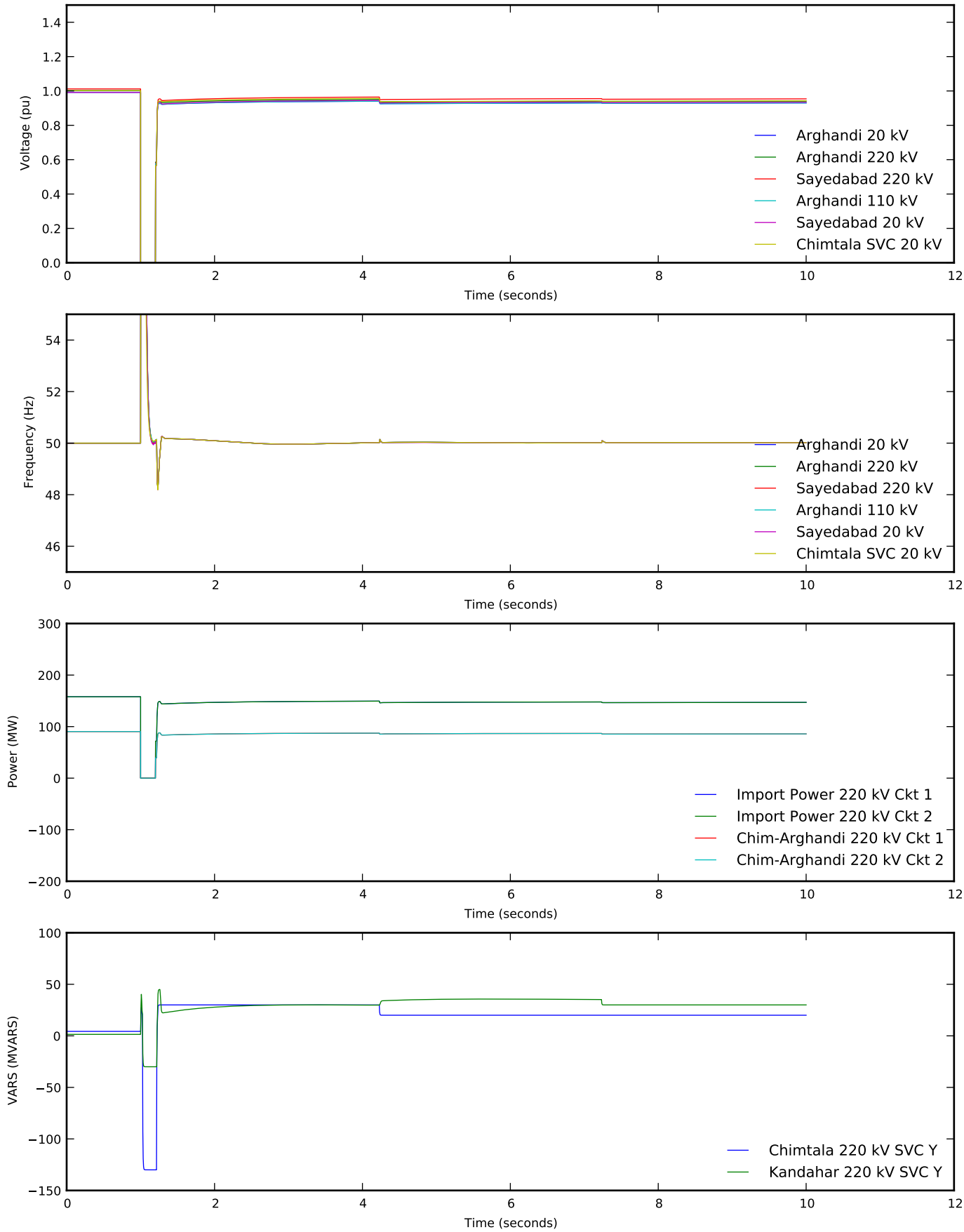
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Pule Khumri(6198) and Chimtala (6171) [Multiple Ckts].
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S11_Pule_Khumri_Chimtala_Outage.out



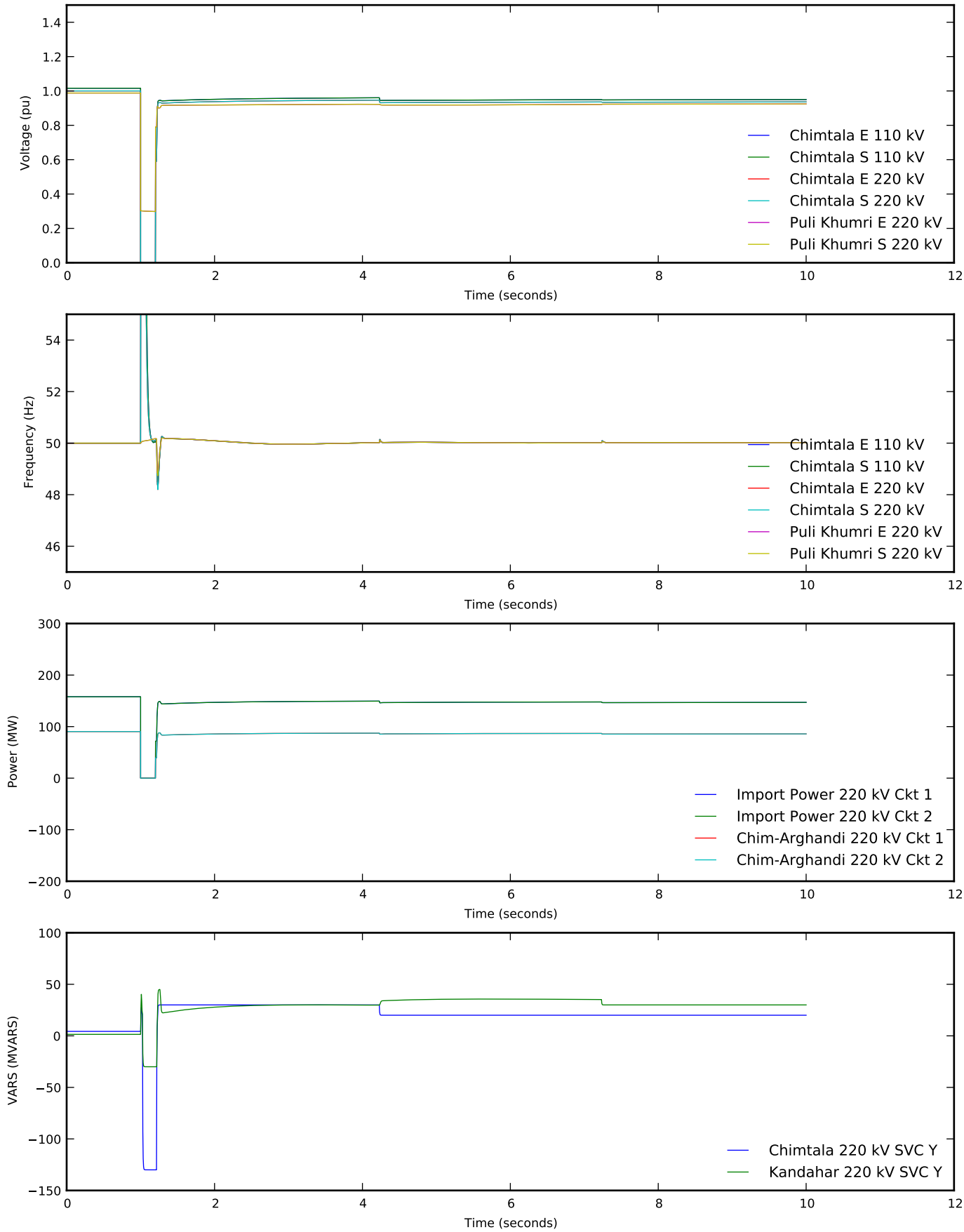
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Pule Khumri(6198) and Chimtala (6171) [Multiple Ckts].
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S11_Pule_Khumri_Chimtala_Outage.out



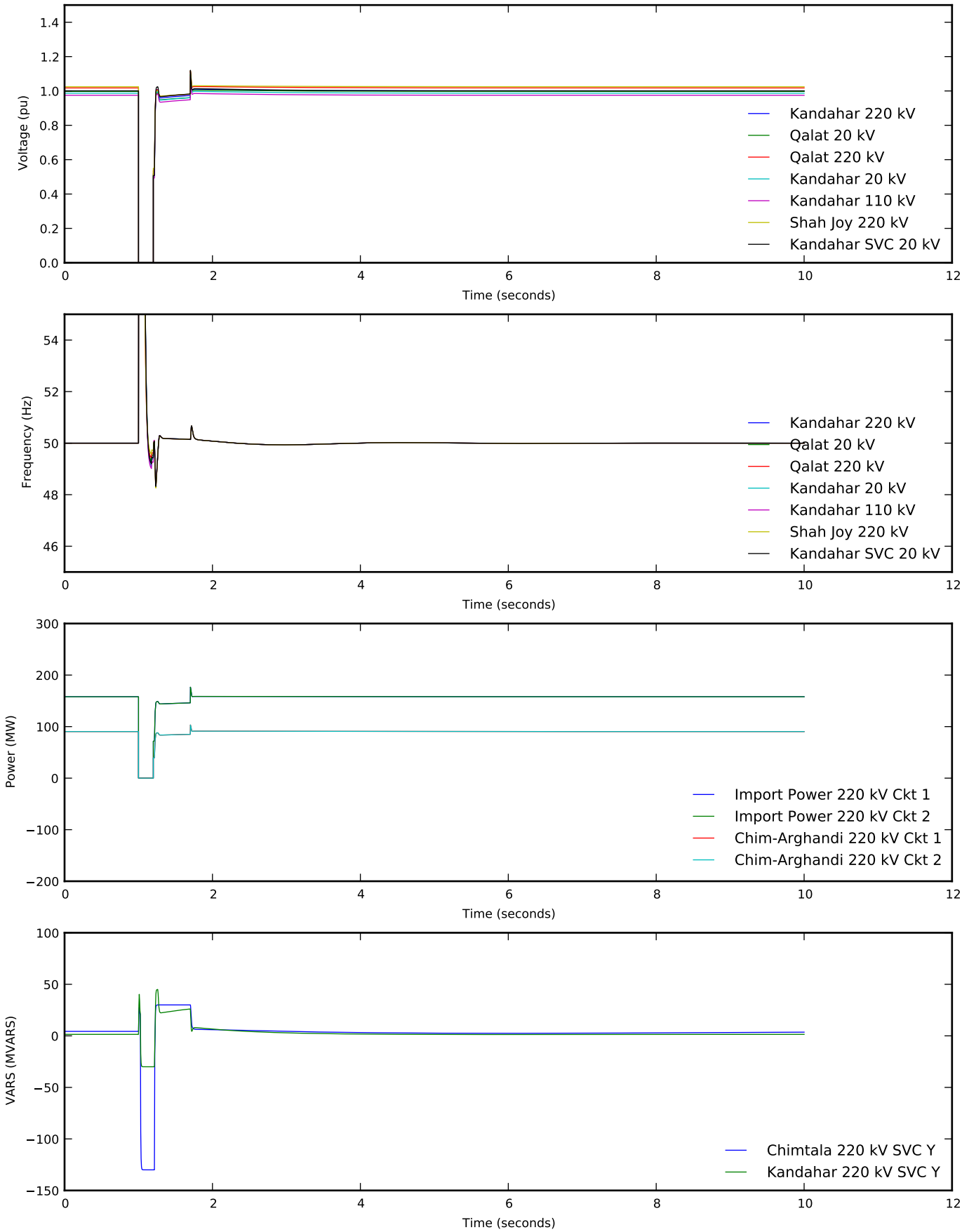
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Pule Khumri(6198) and Chimtala (6171) [Multiple Ckts].
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S11_Pule_Khumri_Chimtala_Outage.out



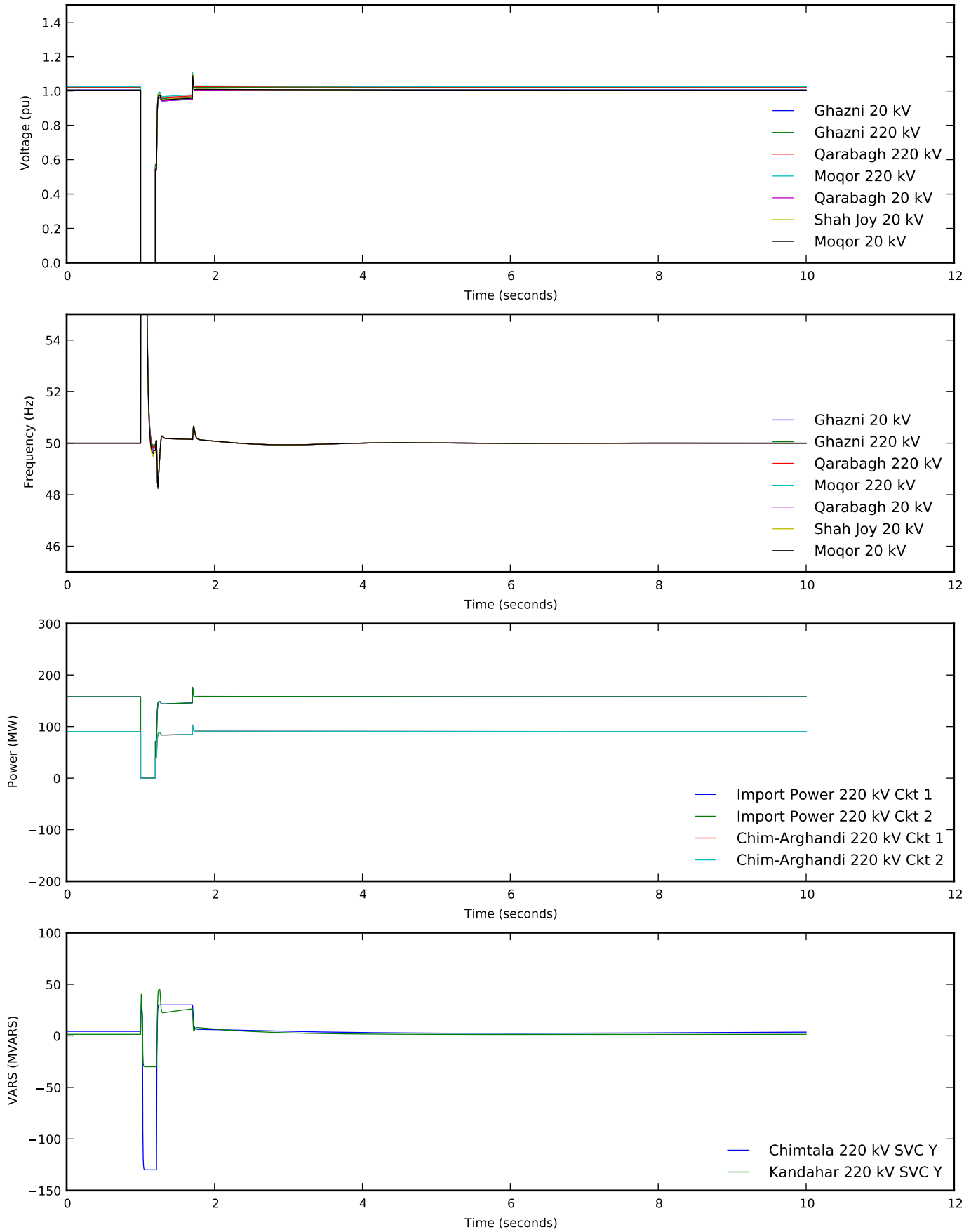
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Pule Khumri(6198) and Chimtala (6171) [Multiple Ckts].
Fault cleared by circuit breaker operation.
Plot File: OUT/LT48_DBL__Base__S11_Pule_Khumri_Chimtala_Outage.out



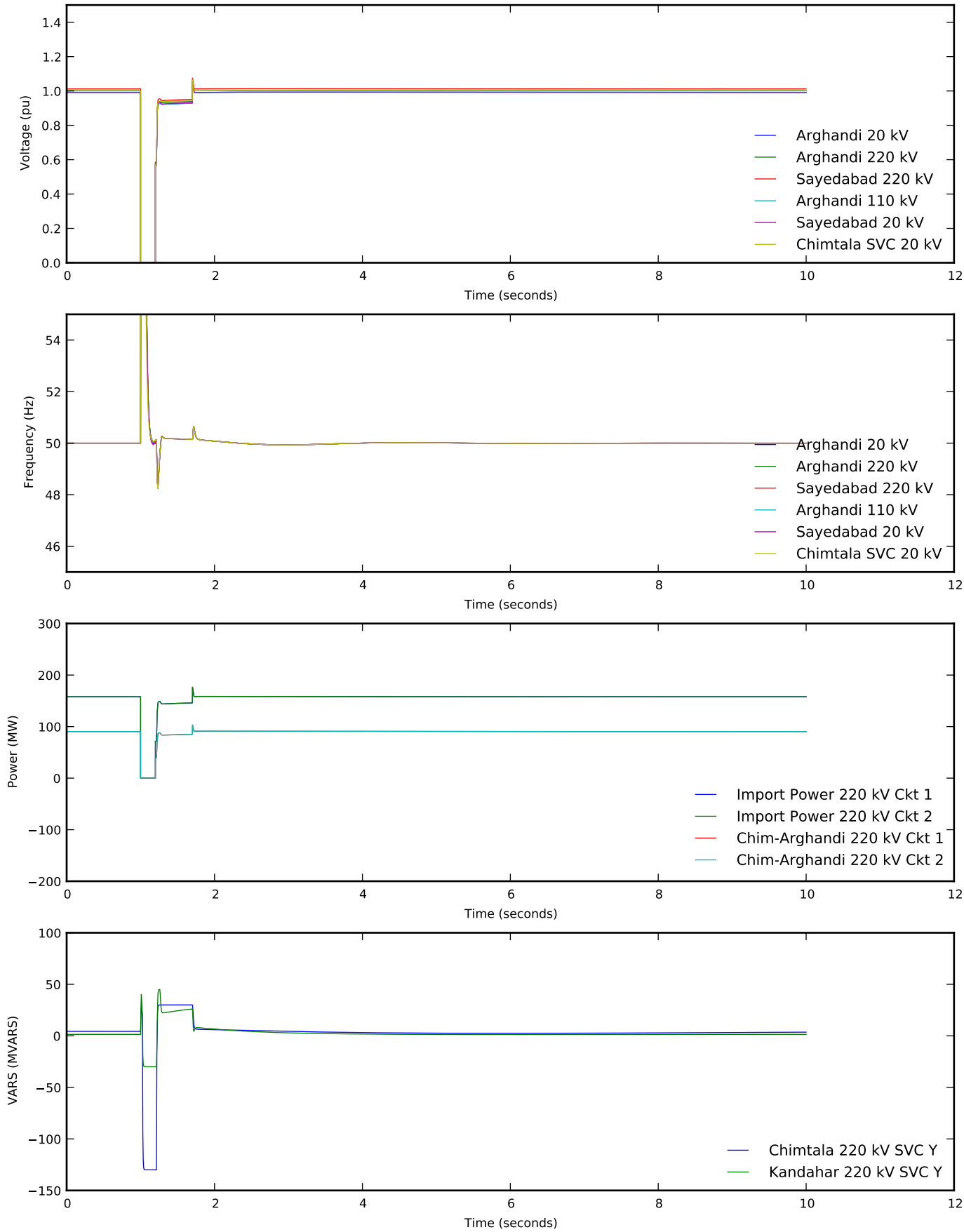
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Pule Khumri(6198) and Chimtala (6171) [Multiple Ckts].
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S12_Pule_Khumri_Chimtala_Reclose.out



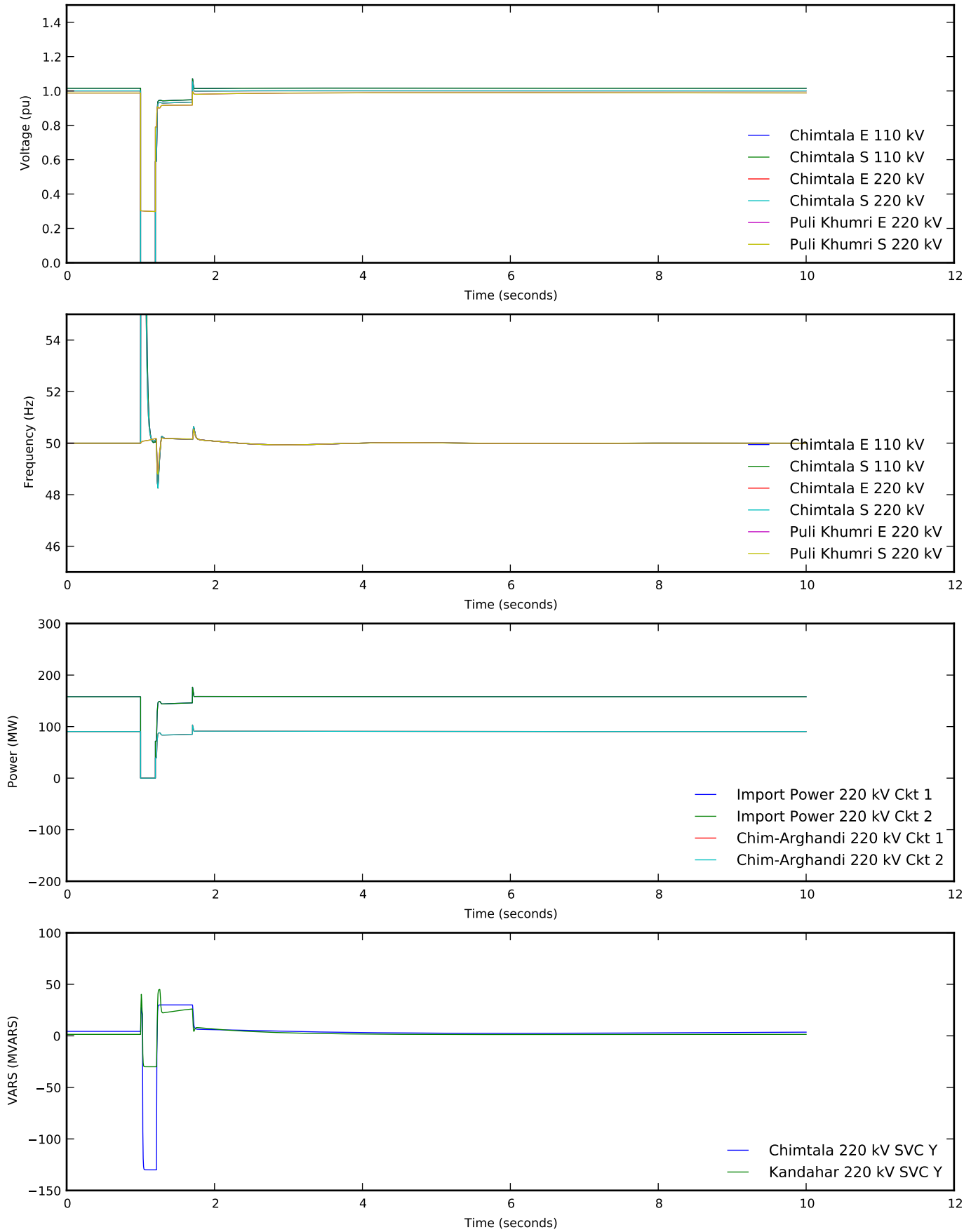
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Pule Khumri(6198) and Chimtala (6171) [Multiple Ckts].
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S12_Pule_Khumri_Chimtala_Reclose.out



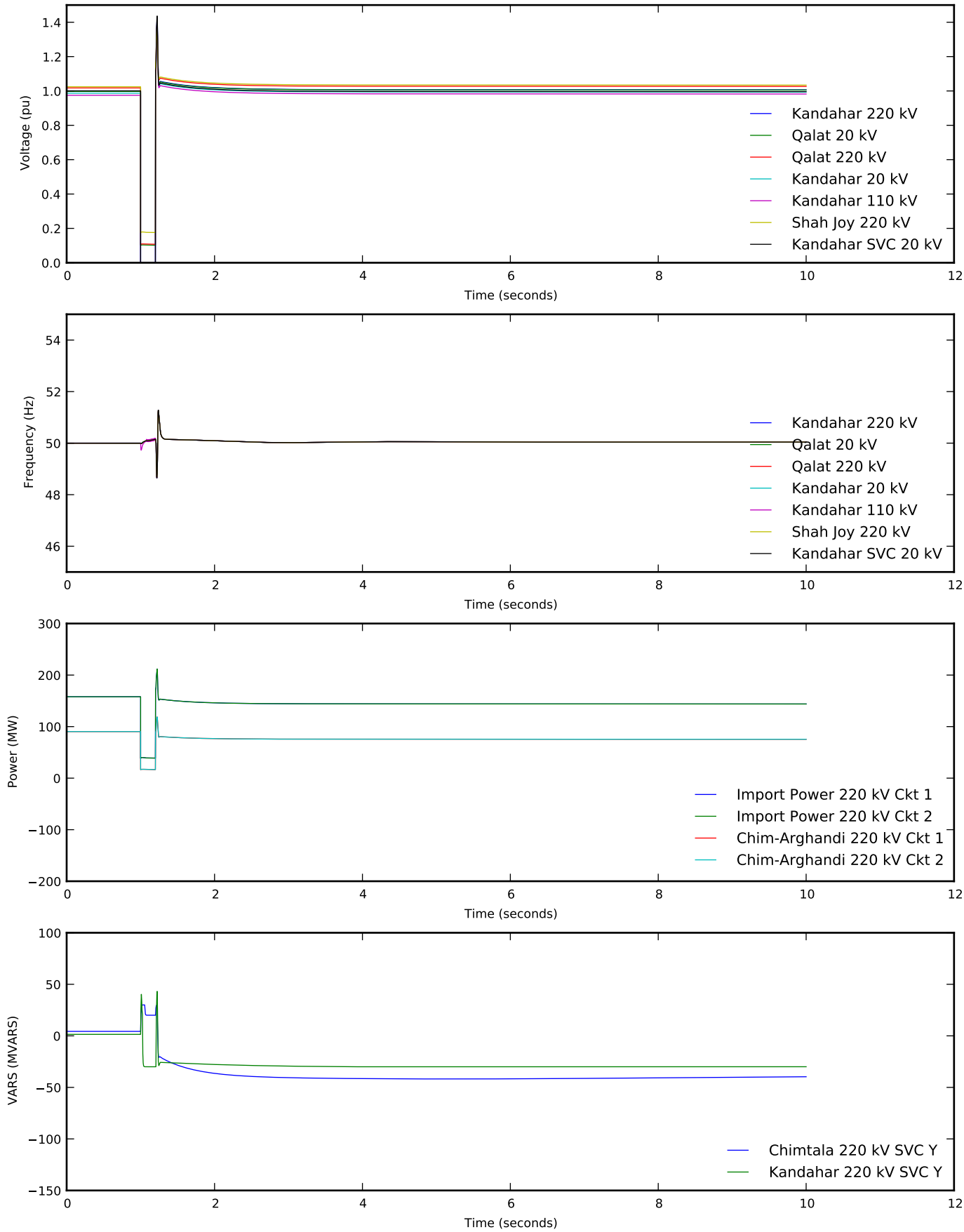
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Pule Khumri(6198) and Chimtala (6171) [Multiple Ckts].
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S12_Pule_Khumri_Chimtala_Reclose.out



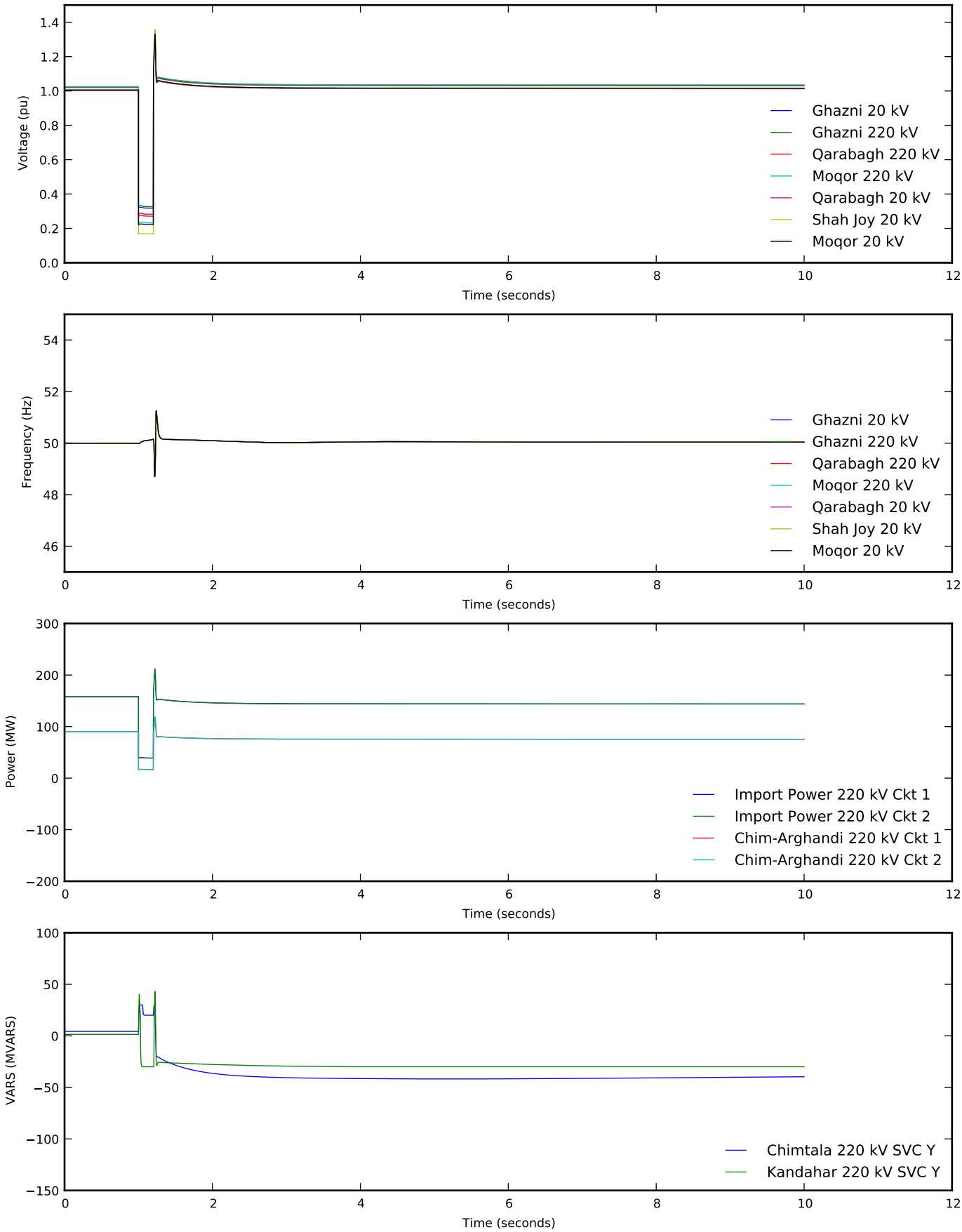
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on end of one of two lines between Pule Khumri(6198) and Chimtala (6171) [Multiple Ckts].
Fault cleared by circuit breaker operation followed by line reclosing.
Plot File: OUT/LT48_DBL__Base__S12_Pule_Khumri_Chimtala_Reclose.out



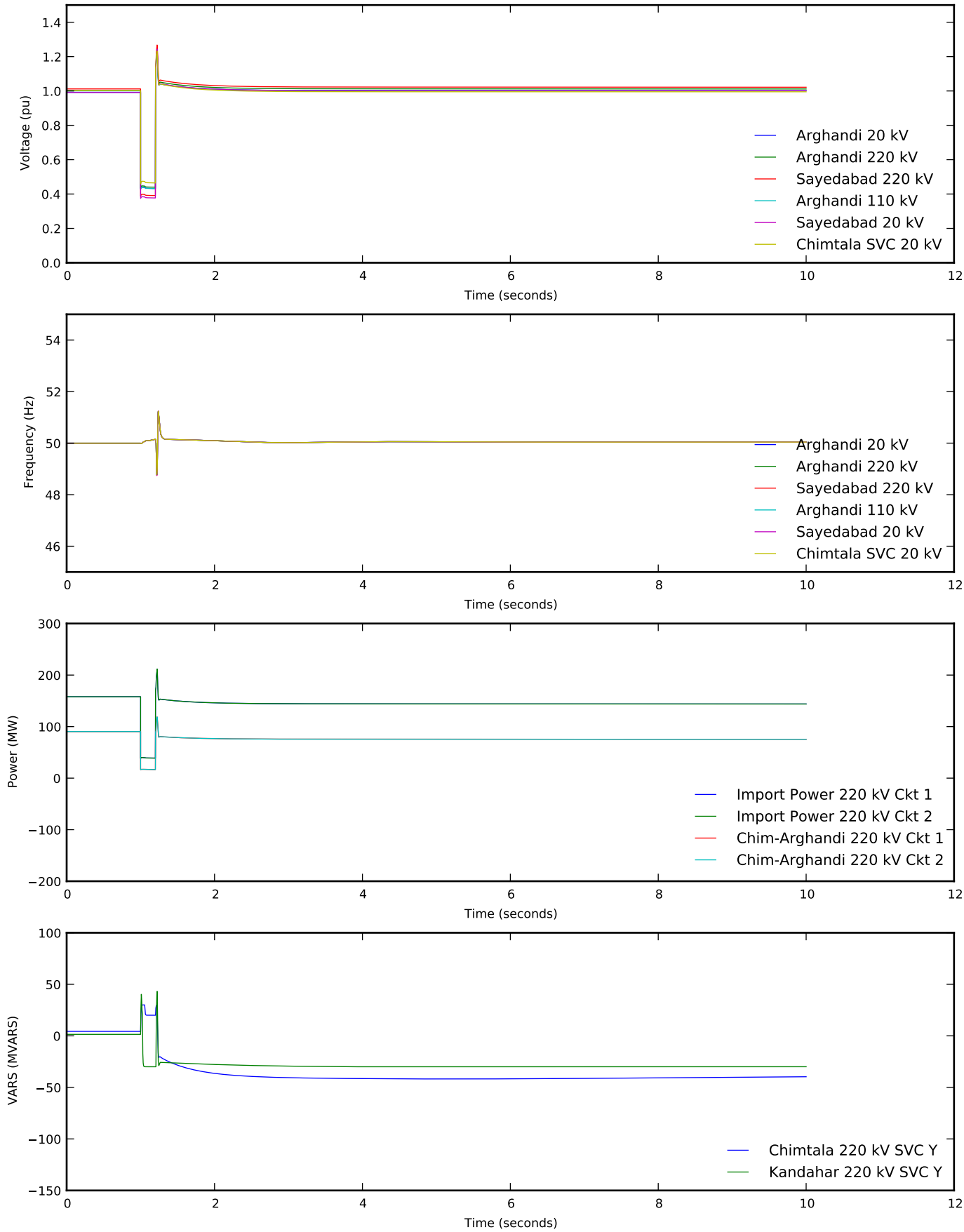
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Kandahar East w/ Loss of load at BUS 6400.
Fault cleared by disconnecting transformer (FROM 4011 to 6400 ID=2).
Plot File: OUT/LT48_DBL__Base__S13_Kand_XF_Load_Loss.out



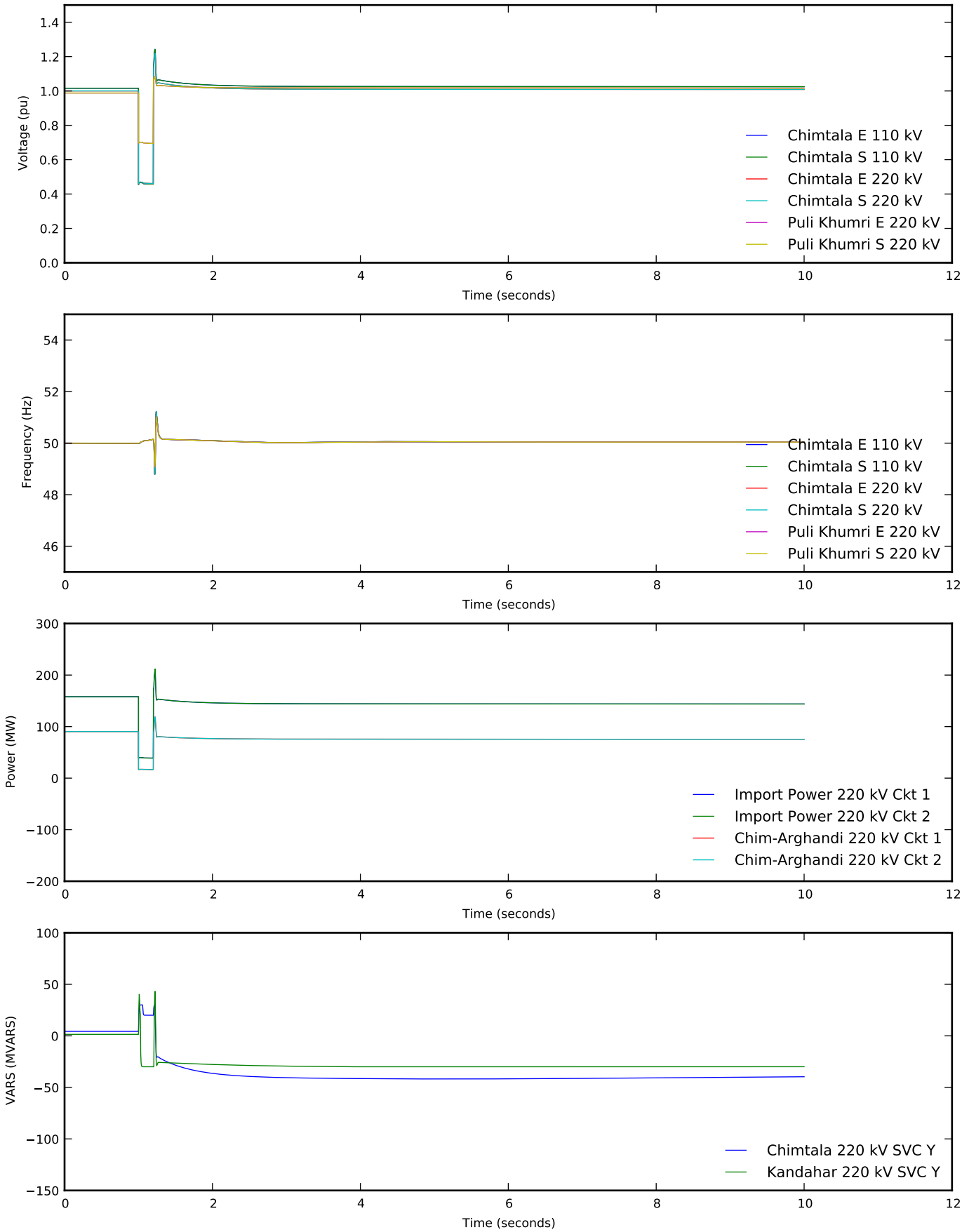
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Kandahar East w/ Loss of load at BUS 6400.
Fault cleared by disconnecting transformer (FROM 4011 to 6400 ID=2).
Plot File: OUT/LT48_DBL__Base__S13_Kand_XF_Load_Loss.out



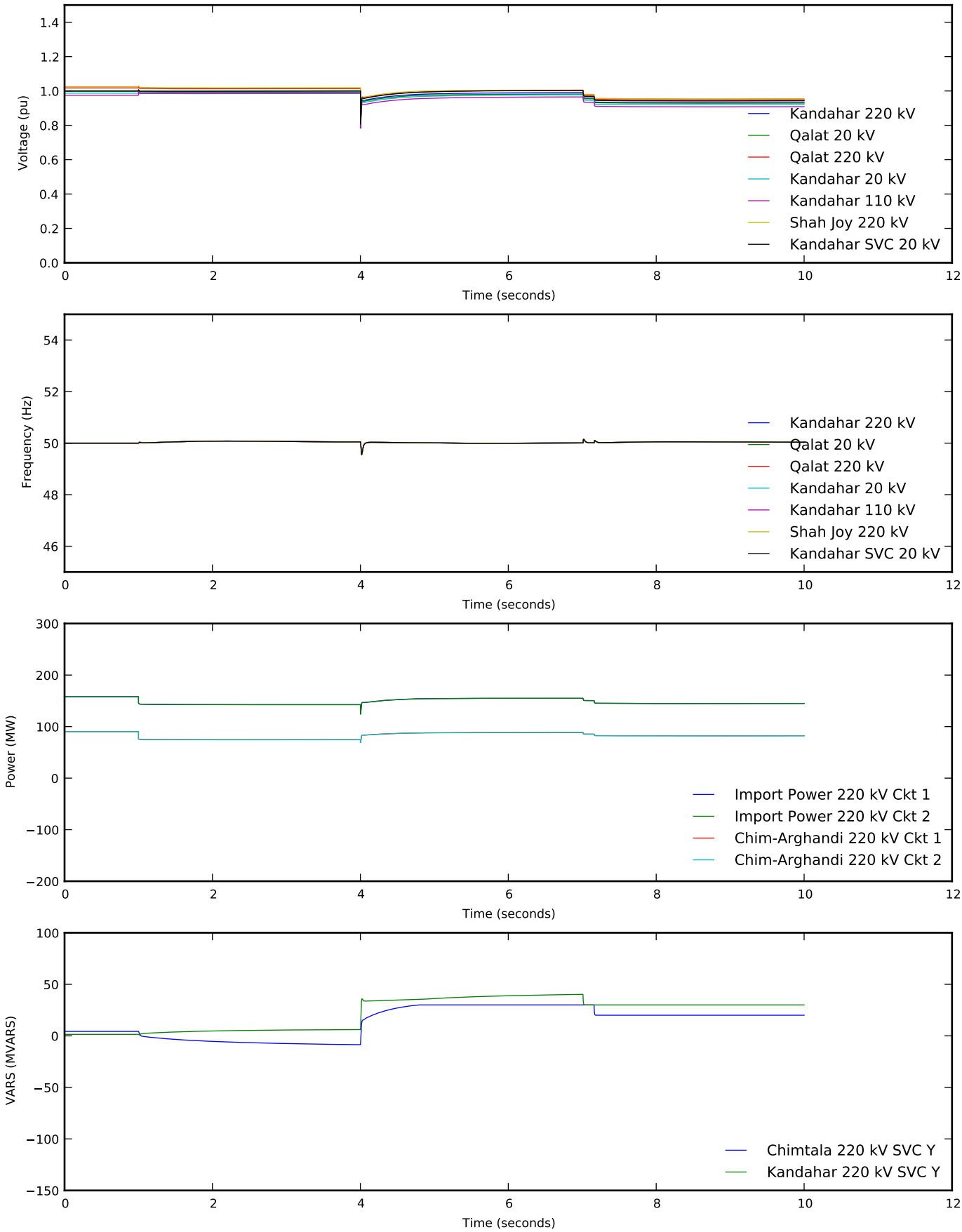
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Kandahar East w/ Loss of load at BUS 6400.
Fault cleared by disconnecting transformer (FROM 4011 to 6400 ID=2).
Plot File: OUT/LT48_DBL__Base__S13_Kand_XF_Load_Loss.out



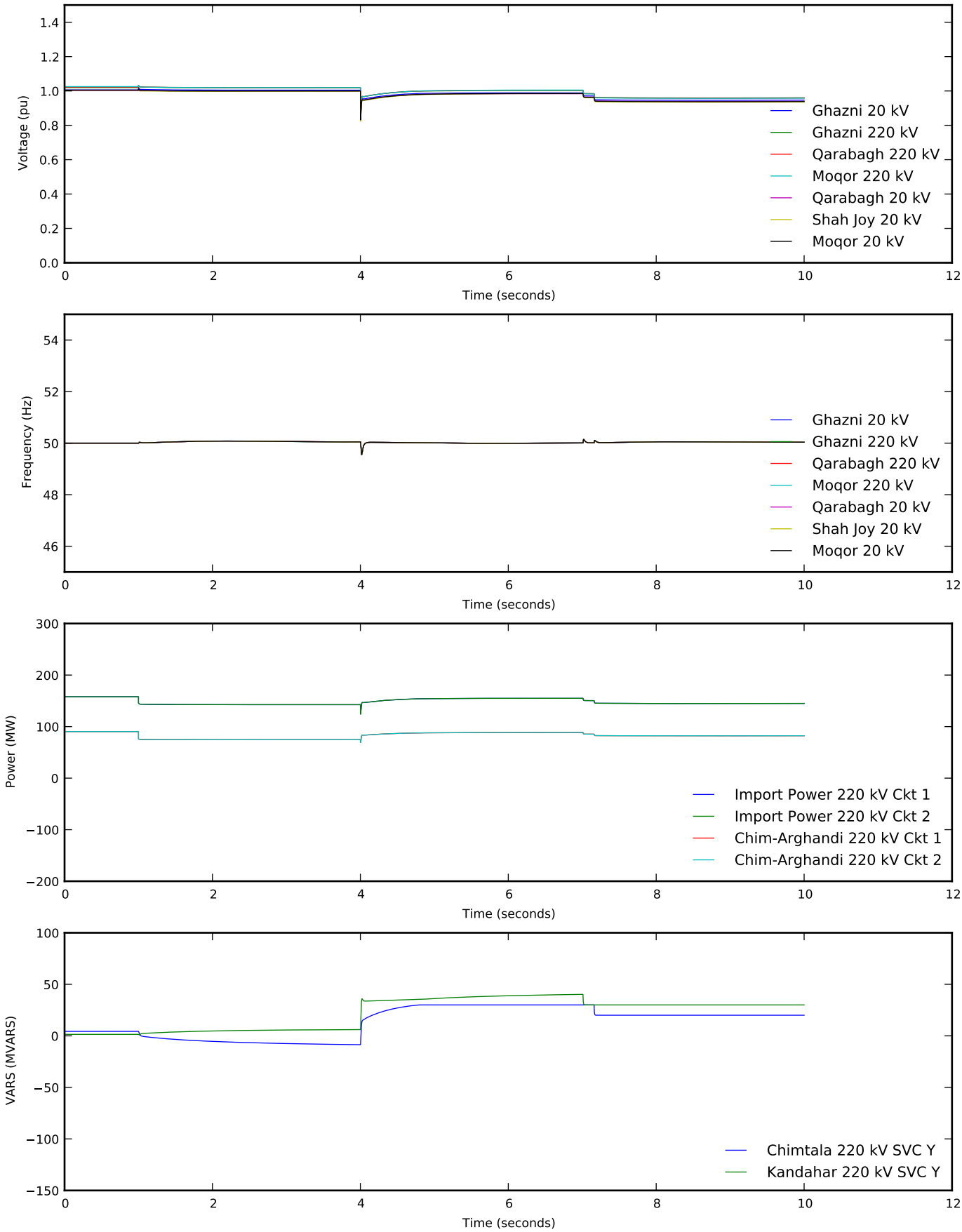
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on largest transformer at Kandahar East w/ Loss of load at BUS 6400.
Fault cleared by disconnecting transformer (FROM 4011 to 6400 ID=2).
Plot File: OUT/LT48_DBL__Base__S13_Kand_XF_Load_Loss.out



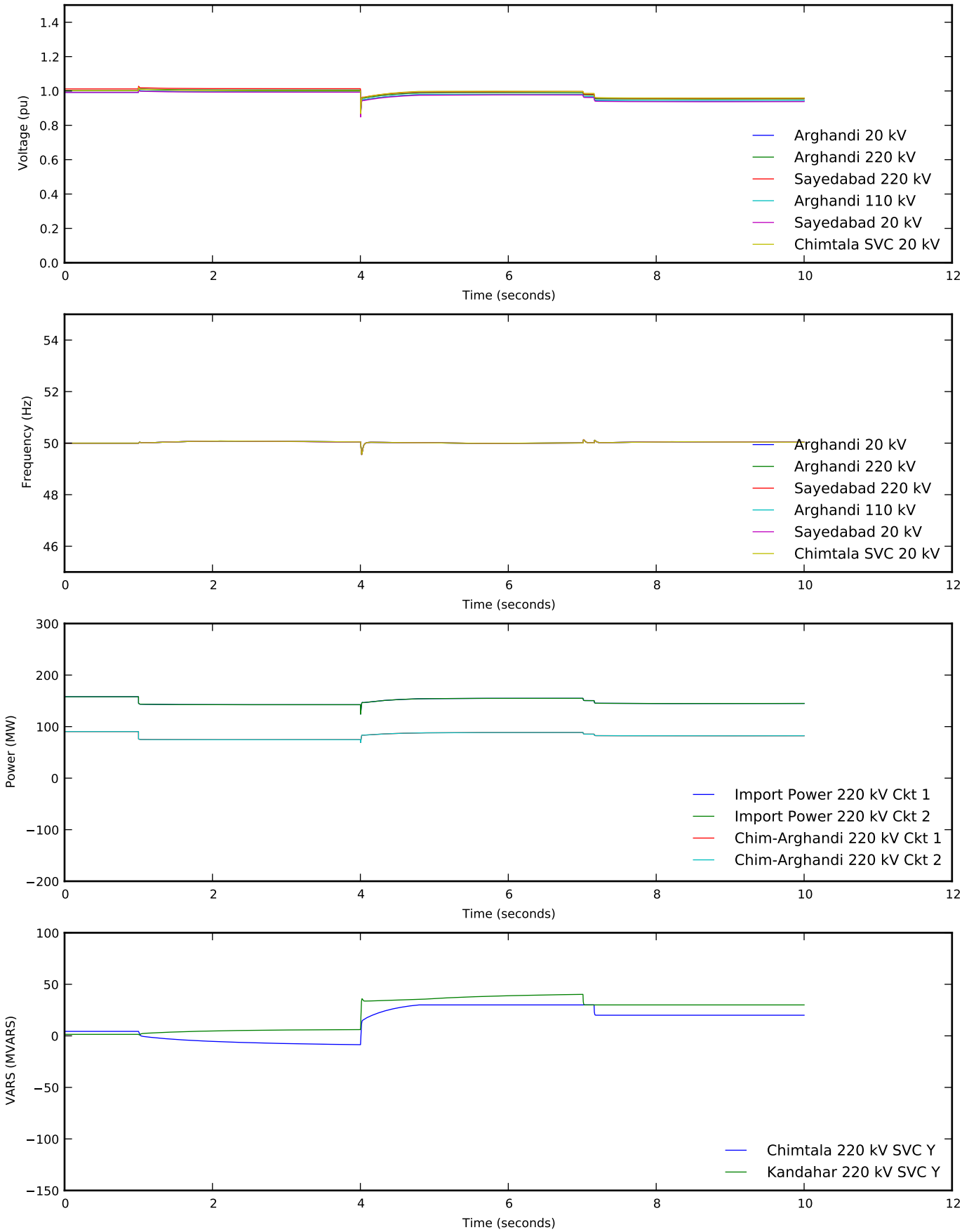
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
30 MW gain of load at Kandahar East.
Simulates turning on largest transformer with all load at Kandahar East.
Plot File: OUT/LT48_DBL__Base__S14_Kand_Load_Increase.out



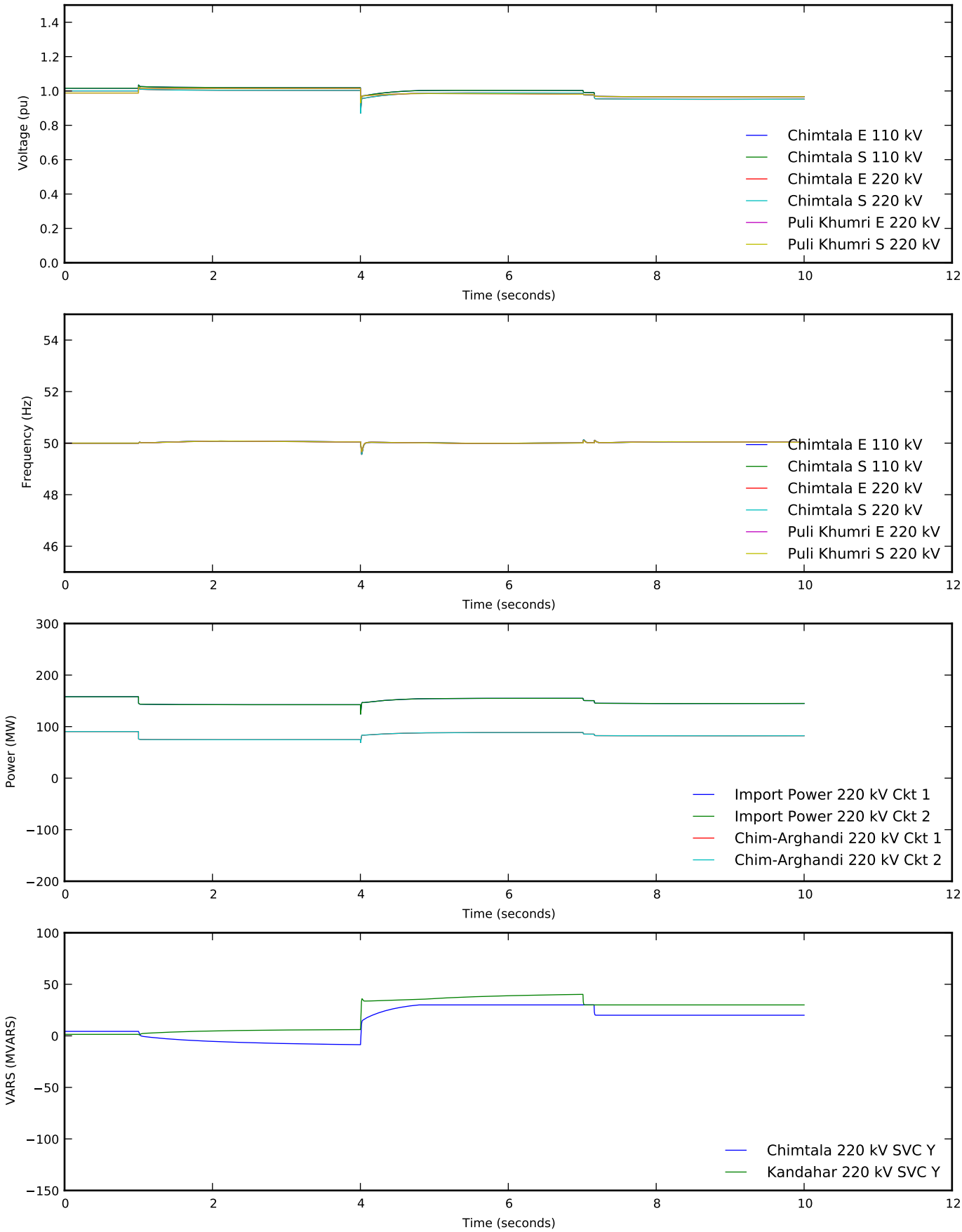
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
30 MW gain of load at Kandahar East.
Simulates turning on largest transformer with all load at Kandahar East.
Plot File: OUT/LT48_DBL__Base__S14_Kand_Load_Increase.out



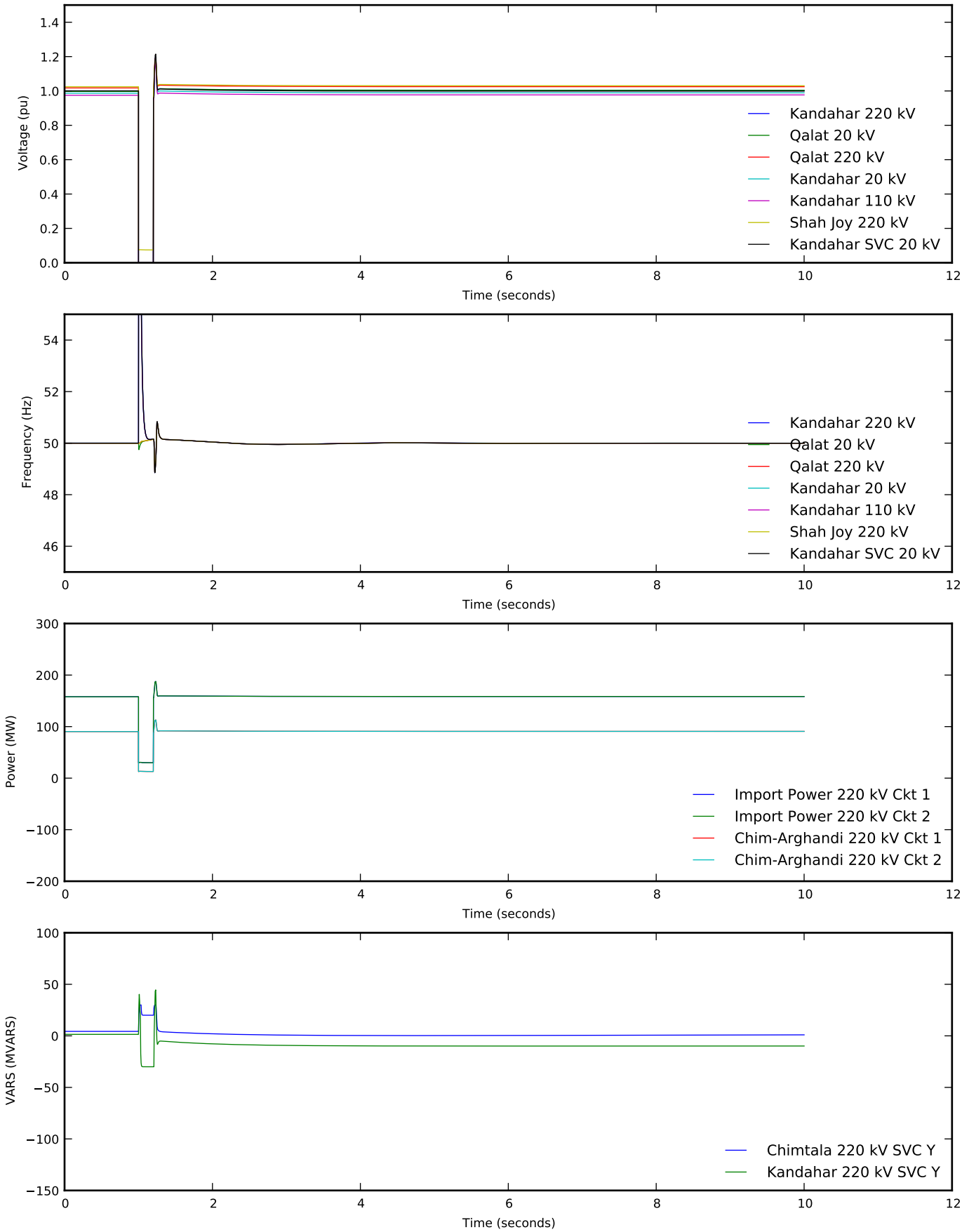
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
30 MW gain of load at Kandahar East.
Simulates turning on largest transformer with all load at Kandahar East.
Plot File: OUT/LT48_DBL__Base__S14_Kand_Load_Increase.out



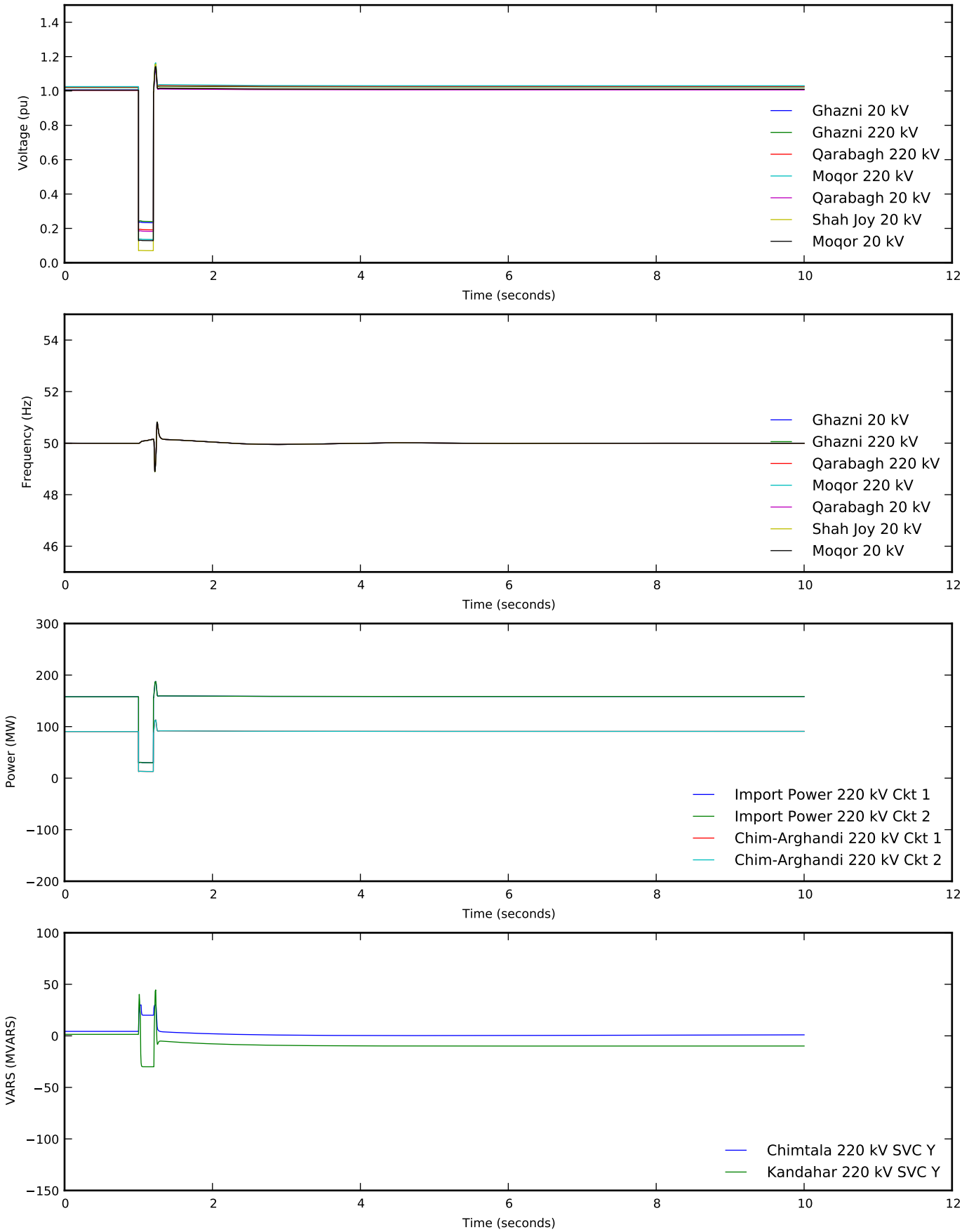
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
30 MW gain of load at Kandahar East.
Simulates turning on largest transformer with all load at Kandahar East.
Plot File: OUT/LT48_DBL__Base__S14_Kand_Load_Increase.out



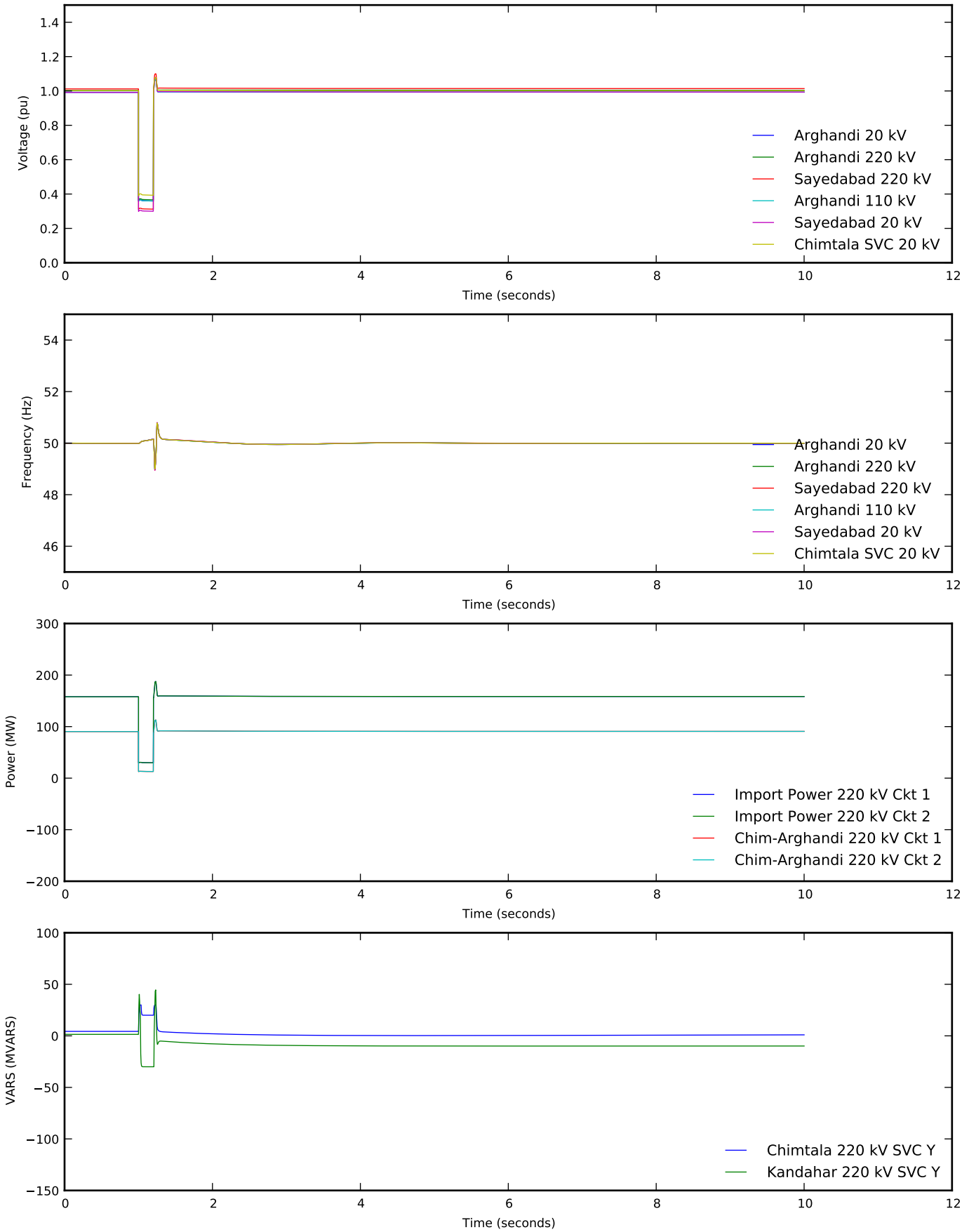
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on MSR at Qalat (4025).
Fault cleared followed by loss of MSR at Qalat.
Plot File: OUT/LT48_DBL__Base__S15_Qalat_MSR_Loss.out



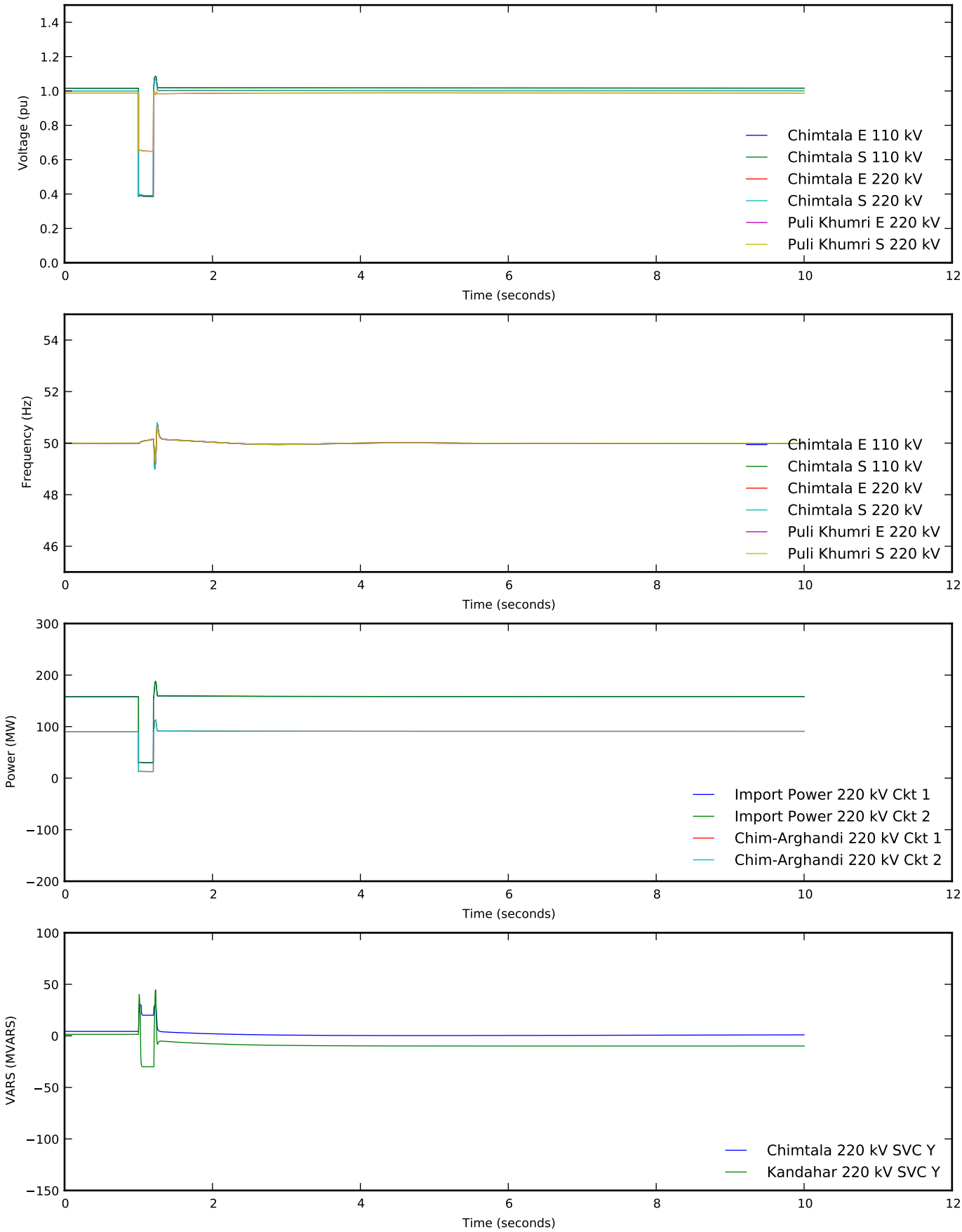
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on MSR at Qalat (4025).
Fault cleared followed by loss of MSR at Qalat.
Plot File: OUT/LT48_DBL__Base__S15_Qalat_MSR_Loss.out



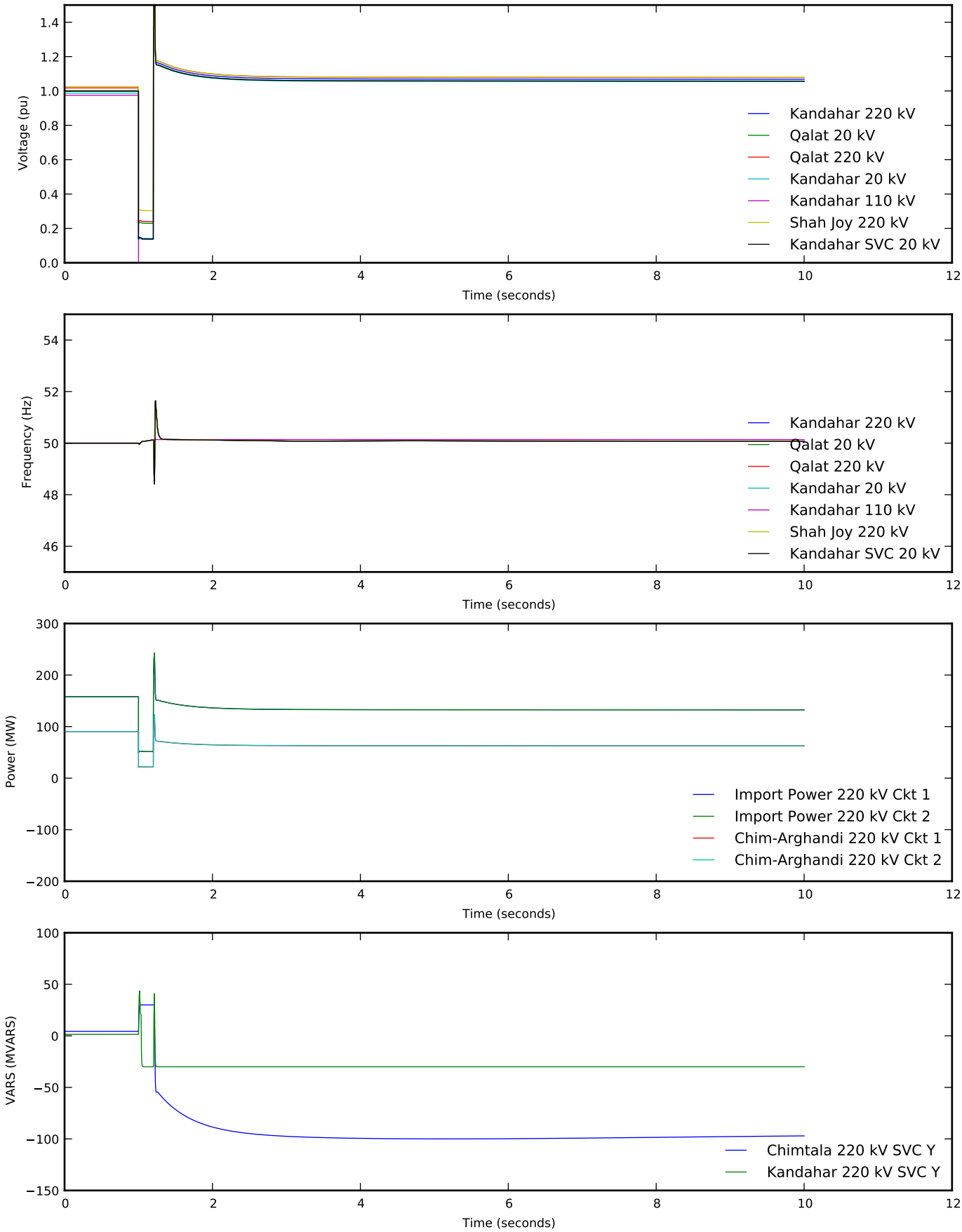
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on MSR at Qalat (4025).
Fault cleared followed by loss of MSR at Qalat.
Plot File: OUT/LT48_DBL__Base__S15_Qalat_MSR_Loss.out



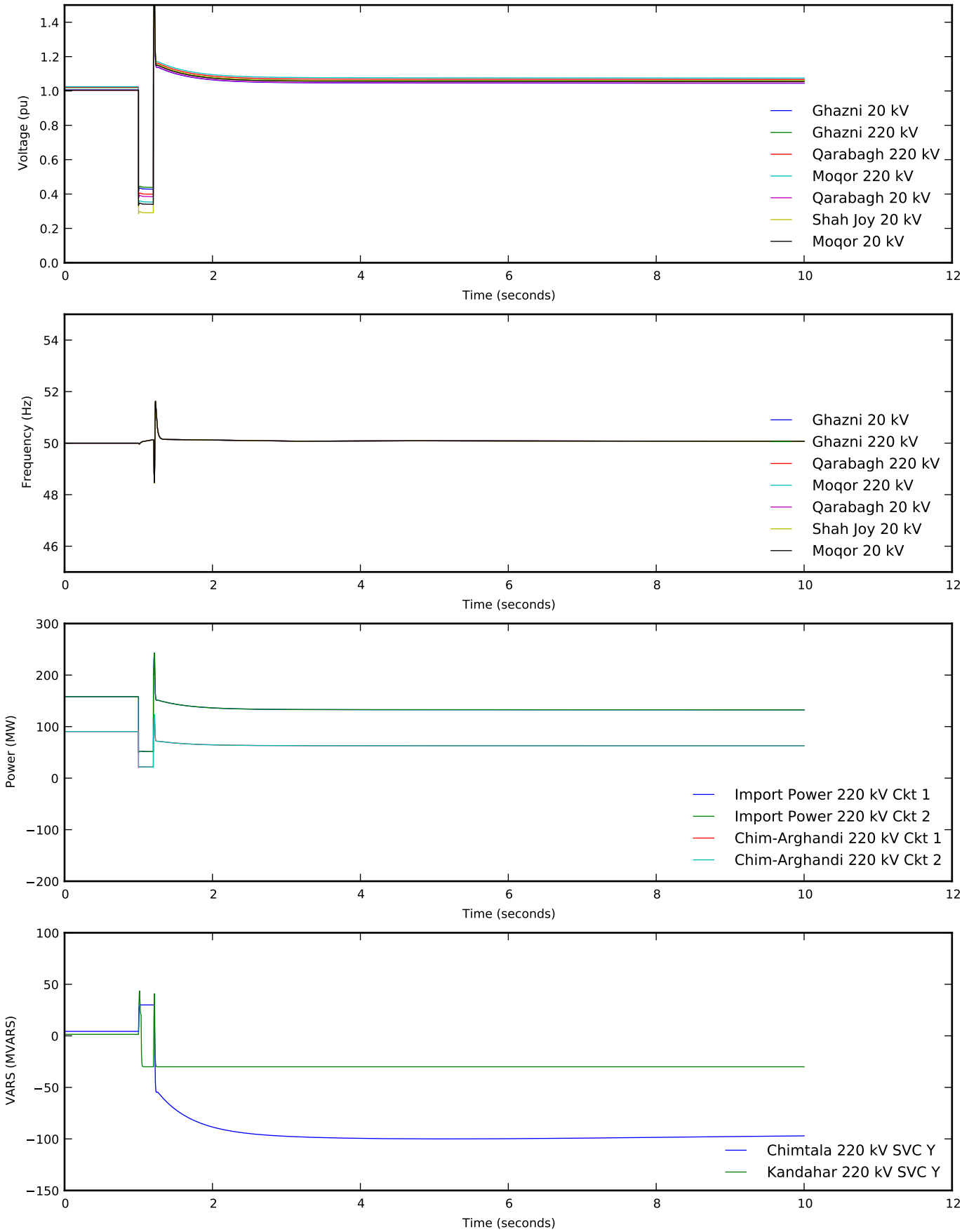
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on MSR at Qalat (4025).
Fault cleared followed by loss of MSR at Qalat.
Plot File: OUT/LT48_DBL__Base__S15_Qalat_MSR_Loss.out



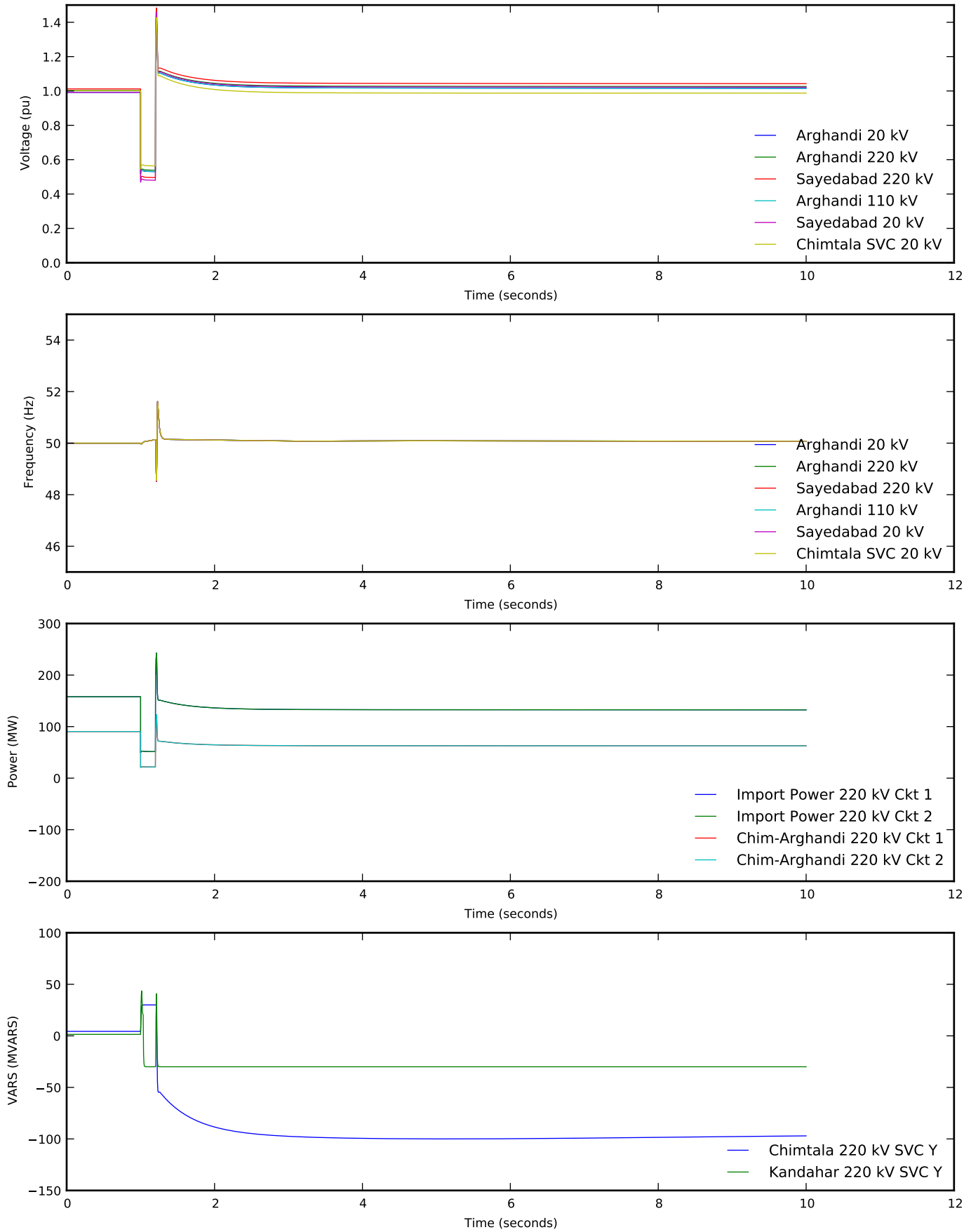
AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on Kandahar East 110 kV Bus w/ Loss of full load at BUS 6400.
Fault cleared by dropping load.
Plot File: OUT/LT48_DBL__Base__S16_Kand_110_Load_Loss.out



AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on Kandahar East 110 kV Bus w/ Loss of full load at BUS 6400.
Fault cleared by dropping load.
Plot File: OUT/LT48_DBL__Base__S16_Kand_110_Load_Loss.out



AFGHANISTAN 2016 MODEL - USAID OCTOBER 2014
DOUBLE CIRCUIT NEPS SEPS CONNECTOR
Fault on Kandahar East 110 kV Bus w/ Loss of full load at BUS 6400.
Fault cleared by dropping load.
Plot File: OUT/LT48_DBL__Base__S16_Kand_110_Load_Loss.out



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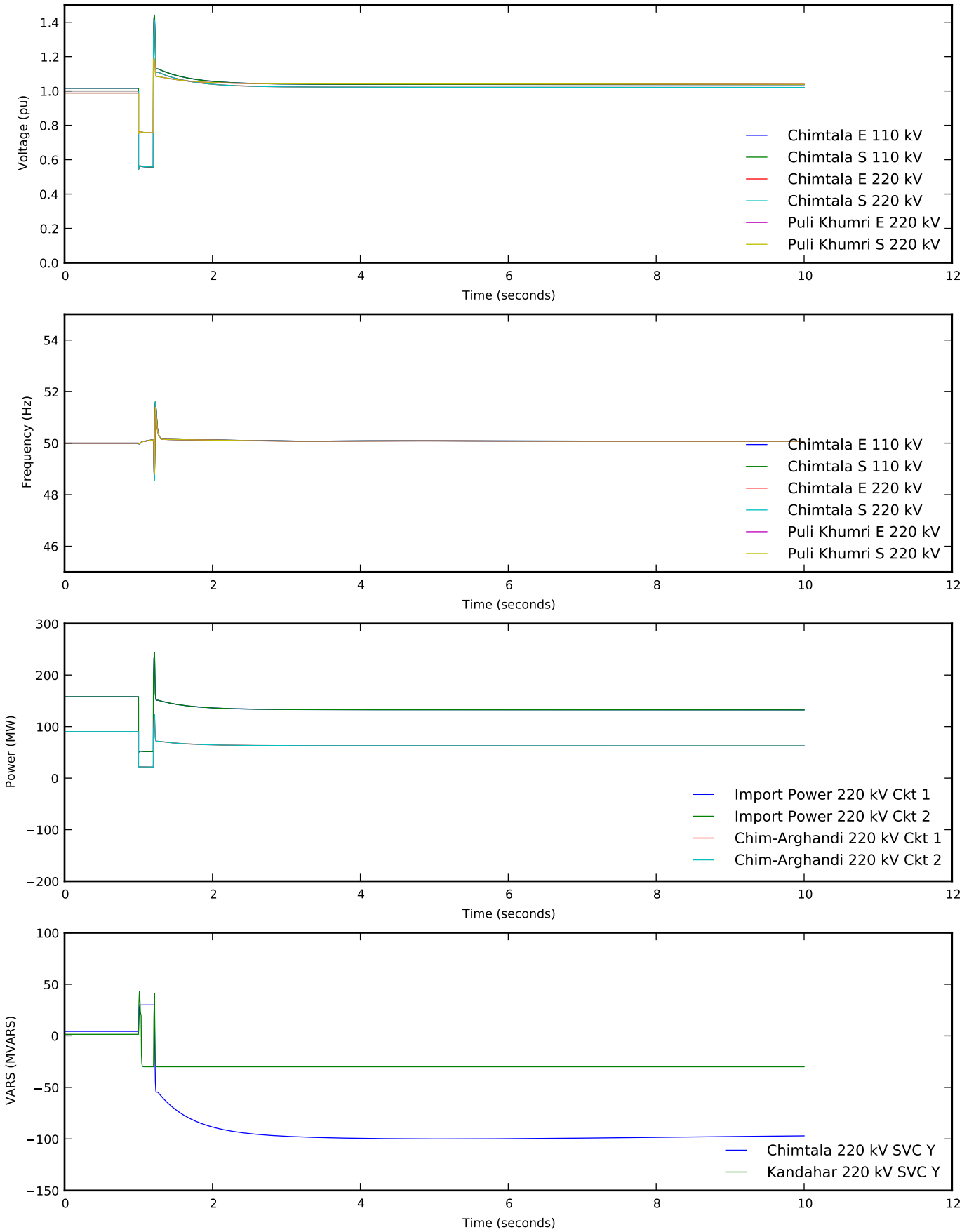

4.2 – PSS/E System Model (see zip file)

AFGHANISTAN ENGINEERING SUPPORT PROGRAM

NEPS/SEPS CONNECTOR FIVE SUBSTATIONS FROM QARABAGH TO KANDAHAR EAST IN ONE LOT

END OF SECTION

PART III CONDITIONS OF CONTRACT AND CONTRACT FORMS

Section 7 - General Conditions of Contract

These General Conditions of Contract (GCC) are based on the Model Form of International Contract for Process Plant Construction published by the Engineering Advancement Association of Japan (ENAA). The Multilateral Development Banks (MDBs) participating in the procurement harmonization process gratefully acknowledge the contribution of ENAA to the advancement of good contracting practices in their member countries. The GCC contain general clauses to be applied on all contracts. The GCC in in this Section, read in conjunction with the Special Conditions of Contract in Section 8 and other documents listed therein should be a complete document expressing all the rights and obligations of the contracting parties. The General Conditions herein shall not be altered.

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General Conditions

A. Contract and Interpretation

1. Definitions 1.1 The following words and expressions shall have the meanings hereby assigned them:

"Contract" means the Contract Agreement entered into between the Employer and the Contractor, together with the Contract Documents referred to therein; they shall constitute the Contract, and the term "the Contract" shall in all such documents be construed accordingly.

"Contract Documents" means the documents listed in Article 1.1 (Contract Documents) of the Contract Agreement (including any amendments thereto).

"GCC" means the General Conditions of Contract.

"SCC" means the Special Conditions of Contract.

"day" means calendar day.

"year" means 365 days.

"month" means calendar month.

"Party" means the Employer or the Contractor, as the context requires.

"Employer" means the person named as such in the SCC and includes the legal successors or permitted assigns of the Employer.

"Project Manager" means the person appointed by the Employer in the manner provided in GCC Sub-Clause 17.1 (Project Manager) hereof and named as such in the SCC to perform the duties delegated by the Employer.

"Contractor" means the person(s) named as Contractor in the Contract Agreement, and includes the legal successors or permitted assigns of the Contractor.

"Contractor's Representative" means any person nominated by the Contractor and approved by the Employer in the manner provided in GCC Sub-Clause 17.2 (Contractor's Representative and Construction Manager) hereof to perform the duties delegated by the Contractor.

"Construction Manager" means the person appointed by the Contractor's Representative in the manner provided in GCC Sub-Clause 17.2.4.

"Subcontractor," including manufacturers, means any person to whom execution of any part of the Facilities, including preparation of any design or supply of any Plant, is sub-contracted directly or indirectly by the Contractor, and includes its legal successors or permitted assigns.

"Dispute Board" (DB) means the person or persons named as such in the SCC appointed by agreement between the Employer and the Contractor to make a decision on or to settle any dispute or

difference between the Employer and the Contractor referred to him or her by the parties pursuant to GCC Sub-Clause 44…. (Dispute Board) hereof.

"The Bank" means the financing institution named in the SCC.

"Contract Price" means the sum specified in Article 2.1 (Contract Price) of the Contract Agreement, subject to such additions and adjustments thereto or deductions there from, as may be made pursuant to the Contract.

"Facilities" means the Plant to be supplied and installed, as well as all the Installation Services to be carried out by the Contractor under the Contract.

"Plant" means permanent plant, equipment, machinery, apparatus, articles and things of all kinds to be provided and incorporated in the Facilities by the Contractor under the Contract (including the spare parts to be supplied by the Contractor under GCC Sub-Clause 7.3 hereof), but does not include Contractor's Equipment.

"Installation Services" means all those services ancillary to the supply of the Plant for the Facilities, to be provided by the Contractor under the Contract, such as transportation and provision of marine or other similar insurance, inspection, expediting, site preparation works (including the provision and use of Contractor's Equipment and the supply of all construction materials required), installation, testing, pre commissioning, commissioning, operations, maintenance, the provision of operations and maintenance manuals, training, etc… as the case may require.

"Contractor's Equipment" means all facilities, equipment, machinery, tools, apparatus, appliances or things of every kind required in or for installation, completion and maintenance of Facilities that are to be provided by the Contractor, but does not include Plant, or other things intended to form or forming part of the Facilities.

"Country of Origin" means the countries and territories eligible under the rules of the Bank as further elaborated in the SCC.

"Site" means the land and other places upon which the Facilities are to be installed, and such other land or places as may be specified in the Contract as forming part of the Site.

"Effective Date" means the date of fulfillment of all conditions stated in Article 3 (Effective Date) of the Contract Agreement, upon which the period until the Time for Completion shall be counted from.

"Time for Completion" means the time within which Completion of the Facilities as a whole (or of a part of the Facilities where a separate Time for Completion of such part has been prescribed) is to be attained, as referred to in GCC Clause 8 and in accordance with the relevant provisions of the Contract.

"Completion" means that the Facilities (or a specific part thereof where specific parts are specified in the Contract) have been completed operationally and structurally and put in a tight and clean condition, that all work in respect of Pre commissioning of the Facilities or such specific part thereof has been completed, and that the Facilities or specific part thereof are ready for Commissioning as provided in GCC

Clause 24 (Completion) hereof.

"Pre commissioning" means the testing, checking and other requirements specified in the Employer's Requirements that are to be carried out by the Contractor in preparation for Commissioning as provided in GCC Clause 24 (Completion) hereof.

"Commissioning" means operation of the Facilities or any part thereof by the Contractor following Completion, which operation is to be carried out by the Contractor as provided in GCC Sub-Clause 25.1 (Commissioning) hereof, for the purpose of carrying out Guarantee Test(s).

"Guarantee Test(s)" means the test(s) specified in the Employer's Requirements to be carried out to ascertain whether the Facilities or a specified part thereof is able to attain the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement in accordance with the provisions of GCC Sub-Clause 25.2 (Guarantee Test) hereof.

"Operational Acceptance" means the acceptance by the Employer of the Facilities (or any part of the Facilities where the Contract provides for acceptance of the Facilities in parts), which certifies the Contractor's fulfillment of the Contract in respect of Functional Guarantees of the Facilities (or the relevant part thereof) in accordance with the provisions of GCC Clause 28 (Functional Guarantees) hereof and shall include deemed acceptance in accordance with GCC Clause 25 (Commissioning and Operational Acceptance) hereof.

"Defect Liability Period" means the period of validity of the warranties given by the Contractor commencing at Completion of the Facilities or a part thereof, during which the Contractor is responsible for defects with respect to the Facilities (or the relevant part thereof) as provided in GCC Clause 27 (Defect Liability) hereof.

2. Contract Documents

2.1 Subject to Article 1.2 (Order of Precedence) of the Contract Agreement, all documents forming part of the Contract (and all parts thereof) are intended to be correlative, complementary and mutually explanatory. The Contract shall be read as a whole.

3. Interpretation

3.1 In the Contract, except where the context requires otherwise:

(a) words indicating one gender include all genders;

(b) words indicating the singular also include the plural and words indicating the plural also include the singular;

(c) provisions including the word "agree", "agreed" or "agreement" require the agreement to be record in writing;

(d) the word "tender" is synonymous with "bid", "tenderer" with "bidder" and "tender documents" with "bidding documents"; and

(e) "written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record.

The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

3.2 <u>Incoterms</u>

Unless inconsistent with any provision of the Contract, the meaning of

any trade term and the rights and obligations of parties thereunder shall be as prescribed by Incoterms.

Incoterms means international rules for interpreting trade terms published by the International Chamber of Commerce (latest edition), 38 Cours Albert 1er, 75008 Paris, France.

3.4 Entire Agreement

Subject to GCC Sub-Clause 16.4 hereof, the Contract constitutes the entire agreement between the Employer and Contractor with respect to the subject matter of Contract and supersedes all communications, negotiations and agreements (whether written or oral) of parties with respect thereto made prior to the date of Contract.

3.5 Amendment

No amendment or other variation of the Contract shall be effective unless it is in writing, is dated, expressly refers to the Contract, and is signed by a duly authorized representative of each party hereto.

3.6 Independent Contractor

The Contractor shall be an independent contractor performing the Contract. The Contract does not create any agency, partnership, joint venture or other joint relationship between the parties hereto. Subject to the provisions of the Contract, the Contractor shall be solely responsible for the manner in which the Contract is performed. All employees, representatives or Subcontractors engaged by the Contractor in connection with the performance of the Contract shall be under the complete control of the Contractor and shall not be deemed to be employees of the Employer, and nothing contained in the Contract or in any subcontract awarded by the Contractor shall be construed to create any contractual relationship between any such employees, representatives or Subcontractors and the Employer.

3.7 Non-Waiver

3.7.1 Subject to GCC Sub-Clause 3.7.2 below, no relaxation, forbearance, delay or indulgence by either party in enforcing any of the terms and conditions of the Contract or the granting of time by either party to the other shall prejudice, affect or restrict the rights of that party under the Contract, nor shall any waiver by either party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract.

3.7.2 Any waiver of a party's rights, powers or remedies under the Contract must be in writing, must be dated and signed by an authorized representative of the party granting such waiver, and must specify the right and the extent to which it is being waived.

3.8 Severability

If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable, such prohibition, invalidity or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract.

3.9 Country of Origin

"Origin" means the place where the plant and component parts thereof are mined, grown, produced or manufactured, and from which the

services are provided. Plant components are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that is substantially in its basic characteristics or in purpose or utility from its components.

4. Communications

4.1 Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be:

(a) in writing and delivered against receipt; and

(b) delivered, sent or transmitted to the address for the recipient's communications as stated in the Contract Agreement.

When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Project Manager, a copy shall be sent to the Project Manager or the other Party, as the case may be.

5. Law and Language

5.1 The Contract shall be governed by and interpreted in accordance with laws of the country specified in the SCC.

5.2 The ruling language of the Contract shall be that stated in the SCC.

5.3 The language for communications shall be the ruling language unless otherwise stated in the SCC.

6. Corrupt Practices

6.1 It is the Government's policy to require that Purchasers, as well as Bidders, Suppliers, and Contractors and their subcontractors under Government-financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts6. In pursuance of this policy, the Government:

(a) Defines, for the purpose of this provision, the terms set forth as follows:

(i) "CORRUPT PRACTICE" is the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party[7];

(ii) "FRAUDULENT PRACTICE" is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party[8] to obtain a financial or other benefit or to avoid an obligation;

(iii) "COLLUSIVE PRACTICE" is an arrangement between two or more parties[9] designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iv) "COERCIVE PRACTICE" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party[10] or the property of the party

[6] *In this context, any action taken by a Bidder, Supplier, Contractor, or a sub-Contractor to influencetheprocurementprocessorcontractexecutionforundueadvantageisimproper.*

[7] *"ANOTHER PARTY" refers to a public official acting in relation to the procurement process or contract execution. In this context, "PUBLIC OFFICIAL" includes Government staff and employees of other organizations taking or reviewing procurement decisions.*

[8] *A "PARTY" refers to a public official; the terms "BENEFIT" and "OBLIGATION" relate to the procurement process or contract execution; and the "ACT OR OMISSION" is intended to influence the procurement process contract execution.*

[9] *"PARTIES" refers to participants in the procurement process (including officials) attempting to establish Bid prices at artificial, noncompetitive levels.*

to influence improperly the actions of a party;

(v) "OBSTRUCTIVE PRACTICE" is

- Deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Government investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or
- Acts intended to materially impede the exercise of the Government's inspection and audit rights provided for under sub-clause 3.1(e) below.

(b) Will reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for the contract in question;

(c) Will sanction and prosecute any procurement official if it is found at any time that representative of the procuring entity engaged in corrupt, fraudulent, collusive ,coercive or obstructive practices during the procurement or the execution of the contract, without the procuring entity having taken timely and appropriate action satisfactory to the Government to address such practices when they occur;

(d) Will sanction a firm or individual, including declaring ineligible, either indefinitely or for a stated period of time, to be awarded a GoA financed contract if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for, or in executing, a GoA financed contract; and

(e) Will have the right to require that a provision be included in bidding documents and in contracts financed by the GoA, requiring Bidders, suppliers, and contractors and their sub-contractors to permit the Government to inspect their accounts and records and other documents relating to the Bid submission and contract performance and to have them audited by auditors appointed by the Government.

B. Subject Matter of Contract

7. Scope of Facilities

7.1 Unless otherwise expressly limited in the Employer's Requirements, the Contractor's obligations cover the provision of all Plant and the performance of all Installation Services required for the design, the manufacture (including procurement, quality assurance, construction, installation, associated civil works, Pre commissioning and delivery) of the Plant and the installation, completion and commissioning of the Facilities in accordance with the plans, procedures, specifications, drawings, codes and any other documents as specified in the Section, Employer's Requirements. Such specifications include, but are not limited to, the provision of supervision and engineering services; the supply of labor, materials, equipment, spare parts (as specified in GCC Sub-Clause 7.3 below) and accessories; Contractor's Equipment; construction utilities and supplies; temporary materials, structures and

[10] *a "PARTY" refers to a participant in the procurement process or contract execution.*

facilities; transportation (including, without limitation, unloading and hauling to, from and at the Site); and storage, except for those supplies, works and services that will be provided or performed by the Employer, as set forth in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement.

7.2 The Contractor shall, unless specifically excluded in the Contract, perform all such work and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for attaining Completion of the Facilities as if such work and/or items and materials were expressly mentioned in the Contract.

7.3 In addition to the supply of Mandatory Spare Parts included in the Contract, the Contractor agrees to supply spare parts required for the operation and maintenance of the Facilities for the period specified in the SCC and the provisions, if any, specified in the SCC. However, the identity, specifications and quantities of such spare parts and the terms and conditions relating to the supply thereof are to be agreed between the Employer and the Contractor, and the price of such spare parts shall be that given in Price Schedule No. 6, which shall be added to the Contract Price. The price of such spare parts shall include the purchase price therefore and other costs and expenses (including the Contractor's fees) relating to the supply of spare parts.

8. Time for Commencement and Completion

8.1 The Contractor shall commence work on the Facilities within the period specified in the SCC and without prejudice to GCC Sub-Clause 26.2 hereof, the Contractor shall thereafter proceed with the Facilities in accordance with the time schedule specified in the Appendix 4 (Time Schedule) to the Contract Agreement.

8.2 The Contractor shall attain Completion of the Facilities or of a part where a separate time for Completion of such part is specified in the Contract, within the time stated in the SCC or within such extended time to which the Contractor shall be entitled under GCC Clause 40 hereof.

9. Contractor's Responsibilities

9.1 The Contractor shall design, manufacture including associated purchases and/or subcontracting, install and complete the Facilities in accordance with the Contract. When completed, the Facilities should be fit for the purposes for which they are intended as defined in the Contract.

9.2 The Contractor confirms that it has entered into this Contract on the basis of a proper examination of the data relating to the Facilities including any data as to boring tests provided by the Employer, and on the basis of information that the Contractor could have obtained from a visual inspection of the Site if access thereto was available and of other data readily available to it relating to the Facilities as of the date twenty-eight (28) days prior to bid submission. The Contractor acknowledges that any failure to acquaint itself with all such data and information shall not relieve its responsibility for properly estimating the difficulty or cost of successfully performing the Facilities.

9.3 The Contractor shall acquire and pay for all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located which such authorities or undertakings require the Contractor to obtain in its name and which are necessary for the performance of the Contract, including, without limitation, visas for the Contractor's and Subcontractor's personnel and entry permits for all imported Contractor's Equipment. The Contractor shall acquire all other permits, approvals and/or licenses that are not the responsibility of the

Employer under GCC Sub-Clause 10.3 hereof and that are necessary for the performance of the Contract.

9.4 The Contractor shall comply with all laws in force in the country where the Facilities are to be implemented. The laws will include all local, state, national or other laws that affect the performance of the Contract and bind upon the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any and all liabilities, damages, claims, fines, penalties and expenses of whatever nature arising or resulting from the violation of such laws by the Contractor or its personnel, including the Subcontractors and their personnel, but without prejudice to GCC Sub-Clause 10.1 hereof.

9.5 Any plant and services that will be incorporated in or be required for the Facilities and other supplies shall have their origin as specified under GCC Clause 1 (Country of Origin). Any subcontractors retained by the Contractor shall be from a country as specified in GCC Clause 1 (Country of Origin).

9.6 The Contractor shall permit the Bank to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the Bank, if so required by the Bank.

9.7 If the Contractor is a joint venture or consortium of two or more persons, all such persons shall be jointly and severally bound to the Employer for the fulfillment of the provisions of the Contract and shall designate one of such *persons* to act as a leader with authority to bind the joint venture or consortium. The composition or the constitution of the joint venture or consortium shall not be altered without the prior consent of the Employer.

10. Employer's Responsibilities

10.1 All information and/or data to be supplied by the Employer as described in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement shall be deemed to be accurate, except when the Employer expressly states otherwise.

10.2 The Employer shall be responsible for acquiring and providing legal and physical possession of the Site and access thereto, and for providing possession of and access to all other areas reasonably required for the proper execution of the Contract, including all requisite rights of way, as specified in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement. The Employer shall give full possession of an accord all rights of access thereto on or before the date(s) specified in that Appendix.

10.3 The Employer shall acquire and pay for all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located which (a) such authorities or undertakings require the Employer to obtain in the Employer's name, (b) are necessary for the execution of the Contract, including those required for the performance by both the Contractor and the Employer of their respective obligations under the Contract, and (c) are specified in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement.

10.4 If requested by the Contractor, the Employer shall use its best endeavors to assist the Contractor in obtaining in a timely and expeditious manner all permits, approvals and/or licenses necessary for the execution of the Contract from all local, state or national government authorities or public service undertakings that such

authorities or undertakings require the Contractor or Subcontractors or the personnel of the Contractor or Subcontractors, as the case may be, to obtain.

10.5 Unless otherwise specified in the Contract or agreed upon by the Employer and the Contractor, the Employer shall provide sufficient, properly qualified operating and maintenance personnel; shall supply and make available all raw materials, utilities, lubricants, chemicals, catalysts, other materials and facilities; and shall perform all work and services of whatsoever nature, including those required by the Contractor to properly carry out Pre commissioning, Commissioning and Guarantee Tests, all in accordance with the provisions of the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement at or before the time specified in the program furnished by the Contractor under GCC Sub-Clause 18.2 hereof and in the manner thereupon specified or as otherwise agreed upon by the Employer and the Contractor.

10.6 The Employer shall be responsible for the continued operation of the Facilities after Completion, in accordance with GCC Sub-Clause 24.8, and shall be responsible for facilitating the Guarantee Test(s) for the Facilities, in accordance with GCC Sub-Clause 25.2.

10.7 All costs and expenses involved in the performance of the obligations under this GCC Clause 10 shall be the responsibility of the Employer, except those incurred by the Contractor with respect to the performance of Guarantee Tests, in accordance with GCC Sub-Clause 25.2.

10.8 In the event that the Employer shall be in breach of any of his obligations imposed by the Contract, then the additional cost reasonably incurred by the Contractor in consequence thereof shall be added to the Contract Price.

C. Payment

11. Contract Price

11.1 The Contract Price shall be as specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement.

11.2 Unless an escalation clause is provided for in the SCC, the Contract Price shall be a firm lump sum not subject to any alteration, except in the event of a Change in the Facilities or as otherwise provided in the Contract.

11.3 Subject to GCC Sub-Clauses 9.2, 10.1 and 35 hereof, the Contractor shall be deemed to have satisfied itself as to the correctness and sufficiency of the Contract Price, which shall, except as otherwise provided for in the Contract, cover all its obligations under the Contract.

12. Terms of Payment

12.1 The Contract Price shall be paid as specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement and in the Appendix (Terms and Procedures of Payment) to the Contract Agreement, which also outlines the procedures to be followed in making application for and processing payments.

12.2 No payment made by the Employer herein shall be deemed to constitute acceptance by the Employer of the Facilities or any part(s) thereof.

12.3 In the event that the Employer fails to make any payment by its respective due date or within the period set forth in the Contract, the

Employer shall pay to the Contractor interest on the amount of such delayed payment at the rate(s) shown in the Appendix (Terms and Procedures of Payment) to the Contract Agreement for the period of delay until payment has been made in full, whether before or after judgment or arbitrage award.

12.4 The currency or currencies in which payments are made to the Contractor under this Contract shall be specified in the Appendix(Terms and Procedures of Payment) to the Contract Agreement, subject to the general principle that payments will be made in the currency or currencies in which the Contract Price has been stated in the Contractor's bid.

13. Securities

13.1 Issuance of Securities

The Contractor shall provide the securities specified below in favor of the Employer at the times, and in the amount, manner and form specified below.

13.2 Mobilization Payment Security

13.2.1 The Contractor shall, within twenty-eight (28) days of the notification of contract award, provide a security in an amount equal to the advance payment calculated in accordance with the Appendix (Terms and Procedures of Payment) to the Contract Agreement, and in the same currency or currencies.

13.2.2 The security shall be in the form provided in the bidding documents or in another form acceptable to the Employer. The amount of the security shall be reduced in proportion to the value of the Facilities executed by and paid to the Contractor from time to time, and shall automatically become null and void when the full amount of the mobilization payment has been recovered by the Employer. The security shall be returned to the Contractor immediately after its expiration.

13.3 Performance Security

13.3.1 The Contractor shall, within twenty-eight (28) days of the notification of contract award, provide a security for the due performance of the Contract in the amount specified in the SCC.

13.3.2 The security shall be denominated in the currency or currencies of the Contract, or in a freely convertible currency acceptable to the Employer, and shall be in one of the forms *of bank guarantees* provided in the bidding documents, as stipulated by the Employer in the SCC, or in another form acceptable to the Employer.

13.3.3 Unless otherwise specified in the SCC, the security shall be reduced by half on the date of the Operational Acceptance. The Security shall become null and void, or shall be reduced pro rata to the Contract Price of a part of the Facilities for which a separate Time for Completion is provided, five hundred and forty (540) days after Completion of the Facilities or three hundred and sixty five (365) days after Operational Acceptance of the Facilities, whichever occurs first; provided, however, that if the Defects Liability Period has been extended on any part of the Facilities pursuant to GCC Sub-Clause 27.8 hereof, the Contractor shall issue an additional security in an amount proportionate to the Contract Price of that part. The security shall be returned to the Contractor immediately after its expiration, provided, however, that if the Contractor, pursuant to GCC Sub-Clause 27.10, is liable for an extended defect liability

obligation, the performance security shall be extended for the period and up to the amount specified in the SCC.

14. Taxes and Duties

14.1 Except as otherwise specifically provided in the Contract, the Contractor shall bear and pay all taxes, duties, levies and charges assessed on the Contractor, its Subcontractors or their employees by all municipal, state or national government authorities in connection with the Facilities in and outside of the country where the Site is located.

14.2 Notwithstanding GCC Sub-Clause 14.1 above, the Employer shall bear and promptly pay all customs and import duties as well as other local taxes like, e.g., a value added tax (VAT), imposed by the law of the country where the Site is located on the Plant specified in Price Schedule No. 2 and that are to be incorporated into the Facilities.

14.3 If any tax exemptions, reductions, allowances or privileges may be available to the Contractor in the country where the Site is located, the Employer shall use its best endeavors to enable the Contractor to benefit from any such tax savings to the maximum allowable extent.

14.4 For the purpose of the Contract, it is agreed that the Contract Price specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement is based on the taxes, duties, levies and charges prevailing at the date twenty-eight (28) days prior to the date of bid submission in the country where the Site is located (hereinafter called "Tax" in this GCC Sub-Clause 14.4). If any rates of Tax are increased or decreased, a new Tax is introduced, an existing Tax is abolished, or any change in interpretation or application of any Tax occurs in the course of the performance of Contract, which was or will be assessed on the Contractor, Subcontractors or their employees in connection with performance of the Contract, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition to the Contract Price or deduction therefrom, as the case may be, in accordance with GCC Clause 36 hereof.

D. Intellectual Property

15. License/Use of Technical Information

15.1 For the operation and maintenance of the Plant, the Contractor hereby grants a non-exclusive and non-transferable license (without the right to sub-license) to the Employer under the patents, utility models or other industrial property rights owned by the Contractor or by a third party from whom the Contractor has received the right to grant licenses thereunder, and shall also grant to the Employer a non-exclusive and non-transferable right (without the right to sub-license) to use the know-how and other technical information disclosed to the Employer under the Contract. Nothing contained herein shall be construed as transferring ownership of any patent, utility model, trademark, design, copyright, know-how or other intellectual property right from the Contractor or any third party to the Employer.

15.2 The copyright in all drawings, documents and other materials containing data and information furnished to the Employer by the Contractor herein shall remain vested in the Contractor or, if they are furnished to the Employer directly or through the Contractor by any third party, including suppliers of materials, the copyright in such

materials shall remain vested in such third party.

16. Confidential Information

16.1 The Employer and the Contractor shall keep confidential and shall not, without the written consent of the other party hereto, divulge to any third party any documents, data or other information furnished directly or indirectly by the other party hereto in connection with the Contract, whether such information has been furnished prior to, during or following termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Subcontractor(s) such documents, data and other information it receives from the Employer to the extent required for the Subcontractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Subcontractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this GCC Clause 16.

16.2 The Employer shall not use such documents, data and other information received from the Contractor for any purpose other than the operation and maintenance of the Facilities. Similarly, the Contractor shall not use such documents, data and other information received from the Employer for any purpose other than the design, procurement of Plant, construction or such other work and services as are required for the performance of the Contract.

16.3 The obligation of a party under GCC Sub-Clauses 16.1 and 16.2 above, however, shall not apply to that information which

(a) now or hereafter enters the public domain through no fault of that party

(b) can be proven to have been possessed by that party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other party hereto

(c) otherwise lawfully becomes available to that party from a third party that has no obligation of confidentiality.

16.4 The above provisions of this GCC Clause 16 shall not in any way modify any undertaking of confidentiality given by either of the parties hereto prior to the date of the Contract in respect of the Facilities or any part thereof.

16.5 The provisions of this GCC Clause 16 shall survive termination, for whatever reason, of the Contract.

E. Execution of the Facilities

17. Representatives

17.1 Project Manager

If the Project Manager is not named in the Contract, then within fourteen (14) days of the Effective Date, the Employer shall appoint and notify the Contractor in writing of the name of the Project Manager. The Employer may from time to time appoint some other person as the Project Manager in place of the person previously so appointed, and shall give a notice of the name of such other person to the Contractor without delay. No such appointment shall be made at such a time or in such a manner as to impede the progress of work on the Facilities. Such appointment shall only take effect upon receipt of such notice by the Contractor. The Project Manager shall represent and act for the Employer at all times during the performance of the Contract. All notices, instructions, orders,

certificates, approvals and all other communications under the Contract shall be given by the Project Manager, except as herein otherwise provided.

All notices, instructions, information and other communications given by the Contractor to the Employer under the Contract shall be given to the Project Manager, except as herein otherwise provided.

17.2 Contractor's Representative & Construction Manager

17.2.1 If the Contractor's Representative is not named in the Contract, then within fourteen (14) days of the Effective Date, the Contractor shall appoint the Contractor's Representative and shall request the Employer in writing to approve the person so appointed. If the Employer makes no objection to the appointment within fourteen (14) days, the Contractor's Representative shall be deemed to have been approved. If the Employer objects to the appointment within fourteen (14) days giving the reason therefore, then the Contractor shall appoint a replacement within fourteen (14) days of such objection, and the foregoing provisions of this GCC Sub-Clause 17.2.1 shall apply thereto.

17.2.2 The Contractor's Representative shall represent and act for the Contractor at all times during the performance of the Contract and shall give to the Project Manager all the Contractor's notices, instructions, information and all other communications under the Contract.

All notices, instructions, information and all other communications given by the Employer or the Project Manager to the Contractor under the Contract shall be given to the Contractor's Representative or, in its absence, its deputy, except as herein otherwise provided.

The Contractor shall not revoke the appointment of the Contractor's Representative without the Employer's prior written consent, which shall not be unreasonably withheld. If the Employer consents thereto, the Contractor shall appoint some other person as the Contractor's Representative, pursuant to the procedure set out in GCC Sub-Clause 17.2.1.

17.2.3 The Contractor's Representative may, subject to the approval of the Employer which shall not be unreasonably withheld, at any time delegate to any person any of the powers, functions and authorities vested in him or her. Any such delegation may be revoked at any time. Any such delegation or revocation shall be subject to a prior notice signed by the Contractor's Representative, and shall specify the powers, functions and authorities thereby delegated or revoked. No such delegation or revocation shall take effect unless and until a copy thereof has been delivered to the Employer and the Project Manager.

Any act or exercise by any person of powers, functions and authorities so delegated to him or her in accordance with this GCC Sub-Clause 17.2.3 shall be deemed to be an act or exercise by the Contractor's Representative.

17.2.4 From the commencement of installation of the Facilities at the Site until Completion, the Contractor's Representative shall appoint a suitable person as the Construction Manager. The Construction Manager shall supervise all work done at the Site by the Contractor and shall be present at the Site throughout normal working hours except when on leave, sick or absent for reasons

connected with the proper performance of the Contract. Whenever the Construction Manager is absent from the Site, the Contractor's Representative or the Construction Manager shall appoint a suitable person to act as the Construction Manager's deputy.

17.2.5 The Employer may by notice to the Contractor object to any representative or person employed by the Contractor in the execution of the Contract who, in the reasonable opinion of the Employer, may behave inappropriately, may be incompetent or negligent, or may commit a serious breach of the Site regulations provided under GCC Sub-Clause 22.4. The Employer shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities.

17.2.6 If any representative or person employed by the Contractor is removed in accordance with GCC Sub-Clause 17.2.5, the Contractor shall, where required, promptly appoint a replacement.

18. Work Program

18.1 Contractor's Organization

The Contractor shall supply to the Employer and the Project Manager a chart showing the proposed organization to be established by the Contractor for carrying out work on the Facilities within twenty-one (21) days of the Effective Date. The chart shall include the identities of the key personnel and the curricula vitae of such key personnel to be employed shall be supplied together with the chart. The Contractor shall promptly inform the Employer and the Project Manager in writing of any revision or alteration of such an organization chart.

18.2 Program of Performance

Within twenty-eight (28) days after the Effective Date, the Contractor shall submit to the Project Manager a detailed program of performance of the Contract, made in a form acceptable to the Project Manager and showing the sequence in which it proposes to design, manufacture, transport, assemble, install and precommission the Facilities, as well as the date by which the Contractor reasonably requires that the Employer shall have fulfilled its obligations under the Contract so as to enable the Contractor to execute the Contract in accordance with the program and to achieve Completion, Commissioning and Acceptance of the Facilities in accordance with the Contract. The program so submitted by the Contractor shall accord with the Time Schedule included in the Appendix (Time Schedule) to the Contract Agreement and any other dates and periods specified in the Contract. The Contractor shall update and revise the program as and when appropriate or when required by the Project Manager, but without modification in the Times for Completion given in the SCC and any extension granted in accordance with GCC Clause 40, and shall submit all such revisions to the Project Manager.

18.3 Progress Report

The Contractor shall monitor progress of all the activities specified in the program referred to in GCC Sub-Clause 18.2 above, and supply a progress report to the Project Manager every month.

The progress report shall be in a form acceptable to the Project Manager and shall indicate: (a) percentage completion achieved compared with the planned percentage completion for each activity; and (b) where any activity is behind the program, giving comments and likely consequences and stating the corrective action being

taken.

18.4 Progress of Performance

If at any time the Contractor's actual progress falls behind the program referred to in GCC Sub-Clause 18.2, or it becomes apparent that it will so fall behind, the Contractor shall, at the request of the Employer or the Project Manager, prepare and submit to the Project Manager a revised program, taking into account the prevailing circumstances, and shall notify the Project Manager of the steps being taken to expedite progress so as to attain Completion of the Facilities within the Time for Completion under GCC Sub-Clause 8.2, any extension thereof entitled under GCC Sub-Clause 40.1, or any extended period as may otherwise be agreed upon between the Employer and the Contractor.

18.5 Procedures

The Contract shall be executed in accordance with the Contract Documents including the procedures given in the Forms and Procedures of the Employer's Requirements.

The Contractor may execute the Contract in accordance with its own standard project execution plans and procedures to the extent that they do not conflict with the provisions contained in the Contract.

19.Subcontracting

19.1 The Appendix 7 (List of Major Items of Supply and Services and List of Approved Subcontractors) to the Contract Agreement specifies major items of supply or services and a list of approved Subcontractors against each item, including manufacturers. Insofar as no Subcontractors are listed against any such item, the Contractor shall prepare a list of Subcontractors for such item for inclusion in such list. The Contractor may from time to time propose any addition to or deletion from any such list. The Contractor shall submit any such list or any modification thereto to the Employer for its approval in sufficient time so as not to impede the progress of work on the Facilities. Such approval by the Employer for any of the Subcontractors shall not relieve the Contractor from any of its obligations, duties or responsibilities under the Contract.

19.2 The Contractor shall select and employ its Subcontractors for such major items from those listed in the lists referred to in GCC Sub-Clause 19.1.

19.3 For items or parts of the Facilities not specified in the Appendix (List of Major Items of Supply and Services and List of Approved Subcontractors for Major Items) to the Contract Agreement, the Contractor may employ such Subcontractors as it may select, at its discretion.

19.4 Each sub-contract shall include provisions which would entitle the Employer to require the sub-contract to be assigned to the Employer under GCC 19.5 (if and when applicable), or in event of termination by the Employer under GCC 42.2.

19.5 If a sub-contractor's obligations extend beyond the expiry date of the relevant Defects Liability Period and the Project Manager, prior to that date, instructs the Contractor to assign the benefits of such obligations to the Employer, then the Contractor shall do so.

20. Design and Engineering

20.1 Specifications and Drawings

20.1.1 The Contractor shall execute the basic and detailed design and the engineering work in compliance with the provisions

of the Contract, or where not so specified, in accordance with good engineering practice.

The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents that it has prepared, whether such specifications, drawings and other documents have been approved by the Project Manager or not, provided that such discrepancies, errors or omissions are not because of inaccurate information furnished in writing to the Contractor by or on behalf of the Employer.

20.1.2 The Contractor shall be entitled to disclaim responsibility for any design, data, drawing, specification or other document, or any modification thereof provided or designated by or on behalf of the Employer, by giving a notice of such disclaimer to the Project Manager.

20.2 Codes and Standards

Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date twenty-eight (28) days prior to date of bid submission shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied subject to approval by the Employer and shall be treated in accordance with GCC Clause 39.

20.3 Approval/Review of Technical Documents by Project Manager

20.3.1 The Contractor shall prepare or cause its Subcontractors to prepare, and furnish to the Project Manager the documents listed in the Appendix (List of Documents for Approval or Review) to the Contract Agreement for its approval or review as specified and in accordance with the requirements of GCC Sub-Clause 18.2 (Program of Performance).

Any part of the Facilities covered by or related to the documents to be approved by the Project Manager shall be executed only after the Project Manager's approval thereof.

GCC Sub-Clauses 20.3.2 through 20.3.7 shall apply to those documents requiring the Project Manager's approval, but not to those furnished to the Project Manager for its review only.

20.3.2 Within fourteen (14) days after receipt by the Project Manager of any document requiring the Project Manager's approval in accordance with GCC Sub-Clause 20.3.1, the Project Manager shall either return one copy thereof to the Contractor with its approval endorsed thereon or shall notify the Contractor in writing of its disapproval thereof and the reasons therefore and the modifications that the Project Manager proposes.

If the Project Manager fails to take such action within the said fourteen (14) days, then the said document shall be deemed to have been approved by the Project Manager.

20.3.3 The Project Manager shall not disapprove any document, except on the grounds that the document does not comply with the Contract or that it is contrary to good engineering practice. If the Project Manager disapproves a document, he shall specify the

reasons for his decision.

20.3.4 If the Project Manager disapproves the document, the Contractor shall modify the document and resubmit it for the Project Manager's approval in accordance with GCC Sub-Clause 20.3.2. If the Project Manager approves the document subject to modification(s), the Contractor shall make the required modification(s), whereupon the document shall be deemed to have been approved.

20.3.5 If any dispute or difference occurs between the Employer and the Contractor in connection with or arising out of the disapproval by the Project Manager of any document and/or any modification(s) thereto that cannot be settled between the parties within a reasonable period, then such dispute or difference may be referred to an Dispute Board for determination in accordance with GCC Sub-Clause 45.3 hereof. If such dispute or difference is referred to a Dispute Board, the Project Manager shall give instructions as to whether and if so, how, performance of the Contract is to proceed. The Contractor shall proceed with the Contract in accordance with the Project Manager's instructions, provided that if the Dispute Board upholds the Contractor's view on the dispute and if the Employer has not given notice under Sub-Clause 45.3 hereof, then the Contractor shall be reimbursed by the Employer for any additional costs incurred by reason of such instructions and shall be relieved of such responsibility or liability in connection with the dispute and the execution of the instructions as the Dispute Board shall decide, and the Time for Completion shall be extended accordingly.

20.3.6 The Project Manager's approval, with or without modification of the document furnished by the Contractor, shall not relieve the Contractor of any responsibility or liability imposed upon it by any provisions of the Contract except to the extent that any subsequent failure results from modifications required by the Project Manager.

20.3.7 The Contractor shall not depart from any approved document unless the Contractor has first submitted to the Project Manager an amended document and obtained the Project Manager's approval thereof, pursuant to the provisions of this GCC Sub-Clause 20.3.

If the Project Manager requests any change in any already approved document and/or in any document based thereon, the provisions of GCC Clause 39 shall apply to such request.

21. Procurement

21.1 Materials

Subject to GCC Sub-Clause 14.2, the Contractor shall procure and transport all materials in an expeditious and orderly manner to the Site.

21.2 Employer-Supplied Materials

If the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement provides that the Employer shall furnish any specific items to the Contractor, the following provisions shall apply:

21.2.1 The Employer shall, at its own risk and expense, transport each item to the place on or near the Site as agreed upon by the parties and make such item available to the Contractor at the time specified in the program furnished by the Contractor, pursuant to

GCC Sub-Clause 18.2, unless otherwise mutually agreed.

21.2.2 Upon receipt of such item, the Contractor shall inspect the same visually and notify the Project Manager of any detected shortage, defect or default. The Employer shall immediately remedy any shortage, defect or default, or the Contractor shall, if practicable and possible, at the request of the Employer, remedy such shortage, defect or default at the Employer's cost and expense. After inspection, such item shall fall under the care, custody and control of the Contractor. The provision of this GCC Sub-Clause 21.2.2 shall apply to any item supplied to remedy any such shortage or default or to substitute for any defective item, or shall apply to defective items that have been repaired.

21.2.3 The foregoing responsibilities of the Contractor and its obligations of care, custody and control shall not relieve the Employer of liability for any undetected shortage, defect or default, nor place the Contractor under any liability for any such shortage, defect or default whether under GCC Clause 27 or under any other provision of Contract.

21.3 Transportation

21.3.1 The Contractor shall at its own risk and expense transport all the materials and the Contractor's Equipment to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances.

21.3.2 Unless otherwise provided in the Contract, the Contractor shall be entitled to select any safe mode of transport operated by any person to carry the materials and the Contractor's Equipment.

21.3.3 Upon dispatch of each shipment of materials and the Contractor's Equipment, the Contractor shall notify the Employer by telex, cable, facsimile or electronic means, of the description of the materials and of the Contractor's Equipment, the point and means of dispatch, and the estimated time and point of arrival in the country where the Site is located, if applicable, and at the Site. The Contractor shall furnish the Employer with relevant shipping documents to be agreed upon between the parties.

21.3.4 The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the materials and the Contractor's Equipment to the Site. The Employer shall use its best endeavors in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any claim for damage to roads, bridges or any other traffic facilities that may be caused by the transport of the materials and the Contractor's Equipment to the Site.

21.4 Customs Clearance

The Contractor shall, at its own expense, handle all imported materials and Contractor's Equipment at the point(s) of import and shall handle any formalities for customs clearance, subject to the Employer's obligations under GCC Sub-Clause 14.2, provided that if applicable laws or regulations require any application or act to be made by or in the name of the Employer, the Employer shall take all necessary steps to comply with such laws or regulations. In the event of delays in customs clearance that are not the fault of the Contractor, the Contractor shall be entitled to an extension in the

Time for Completion, pursuant to GCC Clause 40.

22. Installation

22.1 Setting Out/Supervision

22.1.1 Bench Mark

(a) The Contractor shall be responsible for the true and proper setting-out of the Facilities in relation to bench marks, reference marks and lines provided to it in writing by *or on behalf of* the Employer.

(b) If, at any time during the progress of installation of the Facilities, any error shall appear in the position, level or alignment of the Facilities, the Contractor shall forthwith notify the Project Manager of such error and, at its own expense, immediately rectify such error to the reasonable satisfaction of the Project Manager. If such error is based on incorrect data provided in writing by *or on behalf of* the Employer, the expense of rectifying the same shall be borne by the Employer.

22.1.2 Contractor's Supervision

The Contractor shall give or provide all necessary superintendence during the installation of the Facilities, and the Construction Manager or its deputy shall be constantly on the Site to provide full-time superintendence of the installation. The Contractor shall provide and employ only technical personnel who are skilled and experienced in their respective callings and supervisory staff who are competent to adequately supervise the work at hand.

22.2 Labor

22.2.1 Engagement of Staff and Labor

(a) Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labor, local or otherwise, and for their payment, housing, feeding and transport.

(b) The Contractor shall provide and employ on the Site in the installation of the Facilities such skilled, semi-skilled and unskilled labor as is necessary for the proper and timely execution of the Contract. The Contractor is encouraged to use local labor that has the necessary skills.

(c) The Contractor shall be responsible for obtaining all necessary permit(s) and/or visa(s) from the appropriate authorities for the entry of all labor and personnel to be employed on the Site into the country where the Site is located. The Employer will, if requested by the Contractor, use his best endeavors in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national or government permission required for bringing in the Contractor's personnel.

(d) The Contractor shall at its own expense provide the means of repatriation to all of its and its Subcontractor's personnel employed on the Contract at the Site to the place where they were recruited or to

their domicile. It shall also provide suitable temporary maintenance of all such persons from the cessation of their employment on the Contract to the date programmed for their departure. In the event that the Contractor defaults in providing such means of transportation and temporary maintenance, the Employer may provide the same to such personnel and recover the cost of doing so from the Contractor.

22.2.2 Persons in the Service of Employer

The Contractor shall not recruit, or attempt to recruit, staff and labor from amongst the Employer's Personnel.

22.2.3 Labor Laws

(a) The Contractor shall comply with all the relevant labor Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration and emigration, and shall allow them all their legal rights.

(b) The Contractor shall at all times during the progress of the Contract use its best endeavors to prevent any unlawful, riotous or disorderly conduct or behavior by or amongst its employees and the labor of its Subcontractors.

(c) The Contractor shall, in all dealings with its labor and the labor of its Subcontractors currently employed on or connected with the Contract, pay due regard to all recognized festivals, official holidays, religious or other customs and all local laws and regulations pertaining to the employment of labor.

22.2.4 Rates of Wages and Conditions of Labor

(a) The Contractor shall pay rates of wages, and observe conditions of labor, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.

(b) The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages and allowances as are chargeable under the Laws for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

22.2.5 Working Hours

(a) No work shall be carried out on the Site on locally recognized days of rest, or outside the normal working hours stated in the SCC, unless:

(i) otherwise stated in the Contract,

(ii) the Project Manager gives consent, or

(iii the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Project Manager.

(b) If and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the Project Manager's consent thereto, the Project Manager shall not unreasonably withhold such consent.

(c) This Sub-Clause shall not apply to any work which is customarily carried out by rotary or double-shifts.

22.2.6 Facilities for Staff and Labor

(a) Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification.

(b) The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

22.2.7 Health and Safety

(a) The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

(b) The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the performance of the Contract, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

(c) The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety and welfare of persons, and damage to property, as the Engineer may reasonably require.

22.2.8 Funeral Arrangements

In the event of the death of any of the Contractor's personnel or accompanying members of their families, the Contractor shall be responsible for making the appropriate

arrangements for their return or burial, unless otherwise specified in the SCC.

22.2.9 Records of Contractor's Personnel
The Contractor shall keep accurate records of the Contractor's personnel, including the number of each class of Contractor's Personnel on the Site and the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis in a form approved by the Project Manager and shall be available for inspection by the Project Manager. until the Contractor has completed all work.

22.2.10 Supply of Foodstuffs
The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

22.2.11 Supply of Water
The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.

22.2.12 Measures against Insect and Pest Nuisance
The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

22.2.13 Alcoholic Liquor or Drugs
The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift barter or disposal by Contractor's Personnel.

22.2.14 Arms and Ammunition
The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

22.2.15 Prohibition of All Forms of Forced or Compulsory Labor
The contractor shall not employ "forced or compulsory labor" in any form. "Forced or compulsory labor" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

22.2.16 Prohibition of Harmful Child Labor
The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development.

22.3 Contractor's Equipment

22.3.1 All Contractor's Equipment brought by the Contractor onto

the Site shall be deemed to be intended to be used exclusively for the execution of the Contract. The Contractor shall not remove the same from the Site without the Project Manager's consent that such Contractor's Equipment is no longer required for the execution of the Contract.

22.3.2 Unless otherwise specified in the Contract, upon completion of the Facilities, the Contractor shall remove from the Site all Equipment brought by the Contractor onto the Site and any surplus materials remaining thereon.

22.3.3 The Employer will, if requested, use its best endeavors to assist the Contractor in obtaining any local, state or national government permission required by the Contractor for the export of the Contractor's Equipment imported by the Contractor for use in the execution of the Contract that is no longer required for the execution of the Contract.

22.4 Site Regulations and Safety

The Employer and the Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Site and shall comply therewith. The Contractor shall prepare and submit to the Employer, with a copy to the Project Manager, proposed Site regulations for the Employer's approval, which approval shall not be unreasonably withheld.

Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the Facilities, gate control, sanitation, medical care, and fire prevention.

22.5 Opportunities for Other Contractors

22.5.1 The Contractor shall, upon written request from the Employer or the Project Manager, give all reasonable opportunities for carrying out the work to any other contractors employed by the Employer on or near the Site.

22.5.2 If the Contractor, upon written request from the Employer or the Project Manager, makes available to other contractors any roads or ways the maintenance for which the Contractor is responsible, permits the use by such other contractors of the Contractor's Equipment, or provides any other service of whatsoever nature for such other contractors, the Employer shall fully compensate the Contractor for any loss or damage caused or occasioned by such other contractors in respect of any such use or service, and shall pay to the Contractor reasonable remuneration for the use of such equipment or the provision of such services.

22.5.3 The Contractor shall also so arrange to perform its work as to minimize, to the extent possible, interference with the work of other contractors. The Project Manager shall determine the resolution of any difference or conflict that may arise between the Contractor and other contractors and the workers of the Employer in regard to their work.

22.5.4 The Contractor shall notify the Project Manager promptly of any defects in the other contractors' work that come to its notice, and that could affect the Contractor's work. The

Project Manager shall determine the corrective measures, if any, required to rectify the situation after inspection of the Facilities. Decisions made by the Project Manager shall be binding on the Contractor.

22.6 Emergency Work

If, by reason of an emergency arising in connection with and during the execution of the Contract, any protective or remedial work is necessary as a matter of urgency to prevent damage to the Facilities, the Contractor shall immediately carry out such work.

If the Contractor is unable or unwilling to do such work immediately, the Employer may do or cause such work to be done as the Employer may determine is necessary in order to prevent damage to the Facilities. In such event the Employer shall, as soon as practicable after the occurrence of any such emergency, notify the Contractor in writing of such emergency, the work done and the reasons therefor. If the work done or caused to be done by the Employer is work that the Contractor was liable to do at its own expense under the Contract, the reasonable costs incurred by the Employer in connection therewith shall be paid by the Contractor to the Employer. Otherwise, the cost of such remedial work shall be borne by the Employer.

22.7 Site Clearance

22.7.1 Site Clearance in Course of Performance

In the course of carrying out the Contract, the Contractor shall keep the Site reasonably free from all unnecessary obstruction, store or remove any surplus materials, clear away any wreckage, rubbish or temporary works from the Site, and remove any Contractor's Equipment no longer required for execution of the Contract.

22.7.2 Clearance of Site after Completion

After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site and Facilities in a clean and safe condition.

22.8 Watching and Lighting

The Contractor shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper execution and the protection of the Facilities, or for the safety of the owners and occupiers of adjacent property and for the safety of the public.

23. Test and Inspection

23.1 The Contractor shall at its own expense carry out at the place of manufacture and/or on the Site all such tests and/or inspections of the Plant and any part of the Facilities as are specified in the Contract.

23.2 The Employer and the Project Manager or their designated representatives shall be entitled to attend the aforesaid test and/or inspection, provided that the Employer shall bear all costs and expenses incurred in connection with such attendance including, but not limited to, all traveling and board and lodging expenses.

23.3 Whenever the Contractor is ready to carry out any such test and/or inspection, the Contractor shall give a reasonable advance notice of

such test and/or inspection and of the place and time thereof to the Project Manager. The Contractor shall obtain from any relevant third party or manufacturer any necessary permission or consent to enable the Employer and the Project Manager or their designated representatives to attend the test and/or inspection.

23.4 The Contractor shall provide the Project Manager with a certified report of the results of any such test and/or inspection.

23.5 If the Employer or Project Manager or their designated representatives fails to attend the test and/or inspection, or if it is agreed between the parties that such persons shall not do so, then the Contractor may proceed with the test and/or inspection in the absence of such persons, and may provide the Project Manager with a certified report of the results thereof.

23.6 If the Employer or Project Manager may require the Contractor to carry out any test and/or inspection not required by the Contract, provided that the Contractor's reasonable costs and expenses incurred in the carrying out of such test and/or inspection shall be added to the Contract Price. Further, if such test and/or inspection impedes the progress of work on the Facilities and/or the Contractor's performance of its other obligations under the Contract, due allowance will be made in respect of the Time for Completion and the other obligations so affected.

23.7 If any Plant or any part of the Facilities fails to pass any test and/or inspection, the Contractor shall either rectify or replace such Plant or part of the Facilities and shall repeat the test and/or inspection upon giving a notice under GCC Sub-Clause 23.3.

23.8 If any dispute or difference of opinion shall arise between the parties in connection with or arising out of the test and/or inspection of the Plant or part of the Facilities that cannot be settled between the parties within a reasonable period of time, it may be referred to an Dispute Board for determination in accordance with GCC Sub-Clause 45.

23.9 The Contractor shall afford the Employer and the Project Manager, at the Employer's expense, access at any reasonable time to any place where the Plant are being manufactured or the Facilities are being installed, in order to inspect the progress and the manner of manufacture or installation, provided that the Project Manager shall give the Contractor a reasonable prior notice.

23.10 The Contractor agrees that neither the execution of a test and/or inspection of Plant or any part of the Facilities, nor the attendance by the Employer or the Project Manager, nor the issue of any test certificate pursuant to GCC Sub-Clause 23.4, shall release the Contractor from any other responsibilities under the Contract.

23.11 No part of the Facilities or foundations shall be covered up on the Site without the Contractor carrying out any test and/or inspection required under the Contract. The Contractor shall give a reasonable notice to the Project Manager whenever any such parts of the Facilities or foundations are ready or about to be ready for test and/or inspection; such test and/or inspection and notice thereof shall be subject to the requirements of the Contract.

23.12 The Contractor shall uncover any part of the Facilities or

foundations, or shall make openings in or through the same as the Project Manager may from time to time require at the Site, and shall reinstate and make good such part or parts.

If any parts of the Facilities or foundations have been covered up at the Site after compliance with the requirement of GCC Sub-Clause 23.10 and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating, and making good the same shall be borne by the Employer, and the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been delayed or impeded in the performance of any of its obligations under the Contract.

24. Completion of the Facilities

24.1 As soon as the Facilities or any part thereof has, in the opinion of the Contractor, been completed operationally and structurally and put in a tight and clean condition as specified in the Employer's Requirements, excluding minor items not materially affecting the operation or safety of the Facilities, the Contractor shall so notify the Employer in writing.

24.2 Within seven (7) days after receipt of the notice from the Contractor under GCC Sub-Clause 24.1, the Employer shall supply the operating and maintenance personnel specified in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement for Pre commissioning of the Facilities or any part thereof.

Pursuant to the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement, the Employer shall also provide, within the said seven (7) day period, the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters required for Pre commissioning of the Facilities or any part thereof.

24.3 As soon as reasonably practicable after the operating and maintenance personnel have been supplied by the Employer and the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters have been provided by the Employer in accordance with GCC Sub-Clause 24.2, the Contractor shall commence Pre commissioning of the Facilities or the relevant part thereof in preparation for Commissioning, subject to GCC Sub-Clause 25.5.

24.4 As soon as all works in respect of Pre commissioning are completed and, in the opinion of the Contractor, the Facilities or any part thereof is ready for Commissioning, the Contractor shall so notify the Project Manager in writing.

24.5 The Project Manager shall, within fourteen (14) days after receipt of the Contractor's notice under GCC Sub-Clause 24.4, either issue a Completion Certificate in the form specified in the Employer's Requirements (Forms and Procedures), stating that the Facilities or that part thereof have reached Completion as of the date of the Contractor's notice under GCC Sub-Clause 24.4, or notify the Contractor in writing of any defects and/or deficiencies.

If the Project Manager notifies the Contractor of any defects and/or deficiencies, the Contractor shall then correct such defects and/or deficiencies, and shall repeat the procedure described in GCC Sub-

Clause 24.4.

If the Project Manager is satisfied that the Facilities or that part thereof have reached Completion, the Project Manager shall, within seven (7) days after receipt of the Contractor's repeated notice, issue a Completion Certificate stating that the Facilities or that part thereof have reached Completion as of the date of the Contractor's repeated notice.

If the Project Manager is not so satisfied, then it shall notify the Contractor in writing of any defects and/or deficiencies within seven (7) days after receipt of the Contractor's repeated notice, and the above procedure shall be repeated.

24.6 If the Project Manager fails to issue the Completion Certificate and fails to inform the Contractor of any defects and/or deficiencies within fourteen (14) days after receipt of the Contractor's notice under GCC Sub-Clause 24.4 or within seven (7) days after receipt of the Contractor's repeated notice under GCC Sub-Clause 24.5, or if the Employer makes use of the Facilities or part thereof, then the Facilities or that part thereof shall be deemed to have reached Completion as of the date of the Contractor's notice or repeated notice, or as of the Employer's use of the Facilities, as the case may be.

24.7 As soon as possible after Completion, the Contractor shall complete all outstanding minor items so that the Facilities are fully in accordance with the requirements of the Contract, failing which the Employer will undertake such completion and deduct the costs thereof from any monies owing to the Contractor.

24.8 Upon Completion, the Employer shall be responsible for the care and custody of the Facilities or the relevant part thereof, together with the risk of loss or damage thereto, and shall thereafter take over the Facilities or the relevant part thereof.

25. Commissioning and Operational Acceptance

25.1 Commissioning

25.1.1 Commissioning of the Facilities or any part thereof shall be commenced by the Contractor immediately after issue of the Completion Certificate by the Project Manager, pursuant to GCC Sub-Clause 24.5, or immediately after the date of the deemed Completion, under GCC Sub-Clause 24.6.

25.1.2 The Employer shall supply the operating and maintenance personnel and all raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters required for Commissioning.

25.1.3 In accordance with the requirements of the Contract, the Contractor's and Project Manager's advisory personnel shall attend the Commissioning, including the Guarantee Test, and shall advise and assist the Employer.

25.2 Guarantee Test

25.2.1 Subject to GCC Sub-Clause 25.5, the Guarantee Test and repeats thereof shall be conducted by the Contractor during Commissioning of the Facilities or the relevant part thereof to ascertain whether the Facilities or the relevant part can attain the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement. The Employer shall promptly provide the Contractor with such

information as the Contractor may reasonably require in relation to the conduct and results of the Guarantee Test and any repeats thereof.

25.2.2 If for reasons not attributable to the Contractor, the Guarantee Test of the Facilities or the relevant part thereof cannot be successfully completed within the period from the date of Completion specified in the SCC or any other period agreed upon by the Employer and the Contractor, the Contractor shall be deemed to have fulfilled its obligations with respect to the Functional Guarantees, and GCC Sub-Clauses 28.2 and 28.3 shall not apply.

25.3 Operational Acceptance

25.3.1 Subject to GCC Sub-Clause 25.4 below, Operational Acceptance shall occur in respect of the Facilities or any part thereof when

(a) the Guarantee Test has been successfully completed and the Functional Guarantees are met; or

(b) the Guarantee Test has not been successfully completed or has not been carried out for reasons not attributable to the Contractor within the period from the date of Completion specified in the SCC or any other agreed upon period as specified in GCC Sub-Clause 25.2.2 above; or

(c) the Contractor has paid the liquidated damages specified in GCC Sub-Clause 28.3 hereof; and

(d) any minor items mentioned in GCC Sub-Clause 24.7 hereof relevant to the Facilities or that part thereof have been completed.

25.3.2 At any time after any of the events set out in GCC Sub-Clause 25.3.1 have occurred, the Contractor may give a notice to the Project Manager requesting the issue of an Operational Acceptance Certificate in the form provided in the Employer's Requirements (Forms and Procedures)in respect of the Facilities or the part thereof specified in such notice as of the date of such notice.

25.3.3 The Project Manager shall, after consultation with the Employer, and within seven (7) days after receipt of the Contractor's notice, issue an Operational Acceptance Certificate.

25.3.4 If within seven (7) days after receipt of the Contractor's notice, the Project Manager fails to issue the Operational Acceptance Certificate or fails to inform the Contractor in writing of the justifiable reasons why the Project Manager has not issued the Operational Acceptance Certificate, the Facilities or the relevant part thereof shall be deemed to have been accepted as of the date of the Contractor's said notice.

25.4 Partial Acceptance

25.4.1 If the Contract specifies that Completion and Commissioning shall be carried out in respect of parts of the Facilities, the provisions relating to Completion and Commissioning

including the Guarantee Test shall apply to each such part of the Facilities individually, and the Operational Acceptance Certificate shall be issued accordingly for each such part of the Facilities.

25.4.2 If a part of the Facilities comprises facilities such as buildings, for which no Commissioning or Guarantee Test is required, then the Project Manager shall issue the Operational Acceptance Certificate for such facility when it attains Completion, provided that the Contractor shall thereafter complete any outstanding minor items that are listed in the Operational Acceptance Certificate.

25.5 Delayed Pre commissioning and/or Guarantee Test

25.5.1 In the event that the Contractor is unable to proceed with the Pre commissioning of the Facilities pursuant to Sub-Clause 24.3, or with the Guarantee Test pursuant to Sub-Clause 25.2, for reasons attributable to the Employer either on account of non-availability of other facilities under the responsibilities of other contractor(s), or for reasons beyond the Employer's control, the provisions leading to "deemed" completion of activities such as Completion, pursuant to GCC Sub-Clause 24.6, and Operational Acceptance, pursuant to GCC Sub-Clause 25.3.4, and Contractor's obligations regarding Defect Liability Period, pursuant to GCC Sub-Clause 27.2, Functional Guarantee, pursuant to GCC Clause 28, and Care of Facilities, pursuant to GCC Clause 32, and GCC Clause 41.1, Suspension, shall not apply. In this case, the following provisions shall apply.

25.5.2 When the Contractor is notified by the Project Manager that he will be unable to proceed with the activities and obligations pursuant to above Sub-Clause 25.5.1, the Contractor shall be entitled to the following:

(a) the Time of Completion shall be extended for the period of suspension without imposition of liquidated damages pursuant to GCC Sub-Clause 26.2;

(b) payments due to the Contractor in accordance with the provision specified in the Appendix (Terms and Procedures of Payment) to the Contract Agreement, which would not have been payable in normal circumstances due to non-completion of the subject activities, shall be released to the Contractor against submission of a security in the form of a bank guarantee of equivalent amount acceptable to the Employer, and which shall become null and void when the Contractor will have complied with its obligations regarding those payments, subject to the provision of Sub-Clause 25.5.3 below;

(c) the expenses towards the above security and extension of other securities under the contract, of which validity needs to be extended, shall be reimbursed to the Contractor by the Employer;

(d) the additional charges towards the care of the Facilities pursuant to GCC Sub-Clause 32.1 shall be

reimbursed to the Contractor by the Employer for the period between the notification mentioned above and the notification mentioned in Sub-Clause 25.5.4 below. The provision of GCC Sub-Clause 33.2 shall apply to the Facilities during the same period.

25.5.3 In the event that the period of suspension under above Sub-Clause 25.5.1 actually exceeds one hundred eighty (180) days, the Employer and Contractor shall mutually agree to any additional compensation payable to the Contractor.

25.5.4 When the Contractor is notified by the Project Manager that the plant is ready for Pre commissioning, the Contractor shall proceed without delay in performing all the specified activities and obligations under the contract.

F. Guarantees and Liabilities

26. Completion Time Guarantee

26.1 The Contractor guarantees that it shall attain Completion of the Facilities (or a part for which a separate time for completion is specified) within the Time for Completion specified in the SCC pursuant to GCC Sub-Clause 8.2, or within such extended time to which the Contractor shall be entitled under GCC Clause 40 hereof.

26.2 If the Contractor fails to attain Completion of the Facilities or any part thereof within the Time for Completion or any extension thereof under GCC Clause 40, the Contractor shall pay to the Employer liquidated damages in the amount specified in the SCC as a percentage rate of the Contract Price or the relevant part thereof. The aggregate amount of such liquidated damages shall in no event exceed the amount specified as “Maximum” in the SCC as a percentage rate of the Contract Price. Once the “Maximum” is reached, the Employer may consider termination of the Contract, pursuant to GCC Sub-Clause 42.2.2.

Such payment shall completely satisfy the Contractor’s obligation to attain Completion of the Facilities or the relevant part thereof within the Time for Completion or any extension thereof under GCC Clause 40. The Contractor shall have no further liability whatsoever to the Employer in respect thereof.

However, the payment of liquidated damages shall not in any way relieve the Contractor from any of its obligations to complete the Facilities or from any other obligations and liabilities of the Contractor under the Contract.

Save for liquidated damages payable under this GCC Sub-Clause 26.2, the failure by the Contractor to attain any milestone or other act, matter or thing by any date specified in the Appendix (Time Schedule) to the Contract Agreement and/or other program of work prepared pursuant to GCC Sub-Clause 18.2 shall not render the Contractor liable for any loss or damage thereby suffered by the Employer.

26.3 If the Contractor attains Completion of the Facilities or any part thereof before the Time for Completion or any extension thereof under GCC Clause 40, the Employer shall pay to the Contractor a bonus in the amount specified in the SCC. The aggregate amount of such bonus shall in no event exceed the amount specified as

"Maximum" in the SCC.

27. Defect Liability

27.1 The Contractor warrants that the Facilities or any part thereof shall be free from defects in the design, engineering, materials and workmanship of the Plant supplied and of the work executed.

27.2 The Defect Liability Period shall be five hundred and forty (540) days from the date of Completion of the Facilities (or any part thereof) or one year from the date of Operational Acceptance of the Facilities (or any part thereof), whichever first occurs, unless specified otherwise in the SCC pursuant to GCC Sub-Clause 27.10.

If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant supplied or of the work executed by the Contractor, the Contractor shall promptly, in consultation and agreement with the Employer regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good as the Contractor shall determine at its discretion, such defect as well as any damage to the Facilities caused by such defect. The Contractor shall not be responsible for the repair, replacement or making good of any defector of any damage to the Facilities arising out of or resulting from any of the following causes:

(a) improper operation or maintenance of the Facilities by the Employer;

(b) operation of the Facilities outside specifications provided in the Contract; or

(c) normal wear and tear.

27.3 The Contractor's obligations under this GCC Clause 27 shall not apply to:

(a) any materials that are supplied by the Employer under GCC Sub-Clause 21.2, are normally consumed in operation, or have a normal life shorter than the Defect Liability Period stated herein;

(b) any designs, specifications or other data designed, supplied or specified by or on behalf of the Employer or any matters for which the Contractor has disclaimed responsibility herein; or

(c) any other materials supplied or any other work executed by or on behalf of the Employer, except for the work executed by the Employer under GCC Sub-Clause 27.7

27.4 The Employer shall give the Contractor a notice stating the nature of any such defect together with all available evidence thereof, promptly following the discovery thereof. The Employer shall afford all reasonable opportunity for the Contractor to inspect any such defect.

27.5 The Employer shall afford the Contractor all necessary access to the Facilities and the Site to enable the Contractor to perform its obligations under this GCC Clause 27.

The Contractor may, with the consent of the Employer, remove from the Site any Plant or any part of the Facilities that are defective if the nature of the defect, and/or any damage to the Facilities caused by the defect, is such that repairs cannot be expeditiously carried out at

the Site.

27.6 If the repair, replacement or making good is of such a character that it may affect the efficiency of the Facilities or any part thereof, the Employer may give to the Contractor a notice requiring that tests of the defective part of the Facilities shall be made by the Contractor immediately upon completion of such remedial work, whereupon the Contractor shall carry out such tests.

If such part fails the tests, the Contractor shall carry out further repair, replacement or making good, as the case may be, until that part of the Facilities passes such tests. The tests shall be agreed upon by the Employer and the Contractor.

27.7 If the Contractor fails to commence the work necessary to remedy such defect or any damage to the Facilities caused by such defect within a reasonable time (which shall in no event be considered to be less than fifteen (15) days), the Employer may, following notice to the Contractor, proceed to do such work, and the reasonable costs incurred by the Employer in connection therewith shall be paid to the Employer by the Contractor or may be deducted by the Employer from any monies due the Contractor or claimed under the Performance Security.

27.8 If the Facilities or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities or such part, as the case may be, shall be extended by a period equal to the period during which the Facilities or such part cannot be used by the Employer because of any of the aforesaid reasons.

27.9 Except as provided in GCC Clauses 27 and 33, the Contractor shall be under no liability whatsoever and howsoever arising, and whether under the Contract or at law, in respect of defects in the Facilities or any part thereof, the Plant, design or engineering or work executed that appear after Completion of the Facilities or any part thereof, except where such defects are the result of the gross negligence, fraud, criminal or willful action of the Contractor.

27.10 In addition, any such component of the Facilities and during the period of time as may be specified in the SCC shall be subject to an extended Defect Liability Period. Such obligation of the Contractor shall be in addition to the Defect Liability Period specified under GCC Sub-Clause 27.2.

28. Functional Guarantees

28.1 The Contractor guarantees that during the Guarantee Test, the Facilities and all parts thereof shall attain the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement, subject to and upon the conditions therein specified.

28.2 If, for reasons attributable to the Contractor, the minimum level of the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement are not met either in whole or in part, the Contractor shall at its cost and expense make such changes, modifications and/or additions to the Plant or any part thereof as may be necessary to meet at least the minimum level of such Guarantees. The Contractor shall notify the Employer upon completion of the necessary changes, modifications and/or additions, and shall request the Employer to repeat the Guarantee Test until the minimum level of the Guarantees has been met. If the Contractor eventually fails to meet the minimum level of Functional Guarantees, the Employer may consider termination of the Contract,

pursuant to GCC Sub-Clause 42.2.2.

28.3 If, for reasons attributable to the Contractor, the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement are not attained either in whole or in part, but the minimum level of the Functional Guarantees specified in the said Appendix to the Contract Agreement is met, the Contractor shall, at the Contractor's option, either

(a) make such changes, modifications and/or additions to the Facilities or any part thereof that are necessary to attain the Functional Guarantees at its cost and expense, and shall request the Employer to repeat the Guarantee Test or

(b) pay liquidated damages to the Employer in respect of the failure to meet the Functional Guarantees in accordance with the provisions in the Appendix (Functional Guarantees) to the Contract Agreement.

28.4 The payment of liquidated damages under GCC Sub-Clause 28.3, up to the limitation of liability specified in the Appendix (Functional Guarantees) to the Contract Agreement, shall completely satisfy the Contractor's guarantees under GCC Sub-Clause 28.3, and the Contractor shall have no further liability whatsoever to the Employer in respect thereof. Upon the payment of such liquidated damages by the Contractor, the Project Manager shall issue the Operational Acceptance Certificate for the Facilities or any part thereof in respect of which the liquidated damages have been so paid.

29. Patent Indemnity

29.1 The Contractor shall, subject to the Employer's compliance with GCC Sub-Clause 29.2, indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Employer may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract by reason of: (a) the installation of the Facilities by the Contractor or the use of the Facilities in the country where the Site is located; and (b) the sale of the products produced by the Facilities in any country.

29.2 Such indemnity shall not cover any use of the Facilities or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Contract, any infringement resulting from the use of the Facilities or any part thereof, or any products produced thereby in association or combination with any other equipment, plant or materials not supplied by the Contractor, pursuant to the Contract Agreement.

29.3 If any proceedings are brought or any claim is made against the Employer arising out of the matters referred to in GCC Sub-Clause 29.1, the Employer shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in the Employer's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim.

29.4 If the Contractor fails to notify the Employer within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the twenty-eight (28) day period, the

Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

29.5 The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.

29.6 The Employer shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Contractor may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract arising out of or in connection with any design, data, drawing, specification, or other documents or materials provided or designed by or on behalf of the Employer.

30. Limitation of Liability

30.1 Except in cases of criminal negligence or willful misconduct,

(a) the Contractor shall not be liable to the Employer, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Employer and

(b) the aggregate liability of the Contractor to the Employer, whether under the Contract, in tort or otherwise, shall not exceed a multiple of the Contract Price specified in the SCC or, if a multiple is not so specified, the total Contract Price, provided that this limitation shall not apply to the cost of repairing or replacing defective equipment, or to any obligation of the Contractor to indemnify the Employer with respect to patent infringement.

G. Risk Distribution

31. Transfer of Ownership

31.1 Ownership of the Plant (including spare parts) to be imported into the country where the Site is located shall be transferred to the Employer upon loading on to the mode of transport to be used to convey the Plant from the country of origin to that country.

31.2 Ownership of the Plant (including spare parts) procured in the country where the Site is located shall be transferred to the Employer when the Plant are brought on to the Site.

31.3 Ownership of the Contractor's Equipment used by the Contractor and its Subcontractors in connection with the Contract shall remain with the Contractor or its Subcontractors.

31.4 Ownership of any Plant in excess of the requirements for the Facilities shall revert to the Contractor upon Completion of the Facilities or at such earlier time when the Employer and the Contractor agree that the Plant in question are no longer required for the Facilities.

31.5 Notwithstanding the transfer of ownership of the Plant, the

responsibility for care and custody thereof together with the risk of loss or damage thereto shall remain with the Contractor pursuant to GCC Clause 32 (Care of Facilities) hereof until Completion of the Facilities or the part thereof in which such Plant are incorporated.

32. Care of Facilities

32.1 The Contractor shall be responsible for the care and custody of the Facilities or any part thereof until the date of Completion of the Facilities pursuant to GCC Clause 24 or, where the Contract provides for Completion of the Facilities in parts, until the date of Completion of the relevant part, and shall make good at its own cost any loss or damage that may occur to the Facilities or the relevant part thereof from any cause whatsoever during such period. The Contractor shall also be responsible for any loss or damage to the Facilities caused by the Contractor or its Subcontractors in the course of any work carried out, pursuant to GCC Clause 27. Notwithstanding the foregoing, the Contractor shall not be liable for any loss or damage to the Facilities or that part thereof caused by reason of any of the matters specified or referred to in paragraphs (a), (b) and (c) of GCC Sub-Clauses 32.2 and 38.1.

32.2 If any loss or damage occurs to the Facilities or any part thereof or to the Contractor's temporary facilities by reason of

(a) insofar as they relate to the country where the Site is located, nuclear reaction, nuclear radiation, radioactive contamination, pressure wave caused by aircraft or other aerial objects, or any other occurrences that an experienced contractor could not reasonably foresee, or if reasonably foreseeable could not reasonably make provision for or insure against, insofar as such risks are not normally insurable on the insurance market and are mentioned in the general exclusions of the policy of insurance, including War Risks and Political Risks, taken out under GCC Clause 34 hereof; or

(b) any use or occupation by the Employer or any third party other than a Subcontractor, authorized by the Employer of any part of the Facilities; or

(c) any use of or reliance upon any design, data or specification provided or designated by or on behalf of the Employer, or any such matter for which the Contractor has disclaimed responsibility herein,

the Employer shall pay to the Contractor all sums payable in respect of the Facilities executed, notwithstanding that the same be lost, destroyed or damaged, and will pay to the Contractor the replacement value of all temporary facilities and all parts thereof lost, destroyed or damaged. If the Employer requests the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Contractor shall make good the same at the cost of the Employer in accordance with GCC Clause 39. If the Employer does not request the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Employer shall either request a change in accordance with GCC Clause 39, excluding the performance of that part of the Facilities thereby lost, destroyed or damaged, or, where the loss or damage affects a substantial part of the Facilities, the Employer shall terminate the Contract pursuant to GCC Sub-Clause 42.1 hereof.

32.3 The Contractor shall be liable for any loss of or damage to any

Contractor's Equipment, or any other property of the Contractor used or intended to be used for purposes of the Facilities, except (i) as mentioned in GCC Sub-Clause 32.2 with respect to the Contractor's temporary facilities, and (ii) where such loss or damage arises by reason of any of the matters specified in GCC Sub-Clauses 32.2 (b) and (c) and 38.1.

32.4 With respect to any loss or damage caused to the Facilities or any part thereof or to the Contractor's Equipment by reason of any of the matters specified in GCC Sub-Clause 38.1, the provisions of GCC Sub-Clause 38.3 shall apply.

33. Loss of or Damage to Property; Accident or Injury to Workers; Indemnification

33.1 Subject to GCC Sub-Clause 33.3, the Contractor shall indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, in respect of the death or injury of any person or loss of or damage to any property other than the Facilities whether accepted or not, arising in connection with the supply and installation of the Facilities and by reason of the negligence of the Contractor or its Subcontractors, or their employees, officers or agents, except any injury, death or property damage caused by the negligence of the Employer, its contractors, employees, officers or agents.

33.2 If any proceedings are brought or any claim is made against the Employer that might subject the Contractor to liability under GCC Sub-Clause 33.1, the Employer shall promptly give the Contractor a notice thereof and the Contractor may at its own expense and in the Employer's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim.

If the Contractor fails to notify the Employer within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the twenty-eight (28) day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.

33.3 The Employer shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from any liability for loss of or damage to property of the Employer, other than the Facilities not yet taken over, that is caused by fire, explosion or any other perils, in excess of the amount recoverable from insurances procured under GCC Clause 34, provided that such fire, explosion or other perils were not caused by any act or failure of the Contractor.

33.4 The party entitled to the benefit of an indemnity under this GCC Clause 33 shall take all reasonable measures to mitigate any loss or damage which has occurred. If the party fails to take such measures, the other party's liabilities shall be correspondingly

reduced.

34. Insurance

34.1 To the extent specified in the Appendix (Insurance Requirements) to the Contract Agreement, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified in the said Appendix. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, who should not unreasonably withhold such approval.

(a) Cargo Insurance During Transport

Covering loss or damage occurring while in transit from the Contractor's or Subcontractor's works or stores until arrival at the Site, to the Plant (including spare parts therefore) and to the Contractor's Equipment.

(b) Installation All Risks Insurance

Covering physical loss or damage to the Facilities at the Site, occurring prior to Completion of the Facilities, with extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the Defect Liability Period while the Contractor is on the Site for the purpose of performing its obligations during the Defect Liability Period.

(c) Third Party Liability Insurance

Covering bodily injury or death suffered by third parties including the Employer's personnel, and loss of or damage to property occurring in connection with the supply and installation of the Facilities.

(d) Automobile Liability Insurance

Covering use of all vehicles used by the Contractor or its Subcontractors, whether or not owned by them, in connection with the execution of the Contract.

(e) Workers' Compensation

In accordance with the statutory requirements applicable in any country where the Contract or any part thereof is executed.

(f) Employer's Liability

In accordance with the statutory requirements applicable in any country where the Contract or any part thereof is executed.

(g) Other Insurances

Such other insurances as may be specifically agreed upon by the parties hereto as listed in the Appendix (Insurance Requirements) to the Contract Agreement.

34.2 The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 34.1, except for the Third Party Liability, Workers' Compensation and Employer's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance

policies taken out by the Contractor pursuant to GCC Sub-Clause 34.1 except for the Cargo Insurance During Transport, Workers' Compensation and Employer's Liability Insurances. All insurer's rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies.

34.3 The Contractor shall, in accordance with the provisions of the Appendix (Insurance Requirements) to the Contract Agreement, deliver to the Employer certificates of insurance or copies of the insurance policies as evidence that the required policies are in full force and effect. The certificates shall provide that no less than twenty-one (21) days' notice shall be given to the Employer by insurers prior to cancellation or material modification of a policy.

34.4 The Contractor shall ensure that, where applicable, its Subcontractor(s) shall take out and maintain in effect adequate insurance policies for their personnel and vehicles and for work executed by them under the Contract, unless such Subcontractors are covered by the policies taken out by the Contractor.

34.5 The Employer shall at its expense take out and maintain in effect during the performance of the Contract those insurances specified in the Appendix (Insurance Requirements) to the Contract Agreement, in the sums and with the deductibles and other conditions specified in the said Appendix. The Contractor and the Contractor's Subcontractors shall be named as co-insureds under all such policies. All insurers' rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies. The Employer shall deliver to the Contractor satisfactory evidence that the required insurances are in full force and effect. The policies shall provide that not less than twenty-one (21) days' notice shall be given to the Contractor by all insurers prior to any cancellation or material modification of the policies. If so requested by the Contractor, the Employer shall provide copies of the policies taken out by the Employer under this GCC Sub-Clause 34.5.

34.6 If the Contractor fails to take out and/or maintain in effect the insurances referred to in GCC Sub-Clause 34.1, the Employer may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Contractor under the Contract any premium that the Employer shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Contractor. If the Employer fails to take out and/or maintain in effect the insurances referred to in GCC 34.5, the Contractor may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Employer under the Contract any premium that the Contractor shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Employer. If the Contractor fails to or is unable to take out and maintain in effect any such insurances, the Contractor shall nevertheless have no liability or responsibility towards the Employer, and the Contractor shall have full recourse against the Employer for any and all liabilities of the Employer herein.

34.7 Unless otherwise provided in the Contract, the Contractor shall prepare and conduct all and any claims made under the policies affected by it pursuant to this GCC Clause 34, and all monies payable by any insurers shall be paid to the Contractor. The Employer shall give to the Contractor all such reasonable assistance as may be required by the Contractor. With respect to insurance

claims in which the Employer's interest is involved, the Contractor shall not give any release or make any compromise with the insurer without the prior written consent of the Employer. With respect to insurance claims in which the Contractor's interest is involved, the Employer shall not give any release or make any compromise with the insurer without the prior written consent of the Contractor.

35. Unforeseen Conditions

35.1 If, during the execution of the Contract, the Contractor shall encounter on the Site any physical conditions other than climatic conditions, or artificial obstructions that could not have been reasonably foreseen prior to the date of the Contract Agreement by an experienced contractor on the basis of reasonable examination of the data relating to the Facilities including any data as to boring tests, provided by the Employer, and on the basis of information that it could have obtained from a visual inspection of the Site if access thereto was available, or other data readily available to it relating to the Facilities, and if the Contractor determines that it will in consequence of such conditions or obstructions incur additional cost and expense or require additional time to perform its obligations under the Contract that would not have been required if such physical conditions or artificial obstructions had not been encountered, the Contractor shall promptly, and before performing additional work or using additional Plant or Contractor's Equipment, notify the Project Manager in writing of

(a) the physical conditions or artificial obstructions on the Site that could not have been reasonably foreseen;

(b) the additional work and/or Plant and/or Contractor's Equipment required, including the steps which the Contractor will or proposes to take to overcome such conditions or obstructions;

(c) the extent of the anticipated delay; and

(d) the additional cost and expense that the Contractor is likely to incur.

On receiving any notice from the Contractor under this GCC Sub-Clause 35.1, the Project Manager shall promptly consult with the Employer and Contractor and decide upon the actions to be taken to overcome the physical conditions or artificial obstructions encountered. Following such consultations, the Project Manager shall instruct the Contractor, with a copy to the Employer, of the actions to be taken.

35.2 Any reasonable additional cost and expense incurred by the Contractor in following the instructions from the Project Manager to overcome such physical conditions or artificial obstructions referred to in GCC Sub-Clause 35.1 shall be paid by the Employer to the Contractor as an addition to the Contract Price.

35.3 If the Contractor is delayed or impeded in the performance of the Contract because of any such physical conditions or artificial obstructions referred to in GCC Sub-Clause 35.1, the Time for Completion shall be extended in accordance with GCC Clause 40.

36. Change in Laws

36.1 If, after the date twenty-eight (28) days prior to the date of Bid submission, in the country where the Site is located, any law,

and Regulations

regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated or changed which shall be deemed to include any change in interpretation or application by the competent authorities, that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract. Notwithstanding the foregoing, such additional or reduced costs shall not be separately paid or credited if the same has already been accounted for in the price adjustment provisions where applicable, in accordance with the SCC, pursuant to GCC Sub-Clause 11.2.

37. Force Majeure

37.1 "Force Majeure" shall mean any event beyond the reasonable control of the Employer or of the Contractor, as the case may be, and which is unavoidable notwithstanding the reasonable care of the party affected, and shall include, without limitation, the following:

(a) war, hostilities or warlike operations whether a state of war be declared or not, invasion, act of foreign enemy and civil war

(b) rebellion, revolution, insurrection, mutiny, usurpation of civil or military government, conspiracy, riot, civil commotion and terrorist acts

(c) confiscation, nationalization, mobilization, commandeering or requisition by or under the order of any government or de jure or de facto authority or ruler or any other act or failure to act of any local state or national government authority

(d) strike, sabotage, lockout, embargo, import restriction, port congestion, lack of usual means of public transportation and communication, industrial dispute, shipwreck, shortage or restriction of power supply, epidemics, quarantine and plague

(e) earthquake, landslide, volcanic activity, fire, flood or inundation, tidal wave, typhoon or cyclone, hurricane, storm, lightning, or other inclement weather condition, nuclear and pressure waves or other natural or physical disaster

(f) shortage of labor, materials or utilities where caused by circumstances that are themselves Force Majeure.

37.2 If either party is prevented, hindered or delayed from or in performing any of its obligations under the Contract by an event of Force Majeure, then it shall notify the other in writing of the occurrence of such event and the circumstances thereof within fourteen (14) days after the occurrence of such event.

37.3 The party who has given such notice shall be excused from the performance or punctual performance of its obligations under the Contract for so long as the relevant event of Force Majeure continues and to the extent that such party's performance is prevented, hindered or delayed. The Time for Completion shall be extended in accordance with GCC Clause 40.

37.4 The party or parties affected by the event of Force Majeure shall use reasonable efforts to mitigate the effect thereof upon its or their performance of the Contract and to fulfill its or their obligations under the Contract, but without prejudice to either party's right to

terminate the Contract under GCC Sub-Clauses 37.6 and 38.5.

37.5 No delay or nonperformance by either party hereto caused by the occurrence of any event of Force Majeure shall

(a) constitute a default or breach of the Contract, or

(b) give rise to any claim for damages or additional cost or expense occasioned thereby, subject to GCC Sub-Clauses 32.2, 38.3 and 38.4

if and to the extent that such delay or nonperformance is caused by the occurrence of an event of Force Majeure.

37.6 If the performance of the Contract is substantially prevented, hindered or delayed for a single period of more than sixty (60) days or an aggregate period of more than one hundred and twenty (120) days on account of one or more events of Force Majeure during the currency of the Contract, the parties will attempt to develop a mutually satisfactory solution, failing which either party may terminate the Contract by giving a notice to the other, but without prejudice to either party's right to terminate the Contract under GCC Sub-Clause 38.5.

37.7 In the event of termination pursuant to GCC Sub-Clause 37.6, the rights and obligations of the Employer and the Contractor shall be as specified in GCC Sub-Clauses 42.1.2 and 42.1.3.

37.8 Notwithstanding GCC Sub-Clause 37.5, Force Majeure shall not apply to any obligation of the Employer to make payments to the Contractor herein.

38. War Risks

38.1 "War Risks" shall mean any event specified in paragraphs (a) and (b) of GCC Sub-Clause 37.1 and any explosion or impact of any mine, bomb, shell, grenade or other projectile, missile, munitions or explosive of war, occurring or existing in or near the country (or countries) where the Site is located.

38.2 Notwithstanding anything contained in the Contract, the Contractor shall have no liability whatsoever for or with respect to

(a) destruction of or damage to Facilities, Plant, or any part thereof;

(b) destruction of or damage to property of the Employer or any third party; or

(c) injury or loss of life

if such destruction, damage, injury or loss of life is caused by any War Risks, and the Employer shall indemnify and hold the Contractor harmless from and against any and all claims, liabilities, actions, lawsuits, damages, costs, charges or expenses arising in consequence of or in connection with the same.

38.3 If the Facilities or any Plant or Contractor's Equipment or any other property of the Contractor used or intended to be used for the purposes of the Facilities shall sustain destruction or damage by reason of any War Risks, the Employer shall pay the Contractor for

(a) any part of the Facilities or the Plant so destroyed or damaged to the extent not already paid for by the Employer and so far

as may be required by the Employer, and as may be necessary for completion of the Facilities

(b) replacing or making good any Contractor's Equipment or other property of the Contractor so destroyed or damaged

(c) replacing or making good any such destruction or damage to the Facilities or the Plant or any part thereof.

If the Employer does not require the Contractor to replace or make good any such destruction or damage to the Facilities, the Employer shall either request a change in accordance with GCC Clause 39, excluding the performance of that part of the Facilities thereby destroyed or damaged or, where the loss, destruction or damage affects a substantial part of the Facilities, shall terminate the Contract, pursuant to GCC Sub-Clause 42.1.

If the Employer requires the Contractor to replace or make good on any such destruction or damage to the Facilities, the Time for Completion shall be extended in accordance with GCC 40.

38.4 Notwithstanding anything contained in the Contract, the Employer shall pay the Contractor for any increased costs or incidentals to the execution of the Contract that are in any way attributable to, consequent on, resulting from, or in any way connected with any War Risks, provided that the Contractor shall as soon as practicable notify the Employer in writing of any such increased cost.

38.5 If during the performance of the Contract any War Risks shall occur that financially or otherwise materially affect the execution of the Contract by the Contractor, the Contractor shall use its reasonable efforts to execute the Contract with due and proper consideration given to the safety of its and its Subcontractors' personnel engaged in the work on the Facilities, provided, however, that if the execution of the work on the Facilities becomes impossible or is substantially prevented for a single period of more than sixty (60) days or an aggregate period of more than one hundred and twenty (120) days on account of any War Risks, the parties will attempt to develop a mutually satisfactory solution, failing which either party may terminate the Contract by giving a notice to the other.

38.6 In the event of termination pursuant to GCC Sub-Clauses 38.3 or 38.5, the rights and obligations of the Employer and the Contractor shall be specified in GCC Sub-Clauses 42.1.2 and 42.1.3.

H. Change in Contract Elements

39. Change in the Facilities

39.1 Introducing a Change

39.1.1 Subject to GCC Sub-Clauses 39.2.5 and 39.2.7, the Employer shall have the right to propose, and subsequently require, that the Project Manager order the Contractor from time to time during the performance of the Contract to make any change, modification, addition or deletion to, in or from the Facilities hereinafter called "Change", provided that such Change falls within the general scope of the Facilities and does not constitute unrelated work and that it is technically practicable, taking into account both the state of advancement of the Facilities and the technical compatibility

of the Change envisaged with the nature of the Facilities as specified in the Contract.

39.1.2 The Contractor may from time to time during its performance of the Contract propose to the Employer with a copy to the Project Manager, any Change that the Contractor considers necessary or desirable to improve the quality, efficiency or safety of the Facilities. The Employer may at its discretion approve or reject any Change proposed by the Contractor, provided that the Employer shall approve any Change proposed by the Contractor to ensure the safety of the Facilities.

39.1.3 Notwithstanding GCC Sub-Clauses 39.1.1 and 39.1.2, no change made necessary because of any default of the Contractor in the performance of its obligations under the Contract shall be deemed to be a Change, and such change shall not result in any adjustment of the Contract Price or the Time for Completion.

39.1.4 The procedure on how to proceed with and execute Changes is specified in GCC Sub-Clauses 39.2 and 39.3, and further details and forms are provided in the Employer's Requirements (Forms and Procedures).

39.2 Changes Originating from Employer

39.2.1 If the Employer proposes a Change pursuant to GCC Sub-Clause 39.1.1, it shall send to the Contractor a "Request for Change Proposal," requiring the Contractor to prepare and furnish to the Project Manager as soon as reasonably practicable a "Change Proposal," which shall include the following:

(a) brief description of the Change

(b) effect on the Time for Completion

(c) estimated cost of the Change

(d) effect on Functional Guarantees (if any)

(e) effect on the Facilities

(f) effect on any other provisions of the Contract.

39.2.2 Prior to preparing and submitting the "Change Proposal," the Contractor shall submit to the Project Manager an "Estimate for Change Proposal," which shall be an estimate of the cost of preparing and submitting the Change Proposal.

Upon receipt of the Contractor's Estimate for Change Proposal, the Employer shall do one of the following:

(a) accept the Contractor's estimate with instructions to the Contractor to proceed with the preparation of the Change Proposal

(b) advise the Contractor of any part of its Estimate for Change Proposal that is unacceptable and request

the Contractor to review its estimate

(c) advise the Contractor that the Employer does not intend to proceed with the Change.

39.2.3 Upon receipt of the Employer's instruction to proceed under GCC Sub-Clause 39.2.2 (a), the Contractor shall, with proper expedition, proceed with the preparation of the Change Proposal, in accordance with GCC Sub-Clause 39.2.1.

39.2.4 The pricing of any Change shall, as far as practicable, be calculated in accordance with the rates and prices included in the Contract. If such rates and prices are inequitable, the parties thereto shall agree on specific rates for the valuation of the Change.

39.2.5 If before or during the preparation of the Change Proposal it becomes apparent that the aggregate effect of compliance therewith and with all other Change Orders that have already become binding upon the Contractor under this GCC Clause 39 would be to increase or decrease the Contract Price as originally set forth in Article 2 (Contract Price) of the Contract Agreement by more than fifteen percent (15%), the Contractor may give a written notice of objection thereto prior to furnishing the Change Proposal as aforesaid. If the Employer accepts the Contractor's objection, the Employer shall withdraw the proposed Change and shall notify the Contractor in writing thereof.

The Contractor's failure to so object shall neither affect its right to object to any subsequent requested Changes or Change Orders herein, nor affect its right to take into account, when making such subsequent objection, the percentage increase or decrease in the Contract Price that any Change not objected to by the Contractor represents.

39.2.6 Upon receipt of the Change Proposal, the Employer and the Contractor shall mutually agree upon all matters therein contained. Within fourteen (14) days after such agreement, the Employer shall, if it intends to proceed with the Change, issue the Contractor with a Change Order.

If the Employer is unable to reach a decision within fourteen (14) days, it shall notify the Contractor with details of when the Contractor can expect a decision.

If the Employer decides not to proceed with the Change for whatever reason, it shall, within the said period of fourteen (14) days, notify the Contractor accordingly. Under such circumstances, the Contractor shall be entitled to reimbursement of all costs reasonably incurred by it in the preparation of the Change Proposal, provided that these do not exceed the amount given by the Contractor in its Estimate for Change Proposal submitted in accordance with GCC Sub-Clause 39.2.2.

39.2.7 If the Employer and the Contractor cannot reach agreement on the price for the Change, an equitable adjustment to the Time for Completion, or any other matters identified in the

Change Proposal, the Employer may nevertheless instruct the Contractor to proceed with the Change by issue of a "Pending Agreement Change Order."

Upon receipt of a Pending Agreement Change Order, the Contractor shall immediately proceed with effecting the Changes covered by such Order. The parties shall thereafter attempt to reach agreement on the outstanding issues under the Change Proposal.

If the parties cannot reach agreement within sixty (60) days from the date of issue of the Pending Agreement Change Order, then the matter may be referred to the Dispute Board in accordance with the provisions of GCC Sub-Clause 45.1.

39.3 Changes Originating from Contractor

39.3.1 If the Contractor proposes a Change pursuant to GCC Sub-Clause 39.1.2, the Contractor shall submit to the Project Manager a written "Application for Change Proposal," giving reasons for the proposed Change and including the information specified in GCC Sub-Clause 39.2.1.

Upon receipt of the Application for Change Proposal, the parties shall follow the procedures outlined in GCC Sub-Clauses 39.2.6 and 39.2.7. However, should the Employer choose not to proceed, the Contractor shall not be entitled to recover the costs of preparing the Application for Change Proposal.

40. Extension of Time for Completion

40.1 The Time(s) for Completion specified in the SCC shall be extended if the Contractor is delayed or impeded in the performance of any of its obligations under the Contract by reason of any of the following:

(a) any Change in the Facilities as provided in GCC Clause 39

(b) any occurrence of Force Majeure as provided in GCC Clause 37, unforeseen conditions as provided in GCC Clause 35, or other occurrence of any of the matters specified or referred to in paragraphs (a), (b) and (c) of GCC Sub-Clause 32.2

(c) any suspension order given by the Employer under GCC Clause 41 hereof or reduction in the rate of progress pursuant to GCC Sub-Clause 41.2 or

(d) any changes in laws and regulations as provided in GCC Clause 36 or

(e) any default or breach of the Contract by the Employer, or any activity, act or omission of the Employer, or the Project Manager, or any other contractors employed by the Employer or

(f) any other matter specifically mentioned in the Contract

(g) any delay on the part of a sub-contractor, provided such delay is due to a cause for which the Contractor himself would have been entitled to an extension of time under this sub-clause

by such period as shall be fair and reasonable in all the circumstances and as shall fairly reflect the delay or impediment sustained by the Contractor.

40.2 Except where otherwise specifically provided in the Contract, the Contractor shall submit to the Project Manager a notice of a claim for an extension of the Time for Completion, together with particulars of the event or circumstance justifying such extension as soon as reasonably practicable after the commencement of such event or circumstance. As soon as reasonably practicable after receipt of such notice and supporting particulars of the claim, the Employer and the Contractor shall agree upon the period of such extension. In the event that the Contractor does not accept the Employer's estimate of a fair and reasonable time extension, the Contractor shall be entitled to refer the matter to a Dispute Board, pursuant to GCC-Clause 44.0

40.3 The Contractor shall at all times use its reasonable efforts to minimize any delay in the performance of its obligations under the Contract.

In all cases where the Contractor has given a notice of a claim for an extension of time under GCC 40.2, the Contractor shall consult with the Project Manager in order to determine the steps (if any) which can be taken to overcome or minimize the actual or anticipated delay. The Contractor shall there after comply with all reasonable instructions which the Project Manager shall give in order to minimize such delay. If compliance with such instructions shall cause the Contractor to incur extra costs and the Contractor is entitled to an extension of time under GCC Sub Clause 40.1, the amount of such extra costs shall be added to the Contract Price.

41. Suspension

41.1 The Employer may request the Project Manager, by notice to the Contractor, to order the Contractor to suspend performance of any or all of its obligations under the Contract. Such notice shall specify the obligation of which performance is to be suspended, the effective date of the suspension and the reasons therefor. The Contractor shall thereupon suspend performance of such obligation, except those obligations necessary for the care or preservation of the Facilities, until ordered in writing to resume such performance by the Project Manager.

If, by virtue of a suspension order given by the Project Manager, other than by reason of the Contractor's default or breach of the Contract, the Contractor's performance of any of its obligations is suspended for an aggregate period of more than ninety (90) days, then at any time thereafter and provided that at that time such performance is still suspended, the Contractor may give a notice to the Project Manager requiring that the Employer shall, within twenty-eight (28) days of receipt of the notice, order the resumption of such performance or request and subsequently order a change in accordance with GCC Clause 39, excluding the performance of the suspended obligations from the Contract.

If the Employer fails to do so within such period, the Contractor may, by a further notice to the Project Manager, elect to treat the suspension, where it affects a part only of the Facilities, as a deletion of such part in accordance with GCC Clause 39 or, where it affects the whole of the Facilities, as termination of the Contract

under GCC Sub-Clause 42.1.

41.2 If

(a) the Employer has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause pursuant to the Appendix (Terms and Procedures of Payment) to the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to the Employer that requires payment of such sum, with interest thereon as stipulated in GCC Sub-Clause 12.3, requires approval of such invoice or supporting documents, or specifies the breach and requires the Employer to remedy the same, as the case may be. If the Employer fails to pay such sum together with such interest, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, or fails to remedy the breach or take steps to remedy the breach within fourteen (14) days after receipt of the Contractor's notice or

(b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Employer, including but not limited to the Employer's failure to provide possession of or access to the Site or other areas in accordance with GCC Sub-Clause 10.2, or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities,

then the Contractor may by fourteen (14) days' notice to the Employer suspend performance of all or any of its obligations under the Contract, or reduce the rate of progress.

41.3 If the Contractor's performance of its obligations is suspended or the rate of progress is reduced pursuant to this GCC Clause 41, then the Time for Completion shall be extended in accordance with GCC Sub-Clause 40.1, and any and all additional costs or expenses incurred by the Contractor as a result of such suspension or reduction shall be paid by the Employer to the Contractor in addition to the Contract Price, except in the case of suspension order or reduction in the rate of progress by reason of the Contractor's default or breach of the Contract.

41.4 During the period of suspension, the Contractor shall not remove from the Site any Plant, any part of the Facilities or any Contractor's Equipment, without the prior written consent of the Employer.

42. Termination

42.1 <u>Termination for Employer's Convenience</u>

42.1.1 The Employer may at any time terminate the Contract for any reason by giving the Contractor a notice of termination that refers to this GCC Sub-Clause 42.1.

42.1.2 Upon receipt of the notice of termination under GCC Sub-Clause 42.1.1, the Contractor shall either immediately or upon the date specified in the notice of termination

(a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition

(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) (ii) below

(c) remove all Contractor's Equipment from the Site, repatriate the Contractor's and its Subcontractors' personnel from the Site, remove from the Site any wreckage, rubbish and debris of any kind, and leave the whole of the Site in a clean and safe condition, and

(d) subject to the payment specified in GCC Sub-Clause 42.1.3,

(i) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination

(ii) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors; and

(iii) deliver to the Employer all non-proprietary drawings, specifications and other documents prepared by the Contractor or its Subcontractors as at the date of termination in connection with the Facilities.

42.1.3 In the event of termination of the Contract under GCC Sub-Clause 42.1.1, the Employer shall pay to the Contractor the following amounts:

(a) the Contract Price, properly attributable to the parts of the Facilities executed by the Contractor as of the date of termination

(b) the costs reasonably incurred by the Contractor in the removal of the Contractor's Equipment from the Site and in the repatriation of the Contractor's and its Subcontractors' personnel

(c) any amounts to be paid by the Contractor to its Subcontractors in connection with the termination of any subcontracts, including any cancellation charges

(d) costs incurred by the Contractor in protecting the Facilities and leaving the Site in a clean and safe condition pursuant to paragraph (a) of GCC Sub-Clause 42.1.2

(e) the cost of satisfying all other obligations, commitments and claims that the Contractor may in good faith have undertaken with third parties in connection with the Contract and that are not covered by paragraphs (a) through (d) above.

42.2 <u>Termination for Contractor's Default</u>

42.2.1 The Employer, without prejudice to any other rights or remedies it may possess, may terminate the Contract forthwith in the following circumstances by giving a notice of termination and its reasons therefore to the Contractor, referring to this GCC Sub-Clause 42.2:

(a) if the Contractor becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, if the Contractor is a corporation, a resolution is passed or order is made for its winding up, other than a voluntary liquidation for the purposes of amalgamation or reconstruction, a receiver is appointed over any part of its undertaking or assets, or if the Contractor takes or suffers any other analogous action in consequence of debt

(b) if the Contractor assigns or transfers the Contract or any right or interest therein in violation of the provision of GCC Clause 43.

(c) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices, as defined in GCC Clause 6, in competing for or in executing the Contract.

42.2.2 If the Contractor

(a) has abandoned or repudiated the Contract

(b) has without valid reason failed to commence work on the Facilities promptly or has suspended, other than pursuant to GCC Sub-Clause 41.2, the progress of Contract performance for more than twenty-eight (28) days after receiving a written instruction from the Employer to proceed

(c) persistently fails to execute the Contract in accordance with the Contract or persistently neglects to carry out its obligations under the Contract without just cause

(d) refuses or is unable to provide sufficient materials, services or labor to execute and complete the Facilities in the manner specified in the program furnished under GCC Sub-Clause 18.2 at rates of progress that give reasonable assurance to the Employer that the Contractor can attain Completion of the Facilities by the Time for Completion as extended,

then the Employer may, without prejudice to any other rights it may possess under the Contract, give a notice to the Contractor stating the nature of the default and requiring the Contractor to remedy the same. If the Contractor fails to remedy or to take steps to remedy the same within fourteen (14) days of its receipt of such notice, then the Employer may terminate the Contract forthwith by giving a notice of termination to the Contractor that refers to this GCC Sub-Clause 42.2.

42.2.3 Upon receipt of the notice of termination under GCC Sub-Clauses 42.2.1 or 42.2.2, the Contractor shall, either

immediately or upon such date as is specified in the notice of termination,

(a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition

(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) below

(c) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination

(d) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors

(e) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as of the date of termination in connection with the Facilities.

42.2.4 The Employer may enter upon the Site, expel the Contractor, and complete the Facilities itself or by employing any third party. The Employer may, to the exclusion of any right of the Contractor over the same, take over and use with the payment of a fair rental rate to the Contractor, with all the maintenance costs to the account of the Employer and with an indemnification by the Employer for all liability including damage or injury to persons arising out of the Employer's use of such equipment, any Contractor's Equipment owned by the Contractor and on the Site in connection with the Facilities for such reasonable period as the Employer considers expedient for the supply and installation of the Facilities.

Upon completion of the Facilities or at such earlier date as the Employer thinks appropriate, the Employer shall give notice to the Contractor that such Contractor's Equipment will be returned to the Contractor at or near the Site and shall return such Contractor's Equipment to the Contractor in accordance with such notice. The Contractor shall thereafter without delay and at its cost remove or arrange removal of the same from the Site.

42.2.5 Subject to GCC Sub-Clause 42.2.6, the Contractor shall be entitled to be paid the Contract Price attributable to the Facilities executed as of the date of termination, the value of any unused or partially used Plant on the Site, and the costs, if any, incurred in protecting the Facilities and in leaving the Site in a clean and safe condition pursuant to paragraph (a) of GCC Sub-Clause 42.2.3. Any sums due the Employer from the Contractor accruing prior to the date of termination shall be deducted from the amount to be paid

to the Contractor under this Contract.

42.2.6 If the Employer completes the Facilities, the cost of completing the Facilities by the Employer shall be determined.

If the sum that the Contractor is entitled to be paid, pursuant to GCC Sub-Clause 42.2.5, plus the reasonable costs incurred by the Employer in completing the Facilities, exceeds the Contract Price, the Contractor shall be liable for such excess.

If such excess is greater than the sums due the Contractor under GCC Sub-Clause 42.2.5, the Contractor shall pay the balance to the Employer, and if such excess is less than the sums due the Contractor under GCC Sub-Clause 42.2.5, the Employer shall pay the balance to the Contractor.

The Employer and the Contractor shall agree, in writing, on the computation described above and the manner in which any sums shall be paid.

42.3 Termination by Contractor

42.3.1 If

(a) the Employer has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause pursuant to the Appendix (Terms and Procedures of Payment) to the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to the Employer that requires payment of such sum, with interest thereon as stipulated in GCC Sub-Clause 12.3, requires approval of such invoice or supporting documents, or specifies the breach and requires the Employer to remedy the same, as the case may be. If the Employer fails to pay such sum together with such interest, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, fails to remedy the breach or take steps to remedy the breach within fourteen (14) days after receipt of the Contractor's notice, or

(b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Employer, including but not limited to the Employer's failure to provide possession of or access to the Site or other areas or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities,

then the Contractor may give a notice to the Employer thereof, and if the Employer has failed to pay the outstanding sum, to approve the invoice or supporting documents, to give its reasons for withholding such approval, or to remedy the breach within twenty-eight (28) days of such notice, or if the Contractor is still unable to carry out any of its obligations under the Contract for any reason attributable to the Employer within twenty-eight (28) days of the said notice, the Contractor may by a further

notice to the Employer referring to this GCC Sub-Clause 42.3.1, forthwith terminate the Contract.

42.3.2 The Contractor may terminate the Contract forthwith by giving a notice to the Employer to that effect, referring to this GCC Sub-Clause 42.3.2, if the Employer becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, being a corporation, if a resolution is passed or order is made for its winding up (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), a receiver is appointed over any part of its undertaking or assets, or if the Employer takes or suffers any other analogous action in consequence of debt.

42.3.3 If the Contract is terminated under GCC Sub-Clauses 42.3.1 or 42.3.2, then the Contractor shall immediately

(a) cease all further work, except for such work as may be necessary for the purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition

(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) (ii)

(c) remove all Contractor's Equipment from the Site and repatriate the Contractor's and its Subcontractors' personnel from the Site, and

(d) subject to the payment specified in GCC Sub-Clause 42.3.4,

(i) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination

(ii) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors, and

(iii) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as of the date of termination in connection with the Facilities.

42.3.4 If the Contract is terminated under GCC Sub-Clauses 42.3.1 or 42.3.2, the Employer shall pay to the Contractor all payments specified in GCC Sub-Clause 42.1.3 and reasonable compensation for all loss, except for loss of profit, or damage sustained by the Contractor arising out of, in connection with or in consequence of such termination.

42.3.5 Termination by the Contractor pursuant to this GCC Sub-Clause 42.3 is without prejudice to any other rights or remedies of the Contractor that may be exercised in lieu of

or in addition to rights conferred by GCC Sub-Clause 42.3.

42.4 In this GCC Clause 42, the expression "Facilities executed" shall include all work executed, Installation Services provided, and all Plant acquired, or subject to a legally binding obligation to purchase, by the Contractor and used or intended to be used for the purpose of the Facilities, up to and including the date of termination.

42.5 In this GCC Clause 42, in calculating any monies due from the Employer to the Contractor, account shall be taken of any sum previously paid by the Employer to the Contractor under the Contract, including any mobilization payment paid pursuant to the Appendix (Terms and Procedures of Payment) to the Contract Agreement.

43. Assignment

43.1 Neither the Employer nor the Contractor shall, without the express prior written consent of the other party which consent shall not be unreasonably withheld, assign to any third party the Contract or any part thereof, or any right, benefit, obligation or interest therein or thereunder, except that the Contractor shall be entitled to assign either absolutely or by way of charge any monies due and payable to it or that may become due and payable to it under the Contract.

I. Claims, Disputes and Arbitration

Any claims or disputes regarding this Contract shall be initiated, prepared, submitted and adjudicated in accordance with this Article of the Contract.

44. Contractor's Claims

44.1 If the Contractor considers himself to be entitled to any extension of the time for completing the Work and/or any additional payment, in connection with the Contract, the Contractor shall give notice to the Project Manager, describing the event or circumstance giving rise to the claim.
The notice shall be given as soon as practicable as and not later than thirty (30) days after the Contractor became aware, or should have become aware, of the event or circumstance.

If the Contractor fails to give notice of a claim within such period of thirty (30) days, the time for completing the Work shall not be extended, the Contractor shall not be entitled to additional payment, and the Owner shall be discharged and released from all liability in connection with the claim. The Contractor shall also submit any other notices which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Project Manager. Without admitting the Employer's liability, the Project Manager may, after receiving any notice under this Article, monitor the record-keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Project Manager and the Third Party QA firm to inspect all these records, and shall (if instructed) submit copies to the Project Manager and the Third Party QA firm.

Within forty-five (45) days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Project Manager, the Contractor shall send to the Project Manager and the Third Party QA firm a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect:

(i) this fully detailed claim shall be considered as interim;

(ii) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Project Manager may reasonably require; and

(iii) the Contractor shall send a final claim within thirty (30) days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Project Manager.

Within thirty (60) days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be agreed by both the Project Manager and the Contractor, the Project Manager shall respond with:

1) a recommendation to the Employer for approval; or

2) recommendation to the Employer for disapproval with detailed comments.

The Project Manager may also request any necessary further particulars, but shall nevertheless give his recommendation response to the Employer on the principles of the claim within the above defined time period. The Project Manager shall consult with the Third Party QA firm during the development of his recommendation on any claim. Any recommendation for approval by the Project Manager shall include an evaluation of any additional time and/or additional payment, if such additional time and/or payment is justified. The Employer shall not be bound by the Project Manager's recommendation and shall provide a final decision on the claim to the Contractor within fifteen (15) days following the receipt of the Project Manager's recommendation. Each subsequent Payment Request shall include such additional payment for any claim that has been substantiated as due under the relevant provision of the Contract and approved by the Employer. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate to the satisfaction of the Project Manager and Employer. Any recommendation of the Project Manager or decision of the Employer concerning a claim, change request or

dispute shall not obligate or otherwise transfer liability to the Provider of Funds.

If the Project Manager does not respond within the timeframe defined in this Article, either Party may consider that the claim is rejected by the Project Manager and any of the Parties may refer it to the Dispute Board in accordance with the following provisions of this Article 44. The requirements of this Article are in addition to those of any other section or article of the Contract which may apply to a claim. If the Contractor fails to comply with this or another article in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim.

44.2 Organization of the Dispute Board

Disputes shall be referred to a Dispute Board (DB) for decision in accordance with **Article 44.3 Obtaining Dispute Board's Decision**. The DB shall be comprised of three qualified persons ("the Members") and the On-Budget Monitor serving as a non-voting member, who are employees of the Provider of Funds. One of the three Members shall serve as the chairman of the DB. The On-Budget Monitor will manage and monitor the DB for the Provider of Funds and will assist in gathering information for the DB, support the DB Members and perform other tasks related to the DB operation as directed by the Provider of Funds.

The Provider of Funds shall:

i. appoint the Members;

ii. organize the DB;

iii. provide the names of the Members and the On-Budget Monitor to the Contractor and Employer; and identify which member is to serve as chairman, all within thirty (30) days of the Notice to Proceed.

44.3 Obtaining Dispute Board's Decision

If the Contractor disagrees with the decision of the Project Manager or Employer regarding a claim or a dispute, the Contractor may refer the matter in writing to the DB (through the On-Budget Monitor) for its decision, with copies to the Employer and the Project Manager. The DB shall be deemed to have received such reference on the date when it is received by the On-Budget Monitor.

Both Parties shall promptly make available to the DB all such additional information, further access to the Site, and appropriate facilities, as the DB may require for the purposes of making a decision on such matters. The DB shall not act as, or take the place of, arbitrator(s). Within thirty (30) days after receiving such reference, or within such other period as may be proposed by the DB and approved by both Parties, the DB shall give its decision, which shall be in accordance with this provision of the Contract

and the Dispute Board Procedural Rules included in **Article 44.5 Dispute Board Procedural Rules**. Parties shall use best efforts to give binding effect to the decision, without waiving any future rights to arbitration within the period described below. Unless the Contract has already been abandoned, repudiated or terminated, the Contractor shall continue to proceed with the Works in accordance with the Contract during any dispute resolution proceeding.

If either Party is dissatisfied with the DB's decision, then either Party may, within thirty (30) days after receiving the decision, give notice to the other Party of its dissatisfaction and intention to commence arbitration. If the DB fails to give its decision within the period of thirty (30) days (or as otherwise approved) after receiving such reference, then either Party may, within thirty (30) days after this period has expired, give notice to the other Party of its dissatisfaction and intention to commence arbitration. In either event, this notice of dissatisfaction shall state that it is given under this provision of the Contract, and shall set out the matter in dispute and the reason(s) for dissatisfaction. Neither Party shall be entitled to commence arbitration of a dispute unless such notice of dissatisfaction has been given in accordance with this provision of the Contract. If the DB has given its decision as to a matter in dispute to both Parties, and no notice of dissatisfaction has been given by either Party within thirty (30) days after it has received the DB's decision, then the decision shall become final.

44.4. Arbitration

Any dispute not settled amicably and in respect of which the DB's decision (if any) has not become final and binding, shall be finally settled by arbitration. Unless otherwise agreed by both Parties:

i. Arbitration shall be conducted in accordance with the rules of procedure for arbitration of the United Nations Commission on International Trade Law (UNCITRAL) as in force on the date of this Contract,

ii. the place of arbitration shall be Dubai, UAE,

iii. the arbitration shall be conducted in English.

The arbitrators shall have full power to open up, review and revise any certificate, determination, instruction, opinion or valuation of the Project Manager, and any decision of the DB, relevant to the dispute. Nothing shall disqualify representatives of the Parties and the Project Manager from being called as a witness and giving evidence before the arbitrator(s) on any matter whatsoever relevant to the dispute. Neither Party shall be limited in the proceedings before the arbitrator(s) to the evidence or arguments previously put before the DB to obtain its decision, or to the reasons for dissatisfaction given in its notice of dissatisfaction. Any decision of the DB shall be admissible in evidence in the arbitration. Arbitration may be commenced prior to, or after, completion of the Works. The obligations of the Parties, the Project Manager and the DB shall not be altered by

reason of any arbitration being conducted during the progress of the Works.

44.5 Dispute Board Procedural Rules

The Employer, Project Manager and the Contractor shall furnish to the DB one copy of all documents which the DB may request, including Contract documents, progress reports, variation instructions, certificates and other documents pertinent to the performance of the Contract and the matter under review. All communications between the DB and the Employer or the Contractor shall be copied to the other Party.
If any dispute is referred to the DB in accordance with the provisions of the Contract, the DB shall proceed in accordance with those provisions and these Rules. Subject to the time allowed to give notice of a decision and other relevant factors, the DB shall:

i. act fairly and impartially as between the Employer and the Contractor, giving each of them a reasonable opportunity of presenting their case and responding to the other's case, and

ii. adopt procedures suitable to the dispute, avoiding unnecessary delay or expense.

The DB, at its option, may conduct a hearing on the dispute, in which event it will decide on the date and place for the hearing and may request that written documentation and arguments from the Employer and the Contractor be presented to it prior to, or during, the hearing. The DB shall be under no obligation to conduct a hearing.

Except as otherwise agreed in writing by the Employer and the Contractor, the DB shall have power to adopt an inquisitorial procedure, to refuse admission to hearings or audience at hearings to any persons other than representatives of the Employer, the Contractor and the Project Manager, and to proceed in the absence of any party who the DB is satisfied received notice of the hearing; but shall have discretion to decide whether and to what extend this power may be exercised.

The Employer and the Contractor empower the DB, among other things, to:

i. establish the procedure to be applied in deciding a dispute,

ii. decide upon the DB's own jurisdiction, and as to the scope of any dispute referred to it,

iii. conduct any hearing as it thinks fit, not being bound by any rules or procedures other than those contained in the Contract and these Rules,

iv. take the initiative in ascertaining the facts and matters

required for a decision,

v. make use of its own specialist knowledge, if any,

vi. decide upon the payment of financing charges in accordance with the Contract,

vii. decide upon any provisional relief such as interim or conservatory measures, and

viii. open up, review and revise any certificate, decision, determination, instruction, opinion or valuation of the Project Manager, relevant to the dispute.

The DB shall not express any opinions during any hearing concerning the merits of any arguments advanced by the Parties. Thereafter, the DB shall make and give its decision in accordance with Article 44.3, or as otherwise agreed by the Employer and the Contractor in writing. The DB:

i. shall convene in private after a hearing, in order to have discussions and prepare its decision;

ii. shall endeavor to reach a unanimous decision: if this proves impossible the applicable decision shall be made by a majority of the Members, who may require the minority Member to prepare a written report for submission to the Employer and the Contractor; and

iii. shall make every effort for its Members to attend all meetings or hearings. If a Member fails to attend a meeting or hearing, or to fulfil any required function, the other two Members may nevertheless proceed to make a decision, unless:

a) either the Employer or the Contractor do not agree that they do so, or

b) the absent Member is the chairman and he/she instructs the other members not to make a decision.

iv. render its decision to the Parties in the most efficient manner possible, both in time and expense to the Parties and the project.

Section 8 - Special Conditions of Contract

The following Special Conditions of Contract (SCC) shall supplement the General Conditions of Contract (GCC). Whenever there is a conflict, the provisions herein shall prevail over those in the GCC. The clause number of the SCC is the corresponding clause number of the GCC.

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1. Definitions

The Employer is: Da Afghanistan Breshna Sherkat (DABS)

The Project Manager is: To be determined by DABS

Country of Origin: Any of the eligible countries listed as per Section 5

5. Law and Language

5.1 The Contract shall be interpreted in accordance with the laws of: Islamic Republic of Afghanistan

5.2 The ruling language is: English

5.3 The language for communications is: English

7. Scope of Facilities

7.1 The Contractor agrees to supply spare parts for a period of years: 5

The Contractor shall carry sufficient inventories to ensure an ex-stock supply of consumable spares for the Plant. Other spare parts and components shall be supplied as promptly as possible, but at the most within 6 months of placing the order and payment will be based on Withdrawal Application (Direct Payment). In addition, in the event of termination of the production of spare parts, advance notification will be made to the Employer of the pending termination, with sufficient time to permit the Employer to procure the needed requirement. Following such termination, the Contractor will furnish to the extent possible and at no cost to the Employer the blueprints, drawings and specifications of the spare parts, if requested.

8. Time for Commencement and Completion

8.1 The Contractor shall commence work on the Facilities within fifteen (15) days from the Effective Date for determining Time for Completion as specified in the Contract Agreement.

8.2 The Time for Completion of the whole of the Facilities shall be as described in the Contract Agreement.

8.3 The Contractor shall not commence construction works until the updated Resettlement Plan (RP) has been approved by DABS, except for specific geographic areas or sections for which the construction works shall only commence after updated RP has been fully implemented by the Contractor to the satisfaction of DABS. The Contractor shall coordinate with the Project Manager on identifying geographic areas and sections where work can be commence.

13. Securities

13.3.1 The amount of performance security, as a percentage of the Contract Price for the Facility or for the part of the Facility for which a separate Time for Completion is

provided, shall be: Ten (10%) percent of the Contract Price, denominated in the proportions of currencies which Contract Price is payable.

13.3.2 The performance security shall be in the form of the Bank Security as per form included in Section 9 (Employer's Requirements, Bank Guarantees and Certificates).

1. If the institution issuing the security is located outside the Islamic Republic of Afghanistan, it shall have a correspondent financing institution located in the Islamic Republic of Afghanistan to make it enforceable.[1]

14. Tax & Duties

14.1 The grantor Requirements (Section 5) provides guidance on available tax exemptions for USAID-financed projects. Available tax exemptions include, in summary, an exemption for (1) taxes on the income, profits or property of all non-Afghan organizations, on non-Afghan employees of both Afghan and non-Afghan organizations and on non-Afghan individual contractors and grantees, including social security taxes and taxes on the property, personal or real, owned by non-Afghan organizations or persons and (2) customs duties, import taxes and other levies on all goods and equipment imported by both Afghan and non-Afghan contractors for use on the project. The grantors requirements section also contains other important limitations on the goods and services that can be financed by USAID.

20. Design and Engineering

20.4 Construction Documents

(a) Construction shall not commence until the Contractor receives from the Project Manager approval of the Construction Documents relevant to the design and construction of such parts.

(b) The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents that it has prepared, whether such specifications, drawings and other documents have been approved by the Employer's Representative or not. The Contractor bears full responsibility for the accuracy, completeness and consistency of all information it uses including, without limitation, information furnished to the Contractor by or on behalf of the Employer before and after execution of the Contract.

(c) The Employer's Representative's approval, with or without modification of the document furnished by the Contractor, shall not relieve the Contractor of any responsibility or liability imposed upon it by any provisions of the Contract except to the extent that any subsequent failure results from modifications required by the Employer's Representative."

20.5 Installation, Operating, Service and Maintenance Manuals

(a) Prior to the commencement of erection, the Contractor shall submit to the Employer's Representative three sets of fully detailed installation, operating, service and maintenance instructions for each Section of the Works, in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust, service and repair the Works.

[1] *The format of the performance security shall be in the form of a bank guarantee, or cash deposit, in accordance with the standard bidding documents, and shall be issued by a reputable bank or financial institution selected by the bidder. If the institution issuing the security is located outside the country of the borrower, it shall have a correspondent financial institution located in the country of the borrower to make it enforceable.*

(b) Prior to taking over, the manuals shall be revised to as-built status and one original plus six copies shall be reproduced as a book or books of

approximately A4 size and bound into strong durable imitation leather covers. A CD containing all the installation, operating, service and maintenance manuals documentation files shall also be handed over to the Employer.

(c) The Works or if applicable the Section shall not be considered to be completed for the purposes of taking-over under Clause 24 until such as-built status installation, operation and maintenance manuals have been submitted to the Employer's Representative."

20.6 Commissioning and Completion Report

Prior to the issue of the Taking-Over Certificate the Contractor shall submit to the Employer's Representative one original and six copies of a Commissioning

22. Installation

22.1.1 Labor Laws

(e) The Contractor shall not make employment decisions based upon personal characteristics unrelated to job requirements. The Contractor shall base the employment relationship upon equal opportunity and fair treatment, and shall not discriminate with respect to aspect of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment or retirement, and discipline.

The Contractor shall provide equal wages and benefits to men and women for work of equal value or type and shall use their best efforts to employ women and local people negatively affected by, or living in the vicinity of, the project.

22.2 Labor

22.2. Prohibition of Harmful Child labor

"Child" means a child below the age of 14 (as specified by the Islamic Republic of Afghanistan under the U.N. Minimum Age Convention of 1973) or such older age as may otherwise be applicable under relevant national, provincial or local laws.

22.9 Protection of the Environment and Social Safeguards

(i) The Contractor shall comply and budget for the monitoring and mitigation measures set forth in the Initial Environmental Examination (IEE) prepared by the Employer and submitted to DABS, and notify the Employer in writing of any unanticipated environmental issues that arise and are not covered by the IEE.

(ii) The Contractor shall ensure that all Project facilities are designed and constructed in compliance with applicable local laws and regulations of the Employer concerning environmental protection and an initial environmental examination (IEE), including an environmental management plan (EMP) as agreed by DABS.

(iii) without limiting the generality of the foregoing, the Contractor shall ensure that all mitigation and monitoring measures identified in the EMP (a) are incorporated into the detailed design and implemented during design and construction of the Project facilities and (b) comply with all Project contract provisions requiring compliance with these requirements, and that information about the implementation of EMP is included in bi-annual environmental monitoring reports submitted to the Employer.

(iv) the Contractor shall ensure that all its activities are carried out in full compliance with all applicable laws and regulations of the Employer *Policy on Involuntary Resettlement* (1995) and the updated Resettlement Plan (RP) agreed to by

DABS and based upon the detailed technical design and in full consultation with affected people.

(v) the Contractor shall not act on any notice to proceed which lacks a compensation program as detailed in the updated Resettlement Plan and fully implemented to the satisfaction of DABS.

(vi) concerning the Afghan Component, under the heading "Environment and Social Safeguard Measures", the Contractor shall not proceed to undertake its contractual obligations until the demining agency selected under the Project has certified that the construction site has been cleared from any unexploded ordinance.

22.10 Landmines and Unexploded Ordinance

Demining of the transmission line route sites will be carried by UNAMACA (United Nations Mine Action Centre, Afghanistan).

The Contractor shall liaise with UNMACA regarding the areas to be cleared, sequence of work and for obtaining clearance before commencing work. The Contractor shall ensure that all site personnel are aware of the dangers of landmines and UXO.

22.11 Compliance with Minimum Operating Security Standards (MOSS)

The Contractor shall follow the Asian Development Bank's Afghanistan Resident Mission (AFRM) Guideline's for Minimum Operating Security Standards (MOSS) and shall familiarize all field staff in the same.

The Contractor shall designate one senior project officer as Project MOSS Co-ordinator who shall be responsible for ensuring all site personnel are familiar with and follow AFRM's MOSS procedures. The Project MOSS Co-ordinator shall also maintain regular liaison with the appropriate AFRM and local UN security counterparts, including United Nations Mine Action Centre, Afghanistan (UNMACA). The Project MOSS Co-ordinator shall be familiar with the UN Field Security Handbook; UN Security Awareness Handbook; UN Country Security Plan; UN Country Security Structure; Country Travel Clearance Procedures; Country Security Standard Operating and Emergency Procedures; Country Security Notices, Local Sub-Office Security Procedures and Medevac Procedures (as appropriate).

The Contractor's Field Offices shall be equipped with a satellite telephone and VHF and HF (Codan) communications facilities and shall maintain regular reporting schedules to AFRM. Project field transport vehicles shall be equipped with VHF and HF (Codan) communications and shall maintain regular reporting schedules to the Project Field Office. All international staff and key national staff shall be issued with handheld VHF radios. All communications equipment (including charged batteries) shall be regularly checked for proper operations and regular radio checks shall be conducted.

All project staff shall be provided with full country and security briefing prior to deployment in Afghanistan and shall have training in personal security, hostage survival, office/residential security, use of communications equipment, basic first aid and mine awareness.

In addition to the MOSS, the Contractor shall prepare an action plan, acceptable to the Employer for adequate security for the smooth uninterrupted implementation of the Project, and implement such plan.

25. Commissioning and Operational Acceptance

25.2.2 The Guarantee Test of the Facilities shall be successfully completed before turnover to DABS.

25.2.3 Tests and Inspections specified in Section VI, Schedule of Supply, shall be carried

out at the following times or milestones, and places:

Substations

220 kV Overhead Line Conductor and Hardware

At the manufacturer's works during routine tests

220 kV Insulators and Hardware

At the manufacturer's works during routine tests

Substation Earth Resistance and Geotechnical Tests

On site prior to construction and after completion of the substation earthing

Substation Commissioning

On site for the commissioning of the substation

26. Completion Time Guarantee

26.2 Applicable rate for liquidated damages: Zero point one (0.1) % of the Contract Price per day in the proportions of currencies in which the Contract Price is payable of part thereof

Maximum deduction for liquidated damages: Ten (10) % of the Contract Price

26.3 No bonus will be given for earlier Completion of the Facilities or part thereof.

27. Defect Liability

27.10 There is no extended Defect Liability Period.

30. Limitation of Liability

30.1 (b) The multiplier of the Contract Price is: One point zero (1.0)

38. War Risks

38. Delete the entire article 38 war risk (not applicable to this contract)

Condition of Award of Contract

DABS will not award a contract for Works under any subproject until after the updated LARP with respect to such subproject has been approved by DABS.

Considering poor history of payment of Afghanistan projects under commitment Procedure, Withdrawal Application (Direct Payment) will be used for this contract under bidding.

Section 9 - Contract Forms

This Section contains the Letter of Acceptance, the Contract Agreement and Appendices to the Contract Agreement which, once completed, will form part of the Contract.

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Notification of Award

[Employer's letter head]

Letter of Acceptance

[date]

To: [Name and address of the Contractor]

This is to notify you that your Bid consisting of the Technical and Price Bids dated [date] for execution of the [name of the Contract and identification number, as given in the Contract Data] for the Contract Price in the aggregate of [amounts in numbers and words] [name of currency], as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by our Agency.

You are requested to furnish the Performance Security within 28 days in accordance with the Conditions of Contract, using for that purpose one of the Performance Security Forms included in Section 9 (Contract Forms) of the Bidding Document

[Authorized Signature]
[Name and Title of Signatory]
[Name of Agency]

Attachment: Contract Agreement

Contract Agreement

THIS AGREEMENT made the _____ day of _____, _____,

BETWEEN

(1) [***name of Employer***], a corporation incorporated under the laws of [***country of Employer***] and having its principal place of business at [***address of Employer***] (hereinafter called "the Employer"), and (2) [***name of Contractor***], a corporation incorporated under the laws of [***country of Contractor***] and having its principal place of business at [***address of Contractor***] (hereinafter called "the Contractor").

WHEREAS the Employer desires to engage the Contractor to design, manufacture, test, deliver, install, complete and commission certain Facilities, viz. [***list of facilities***] ("the Facilities") and the Contractor have agreed to such engagement upon and subject to the terms and conditions hereinafter appearing.

NOW IT IS HEREBY AGREED as follows:

Article 1 Contract Documents

1.1 **Contract Documents** (Reference GCC Clause 2)
The following documents shall constitute the Contract between the Employer and the Contractor, and each shall be read and construed as an integral part of the Contract:

(a) This Contract Agreement and the Appendices hereto
(b) Letter of Price Bid and Price Schedules submitted by the Contractor
(c) Letter of Technical Bid and Technical Proposal submitted by the Contractor
(d) Special Conditions of Contract
(e) General Conditions of Contract
(f) Specification
(g) Drawings
(h) Other completed Bidding Forms submitted with the Letters of Technical and Price Bids
(i) Any other documents part of the Employer's Requirements
(j) Any other documents shall be added here

1.2 **Order of Precedence** (Reference GCC Clause 2)
In the event of any ambiguity or conflict between the Contract Documents listed above, the order of precedence shall be the order in which the Contract Documents are listed in Article 1.1 (Contract Documents) above.

1.3 **Definitions** (Reference GCC Clause 1)
Capitalized words and phrases used herein shall have the same meanings as are ascribed to them in the General Conditions.

Article 2 Contract Price and Terms of Payment

2.1 **Contract Price** (Reference GCC Clause 11)
The Employer hereby agrees to pay to the Contractor the Contract Price in consideration of the performance by the Contractor of its obligations hereunder. The Contract Price shall be the aggregate of: [. . . ***amounts of foreign currency in words*** . . .], [. . . ***amounts in figures***. . .] as specified in Price Schedule No. 5 (Grand Summary), [. . . ***amounts of local currency in words*** . . .], [. . . ***amounts in figures***. . .], or such other sums as may be determined in accordance with the terms and conditions of the Contract.

2.2 **Terms of Payment** (Reference GCC Clause 12)
The terms and procedures of payment according to which the Employer will reimburse the Contractor are given in the Appendix (Terms and Procedures of Payment) hereto.

Article 3
Effective Date

3.1 **Effective Date** (Reference GCC Clause 1)
The Effective Date upon which the period until the Time for Completion of the Facilities shall be counted from is the date when all of the following conditions have been fulfilled:

(a) This Contract Agreement has been duly executed for and on behalf of the Employer and the Contractor;

(b) The Contractor has submitted to the Employer the performance security and the mobilization payment guarantee;

(c) The Employer has paid the Contractor the mobilization payment

(d)

Each party shall use its best efforts to fulfill the above conditions for which it is responsible as soon as practicable.

3.2 If the conditions listed under 3.1 are not fulfilled within 2 months from the date of this Contract notification because of reasons not attributable to the Contractor, the parties shall discuss and agree on an equitable adjustment to the Contract Price and the Time for Completion and/or other relevant conditions of the Contract.

Article4
Communications

4.1 The address of the Employer for notice purposes, pursuant to GCC 4.1 is:

Attention: Ahmad Shah Sahil, Chief Financial Officer

Street Address: Chaman Houzouri,

Floor/Room number: CFO's Office

Da Afghanistan Breshna Sherkat (DABS), H.Q

City: Kabul

ZIP Code: N/A

Country: Afghanistan

4.2 The address of the Contractor for notice purposes, pursuant to GCC 4.1 is: [***Contractor's address***].

Article.5
Appendices

5.1 The Appendices listed in the attached List of Appendices shall be deemed to form an integral part of this Contract Agreement.

5.2 Reference in the Contract to any Appendix shall mean the Appendices attached hereto, and the Contract shall be read and construed accordingly.

IN WITNESS WHEREOF the Employer and the Contractor have caused this Agreement to be duly executed by their duly authorized representatives the day and year first above written.

Signed by, for and on behalf of the Employer

[***Signature***]

[***Title***]

in the presence of

[***Signature***]

[***Title***]

Signed by, for and on behalf of the Contractor

[***Signature***]
[***Title***]

in the presence of

[***Signature***]
[***Title***]

Appendices

Appendix 1-	Bank Guarantees and Certificates
Appendix 2-	Change Orders
Appendix 3 -	Terms and Procedures of Payment
Appendix 4 -	Price Escalation
Appendix 5 -	Insurance Requirements
Appendix 6 -	Time Schedule
Appendix 7 -	List of Major Items of Plant and services and List of Approved Subcontractors
Appendix 8 -	Scope of Works and Supply by the Employer

Appendix 9 - List of Documents for Approval or Review

Appendix 10 - Functional Guarantees

Appendix 11 - Environmental Documents

Appendix 1 - Bank Guarantees and Certificates

1. Form of Performance Security

Bank's Name, and Address of Issuing Branch or Office
Beneficiary: Name and Address of Employer
Date:
Performance Guarantee No.:

We have been informed that . . . . . name of the Contractor. . . . . (hereinafter called "the Contractor") has entered into Contract No. . . . . reference number of the Contract. . . . . dated . . . . . .with you, for the execution of . . . . . name of contract and brief description of Works. . . . . (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Contractor, we . . . . . name of the Bank. . . . . hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of . . . . . name of the currency and amount in figures*. . . . . (. . . . . amount in words. . . . .) such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire no later than the earlier of:

(a) eighteen months after our receipt of:

(i) a copy of the Completion Certificate; or

(ii) a registered letter from the Contractor, attaching a copy of the notice to the project manager that the Facilities are ready for commissioning, and stating that fourteen days have elapsed from receipt of such notice (or seven days have elapsed if the notice was a repeated notice) and the project manager has failed to issue a Completion Certificate or inform the Contractor in writing of any defects or deficiencies; or

(iii) a registered letter from the Contractor stating that no Completion Certificate has been issued but the Employer is making use of the Facilities; or

(b) the ____ day of _____, 2___.

Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458, except that subparagraph (ii) of Sub-article 20(a) is hereby excluded.

……
Seal of Bank and Signature(s)

2. Form of Mobilization Payment Security

Bank's Name, and Address of Issuing Branch or Office
Beneficiary: Name and Address of Employer
Date:
Mobilization Payment Guarantee No.:

We have been informed that . . . . . name of the Contractor. . . . . (hereinafter called "the Contractor") has entered into Contract No. . . . . reference number of the Contract. . . . . dated . . . . . .with you, for the execution of . . . . . name of contract and brief description of Works. . . . . (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, a mobilization payment in the sum . . . . . (the Guarantor shall insert an amount representing the amount of the mobilization payment denominated either in the currency(ies) of the mobilization payment as specified in the Contract, or in a freely convertible currency acceptable to the Employer.). . . . . (. . . . . Amount in words. . . . .) is to be made against a mobilization payment guarantee.

At the request of the Contractor, we . . . . . name of the Bank. . . . . hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of . . . . . name of the currency and amount in figures*. . . . . (. . . . . amount in words. . . . .) upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor used the mobilization payment for purposes other than the costs of mobilization in respect of the Works.

It is a condition for any claim and payment under this guarantee to be made that the mobilization payment referred to above must have been received by the Contractor on its account number . . . . . Contractor's account number. . . . . at . . . . . name and address of the Bank. . . . . .

The maximum amount of this guarantee shall be progressively reduced by the amount of the mobilization payment repaid by the Contractor as indicated in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that eighty (80) percent of the Contract Price has been certified for payment, or on the . . . day of . . . . . (insert the expected expiration date of the Time for Completion. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months][one year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee"). , ..., whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.
This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

Seal of Bank and Signature(s)

3. Form of Completion Certificate

Contract: [. . . . .insert name of contract and contract identification details. . . . .]

Date:
Certificate No.:

To: [. . . . .insert name and address of Contractor. . . . .]

Dear Ladies and/or Gentlemen,

Pursuant to GC Clause 24 (Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and the Employer dated [. . . . .insert date. . . . .], relating to the [. . . .brief description of the Facilities . . . .], we hereby notify you that the following part(s) of the facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part(s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below.

1. Description of the Facilities or part thereof: [. . . .description . . . .]

2. Date of Completion: [. . . .date . . . .]

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defect Liability Period.

Very truly yours,

[. . . .Signature . . . .]
Project Manager

4. Form of Operational Acceptance Certificate

Contract: [. . . . .insert name of contract and contract identification details. . . . .]

Date:
Certificate No.:

To: [. . . . .insert name and address of Contractor. . . . .]

Pursuant to GC Sub-Clause 25.3 (Operational Acceptance) of the General Conditions of the Contract entered into between yourselves and the Employer dated [date], relating to the [brief description of the Facilities], we hereby notify you that the Functional Guarantees of the following part(s) of the Facilities were satisfactorily attained on the date specified below.

1. Description of the Facilities or part thereof: [description]
2. Date of Operational Acceptance: [date]

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defect Liability Period.

Very truly yours,

[. . . .Signature . . . .]
Project Manager

Appendix 2 - Change Orders

2.1 Change Order Procedure
2.1.1 General
2.1.2 Change Order Log
2.1.3 References for Changes
2.2. Change Order Forms
2.2.1 Request for Change Proposal
2.2.2 Estimate for Change Proposal
2.2.3 Acceptance of Estimate
2.2.4 Change Proposal
2.2.5 Change Order
2.2.6 Pending Agreement Change Order
2.2.7 Application for Change Proposal

2.1 Change Order Procedure

2.1.1 General

This section provides samples of procedures and forms for implementing changes in the Facilities during the performance of the Contract in accordance with GCC Clause 39 (Change in the Facilities) of the General Conditions.

2.1.2 Change Order Log

The Contractor shall keep an up-to-date Change Order Log to show the current status of Requests for Change and Changes authorized or pending, as Annex 8. Entries of the Changes in the Change Order Log shall be made to ensure that the log is up-to-date. The Contractor shall attach a copy of the current Change Order Log in the monthly progress report to be submitted to the Employer.

2.1.3 References for Changes

(1) Request for Change as referred to in GC Clause 39 shall be serially numbered CR-X-nnn.
(2) Estimate for Change Proposal as referred to in GC Clause 39 shall be serially numbered CN-X-nnn.
(3) Acceptance of Estimate as referred to in GC Clause 39 shall be serially numbered CA-X-nnn.
(4) Change Proposal as referred to in GC Clause 39 shall be serially numbered CP-X-nnn.
(5) Change Order as referred to in GC Clause 39 shall be serially numbered CO-X-nnn.

Note:

(a) Requests for Change issued from the Employer's Home Office and the Site representatives of the Employer shall have the following respective references:

Home Office	CR-H-nnn
Site	CR-S-nnn

(b) The above number "nnn" is the same for Request for Change, Estimate for Change Proposal, Acceptance of Estimate, Change Proposal and Change Order.

2.2 Change Order Forms

2.2.1 Request for Change Proposal Form

[Employer's Letterhead]

To: [Contractor's name and address] Date:

Attention: [Name and title]

Contract Name: [Contract name]
Contract Number: [Contract number]

Dear Ladies and/or Gentlemen:

With reference to the captioned Contract, you are requested to prepare and submit a Change Proposal for the Change noted below in accordance with the following instructions within [number] days of the date of this letter [or on or before (date)].

1. Title of Change: [Title]
2. Change Request No./Rev.: [Number]
3. Originator of Change:
   Employer: [Name]
   Contractor (by Application for Change Proposal No. [Number Refer to Annex 2.2.7]
4. Brief Description of Change: [Description]
5. Facilities and/or Item No. of equipment related to the requested Change: [Description]
6. Reference drawings and/or technical documents for the request of Change:
   Drawing No./Document No.[Description]
7. Detailed conditions or special requirements on the requested Change: [Description]
8. General Terms and Conditions:
   (a) Please submit your estimate to us showing what effect the requested Change will have on the Contract Price.
   (b) Your estimate shall include your claim for the additional time, if any, for completion of the requested Change.
   (c) If you have any critical opinion regarding the adoption of the requested Change in connection with the conformability to the other provisions of the Contract or the safety of the Plant or Facilities, please inform us of your opinion in your proposal of revised provisions.
   (d) Any increase or decrease in the work of the Contractor relating to the services of its personnel shall be calculated.
   (e) You shall not proceed with the execution of the work for the requested Change until we have accepted and confirmed the amount and nature in writing.

[Employer's Name]
[Signature]
[Name of signatory]
[Title of signatory]

2.2.2 Estimate for Change Proposal Form

[Contractor's Letterhead]

To: [Employer's name and address] Date:

Attention: [Name and title]

Contract Name: [Contract name]

Contract Number: [Contract number]

Dear Ladies and/or Gentlemen:

With reference to your Request for Change Proposal, we are pleased to notify you of the approximate cost of preparing the below-referenced Change Proposal in accordance with GC Sub-Clause 39.2.1 of the General Conditions. We acknowledge that your agreement to the cost of preparing the Change Proposal, in accordance with GC Sub-Clause 39.2.2, is required before estimating the cost for change work.

1. Title of Change: [Title]
2. Change Request No./Rev.: [Number]
3. Brief Description of Change: [Description]
4. Scheduled Impact of Change: [Description]
5. Cost for Preparation of Change Proposal: [insert costs which shall be in the currencies of the Contract]

(a) Engineering (Amount)

(i) Engineer hrs x rate/hr =

(ii) Draftsperson hrs x rate/hr =

Sub-total hrs

Total Engineering Cost

(b) Other Cost

Total Cost (a) + (b)

[Contractor's Name]
[Signature]
[Name of signatory]
[Title of signatory]

2.2.3 Acceptance of Estimate Form

[Employer's Letterhead]

To: [Contractor's name and address] Date:

Attention: [Name and title]

Contract Name: [Contract name]

Contract Number: [Contract number]

Dear Ladies and/or Gentlemen:

We hereby accept your Estimate for Change Proposal and agree that you should proceed with the preparation of the Change Proposal.

1. Title of Change: [Title]
2. Change Request No./Rev.: [Request number/revision]
3. Estimate for Change Proposal No./Rev.: [Proposal number/revision]
4. Acceptance of Estimate No./Rev.: [Estimate number/revision]
5. Brief Description of Change: [Description]
6. Other Terms and Conditions: In the event that we decide not to order the Change accepted,

you shall be entitled to compensation for the cost of preparation of Change Proposal described in your Estimate for Change Proposal mentioned in para. 3 above in accordance with GC Clause 39 of the General Conditions.

[Employer's Name]

[Signature]

[Name of signatory]

[Title of signatory]

2.2.4 Change Proposal Form

[Contractor's Letterhead]

To: [Employer's name and address] Date:

Attention: [Name and title]

Contract Name: [Contract name]

Contract Number: [Contract number]

Dear Ladies and/or Gentlemen:

In response to your Request for Change Proposal No. [Number], we hereby submit our proposal as follows:

1. Title of Change: [Name]
2. Change Proposal No./Rev.: [Proposal number / revision]
3. Originator of Change: Employer: [Name] / Contractor: [Name]
4. Brief Description of Change: [Description]
5. Reasons for Change: [Reason]
6. Facilities and/or Item No. of Equipment related to the requested Change:
   [Facilities]
7. Reference drawings and/or technical documents for the requested Change:
   [Drawing/Document No./Description]
8. Estimate of increase/decrease to the Contract Price resulting from Change

Proposal:

Amount
[insert amounts in the currencies of the Contract]

(a) Direct material
(b) Major construction equipment
(c) Direct field labor (Total hrs.)
(d) Subcontracts
(e) Indirect material and labor
(f) Site supervision
(g) Head office technical staff salaries

Process engineer	hrs @	rate/hr
Project engineer	hrs @	rate/hr
Equipment engineer	hrs @	rate/hr
Procurement	hrs @	rate/hr
Draftsperson	hrs @	rate/hr
Total	hrs	

(h) Extraordinary costs (computer, travel, etc.)

(i) Fee for general administration, % of Items
(j) Taxes and customs duties

Total lump sum cost of Change Proposal [Sum of items (a) to (j)]
Cost to prepare Estimate for Change Proposal [Amount payable if Change is not accepted]

9. Additional time for Completion required due to Change Proposal

10. Effect on the Functional Guarantees

11. Effect on the other terms and conditions of the Contract

12. Validity of this Proposal: within [Number] days after receipt of this Proposal by the Employer

13. Other terms and conditions of this Change Proposal:

    (a) You are requested to notify us of your acceptance, comments or rejection of this detailed Change Proposal within [Number] days from your receipt of this Proposal.

    (b) The amount of any increase and/or decrease shall be taken into account in the adjustment of the Contract Price.

    (c) Contractor's cost for preparation of this Change Proposal: [insert amount]. This cost shall be reimbursed by the Employer in case of Employer's withdrawal or rejection of this Change Proposal without default of the Contractor in accordance with GC Clause 39 of the General Conditions]

[Contractor's Name]

[Signature]

[Name of signatory]

[Title of signatory]

2.2.5 Change Order Form

[Employer's Letterhead]

To: [Contractor's name and address]

Date:

Attention: [Name and title]

Contract Name: [Contract name]

Contract Number: [Contract number]

Dear Ladies and/or Gentlemen:

We approve the Change Order for the work specified in the Change Proposal (No. [number]), and agree to adjust the Contract Price, Time for Completion and/or other conditions of the Contract in accordance with GC Clause 39 of the General Conditions.

1. Title of Change: [Name]
2. Change Request No./Rev.: [Request number / revision]
3. Change Order No./Rev.: [Order number / revision]
4. Originator of Change: Employer: [Name] / Contractor: [Name]
5. Authorized Price:

   Ref. No.: [Number] Date: [Date]

   Foreign currency portion [Amount] plus Local currency portion [Amount]
6. Adjustment of Time for Completion

   None Increase [Number] days Decrease [Number] days
7. Other effects, if any

Authorized by: Date:

Employer

Accepted by: Date:

Contractor

2.2.6 Pending Agreement Change Order Form

[Employer's Letterhead]

To: [Contractor's name and address] Date:

Attention: [Name and title]

Contract Name: [Contract name]

Contract Number: [Contract number]

Dear Ladies and/or Gentlemen:

We instruct you to carry out the work in the Change Order detailed below in accordance with GC Clause 39 of the General Conditions.

1. Title of Change: [Name]
2. Employer's Request for Change Proposal No./Rev.: [number/revision] dated: [date]
3. Contractor's Change Proposal No./Rev.: [number / revision] dated: [date]
4. Brief Description of Change: [Description]
5. Facilities and/or Item No. of equipment related to the requested Change: [Facilities]]
6. Reference Drawings and/or technical documents for the requested Change: [Drawing / Document No. / Description]
7. Adjustment of Time for Completion:
8. Other change in the Contract terms:
9. Other terms and conditions:

[Employer's Name]

[Signature]

[Name of signatory]

[Title of signatory]

2.2.7 Application for Change Proposal Form

[Contractor's Letterhead]

To: [Employer's name and address] Date:

Attention: [Name and title]

Contract Name: [Contract name]
Contract Number: [Contract number]

Dear Ladies and/or Gentlemen:

We hereby propose that the below-mentioned work be treated as a Change in the Facilities.

1. Title of Change: [Name]
2. Application for Change Proposal No./Rev.: [Number / revision] dated: [Date]
3. Brief Description of Change: [Description]
4. Reasons for Change:
5. Order of Magnitude Estimation (amount in the currencies of the Contract): [Amount]
6. Scheduled Impact of Change:
7. Effect on Functional Guarantees, if any:
8. Appendix:

[Contractor's Name]
[Signature]
[Name of signatory]
[Title of signatory]

Appendix 3 - Terms and Procedures of Payment

In accordance with the provisions of GCC Clause 12 (Terms of Payment), the Employer shall pay the Contractor in the following manner and at the following times, on the basis of the Price Breakdown given in the section on Price Schedules. Payments will be made in the currencies quoted by the Bidder unless otherwise agreed between the parties. Applications for payment in respect of part deliveries may be made by the Contractor as work proceeds.

(A) Terms of Payment

All approved payments exclusive of the Mobilization payment shall be made within sixty (60) days of receipt of invoice.

Item No. 1 - Design, Drawings and Documentation

One hundred percent (100%) of the total or pro rata design services amount upon acceptance of design by the Project Manager.

Item No. 2 - Plant, Equipment, Mandatory Spare Parts, Tools

All supply items are per INCOTERM 2010 DAP.

Ten percent (10%) as a mobilization payment against receipt of invoice and an irrevocable mobilization payment security for the equivalent amount made out in favor of the Employer. An amount of 10% shall be deducted from all Contractors' invoices until the mobilization payment has been fully repaid. The mobilization payment security may be reduced in proportion to the amount repaid and/or the value of the plant and equipment delivered to the site, as evidenced by delivery documents.

Fifty percent (50%) of the total or pro rata amount on shipment after receipt of invoice and shipping documents (negotiable bill of lading, a non-negotiable sea way bill, an airway bill, a railway consignment note, a road consignment note, insurance certificate, Manufacturer's or Supplier's warranty certificate, inspection certificate issued by nominated inspection agency, Supplier's factory shipping details, packing list, certificate of origin etc).

Forty percent (40%) of the total or pro rata amount after receipt of invoice and delivery documents to the site. In the event that items are stored in the Contractor's secured warehouse located in Afghanistan but delivery to the site is delayed upon agreement with the Employer for security reasons, the Contractor may make application for this part of the payment against warehouse receipts, provided always that the plant and equipment are ready for delivery on the date shown in the said Program.

Five percent (5%) of the total or pro rata amount upon issuance of the Completion Certificate.

Five percent (5%) of the total or pro rata amount upon completion of the Defects Liability Period without defect(s) in accordance with GCC Sub-Clause 27.

Item No. 3 - Construction, Installation, Testing and Commissioning, and Other Charges

Ten percent (10%) of the total installation and other services amount as a mobilization payment against receipt of invoice and an irrevocable mobilization payment security for the equivalent amount made out in favor of the Employer. An amount of 10% shall be

deducted from all Contractor's invoices until the mobilization payment has been fully repaid. The mobilization payment security may be reduced in proportion to the amount repaid and/or the value of the plant and equipment delivered to the site, as evidenced by delivery documents.

Ninety percent (90%) of the measured value of work performed by the Contractor, as identified in the said Program of Performance, during the preceding month, as evidenced by the Employer's authorization of the Contractor's application, will be made monthly.

Five percent (5%) of the total or pro rata value of installation services performed by the Contractor as evidenced by the Employer's authorization of the Contractor's monthly applications, upon issuance of the Completion Certificate.

Five percent (5%) of the total or pro rata value of installation services performed by the Contractor as evidenced by the Employer's authorization of the Contractor's monthly applications, upon completion of the Defects Liability Period without defect(s) in accordance with GCC Sub-Clause 27.

Item No. 4 - On the Job Training, Transfer of Knowledge

One Hundred percent (100%) of the total or pro rata On the Job Training amount upon acceptance of On the Job Training by the Project Manager.

(B) Payment Procedures

The procedures to be followed in applying for certification and making payments shall be as follows and may be changed as agreed by and between the parties during contract negotiations.

1. The Contractor is entitled to submit monthly Progress Payment Invoices to the Project Manager for approval.

(C) Delayed Payment and Interest Rate

In the event that the Employer fails to make any payment on its respective due date per the Terms of Payment, the Employer shall pay to the Contractor interest on the amount of 1% per month of such delayed payment for the period of delay until payment has been made in full.

(D) Provisional Sum for Contingency

The Provisional Sum will be used for the following purposes:

1. Demining and UXO clearance if required

2. Security

3. Unforeseen Conditions and Change Orders

4. Reconciliation of final line item unit quantities as applicable

Unused portions of the PSC may be used for procurement by the Contractor who shall provide price quotes and delivery of items as approved and directed by DABS.

Appendix 4 - Price Escalation (Not Applicable)

Prices payable to the Contractor, in accordance with the Contract, shall be subject to adjustment during performance of the Contract to reflect changes in the cost of labor and material components, in accordance with the following formula:

$$P_1 = P_0 \times (a + b\frac{L_1}{L_0} + c\frac{M_1}{M_0}) - P_0$$

in which:

P_1 = adjustment amount payable to the Contractor

P_0 = Contract price (base price)

a = percentage of fixed element in Contract price (a = _ %)

b = percentage of labor component in Contract price (b = _%)

c = percentage of material and equipment component in Contract price (c = _%)

L_0, L_1 = labor indices applicable to the appropriate industry in the country of origin on the base date and the date for adjustment, respectively

M_0, M_1= material and equipment indices in the country of origin on the base date and the date for adjustment, respectively

Conditions Applicable To Price Adjustment

The Bidder shall indicate the source of labor and materials indices and the base date indices in its bid.

Item	Source of Indices Used	Base Date Indices

The base date shall be the date 30 days prior to the Bid closing date.

The date of adjustment shall be the mid-point of the period of manufacture or installation of component or Plant.

The following conditions shall apply:

(a) No price increase will be allowed beyond the original delivery date unless covered by an extension of time awarded by the Employer under the terms of the Contract. No price increase will be allowed for periods of delay for which the Contractor is responsible. The Employer will, however, be entitled to any price decrease occurring during such periods of delay.

(b) If the currency in which the Contract price, P_0, is expressed is different from the currency of the country of origin of the labor and/or materials indices, a correction factor will be applied to avoid incorrect adjustments of the Contract price. The correction factor shall correspond to the ratio of exchange rates between the two currencies on the base date and the date for adjustment as defined above.

(c) No price adjustment shall be payable on the portion of the Contract price paid to the Contractor as an advance payment.

Appendix 5 - Insurance Requirements

(A) Insurances To Be Taken Out By The Contractor

In accordance with the provisions of GCC Clause 34, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, such approval not to be unreasonably withheld.

(a) Cargo Insurance

Covering loss or damage occurring, while in transit from the supplier's or manufacturer's works or stores until arrival at the Site, to the Facilities (including spare parts therefore) and to the construction equipment to be provided by the Contractor or its Subcontractors.

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]

(b) Installation All Risks Insurance

Covering physical loss or damage to the Facilities at the Site, occurring prior to completion of the Facilities, with an extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the defect liability period while the Contractor is on the Site for the purpose of performing its obligations during the defect liability period.

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]

(c) Third Party Liability Insurance

Covering bodily injury or death suffered by third parties (including the Employer's personnel) and loss of or damage to property (including the Employer's property and any parts of the Facilities that have been accepted by the Employer) occurring in connection with the supply and installation of the Facilities.

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]

(d) Automobile Liability Insurance

Covering use of all vehicles used by the Contractor or its Subcontractors (whether or not owned by them) in connection with the supply and installation of the Facilities. Comprehensive insurance in accordance with statutory requirements.

(e) Workers' Compensation

In accordance with the statutory requirements applicable in any country where the Facilities or any part thereof is executed.

(f) Employer's Liability

In accordance with the statutory requirements applicable in any country where the Facilities or any part thereof is executed.

(g) Other Insurances

The Contractor is also required to take out and maintain at its own cost the following insurances:

Details:

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]

The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 34.1, except for the Third Party Liability, Workers' Compensation and Employer's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 34.1, except for the Cargo, Workers' Compensation and Employer's Liability Insurances. All insurer's rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies.

(B) Insurances to Be Taken Out By the Employer

The Employer shall at its expense take out and maintain in effect during the performance of the Contract the following insurances.

Details:

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]

Appendix 6 - Time Schedule

Appendix 7 - List of Major Items of Plant and Services and List of Approved Subcontractors

A list of major items of plant and services is provided below.

The following Subcontractors and/or manufacturers are approved for carrying out the item of the facilities indicated. Where more than one Subcontractor is listed, the Contractor is free to choose between them, but it must notify the Employer of its choice in good time prior to appointing any selected Subcontractor. In accordance with GCC Sub-Clause 19.1, the Contractor is free to submit proposals for Subcontractors for additional items from time to time. No Subcontracts shall be placed with any such Subcontractors for additional items until the Subcontractors have been approved in writing by the Employer and their names have been added to this list of Approved Subcontractors.

Major Items of Plant and Services	Approved Subcontractors/Manufacturers	Nationality

Appendix 8 - Scope of Works and Supply by the Employer

The following personnel, facilities, works and supplies will be provided/supplied by the Employer, and the provisions of GCC Clauses 10, 21 and 24 shall apply as appropriate.

All personnel, facilities, works and supplies will be provided by the Employer in good time so as not to delay the performance of the Contractor, in accordance with the approved Time Schedule and Program of Performance pursuant to GCC Sub-Clause 18.2.

Unless otherwise indicated, all personnel, facilities, works and supplies will be provided free of charge to the Contractor.

Personnel	Charge to Contractor (if any)

Facilities	Charge to Contractor (if any)

Works	Charge to Contractor (if any)

Supplies	Charge to Contractor (if any)

Appendix 9 - List of Documents for Approval or Review

Pursuant to GCC Sub-Clause 20.3.1, the Contractor shall prepare, or cause its Subcontractor to prepare, and present to the Project Manager in accordance with the requirements of GCC Sub-Clause 18.2 (Program of Performance), the following documents for

(A) Approval

1. .....

2. .....

3. .....

(B) Review

1. .....

2. .....

3. .....

Appendix 10 - Functional Guarantees

1. General

This Appendix sets out

(a) the functional guarantees referred to in GCC Clause 28 (Functional Guarantees)

(b) the preconditions to the validity of the functional guarantees, either in production and/or consumption, set forth below

(c) the minimum level of the functional guarantees

(d) the formula for calculation of liquidated damages for failure to attain the functional guarantees.

2. Preconditions

The Contractor gives the functional guarantees (specified herein) for the facilities, subject to the following preconditions being fully satisfied:

3. Functional Guarantees

Subject to compliance with the foregoing preconditions, the Contractor guarantees as follows:

3.1 Production Capacity

3.2 Raw Materials and Utilities Consumption

4. Failure in Guarantees and Liquidated Damages

4.1 Failure to Attain Guaranteed Production Capacity

If the production capacity of the facilities attained in the guarantee test, pursuant to GCC Sub-Clause 25.2, is less than the guaranteed figure specified in para. 3.1 above, but the actual production capacity attained in the guarantee test is not less than the minimum level specified in para. 4.3 below, and the Contractor elects to pay liquidated damages to the Employer in lieu of making changes, modifications and/or additions to the Facilities, pursuant to GCC Sub-Clause 28.3, then the Contractor shall pay liquidated damages at the rate of 100 percent for every complete 1% of the deficiency in the production capacity of the Facilities, or at a proportionately reduced rate for any deficiency, or part thereof, of less than a complete 1%.

4.2 Raw Materials and Utilities Consumption in Excess of Guaranteed Level

If the actual measured figure of specified raw materials and utilities consumed per unit (or their average total cost of consumption) exceeds the guaranteed figure specified in para. 3.2 above (or their specified average total cost of consumption), but the actual consumption attained in the guarantee test, pursuant to GCC Sub-Clause 25.2, is not more than the maximum level specified in para. 4.3 below, and the Contractor elects to pay liquidated damages to the Employer in lieu of making changes, modifications and/or additions to the Facilities pursuant to GCC Sub-Clause 28.3, then the Contractor shall pay liquidated damages at the rate of 100 percent for every complete 1% of the excess consumption of the Facilities, or part thereof, of less than a complete 1%.

4.3 Minimum Levels

Notwithstanding the provisions of this paragraph, if as a result of the guarantee test(s), the following minimum levels of performance guarantees (and consumption guarantees) are not attained by the Contractor, the Contractor shall at its own cost make good any deficiencies until the Facilities reach any of such minimum performance levels, pursuant to GCC Sub-Clause 28.2:

(a) production capacity of the Facilities attained in the guarantee test: 100% of the guaranteed production capacity

and/or

(b) average total cost of consumption of all the raw materials and utilities of the Facilities: 105% of the guaranteed figures.

4.4 Limitation of Liability

Subject to para. 4.3 Above, the Contractor's aggregate liability to pay liquidated damages for failure to attain the functional guarantees shall not exceed one hundred percent (100%) of the Contract price

Appendix 11 - Environmental Documents

11a – PTEC IEE Amendment 5

11b - PTEC Environmental Impact Assessment

11c – EMMP Items for Transmission Lines

11d – EMMP Items for Substations

11e – EMMP Template

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Office for Afghanistan and Pakistan Affairs (OAPA)

INITIAL ENVIRONMENTAL EXAMINATION
Amendment No. 5

PROGRAM/ACTIVITY DATA

Country Code and SO:	306-06
Strategic Objective Name:	Expanded, Sustainable Physical Infrastructure
Country or Region:	Afghanistan
Activity Name:	Power Expansion, Transmission and Connectivity (PTEC) Project
Funding begin:	9/2011
Funding end:	12/31/2018
LOP amount:	$864.4 million
IEE prepared by:	Eric Pulliam **Date:** 09/15/2014
IEE Amendment:	Yes
Previous Amendments:	Amendment 4: OAPA-14-JUL-AFG-0052, 7/17/2014 Amendment 3: OAPA-14-FEB-AFG-0025, 2/06/2014 Amendment 2: OAPA-13-APR-AFG-0037, 4/16/2013 Amendment 1: OAPA-12-JUL-AFG-0050, 7/8/2012
Original IEE:	PTEC IEE: OAPA-11-AUG-AFG-0037, 8/22/2011
Scoping Statement with EMMP:	OAPA-13-MAR-AFG-0028, 3/5/2013

ENVIRONMENTAL ACTION RECOMMENDED: (Place X where applicable)

Categorical Exclusion	[X]	Deferral	[ ]
Positive Determination	[ ]	Negative Determination	[ ]
Negative Determination With Conditions	[X]	Exemption	[ ]

1.0 PURPOSE, BACKGROUND AND ACTIVITY DESCRIPTION

1.1. Purpose

The purpose of Amendment No. 5 to the Power Expansion, Transmission and Connectivity (PTEC) Project Initial Environmental Examination (IEE) is, in a timely manner, to duly 1) reduce Life of Project (LOP) funding by $[redacted] million through elimination of the Ministry of Energy and Water capacity-building activity, 2) descope the Jalalabad to Hisare-Shahi Industrial Park transmission line activity, 3) amend the mechanism for constructing the transmission line and substations between Ghazni and Kandahar, and 4) increase the LOP funding by $[redacted] million (transfer from

Afghanistan Infrastructure Funds) from $815.4 to $864.4 million for the rehabilitation of the transmission lines and substations in Helmand and Kandahar provinces.

1.2. Background

On August 22, 2011, Amendment No. 1 (OAPA-12-JUL-AFG-0050) to the PTEC IEE was approved that descoped the Bamyan Loop and expansion of the Southern Electrical Power System (SEPS), reduced the LOP amount from $[redacted] billion to $[redacted] million, and extended the LOP from FY 2016 to FY 2017.

On April 16, 2013, PTEC IEE Amendment No. 2 (OAPA-13-APR-AFG-0037) was approved that extended the project duration to December 31, 2016, and reversed the Threshold Decision for a Positive Determination for high voltage transmission lines as a result of the PTEC Scoping Statement recommendation.

On April 6, 2013, PTEC IEE Amendment No. 3 (OAPA-14-FEB-AFG-0025) was approved that transferred $[redacted] million to the Afghanistan Infrastructure Trust Fund (AITF) mechanism managed by the Asian Development Bank (ADB). The descoped activities included the transmission line from Ghazni to Kandahar and the rehabilitation of Darunta Hydroelectric Power Plant, both to be implemented through AITF. AITF was given a Categorical Exclusion (RCE), approved on March 5, 2013, (OAPA-13-MAR-AFG-0020), with the condition that the project be subject to ADB's environmental process.

On July 14, 2014, PTEC IEE Amendment No. 4 (OAPA-14-JUL-AFG-0052) was approved, adding a Clean Energy Hybrid Systems Program and Clean Energy Advisory Services to PTEC, increased the LOP funds with the addition of $[redacted] million (Clean Energy funds) from $[redacted] million to $[redacted] million, and increased the project duration by one year to December 31, 2018.

On March 15, 2013 (OAPA-13-MAR-AFG-0028) the PTEC Environmental Scoping Statement (ESS) and the Environmental Mitigation Management Plan (EMMP) were approved laying out the requirements for the PTEC project. These continue to be the guiding documents for mitigating and monitoring potential environmental and social impacts from the project.

This IEE Amendment No. 5 to the PTEC PAD will allow for the following revisions.

1.3. Activity Description

<u>Descoping of the Ministry of Energy and Water (MEW) Capacity Building Program</u>

The $[redacted] million for the MEW capacity-building program activity has been cut due to changes in Mission priorities and funding reductions. The final LOP will incorporate the $[redacted] million reduction and descoping.

<u>Descoping of the Jalalabad to Hisare-Shahi Industrial Park Transmission Line</u>

The planned Jalalabad to Hisare-Shahi Industrial Park transmission line activity was descoped from PTEC since it is unlikely that adequate power will be available to serve the

Industrial Park. Also, DABS has indicated that stabilization of the distribution system in Kabul is a higher priority so would rather have the funds allocated to that activity.

Construction of a Transmission Line from Ghazni to Kandahar

The high voltage transmission line from Arghandi to Ghazni, an activity within PTEC, was contracted for construction by Da Afghanistan Breshna Sherkat (DABS), USAID's on-budget partner. The remaining segment of this line from Ghazni to Kandahar was to be built using the Afghanistan Infrastructure Trust Fund (AITF) as the mechanism. Under this amendment, the funds for construction of this 370 km transmission line and five substations will be shifted back from the AITF to an on-budget mechanism through DABS. Construction of this line was approved July 12, 2012 (AFG-0050) in Amendment 1 to the original PTEC IEE with a "negative determination with conditions and positive threshold decision. The conditions are still applicable, but were changed per PTEC IEE Amendment 2 (AFG-0037).

Life of Project (LOP) Funding Increase

The Life of Project funds will decrease by $[redacted] million from the descoped MEW Capacity Building Program and will also increase by $[redacted] million, using AIF funds, totaling $[redacted] million. The additional AITF funds will enable the rehabilitation of the 110 kV transmission lines and substations in Helmand and Kandahar provinces. The U.S. Army Corp of Engineers was not able to accomplish this work under its multiple award task order, so plans to transfer $[redacted] million of Afghanistan Infrastructure Funds (AIF) to USAID to complete these projects.

2.0 RECOMMENDED THRESHOLD DECISIONS

Below are the recommended actions for the existing activities and the amendments described above, the impacts on the environment, and recommended Threshold Determinations and Conditions, if any:

Table 1: Revised PTEC Activities and Recommended Threshold Decisions

PTEC Component Task Number and Activities	Potential Effect on Natural or Physical Environment	Determination and Reg. 216 actions required
1. Arghandi to Kandahar Transmission Line (on-budget)		
1.1 Design, development of construction bid packages, and CMC and QA oversight for construction of high voltage transmission lines including substations and distribution systems	*No effect*	Categorical Exclusion per 22 CFR 216.2(c)(2)(i), (iii) (v) and (xiv): no action required
1.2 Procurement of LV/MV transformers, distribution kits, materials, and equipment	*Minor with appropriate mitigation and monitoring*	Negative Determination with Conditions as established in the Scoping Statement (OAPA-13-MAR-AFG-0028) and in compliance with the
1.3 Construction of seven new 220 kv substations, typically 350m x 350m with security boundary walls		
1.4 Construction of a new 220 kv transmission		

line, including lattice towers typically spaced at 300m with a footprint of 8m x 8m each and a dirt/gravel access road from the highway		approved EMMP.
1.5 Construction of low/medium voltage transmission and distribution lines along public right-of ways, including concrete pole towers spaced at approximately 40 m, meter boxes, and small 20kv/400v transformers		
2. Salang Tunnel Substation (on-budget)		
2.1 Design, development of construction bid packages, and CMC and QA oversight for construction of the substation and distribution feeders	*No effect*	Categorical Exclusion per 22 CFR 216.2(c)(2)(i), (iii) (v) and (xiv): no action required
2.2 Construction of one new 220 kv substation with a security boundary wall and 20 kv feeder lines	*Minor with appropriate mitigation and monitoring*	Negative Determination with Conditions as established in PTEC Amendment 2 (OAPA-13-APR-AFG-0037) and in compliance with the approved EMMP.
2.3 Procurement of materials and equipment		
2.4 Construction of generator station		
3. SEPS 1 and SEPS 2 Transmission Line and Substation Rehabilitation (on-budget)		
3.1 Design, development of construction bid packages, and CMC and QA oversight for construction of transmission line systems, including substations	*No effect*	Categorical Exclusion per 22 CFR 216.2(c)(2)(i), (iii) (v) and (xiv): no action required
3.2 Procurement of materials and equipment	*Minor with appropriate mitigation and monitoring*	Negative Determination with Conditions as established in PTEC IEE Amendment 1 (OAPA-12-JUL-AFG-0050) and in compliance with EMMP.
3.3 Installation of new, more efficient high voltage equipment in substations to replace old or non-functional equipment at existing substations.		
3.4 Construction of new 110 kV transmission lines, including poles.		
4. NEPS Improvements (on-budget)		
4.1 Design, development of construction bid packages, and CMC and QA oversight for upgrade and rehabilitation of existing transmission lines, substations, distribution networks, and power facilities	*No effect*	Categorical Exclusion per 22 CFR 216.2(c)(2)(i), (iii) (v) and (xiv): no action required
4.2 Procurement of materials and equipment	*Minor with appropriate mitigation and monitoring*	Negative Determination with Conditions as established in PTEC IEE Amendment 1 (OAPA-12-JUL-AFG-0050) and in compliance with EMMP.
4.3 Upgrade/rehabilitation of existing NEPS transmission lines, substations, and distribution systems		
4.4 Upgrade/rehabilitation of existing NEPS power facilities		
5. Capacity Building DABS (on-budget)		

5.1 Technical assistance to DABS for commercialization to increase cost recovery and reduce losses	*No effect*	Categorical Exclusion per 22 CFR 216.2(c)(2)(i), (iii) (v) and (xiv): no action required
5.2 Technical assistance to increase capacity of DABS management and technical departments to operate and maintain the national electric grid system		
5.3 IFC assessment of SEPS for feasibility of a private sector management contract		
5.4 Private sector management contract for SEPS operations and management		
5.5 Procurement of energy sector materials and equipment for maintenance of the national electric grid	*Minor with appropriate mitigation and monitoring*	Negative Determination with Conditions as established in PTEC IEE Amendment 2 (OAPA-13-APR-AFG-0037) and in compliance with EMMP.
6. Clean Energy Hybrid Systems Program (off-budget)		
6.1 Attracting independent power producers to construct, operate, maintain, and sell power to DABS from one or more 10 MW solar power plants through a capital buy-down reverse auction.	*No effect*	Categorical Exclusion per 22 CFR 216.2(c)(2)(i), (iii) (v) and (xiv): no action required
	Minor with appropriate mitigation and monitoring	Negative Determination with the following Conditions: 1. Diligent site selection. 2. Preparation of an EDF/RR and EMMP to be approved by the COR and MEO. 3. Approval of designs by a USAID engineer. 4. If preparation of an EDF/RR reveals any potential significant adverse environmental or social impacts, COR will seek guidance from the BEO/OAPA on how to proceed. 5. The power producer shall provide USAID with certification that it has complied with all applicable Afghan EIA and other relevant laws. <u>Equipment</u>: The implementing partner shall provide evidence that equipment and materials procured will be used in a safe manner; that all national and

		provincial environmental laws and regulations are followed; and that after the equipment has completed its useful life, it shall be either returned to the supplier for safe and sound disposal, or disposed of by Government of Afghanistan agencies and/or by the implementing partner in accordance with relevant legislation and/or USAID rules and regulations. Construction: The implementing partner shall follow international standards for construction of solar power units, drainage, perimeter fencing, and office space with bathroom facilities. The designs will be reviewed and approved by engineers of USAID/Afghanistan's Office of Economic Growth and Infrastructure. Drinking water shall be tested for safety according to USG standards for coliform bacteria, arsenic, and other pollutants. Dust, noise, air pollution, erosion, safety hazards, and other negative environmental and human health impacts will be minimized using standard mitigation measures as available See USAID's Global Environmental Management Support Sectoral Guidelines on Construction (http://www.usaidgems.org/Sectors/construction.htm). The EMMP that was previously developed and approved by the MEO (as part of the Scoping Statement, OAPA-13-MAR-AFG-0028) on March 5, 2013 shall be amended to include preparation of an Environmental Data Form/Review Report for the selected site and mitigation measures for solar power construction. The amendment shall be submitted to the MEO for review before solicitations for bids are made.

3.0 ENVIRONMENTAL RECOMMENDATIONS

Recommended Action: ***Categorical Exclusions*** (ca. 30 % of funding)

PTEC activities for Task Orders 1.1, 2.1, 3.1, 4.1, 5.1-4, and 6.1 do not have an effect on the natural and physical environment, and fit within the categories listed in 22 CFR 216.2 (c)(2) as being categorically excluded from any further environmental review requirements. The originator of the proposed action has determined that the proposed activities are within the following classes of actions:

- Education, technical assistance, or training programs, except to the extent such programs include activities directly affecting the environment (such as construction of facilities, etc.) [22 CFR 216.2(c)(2)(i)];
- Analyses, studies, academic or research workshops and meetings [22 CFR 216.2(c)(2)(iii)];
- Document and information transfers [22 CFR 216.2(c)(2)(v)]; and,
- Studies, projects, or programs intended to develop the capability of recipient countries to engage in development planning, except to the extent designed to result in activities directly affecting the environment (such as construction of facilities, etc.) [22 CFR 216.2(c)(2)(xiv)].

Recommended Action: ***Negative Determination with Conditions*** (ca. 70 % of funding)
All remaining Task Orders (T.O. 1.2-5, 2.2-4, 3.2-4, 4.2-4, 5.5, and 6.3) require mitigation measures to be implemented to avoid potential negative environmental and social impacts:

T.O. 1.2-5, 2.2-4, 3.2-4, 4.2-4, 5.5 and 6.3: Implementer is required to follow the Conditions and EMMP as established in the Scoping Statement, OAPA-13-MAR-AFG-0028, approved by the BEO on March 5, 2013.
Conditions:

- Equipment: The implementing partner shall provide evidence that equipment and materials procured will be used in a safe manner; that all national and provincial environmental laws and regulations are followed; and that after the equipment has completed its useful life, it shall be either returned to the supplier for safe and sound disposal, or disposed of by Government of Afghanistan agencies and/or by the implementing partner in accordance with relevant legislation and/or USAID rules and regulations.
- Refurbishments: The implementing partner shall submit an ERF/ERR for review and approval by COR and MEO (Annex 1). Multiple refurbishment activities can be combined in a single ERF/ERR. Best practices shall be followed. See USAID Sector Guidelines: Small-Scale Construction (http://www.usaidgems.org/Sectors/construction.htm).
- Sanitation and Potable Water: If refurbishment will include provision or improvement of sanitation and/or potable water, the implementer shall adhere to best practices and applicable international and national standards, including testing for arsenic and coliform bacteria. See USAID Sector Guidelines: Water and Sanitation (http://www.usaidgems.org/sectorGuidelines.htm).
- Procurement or Use of Asbestos, Mercury and Lead Containing Materials: These or other hazardous materials are prohibited by the U.S. Environmental Protection Agency (see http://www.epa.gov/asbestos) and under international environmental agreements and conventions (e.g., the Stockholm Convention on Persistent Organic Pollutants (see http://chm.pops.int).

T.O. 6.2-3: Procurement of materials and equipment and construction of one or more solar power generation facilities, producing up to 10 MW of power. The anticipated land usage will range from four to six acres per MW of installed capacity and will include perimeter fencing, minor land leveling, drainage, and erosion protection measures. Additionally, a small security office structure with a sanitation facility is anticipated as part of the design.
Conditions:

- Equipment: The implementing partner shall provide evidence that equipment and materials procured will be used in a safe manner; that all national and provincial environmental laws and regulations are followed; and that after the equipment has completed its useful life, it shall be either returned to the supplier for safe and sound disposal, or disposed of by Government of Afghanistan agencies and/or by the implementing partner in accordance with relevant legislation and/or USAID rules and regulations.
- Construction: The implementing partner shall follow international standards for construction of solar power units, drainage, perimeter fencing, and office space with bathroom facilities. The designs will be reviewed and approved by engineers in USAID/Afghanistan's Office of Economic Growth and Infrastructure. Drinking water shall be tested for safety according to USG standards for coliform bacteria, arsenic, and other pollutants. Dust, noise, air pollution, erosion, safety hazards, and other negative environmental and human health impacts will be minimized using standard mitigation measures as available See USAID's Global Environmental Management Support Sectoral Guidelines on Construction (http://www.usaidgems.org/Sectors/construction.htm).

4.0 REVISIONS

Pursuant to 22 CFR 216.3(a)(9), if new information becomes available which indicates that activities to be funded by the project might be "major" and the project's effect "significant," or if additional activities are proposed that might be considered "major" and their effects "significant," this IEE will be reviewed and revised by the originator of the project and submitted to the Bureau Environmental Officer (BEO) for approval and, if appropriate, an environmental assessment will be prepared. It is the responsibility of the USAID Contract/Agreement Officer's Representative (COR/AOR) to keep the MEO and the BEO informed of any new information or changes in the activity that might require revision of the IEE.

APPROVAL OF RECOMMENDED ENVIRONMENTAL ACTIONS

Power Expansion, Transmission and Connectivity (PTEC), IEE Amendment 5

CLEARANCES:

		Date:
COR and OBM, PTEC	_____ Eugene Lin	September 8 , 2014
Acting Director Office of Economic Growth and Infrastructure	_____ Jeff Kaufman	September 8, 2014
Acting Mission Environmental Officer	_____ Andrei Barannik	September 17 , 2014
Regional Environmental Advisor/SCA & OAPA	_____ Andrei Barannik	September 17, 2014
Director, Program Office	_____ Amy Tohill-Stull	September 24, 2014
Regional Legal Advisor	_____ Betty Chung	September 23, 2014
Deputy Mission Director	_____ Roy Plucknett	_____
Mission Director	_____ William Hammink	_____

APPROVAL:

Bureau Environmental Officer/OAPA	_____ Gordon Weynand	_____

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POWER TRANSMISSION EXPANSION and CONNECTIVITY (PTEC) PROJECT

Environmental Impact Statement

January 14th 2013

This publication was produced for review by the United States Agency for International Development. It was prepared by Mr. Nick Skinner, Environmental Specialist.

DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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Acronyms and Abbreviations

ADB	Asian Development Bank
Afs	50 Afs = 1 US$
ANSA	Afghanistan National Standardization Authority
BEO	Bureau Environmental Officer
CHSP	Community Health and Safety Plan
CMC	Construction Management Consultant
COTR	Contracting Officers Technical Representative
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DABs	Da Afghanistan Breshna Sherkat
EA	Environmental Assessment
ESP	Environmentally Sustainable procurement
EMMP	Environmental Mitigation and Monitoring Plan
GoA	Government of Afghanistan
GPP	European Union Green Public Procurement Toolkit
HazMat	Hazardous Materials
H2S	Hydrogen Sulphide
KM	Kilometer
Kv	Kilovolt
kWH	Kilowatts per hour
M^3	Cubic Meter
MMCM	Million Metric Cubic Meters
mg	Milligram
MEO	Mission Environment Officer
MEW	Ministry of Energy and Water
MOF	Ministry of Finance
MOIC	Ministry of Information and Culture
m/s	Meters per second
MW	Megawatt
NEPA	National Environmental Protection Agency
NEPS	North East Power System
Nm^3	Normal cubic meters
NOx	Nitrogen Oxide
O&M	Operation and Maintenance
OHS	Occupational Health and safety
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IFI	International Financial Institutions
LARP	Land Acquisition and Resettlement Plan
Mirab	Water Master
Mirab Bashi	Head Water Master
PID	Project Identification Document
PM	Particulate Matter
PPM	Parts Per Million
REA	Regional Environmental Advisor
ROW	Right of Way
SCF	standard cubic foot (SCF)
SF_6	Sulphur Hexafluoride
SEPS	South East Power System
SO_2	Sulfur Dioxide

SOx	Sulfur Oxide
SoW	Scope of Works
STTA	Short Term Technical Assistance
TBD	To be Determined
ToR	Terms of Reference
USAID	United Stated Agency for International Development
USD	United Stated Dollar
VOCs	Volatile Organic Compounds
WB	World Bank
WMP	Waste Management Plan

Executive Summary

A. Introduction

Afghanistan is one of the least electrified countries in the world and, as a result, the lack of electricity restricts the development of all aspects of a normal modern life style. Due to the war with the Soviets, followed by internal civil war and the subsequent rule of the Taliban, the existing power system in Afghanistan has deteriorated steadily. The Government of Afghanistan (GoA) and international donors have agreed that restoring and increasing the electric power supply is a top national priority. Accordingly, USAID intends to fund the Power Transmission Expansion and Connectivity (PTEC) Project which intends to address many of these issues.

B. Project Description

USAID proposes to install, through on-budget funding via the Afghan Electricity Utility Da Afghanistan Breshna Sherkat (DABS), a wide range of activities which include:

1. Upgrade of existing NEPS transmission lines, substations, and distribution systems;
2. Upgrade of existing NEPS transmission lines, substations, and distribution networks and NEPS power facilities such as Tarakhil Thermal Power Plant and Darunta Dam Hydro Power Plant;
3. New medium and high voltage transmission lines to expand NEPS and connect NEPS with SEPS; and
4. New substations and distribution networks in NEPS and the NEPS-SEPS corridor.

Most of the proposed high voltage transmission lines will be along the existing road and highway right-of-ways (ROW). A 30-35 meter (m) wide corridor will be required for the installation and operations and maintenance (O&M) of the transmission lines. The proposed transmission line will be designed and installed in accordance with the Afghanistan National Standardization Authority (ANSA) standards. Other components are intended to be funded, such as improvements to the NEPS system, and these items are assessed in this report. But the main focus of this study is the NEPS-SEPS expansion.

As stated above, the Project will be implemented by DABS who will establish a Project Implementation Office (PIO). The PIO, consisting of DABS' staff from all relevant offices, will be aided by a Construction Management Consultant (CMC) who will provide experts that DABS does not have. The main aim of the CMC is to provide engineering services to DABS, while at the same time building their construction management capacity. Quality assurance activities will be managed by an independent contractor through USAID's direct Engineering, Quality Assurance, and Logistics Support (EQUALS) Project.

C. Legal Context

Chapter 22 of the Code of Federal Regulations § 216 (hereafter 22 CFR 216) was designed to implement U.S.-NEPA requirements as they apply to activities of USAID. 22 CFR 216 applies to "all new projects, programs or activities authorized or approved" by USAID. 22 CFR 216 requires an Initial Environmental Examination (IEE) as the first review of a proposed USAID action or project. An IEE was prepared for PTEC in 2011 and approved by the USAID Bureau Environmental Officer (BEO) in August 2011. The IEE was subsequently amended to account for changes in the scope and budget of the Project and was approved by the BEO on the 18th July 2012. The original IEE recommended that a Programmatic Environmental Assessment (PEA) be undertaken for PTEC, the first step of which is the

Scoping Statement. The Scoping Statement, the document in hand, identifies at an early stage those impacts that are deemed significant and require further additional study and assessment during the PEA phase. It also identifies the less than significant impacts that can be reduced or negated by appropriate environmental mitigation and monitoring via environmental management plans adopted within Contractual provisions. The Scoping Study shall then be reviewed and approved by USAID Mission MEO, REA and BEO.

In addition to the requirements of USAID, this Project shall also follow Afghan environmental legislation, specifically, the Water Law, Waste Management Regulations, Air Quality Standards, and the Environment Law which specifies that PTEC requires the completion of an Environmental Assessment to be submitted for review by ANEPA.

D. Potential Impacts

The potential impacts of the project identified by this study are both positive and negative. Positive impacts are predominantly socio-economic in nature, they include:

- **Improvements to Agriculture** – Consultations revealed that the agricultural sector suffers from a lack of available, or affordable electricity. Improvements to the electricity supply network will help farmers with irrigation, through the groundwater and surface water pumps and will also allow cold storage facilities to be established which enable farmers to store goods for longer periods and reduce crop losses and decrease transport related costs through improved logistics. However, it is important that facilities, such as cold storage are not subject to load shedding.
- **Increased industrial Activities** – Areas such as Ghazni, Qalat and Kandahar lack and a significant industrial sector; that means that most goods have to be imported from outside of Afghanistan at high costs. Providing cheap, reliable electricity to these areas will help build an industrial base, which in turn will create jobs and improve the economy.
- **Improved medical and educational facilities** – Provision of electricity at medical facilities and schools will provide a better working and living environment, through improved heating and lighting. Schools will also benefit through access to electronic media.
- **Cheaper electricity** – This issue was highlighted as one of the key benefits during stakeholder consultations. The price of electricity is currently as much as 40 Afs per KWh in areas relying on diesel generated power. This price could be reduced to between two and five Afs per KWh by connection to the national grid system. These costs savings will mean that people are able to spend money on other items, such as food for a better quality diet, or invest in items for their business, such as fertilizers for farmers.
- **Creation of jobs** - This falls into two categories:
  - Construction and Operational Jobs associated with the actual transmission line projects; and
  - Jobs created by increased economic activities.

  This issue is extremely important in areas where unemployment is very high (as much as (80% in some regions) and where lack of jobs in one of the main reasons for disenfranchised youth supporting anti-government forces.

The identified potentially negative impacts relate to both environmental and social aspects, they include:

- Vegetation damage along the ROW and access roads and around any substation sites (during construction and during operation).
- Interference with (migratory) bird and bat flight patterns
- Waste management, discharges and emissions, and land degradation.
- Construction activities near/in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.

- Runoff and sedimentation from grading for access roads, tower pads, and substation facilities,
- Alteration of hydrological patterns due to maintenance roads.
- Disturbance/degradation/removal of physical cultural assets
- Health effects and annoyance from ambient noise.
- Noise, dust, emissions and increased traffic during construction period.
- Impacts from blasting.
- Soil erosion and sediment control from materials sourcing
- Areas and site preparation activities.
- Hazardous materials including preservatives, SF_6, insulating oils, etc.
- Occupational Health and Safety Impacts.
- Community health and safety impacts
- Fuels and lubricants used during the construction & maintenance phases.
- Community Health and safety.
- Land acquisition and Resettlement
- Load Shedding

E. Mitigations Measures

Mitigation measures have been prepared for all of the negative impacts identified above and have been integrated within Environmental Mitigation and Management Plans (EMMPs) included in this Scoping Statement in **Appendix B**. They will be adopted throughout the design, construction and operational periods of the Project. The preferred method for implementation of the mitigation measures by Contractors is through adoption of EMMPS within contract documents. The preparation of several additional management plans are also recommended to be prepared by the Contractor, including for example a Waste Management Plan and (if required) a Blast Plan.

F. Conclusions

The Scoping Study has identified numerous environmental and social related impacts that will result from Project implementation, however, it is noted that nearly all of these impacts will be short term, localized construction related impacts that, with adoption of the mitigation specified within **Section 4** and the EMMPs, can be adequately managed without giving rise to significant negative environmental impacts. It is also noted that incorporation of the recommended design mitigation measures will further reduce the significance of impacts. In addition, this study has identified, through consultations with key stakeholders, that the Project will have significant beneficial social impacts which outweigh almost all negative impacts.

Accordingly, the scoping statement concludes that there are no identified socio-economic or physical/natural environmental impacts that cannot be adequately mitigated by adoption of the measures outlined within Section 4 of the report and the EMMPs, and that further study of impacts via an Environmental Assessment is not deemed warranted.

G. Recommendations

The following recommendations are made to ensure suitable environmental management throughout the Project lifecycle.

The EMMP and Contracts - In the first instance the Project must adhere to the mitigation and monitoring measures outlined in **Section 4** and provided in detail by the EMMPs in **Appendix B**. The EMMPs, outline the mitigation measures, the parties responsible and

schedule for implementing the mitigation and a schedule of any required mitigation monitoring and reporting. To ensure adoption of the EMMPS, they shall be included directly within on-budget construction contracts.

Oversight of the EMMP – Oversight of the EMMP will be required through the construction and operational phases of the project as follows:

- Construction – During the construction phase the responsibility of implementing the EMMP will be the Contractor. Monitoring of the Contractor's compliance with the EMMP during works will be the responsibility of the CMC and QA. The CMC will to develop capacity within DABS to monitor environmental compliance during construction. This will enable DABS to eventually undertake the environmental monitoring portion of the CMC activities throughout the construction phase of the Project. This activity could be co-funded with the World Bank who also intends to build environmental capacity within DABS for other projects, such as Naghlu Dam.
- Operational monitoring – DABS shall be responsible for implementing the EMMP during the operational phase of the Project.

Environmentally Sustainable Procurement (ESP) – In addition to the mitigation measures and the required institutional requirements, a further requirement to ensure appropriate management of socio-environmental issues is the use of environmentally sustainable procurement practices. ESP is a process whereby organizations or companies seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured. The benefits associated with ESP are not limited to environmental impact, but can include everything from social and health to economic and political benefits. The main components of PTEC that will benefit from ESP are the Construction Management Services (EQUALS) and the Technical Assistance for Commercialization of DABs; which include procurement of vehicles, computers, office equipment and furniture. Two specific guidelines are recommended:

- European Union Green Public Procurement (GPP) Toolkit
- United Nations Sustainable Procurement Guidelines (UNSPG)

Of these the UN SPG is the most relevant with specific guidelines for the procurements of IT Equipment, Vehicles and Furniture. As such, the Contractor for these components of the Project shall ensure that the inclusion of ESP within their scope of works.

Land Acquisition and Compensation – The majority of land needed for PTEC is owned by the Afghan government and after final identification will be transferred from the relevant entity to DABS. However, there will still be the requirement for additional Project land acquisition and compensation. Given the relative shortcomings of the Afghan Expropriation laws, it shall be the responsibility of DABS to ensure that the Project follows the resettlement and compensation guidelines provided by the World Banks Operational Policy 4.12 for Involuntary Resettlement. Land acquisition, both temporary and permanent is the responsibility of DABS as their in-kind contribution to PTEC. The Land Acquisition and Resettlement Plan (LARP) will be implemented by either DABS or MEW, possibly with help from a third party through the technical assistance component of PTEC. The LARP will require approval from DABS, USAID MEO and COR. In addition to the implementation of LARP a Grievance Mechanism should be prepared by DABS to ensure that project affected persons have a method to voice potential concerns, particularly with regards to the LARP. IFC Guidelines for designing Grievance Mechanisms[1] should be employed in this process

[1] Good Practice Note: Addressing Grievances from Project Affected Communities, Guidance for Projects and Companies Designing Grievance Mechanisms, IFC, 2009

Media Campaign - Consultations with Stakeholders, specifically DABS and USAID, have noted the potential security issues relating to implementation of construction of transmission lines and substations. It will be important for the public to be aware of upcoming construction and how it will impact their lives. Accordingly, it has been recommended that a Media Campaign be established by USAID and DABS to promote the Project and the notion that the Project belongs to the people of Afghanistan and as such they have a role in ensuring that the Project can be constructed and operated successfully.

The Media Campaign will be developed prior to the start of construction primarily by DABS with assistance and oversight from USAID. Notwithstanding the above, initial consultations with DABS and USAID at this scoping stage have attempted to kick-start the Campaign by identifying two keys issues for its successful implementation:

1. The Message – i.e. what do we want to tell the local community to help develop a safe and secure project?
2. Distribution Methods – i.e. how should the message be delivered to the local community?

In summary, it was indicated that the preferred message would include:

- Benefits, such as low-cost grid power, construction phase job creation, operational phase job creation through expansion of agriculture and industry, improvements to health and educational facilities and improved access to media;
- Potential negative construction related impacts, such as air quality and noise;
- Potential requirements for resettlement and compensation;
- Timescale for construction and completion of the project;
- Decreased poverty and increased security; and
- Indication that power distribution will be limited to areas around substations.

Regarding distribution methods, stakeholder consultations with Local MPs, Governors, DABS and ANEPA indicated the following preferred methods:

- Radio – via some form of drama series;
- TV – although the potential may be limited;
- Advertising Hoardings – particularly along the Project Corridor;
- Via Village Elders and Mullahs.

An initial outline and action plan for the Media Campaign, addressing these points in more detail is discussed within **Appendix C**.

Preparation of Management Plans to Complement the EMMP – It is recommended that the Contractor prepare the following management plans to comply with the recommendations of the EMMP.

- Waste Management Plan – A Waste Management Plan (WMP) should be prepared by the Contractor prior to construction to ensure that waste disposal measures will be undertaken to reuse and recycle all materials wherever possible minimize the generation of waste. With the proper implementation of an appropriate waste disposal plan, there will be no residual risk due to improper waste disposal.
- Hazardous Materials Plan – The Contractor should be responsible for preparing a HazMat Plan prior to the commencement of construction works. The document shall include provisions for the safe transport, storage, handling and disposal of all hazardous materials on site.
- Health and Safety Plan (HSP) – Contractors are obliged to implement all reasonable precautions to protect the health and safety of workers through; eliminating the hazard by removing the activity from the work process; Controlling the hazard at its source through use of engineering controls; Minimizing the hazard through design of safe work systems and administrative or institutional control measures, and providing appropriate

personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE. In addition, to prevent impacts to the local population during Project works a Community Health and Safety section should be included within the Plan. The potential also exists for the blocking of existing roads and many other footpaths and tracks during construction. Therefore consideration of traffic management aspects shall be outlined within the HSP.

- Blast Plan – Blasting may potentially be required during the preparation of foundations for transmission towers. To prevent impacts arising from any blasting activities a Blast Plan should be prepared by the Contractor.

Greenhouse Gases - The study has also highlighted the potential impacts of the use of Sulphur Hexafluoride (SF_6) used in transformer switchgear, which is likely to be the preferred type of gas insulated switchgear. SF_6 is a greenhouse gas and as such contributes to global warming. It is recommended that selected SF_6 equipment should have a nominal leakage and replacement rate of less than 1% per year, and in addition, that DABS should undertake research during the design phase of the Project to assess methods of recycling SF_6 and safe disposal methods.

Afghanistan National Environmental Protection Agency (ANEPA) – Finally, it is noted that PTEC is classified as an Annex A project by ANEPA, meaning that this scoping study should be submitted for review to ANEPA in accordance with Afghanistan's Environmental Assessment Policy. Although beyond the scope of this particular Project, it is recommended that USAID meet with ANEPA and draft an MOU in which ANEPA recognizes USAID's environmental procedures in lieu of ANEPA requirements.

Amendments to the IEE – The Project IEE (**Appendix A**) is currently being amended to reflect changes in the PTEC scope of works and will need to be amended further if future projects are added to PTEC that are not currently covered by this Scoping Study or the amended IEE.

1. Introduction

1.1 Project Background

Afghanistan is one of the least electrified countries in the world and, as a result, the lack of electricity restricts the development of all aspects of a normal modern life style. Due to the war with the Soviets, followed by internal civil war and the subsequent rule of the Taliban, the existing power system in Afghanistan has deteriorated steadily. The Government of Afghanistan (GoA) and international donors have agreed that restoring and increasing the electric power supply is a top national priority. This is needed to support improved economic growth with resulting improvement in the standard of living. All parts of the power sector in Afghanistan are in need of capital investment, training, and capacity building in areas such as power generation, transmission, distribution, operations, maintenance, management, and electric system regulation. Accordingly, USAID intends to fund the Power Transmission Expansion and Connectivity (PTEC) Project, which intends to address many of these issues.

PTEC started in 2011 and has a US$ 814 million budget to expand Afghanistan's electrical transmission network and build capacity within the Government and National Utility to manage the network. Electrical infrastructure and generation is subsidized at great expense by the Ministry of Finance (MOF) and is meeting only a small fraction of the country's needs. The primary focus of PTEC as part of a multi-donor effort with Asian Development Bank (ADB) is to expand the electrical high transmission lines in NEPS and to connect NEPS with the Southern Electric Power Supply (SEPS). The communities along the NEPS-SEPS corridor, which runs broadly parallel to the Kabul – Kandahar National Highway 1 (via Ghazni and Qalat) are either underserved or have never previously been served with low cost grid power. The rates for electricity that will be introduced will be a great savings for populations now receiving electricity from diesel generation plants at approximately $0.80/kwh. Preliminary estimates for grid power rates will be approximately $0.10/kwh once the transmission line and distribution networks are installed. Availability of grid power will spur economic growth within communities served as it has already in Kabul. This economic growth will allow local communities to remain intact and dissuade migration to other economic centers such as Kabul. Decisions regarding allotments of power from this project will be decided by DABS with the input of Provincial Governors. This project is part of a backbone of a future electric grid in eastern and southeastern Afghanistan. Future power generation capacities and imported power are planned throughout Afghanistan and as these systems come online more transmission lines will be installed and more power will be available in this region and the entire nation.

1.2 Scoping Objectives

As required by 22 CFR 216.3(a)(4), the objectives of this Scoping Statement are the following:

- A determination of the scope and significance of issues to be analyzed in an EA; including direct and indirect effects of the project on the environment. Identification and elimination from detailed study of the issues that are not significant or have been covered by earlier environmental review, or approved design considerations, narrowing the discussion of these issues to a brief presentation of why they will not have a significant effect on the environment.
- A description of:
    - The timing of the preparation of environmental analyses, including phasing, if appropriate.
    - Variations required in the format of the EA.
    - The tentative planning and decision-making schedule.
    - A description of how the analysis will be conducted and the disciplines that will participate in the analysis.

1.3 Contents of the Scoping Statement

The format and contents of this Scoping Statement is based on similar scoping exercises undertaken for USAID Afghanistan and is summarized as follows:

Section 1: Introduction - Provides the introductory information for the Project
Section 2: Policy, Legal and Administrative Framework – This section provides an overview of USAID and GoA environmental/social requirements.
Section 3: Project Description and Alternatives – Provides an overview of the PTEC Project in its current form and a description of the projects alternatives including the 'do nothing' scenario.
Section 4: Significant and Non-Significant Issues – Provides an overview of the existing baseline environmental conditions and lists the potentially significant impacts that require additional study and those impacts that are less than significant that do not require any additional environmental assessment.
Section 5: Summary of Consultations – Includes details of the consultations undertaken with key Project Stakeholders.
Section 6: Conclusion and Recommendations – Summarizes the key findings of the report and makes recommendations for further environmental assessment activities, if warranted.

2. Policy, Legal & Administrative Framework

2.1 General

This section of the report provides a summary of USAIDs environmental compliance requirements and the documentation completed to date along with an overview of the national environmental legislation relevant to PTEC.

2.2 USAID 22 CFR 216 Environmental Compliance Requirements

Chapter 22 of the Code of Federal Regulations § 216 (hereafter 22 CFR 216) was designed to implement U.S.-NEPA requirements as they apply to activities of USAID.[2] 22 CFR 216 applies to "all new projects, programs or activities authorized or approved" by USAID. 22 CFR 216 requires an initial environmental examination (IEE) as the first review of a proposed USAID action or project.[3] The IEE should be prepared with the Project Identification Document (PID).[4] On the basis of that initial environmental examination and the information in the PID, USAID will make the Threshold Decision as to whether an Environmental Assessment or Environmental Impact Statement will be required for the proposed action. An Initial Environmental Examination (IEE) was prepared for PTEC in 2011 and approved by the USAID Bureau Environmental Officer (BEO) in August 2011. The IEE was subsequently amended to account for changes in the scope and budget (from 1.292 billion USD to 970 million USD) of the Project and was approved by the BEO on the 18th July 2012. The most significant change in the Project was the elimination of the initial first project task, NEPS Extension (380 million USD), which is now being funded by other donors. Copies of the original and amended IEEs can be found as **Appendix A**. In addition, IEEs have been prepared for Tarakhil Power Plant and Darunta Dam Rehabilitation, which form part of the PTEC program. These IEEs conclude a Negative Determination with Conditions (Tarakhil) and a Negative Determination with Conditions for Darunta Dam.

The original PTEC IEE recommended that a Programmatic Environmental Assessment (PEA) be undertaken for PTEC. The PEA is a useful tool that assesses the impacts of a set of regional, or program specific projects in one go, rather than producing project specific Environmental Assessments (EA) for each Program activity. The PEA activity usually saves time, resources and money while also providing the necessary level of assessment and mitigation. The first step in the PEA process is the Scoping Statement. This document, in hand, identifies at an early stage those impacts that are deemed significant and require further additional study and assessment during the PEA phase. It also identifies the less than significant impacts that can be reduced or negated by appropriate environmental mitigation and monitoring via environmental management plans adopted within Contractual provisions. In essence, this allows the PEA to focus on the key environmental impacts and not waste time and resources studying in detail impacts that are not significant. The Scoping Study phase is also important as it provides a forum for public consultation which aids the impact identification process. Finally, Scoping will result in a set of recommendations that may include Framework Environmental Mitigation and Monitoring Plans (EMMPs) for the impacts that have been identified as less than significant, and, if required, a Terms of Reference (ToR) for the PEA. The Scoping Study shall then be reviewed and approved by USAID BEO.

[2] 22 CFR 216.1(a).
[3] 22 CFR 216.1(c)(2).
[4] 22 CFR 216.3(a)(1).

2.3 Other Relevant Legislation

In addition to the requirements of 22 CFR 216, the Project should also consider national legislation as outlined below.

2.3.1 The Environmental Law of Afghanistan (2007)

Afghanistan enacted an updated Environment Law on January 25, 2007. The Environment Law has five main purposes: 1) improve livelihoods and protect the health of humans, fauna and flora; 2) maintain ecological functions and evolutionary processes; 3) secure the needs and interests of present and future generations; 4) conserve natural and cultural heritage; and 5) facilitate the reconstruction and sustainable development of the national economy.[5] The implementing agency for the Environment Law is the Afghan National Environmental Protection Agency (ANEPA), which acts as an independent institutional entity, and is responsible for coordinating and monitoring conservation and rehabilitation of the environment.[6] The Environment law contains a supremacy clause which states: "where there is inconsistency between the provisions of this Act and any other law that affects the environment, other than the Constitution of Afghanistan, this Act shall prevail."[7] This addition makes the Environment Law a very powerful law when planning projects and activities that could impact the environment.

The Environment Law contains a blanket prohibition on two types of activities. The first is that "no person may undertake an activity or implement a project, plan or policy that is likely to have a significant adverse effect on the environment" unless the provisions of Article 16 are followed.[8] The second is that "no ministry or national authority may grant an authorization for the execution or implementation of a project, plan or policy that is likely to have a significant adverse effect on the environment" unless the provisions of Article 16 are followed.[9] The language in the Afghan Environment Law is substantially similar to that of the National Environmental Policy Act (hereafter U.S.-NEPA) in the United States and the standard of "significantly affecting the quality of the human environment." Also similar to the U.S.-NEPA process, the Afghan Environment Law requires that the person or agency make an informed choice regarding the proposed action, rather than requiring a specific course of action or no action. The Afghan Environment Law, again similar to U.S.-NEPA, requires that environmental issues be integrated into all national and local land use plans and natural resource management plans developed by relevant ministries and national institutions.[10]

One of the requirements of the process under the Afghan Environment Law is the submission of a preliminary assessment. The preliminary assessment should contain accurate information to allow ANEPA to determine the potential adverse effects and positive impacts of the project, plan, policy or activity.[11] ANEPA will review the brief and solicit advice from the EIA Board of Experts (see below) before making a decision to authorize the project, plan, policy or activity.[12] ANEPA can also place conditions on the proposed project, plan, policy or activity, without requiring further action by the proposing party.[13] However, if ANEPA considers the adverse effects likely to be significant, it can require the proposing

[5] Chapter 1, Article 2: Purpose. The Environment Law. January 25, 2007.
[6] Chapter 1, Article 3: Implementing Agency; also see Chapter 2, Article 9: Functions.
[7] Chapter 9, Article 76: Supremacy of the Act.
[8] Chapter 3, Article 13: Prohibited Activities.
[9] Id.
[10] Chapter 3, Article 22: Integrating environmental issues into development planning.
[11] Chapter 3, Article 14: Preliminary Assessment.
[12] Id.
[13] Id.

party to submit an Environmental Impact Statement[14] or a Comprehensive Mitigation Plan under the Law.[15] If ANEPA chooses to require a comprehensive mitigation plan, it must include the following: 1) a description of the mitigation measures that will be implemented in order to prevent, reduce or otherwise manage the environmental impacts of a project, plan, policy or activity; 2) how these measures will be implemented; and 3) any other information prescribed by ANEPA.[16] The costs incurred in preparing the preliminary assessment, an environmental impact statement, a final record of opinion or a comprehensive mitigation plan are the responsibility of the applicant proposing the project, plan, policy or activity.[17]

On the basis of the preliminary assessment and any required follow–up documentation, such as an Environmental Impact Statement or Comprehensive Mitigation Plan, ANEPA can choose to either grant or refuse to grant the permit for the project, plan, policy or activity. If ANEPA, acting on the advice of the EIA Board of Experts, finds that the environmental impacts and concerns are adequately addressed by the environmental impact statement/preliminary assessment it can grant the permit subject to any conditions recommended by the EIA Board of Experts.[18] If ANEPA, acting on the advice of the EIA Board of Experts, finds that the implementation of the project would bring about unacceptable significant adverse effects or that the proposed mitigation measures would be inadequate, it can reject the proposed project, plan, policy or activity, and the reasons for rejection must be provided in writing.[19] A permit may also be withdrawn if the applicant fails to comply with any of the terms and conditions of the permit.[20] Permits will lapse if the applicant fails to implement the project, plan or policy or undertake the activity within three years from the date of issuance.[21]

Similar to the U.S.-NEPA process, the Environment Law requires that affected persons be given the opportunity to comment on the proposed project, plan, policy or activity, as well as the preliminary assessment, the environmental impact statement, the final record of opinion and a comprehensive mitigation plan (if one was required) before ANEPA approves the permit.[22] The applicant must also demonstrate to ANEPA that there has been an appropriate time and meaningful opportunity, in both individual consultations and public hearings, for affected persons to comment on the proposed project, plan, policy or activity.[23] If the proposed project is likely to have "highly significant adverse effects on the environment," affected persons must have the opportunity to participate in each of the phases of approval by ANEPA.[24]

2.3.2 The Land Expropriation Law (2000) and its Amendments (2005)

The Law sets out the provisions for governing the expropriation or acquisition of land for public interest purposes, such as the establishment of public infrastructure or for the acquisition of land with cultural or scientific values, land of higher agricultural productivity

[14] Under the Afghan Environment Law, an Environmental Impact Statement is defined as: "the procedures used for evaluating the likely adverse or positive environmental and social impacts of proposed projects, plans, policies, or activities in order to improve the quality and development impact of such projects by identifying ways of improving project selection, siting, planning, design and implementation." (Chapter 1, Article 4: Definitions, subpoint 33.)
[15] Chapter 3, Article 14: Preliminary Assessment.
[16] Chapter 3, Article 15: Comprehensive Mitigation Plan.
[17] Chapter 3, Article 18: Costs borne by proponent.
[18] Chapter 3, Article 16: Approval Procedure, subpoint 1.
[19] Id. at subpoint 2.
[20] Id. at subpoint 3.
[21] Id. at subpoint 4.
[22] Chapter 3, Article 19: Public Participation, subpoint 1.
[23] Id.
[24] Id. at subpoint 2.

and large gardens. It declares, inter alia, that: a) acquisition of a plot or portion of a plot of land for public use is decided by the Council of Ministers and is compensated at fair value bases on the current market rates (Article 2); b) the right of the owner or land user will be terminated three months prior to the start of civil works on the project and after the proper reimbursement to the owner or person using the land has been made. (Article 6); c) the value of land, value of houses and buildings on the land and value of trees and other assets on the land will be considered for compensation (Article 8); and f) compensation is determined by the Council of Ministers. The Law however, is silent on resettlement. It makes no special provision for a resettlement plan or indeed and arrangements for resettlement. In addition, the current law does not permit squatters and occupiers of land under customary deeds to receive compensation for the loss of their land.[25] Given these identified shortcomings, the PTEC Program will follow the World Banks Operational Policy 4.12 for Involuntary Resettlement which is considered international best practice for such issues.

2.3.3 Law on the Preservation of Afghanistan's Cultural and Historical Artifacts[26]

According to the Law on the Preservation of Afghanistan Historical and Cultural Artifacts, operations which cause destruction or harm to the recorded historical and cultural sites or artifacts is prohibited (Art. 11, Art. 16). The law provides guidelines for how to deal with historical and cultural artifacts if they are discovered. The PTEC Scoping Study shall ensure the Projects compliance with these guidelines.

2.3.4 Water Law[27]

The Water Law was enacted on April 26, 2009. The Law was enacted under Article Nine of the Afghan Constitution, which states in relevant part: "Protection, management and proper utilization of public properties as well as natural resources shall be regulated by law." The purpose of the law is "conservation, equitable distribution, and the efficient and sustainable use of water resources." Under the law, water is considered a public property, making the government responsible for its protection and management. The use of water for drinking water and livelihood is given priority, but water can also be used for industry, public services and energy production. The use of water is free, but service providers can charge for operation and maintenance of water systems.

A permit is required for any use of water except the following: 1) drinking water, livelihood and other needs, if the total daily consumption does not exceed five cubic meters per household; 2) use for navigation as long as no damage is done to either the banks/right-of-way or the quality of water; 3) fire extinguishing; 4) existing rights that are pending conversion to permits. Following the implementation of the Water Law, existing water rights will be converted to permits "gradually" and Water User Associations can obtain water permits after proper registration.

An Activity Permit and Usage License is required for: 1) surface and groundwater use for newly established development projects; 2) use of water for commercial and industrial purposes; 3) digging and installation of shallow and deep wells for the commercial, agricultural, industrial and urban water supply purposes; and other purposes (remaining described purposes are not relevant to the proposed IPP transaction). The sale and purchase of an Activity Permit and Usage License is prohibited. The procedure to issue Activity Permits and Usage Licenses is to be prepared by MEW, in coordination with other Ministries. A River Basin Council can cancel or modify a permit under the following conditions: 1) when the water user, without a justified reason, does not utilize or over utilizes

[25] Land Acquisition in Afghanistan, World bank, 2007.
[26] Law on the Preservation of Afghanistan's Historical and Cultural Artifacts, 2004
[27] Water Law, 2009

the allocated water; 2) when adequate water is not available; or 3) when national interest requires.

The Water Law has a provision for use of water for power generation. According to the Law, water use for generating energy on micro and macro scales, based on a feasibility study, must be managed in accordance with the Water Law. However, this section appears to describe hydropower facilities, but could be interpreted to include other forms of energy as well.

The Water Law has a built in mechanism for resolution of disputes among water users. The dispute resolution process proceeds along a specified path, with a specified number of days for each actor to make a decision before the issue moves to the next actor in the process. At the Water User Association level, the dispute is resolved with the help of the Head Water Master (Mirab *Bashi)* and a Water Master (Mirab).

2.3.5 National Waste Management Policy[28]

A Draft National Waste Management Policy was prepared in 2008. The policy makes recommendations for the management of medical waste, hazardous waste and municipal solid waste. Although still in draft format the Scoping Study will seek to adhere to the requirements of the policy where practical, e.g. the requirement to reduce, reuse and recycle waste and to dispose of hazardous waste to international standards.

2.3.6 Air Quality Standards

Afghanistan has drafted National Ambient Air Quality Standards[29]. The primary objective of Air Quality Standards is to ensure that all citizens should have access to outdoor air without significant risk to their health, where this is economically and technically feasible. The secondary objectives of Air Quality Standards are:

- To provide the basis for assessing the quality of air
- To act as the foundation for setting control programs
- To assess the new sources of air pollution, and
- To create awareness and alert the public (use of Air Quality Index)

The standards are provided as **Appendix Q**.

2.4 Multi-lateral Environmental Agreements (MEA)

According to the UNEP[30], Afghanistan is signatory to a number of multi-lateral environmental agreements. Exhibit 1 provides a summary of these agreements. PTEC will not be affected by any of these agreements, nor will PTEC affect any of these agreements.

Exhibit 2-1: Afghanistan MEAs

#	Title	Signed	Ratified	Comment
1	Convention on Biological Diversity	1992	2002	
2	Desertification Convention UNCCD	1995	2002	

[28] National Waste Management Policy, Draft, 2008

[29] National Ambient Air Quality Standard for Afghanistan, Draft for Discussion, September 2009. Prepared by National Environmental Protection Agency with technical support from the United Nations Environment Programme

[30] Multilateral Environmental Agreements: A Handbook for Afghan Officials, UNEP (2008)

3	United Nations Framework Convention on Climate Change	1992	2002	
4	Convention on International Trade in Endangered Species of Fauna and Flora	1985	1986	
5	Vienna Convention for the Protection of the Ozone Layer			Acceded to on 17 June 2004

2.5 Administrative Context

DABS will be the government department responsible for the design, construction and operational phase of the Project. They will be assisted during the construction phase of the Project by the CMC.

3. Project Description & Alternatives

3.1 Project Description

USAID proposes to install medium and high voltage transmission lines in NEPS and the NEPS-SEPS corridor (see **Exhibit 3-2**). Substations and distribution networks will also be installed and upgraded as determined along the transmission line corridors. Most of the proposed high voltage transmission lines will be along the existing road right-of-ways (ROWs), see **Exhibit 3-6**. A 30-35 meter (m) wide corridor will be required for the installation and operations and maintenance (O&M) of the transmission lines and five meter access roads. The proposed transmission line will be designed and installed in accordance with the Afghanistan National Standardization Authority (ANSA) standards.

The intention is that the transmission lines will be as straight as possible, but be realigned as necessary to accommodate the road, private structures and other infrastructure. As part of the construction process landmines and unexploded ordnances (UXO) will be identified, avoided, and/or cleared as per the International Mine Action Standards (IMAS). PTEC activities can be summarized as follows:

Exhibit 3-1: Summary of PTEC Activities (and their IEE Determinations)

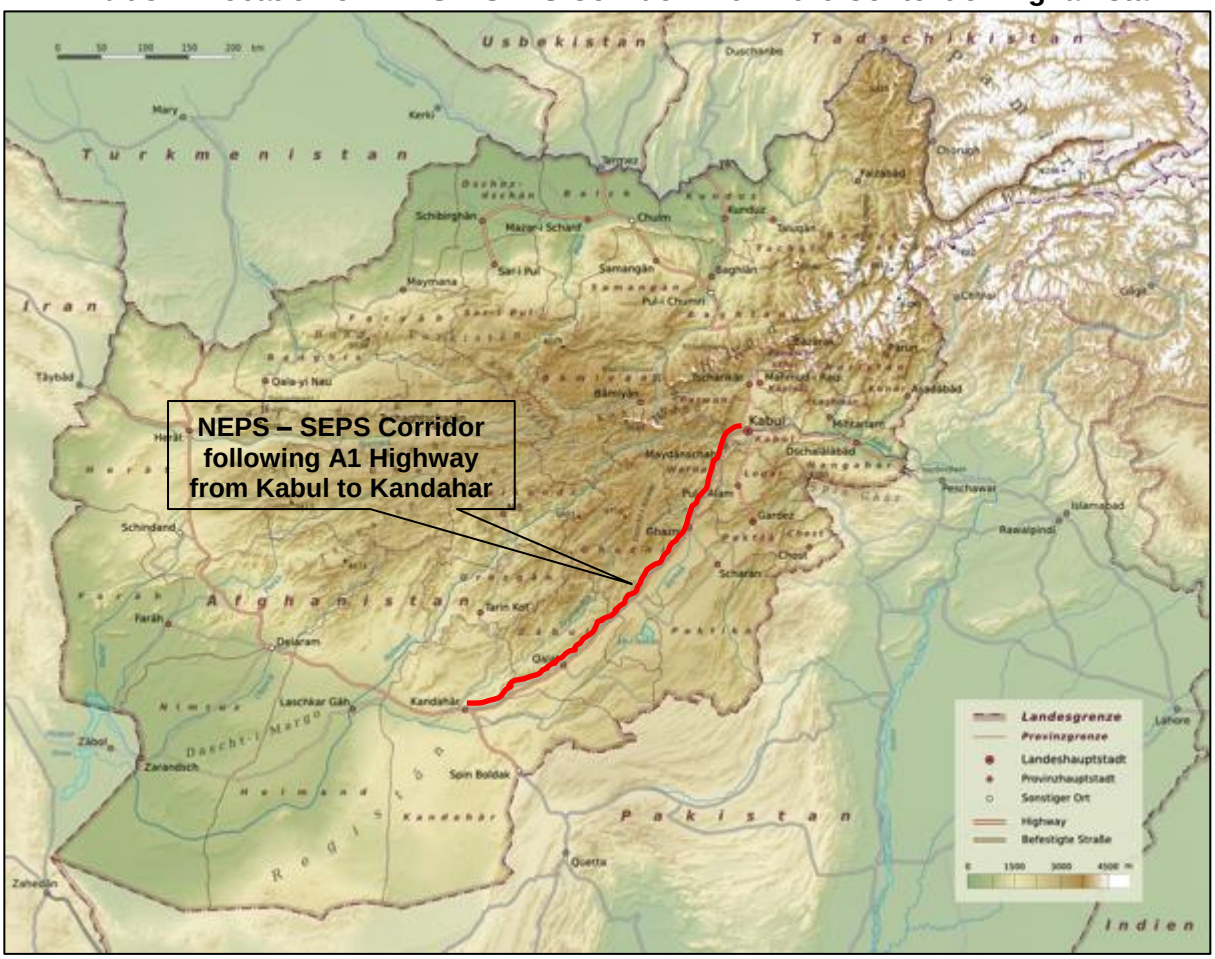
Task #	Task	Indicative Cost	IEE Determination
1	NEPS to SEPS Connection (on-budget)		Negative Determination with Conditions
2	NEPS Expansion (on-budget)		Negative Determination with Conditions
3	NEPS Improvements (on-budget)		Negative Determination with Conditions
4.1	Design Services and Development of On-Budget bid packages (off-budget)		Categorical Exclusion
4,2	Construction Management Services (on-budget)		Categorical Exclusion & Negative Determination with Conditions
4.3	Quality Assurance of Construction Activities (off-budget)		Categorical Exclusion
5	Technical Assistance for DABs (on-budget)		Categorical Exclusion & Negative Determination with Conditions
6	Technical Assistance for the Ministry of Energy and Water (off-budget)		Categorical Exclusion

3.2 General Environmental Setting

Afghanistan is a republic in southwestern Asia, bordered on the north by Turkmenistan, Uzbekistan, and Tajikistan; on the east by China and Pakistan; on the south by Pakistan; and on the west by Iran. Afghanistan's topography in the northeast is dominated by the Hindu Kush mountain range. The main lowlands are a series of river valleys in the north and various desert regions in the south and southwest. The chief rivers are the Amu Darya on the border of Tajikistan; the Kabul, which flows into the Indus River; the Helmand in the south; and the Harirud in the west. **Exhibit 3-2** provides the location of the NEPS-SEPS Corridor and gives an indication of the topographical conditions within the country. More

specific socio-environmental data relating to Afghanistan and the Project Area can be found in tabular format in **Section 4**.

Exhibit 3-2: Location of NEPS – SEPS Corridor Within the Context of Afghanistan



Task #1 NEPS to SEPS Connection

Location – NEPS will be connected to SEPS providing it with low-cost grid power and a means to meet SEPS power demands. The NEPS – SEPS 220 kv Connection is a multi-donor effort with the first 30 km section from Chimtala Substation (SS) in Kabul to Arghandi SS provided by ADB. USAID will provide the 490 km section that will run along the A1 road corridor from Arghandi SS to Kandahar City (see **Exhibits 3-2** & **3-6)**. Substations will be provided along the corridor that will distribute power to the major population centers along the corridor. Substation locations have been determined in coordination with DABS at Sayad Abad, Ghazni, Qarabagh, Moqor, Shahjoy, Qalat, and Kandahar East. The NEPS-SEPS Connection includes approximately 15 km of 110 kv transmission from the Kandahar East substation to the existing SEPS Breshna Kot/Kandahar substation which finally connects NEPS with SEPS. In addition, the USACE will provide a transmission line from USAID's Sayad Abad SS to Pul-e Alam and Gardez in Logar and Paktia Provinces respectively.

Transmission Line Actions - The following is a sequential description of the potential activities associated with the construction of the transmission lines and the major and ancillary facilities of the projects. **Exhibit 3-3** provides a summary of the type of personnel and equipment required for the PTEC transmission line construction works. These activities include the following tasks:

1. Surveying the transmission centerline, other project features, and work areas
2. Upgrading or construction of temporary and permanent access roads

3. Clearing and grading activities for the right-of-way, tower sites, staging areas and batch plants
4. Excavating and installing foundations
5. Assembling and erecting towers with temporary and permanent pad-sites
6. Stringing conductors and ground wires
7. Installing counterpoise (tower grounds) where needed
8. Cleanup and reclamation of affected areas

Exhibit 3-3: Estimated Personnel and Equipment for a Typical High Voltage Transmission Line Project[31]

ESTIMATED PERSONNEL AND EQUIPMENT			
Activity	**People**	**Quantity and Type of Equipment**	
Survey Crew	4	2	pickup trucks
Road Construction Crew	4-8	1	bulldozer (D-8 Cat or equivalent)
		2	motor graders
		2	pickup trucks
		3	water trucks (for construction and maintenance)
Footing Installation Crew	28	6	hole diggers
		2	bulldozers
		3	trucks
		6	concrete trucks
		2	dump trucks
		6	pickup trucks
		1	carry all
		2	hydraulic cranes
		1	wagon drill
Structure Steel Haul Crew	6	4	steel haul trucks
		2	pickup trucks
		3	yard and field cranes
		3	fork lifts
Structure Assembly Crews 4-6 Crews	40	4	pickup trucks
		6	carry alls
		4	cranes (rubber tired)
		3	trucks (2 ton)
Structure Erection Crews 1-2 Crews	14	2	cranes (120 - 300 ton)
		1	2 ton truck
		2	pickup trucks
		2	carry alls
Wire Installation Crew	36	6	wire reel trailers
		6	diesel tractors
		4	cranes (2) 20 ton, (2) 30 ton
		4	trucks (5 ton)
		4	pickup trucks
		2	splicing trucks
		4	3-drum pullers (2 medium, 2 heavy)
		1	single drum puller (large)
		2	double bull-wheel tensioner (1 light and 1 heavy)
		2	sagging equipment (D-8 Cat)
		6	carry alls
		2	static wire reel trailers
Clean-Up Crew	4	3	trucks
		1	pickup trucks
		1	(D-6 Cat)
Road Rehabilitation Crew (Right-of-Way Restoration)	4	1	bulldozer
		1	motor grader
		2	pickup trucks
Estimated personnel required for all tasks including maintenance, management, and quality control personnel = 250			

1. Surveying the Transmission Centerline, Other Project Features, and Work Areas - Ground survey and staking will be performed to locate tower centers, right-of-way boundaries, new access roads, spur roads to tower sites, overland access and temporary

[31] Construction, Operation and Maintenance Plan for the Southwest Intertie Project 500kV Transmission Line, Bureau of Land Management, Arizona,2008

work areas. Flagging will be maintained until final cleanup and/or reclamation is completed, after which they will be removed.

2. Upgrading or Construction of Temporary and Permanent Access Roads - Where possible, existing paved and unpaved highways and roads will be used for the initial transportation of materials and equipment from the staging and storage areas to locations where they will be needed along the transmission line right-of-way. If necessary, existing roads will be upgraded, and all roads utilized will be left in a condition equal to or better than their condition prior to construction. Where possible, existing access roads will be used and, as required new access roads to tower sites will be constructed and located to minimize impacts. During construction, dust control measures will be implemented on all roads. New access roads not required for operation and maintenance of the projects and/or other planned facilities may be closed using the most effective and least environmentally damaging methods appropriate to that area.

3. Clearing and Grading Activities for the Right-of-Way, Tower Sites, Staging Areas and Batch Plants - Clearing of natural vegetation will be required for construction purposes (access road, tower sites, pulling and tensioning areas, and concrete batch plants/laydown areas), clearances for electrical safety, long-term maintenance, and reliability of the transmission line. Within the rights-of-way, mature vegetation will be selectively removed under or near the conductors to provide adequate electrical clearance as required by National Standards. Trees that could fall onto the transmission line, affect the transmission line during wind-induced conductor swing or otherwise present an immediate hazard to the transmission line, or have the potential to encroach within safe distance to the conductor as a result of bending, growing, swinging, or falling toward the conductor, will be removed.

4. Excavating and Installing Foundations - Vertical excavations for foundations will be made with power drilling equipment. Where soils permit, a vehicle-mounted power auger or backhoe will be used. In rocky areas, the foundation holes will be excavated by drilling or blasting methods or installing special rock anchors. All safeguards associated with using explosives (e.g., blasting mats) will be employed. Cast-in-place footings will be installed by placing reinforcing steel and a tower stub into the foundation hole, positioning the stub, and encasing it in concrete. The foundation excavation and installation will require access to the site by power augers or drills, cranes, material trucks, and ready-mix concrete trucks.

5. Assembling and Erecting Towers with Temporary and Permanent Pad Sites - Bundles of steel members and associated hardware (and often times insulators, hardware and stringing sheaves) will be transported to each tower site by truck. Wood blocking is hauled to each location and laid out, then the tower steel bundles are opened and laid out for assembly by sections and assembled into subsections of convenient size and weight. Typically, the leg extensions for the structures are assembled and erected by separate crews with smaller cranes to make ready for setting of the main structure assembly. The assembled subsections are then hoisted into place by means of a large crane and fastened together to form a complete tower. A follow-up crew then tightens all the bolts in the required joints. Refer to **Exhibit 3-4** for a general illustration of this procedure.

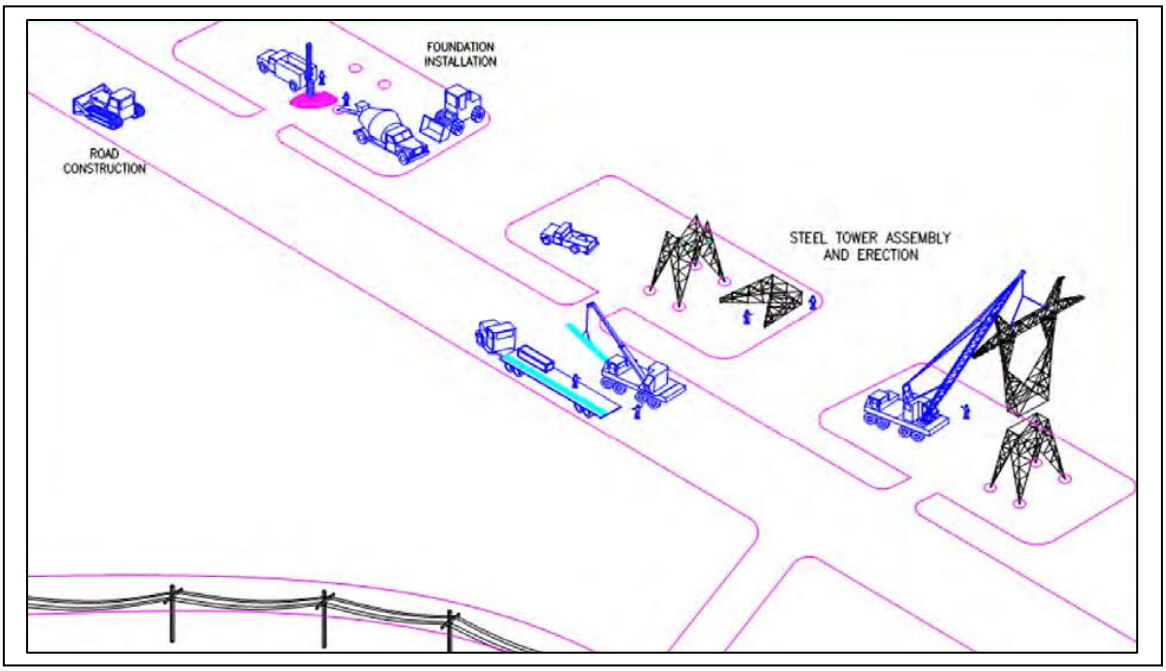


Exhibit 3-4: **Foundation Installation, Tower Assembly, and Tower Erection**

6. String Conductors, Ground Wires, and Fiber Optic Cable - Insulators, hardware, and stringing sheaves will be delivered to each tower site. The towers will be rigged with insulator strings and stringing sheaves at each ground wire and conductor position. For protection of the public during wire installation, guard structures will be erected over highways, railroads, power lines, structures, and other barriers. Guard structures will consist of H-frame wood poles placed on either side of the barriers or by using boom trucks raising a guard cross beam. These structures will prevent ground wires, conductors, or equipment from falling across obstacles. Equipment for erecting guard structures will include augers, backhoes, line trucks, boom trucks, pole trailers, and cranes. Guard structures may not be required for small roads. In such cases other safety measures such as barriers, flagmen, or other traffic control will be used. Following stringing and tensioning of all conductors, the guard structures will be removed, and the area restored. Pilot lines will be pulled (strung) from tower to tower by land operated equipment and threaded through the stringing sheaves at each tower. Following pilot lines, a stronger, larger diameter line will be attached to conductors to pull them onto towers. This process will be repeated until the ground wire or conductor is pulled through all sheaves. Ground wires, fiber optic cable and conductors will be strung using powered pulling equipment at one end and powered braking or tensioning equipment at the other end of a conductor segment. Sites for tensioning equipment and pulling equipment will be approximately two to three kilometers apart as determined by the Contractor. The tensioning and pulling sites will be an area approximately 200 feet by 400 - 600 feet depending on the structure's purpose (e.g., mid-span or dead end). Tensioners, pullers, line trucks, wire trailers, dozers, pickups and tractors needed for stringing and anchoring the ground wire or conductor will be located at these sites. The tensioner, in concert with the puller, will maintain tension on the ground wire or conductor while they are fastened to the towers. Tension will be maintained on all insulator assemblies to assure positive contact between insulators, thereby avoiding sparking. Caution also will be exercised during construction to avoid scratching or nicking the conductor surface, which may provide points for corona to occur.

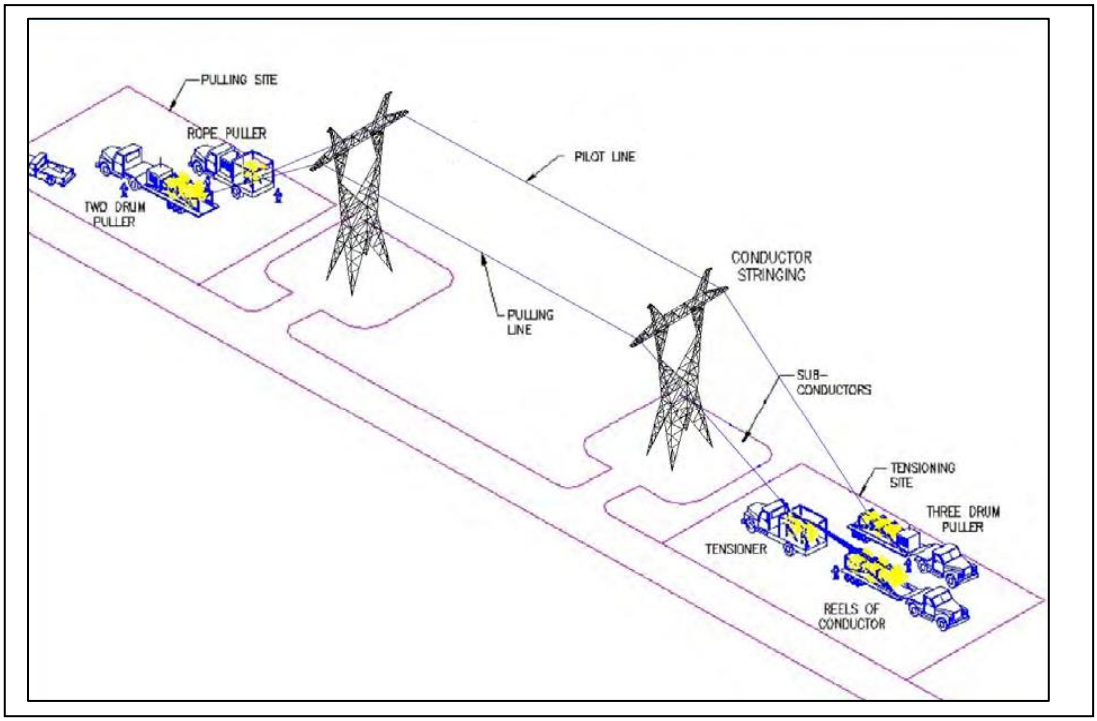


Exhibit 3-5: Wire Hanging

7. Installing Counterpoise (Tower Grounds) Where Needed - Part of standard construction practices prior to conductor installation will involve measuring the resistance of the ground to electrical current near the tower structures. If the measurements indicate a high resistance, counterpoise will be installed, which will consist of trenching in- ground wire to a depth of 12 inches in non-cultivated land and 18 inches in cultivated land, with a ground rod driven at the end. The counterpoise will be contained within the limits of the rights- of-way and may be altered or doubled back-and-forth to meet the requirements of the projects. Typical equipment used for installing ground rods includes line trucks, backhoes and trenchers, etc.

8. Cleanup and Reclamation of Affected Areas - Construction sites, material storage yards, and access roads will be kept in an orderly condition throughout the construction period. Refuse and trash will be removed from the sites and disposed of in an approved manner (e.g., in an approved landfill). In remote areas, trash and refuse could be removed to a construction staging area and contained temporarily until such time as it could be hauled to an approved site. No open burning of construction trash would occur. Contaminants such as oils, hydraulic fluids, antifreeze and fuels will not be dumped on the ground, and all spills will be cleaned up.

The following are additional components for the construction of the projects that will be used in conjunction with the general construction activities discussed previously.

Substation Actions - The construction of the substations will initially consist of survey work, geotechnical sample drillings and soil resistivity measurements that will be used in the final design phases of the station. Once the near final design of the station has been completed a civil contractor will mobilize to perform site development work including grubbing and then reshaping the general grade to form a relatively (1 percent slope) flat working surface. This effort also will include the all weather access roads. A fence will be erected around the perimeter of the substation to prevent unauthorized personnel from accessing the construction and staging areas. The perimeter fence will be permanent feature to protect the general public from accessing the substation. The excavated and fill areas will be compacted

to the required densities to allow structural foundation installations. Following the foundation installation, underground electrical raceways and copper ground grid installation will take place, followed by steel structure erection and area lighting. The steel structure erection will overlap with the installation of the insulators and bus bar, as well as the installation of the various high-voltage apparatus typical of an electrical substation. The installation of the high-voltage transformers will require special high-capacity cranes and crews (as recommended by the manufacturer) to be mobilized for the unloading, setting into place, and final assembly of the transformers. While the above mentioned activities are taking place the enclosure that contains the control and protection equipment for the substation, will be constructed, equipped, and wired. A final crushed rock surfacing will be placed on the subgrade to make for a stable driving and access platform for the maintenance of the equipment. After the equipment has been installed, testing of the various systems will take place, followed by electrical energization of the facility. The energization of the facility generally is timed to take place with the completion of the transmission line work and other required facilities.

Construction Storage Yards and Concrete Batch Plants - Previously disturbed government owned lands will be used to the maximum extent practicable for construction staging and personnel reporting. These areas will be long-term (duration of project) material storage yards for these projects, ranging in size from five to seven acres each. These yards will be used throughout the duration of the project for receiving, storage and transfer of required materials. Concrete for use in the structure foundations will be dispensed from portable concrete batch plants located at intervals along the right-of-way. Equipment typically required at a batch plant site includes generators, concrete trucks, front end loaders, Bobcat loaders, dump trucks, transport trucks and trailers, water tanks, concrete storage tanks, scales and job site trailers. Rubber tired trucks and flatbed trailers will be used to assist in relocating the portable plant along the right-of-way. Commercial ready-mix concrete may be used when access to tower construction sites is economically feasible. The construction camps and batch plants may also serve as field offices, reporting locations for workers, parking areas for vehicles and equipment and locations for equipment maintenance.

Equipment Staging - Staging of equipment will be located at pulling and tensioning sites or work areas previously described. These areas will be used to temporarily lay out equipment to be used for work on specific project activities at nearby locations.

Equipment Refueling - The contractor will implement standard refueling procedures for heavy equipment that is left on the rights-of-way for long periods of time, such as cranes, blades, dozers, drill rigs, etc. This equipment will be refueled in place.

Other Activities – In addition to the above actions, the Project will also include:

- Construction and commissioning of RPC control buildings, life support features, communication systems, security features, and yard equipment.
- Design, construct, and test hardware and software required to integrate all substations and related control and monitoring equipment constructed under this contract into the NLCC SCADA system.
- Provide services to integrate remote control and monitoring of power flow through the transmission system and reactive power compensation system components constructed under this contract into the NLCC SCADA system.

3.2.1 NEPS – SEPS Location and Setting

The NEPS-SEPS corridor is within the eastern and southeastern areas of Afghanistan (see **Exhibit 3-6**). These areas are mostly arid and semi-arid rangeland (i.e., desert), with sporadic areas of irrigated cropland, rain fed cropland, and bare soil. Afghanistan's semi-arid rangeland is characterized by various species of grasses and low-lying shrubs. Ephemeris vegetation grows in the sandy semi-deserts, and halophilous vegetation is found in the salt semi-deserts. The environmental setting of the project corridor is described in detail by **Section 4**.

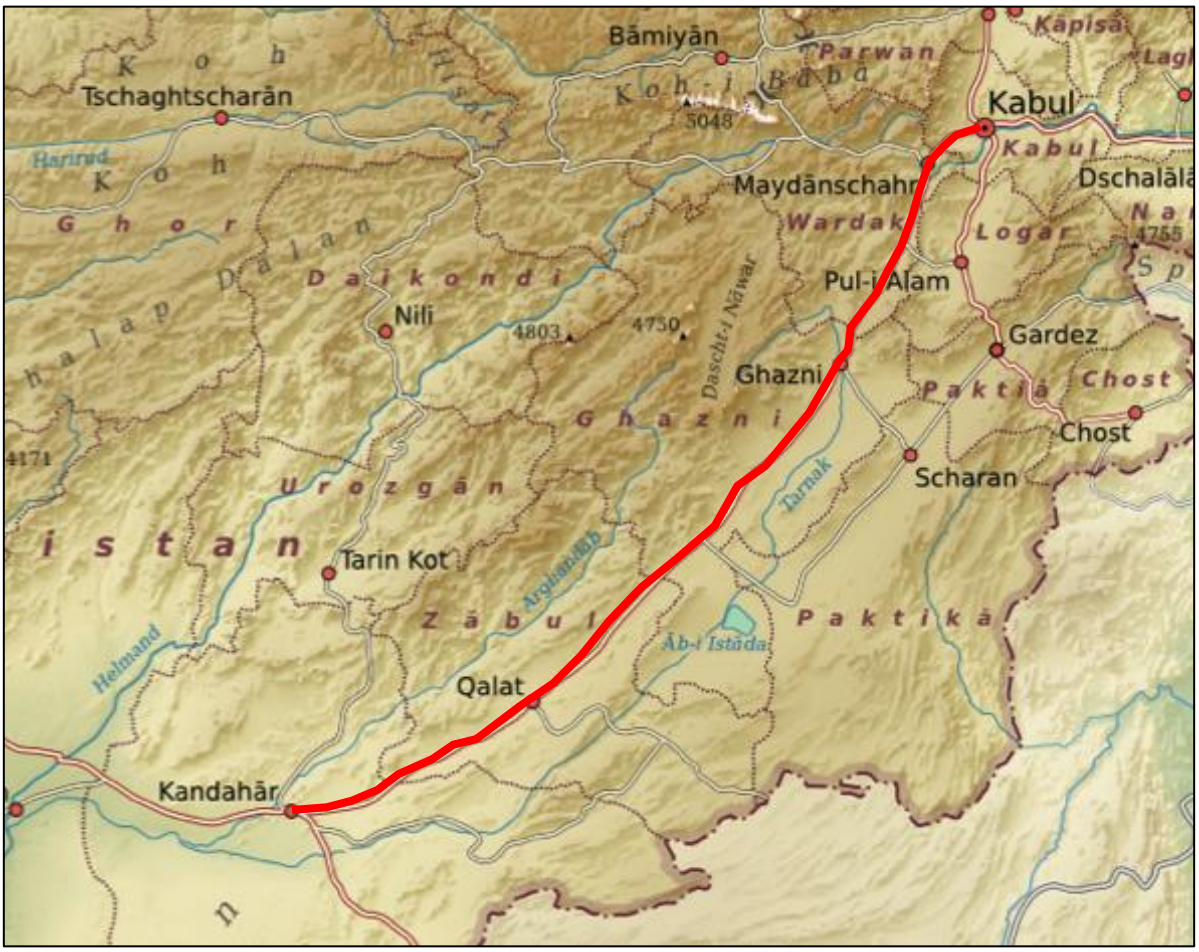


Exhibit 3-6: Location of NEPS – SEPS Corridor within Kabul, Wardak, Ghazni, Zabul and Kandahar Provinces.

- **Task #2 NEPS Expansion** – This task will include:
  - New high voltage (110 kv or 220 kv) transmission lines and substations from Jalalabad to the Hisare Shahi Industrial Plant (HIP), and from Breshna Kot/Kabul SS to Arghandi SS,
  - New substations at Salang Tunnel and HIP.

The work involved in the high voltage transmission lines and substations is the same as described above in Task 1.

- **Task #3 NEPS Improvements –** This task includes:
  - Automating existing NEPS RPC for control from the NLCC;
  - Upgrading Darunta Dam - This activity consists of replacement of three new turbine generating units that combined will have a capacity of 11.5 MW, related controls, and protection equipment. The activity also includes the rehabilitation or replacement of water gates and related lifting equipment and controls, and a 6 kV/35 kV transformer at the dam substation.

- Upgrading the piping of the Tarakhil Power Plant fire suppression system; and
- Upgrade of existing medium and low voltage transmission lines and the distribution network in Kabul to stabilize the system from blackouts.

- **Task #4 The tasks below will support Tasks 1, 2, and 3 construction activities**
  - **Task #4.1: Design services and development of bid documents -** Off Budget through the Afghanistan Engineering Support Services Project.
  - **Task #4.2: Construction Management Services –** This task supports the construction tasks outlined above and includes; design services and development; oversight of all construction activities; review of technical submittals; monitoring construction; construction meetings with Stakeholders and Quality Assurance activities. This activity will also require the procurement of Vehicles, Computers, Office Equipment and Furniture.
  - **Task #4.3: Quality Assurances of Construction Activities –** Off budget through the Engineering, Quality Assurance, and Logistics Support Program.

- **Task #5 Technical Assistance for DABs –** This task includes commercialization to increase DABS' costs recovery through improvements in bill generation and collection in Kabul and up to four other major cities. Activities include training DABS commercialization staff, procurement of Vehicles, Computers, Office Equipment and Furniture and setting up private management contracts for the operation and maintenance of the power system. This activity will also include installation of meters. This task also includes a private sector management contract in SEPS to assist DABS staff.

- **Task #6 Technical Assistance to MEW:** Focuses on increases MEW's ability to perform core functions of setting energy policy, regulation, and planning. It includes procurement of training and other equipment and approximately $3M for lab equipment.

3.3 Codes, Standards and Specifications

All material used, plant supplied and all workmanship and tests associated with PTEC shall be in accordance with the latest editions of IEC and ISO Standards, or where International Standards are not applicable, with national standards such as ASA, ANSI, ASTM, BS or VDE + DIN, IEEE, ASCE. Where such standards and codes are national or relate to a particular country or region, other authoritative standards that ensure substantial equivalence to the standards and codes specified or in accordance with technical requirements of a Country where the site is located, will be acceptable. For any such standards which are not written in the English language, the Contractor shall make available copies of a certified English translation thereof. Where standards do not exist, as in the case of patent or special materials, all such materials and workmanship shall be of the best quality and full details of the material and any quality control tests to which they may be subjected, shall be submitted to the Engineer for approval.

3.4 Alternatives

3.4.1 No Project Alternative

The "No Action" Alternative in this instance is defined as a decision not to undertake the proposed construction of the Project. The "No Action" Alternative would result in the continued lack of affordable power in the region, thereby severely impeding the economic recovery of the Project Area and the country as a whole. All positive benefits would be foregone. The relatively minor, less than significant environmental impacts (such as noise and short-term air quality impacts due to maintenance activities) and inconveniences (such as traffic diversions) would be avoided in the short-run. In the long-run, however, the lack of

affordable power will severely hamper economic development in the Project Corridor. In light of these considerations, the “No Action” Alternative is deemed to be neither prudent not in the best interest of Afghanistan or those with an interest in, and attempting to assist restoration of, Afghanistan’s well being.

3.4.2 Site Alternatives

Site alternatives generally include alternative routes and re-alignments. In this instance, the Project route is pre-determined by the following factors:

- An existing RoW already exists for the Project in the form of the A1.
- Access outside of this RoW brings with it issues relating to poor security, lack of access roads, and potentially UXO.
- The need to construct substations at regional centers which are located adjacent to the Project Corridor.

As such, there has been no consideration given to any alternative alignment.

3.3.2 Alignment Alternatives.

It is possible, that within the boundaries of the Project corridor alternative alignments can be chosen to avoid residential and commercial properties and productive lands. Such alternative alignment options will be discussed and decided by the Contractor in consultation with DABS at the design phase of the Project and in conjunction with the proposed LARP. The document in hand will however, help the Contractor and DABS in that decision making process.

3.3.4 Alternative Construction Methods

The feasibility and constructability of the transmission line towers is well established in Afghanistan and the construction and installation of equipment is well practiced in the international context. The process basically includes the transportation of equipment to site and the assembly of pre-fabricated units’ in-situ. Thus the impacts from construction of towers are very manageable from the environmental viewpoint.

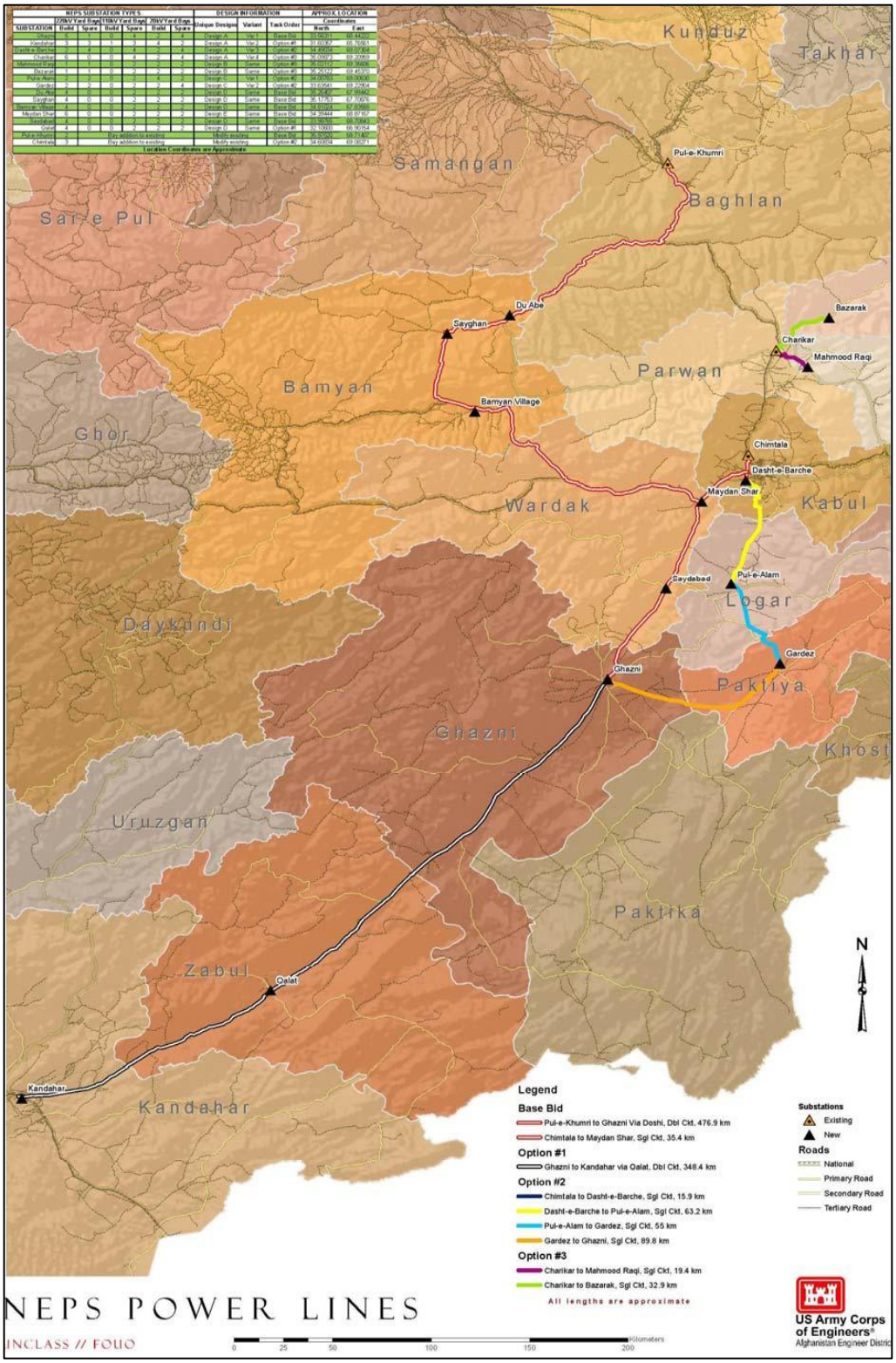


Exhibit 3-7: NEPS Power Lines

4. Identification of Significant and Non-significant Issues

4.1 Scoping Methodology

4.1.1 General

The following section of this report focuses on identification of the key significant issues that should be assessed further at the EA stage. The less than significant impacts will also be identified and mitigation measures proposed for these items, thereby eliminating them from further study at the EA stage of the Project.

4.1.2 Assessment Methods

Two specific assessment methods have been used during the preparation of the Scoping Study:

1. Desk-top Study
2. Consultations

Desk-top Study includes the review of existing documents that are particularly relevant to the Project scope and location. A wide range of documents relating to power transmission have been reviewed to establish a set of best practice mitigation measures for potential impacts. A list of these documents can be found in **Appendix T: Bibliography**. Several of these documents relate to Power Transmission Projects in Afghanistan and the Central Asia region and have been prepared for donor agencies such as the World Bank and the ADB, thus making them excellent reference sources. In addition, reviews of resettlement and compensation plans have been undertake for ADB projects, including in Afghanistan. Other documents, not specifically relating to Transmission Lines, have been reviewed to establish baseline environmental and social conditions within the Project corridor, the most important of which is the Kabul – Kandahar Road EIA which was prepared for USAID in 2003. This document is an excellent source for baseline data as the Project sits almost entirely within the road corridor. Other documents reviewed include country specific environmental data prepared by UNEP and other agencies such as the IFC, WFP and WHO.

Consultations have been undertaken with a wide range of Project Stakeholders. The findings of these consultations are provided below under **Section 5**. These consultations have revealed specific issues that would not have been known without these interviews and as such are essential to the Scoping process.

4.1.3 Project Area

NEPS – SEPS Connection – This portion of the Project sits primarily within the corridor of the A1 Highway linking Kabul with Kandahar and it is proposed that most of the construction works will occur within the RoW. The boundaries used in this study are shown in **Exhibit 4-1**. The selected boundaries consider the distance from the Center Line of the A1 up to areas where potentially significant environmental effects are possible under standard conditions as observed for similar projects. The distances are based on the expert's experience in relation to the sensitivity of surrounding features in response to construction works.

In addition, as a part of NEPS-SEPS connector 110kV transmission lines will be constructed from Kandahar East Sub Station to Breshna Kot/Kandahar. This Project Area for these lines is also determined by the assessment boundaries outlined in **Table 4-1**.

Exhibit 4-1: NEPS – SEPS Connection Assessment Boundaries adopted for the Study

Terrestrial Environment	Aquatic Environment	Air Shed	Acoustic Environment
200 m on either side of the A1 / transmission line.	50 m upstream and 100m downstream of any project activity crossing a river	400 m from CL of A1 or from the transmission line	400 m from CL of A1 and the transmission line and extended on sensitive areas such as towns

Substations will also be constructed and low voltage transmission lines will be constructed from the substations into various towns and villages. However, the Project is classified as a 'design-build' and as such the precise locations of all the facilities and transmission lines is not currently know until the detailed design is complete. However, the potential environmental impacts associated with these facilities will be limited in nature and duration and can be adequately managed with the use of the environmental mitigation measures outlined within this report. Accordingly the fact that the precise locations of these facilities is not currently known will not be a limiting factor to this report.

4.1.4 Notion of Significance

Two key characteristics of possible impacts that should be considered in determining significance are **"duration"** and **"probability"**. Duration assesses the period of which an impact may occur, will it be short term or long term, will it occur throughout the lifecycle of the project or in just one phase, i.e. construction; Probability assesses the likelihood of an impact occurring, does the impact have a low, medium or high chance of happening during the various project phases. Each impact of an action must be judged by these two characteristics, then a better assessment of the significance of an impact can be made.

4.2 Primary List of Environmental / Social Issues

Using examples and case studies from similar Project a Primary List of Potential Environmental Impacts was established. The following table indicates where if these impacts are applicable to the Project.

#	Type of Impact	Comment
1	Vegetation damage, natural habitat (and critical natural habitat) loss; along the ROW and access roads and around any substation sites (during construction and during operation).	No critical natural habitat will be lost due to the degraded nature of the Project corridor. Low/medium voltage lines and substations will be sited to avoid significant impacts to natural habitat.
2	Habitat fragmentation or disturbance, loss of forest area.	There will be no habitat fragmentation or disturbance or loss of forest area.
3	Interference with (migratory) bird and bat flight patterns	Mitigation measures are recommended to reduce this impact.
4	Waste management, discharges and emissions and land degradation.	Waste will be strictly controlled by enforceable contract provisions. Land degradation is unlikely given the degraded nature of the primary Project Corridor.
5	Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.	Transmission line construction may have limited short term localized impacts to surface water courses, but it is doubtful that this will lead to habitat alteration.

6	un-off and sedimentation from grading for access roads, tower pads, and substation facilities, alteration of hydrological patterns due to maintenance roads.	This impact is possible, although mitigation within contract provisions should limit such impacts.
7	Discharge of liquid waste into aquatic ecosystems, accidental spills.	Spills could occur during the construction and operational phase of the Project. Mitigation shall be provided to reduce the risk of spills causing pollution.
8	Impacts on socio-economic issues.	Socio-economic benefits will be significant, but there may be some short-term impacts, such as impacts to businesses operating adjacent to site works, or temporary loss of agricultural or grazing land.
9	Disturbance / degradation / removal of physical cultural assets	Contract provisions will include chance find procedures.
10	Health effects and annoyance from electromagnetic radiation and ambient noise.	IFC standards for EMF will be applied to ensure a safe environment for locals and workers. Ambient noise will be mitigated by siting of substations away from heavily populated areas (as far as is practical).
11	Interference of power line operation with communication systems in the area (telephone, radio, television, etc.)	Interference with communications systems is a possibility.
12	Aesthetic impact on landscape, visibility from villages and settlements.	The project corridor is not noted for its high aesthetic value and as such impacts are considered minimal.
13	Noise, dust, emissions and increased traffic during construction period.	These issues are an unavoidable consequence of construction, but their significance can be reduced with appropriate mitigation measures.
14	Insulating oils.	Oils will be required for substations, spills could occur during construction and maintenance.
15	Fuels and lubricants used during construction time.	Spills are possible, but environmental contract provisions will reduce the potential risk.
16	Construction site waste management.	Provisions will be included with the EMP to manage this issue.
17	Use of herbicides.	According to DABS no herbicides are used at any sites.
18	Soil erosion and sediment control from materials sourcing areas and site preparation activities.	A potential short term localized impact that can be suitably managed by contract provisions.
19	Use of wood preservatives	Preservatives may be required for low voltage transmission poles. Storage and handling of these preservatives shall be strictly controlled.
20	Occupational Health and Safety Impacts.	The Contractor and Operator should have their own standards for health and safety; recommendations shall be made for best practice guidelines, such as IFC.
21	Corona Noise.	Corona noise could have impacts to local

		residents.
22	High water table issues during construction.	A high water table may impact upon the foundations for transmission towers.
23	Community Health and safety.	Best practice standards shall be incorporated into the project to prevent health and safety issues impacting upon the local community.
24	Aircraft navigation safety.	The Project should ensure that the lines and towers do not interfere with aircraft navigation services and that where located close to airports or military facilities all towers over 90m have visual markings and conductors.
25	Land acquisition.	Land acquisition, both permanent and temporary will be required.
26	Resettlement.	Resettlement may be required depending upon the results of the detailed design by the Project contractor.
27	Load Shedding.	Load shedding during the operational period can lead to social tensions.
28	Traffic Delays.	Given the proximity of the works to the A1 Highway, it is possible that traffic delays could occur during the construction phase caused by heavy vehicle movements.

4.3 Project Benefits

The potential benefits of the Project are extensive and wide ranging and will impact upon many people. A brief summary of the project benefits include:

- **Improved Agriculture** – Consultations revealed that the agricultural sector suffers from a lack of available, or affordable electricity. Improvements to the electricity supply network will help farmers with irrigation, through the groundwater and surface water pumps and will also allow cold storage facilities to be established which enable farmers to store goods for longer periods and reduce crop losses and decrease transport related costs through improved logistics. However, it is important that facilities, such as cold storage are not subject to load shedding.
- **Increased industrial Activities** – Areas such as Ghazni, Qalat and Kandahar lack a significant industrial sector that means that most goods have to be imported from outside of Afghanistan at high costs. Providing cheap, reliable electricity to these areas will help build an industrial base, which in turn will create jobs and improve the economy.
- **Improved medical and educational facilities** – Provision of electricity at medical facilities and schools will provide a better working and living environment, through improved heating and lighting. Schools will also benefit through access to electronic media.
- **Cheaper electricity** – This issue was highlighted as one of the key benefits during stakeholder consultations. The price of electricity is currently as much as 30 Afs per KWh; this price could be reduced to between two and five Afs per KWh. These costs savings will mean that people are able to spend money on other items, such as food for a better quality diet, or invest in items for their business, such as fertilizers for farmers.
- **Creation of jobs** - this falls into two categories:
    - Construction and Operational Jobs associated with the actual transmission line projects; and
    - Jobs created by increased industrial and agricultural activities.

This issue is extremely important in areas where unemployment is very high (as much as (80% in some regions) and where lack of jobs in one of the main reasons for disenfranchised youth to support anti-government forces.

4.4 Impacts, Mitigation and Issues Requiring Further Study

This section of the report, in tabular format, provides a summary of the baseline environmental and social conditions in the NEPS-SEPS Corridor. It also includes an identification of the potential environmental impacts associated with Project activities and outlines mitigation measures to limit the significance of these impacts. A column is also provided indicating where additional studies, in the form of an Environmental Assessment, or action plans are required.

A. Physical Resources - Soils						
Existing Conditions - *Within the country as a whole, the soils are characterized as high mountains serozems, desert steppe or meadow steppe. A soils map of Afghanistan indicating the locations on the NEPS-SEPS Project Corridor can be found as* ***Appendix I****. Loess is found in the north. The river valley soils are generally alluvial or meadow alluvial. Serozems and brown desert soils cover large portions of the country in the north and southwest. Overgrazing, deforestation, desertification, degradation of watersheds and erosion have been identified as significant environmental issues contributing to soil degradation and reduced soil productivity throughout Afghanistan. Land degradation has also been caused by land mines, which reduce access to agricultural land and irrigation.* *Within the NEPS-SEPS Project Corridor, soils are generally classified as mountain serozems and high mountain desert steppe soils in the northern portions (Kabul to a point south of Ghazni) and mountain light serozems south to Kandahar. Within the immediate Kandahar area soils are alluvial, meadow-alluvial soils, mostly saline. Uncontrolled urbanization in Kabul and to a lesser extent in Kandahar and encroachment on fertile lands are noted as threatening agricultural sustenance to the cities. Agricultural crops in the corridor are reported as fruits (apples in Wardak, Grapes in Kandahar) in irrigated areas the vicinity of Kabul, and some dry land farming and livestock production in pockets along the length of the corridor.*						
Potential Impact		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *A.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*A.1.1 - Potential soil erosion from grading for access roads and tower pads.*	*Throughout construction*	*Low-medium*	*Low*	*A.1.1.1 – The Contractor shall ensure the following:* • *Schedule work so clearing and grading are done during the time of minimum rainfall.* • *Clear only areas essential for construction.* • *Locate potential area pollutant sources away from steep slopes, water bodies, and other critical areas.* • *Route construction traffic to avoid existing works or newly planted vegetation.* • *Protect natural vegetation with fencing, tree armoring, and retaining walls or tree wells.* • *Stockpile topsoil and reapply to re-vegetate the site.* • *Cover and stabilize topsoil stockpiles.* • *Stockpiles should not be located within 20m of water courses.*	*None.*
	A.1.2 - Spills / Leaks of hazardous liquids during construction.	*Throughout construction*	*Low-medium*	*Low-medium*	*A.1.2.1 Spills and leaks of chemicals and oils could contaminate soils, which could in turn lead to contamination of groundwater. Contract provisions shall be included to ensure that:* • *All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and*	*None*

					secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 percent of the volume of tanks. • *Any construction camp maintenance yard shall be constructed on impervious hardstanding with adequate drainage to collect spills, there shall be no vehicle maintenance activities on open ground.* • *Filling and refueling shall be strictly controlled and subject to formal procedures. Drip pans shall be placed under all filling and fueling areas. Waste oils shall be stored and disposed of by a licensed contractor.* • *All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.* • *The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any soils.*	

1.1.1 Task #1 - *A.2 - NEPS to SEPS Connection - Construction of New Substations*	*A.2.1 - Spills of oils during operational phase - Transformers and certain types of breakers contain mineral oil, which is essential for both insulation and cooling. This oil is relatively inert and similar in many ways to clear motor oil. However, the quantity of oil at a substation is very large -– a single transformer with its associated equipment can contain up to 40,000 liters of oil. A major oil release would be a significant environmental incident.*	*Throughout operational period*	*Low*	*High*	*A.2.1.1 - In order to comply with best international practice to prevent contamination of soil, groundwater and surface water all the new substations will be designed to include dedicated surface drainage and secondary containment to control residual oil spills from installation, maintenance or decommissioning. The secondary containment (bunding) will seal the surface with concrete and shall be of sufficient capacity to hold 10% of the contents of the bunded equipment in the event of a catastrophic failure with loss of all transformer oil.*	*None*
	A.2.2 - Potential soil erosion from grading for substation facilities.	*Throughout construction*	*Low-medium*	*Low*	*See A.1.1.1 above.*	*None*

1.1.2 Task #1 - *A.3 - NEPS to SEPS Connection – Reactive RPC installation*	*No impacts to soils identified*	*N/A*	*N/A*	*N/A*	*None required.*	*None required*
1.1.3 Task #1 - *A.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*No impacts to soils identified*	*N/A*	*N/A*	*N/A*	*None required.*	*None required*
1.1.4 Task #2 - *A.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*A.5.1 - Spills / Leaks of hazardous liquids during rehabilitation.*	*Throughout construction*	*Low-medium*	*Low-medium*	*See A.2.1.1 Above*	*None required*
Task #3 - *A.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*A.6.1 - Spills / Leaks of hazardous liquids during rehabilitation.*	*Throughout construction*	*Low-medium*	*Low-medium*	*See A.2.1.1 Above*	*None required*
Task #4 *– A.7 - Construction Management Services - Procurement*	*No impacts to soils identified*	*N/A*	*N/A*	*N/A*	*None required.*	*None required*

1.1.5 Task #5 – *A.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts to soils identified*	*N/A*	*N/A*	*N/A*	*None required.*	*None required*

B. Physical Resources - Topography						
Existing Conditions - *Afghanistan's topography is dominated by Hindu Kush Mountains which run northeast to southwest through the central portion of the country dividing the northern provinces from the remainder of the country. The southwest is occupied by desert plateau. The lowest point in the country is at Amu Darya at 258 meters above mean sea level (msl). The highest point is at Nowshak 7,485 meters above msl. The southern and western parts of the country are covered by deserts at elevations ranging from 500 to 1,000 meters above msl.* *Compared to other parts of the country, the Kabul-Kandahar Corridor raises few topographic challenges for construction. The Corridor follows relatively flat to rolling surface over a fault line between the mountains in the eastern and south-central portions of the country. The portion of the Project from Kabul to the Ghazni Provincial Border (approximately KM 125) ascends from an elevation of approximately 1,800 meters above msl at Kabul to approximately 2,200 meters at Ghazni. The provincial boundary is the watershed between Indus Drainage Basin and Lake of Sistan Drainage Basin on the Afghanistan-Iran border. After Ghazni, there is an overall decent to an elevation of approximately 1,000 meters at Kandahar. The ascent and descent are generally gradual, although hilly in parts and bordered by steep hills on either side of the Corridor.*						
Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *B.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*B.1.1 - The use of quarried materials will be required for construction purposes.*	*Throughout Construction*	*Low-medium*	*Low*	*B.1.1.1 - Contract provisions specified in the EMMP shall ensure that only licensed quarries shall be used to source construction materials.*	*None*
Task #1 - *B.2 - NEPS to SEPS Connection - Construction of New Substations*	*B.2.1 - The use of quarried materials will be required for construction purposes.*	*Throughout Construction*	*Low-medium*	*Low*	*See B.1.1.1 above.*	*None*
Task #1 - *B.3 - NEPS to SEPS Connection –*	*No impacts to topography identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None*

Reactive RPC installation						
Task #1 - *B.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*No impacts to topography identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None*
Task #2 - *B.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*No impacts to topography identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None*
Task #3 - *B.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*No impacts to topography identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None*
Task #4 *– B.7 - Construction Management Services - Procurement*	*No impacts to topography identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None*
Task #5 *– B.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts to topography identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None*

C. Physical Resources – Geology and Seismicity						
Existing Conditions - *Afghanistan's geological circumstances are complex and generally described in terms of plate tectonics, i.e., the premise that the earth's crust is made up of continent-sized slabs of rocks or plates which float on a more fluid layer of material known as the mantle. The plates move, collide, break up and reform as a result of currents and upwellings in the mantle. The mountain chains comprised of the Hindu Kush, Pamir, Karakoram and Himalayan Ranges are believed to have been the result of a collision of the Indian Plate and Asia Plate which began approximately 50 million years ago and continues to the present day. Much of the country is known to be seismically active. The Kabul-Kandahar Road is located along a fault line between the mountains. There is a history of damaging earthquakes that are most frequent in the northeast but are also reported in the areas east of Ghazni. Virtually the entire corridor is rated as an area with high potential for earthquake damage.*						
Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *C.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*C.1.1 - The Project Corridor is located in a seismically active region.*	*Operational phase*	*Medium*	*Medium*	*C.1.1.1 - Seismic loading shall be applied to the transmission tower designs.*	*None*
Task #1 - *C.2 - NEPS to SEPS Connection - Construction of New Substations*	*C.2.1 - The Project Corridor is located in a seismically active region.*	*Operational phase*	*Medium*	*Low-Medium*	*C.1.2.1 - Seismic loading shall be applied to the substation designs.*	*None*
Task #1 - *C.3 - NEPS to SEPS Connection – Reactive RPC installation*	*No impacts identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*No further actions required*
Task #1 - *C.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*C.4.1 - The Project Corridor is located in a seismically active region.*	*Operational phase*	*Medium*	*Low*	*See C.1.1.1 above.*	*None*
Task #2 - *C.5 -*	*C.5.1 - The Project*	*Operational*	*Medium*	*Low*	*See C.1.1.1 above.*	*None*

NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations	*Corridor is located in a seismically active region.*	*phase*				
***Task #3 -** C.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*C.6.1 - Power plants located in seismically active locations.*	*Operational phase*	*Medium*	*Medium*	*Improvements to Hydropower facilities shall carefully consider seismic conditions.*	*No further actions required*
***Task #4** – C.7 - Construction Management Services - Procurement*	*No impacts identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*No further actions required*
***Task #5** – C.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*No further actions required*

D. Physical Resources - Hydrology

***Existing Conditions -** The sources of most of Afghanistan's rivers are in the mountains. Water levels in the rivers vary greatly with the highest levels in spring and early summer. In the remaining seasons the rivers may change into small streams or entirely disappear. Five river basins can be differentiated in Afghanistan:*

*The Kabul Basin (Indus). The Kabul Basin includes the Kabul and Logar Rivers and their tributaries which drain the eastern part of the country. The rivers within the eastern basin flow generally to the east and eventually join the Indus River and the Arabian Sea. The first portion of the NEPS-SEPS Corridor is located in the southern area of this Basin (See **Appendix L**)*

The Hilmand Basin . The rivers of the Hilmand Basin flow generally to the southwest to the Lake of Sistan on the Afghanistan-Iran border and include the Helmand, the country's longest river, the Farah and the Khash. The Arghandab River forms part of the Hilmand Basin. The majority of the Project Corridor lies within this Basin.

The Northern Basin. The rivers in the northern part of the country flow northward to the Amu Darya River on the country's northern boundary (and eventually to the Aral Sea) or disappear in the desert sands.

The Amu Darya Basin. The Amu Darya basin has its headwater in the High Pamir Mountains of Afghanistan and Tajikistan. The Basin covers 14% of the national territory but drains more than 57% of the total annual water flow of Afghanistan. Therefore the basin has great hydropower potential that is largely

unused.
<u>The Harirud – Murghab</u>. The Harirud – Murghab river basin contributes a tiny 4 percent of the total flow of Afghanistan. The main rivers are the Hari, which takes its source from the western slope of the Koh-i-Baba Mountains in the central highlands and the Murghab, which comes from the Tir Band-I Mountains.

The major hydrological features along the ROW are as follows:

- *Approximately KM 134 – Ghazni River. The Project Corridor is roughly parallel the path of the Ghazni River from around KM 134 on its western bank in south-southwesterly direction until KM 186 at which point the Ghazni turns more directly south to flow into Istadeh-ye Mogor, a large lake north of the town of Nawah. The lake is part of the Ab-I-Estada Waterfowl Sanctuary discussed below. Multiple tributaries flow into the Ghazni river in this section.*
- *Approximately KM 186 to KM 482 (Kandahar) – between KM 186 and 482 the corridor roughly parallels the Tarnak River on its western bank. Beyond Kandahar the Tarnak joins the Arghandab and flows into the Helmand and the eventually the complex of lakes and wetlands on the Afghanistan-Iran border (well outside the Project Area).*

In addition to the rivers and watercourses crossed by the Project, two additional surface hydrological features warrant consideration:

- *Lake Navar. Lake Navar is a freshwater lake located in the mountains to the west of the Project. And is the site of the Daqshte-Nawar Waterfowl Sanctuary. The intervening topography and drainage patterns are such that Lake Navar is well outside the area of potential impact.*
- *Istadeh-ye Moqor. Istadeh-ye Moqor is a saltwater lake located to the east of the Project. The lake is fed by the Ghazni River and its tributaries, most of which are crossed by the Project and are, therefore subject to impact due to the proposed construction activities. The lake is also the site of the Ab-I-Estada Waterfowl Sanctuary.*

*Finally, consideration should be given to Karezes, springs, wells and tube wells, major sources of irrigation water in the Project Corridor (see **Appendix M**). There are 70 canals, 1,280 Karezes and 223 springs alone in Ghazni province. Since the mid 1990's people have started installing private tube wells (Chaimeq) for irrigation which has led to the depletion of the water table and drying of the Karezes as most of the people have dug wells to install pumps near intakes of Karezes. Most of the Karezes have collapsed during war and no proper repair as it is time consuming and need lot of financial resources.*[32]

Potential Impacts		Duration	Probability	Significance	Mitigation	Additional Actions
***Task #1 -** D.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*D.1.1 - Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.*	*During construction phase.*	*Low-medium*	*Low-medium*	*D.1.1.1 - The exact locations of the Transmission Lines are not yet know, however, in order to reach Kandahar the lines will most likely cross surface water courses including those listed above, this could lead to construction related impacts to the water course, however such impacts are likely to be minimal as works will not occur in the rivers, but may potentially occur close to the river banks. To mitigate this potential impact it is recommended that:*	*None required.*

[32] Rural Regional Economic Regeneration Strategies, Provincial Profile for Ghazni, 2006.

					• *Transmission line towers be located at least 50 meters from the river.* • *Sedimentation facilities be set up at rivers where all working stations are within 100m of streams and rivers, to trap and settle out runoff from the works.* • *Where wet works have to be pumped dry the wastewater should first be passed through a proprietary sedimentation tank (or similar) to remove suspended particles before discharge at a location agreed with the CMC.* • *Where works cross streams and rivers the preliminary designs for sedimentation facilities such as sediment traps, filter fabric fences, or straw bale barriers should be included as a line item before those new areas are cleared and opened up for construction works.*	
	D.1.2 - Spills of fuels and lubricants used during construction works.	*During construction phase.*	*Low-medium*	*Low-medium*	*D.1.2.1 - In addition to the measures outlined in A.1.2.1, the following mitigation shall ensure water sources are not impacted by spills and leaks:* • *All construction camps, temporary and permanent shall be located at least 500 meters away from surface water courses.* *D.1.2.2 - If complaints are received relating to spill, or leaks of liquids affecting local water supplies, the incidents and possible sources of water supply disruption will be investigated by the contractor and where the complaint can be substantiated; water samples will be taken and analyzed based on the baseline monitoring results obtained in the preconstruction stage. Samples will be taken as soon after the complaint as possible and analyses immediately and again two weeks after the complaint to determine if water quality has been restored. The criteria will be based on the national standard.*	*None required.*
	D.1.3 - Discharges	*During*	*Low-*	*Low-medium*	*D.1.3.1 - The contractor shall be responsible for the*	*None*

	of liquid waste from general construction works and construction camps.	*construction phase.*	*medium*		*preparation of a Waste Management Plan which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.* *D.1.3.2 – At the locations of general construction works or temporary construction camps portable lavatories or at least pit latrines will be installed and open defecation shall be discouraged and prevented by keeping lavatory facilities clean at all times.*	*required, other than preparation of a WMP.*
	D.1.4 - Runoff and sedimentation from grading for access roads and tower pads, alteration of hydrological patterns due to maintenance roads.	*Construction and Operational Phases.*	*Low-medium*	*Low-medium*	*D.1.4.1 - Designs will require hydrological and drainage impacts during construction to be minimized by early phasing of replacement of culverts and other infrastructure. These plans and designs will be included for in contracts.*	*None required.*
	D.1.5 - Dumping of construction site waste into surface watercourses.	*During construction phase.*	*Low-medium*	*Low-medium*	*D.1.5.1 - The Contractor shall be responsible for ensuring compliance with his Waste Management Plan.*	*None required.*
	D.1.6 - Requirements for construction related water including potable water for construction workers and camps. These requirements	*During construction phase.*	*Low-medium*	*Medium*	*D.1.6.1 - The Contractor shall ensure that water extraction permits have been obtained from the MoM prior to the drilling of any boreholes for ground water extraction.* *D.1.6.2 - If any water is to be taken from local wells, or surface waters, permissions must be sought from the local community by the Contractor with oversight from the CMC.*	*None required.*

	could deplete local resources if not adequately monitored and managed.					
	D.1.7 – Impact to existing irrigation structures.	*During construction phase.*	*Low-medium*	*Medium*	*D.1.7.1 - During the design phase efforts shall be made to site facilities where they have the least impact to existing irrigation structures. Consultations shall be held between the local community to ensure that critical irrigation systems are identified and avoided.* *D.1.7.2 - Contractors will review the irrigation systems and irrigation structures potentially affected by construction of the Project. If the irrigation cannot be maintained they will provide and maintain alternative temporary irrigation structures for the construction phase. At the completion of construction the contractor(s) will re provision the irrigation structures disturbed by construction and agree with the CMC and local community if redesign is required or if new structures will be constructed or if the original irrigation structures will be repaired.*	*None required.*
	D.1.8 – Concrete batching - Potential pollutants in batching plant wastewater and stormwater include cement, sand, aggregates, chemical admixtures, fuels and lubricants.	*During construction phase.*	*Low-medium*	*Low-medium*	*D.1.8.1 - The Contractor shall ensure that the site should be designed and constructed such that clean stormwater, including roof runoff, is diverted to the stormwater discharge system. Process wastewater and contaminated stormwater collected from the entire site should be diverted to a settling pond, or series of ponds, such that the water can be reused in the concrete batching process.* *D.1.8.2 - Any liquids stored on site, including admixtures, fuels and lubricants, should be stored in accordance with the Hazardous Materials Management Plan.*	*None required.*
	D.1.9 - Wood	*Construction*	*Low*	*Low*	*D.1.9.1 - The methods for safe management of*	*None*

	preservatives contaminating ground water and surface waters.	*and Operational Phases.*			*preservatives will be included within the Contractors Hazardous Materials management Plan.*	*required, other than preparation of a Hazmat Plan*
	D.1.10 – Impacts to Kareze Systems.	*During construction phase.*	*Low-medium*	*Medium*	*D.1.10.1 – The Contractor shall ensure that, as far as practical, impacts to Kareze systems are avoided. This shall be achieved through sighting construction facilities at least 50 meters from such a system. This will require consultation with Mirabs regarding this issue.*	*None*
***Task #1 -** D.2 - NEPS to SEPS Connection - Construction of New Substations*	*D.2.1 - Spills of fuels and lubricants used during construction works.*	*During construction phase.*	*Low-medium*	*Low-medium*	*See D.1.2.1 above.*	*None required.*
	D.2.2 - Spills and leaks of Insulating oils during construction and operational periods.	*Construction and Operational Phases.*	*Low-medium*	*Low-medium*	*See A.2.1.1. Above.*	*None required.*
	D.2.3 - Discharges of liquid waste from general construction works and construction camps.	*During construction phase.*	*Low-medium*	*Low-medium*	*See D.1.3.1 Above.*	*None required.*
	D.2.4 – Impacts to Kareze Systems.	*During construction phase.*	*Low-medium*	*Medium*	*See D.1.10.1 above.*	*None*
***Task #1 -** D.3 - NEPS to SEPS Connection – Reactive RPC*	*D.3.1 - Spills of fuels and lubricants used during*	*During construction phase.*	*Low*	*Low*	*See D.1.2.1 above.*	*None required.*

installation	*construction works.*					
***Task #1 -** D.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*D.4.1 - Spills of fuels and lubricants used during construction works.*	*During construction phase.*	*Low-medium*	*Low-medium*	*See D.1.2.1 above.*	*None required.*
	D.4.2 - Discharges of liquid waste from general construction works and construction camps.	*During construction phase.*	*Low-medium*	*Low-medium*	*See D.1.3.1 Above.*	*None required.*
	D.4.3 - Dumping of construction site waste into surface watercourses.	*During construction phase.*	*Low-medium*	*Low-medium*	*See D.1.5.1 above.*	*None required.*
	D.1.10 – Impacts to Kareze Systems.	*During construction phase.*	*Low-medium*	*Medium*	*See D.1.10.1 above.*	*None*
***Task #2 -** D.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*D.5.1 - Spills of fuels and lubricants used during construction works.*	*During construction phase.*	*Low-medium*	*Low-medium*	*See D.1.2.1 above.*	*None required.*
	D.5.2 - Discharges of liquid waste from general construction works and construction camps.	*During construction phase.*	*Low-medium*	*Low-medium*	*See D.1.3.1 Above.*	*None required.*
	D.5.3 - Dumping of construction site waste into surface	*During construction phase.*	*Low-medium*	*Low-medium*	*See D.1.5.1 above.*	*None required.*

	watercourses.					
Task #3 - *D.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*D.6.1 - Spills of fuels and lubricants used during construction works.*	*During construction phase.*	*Low-medium*	*Low-medium*	*See D.1.2.1 above.* *D.6.1.1 - Monthly testing of water quality by DABs downstream of Darunta Dam (Parameters include DO, BOD, Temeprature, pH, Turbidity, Nitrates, Oil and Grease, Total Solids, Conductivity, Fecal Coliforms)*	*None required.*
	D.6.2 - Discharges of liquid waste from general construction works and construction camps.	*During construction phase.*	*Low-medium*	*Medium*	*See D.1.3.1 & D.6.1.1 Above.*	*None required.*
	D.6.3 - Dumping of construction site waste into surface watercourses.	*During construction phase.*	*Medium*	*Medium*	*See D.1.5.1 & D.6.1.1 above.*	*None required.*
	D.6.4 – Changes in downstream discharge during rehabilitation works at hydropower facilities could lead to impacts to river ecology and water users.	*Construction and Operational Phases.*	*Medium*	*Medium - High*	*D.6.4.1 – Ensure discharge is not interrupted or altered significantly during rehabilitation works.* *See D.6.1.1.*	*None required.*
Task #4 *– D.7 - Construction Management Services - Procurement*	*No impacts identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*No further actions required*
Task #5 *– D.8 - Technical Assistance for the Commercialization of DABS –*	*No impacts identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*No further actions required*

Procurement and Installation of Meters						

E. Physical Resources – Air Quality and Climate

Existing Conditions – *Climate, particularly precipitation and wind patterns, is a major determinant of air quality. Afghanistan's climate is continental, arid to semi-arid, with considerable variations from place to place according to altitude. Its lowland areas have cold winters and hot summers. The mountains are extremely cold in winter and cool in summer. Winter lasts from October to May. Most of the country's fresh water supply is reported to fall as snow in the mountains.[i] The Project Area in which rehabilitation activities will occur is located in the lowland areas. Climate is not as a significant impediment to traffic within Kabul-Kandahar corridor as it is within the more mountainous portions of the country. No significant micro-climatic conditions (e.g., air inversions) have come to light. Climate Data for Kabul, Ghazni and Kandahar can be found in* ***Appendix K****.*

Within the Project Area levels of suspended particulate matter (SPM) are particularly high in areas close to the A1 road. No documentation of air quality is the Project Area is known to be available, but the climatic and soil conditions of the Project Area are such, that it is likely to be subject to dust storms, particularly in the summer months, leading to higher levels of SPM. Generally, however, except for the effects of traffic, ambient air pollution levels outside of the urban areas are considered to be relatively low due to the low level of industrialization. The cities are generally the areas with the poorest air quality due to automotive emissions and concentrations of industries.

Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *E.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*E.1.1 - Construction vehicle and machinery emissions, including batching plants and staging areas.*	*During construction phase.*	*Low-medium*	*Medium*	*E.1.1.1 - During the design phase of the Project the prevailing wind direction should be considered to ensure that bunkers and conveyors at batching plants are sited in a leeward position to minimize the effects of the wind.* *E.1.1.2 – Specifically relating to concrete batching plants, the Contractor shall ensure that:* • *The use of wheel and truck wash facilities at site exits, and the introduction of vehicle speed limits.* • *Aggregate stored on site in stockpiles should be contained within three-sided storage bunkers with windshields that project 0.5 meter above the bunker wall.* • *Conveyors must be designed and constructed to prevent fugitive dust emissions. This may include covering the conveyor with a roof, installing side protection barriers and*	*None*

					equipping the conveyor with spill trays, which direct material to a collection point. • *Mixer loading areas should be roofed and enclosed on either two (drive-through) or three sides. Water sprays and a robust curtain of suitable design, or an effective air extraction and filtration system, should be installed to suppress dust generated during mixer truck loading.* • *Weigh bins and hoppers should be enclosed on three sides and roofed where a front-end loader is used. The roof should extend 2 meters in front of the bin.* • *An approved fabric filter incorporating a fabric-cleaning device should be installed on each cement storage silo. The quality of the filter media and the design characteristics of the filter system must be capable of ensuring that the maximum concentration of solid particles in residual gases does not exceed 100 mg/m3* • *To prevent overfill and subsequent filter damage, storage silos should be fitted with high-level audible and visual alarms in addition to an automatic delivery shut-down.* *E.1.1.3 - Relating to general construction activities, the Contractor shall be responsible for ensuring that:* • *If the working surfaces become dry and dusty (roads, staging areas, stockpiles, etc), water will be sprinkled on the and exposed surfaces when work is carried out within 50m of sensitive receptors* • *No work will be carried out during the night (2100hrs to 0700hrs).* • *If works give rise to complaints over dust, the contractor shall investigate the cause and review and propose alternative mitigation measures before works recommence.*	

					• *All heavy equipment and machinery will be fitted in full compliance with the national and local regulations.* • *Fuel-efficient and well-maintained haulage trucks will be employed to minimize exhaust emissions. Smoke belching vehicles and equipment will not be allowed and will be removed from the project.* • *Vehicles transporting soil, sand and other construction materials will be covered with tarpaulin sheets to avoid impact from dust. Speeds limits will be established for vehicles within the works sites and on unpaved edge areas of the project*	
	E.1.2 - Impacts to air quality from open burning.	*During construction phase.*	*Low-medium*	*Medium*	*E.1.2.1 - Cutting and burning trees/shrubs for fuel shall be prohibited. Instead Gas Cylinders should be used in the labor camp for cooking purposes.* *E.1.2.2 - No open burning shall be allowed.*	
***Task #1 -** E.2 - NEPS to SEPS Connection - Construction of New Substations*	*E.2.1 - Construction vehicle and machinery emissions and dust*	*During construction phase.*	*Low-medium*	*Low-medium*	*See A.1.1.1, A.1.1.2 & A.1.1.3 above.*	*None*
	E.2.2 – Green-house Gas Emissions from switchgear and gas insulated equipment, specifically SF_6.	*Operational phase*	*Low-medium*	*Low-medium*	*E.2.2.1 - Methods should be studied and employed by DABS during the operational phase of the Project to recycle SF_6, or implement safe measures for its disposal.* *E.2.2.2 – Switchgear equipment should have a nominal leakage and replacement rate of less than 1% per year.*	*None*
***Task #1 -** E.3 - NEPS to SEPS Connection – Reactive RPC installation*	*E.3.1 - No impacts to air quality and climate identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None*

Task #1 - *E.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*E.4.1 - Construction vehicle and machinery emissions and dust*	*During construction phase.*	*Low-medium*	*Low-medium*	*See A.1.1.1, A.1.1.2 & A.1.1.3 above.*	*None*
Task #2 - *E.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*E.5.1 - Construction vehicle and machinery emissions and dust.*	*During construction phase.*	*Low-medium*	*Low-medium*	*See A.1.1.1, A.1.1.2 & A.1.1.3 above.*	*None*
Task #3 - *E.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*E.6.1 - Construction vehicle and machinery emissions and dust.*	*During construction phase.*	*Low-medium*	*Low-medium*	*See A.1.1.1, A.1.1.2 & A.1.1.3 above.*	*None*
Task #4 *– E.7 - Construction Management Services - Procurement*	*No impacts to air quality and climate identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None*
Task #5 *– E.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts to air quality and climate identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None*

F. Biological Resources – Flora and Fauna

Existing Conditions – Existing Conditions – *Afghanistan's vegetation is typical of the semi-deserts and steppes. Ephemeris vegetation grows in the sandy semi-deserts and halophilous vegetation is found in the salt semi-deserts. The most common trees on the more humid soils are oaks, ashes, willows, poplars and fruit trees in orchards. Himalayan forest, including evergreen oak woods grow in the borderland between Afghanistan and Pakistan. The country's mountains are believed to be home to many plants that exist nowhere else on earth. The steppes and intermediary ecosystems are also of biological interest. Unfortunately, areas supporting natural flora habitat are diminishing. The Asian Development Bank (ADB) reports that one of the most critical environmental problems of Afghanistan is massive deforestation and overgrazing which could be aggravated by the return of the refugees. It is estimated that forest cover declined from 3.4 to 2.6 percent of total land area between 1970 and 1990. Since then, continued timber harvesting and the use of forest resources for fuel have reduced forest cover to less than two percent of the total area. The fauna of Afghanistan is similar to that of the rest of Central Asia. Beast of prey (e.g., snow leopards, brown bears, wolfs, stripped hyenas, jackals and foxes) are believed to live in the mountains. Hoofed animals are represented by Marco Polo sheep, the goitered gazelle and the ibex. Numerous species of birds, rodents, reptiles and amphibians have been reported. The factors that make the ROW and the adjacent areas an unlikely venue for threatened and endangered plant species also make it an unlikely for special status wildlife species. Field investigations revealed no evidence of existing conditions suggesting possibilities of habitat loss; habitat fragmentation, interruption of wildlife migration patterns or significant patterns of accidents involving wildlife within the vicinity of the Project.*

Most of the NEPS-SEPS corridor's natural landscape is uplands dominated by scrub steppe vegetation with juniper scrub and woods occurring along watercourses. No documentation of potential lowland habitat for threatened or endangered plant species has come to light. The Project Area is located in an un-forested lowland area in the southeastern portion of the country. Areas within or adjacent to the ROW have been heavily disturbed by human activities and are highly unlikely to provide habitat for rare or endangered plant species. Trees and other plant life along the ROW are few except along the river valleys crossing the road corridor. A map of the flora of Afghanistan is provided by ***Appendix N****.*

Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *F.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*F.1.1 - Clearing of natural vegetation will be required for construction purposes (access road, tower sites, pulling and tensioning areas, and concrete batch plants/laydown areas), clearances for electrical safety, long-term maintenance, and reliability of the*	*Construction phase*	*Medium*	*Low-medium*	*F.1.1.1 - It will be the Contractor's obligation not to cause any additional destruction to Flora and Fauna of the area by respecting the limits of construction site and not to enter other territories.* *F.1.1.2 - Within the rights-of-way, mature vegetation will be selectively removed under or near the conductors to provide adequate electrical clearance.* *F.1.1.3 - No unauthorized tree or bush cutting shall be allowed.*	*None required.*

	transmission line.					
	F.1.2 - Habitat Fragmentation is not considered likely due to the degraded nature of the Project Corridor.	*N/A*	*N/A*	*N/A*	*None required*	*None required*
	F.1.3 - Effects on migratory birds and bats - The combination of the height of transmission towers and distribution poles and the electricity carried by transmission and distribution lines can pose potentially fatal risk to birds and bats through collisions and electrocutions. Avian collisions with power lines can occur in large numbers if located within daily flyways or migration corridors, or if groups are traveling at night or during low light conditions (e.g.	*Operational phase*	*Low*	*Low-medium*	*F.1.3.1 – Contractor shall consider the following elements during design:* • *Maintaining 1.5 meter (60-inch) 11 spacing between energized components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware;* • *Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters.* [33]	

[33] Environmental Health and Safety Guidlines, Electrical Power Transmission, IFC, 2007.

	dense fog). In addition, bird and bat collisions with power lines may result in power outages and fires.					
	F.1.4 - Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.	*Construction phase*	*Low-medium*	*Low-medium*	*See D.1.1.1 above.*	*None required*
***Task #1 -** F.2 - NEPS to SEPS Connection - Construction of New Substations*	*F.2.1 - Clearing of natural vegetation will be required for construction purposes*	*Construction phase*	*Medium*	*Low-medium*	*See F.1.1.1, F1.1.2 & F1.1.3 above.*	*None required*
	F.2.2 - Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.	*Construction phase*	*Low-medium*	*Low-medium*	*See D.1.1.1 above.*	*None required*
***Task #1 -** F.3 - NEPS to SEPS Connection – Reactive RPC installation*	*No impacts to flora and fauna identified*	*N/A*	*N/A*	*N/A*	*No mitigation required*	*None required*
***Task #1 -** F.4 - NEPS to SEPS Connection – Low Voltage*	*F.4.1 - Clearing of natural vegetation will be required for construction purposes (access*	*Construction phase*	*Low-medium*	*Low-medium*	*See F.1.1.1, F1.1.2 & F1.1.3 above.*	*None required*

Distribution between Substations and Population Centers / Diesel Power Plants	*road, tower sites, pulling and tensioning areas, and concrete batch plants/laydown areas), clearances for electrical safety, long-term maintenance, and reliability of the transmission line.*					
	F.4.2 - Effects on migratory birds and bats.	*Operational phase*	*Low*	*Low-medium*	*See F.1.3.1 above.*	*None required*
***Task #2 -** F.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*F.5.1 - Clearing of natural vegetation will be required for construction purposes (access road, tower sites, pulling and tensioning areas, and concrete batch plants/laydown areas), clearances for electrical safety, long-term maintenance, and reliability of the transmission line.*	*Construction phase*	*Low-medium*	*Low-medium*	*See F.1.1.1, F1.1.2 & F1.1.3 above.*	*None required*
	F.5.2 - Effects on migratory birds and bats.	*Operational phase*	*Low*	*Low-medium*	*See F.1.3.1 above.*	*None required*
***Task #3 -** F.6 - NEPS Improvements to LV/MV networks, Power Plants &*	*F.6.1 – Impacts to river ecology downstream of hydropower facilities.*	*Construction phase*	*Medium*	*Medium*	*See D.6.4.1 above.*	*None*

NLCC						
***Task #4** – F.7 - Construction Management Services - Procurement*	*No impacts to flora and fauna identified.*	*N/A*	*N/A*	*N/A*	*No mitigation required*	*None*
***Task #5** – F.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts to flora and fauna identified.*	*N/A*	*N/A*	*N/A*	*No mitigation required*	*None*

G. Biological Resources – Protected Areas

Existing Conditions – *Three designated and three proposed protected areas (see Protected Areas Map in* ***Appendix J****) have been identified in the country:*
Ab-I-Estada Waterfowl Sanctuary. Ab-I Istada is a large saline lake located at about 2,000 m elevation in the south corner of Ghazni province (Nawa district). Ab-I Istada drains the water from the Ghazni, Sardeh and Nahara Rod and it overflows into the Arghistan River – itself a tributary of the Arghandab River – in years with good rainfall. The site is remarkable for the migratory greater flamingos arriving at high-water level in spring (late March or April), breeding in summer on the islands and departing when water level is low in September or early October. More than 100 other bird species are also present. The site was once a critical stopover point for the central population of Siberian cranes, which bred in the Russian tundra and wintered in north-central India. The last reliable report of a Siberian crane at Ab-I Istada was of one shot dead by a hunter in 1986. Local residents reported that no flamingos had bred successfully since 1999.
Dashte-Nawar Waterfowl Sanctuary. The Dashte-Nawar Waterfowl Sanctuary is located in Ghazni Province in eastern Afghanistan. Dasht-I Nawur is an extensive high-altitude plain in southeast Afghanistan. Some 600 km^2 in area, the plain lies at about 3,350 m elevation, with surrounding peaks, holding ibex and urial, rising to 4,800 m. A narrow brackish lake, more than 10 km long, occurs in the plain. Dasht-I Nawur serves as an important breeding and staging ground for a large number of migratory waterfowl. There are records of breeding populations of avocets (Recurvirosta avocetta), redshanks (Tringa etanus), greater sandplovers (Charadrius leschenaultia), and common terns (Sterna hirundo). The area is also a unique, high-elevation breeding ground for greater flamingo. In contrast with Ab-I Istada, the local population in Dasht-I Nawur does not hunt flamingos. Rather, they revere them, as they associate the pink colour of the plumage with the blood of the martyred Imam Hussain. The villagers of Qarya said that they had seen one flamingo in 2002 and eight in 2001, but that no flamingos had successfully bred since then.
Pamir Buzurg (Proposed) Wildlife Sanctuary. The proposed Pamir Buzurg Wildlife Sanctuary is located in the extreme northeastern part of the country.
Kole Hashmat Khan (Proposed) Waterfowl Sanctuary. The proposed Kole Hashmat Khan Waterfowl Sanctuary is a former royal hunting ground located far south of Kabul and outside the Project Road's potentially affected area.
Ajar Valley (Proposed) Wildlife Reserve. The proposed Ajar Valley Wildlife Reserve is a former royal hunting ground located in Bamian Province in the central part of the country.
Bande Amir National Park. Bande Amir National Park is also located in Bamyan Province near the proposed Ajar Valley Wildlife Reserve in the central part of

the country.						
Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *G.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*G.1.1 - Potential impacts to the Ab-i-Estada wildfowl sanctuary are possible due to construction activities occurring in proximity to the Ghazni River which feeds the lake. However, mitigation measures preventing impacts to hydrological features reduces the potential risk of impacts occurring.*	*Construction and operational phases*	*Low*	*Low-medium*	*Implementation of mitigation outlined by D.1.1.1 above.*	*None required*
Task #1 - *G.2 - NEPS to SEPS Connection - Construction of New Substations*	*No impacts to protected areas identified*	*N/A*	*N/A*	*N/A*	*None*	*None required*
Task #1 - *G.3 - NEPS to SEPS Connection – Reactive RPC installation*	*No impacts to protected areas identified*	*N/A*	*N/A*	*N/A*	*None*	*None required*
Task #1 - *G.4 - NEPS to SEPS Connection – Low*	*No impacts to protected areas identified*	*N/A*	*N/A*	*N/A*	*None*	*None required*

Voltage Distribution between Substations and Population Centers / Diesel Power Plants						
Task #2 - *G.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*G.5.1 - No impacts to protected areas identified*	*N/A*	*N/A*	*N/A*	*None*	*None required*
Task #3 - *G.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*No impacts to protected areas identified associated with Tarakhil or Darunta Power Plants.*	*N/A*	*N/A*	*N/A*	*None*	*None required*
Task #4 *– G.7 - Construction Management Services - Procurement*	*No impacts to protected areas identified*	*N/A*	*N/A*	*N/A*	*None*	*None required*
Task #5 *– G.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts to protected areas identified*	*N/A*	*N/A*	*N/A*	*None*	*None required*

H. Other Socio-environmental Concerns – Waste Management and Hazardous Materials

Existing Conditions – *Today there are still no proper landfills in many cities, and none of the dumpsites are designed to prevent groundwater contamination or toxic air pollution from burning waste. Many dumpsites are located upstream of the cities, where heavy rains could wash the wastes back into populated areas. One such dumpsite is close to a well field used to draw drinking water for Kabul. There has been virtually no management of hazardous chemicals in Afghanistan in recent years. Nor was there any monitoring of pesticide residues in humans or in the environment. Today water resources are still being polluted due to poor storage of these chemicals as well as indiscriminate disposal of untreated industrial effluents. In some aquifers the concentration of*

hazardous chemicals exceeds hygienic standards, and in parts of Kabul city pollutants make the water unsafe for consumption. Pesticides such as DDT and benzene hexachloride were used intensively for locust control in the northern agricultural regions of the country for several decades. Lack of proper management of these persistent organic chemicals represents a potential threat to the health of humans and wildlife in these regions.[34]Typical hazardous materials used in Transmission line construction are provided by ***Appendix T****.*						
Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *H.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*H.1.1 - General solid waste management – Improper disposal of inert waste, such and general construction waste and domestic waste (foodstuff).*	*Construction phase*	*Medium*	*Low-medium*	*H.1.1.1 - The Contractor shall be responsible for the preparation of a Waste Management Plan that will contain provisions for the management of inert waste and its disposal to suitable, licensed locations.* *H.1.1.2 - The Plan shall ensure that all waste is disposed of at a licensed facility, where this may not be practical, the Contractor, with approval from the CMC and the relevant authorities, shall be responsible for operating his own landfill for inert waste only.*	*None, other than preparation of a WMP.*
	H.1.2 - Spoil Material - There may be some surplus rock and soil based materials. The waste management plan (WMP) will be required to ensure waste from construction is managed properly and to reduce, reuse and recycle waste wherever possible.	*Construction phase*	*Low-medium*	*Low-medium*	*H.1.2.1 - The Contractor shall ensure that:* • *Spoil will not be disposed of in rivers and streams or other natural drainage path.* • *Spoil will not be disposed of on fragile slopes, flood ways, wetland, farmland, forest, religious or other culturally sensitive areas or areas where a livelihood is derived.* • *Use surplus spoil for local repair works to fill eroded gullies and depression areas and degraded land in consultation with local community.*	*None, other than preparation of a WMP.*

[34] UNEP in Afghanistan – Laying the Foundations for Sustainable Development, UNEP, 2009.

	H.1.3 - Spills of fuels and lubricants used during construction periods.	*Construction phase*	*Low-medium*	*Medium*	*See A.1.2.1 above.*	*None.*
	H.1.4 – Poor management of hazardous waste can have significant impacts to water resources, soils, air quality and the health and safety of workers and the local community.	*Construction phase*	*Low-medium*	*Medium*	*H.1.4.1 - The Contractor shall prepare a Hazmat Plan, which shall be reviewed, approved and monitored by the CMC. The Contents of the Hazmat Plan are specified by* ***Appendix E****.*	*None, other than preparation of a Hazmat Plan*
	H.1.5 - Clean up of construction camps	*Construction phase*	*Medium*	*Medium*	*H.1.5.1 - At the conclusion of the project, all debris and waste shall be removed. All temporary structures, including office buildings, shelters and toilets shall be removed by the contractor and exposed areas shall be planted with suitable vegetation, to the satisfaction of the CMC.*	*None.*
Task #1 - *H.2 - NEPS to SEPS Connection - Construction of New Substations*	*H.2.2 - Spills / Leaks of insulating oils.*	*Operational phase*	*Low*	*Medium*	*See A.1.2.1 above.*	*None*
	H.2.3 - General waste management.	*Construction phase*	*Low-medium*	*Low-medium*	*See H.1.1.1 & H1.1.2 above.*	*None, other than preparation of a WMP.*
	H.2.4 - Spills of fuels and lubricants used during construction periods.	*Construction phase*	*Low-medium*	*Medium*	*See A.1.2.1, D.1.2.1 & D.1.2.2*	*None*
	H.2.5 - Hazardous	*Construction*	*Low-medium*	*Medium*	*See H.1.4.1 above.*	*None, other*

	waste management and disposal.	*phase*				*than preparation of a Hazmat Plan*
***Task #1 -** H.3 - NEPS to SEPS Connection – Reactive RPC installation*	*H.3.1 - No impacts identified*	*N/A*	*N/A*	*N/A*	*None required*	*None*
***Task #1 -** H.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*H.4.1 - General waste management.*	*Construction phase*	*Low-medium*	*Low-medium*	*See H.1.1.1 & H1.1.2 above.*	*None, other than preparation of a WMP.*
	H.4.2 - Spills of fuels and lubricants used during construction periods.	*Construction phase*	*Low-medium*	*Medium*	*See A.1.2.1, D.1.2.1 & D.1.2.2*	*None*
***Task #2 -** H.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*H.5.1 - General waste management.*	*Construction phase*	*Low-medium*	*Low-medium*	*See H.1.1.1 & H1.1.2 above.*	*None, other than preparation of a WMP.*
	H.5.2 - Spills of fuels and lubricants used during construction periods.	*Construction phase*	*Low-medium*	*Medium*	*See A.1.2.1, D.1.2.1 & D.1.2.2*	*None*
***Task #3 -** H.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*H.6.1 - General waste management.*	*Construction phase*	*Low-medium*	*Low-medium*	*See H.1.1.1 & H1.1.2 above.*	*None, other than preparation of a WMP.*
	H.6.2 - Spills of fuels and lubricants used	*Construction phase*	*Low-medium*	*Medium*	*See A.1.2.1, D.1.2.1 & D.1.2.2*	*None*

	during construction periods.					
***Task #4** – H.7 - Construction Management Services - Procurement*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	*None required*
***Task #5** – H.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	*None required*

I. Other Socio-environmental Concerns – Land Use

***Existing Conditions – Land Use**. Land uses along the NEPS-SEPS Corridor can be characterized as follows:*

***KM 0-42**: Shortly after leaving Kabul the urban land uses dissipate. Most of the arid landscape is not occupied or devoted to productive land uses, with the exception of periodic walled enclaves and agricultural and grazing activities in the vicinity of waterways.*
***KM 43**: Small village (Durrani)*
***KM 43-60**: Most of the arid landscape is not occupied or devoted to productive land uses, with the exception of periodic walled enclaves and agricultural and grazing activities in the vicinity of waterways.*
***KM 60**: Sayadabad*
***KM 60-70**: Terraced area with trees. Wheat, maze and apples are reported to be the major crops.*
***KM 70-120**: Most of the arid landscape in this area is not occupied or devoted to productive land uses, with the exception of periodic walled enclaves and agricultural and grazing activities in the vicinity of waterways.*
***KM 120**: Small village*
***KM 120-134**: Most of the arid landscape is not occupied or devoted to productive land uses, with the exception of periodic walled enclaves and agricultural and grazing activities in the vicinity of waterways.*
***KM 134**: Ghazni. There is a high likelihood of impacts to economic assets and PAPs in this area*
***KM 134-210**: Most of this area is desert landscape punctuated by nomadic groups herding camels, goats and sheep.*
***KM 210**: Small village.*
***KM 210-238**: Most of the arid landscape is not occupied or devoted to productive land uses, with the exception of periodic walled enclaves and agricultural and grazing activities in the vicinity of waterways.*

***KM 238**: **Moqor**. Commercial activities line the roadway in and around Moqor. There is a high likelihood of impacts to economic assets and PAPs in this area.*
***KM 238-250**: Most of the arid landscape is not occupied or devoted to productive land uses, with the exception of periodic walled enclaves and agricultural and grazing activities in the vicinity of waterways.*
***KM 250**: Small village*
***KM 250-285**: Most of the arid landscape is not occupied or devoted to productive land uses, with the exception of periodic walled enclaves and agricultural and grazing activities in the vicinity of waterways.*
***KM 285: Shah Juy**. Commercial activities line the roadway in and around Shah Juy. There is a high likelihood of impacts to economic assets and PAPs in this area.*
***KM 285-352**: This area is punctuated by a number of farming and orchard areas. The corridor parallels the Tarnak River on its western bank.*
***KM 352**: **Qalat**. Commercial activities line the corridor in and around Qalat. There is a high likelihood of impacts to economic assets and PAPs in this area.*
***KM 352-470**: Cultivation continues intermittently after Qalat and yields to urban uses nearing the entrance to Kandahar.*

Significant portions of the Project Corridor are government owned. As noted above, however, there are, however, several areas in which the Project Corridor passes through village bazaars and commercial activities oriented to the road and farming areas in which productive agricultural land may be affected. Those who occupy the stalls and commercial areas within the Project RoW and those engaged in farming and other roadside economic activities will be impacted and qualify as "project-affected persons" (PAPs) as that term is generally defined by the international assistance community, i.e., persons whose livelihood is directly or indirectly affected by a project. The potential for impact is most evident at, but not necessarily limited to, the roadside bazaars and commercial areas in and around Ghazni, Moqor, Qalat, Shah Juy and Kandahar

Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
***Task #1 -** I.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*I.1.1 - Land acquisition will be required, both temporary and permanent.*	*Construction and operational phases*	*High*	*High*	*I.1.1.1 – DABS or MEW shall be responsible for implementing a Land Acquisition and Resettlement Program (LARP) within the Project Corridor. The LARP shall follow the procedures of WB OP 4.12 Technical assistance maybe provided to manage this process.*	*Implementation of a LARP.*
***Task #1 -** I.2 - NEPS to SEPS Connection - Construction of New Substations*	*I.1.2 - Land acquisition may be required, both temporary and permanent.*	*Construction and operational phases*	*High*	*High*	*See I.1.1.1 above.*	*Implementation of a LARP.*

Task #1 - *I.3 - NEPS to SEPS Connection – Reactive RPC installation*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	
Task #1 - *I.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*I.4.1 - Land acquisition may be required, both temporary and permanent.*	*Construction and operational phases*	*High*	*High*	*See I.1.1.1 above.*	*Implementation of a LARP.*
Task #2 - *I.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	*None required.*
Task #3 - *I.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	*None required.*
Task #4 *– I.7 - Construction Management Services - Procurement*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	*None required.*
Task #5 *– I.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	*None required.*

J. Other Socio-environmental Concerns – Infrastructure

Existing Conditions - *The formal infrastructure sector in Afghanistan is largely owned and operated through centralized ministries with some operational and production functions delegated to government enterprises. The reach of formal services, however, is very limited. In the urban water supply and sanitation sectors there is reported to be substantial private participation in service deliveries mainly through communities, NGOs and UN agencies. In rural areas NGOs and communities have been and are likely to remain the core providers of infrastructure services. Available data indicates the following:*

Roads. The road network in Afghanistan has been subject to an upgrading program over the past ten years, as such the road network is in a substantially better condition than it was under the Taliban rule. The NEPS – SEPS Corridor runs parallel with the Kabul – Kandahar Road, which was rehabilitated by USAID.

Water Supply Systems. Piped water supply systems exist only in urban areas and are in need of urgent repair. Coverage is poor and many provincial and secondary towns have no networked services. Localized piped water supply systems are likely to exist in or near the ROW in the portion of the roadway through urban Kandahar, Kabul, Ghazni and possibly other communities traversed by the ROW.

Wastewater Collection Systems. Virtually no rural areas and few residential or public buildings in Afghan cities have networked wastewater collection sewerage facilities and those that do discharge their wastewater directly into rivers without treatment. The World Bank reports that in 1997, sanitation coverage was estimated to be 23 percent of the urban population (versus eight percent of the rural population). No piped wastewater collection systems are known to be within the potential direct impact area.

Electrical Systems. Within the NEPS-SEPS Corridor systems are limited to towns and villages that rely on diesel power generation. The costs of electricity from these sources can be as much as 30 Afs per Kwh.

Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *J.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*J.1.2 - Interference with other infrastructure, water supply, etc.*	*Construction phase*	*Medium*	*Medium*	*J.1.2.1 - During the design phase the Contractor shall coordinate with Utilities in the work area to ensure that all construction sites, transmissions towers, staging areas, etc do not impact upon existing infrastructure.*	*None required.*
	J.1.3 - Traffic Delays caused by construction vehicle movements.	*Construction phase*	*Medium*	*Medium*	*J.1.3.1 – The Contractor shall ensure the following during construction works:* • *Minimize effects on pedestrian movements and amenity;* • *Manage and control vehicular movements to and from the site;* • *Maintain traffic capacity at intersections and in the vicinity of the site;* • *Maintain existing on-street parking in the vicinity of the site where practical;* • *Maintain access to other properties*	*None Required*

					adjacent to the site; • *Restrict vehicle activity to designated truck routes through the area;* • *Maintain safety for workers;* • *Provide appropriate access to the site for demolition, excavation and construction traffic;* • *Manage and control vehicle activity in the vicinity of the site.*	
Task #1 - *J.2 - NEPS to SEPS Connection - Construction of New Substations*	*J.2.1 - Interference with other infrastructure, water supply, etc.*	*Construction phase*	*Medium*	*Medium*	*See J.1.2.1 above.*	*None required.*
Task #1 - *J.3 - NEPS to SEPS Connection – Reactive RPC installation*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	*None required.*
Task #1 - *J.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*J.4.1 - Interference with other infrastructure, water supply, etc.*	*Construction phase*	*Medium*	*Medium*	*See J.1.2.1 above.*	*None required.*
Task #2 - *J.5 - NEPS Expansion – 110 kv 0r 220 kv Transmission Lines and Substations*	*Interference with other infrastructure, water supply, etc.*	*Construction phase*	*Medium*	*Medium*	*See J.1.2.1 above.*	*None required.*
Task #3 - *J.6 - NEPS Improvements to LV/MV networks, Power Plants &*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None.*	*None required.*

NLCC						
***Task #4** – J.7 - Construction Management Services - Procurement*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	*None required.*
***Task #5** – J.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None*	*None required.*

K. Other Socio-environmental Concerns – Historic and Cultural Resources

***Existing Conditions –** Historic and cultural resources include monuments, structures, works of art, the sites of outstanding universal value from historical, aesthetic, scientific ethnological and/or anthropological points of view, including unrecorded graveyards and burial sites. Afghanistan, and Ghazni in particular, is rich in historic and cultural resources. The responsibility for preservation, maintenance and assessment of historical and cultural monuments in Afghanistan rests with the Archaeological Committee under the Ministry of Information and Culture (MOIC). Within the Project Area, the most significant aboveground cultural resources are located within the urban areas. None are known to be susceptible to impacts as a result of the Proposed Action, but there is not known to be an available inventory of such resources and the situation is not well documented.*

Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
***Task #1 -** K.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*K.1.1 - Impacts to existing historical and cultural resources, notably around the city of Ghazni.*	*Construction phase*	*Low-medium*	*Medium*	*K1.1.2 - The Contractor shall ensure that during the design phase consultations are undertaken with MOIC to ensure that the routing of the transmission line does not impact upon historical and cultural resources in the Ghazni area.* *K1.1.3 - The Contractor shall also avoid siting any permanent and temporary facilities within 50 meters of Graveyards or Mosques.*	*None*
	K.1.2 - Chance finds of historical and cultural artifacts may be possible.	*Construction phase*	*Low*	*Medium*	*K.1.2.1 - In the event of unanticipated discoveries of cultural or historic artifacts (movable or immovable) in the course of the work, the Contractor shall take all necessary measures to protect the findings and shall notify the CMC and*	*None*

					provincial-level representatives of the relevant department within MOIC If continuation of the work would endanger the finding, project work shall be suspended until a solution for preservation of the artifacts is agreed upon.	
Task #1 - *K.2 - NEPS to SEPS Connection - Construction of New Substations*	*K.2.1 - Chance finds of historical and cultural artifacts may be possible.*	*Construction phase*	*Low*	*Medium*	*See K.1.2.1 above.*	*None*
Task #1 - *K.3 - NEPS to SEPS Connection – Reactive RPC installation*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None required.*	*None*
Task #1 - *K.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*K.4.1 - Chance finds of historical and cultural artifacts may be possible.*	*Construction phase*	*Low*	*Medium*	*See K.1.2.1 above.*	*None*
Task #2 - *K.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*K.5.1 - Chance finds of historical and cultural artifacts may be possible.*	*Construction phase*	*Low*	*Medium*	*See K.1.2.1 above.*	*None*
Task #3 - *K.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None required.*	*None*
Task #4 *– K.7 - Construction Management*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None required.*	*None*

Services - Procurement						
***Task #5** – K.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None required.*	*None*

L. Other Socio-environmental Concerns – Socio-Economic Conditions

Existing Conditions –** The economy of Afghanistan has improved significantly since 2002 due to the infusion of multi-billion dollars in international assistance and investments, as well as remittances from Afghan expats. However, Afghanistan still remains one of the poorest and least developed countries in the world that is highly dependent on foreign aid. About 35% of its population is unemployed and live below the poverty line, suffering from shortages of housing, clean drinking water, electricity and employment. The Karzai administration along with international donors have remained committed to improving access to these basic necessities by prioritizing infrastructure development, education, housing development, jobs programs, medical care, and economic reform. The Project is located within the Provinces of south and eastern Afghanistan where traditional agriculture is the dominant economic activity. Common agricultural crops include grapes, apples, vegetables, rice, wheat, corn and barley. Other farming activities include the production of cotton, sesame and sunflowers. Further information about crop types in the Project provinces can be found in **Appendix O**. The region included a large number of unemployed people and although health and education facilities are being rapidly developed throughout the country there is still a lack of basic medical and teaching equipment and staff. Details of educational and medical facilities can be found in in **Appendix O.

Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
***Task #1 -** L.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*L.1.1 - Community Health and safety may be affected during the construction period and also during any maintenance periods.*	*Construction and operational phases*	*Medium*	*Medium-high*	*L.1.1.1 - The Contractor shall prepare a Health and Safety Plan (HSP) which shall include a component relating to Community Health and Safety. The contents of the Plan are discussed in **Appendix F**. The Plan shall be reviewed and approved and monitored by the CMC.* *L.1.1.2 - The Plan shall also include provisions for health and safety during the operational phase of the Project.*	*None other than preparation of the HSP*
	L.1.2 - Land acquisition will be needed, both temporary and	*Construction and operational phases*	*High*	*High*	*See I.1.1.1 above.*	*Implementation of a LARP.*

	permanent.					
	L.1.3 - Resettlement may be caused by construction of transmission lines, depending on the results of the detailed designs.	*Construction and operational phases*	*High*	*High*	*See I.1.1.1 above.*	*Implementation of a LARP.*
	L.1.4 - Load Shedding has the potential to cause social unrest if not managed correctly.	*Operational phase*	*High*	*Medium*	*L.1.4.1 – The issue of load shedding should be bought to the attention of the public prior to the start of the operational phase. Using the proposed media campaign to highlight the issue will help the local community understand why it is needed and thus ease any potential social unrest in the future when load shedding is needed.*	*None, other than implementation of the Media Campaign, see* ***Section 6*** *below.*
	L.1.5 - Traffic Delays could occur in towns during construction periods.	*Construction phase*	*Medium*	*Medium*	*See J.1.3.1 above.*	*None, other than implementation of the HSP.*
	L.1.6 - Induced Growth in towns and villages connected to the new network can have an adverse impact on existing infrastructure which may not be able to cope with increased population levels	*Operational phase*	*Medium*	*Medium*	*L.1.6.1 – Induced growth is possible, especially in the locations of the new substations. This issue should be closely monitored by the Afghan government to ensure that growth does not place additional stresses on existing infrastructure and perhaps should be studied further via master plans for Qalat, Ghazni and Kandahar.*	*None*
	L.1.7 - Security	*Construction and operational phases*	*High*	*High*	*L.1.7.1 – The Contractor shall be responsible for the preparation of a Security Plan which will form part of the Health and Safety Plan (HSP) for the construction period.*	*None, apart from preparation of HSP.*
	L.1.8 - Health effects and annoyance from	*Operational phase*	*Low*	*Medium*	*L.1.8.1 - The Contractor shall evaluate potential exposure to the public against the reference*	*None*

	electromagnetic fields (EMF).				*levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Average and peak exposure levels should remain below the ICNIRP recommendation for General Public Exposure.* *L.1.8.2 - If EMF levels are confirmed or expected to be above the recommended exposure limits, application of engineering techniques should be considered to reduce the EMF produced by power lines, substations, or transformers. Examples of these techniques include:* • *Shielding with specific metal alloys* • *Increasing height of transmission towers* • *Modifications to size, spacing, and configuration of conductors.* [35]	
	L.1.9 - Socio-economic benefits, as discussed in detail above, ***Section 3****.*	*N/A*	*N/A*	*N/A*	*None required*	*None*
Task #1 - *L.2 - NEPS to SEPS Connection - Construction of New Substations*	*L.2.1 - Land acquisition may be needed, both temporary and permanent.*	*Construction and operational phases*	*High*	*High*	*See I.1.1.1 above.*	*Implementation of a LARP.*
Task #1 - *L.3 - NEPS to SEPS Connection – Reactive RPC installation*	*No impacts identified.*	*N/A*	*N/A*	*N/A*	*None*	*None required.*
Task #1 - *L.4 - NEPS to SEPS Connection – Low Voltage Distribution*	*L.4.1 - Community Health and safety may be affected during the construction period and also during any*	*Construction and operational phases*	*Medium*	*Medium-high*	*See L.1.1.1 & L.1.1.2 above.*	*None other than preparation of the HSP.*

[35] Environmental Health and Safety Guidlines, Electrical Power Transmission, IFC, 2007.

between Substations and Population Centers / Diesel Power Plants	*maintenance periods.*					
	L.4.2 - Land acquisition may be needed, both temporary and permanent.	*Construction and operational phases*	*High*	*High*	*See I.1.1.1 above.*	*Implementation of a LARP.*
***Task #2 -** L.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*L.5.1 - Community Health and safety may be affected during the construction period and also during any maintenance periods.*	*Construction and operational phases*	*Medium*	*Medium-high*	*See L.1.1.1 & L.1.1.2 above.*	*None other than preparation of the HSP.*
	L.5.2 - Land acquisition may be needed, both temporary and permanent.	*Construction and operational phases*	*High*	*High*	*See I.1.1.1 above.*	*Implementation of a LARP.*
***Task #3 -** L.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*No impacts identified.*	*N/A*	*N/A*	*N/A*	*None*	*None required.*
***Task #4** – L.7 - Construction Management Services - Procurement*	*No impacts identified.*	*N/A*	*N/A*	*N/A*	*None*	*None required.*
***Task #5** – L.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of*	*No impacts identified.*	*N/A*	*N/A*	*N/A*	*None*	*None required.*

Meters						

M. Other Socio-environmental Concerns – Occupational Health and Safety						
Existing Conditions – *There appears to be no formal system of OHS in Afghanistan, no legislative framework or policies regarding this matter. As such, it is up to the individual organization or company to ensure that good OHS standards are maintained.*						
Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *M.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*M.1.1 - Occupational Health and Safety Impacts during construction, e.g. working from heights, electrocution, etc.*	*Construction and operational phases*	*Medium*	*Medium-high*	*M.1.1.1 - The Contractor shall prepare a Health and Safety plan for all construction related activities covering occupational health and safety issues. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	*None, other than preparation of an HSP.*
	M.1.2 - Hazardous materials and waste management.	*Construction and operational phases*	*Medium*	*Medium-high*	*See H.1.4.1 above.*	*None, other than preparation of a Hazmat plan.*
Task #1 - *M.2 - NEPS to SEPS Connection - Construction of New Substations*	*M.2.2 - Occupational Health and Safety Impacts during construction.*	*Construction and operational phases*	*Medium*	*Medium-high*	*See M.1.1.1 above.*	*None, other than preparation of an HSP.*
Task #1 - *M.3 - NEPS to SEPS Connection – Reactive RPC installation*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None required*	*None*
Task #1 - *M.4 - NEPS to SEPS Connection –*	*M.4.1 - Use, storage and disposal of wood preservatives.*	*Construction and operational phases*	*Low-medium*	*Low*	*See H.1.4.1 above.*	*None, other than preparation of a*

Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants						*Hazmat plan.*
	M.4.2 - Occupational Health and Safety Impacts during construction, e.g. working from heights, electrocution, etc.	*Construction and operational phases*	*Medium*	*Medium-high*	*See M.1.1.1 above.*	*None, other than preparation of an HSP.*
***Task #2 -** M.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*M.5.1 - Occupational Health and Safety Impacts during construction.*	*Construction and operational phases*	*Medium*	*Medium-high*	*See M.1.1.1 above.*	*None, other than preparation of an HSP.*
***Task #3 -** M.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*M.6.1 - Occupational Health and Safety Impacts during rehabilitation works.*	*Construction and operational phases*	*Medium*	*Medium-high*	*See M.1.1.1 above.*	*None, other than preparation of an HSP.*
***Task #4** – M.7 - Construction Management Services - Procurement*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None required*	*None required.*
***Task #5** – M.8 - Technical Assistance for the Commercialization of DABS – Procurement and Installation of Meters*	*No impacts identified*	*N/A*	*N/A*	*N/A*	*None required*	*None required.*

N. Other Socio-environmental Concerns – Noise and Vibration						
Existing Conditions - Existing Conditions - *Ambient noise levels in the Project Area are relatively low, even in the more urbanized areas. Existing studies have not revealed the presence of "sensitive receptors", i.e., recipients of sound for whom exposures to excessive sound levels are detrimental - hospitals, for example – in proximity to the Project Corridor.*						
Potential Impacts		**Duration**	**Probability**	**Significance**	**Mitigation**	**Additional Actions**
Task #1 - *N.1 - NEPS to SEPS Connection – High Voltage Transmission Lines*	*N.1.1 - Operational impacts including Corona discharge.*	*Operational phase*	*Low*	*Low-medium*	*N.1.1.1 - Operational noise impacts will be negligible with the exception of any short-term localized maintenance works. In addition, it is possible that Corona Discharge noise could become a nuisance if located close to residential areas. However, this issue can be reduced by increasing the spacing between the conductors, increasing the diameter of the conductor, using bundled conductors, or by using corona rings or grading rings.*	*None*
	N.1.2 - Noise from construction machinery and general construction activities	*Construction phase*	*Medium*	*Medium*	*N.1.2.1 - Cooperation between the Contractor and the local residents is essential and it is the responsibility of DABS to arrange meetings between these parties and arrange such matters as work schedules (hours of equipment operation, traffic lanes to be kept open, diversion roads, etc.), locations of work camps and material storage areas, and siting of rock crushers and batch plants. N.1.2.2 - In addition, the Contractor shall be responsible for ensuring the use of:* • *Source Controls, i.e., requirements that all exhaust systems will be maintained in good working order; properly designed engine enclosures and intake silencers will be employed; and regular equipment maintenance will be undertaken;* • *Site Controls, i.e., requirements that stationary equipment will be placed as far from sensitive land uses as practical; selected to minimize objectionable noise impacts; and provided with shielding*	*None*

					mechanisms where possible; • *Work near Sensitive Receptors shall be limited to short term activities. No asphalt plants, rock crushing plants or any long term generators of significant noise shall be allowed within 300 meters of sensitive receptors;* • *Time and Activity Constraints, i.e., operations will be scheduled to coincide with periods when people would least likely be affected; work hours and work days will be limited to less noise-sensitive times. Construction activities will be strictly prohibited between 10 PM and 6 AM in the residential areas. When operating close to sensitive areas such as residential, nursery, or medical facilities, the Sub-Contractor's hours of working shall be limited to 8 AM to 6 PM;* • *Community Awareness, i.e., public notification of construction operations will incorporate noise considerations; methods to handle complaints will be specified. Sensitive receptors will be avoided as possible (i.e., aggregate crushers, operators, etc.). Disposal sites and haul routes will be coordinated with the CMC.*	
	N.1.3 - It is possible that blasting and drilling activities will be required during the construction of the foundations for transmission line towers. This may impact upon sensitive receptors, depending on the location of the lines.	*Construction phase*	*Low*	*Medium*	*N.1.3.1 - Noise impacts can be mitigated by incorporating the following conditions in Contractors contracts:* • *The Contractor should prepare a Blast Plan prior to the commencement of works. The Plan, which shall be approved by the CMC, should ensure that:* – *Before the firing of any blast, the rock to be blasted shall be covered with approved blasting mats, soil, or other equally serviceable material, to prevent fly rock that may result in damage to life*	*None*

					or property. – *The Contractor shall protect all overhead and underground utilities prior to blasting and immediately repair or replace any damaged by the blasting operations.* – *Warning signs and public notification are required to avoid all risks to the public that use the roadway.* – *Blasting shall be restricted to the times specified by the CMC.* – *The Contractor shall use the utmost care so as not to endanger life or property, or disturb materials outside the limits of the excavation.* – *When blasting, ample warning shall be given to all persons within the vicinity prior to blasting. Warning signs shall be erected a minimum of 24 hours prior to the blast time, and workers shall be stationed to warn people before firing any blasts. The warning signs will state the time and date of each blast.* *N.1.3.2 - The Contractor is forewarned that existing residential and commercial properties may be located in close proximity of the blast and that these properties shall be protected. The Contractor shall be responsible for all damage to these properties, including providing suitable temporary housing to residents or business occupants until repair work is completed.*	
Task #1 - *N.2 - NEPS to SEPS Connection - Construction of New Substations*	*N.2.1 - Transformer noise, or 'hum'.*	*N/A*	*N/A*	*N/A*	*N.2.1.1 - It is possible that transformers may give off a low audible hum. This is unlikely to have significant impacts to the local community, but siting of the substations more than 100 meters from residential properties should make this potential issue moot.*	*None*
Task #1 - *N.3 -*	*N.2.2 - Corona discharge is unlikely to be a significant*	*Operational phase*	*Low*	*Low-medium*	*See N.1.1.1 above*	*None*

NEPS to SEPS Connection – Reactive RPC installation	*negative impact.*					
	N.3.1 - No significant noise impacts identified.	*N/A*	*N/A*	*N/A*	*None required*	*None*
***Task #1 -** N.4 - NEPS to SEPS Connection – Low Voltage Distribution between Substations and Population Centers / Diesel Power Plants*	*N.4.1 - Noise from construction machinery and general construction activities*	*Construction phase*	*Medium*	*Medium*	*See N.1.2.1 & N.1.2.2 above.*	*None*
***Task #2 -** N.5 - NEPS Expansion – 110 kv or 220 kv Transmission Lines and Substations*	*N.5.1 - Noise from construction machinery and general construction activities*	*Construction phase*	*Medium*	*Medium*	*See N.1.2.1 & N.1.2.2 above.*	*None*
***Task #3 -** N.6 - NEPS Improvements to LV/MV networks, Power Plants & NLCC*	*N.6.1 - No significant noise impacts identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None required*
***Task #4** – N.7 - Construction Management Services - Procurement*	*N.7.1 - No significant noise impacts identified.*	*N/A*	*N/A*	*N/A*	*None required*	*None required*
***Task #5** – N.8 - Technical Assistance for the Commercializatio n of DABS –*	*N.8.1 - No significant noise impacts identified.*	*N/A*	*N/A*	*N/A*	*None required.*	*None required*

Procurement and Installation of Meters						

4.6 Issues to be Eliminated from the EA Process

From the analysis above it is noted that no further review of issues is required by an Environmental Assessment. All of the impacts identified can be adequately managed and mitigated by ensuring compliance with the mitigation measures outlined above and contained within the Environmental Mitigation and Monitoring Plans (EMMP) which are discussed below and provided in detail as **Appendix B** to this report.

Many of the issues identified will be short term and localized and as such are not considered to be a 'significant' environmental risk. There are some items that will require the preparation of additional management plans, such as waste management, hazardous materials and health and safety, these management plans should be developed by the Contractor under the guidance of the tables above and the EMMPs provided herewith.

Any additional project components added to PTEC that are not part of this Scoping Study shall require an amendment to the IEE.

4.7 Issues to Receive Further Consideration during the EA Process

As stated above, an EA is not considered warranted given the nature of potential impacts and the mitigation plan provided as part of this report.

4.8 Environmental Mitigation and Monitoring Plans

4.8.1 Overview

As stated above, the Project must adhere to the mitigation and monitoring measures outlined in the tables and provided in detail by the EMMPs in **Appendix B**. The EMMPs, outline the mitigation measures, the parties responsible and schedule for implementing the mitigation and a schedule of any required mitigation monitoring and reporting. To ensure adoption of the EMMPS, they shall be included directly within on-budget construction contracts. As part of the EMMPs the Contractors will also be responsible for the preparation of their supporting documents, such as the Waste Management Plan, and Health and Safety Plan.

4.8.2 Implementation

Oversight of the EMMP will be required through the construction and operational phases of the project as follows:

- Construction – During the construction phase the responsibility of implementing the EMMP will be the Contractor. Initial monitoring of the Contractor's day to day compliance with the EMMP during works will be the responsibility of the CMC and QA. The CMC will then develop capacity within DABS, via a training program, to monitor environmental compliance during construction. This will enable DABS to eventually undertake the environmental monitoring portion of the CMC activities throughout the remainder of the construction phase of the Project.
- Operational monitoring – DABS shall be responsible for implementing the EMMP during the operational phase of the Project.

4.8.3 Estimated Costs

The following table provides a summary of the EMMP costs. It should be noted that these costs are estimates and may vary if changes to the programs scope occur.

#	Item	Description	Responsibility	Cost
1	*Preparation of a Waste Management Plan, Hazmat Plan, Traffic Control Plan, Health and Safety Plan and Blast Plan.*	*Each bid package will require a set of plans to be developed by the Contractor.*	*Contractor*	*$10,000 per bid package.*
2	*LARP*	*Preparation of Project LARP for NEPs - SEPs*	*DABS / GoIRA*	*TBD.*
3	*Observational Monitoring (construction phase)*	*One environmental specialist for each bid package for first 3 months of Project works.*	*CMC*	*$15,000 per bid package*
4	*Environmental Training for DABS provided by CMC.*	*Two months of training to DABS by International Specialist to develop environmental capacity for monitoring*	*DABS*	*$50,000*
5	*Additional Observational Monitoring (DABS Specialist)*	*Continued environmental monitoring of all PTEC activities by DABS specialist*	*DABS*	*$20,000 per annum.*
6	*Water Monitoring (Darunta Dam)*	*Monitoring of water quality throughout rehabilitation phase*	*DABS*	*$5,000 per annum*
7	*DABS Capacity Building*	*??*	*CMC and QA*	
8	*Media Campaign and public consultations*	*Inform citizens on status of energy in Afghanistan and how PTEC will affect them*	*DABS*	*$2,000,000*
9	*Programmatic Scoping Statement review and approval by ANEPA*	*Required by Afghan Procurement Law, ANEPA has agreed to provide full support to PTEC*	*ANEPA*	*$25,000*

5. Summary of Stakeholder Consultation

5.1 Need for Consultations

Stakeholder consultations form an integral part of the scoping process. Consultations are necessary to help understand the potential environmental and social issues that may be associated with the Project and that may not be fully understood without taking into account the perspective of those people with an actual stake in the Project.

5.2 Consultation Methodology

Interviews were undertaken during September 2012 with a range of Stakeholders in Kabul and the results are presented below. Consultations were planned for the Project Area, however, due to security challenges in country it has not been possible to arrange stakeholder consultations in the area at this time without compromising the safety of those visiting the site. However, as noted above in **Section 3**, this report makes recommendations for continued stakeholder consultations throughout the pre-construction and construction phases of the Project that will ensure that the voices of all Project Stakeholders are heard.

5.3 Government Stakeholders

5.3.1 ANEPA

Wali Modaqiq – Deputy Director General (Policy and International Affairs) 19th September, 2012 – Mr Modaqiq mentioned that he was aware of the proposed Project and thought that in theory it was an excellent idea. However, his primary concern with the Project was that initially there will be portions of the Project corridor that do not receive power and that this could create social tensions in these areas. He recommended that the Project be smaller scale, perhaps to Ghazni only, and to ensure that the Project had greater reach to cover smaller communities within this more limited length corridor. He knew of no natural forests or critical wildlife that may be impacted negatively due to the fact that the Project was to be constructed in what is essentially an environmentally degraded corridor. He felt, as stated above, that social impacts would be higher and stated that any resettlement or compensation program for loss of land or property should be implemented by MEW and not USAID. He felt that an information program may help the people understand better the potential impacts of the Project and that such a program should be via Radio programs. Mr Modaqiq mentioned that the Project should take into account Afghan environmental legislation, including the EIA regulations and the draft air quality and noise standards. He was not sure how to manage hazardous waste in the context of the Project though. He also mentioned that it may be possible for ANEPA to help monitor construction impacts.

Ghulam Mohammad Malikyar – Deputy Director General, 20th September, 2012 (by Phone) – Mr Malikyar was contacted regarding the environmental category of the Project. According to ANEPA guidelines, the Project is classified as an Annex 1 Project, meaning that an EIA is required. As such, the Project proponent (USAID) should submit this scoping study to NEPA for review under their environmental screening process. ANEPA will then make a decision of this information contained within this report meets all the environmental assessment requirements of ANEPA, or if further studies are required in the form of a full Environmental Assessment.

5.3.2 Ministry of Energy and Water

Ghulam Faruq – Deputy Minister for Energy – 15th September, 2012. Mr Faruq was very happy that USAID had chosen to fund this Project. He knew of no significant environmental issues that may result from construction and operation of the Project. He stated that the Government department in charge of the land acquisition process would be MEW. He stated

that MEW had completed several similar projects with ADB in the north of the country and as such they had the necessary experience to manage this process according to the requirements of the Afghan Land Expropriation process. The question was raised by the consultant if the MEW had sufficient budget to fund the process, Mr Faruq ensured that the funds would be made available for any compensation. Finally, Mr Faruq recommended that the Consultant speak with SMEC, an international engineering consultancy, who had recently implemented a compensation program for a similar ADB funded transmission program in Afghanistan.

5.3.3 DABs

Mirwais Alami – Chief Commercial Officer. An initial meeting was held with DABS COO on the 15th September to discuss the potential media campaign for the construction and operational phases of the Project. The purpose of the media campaign is to help locals understand the potential impacts, both negative and positive of the Project and to help them take ownership of the Project and to reduce the potential security issues that may arise during the construction phase of the project and impacts to Project infrastructure during the operational phase. It was agreed that two factors are key for a successful media campaign, firstly, the message and secondly, the delivery of the message. Mr Alami believed there were several critical items to include in the message:

- Timescale – it will be extremely important to get the construction and delivery dates correct, otherwise people may become disgruntled with the Project at perceived delays.
- Value – The people have to be aware of the value of the Project in terms of its benefits to them.
- Ownership – The people need to take ownership of the Project, if the people commit to the Project they can help reduce security concerns during construction and prevent damage to infrastructure during the operational phase.
- Cheaper Power – the benefits of cheaper power must be expressed to the users.
- Creation of jobs – The local populations centers will benefit from jobs created during the construction and operational phases of the Project.

Regarding distribution of the message, Mr Alami proposed several methods, including Radio (through some kind of drama program); billboards along the A1 highway (with example slogans to include “power is your property”); Posters at Mosques and information programs at schools. Mr Alami though that this activity could be undertaken primarily by DABS with some oversight and coordination through PRTs in the Project Corridor.

Finally, Mr Alami pointed out that Load Shedding during the operational phase of the Project, could cause social tensions.

DABS Regional Directors – The meeting held on the 19th of September at DABS offices in Kabul included:

- Shekeeb Ahmad – DABS Chief Operating Officer (SA)
- Mirwais Alami – DABS Chief Commercial Officer (MA)
- Eng. Abdul Khaliq Babor – DABS Regional Manager (AKB)
- Shafi Atal – DABS Public Relations and Marketing Manager (SHA)
- Mohammad Salim Saeed – DABS Zabul Breshna Director (MSS)
- Mohammad Sediq – Maydan Shar Breshna Director (MS)
- Eng. Mohammad Wais Wardak – Wardak Power Station Director (MWW)
- Khalil ul Rahman – Expansion Director, Ghazni Breshna (KR)

The purpose of the meeting was to discuss additional public consultation methods and the proposed media campaign for the Projects construction and operational phases.

- SA - noted that the Maydan Shar substation had been removed from the Project and was being replaced with a substation at Arghandi. This illustrates the fluid nature of the

Project and how other portions of the Project may be adapted and changed as it progresses.

- MS – Commented that DABs had already procured land for the substation at Mayden Shar from the government and now wanted to know what to do with the land.
- KR – Thought that social tensions may become evident if power is not shared equally, i.e. if some communities live close to the transmission lines, but not close enough to substations and the associated low voltage lines.
- SA - Commented that offering jobs to locals during construction and operation could reduce such tensions. He noted that not all areas could be connected at this time due to the cost of implementing such a huge project. However, an area around forty kilometers in radius from the substations would be connected to the network.
- KR – Commented that DABS have land set aside for two substations locations in Ghazni, both government owned lands approximately 8 kilometers north of the city center.
- MS – Commented that if DABS do not implement the Project security issues will certainly not improve in the Project area.
- SA – commented that we should advise locals that power is coming, but not immediately and that if the locals decide to destroy the infrastructure then they will never have power. He also commented that in Maydan-Wardak Province the percentage of public to private owned land required for the Project is around 70 % and 30% respectively. It was also noted that land had been acquired for the Sayad Abad substation and that Mosques will receive free electricity.
- MS – Commented that the cell phone network has not been destroyed by Taliban and it may be likely that they will not interfere with the PTEC project.
- SA – Noted that it is possible that land grabbing may occur, and as such the compensation program needs to be robust. The COO indicated that compensation programs had worked elsewhere in the country on other projects, but there were often problems with the process, for example people not having the correct documentation for their land or property.
- MSS – Commented that Zabul needs at least two substations and that approximately 50% of land in the Zabul corridor was government owned with the remaining 50% privately owned.

A general discussion was held about the message that DABS should be sending to the locals as part of the media campaign, comments included:

- Information that the Project will be implemented segment by segment and that power will be provided to each segment as they are completed.
- Price of electricity will reduce form 30 Afs to around 2-5 Afs per kilowatt hour.
- The Project will reduce poverty and increase living standards.

The general consensus regarding distribution methods was that TV, Radio and Leaflets would be the best distribution method along with a verbal message delivered through elders and Mullahs at Mosques.

5.3.4 Ministry of Youth and Culture

A meeting was requested with MOIC, unfortunately they were busy and did not have a suitable time to meet to discuss the project.

5.3.5 District Governors

Ahmadullah Alizai - Governor of Kabul, 17th September, 2012. The Governor started the meeting expressing his gratitude to USAID for funding this Project, he indicated that this would be an extremely beneficial Project, especially for the people of Kandahar, his home town. He stated that he will provide full support to the project even though it only has a small

presence within Kabul Province. He stated that there will be no security issues for the Project in his province, but indicated that there may well be significant security issues within the other Project related provinces. He stated that a meeting should be held between all relevant provincial governors to discuss how to help implement the Project in a secure and timely manner. He knew of no potential environmental impacts within his province that may result from construction or operational activities. Regarding compensation issues, the Governor mentioned that Afghanistan has adequate laws to manage this issue and that the local population will be happy that the Project is happening and as such will not create problems relating to compensation. He noted that most of the proposed corridor in Kabul Province is government owned land and as such compensation issues should be minimal.

Governor of Maydan - Wardak. A meeting with the Governor had been arranged for the 19th September, 2012. Unfortunately the Governor was sacked from his position the preceding day and as such could no longer attend the meeting.

5.3.6 Members of Parliament

Mohammad Ali Alizada - Ghazni MP, 18th September, 2012 – The MP thought that lack of electricity was a key factor limiting the growth of Ghazni. He noted that Ghazni has big potential to expand due to its geographical location in relation to Kabul and Kandahar. He thought that electricity would be a key factor in generating jobs, reducing unemployment and improving security. He noted that the only power supply in Ghazni is through diesel power generators and small solar power systems. He thought the key benefits of the Project were two-fold, firstly it would improve the general standard of living of the people connected to the network and secondly it would help improve industry and agriculture in the province. He also noted that the mining sector would develop as electricity becomes more widespread in the Province and that minerals could then be exported (although reports tend to suggest mining potential in Ghazni is low). Currently most people use the limited and expensive supply of electricity to light their homes and to watch TV in the evenings. He was slightly concerned about the issue of induced growth and what that would mean for the existing infrastructure in Ghazni and if it could cope with a rapid increase in population brought to the city by new jobs and better facilities resulting from improvements to the power network. However, he also commented that developments to the City may increase the potential for tourism particularly given its historical status. He did not think that compensation issues would be significant, and that most people would cooperate with the Project given its significant social benefits. He also noted that the people of Ghazni were likely to stand up to any criminal element or anti-government forces intent on destroying or disrupting the Project for their own gains.

Abdul Qader Qalatwal - Zabul MP, 17th September, 2012. The MP first stated that he was extremely grateful to the US Government for funding the Project and for also USAID to continue to work in Afghanistan during this period of poor security. He knew about the Project after initial consultations with DABS. He mentioned that unemployment is a significant issue within Zabul and as such job creation is key to improving security in the region. He also stated that there is a low military and police presence in Zabul which also increases security risks. He noted that the existing USAID funded Diesel generator program is providing power to Zabul, but in limited supply and at a high cost. He commented that there may be some minor environmental impacts during project construction, but they would be significantly outweighed by the positive social impacts of the Project. He noted that most of the land required for the Project would be government owned land and as such did no see compensation issues being a significant problem in Zabul. Finally, he thought the media campaign would be an excellent way to reduce security risks during the construction phase, although he felt that security issues were not caused by normal members of the public, rather by outside influences. He thought that Zabul and Qalat Radio channels would be the best option for distribution of the campaign.

Mohammad Maem Ahmidzai - Kandahar MP, 18th September, 2012. The MP is from Spin Boldak and was originally a Colonel in the Police Force. He shares his responsibilities with seven other Kandahar MPs including four women MPs. He stated that Kandahar has between 6-8 hours of electricity per day from emergency generators and hydroelectric facilities. He noted that increased provision of electricity will help improve industry, agriculture and general every day life in Kandahar. He also mentioned that it will help people view other forms of media and improve education. He believes that lack of education is a key factor in Kandahar for turning people towards anti-government forces. He believed that the Project would have full support from the normal people of Kandahar and pledged that he would do anything in his power to ensure security issues are minimal during construction. He did not have any comment regarding environmental issues.

Abdul Ahmad Durani - Wardak MP, 19th September 2012. The MP was very happy to hear about the proposed Project and stated that he would ensure the Project is implemented correctly in Wardak. He was concerned about what districts would actually get power and thought that the Project should connect the whole of Wardak to the electricity network, not just portions such as Mayden Shar and Sayad Abad. He did believe that the Project would help establish peace and stability in Wardak which suffers from violence and high levels of unemployment (as high as 80% in some districts). He also believed that the mining sector in Wardak would benefit from the Project, especially the extraction activities concerning chromite, marble and copper. Finally he mentioned that the agricultural sector would also benefit as there would be increased potential for the establishment of cold storage facilities for agricultural crops. This would allow farmers to improve their storage and logistics activities and reduce the amount of crop wastage. He also noted that the price for electricity was currently very high in Wardak, around 300 Afs for six hours supply via diesel generators and as such this limits the use of electricity in the Province. Finally, he noted that currently people use animal waste and wood as fuel. He noted that supply of electricity may reduce the dependence on wood for heating homes.

5.4 Other Consultations

5.4.1 UNEP

Andrew Scanlon – Country Program Manager, 18th September, 2012. Mr Scanlon was contacted to discuss potential environmental issues relating to the Project. He stated that the Project should follow the Afghan EIA Policy and other Afghan related legislation, such as the water law and even draft legislation such as the National Waste Management Legislation. Mr Scanlon did not know of any specific environmental issues particular to the Project corridor, primarily due to the fact that the corridor is degraded by many years of human activity along the alignment. He did however, comment that the Land Expropriation Policy of Afghanistan was quite weak and doubted that it was as rigorous as international best practice, such as the World Banks OP4.12 for Resettlement and Compensation.

5.4.2 SMEC

Naqibullah Hashimi – Resettlement Specialist, 15th September, 2012. A meeting was held with the Resettlement Specialist for SMEC in Kabul. SMEC are currently implementing a transmission line project for the ADB in the north of Afghanistan and accordingly have developed a resettlement and compensation plan in line with ADB Safeguard Policies. Mr Hashimi commented that in order to achieve the best possible results, any resettlement and compensation plan should follow international best practice, such as World Bank or ADB Safeguard Policies, not the legislation of Afghanistan. He noted that detailed design should be completed first, then a resettlement plan prepared based on detailed and accurate plans. He noted that is more than 200 houses are to be impacted in an urban area then the alignment of the towers should be changed to minimize such impacts. He also noted that property prices are significantly different from Province to Province, in Kunduz one square

meter of land was selling at around 500 Afs and in Jalalabad the same area was selling for nearly 2000 Afs. He also commented that according to Afghan legislation, payment is not always made for land as compensation, instead compensation may take the form of another piece of land, which may or may not be suitable for farming, or living and this could result in significant social issues.

6. Conclusions and Recommendations

6.1 Conclusions

The Scoping Study has identified numerous environmental and social related impacts that will result from Project implementation, however, it is noted that nearly all of these impacts will be short term, localized construction related impacts that, with adoption of the mitigation specified within **Section 4** and the EMMP, can be adequately managed without giving rise to significant negative impacts. It is also noted that incorporation of the recommended design mitigation measures will further reduce the significance of impacts. In addition, this study has identified, through consultations with key stakeholders, that the Project will have significant beneficial social impacts which outweigh almost all negative impacts. Accordingly, the scoping statement concludes that there are no identified socio-economic or physical/natural environmental impacts that cannot be adequately mitigated by adoption of the measures outlined within Section 4 of the report and the EMMPs, and that further study of impacts via an Environmental Assessment is not deemed warranted.

6.2 Recommendations

The following recommendations are made to ensure suitable environmental management throughout the Project lifecycle.

6.2.1 General Recommendations

The EMMP, Bid Documents and Contracts - In the first instance the Project must adhere to the mitigation and monitoring measures outlined in **Section 4** and provided in detail by the EMMPs in **Appendix B**. The EMMPs, outline the mitigation measures, the parties responsible and schedule for implementing the mitigation and a schedule of any required mitigation monitoring and reporting. To ensure adoption of the EMMPS, they shall be included directly within on-budget construction contracts.

Oversight of the EMMP – Oversight of the EMMP will be required through the construction and operational phases of the project as follows:

- Construction – During the construction phase the responsibility of implementing the EMMP will be the Contractor. Monitoring of the Contractor's compliance with the EMMP during works will be the responsibility of the CMC and QA. The CMC will to develop capacity within DABS to monitor environmental compliance during construction. This will enable DABS to eventually undertake the environmental monitoring portion of the CMC activities throughout the construction phase of the Project.
- Operational monitoring – DABS shall be responsible for implementing the EMMP during the operational phase of the Project.

Environmentally sustainable procurement (ESP) – In addition to the mitigation measures and the required institutional requirements, a further requirement to ensure appropriate management of socio-environmental issues is the use of environmentally sustainable procurement practices. ESP is a process whereby organizations or companies seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured. The benefits associated with ESP are not limited to environmental impact, but can include everything from social and health to economic and political benefits. The main components of PTEC that will benefit from ESP are the Construction Management Services portion and the Technical Assistance for Commercialization of DABs which includes procurement of vehicles, computers, office equipment and furniture. Two specific guidelines are recommended:

- European Union Green Public Procurement (GPP) Toolkit[36]
- United Nations Sustainable Procurement Guidelines (UNSPG)[37]

Of these the UN SPG is the most relevant with specific guidelines for the procurements of IT Equipment, Vehicles and Furniture.

6.2.2 Land Acquisition and Compensation Recommendations

Land acquisition, both temporary and permanent will be required. It is also likely that resettlement will be required in urban areas such as Ghazni and Qalat. In the first instance efforts should be made at the design phase to limit the extent of construction on private or occupied land. However, private and occupied land will still be required and as such a method for compensation and possibly resettlement will be needed. Given the relative shortcomings of the Afghan Expropriation laws, it shall be the responsibility of DABS to ensure that the Project follows the resettlement and compensation guidelines provided by the World Banks Operational Policy 4.12 for Involuntary Resettlement. Land acquisition, both temporary and permanent is the responsibility of DABS as their in-kind contribution to PTEC. The LARP will be implemented by either DABS or MEW, possibly with help from a third party through the technical assistance component of PTEC. Any project related LARP will require approval by USAID MEO and COR. In addition to the implementation of LARP a Grievance Mechanism should be prepared by DABS to ensure that project affected persons have a method to voice potential concerns, particularly with regards to the LARP. IFC Guidelines for designing Grievance Mechanisms[38] should be employed in this process

6.2.3 Media campaign Recommendations

Consultations with Stakeholders, specifically DABS and USAID, have noted the potential security issues relating to implementation of the Project through design, construction and operation. There are two key security concerns, firstly interruption of the construction phase of the Project, and secondly disruptions and damage to existing infrastructure during the operational phase of the Project (specifically within the NEP-SEPS Corridor). Accordingly, it has been recommended that a Media Campaign be established by USAID and DABS to promote the Project and the notion that the Project belongs to the people of Afghanistan and as such they have a role in ensuring that the Project can be constructed and operated successfully.

The Media Campaign will be developed prior to the start of construction primarily by DABS with oversight from USAID. However, initial consultations with DABS and USAID at this scoping stage have attempted to kick-start the Campaign by identifying two keys issues for its successful implementation:

3. The Message – i.e. what do we want to tell the local community to help develop a safe and secure project?
4. Distribution Methods – i.e. how should the message be delivered to the local community?

In summary, it was indicated that the message would include:

- Benefits, such as cheaper power, construction phase job creation, operational phase job creation through expansion of agriculture and industry, improvements to health and educational facilities and improved access to media;

[36] http://ec.europa.eu/environment/gpp/toolkit_en.htm
[37] https://www.ungm.org/sustainableprocurement/toolsUN/tools.aspx
[38] Good Practice Note: Addressing Grievances from Project Affected Communities, Guidance for Projects and Companies Designing Grievance Mechanisms, IFC, 2009

- Potential negative construction related impacts, such as air quality and noise;
- Potential requirements for resettlement and compensation;
- Timescale for construction and completion of the project;
- Decreased poverty and increased security; and
- Indication that power distribution will be limited to areas around substations.

Regarding distribution methods, stakeholder consultations with Local MPs, Governors, DABS and ANEPA indicated the following preferred methods:

- Radio – via some form of drama series;
- TV – although the potential may be limited;
- Advertising Hoardings – particularly along the Project Corridor;
- Via Village Elders and Mullahs.

An initial outline and action plan for the Media Campaign, addressing these points in more detail is discussed within **Appendix C**.

6.2.4 Recommendations for Other Management Plans

Waste Management Plan - Waste management plans (WMP) shall be prepared by the Contractor prior to construction to ensure that waste disposal measures will be undertaken to reuse and recycle all materials wherever possible minimize the generation of waste. With the proper implementation of an appropriate waste disposal plan, there will be no residual risk due to improper waste disposal. It is recommended that the Contractor follow international best practice in the form of IFC EHS Guidelines for Waste Management[39] during the preparation of this Plan. A proposed table of contents for the WMP can be found as **Appendix D**.

HazMat Plan – The Contractor shall be responsible for preparing a HazMat Plan prior to the commencement of construction works. The document shall include provisions for the safe transport, storage, handling and disposal of all hazardous materials on site. The Plan shall be approved by the CMC prior to the start of construction works. It is recommended that the Contractor follow international best practice in the form of IFC EHS Guidelines for Hazardous Materials Management[40] during the preparation of this Plan. A proposed table of contents for the Hazmat Plan can be found as **Appendix E**.

Health and Safety Plan – Contractors are obliged to implement all reasonable precautions to protect the health and safety of workers through; eliminating the hazard by removing the activity from the work process; Controlling the hazard at its source through use of engineering controls; Minimizing the hazard through design of safe work systems and administrative or institutional control measures, and providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE. Accordingly, it is recommended that the Contractor prepare a Health and Safety Plan (HSP) to implement these conditions. It is recommended that the Contractor follow international best practice in the form of IFC EHS Guidelines for OHS[41] during the preparation of this Plan. A proposed table of contents for the HSP can be found as **Appendix F**. In addition to occupational health and safety issues, the issue of community health and safety should also

[39] Environmental, Health and safety (EHS) Guidelines, General EHS Guidelines: Environmental. Waste Management. IFC, 2007.
[40] Environmental, Health and safety (EHS) Guidelines, General EHS Guidelines: Environmental. Hazardous Materials Management. IFC, 2007.
[41] Environmental, Health and safety (EHS) Guidelines, General EHS Guidelines: Environmental. OHS. IFC, 2007.

be addressed in the HSP. The IFC EHS Guidelines for Community Health and Safety[42] provide an indication of the issues that should be included within this section of the HSP.

Blast Plan – In the event that blasting is required for foundation works, a Blast Plan shall be prepared by the Contractor to prevent impacts arising from blasting activities. An example of the contents of a Blast Plan can be found as **Appendix H**

6.2.5 Other Issues

Greenhouse Gases - The study has also highlighted the potential impacts of the use of Sulphur Hexafluoride (SF_6) used in transformer switchgear, which is likely to be the preferred type of gas insulated switchgear. SF_6 is a greenhouse gas and as such contributes to global warming. It is recommended that selected SF_6 equipment should have a nominal leakage and replacement rate of less than 1% per year, and in addition, that DABS should undertake research during the design phase of the Project to assess methods of recycling SF_6 and safe disposal methods.

ANEPA – Finally, it is noted that PTEC is classified as an Annex A project by ANEPA, meaning that this scoping study should be submitted for review to ANEPA in accordance with Afghanistan's Environmental Assessment Policy. Although beyond the scope of this particular Project, it is recommended that USAID meet with ANEPA and draft an MOU in which ANEPA recognizes USAID's environmental procedures in lieu of ANEPA requirements.

Amendments to the IEE – The Project IEE (**Appendix A**) is currently being amended to reflect changes in the PTEC scope of works and will need to be amended further if future projects are added to PTEC that are not currently covered by this Scoping Study or the amended IEE.

[42] Environmental, Health and safety (EHS) Guidelines, General EHS Guidelines: Environmental. Community Health and Safety. IFC, 2007.

Appendices

Appendix A - Amended IEE

Appendix B – Environmental Mitigation and Monitoring Plans

Project Component – High Voltage Transmission Lines (110 kv and 220 kv) – Design Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Geology and Seismicity	*The Project Corridor is located in a seismically active region.*	*Seismic loading shall be applied to the transmission tower designs.*	• *Contractor to include seismic loading during design.* • *CMC to approve Contractors designs.*	• *CMC regular inspections of construction works.*
Hydrology	*Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.*	*To mitigate this potential impact it is recommended that designs ensure:* • *Transmission line towers be located at least 50 meters from the river.*	• *Contractor to ensure appropriate locations of towers.*	• *CMC to approve designs.*
	Discharges of liquid waste from general construction works and construction camps.	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP), which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to prepare WMP during design phase* • *Contractor to implement WMP during construction*	• *CMC to approve WMP prior to construction.*
	Runoff and sedimentation from grading for access roads and tower pads, alteration of hydrological patterns due to maintenance roads.	*Designs will require hydrological and drainage impacts during construction to be minimized by early phasing of replacement of culverts and other infrastructure. These plans and designs will be included for in contracts.*	• *Contractor to include mitigation measures in designs.*	• *CMC to review and approve designs.* • *CMC to review works upon completion to assess suitability.*
	Impact to existing irrigation structures.	*During the design phase efforts shall be made to site facilities where they have the least impact to existing irrigation structures. Consultations shall be held between the local community to ensure that critical irrigation systems are identified and avoided.*	• *Contractor to consult with local community during the design phase regarding siting of facilities and camps.*	• *CMC to approve designs.*

Air Quality and Climate	*Construction vehicle and machinery emissions, including batching plants and staging areas.*	*During the design phase of the Project the prevailing wind direction should be considered to ensure that bunkers and conveyors at batching plants are sited in a leeward position to minimize the effects of the wind.*	• *Contractor to assess wind conditions during the design phase and site facilities accordingly.*	• *CMC to approved designs.*
Flora and fauna	*Impacts to Birds and bats*	*The Contractor shall consider the following elements during design:* • *Maintaining 1.5 meter (60-inch)11 spacing between energized components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware;* • *Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters.*	• *Contractor to assess requirements for avian protection during design.*	• *CMC to approve designs.*
Land use	*Land acquisition will be required, both temporary and permanent.*	*MEW or DABS shall be responsible for implementing a Land Acquisition and Resettlement Program (LARP) within the Project Corridor. The LARP shall be consistent with the requirements of WB OP4.12.*	• *MEW to engage consultants to prepare a LARP during the design phase.*	• *USAID MEO & COR, CMC, DABS / MEW to approve LARP prior to construction.* • *DABS to monitor implementation of the LARP and resolve any LARP related conflicts.*
Historical and Cultural Heritage	*Impacts to existing historical and cultural resources, notably around the city of Ghazni.*	*The Contractor shall ensure that during the design phase consultations are undertaken with MOIC to ensure that the routing of the transmission line does not impact upon historical and cultural resources in the Ghazni area. In addition.*	• *Contractor to consult with MOIC at the design phase.*	• *CMC to approve designs.*
		The Contractor shall also avoid siting any permanent and temporary facilities within 50 meters of Graveyards or Mosques.	• *Contractor shall ensure via his design, no impacts to these items*	• *CMC to approve designs.*

Socio-economics	*Community Health and safety may be affected during the construction period and also during any maintenance periods.*	*The Contractor shall include community health and safety aspects within the Health and Safety Plan (HSP). Contractor shall follow IFC guidelines for Community Health and Safety (see **Appendix F**)*	• *Contractor to prepare HSP during design phase* • *Contractor to implement HSP during the construction phase.* • *DABS to implement HSP during the operational phase.*	• *CMC to approve HSP prior to construction.* • *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Health effects and annoyance from electromagnetic radiation.	*The Contractor shall evaluate potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Average and peak exposure levels should remain below the ICNIRP recommendation for General Public Exposure.* *If EMF levels are confirmed or expected to be above the recommended exposure limits, application of engineering techniques by the Contractor according to the recommendations of the IFC[43] should be considered to reduce the EMF produced by power lines, substations, or transformers. Examples of these techniques include:* • *Shielding with specific metal alloys* • *Increasing height of transmission towers* • *Modifications to size, spacing, and configuration of conductors*	• *Contractor to evaluate EMF impacts during design.*	• *CMC to review and approve Contractors design.*
Health and Safety	*Occupational Health and Safety Impacts during construction, e.g. working from heights, electrocution, etc.*	*The Contractor shall prepare a Health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to prepare HSP during design phase* • *Contractor to implement HSP during the construction phase.*	• *CMC to approve HSP prior to construction.* • *Review of Monthly reports and daily general observational monitoring by the CMC.*
Noise and Vibration	*Operational impacts including Corona*	*Corona Discharge noise could become a nuisance if located close to residential areas. However, this issue*	• *Contractors to ensure designs include*	• *CMC to review and approve designs.*

[43] Environmental Health and Safety Guidlines, Electrical Power Transmission, IFC, 2007.

	discharge.	*can be reduced by increasing the spacing between the conductors, increasing the diameter of the conductor, using bundled conductors, or by using corona rings or grading rings.*	*equipment to reduce corona noise.*	
	It is possible that blasting and drilling activities will be required during the construction of the foundations for transmission line towers. This may impact upon sensitive receptors, depending on the location of the lines.	*The Contractor should prepare a Blast Plan prior to the commencement of works if blasting is required. The Plan, which shall be approved by the CMC, should ensure that:* – *Before the firing of any blast, the rock to be blasted shall be covered with approved blasting mats, soil, or other equally serviceable material, to prevent fly rock that may result in damage to life or property.* – *The Contractor shall protect all overhead and underground utilities prior to blasting and immediately repair or replace any damaged by the blasting operations.* – *Warning signs and public notification are required to avoid all risks to the public that use the roadway.* – *Blasting shall be restricted to the times specified by the Engineer* – *The Contractor shall use the utmost care so as not to endanger life or property, or disturb materials outside the limits of the excavation.* – *When blasting, ample warning shall be given to all persons within the vicinity prior to blasting. Warning signs shall be erected a minimum of 24 hours prior to the blast time, and workers shall be stationed to warn people before firing any blasts. The warning signs will state the time and date of each blast.*	• *Contractor to prepare Blast Plan during design phase* • *Contractor to implement Blast Plan during the construction phase.*	• *CMC to approve Blast Plan prior to construction.* • *Review of Monthly reports and daily general observational monitoring by the CMC.*

Project Component – High Voltage Transmission Lines (110 kv and 220 kv) – Construction Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Soils	*Potential soil erosion from grading for access roads and tower pads.*	*The Contractor shall ensure that the following measures are implemented:* • *Schedule work so clearing and grading are done during the time of minimum rainfall.* • *Clear only areas essential for construction.* • *Locate potential area pollutant sources away from steep slopes, water bodies, and other critical areas.* • *Route construction traffic to avoid existing works or newly planted vegetation.* • *Protect natural vegetation with fencing, tree armoring, and retaining walls or tree wells.* • *Stockpile topsoil and reapply to re-vegetate the site.* • *Cover and stabilize topsoil stockpiles.* • *Stockpiles should not be located within 20m of water courses.*	• *Contractor implementation during construction.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

	Spills / Leaks of hazardous liquids during construction.	*Spills and leaks of chemicals and oils could contaminate soils, which could in turn lead to contamination of groundwater. Contract provisions shall be included to ensure that:* • *All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 percent of the volume of tanks.* • *Any construction camp maintenance yard shall be constructed on impervious hardstanding with adequate drainage to collect spills, there shall be no vehicle maintenance activities on open ground.* • *Filling and refueling shall be strictly controlled and subject to formal procedures. Drip pans shall be placed under all filling and fueling areas. Waste oils shall be stored and disposed of by a licensed contractor.* • *All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.* • *The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any soils.* • *All construction camps, temporary and permanent shall be located at least 500 meters away from surface water courses.*	*Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
		If complaints are received relating to spill, or leaks of liquids affecting local water supplies, the incidents and possible sources of water supply disruption will be investigated by the Contractor and where the complaint can be substantiated; water samples will be taken and analyzed based on the baseline monitoring results obtained in the preconstruction stage. Samples will be taken as soon after the complaint as possible and analyses immediately and again two weeks after the complaint to determine if water quality has been restored. The criteria will be based on the national standard.	• *Contractor to investigate complaints, if any, during Construction.* • *Contractor to undertake sampling if required.*	• *CMC to ensure complaint is addressed adequately according to the Contractors Grievance mechanism.*

Topography	*The use of quarried materials will be required for construction purposes.*	*Only licensed quarries shall be used to source construction materials.*	• *Contractor to select appropriate quarries as and when required.*	• *CMC to approve locations prior to the use of the quarry.*
Hydrology	*Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.*	*The Contractor shall ensure:* • *Sedimentation facilities be set up at rivers where all working stations are within 100m of streams and rivers, to trap and settle out runoff from the works.* • *Where wet works have to be pumped dry the wastewater should first be passed through a proprietary sedimentation tank (or similar) to remove suspended particles before discharge at a location agreed with the Engineer.* • *Where works cross streams and rivers the preliminary designs for sedimentation facilities such as sediment traps, filter fabric fences, or straw bale barriers should be included as a line item before those new areas are cleared and opened up for construction works.*	• *Contractor to implement mitigation during Construction phase*	• *Review of Monthly reports and daily general observational monitoring by CMC.*
	Discharges of liquid waste from general construction works and construction camps.	*At the locations of general construction works or temporary construction camps portable lavatories or at least pit latrines will be installed and open defecation shall be discouraged and prevented by keeping lavatory facilities clean at all times.*	• *Contractor to provide facilities during construction.*	• *General observational monitoring by the CMC.*
	Dumping of construction site waste into surface watercourses.	*The Contractor shall be responsible for ensuring compliance with his Waste Management Plan.*	• *Contractor to implement WMP during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Requirements for construction related water including potable water for construction	*The Contractor shall ensure that water extraction permits have been obtained from the MoM prior to the drilling of any boreholes for ground water extraction.*	• *Contractor to obtain Permits prior to construction.* • *MoM to issue permits.*	• *CMC to review permit approvals before start of extraction.*
		If any water is to be taken from local wells, or surface waters, permissions must be sought from the local	• *Contractor shall consult with local*	• *CMC to approve extraction locations.*

	workers and camps. These requirements could deplete local resources if not adequately monitored and managed.	*community by the Contractor with oversight from the CMC.*	*community prior to any extraction.*	• *Contractor to monitor water availability if requested by local community or CMC.*
	Impact to existing irrigation structures.	*If the irrigation cannot be maintained Contractors will provide and maintain alternative temporary irrigation structures for the construction phase. At the completion of construction the contractor(s) will re provision the irrigation structures disturbed by construction and agree with the local community if redesign is required or if new structures will be constructed or if the original irrigation structures will be repaired.*	• *Contractor to prepare alternative / temporary irrigation during construction if required.* • *Contractor to re-instate irrigations systems or construct new systems on the completion of project works.*	• *CMC to review designs for temporary / alternative irrigation.* • *DABS to consult with local community at the end of construction to ensure all irrigation is returned to an acceptable standard.*
	Impacts to Kareze networks	*The Contractor shall ensure that, as far as practical, impacts to Kareze systems are avoided. This shall be achieved through sighting construction facilities at least 50 meters from such a system. This will require consultation with Mirabs regarding this issue.*	• *Contractor to consult with Mirabs* • *Contractor to prepare suitable design.*	• *CMC to review and approve designs and provide construction supervision.*
	Concrete batching - Potential pollutants in batching plant wastewater and stormwater include cement, sand, aggregates, chemical admixtures, fuels and lubricants.	*The Contractor shall ensure that the site should be designed and constructed such that clean stormwater, including roof runoff, is diverted to the stormwater discharge system. Process wastewater and contaminated stormwater collected from the entire site should be diverted to a settling pond, or series of ponds, such that the water can be reused in the concrete batching process.*	• *Contractor to design suitable drainage at the design phase.*	• *CMC to approve designs and monitor the completion of satisfactory works during construction of batching plants.*
		Any liquids stored on site, including admixtures, fuels and lubricants, should be stored in accordance with the Hazardous Materials Management Plan.	• *Contractor to prepare Hazmat Plan during design* • *Contractor to implement Hazmat Plan during construction*	• *CMC to approve Hazmat Plan prior to construction.* • *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Wood	*The methods for safe management of preservatives will be*		

	preservatives contaminating ground water and surface waters.	*included within the Contractors Hazardous Materials management Plan.*		
Air Quality and Climate	*Construction vehicle and machinery emissions, including batching plants and staging areas.*	*Specifically relating to concrete batching plants, the Contractor shall ensure that:* • *The use of wheel and truck wash facilities at site exits, and the introduction of vehicle speed limits.* • *Aggregate stored on site in stockpiles should be contained within three-sided storage bunkers with windshields that project 0.5 meter above the bunker wall.* • *Conveyors must be designed and constructed to prevent fugitive dust emissions. This may include covering the conveyor with a roof, installing side protection barriers and equipping the conveyor with spill trays, which direct material to a collection point.* • *Mixer loading areas should be roofed and enclosed on either two (drive-through) or three sides. Water sprays and a robust curtain of suitable design, or an effective air extraction and filtration system, should be installed to suppress dust generated during mixer truck loading.* • *Weigh bins and hoppers should be enclosed on three sides and roofed where a front-end loader is used. The roof should extend 2 meters in front of the bin.* • *An approved fabric filter incorporating a fabric-cleaning device should be installed on each cement storage silo. The quality of the filter media and the design characteristics of the filter system must be capable of ensuring that the maximum concentration of solid particles in residual gases does not exceed 100 mg/m3* • *To prevent overfill and subsequent filter damage, storage silos should be fitted with high-level audible and visual alarms in addition to an automatic delivery shut-down.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
		Relating to general construction activities, the Contractor	• *Contractor*	• *Review of Monthly*

		shall be responsible for ensuring that: • *If the working surfaces become dry and dusty (roads, staging areas, stockpiles, etc), water will be sprinkled on the and exposed surfaces when work is carried out within 50m of sensitive receptors* • *No work will be carried out during the night (2100hrs to 0700hrs).* • *If works give rise to complaints over dust, the contractor shall investigate the cause and review and propose alternative mitigation measures before works recommence.* • *All heavy equipment and machinery will be fitted in full compliance with the national and local regulations.* • *Fuel-efficient and well-maintained haulage trucks will be employed to minimize exhaust emissions. Smoke belching vehicles and equipment will not be allowed and will be removed from the project.* • *Vehicles transporting soil, sand and other construction materials will be covered with tarpaulin sheets to avoid impact from dust. Speeds limits will be established for vehicles within the works sites and on unpaved edge areas of the project*	*implementation during construction*	*reports and daily general observational monitoring by the CMC*
	Impacts to air quality from open burning.	*The Contractor shall ensure:* • *Cutting and burning trees/shrubs for fuel shall be prohibited. Instead Gas Cylinders should be used in the labor camp for cooking purposes.* • *No open burning shall be allowed.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Flora and fauna	*Clearing of natural vegetation will be required for construction purposes (access road, tower sites, pulling and tensioning areas, and concrete batch plants/laydown areas), clearances for electrical safety, long-term maintenance, and reliability of the transmission line.*	*It will be the Contractor's obligation not to cause any additional destruction to Flora and Fauna of the area by respecting the limits of construction site and not to enter other territories.* *The Contractor shall also ensure that:* • *Within the rights-of-way, mature vegetation will be selectively removed under or near the conductors to provide adequate electrical clearance.* • *No unauthorized tree or bush cutting shall be allowed.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Waste Management and, Hazardous Materials	*General solid waste management – Improper disposal of inert waste, such and general construction waste and domestic waste (foodstuff).*	*The Contractor shall be responsible for the preparation of a Waste Management Plan that will contain provisions for the management of inert waste and its disposal to suitable, licensed locations. The Plan shall ensure that all waste is disposed of at a licensed facility, where this may not be practical, the Contractor, with approval from the CMC and the relevant authorities, shall be responsible for operating his own landfill for inert waste only.*	• *Contractor to implement WMP during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Spoil Material - There may be some surplus rock and soil based materials. The waste management	*The Contractor shall ensure that:* • *Spoil will not be disposed of in rivers and streams or other natural drainage path.* • *Spoil will not be disposed of on fragile slopes, flood ways, wetland, farmland, forest, religious or other culturally sensitive areas or areas where a livelihood is*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

	plan (WMP) will be required to ensure waste from construction is managed properly and to reduce, reuse and recycle waste wherever possible	*derived.* • *Use surplus spoil for local repair works to fill eroded gullies and depression areas and degraded land in consultation with local community.*		
	Poor management of hazardous waste can have significant impacts to water resources, soils, air quality and the health and safety of workers and the local community.	*The Contractor shall prepare a Hazmat Plan.*	• *Contractor to implement Hazmat Plan during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC Environmentalist.*
	Clean up of construction camps	*At the conclusion of the project, the Contractor shall ensure all debris and waste shall be removed from construction camps, staging areas, etc. All temporary structures, including office buildings, shelters and toilets shall be removed by the contractor and exposed areas shall be planted with suitable vegetation, to the satisfaction of the Engineer.*	• *Contractor to provide site clear up at the end of construction, or at specific sectors as the works finish, e.g. staging areas, temporary construction camps, etc.*	• *CMC to approve site conditions.*

Infrastructure	*Traffic Delays caused by construction vehicle movements and potential blasting.*	*The Contractor shall be responsible for the preparation of a traffic control measures to limit impacts to traffic movements, locally and on the A1. These measures shall be included within the Health and safety Plan. They shall include measures to:* • *Minimize effects on pedestrian movements and amenity;* • *Manage and control vehicular movements to and from the site;* • *Maintain traffic capacity at intersections and in the vicinity of the site;* • *Maintain existing on-street parking in the vicinity of the site where practical;* • *Maintain access to other properties adjacent to the site;* • *Restrict vehicle activity to designated truck routes through the area;* • *Maintain safety for workers;* • *Provide appropriate access to the site for demolition, excavation and construction traffic;* • *Manage and control vehicle activity in the vicinity of the site.*	• *Contractor to implement HSP during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC,*
Historical and Cultural Heritage	*Chance finds of historical and cultural artifacts may be possible.*	*In the event of unanticipated discoveries of cultural or historic artifacts (movable or immovable) in the course of the work, the Contractor shall take all necessary measures to protect the findings and shall notify the CMC and provincial-level representatives of the relevant department within MOIC If continuation of the work would endanger the finding, project work shall be suspended until a solution for preservation of the artifacts is agreed upon.*	• *Contractor to notify the CMC and MOIC in the event of a chance find.*	*N/A*
Socio-economics	*Community Health and safety may be affected during the construction period and also during any maintenance periods.*	*The Contractor shall include community health and safety aspects within the HSP. Contractor shall follow IFC guidelines for Community Health and Safety (see* ***Appendix F****)*	• *Contractor to implement HSP during the construction phase.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

	Security	*The Contractor shall be responsible for providing security to workers during construction periods. This shall be implemented through a Security Plan.*	• *Contractor to prepare a security plan.*	*N/A*
Health and Safety	*Occupational Health and Safety Impacts during construction, e.g. working from heights, electrocution, etc.*	• *The Contractor shall prepare a Health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to implement HSP during the construction phase.*	• *Review of Monthly* • *reports and daily general observational monitoring by the CMC.*
Noise and Vibration	*It is possible that blasting and drilling activities will be required during the construction of the foundations for transmission line towers. This may impact upon sensitive receptors, depending on the location of the lines.*	*The Contractor should prepare a Blast Plan prior to the commencement of works if blasting is required. The Plan, which shall be approved by the CMC, should ensure that:* – *Before the firing of any blast, the rock to be blasted shall be covered with approved blasting mats, soil, or other equally serviceable material, to prevent fly rock that may result in damage to life or property.* – *The Contractor shall protect all overhead and underground utilities prior to blasting and immediately repair or replace any damaged by the blasting operations.* – *Warning signs and public notification are required to avoid all risks to the public that use the roadway.* – *Blasting shall be restricted to the times specified by the Engineer* – *The Contractor shall use the utmost care so as not to endanger life or property, or disturb materials outside the limits of the excavation.* – *When blasting, ample warning shall be given to all persons within the vicinity prior to blasting. Warning signs shall be erected a minimum of 24 hours prior to the blast time, and workers shall be stationed to warn people before firing any blasts. The warning signs will state the time and date of each blast.*	• *Contractor to implement Blast Plan during the construction phase.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
		• *The Contractor shall be responsible for all damage to properties, including providing suitable temporary*	• *Contractor to compensate*	• *DABS to ensure adequate compensation*

		housing to residents or business occupants until repair work is completed.	*residents/businesses in the event of damage.* •	*is paid by the Contractor and disputes are resolved.*
	Noise from construction machinery and general construction activities	*Cooperation between the Contractor and the local residents is essential and it is the responsibility of DABS to arrange meetings between these parties and arrange such matters as work schedules (hours of equipment operation, traffic lanes to be kept open, diversion roads, etc.), locations of work camps and material storage areas, and siting of rock crushers and batch plants. In addition, the Contractor shall be responsible for ensuring the use of:* • *Source Controls, i.e., requirements that all exhaust systems will be maintained in good working order; properly designed engine enclosures and intake silencers will be employed; and regular equipment maintenance will be undertaken;* • *Site Controls, i.e., requirements that stationary equipment will be placed as far from sensitive land uses as practical; selected to minimize objectionable noise impacts; and provided with shielding mechanisms where possible;* • *Work near Sensitive Receptors shall be limited to short term activities. No asphalt plants, rock crushing plants or any long term generators of significant noise shall be allowed within 300 meters of sensitive receptors;* • *Time and Activity Constraints, i.e., operations will be scheduled to coincide with periods when people would least likely be affected; work hours and work days will be limited to less noise-sensitive times. Hours-of-work will be approved by the site engineer having due regard for possible noise disturbance to the local residents or other activities. Construction activities will be strictly prohibited between 10 PM and 6 AM in the residential areas. When operating close to sensitive areas such as residential, nursery, or medical facilities, the Sub-Contractor's hours of working shall be limited to 8 AM to 6 PM;* • *Community Awareness, i.e., public notification of*	• *Contractor to consult with local community prior to the commencement of works in residential areas.* • *DABS to coordinate meetings.* • *Contractor to implement construction phase mitigation.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

		construction operations will incorporate noise considerations; methods to handle complaints will be specified. Sensitive receptors will be avoided as possible (i.e., aggregate crushers, operators, etc.). • *Disposal sites and haul routes will be coordinated with the Engineer.*		

Project Component – High Voltage Transmission Lines (110 kv and 220 kv) – Operational Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Socio-economics	*Load Shedding has the potential to cause social unrest if not managed correctly.*	*The issue of load shedding should be bought to the attention of the public prior to the start of the operational phase. Using the proposed media campaign to highlight the issue will help the local community understand why it is needed and thus ease any potential social unrest in the future when load shedding is needed.*	• *DABS to consult with local community via media campaign.*	*N/A*

Project Component - Construction of New Substations (110 kv and 220 kv) – Design Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Geology and Seismicity	*The Project Corridor is located in a seismically active region.*	*Seismic loading shall be applied to the substation designs.*	• *Contractor to include seismic loading during design.* • *CMC to approve designs.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Hydrology	*Discharges of liquid waste from general construction works and construction camps.*	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP) which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to prepare WMP during design phase*	• *CMC to approve WMP prior to construction.*
Air Quality and Climate	*Construction vehicle and*	*During the design phase of the Project the prevailing wind direction should be considered to ensure that bunkers and*	• *Contractor to assess wind conditions during*	• *CMC to approve designs.*

	machinery emissions and dust	*conveyors at batching plants are sited in a leeward position to minimize the effects of the wind.*	*the design phase and site facilities accordingly.*	
		The Contractor shall ensure switchgear equipment should have a nominal leakage and replacement rate of less than 1% per year.	• *Contractor to prepare suitable designs.*	• *CMC to approve designs.*
Waste Management and Hazardous Materials	*Hazardous waste management and disposal.*	*The Contractor shall be responsible for the preparation of a HazMat Plan.*	• *Contractor to prepare HazMat during design*	• *CMC to approve HazMat prior to construction.*
Land use	*Land acquisition will be required, both temporary and permanent.*	*MEW or DABS shall be responsible for implementing a Land Acquisition and Resettlement Program (LARP) within the Project Corridor. The LARP shall be consistent with the requirements of WB OP4.12.*	• *MEW or DABS to engage consultants to prepare a LARP during the design phase.*	• *USAID MEO & COR CMC, DABS / MEW to approve LARP prior to construction.* • *DABS to monitor implementation of the LARP and resolve any LARP related conflicts.*
Infrastructure	*Interference with other infrastructure, water supply, etc.*	*During the design phase the Contractor shall coordinate with Utilities in the work area to ensure that all construction sites, transmissions towers, staging areas, etc, do not impact upon existing infrastructure.*	• *Contractor to consult with Utilities during the design phase.*	• *CMC to approve designs.*
Health and Safety	*Occupational Health and Safety Impacts during construction.*	*The Contractor shall prepare a health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to prepare HSP during design phase*	• *CMC to approve HSP Plan prior to construction.*
Noise and Vibration	*Transformer noise, or 'hum'.*	*It is possible that transformers may give off a low audible hum. This is unlikely to have significant impacts to the local community, but siting of the substations more than 100 meters from residential properties should make this potential issue moot.*	• *Contractor to site substations more that 100 meters from residential areas.*	• *CMC to approve designs.*
	Corona discharge	*Corona Discharge noise could become a nuisance if located close to residential areas. However, this issue can be reduced by increasing the spacing between the*	• *Contractors to ensure designs include equipment to reduce*	• *CMC to review and approve designs.*

		conductors, increasing the diameter of the conductor, using bundled conductors, or by using corona rings or grading rings.	*corona noise.*	

Project Component - Construction of New Substations (110 kv and 220 kv) – Construction Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Soils			•	•
	Potential soil erosion from grading for substation facilities.	*The Contractor shall ensure the following:* • *Schedule work so clearing and grading are done during the time of minimum rainfall.* • *Clear only areas essential for construction.* • *Locate potential area pollutant sources away from steep slopes, water bodies, and other critical areas.* • *Route construction traffic to avoid existing works or newly planted vegetation.* • *Protect natural vegetation with fencing, tree armoring, and retaining walls or tree wells.* • *Stockpile topsoil and reapply to re-vegetate the site.* • *Cover and stabilize topsoil stockpiles.* • *Stockpiles should not be located within 20m of water courses.*	• *Contractor implementation during construction.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Topography	*The use of quarried materials will be required for construction purposes.*	*Contract provisions specified in the EMMP shall ensure that only licensed quarries shall be used to source construction materials.*	• *Contractor to select appropriate quarries as and when required.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Hydrology	*Spills of fuels and lubricants used during construction works.*	*Contract provisions shall be included to ensure that:* • *All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 percent of the volume of tanks.* • *Any construction camp maintenance yard shall be constructed on impervious hardstanding with adequate drainage to collect spills; there shall be no vehicle maintenance activities on open ground.* • *Filling and refueling shall be strictly controlled and subject to formal procedures. Drip pans shall be placed under all filling and fueling areas. Waste oils shall be stored and disposed of by a licensed contractor.* • *All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.* • *The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any soils.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Discharges of liquid waste from general construction works and construction camps.	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP) which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to implement WMP during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Air Quality and Climate	*Construction vehicle and machinery emissions and dust*	*Specifically relating to concrete batching plants, the Contractor shall ensure that:* • *The use of wheel and truck wash facilities at site exits, and the introduction of vehicle speed limits.* • *Aggregate stored on site in stockpiles should be contained within three-sided storage bunkers with windshields that project 0.5 meter above the bunker wall.* • *Conveyors must be designed and constructed to prevent fugitive dust emissions. This may include covering the conveyor with a roof, installing side protection barriers and equipping the conveyor with spill trays, which direct material to a collection point.* • *Mixer loading areas should be roofed and enclosed on either two (drive-through) or three sides. Water sprays and a robust curtain of suitable design, or an effective air extraction and filtration system, should be installed to suppress dust generated during mixer truck loading.* • *Weigh bins and hoppers should be enclosed on three sides and roofed where a front-end loader is used. The roof should extend 2 meters in front of the bin.* • *An approved fabric filter incorporating a fabric-cleaning device should be installed on each cement storage silo. The quality of the filter media and the design characteristics of the filter system must be capable of ensuring that the maximum concentration of solid particles in residual gases does not exceed 100 mg/m3* • *To prevent overfill and subsequent filter damage, storage silos should be fitted with high-level audible and visual alarms in addition to an automatic delivery shut-down.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC*

		Relating to general construction activities, the Contractor shall be responsible for ensuring that: • *If the working surfaces become dry and dusty (roads, staging areas, stockpiles, etc), water will be sprinkled on the and exposed surfaces when work is carried out within 50m of sensitive receptors* • *No work will be carried out during the night (2100hrs to 0700hrs).* • *If works give rise to complaints over dust, the contractor shall investigate the cause and review and propose alternative mitigation measures before works recommence.* • *All heavy equipment and machinery will be fitted in full compliance with the national and local regulations.* • *Fuel-efficient and well-maintained haulage trucks will be employed to minimize exhaust emissions. Smoke belching vehicles and equipment will not be allowed and will be removed from the project.* • *Vehicles transporting soil, sand and other construction materials will be covered with tarpaulin sheets to avoid impact from dust. Speeds limits will be established for vehicles within the works sites and on unpaved edge areas of the project*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC*
Flora and fauna	*Clearing of natural vegetation will be required for construction purposes*	*It will be the Contractor's obligation not to cause any additional destruction to Flora and Fauna of the area by respecting the limits of construction site and not to enter other territories.* *The Contractor shall also ensure that:* • *Within the rights-of-way, mature vegetation will be selectively removed under or near the conductors to provide adequate electrical clearance.* • *No unauthorized tree or bush cutting shall be allowed.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Waste Management and Hazardous Materials	*General waste management.*	*The Contractor shall be responsible for the preparation of a Waste Management Plan that will contain provisions for the management of inert waste and its disposal to suitable, licensed locations. The Plan shall ensure that all waste is disposed of at a licensed facility, where this may not be practical, the Contractor, with approval from the CMC and*	• *Contractor to implement WMP during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC*

		the relevant authorities, shall be responsible for operating his own landfill for inert waste only.		
	Hazardous waste management and disposal.	*The Contractor shall be responsible for the preparation of a HazMat Plan.*	• *Contractor to implement HazMat during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Historical and Cultural Heritage	*Chance finds of historical and cultural artifacts may be possible.*	*In the event of unanticipated discoveries of cultural or historic artifacts (movable or immovable) in the course of the work, the Contractor shall take all necessary measures to protect the findings and shall notify the CMC and provincial-level representatives of the relevant department within MOIC If continuation of the work would endanger the finding, project work shall be suspended until a solution for preservation of the artifacts is agreed upon.*	• *Contractor to notify the CMC and MOIC in the event of a chance find.*	*N/A*
Health and Safety	*Occupational Health and Safety Impacts during construction.*	*The Contractor shall prepare a health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to implement HSP Plan during the construction phase.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Project Component - Construction of New Substations (110 kv and 220 kv) – Operational Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Soils	*Spills of oils during operational phase*	*In order to comply with best international practice to prevent contamination of soil, groundwater and surface water all the new substations will be designed to include dedicated surface drainage and secondary containment to control residual oil spills from installation, maintenance or decommissioning. The secondary containment (bunding) will seal the surface with concrete and shall be of sufficient capacity to hold 10% of the contents of the bunded equipment in the event of a catastrophic failure with loss of all transformer oil.*	• *Contractor to design substations with suitable drainage and containment measures.*	• *CMC to approve designs and sign off construction works.*

Project Component – Upgrading of Darunta Dam and Tarakhil Power Plant – Design Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Geology and Seismicity	*Darunta Dam is located in a seismically active region.*	*Seismic conditions shall be considered during any rehabilitation works.*	• *CMC to ensure all rehabilitation works include seismic loading if necessary.*	• *None.*
Health and Safety	*Occupational Health and Safety Impacts during construction.*	*The Contractor shall prepare a health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to prepare HSP during design phase*	• *CMC to approve HSP Plan prior to construction.*

Project Component – Upgrading of Darunta Dam and Tarakhil Power Plant – Construction Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Hydrology	*Spills of fuels and lubricants used during rehabilitation works.*	*The Contractor shall ensure that all fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 percent of the volume of tanks.*	• *Contractor implementation during rehabilitation works.*	• *Daily general observational monitoring by the CMC.*
	Discharges of liquid waste from general construction works.	*The contractor shall be responsible for ensuring that all waste is disposed of at approved locations and that under no circumstances is waste discharged to surface water courses. Hazardous waste shall be collected and transported from the site by a licensed operator.*	• *Contractor to dispose of waste.*	• *Daily general observational monitoring by the CMC.* • *Monthly testing of water quality by DABs downstream of Darunta Dam (Parameters include DO, BOD, Temeprature, pH, Turbidity, Nitrates, Oil and Grease, Total Solids, Conductivity, Fecal Coliforms)*
	Impacts to downstream water users and ecology from alterations in discharge	*DABS shall ensure discharge is not interrupted or altered significantly during rehabilitation works.*	• *DABS to ensure regular discharge of waters.*	• *Daily general observational monitoring by the CMC.*

Air Quality and Climate	*Construction vehicle and machinery emissions and dust*	*The Contractor shall be responsible for ensuring that:* • *If the working surfaces become dry and dusty (roads, staging areas, stockpiles, etc), water will be sprinkled on the and exposed surfaces when work is carried out within 50m of sensitive receptors* • *If works give rise to complaints over dust, the contractor shall investigate the cause and review and propose alternative mitigation measures before works recommence.* • *Vehicles transporting soil, sand and other construction materials will be covered with tarpaulin sheets to avoid impact from dust. Speeds limits will be established for vehicles within the works sites and on unpaved edge areas of the project.*	• *Contractor implementation during construction*	• *Daily general observational monitoring by the CMC*
Waste Management and Hazardous Materials	*General waste management.*	*The contractor shall be responsible for ensuring that all waste is disposed of at approved locations and that under no circumstances is waste discharged to surface water courses. Hazardous waste shall be collected and transported from the site by a licensed operator.*	• *Contractor to dispose of waste.*	• *Daily general observational monitoring by the CMC.*
Health and Safety	*Occupational Health and Safety Impacts during construction.*	*The Contractor shall prepare a health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to implement HSP Plan during the construction phase.*	• *Daily general observational monitoring by the CMC.*

Project Component – Construction and Upgrading of Low/Medium Voltage Transmission Lines – Design Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Geology and Seismicity	*The Project Corridor is located in a seismically active region.*	*Seismic loading shall be applied to the transmission tower designs.*	• *Contractor to include seismic loading during design.* • *CMC to approve Contractors designs.*	• *CMC regular inspections of construction works.*

Hydrology	*Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.*	*To mitigate this potential impact it is recommended that designs ensure:* • *Transmission line towers be located at least 50 meters from the river.*	• *Contractor to ensure appropriate locations of towers.*	• *CMS to approve designs.*
	Discharges of liquid waste from general construction works and construction camps.	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP) which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to prepare WMP during design phase*	• *CMC to approve WMP prior to construction.*
	Dumping of construction site waste into surface watercourses.	*The Contractor shall be responsible for ensuring compliance with his Waste Management Plan.*	• *Contractor to prepare WMP during design*	• *Review and approval of the WMP by CMC.*
	Impact to existing irrigation structures.	*During the design phase efforts shall be made to site facilities where they have the least impact to existing irrigation structures. Consultations shall be held between the local community to ensure that critical irrigation systems are identified and avoided.*	• *Contractor to consult with local community during the design phase regarding siting of facilities and camps.*	• *CMC to approve designs.*
	Wood preservatives contaminating ground water and surface waters.	*The methods for safe management of preservatives will be included within the Contractors Hazardous Materials management Plan.*	• *Contractor to prepare Hazmat Plan during design*	• *Review and approval of Plan by CMC.*
	Impacts to Kareze networks	*The Contractor shall ensure that, as far as practical, impacts to Kareze systems are avoided. This shall be achieved through sighting construction facilities at least 50 meters from such a system. This will require consultation with Mirabs regarding this issue.*	• *Contractor to consult with Mirabs* • *Contractor to prepare suitable design.*	• *CMC to review and approve designs and provide construction supervision.*
Waste	*General solid*	*The Contractor shall be responsible for the preparation of a*	• *Contractor to prepare*	• *Review and approval of*

Management and, Hazardous Materials	*waste management – Improper disposal of inert waste, such and general construction waste and domestic waste (foodstuff).*	*Waste Management Plan that will contain provisions for the management of inert waste and its disposal to suitable, licensed locations. The Plan shall ensure that all waste is disposed of at a licensed facility, where this may not be practical, the Contractor, with approval from the CMC and the relevant authorities, shall be responsible for operating his own landfill for inert waste only.*	*WMP during design*	*Plan by CMC..*
	Poor management of hazardous waste.	*The Contractor shall prepare a Hazmat Plan.*	• *Contractor to prepare Hazmat Plan during design*	• *CMC to approve Hazmat Plan prior to construction.*
Land use	*Land acquisition will be required, both temporary and permanent.*	*MEW or DABS shall be responsible for implementing a Land Acquisition and Resettlement Program (LARP) within the Project Corridor. The LARP shall be consistent with the requirements of WB OP4.12.*	• *MEW to engage consultants to prepare a LARP during the design phase.*	• *USAID MEO & COR CMC, DABS / MEW to approve LARP prior to construction.* • *DABS to monitor implementation of the LARP and resolve any LARP related conflicts.*
Infrastructure	*Interference with other infrastructure, water supply, etc.*	*During the design phase the Contractor shall coordinate with Utilities in the work area to ensure that all construction sites, transmissions towers, staging areas, etc, do not impact upon existing infrastructure.*	• *Contractor to consult with Utilities during the design phase.*	• *CMC to approve designs.*
Historical and Cultural Heritage	*Impacts to existing historical and cultural resources.*	*The Contractor shall also avoid siting any permanent and temporary facilities within 50 meters of Graveyards or Mosques.*	• *Contractor shall ensure via his design, no impacts to these items*	• *CMC to approve designs.*
Socio-economics	*Security*	*The Contractor shall be responsible for providing security to workers during construction periods. This shall be implemented through a Security Plan.*	• *Contractor to prepare a security plan.*	*N/A*
Health and	*Occupational*	*The Contractor shall prepare a Health and safety plan for all*	• *Contractor to prepare*	• *CMC to approve HSP*

Safety	*Health and Safety Impacts during construction, e.g. working from heights, electrocution, etc.*	*construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	*HSP during design phase*	*prior to construction.*

Project Component – Construction and Upgrading of Low/Medium Voltage Transmission Lines – Construction Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Soils	*Potential soil erosion from grading for access roads and tower pads.*	*The Contractor shall ensure that the following measures are implemented:* • *Schedule work so clearing and grading are done during the time of minimum rainfall.* • *Clear only areas essential for construction.* • *Locate potential area pollutant sources away from steep slopes, water bodies, and other critical areas.* • *Route construction traffic to avoid existing works or newly planted vegetation.* • *Protect natural vegetation with fencing, tree armoring, and retaining walls or tree wells.* • *Stockpile topsoil and reapply to re-vegetate the site.* • *Cover and stabilize topsoil stockpiles.* • *Stockpiles should not be located within 20m of water courses.*	• *Contractor implementation during construction.*	• *General observational monitoring by the CMC.*

	Spills / Leaks of hazardous liquids during construction.	*Spills and leaks of chemicals and oils could contaminate soils, which could in turn lead to contamination of groundwater. Contract provisions shall be included to ensure that:* • *All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 percent of the volume of tanks.* • *Any construction camp maintenance yard shall be constructed on impervious hardstanding with adequate drainage to collect spills; there shall be no vehicle maintenance activities on open ground.* • *Filling and refueling shall be strictly controlled and subject to formal procedures. Drip pans shall be placed under all filling and fueling areas. Waste oils shall be stored and disposed of by a licensed contractor.* • *All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.* • *The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any soils.* • *All construction camps, temporary and permanent shall be located at least 500 meters away from surface water courses.*	*Contractor implementation during construction*	• *General observational monitoring by the CMC.*
		If complaints are received relating to spill, or leaks of liquids affecting local water supplies, the incidents and possible sources of water supply disruption will be investigated by the Contractor and where the complaint can be substantiated; water samples will be taken and analyzed based on the baseline monitoring results obtained in the preconstruction stage. Samples will be taken as soon after the complaint as possible and analyses immediately and again two weeks after the complaint to determine if water quality has been restored. The criteria will be based on the national standard.	• *Contractor to investigate complaints, if any, during Construction.* • *Contractor to undertake sampling if required.*	• *CMC to ensure complaint is addressed adequately.*

Hydrology	*Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.*	*To mitigate this potential impact it is recommended that designs ensure:* • *Transmission line towers be located at least 50 meters from the river.* *In addition, the Contractor shall ensure:* • *Sedimentation facilities are set up at rivers where all working stations are within 100m of streams and rivers, to trap and settle out runoff from the works.* • *Where wet works have to be pumped dry the wastewater should first be passed through a proprietary sedimentation tank (or similar) to remove suspended particles before discharge at a location agreed with the Engineer.* • *Where works cross streams and rivers the preliminary designs for sedimentation facilities such as sediment traps, filter fabric fences, or straw bale barriers should be included as a line item before those new areas are cleared and opened up for construction works.*	• *Contractor to ensure appropriate locations of towers.* • *Contractor to implement mitigation during Construction phase*	• *General observational monitoring by the CMC.*
	Discharges of liquid waste from general construction works and construction camps.	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP) which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to implement WMP during construction*	• *General observational monitoring by the CMC.*
		At the locations of general construction works or temporary construction camps portable lavatories or at least pit latrines will be installed and open defecation shall be discouraged and prevented by keeping lavatory facilities clean at all times.	• *Contractor to provide facilities during construction.*	• *General observational monitoring by the CMC.*
	Dumping of construction site waste into surface watercourses.	*The Contractor shall be responsible for ensuring compliance with his Waste Management Plan.*	• *Contractor to implement WMP during construction*	• *General observational monitoring by the CMC.*

	Requirements for construction related water including potable water for construction workers and camps.	*If any water is to be taken from local wells, or surface waters, permissions must be sought from the local community by the Contractor with oversight from the CMC.*	• *Contractor shall consult with local community prior to any extraction.*	• *CMC to approve extraction locations.* • *Contractor to monitor water availability if requested by local community or CMC.*
	Impact to existing irrigation structures.	*If the irrigation cannot be maintained Contractors will provide and maintain alternative temporary irrigation structures for the construction phase. At the completion of construction the contractor(s) will re provision the irrigation structures disturbed by construction and agree with the local community if redesign is required or if new structures will be constructed or if the original irrigation structures will be repaired.*	• *Contractor to prepare alternative / temporary irrigation during construction if required.* • *Contractor to re-instate irrigations systems or construct new systems on the completion of project works.*	• *CMC to review designs for temporary / alternative irrigation.* • *DABS to consult with local community at the end of construction to ensure all irrigation is returned to an acceptable standard.*
	Wood preservatives contaminating ground water and surface waters.	*The methods for safe management of preservatives will be included within the Contractors Hazardous Materials management Plan.*	• *Contractor to implement Hazmat Plan during construction*	• *General observational monitoring by the CMC.*

Air Quality and Climate	*Construction vehicle and machinery emissions, including batching plants and staging areas.*	*Relating to general construction activities, the Contractor shall be responsible for ensuring that:* • *If the working surfaces become dry and dusty (roads, staging areas, stockpiles, etc), water will be sprinkled on the and exposed surfaces when work is carried out within 50m of sensitive receptors* • *No work will be carried out during the night (2100hrs to 0700hrs).* • *If works give rise to complaints over dust, the contractor shall investigate the cause and review and propose alternative mitigation measures before works recommence.* • *All heavy equipment and machinery will be fitted in full compliance with the national and local regulations.* • *Fuel-efficient and well-maintained haulage trucks will be employed to minimize exhaust emissions. Smoke belching vehicles and equipment will not be allowed and will be removed from the project.* • *Vehicles transporting soil, sand and other construction materials will be covered with tarpaulin sheets to avoid impact from dust. Speeds limits will be established for vehicles within the works sites and on unpaved edge areas of the project*	• *Contractor implementation during construction*	• *General observational monitoring by the CMC.*
	Impacts to air quality from open burning.	*The Contractor shall ensure:* • *Cutting and burning trees/shrubs for fuel shall be prohibited. Instead Gas Cylinders should be used in the labor camp for cooking purposes.* • *No open burning shall be allowed.*	• *Contractor implementation during construction*	• *General observational monitoring by the CMC.*
Flora and fauna	*Clearing of natural vegetation.*	*It will be the Contractor's obligation not to cause any additional destruction to Flora and Fauna of the area by respecting the limits of construction site and not to enter other territories.* *The Contractor shall also ensure that:* • *Within the rights-of-way, mature vegetation will be selectively removed under or near the conductors to provide adequate electrical clearance.* • *No unauthorized tree or bush cutting shall be allowed.*	• *Contractor implementation during construction*	• *General observational monitoring by the CMC.*
Waste	*General solid*	*The Contractor shall be responsible for the preparation of a*	• *Contractor to*	• *General observational*

Management and, Hazardous Materials	*waste management – Improper disposal of inert waste, such and general construction waste and domestic waste (foodstuff).*	*Waste Management Plan that will contain provisions for the management of inert waste and its disposal to suitable, licensed locations. The Plan shall ensure that all waste is disposed of at a licensed facility, where this may not be practical, the Contractor, with approval from the CMC and the relevant authorities, shall be responsible for operating his own landfill for inert waste only.*	*implement WMP during construction*	*monitoring by the CMC.*
	Spoil Material.	*The Contractor shall ensure that:* • *Spoil will not be disposed of in rivers and streams or other natural drainage path.* • *Spoil will not be disposed of on fragile slopes, flood ways, wetland, farmland, forest, religious or other culturally sensitive areas or areas where a livelihood is derived.* • *Use surplus spoil for local repair works to fill eroded gullies and depression areas and degraded land in consultation with local community.*	• *Contractor implementation during construction*	• *General observational monitoring by the CMC.*
	Poor management of hazardous waste.	*The Contractor shall prepare a Hazmat Plan.*	• *Contractor to implement Hazmat Plan during construction*	• *General observational monitoring by the CMC.*
	Clean up of construction camps	*At the conclusion of the project, the Contractor shall ensure all debris and waste shall be removed from construction camps, staging areas, etc. All temporary structures, including office buildings, shelters and toilets shall be removed by the contractor and exposed areas shall be planted with suitable vegetation, to the satisfaction of the Engineer.*	• *Contractor to provide site clear up at the end of construction, or at specific sectors as the works finish, e.g. staging areas, temporary construction camps, etc.*	• *CMC to approve site conditions.*

Historical and Cultural Heritage	*Chance finds of historical and cultural artifacts may be possible.*	*In the event of unanticipated discoveries of cultural or historic artifacts (movable or immovable) in the course of the work, the Contractor shall take all necessary measures to protect the findings and shall notify the CMC and provincial-level representatives of the relevant department within MOIC If continuation of the work would endanger the finding, project work shall be suspended until a solution for preservation of the artifacts is agreed upon.*	• *Contractor to notify the CMC and MOIC in the event of a chance find.*	*N/A*
Socio-economics	*Security*	*The Contractor shall be responsible for providing security to workers during construction periods. This shall be implemented through a Security Plan.*	• *Contractor to prepare a security plan.*	*N/A*
Health and Safety	*Occupational Health and Safety Impacts during construction, e.g. working from heights, electrocution, etc.*	*The Contractor shall prepare a Health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to implement HSP during the construction phase.*	• *General observational monitoring by the CMC.*
Noise and Vibration	*Noise from construction machinery and general construction activities*	*Cooperation between the Contractor and the local residents is essential and it is the responsibility of DABS to arrange meetings between these parties and arrange such matters as work schedules (hours of equipment operation, traffic lanes to be kept open, diversion roads, etc.), locations of work camps and material storage areas, and siting of rock crushers and batch plants. In addition, the Contractor shall be responsible for ensuring the use of:* • *Source Controls, i.e., requirements that all exhaust systems will be maintained in good working order; properly designed engine enclosures and intake silencers will be employed; and regular equipment maintenance will be undertaken;* • *Site Controls, i.e., requirements that stationary equipment will be placed as far from sensitive land uses as practical; selected to minimize objectionable noise impacts; and provided with shielding mechanisms where possible;*	• *Contractor to consult with local community prior to the commencement of works in residential areas.* • *DABS to coordinate meetings.* • *Contractor to implement construction phase mitigation.*	• *General observational monitoring by the CMC.*

		• *Work near Sensitive Receptors shall be limited to short term activities. No asphalt plants, rock crushing plants or any long term generators of significant noise shall be allowed within 300 meters of sensitive receptors;* • *Time and Activity Constraints, i.e., operations will be scheduled to coincide with periods when people would least likely be affected; work hours and work days will be limited to less noise-sensitive times. Hours-of-work will be approved by the site engineer having due regard for possible noise disturbance to the local residents or other activities. Construction activities will be strictly prohibited between 10 PM and 6 AM in the residential areas. When operating close to sensitive areas such as residential, nursery, or medical facilities, the Sub-Contractor's hours of working shall be limited to 8 AM to 6 PM;* • *Community Awareness, i.e., public notification of construction operations will incorporate noise considerations; methods to handle complaints will be specified. Sensitive receptors will be avoided as possible (i.e., aggregate crushers, operators, etc.).* • *Disposal sites and haul routes will be coordinated with the Engineer.*		

Project Component – Construction Management Services & Technical Assistance to DABS and MEW				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Procurement of goods (vehicles, furniture, computers, etc).	*Poor procurement practices that may impact upon the environment.*	*The Contractor responsible for implementing these components of the Project shall ensure that all procurement activities follow either of these guidelines:* • *European Union Green Public Procurement (GPP) Toolkit.* • *United Nations Sustainable Procurement Guidelines (UNSPG).*	• *Project Component contractor.*	• *USAID to ensure contractors contracts contain clauses relating to the requirement for procurement good practices.*

Appendix C – Preparation of a Media Campaign

C.1 Introduction and Objectives

PTEC comprises a number of elements, the most significant of which is the NEPS-SEPS Connection component, which will be implemented predominantly within the A1 Highway corridor between Kabul and Kandahar. This corridor is encompassed within the Provinces of Kabul, Wardak, Ghazni, Zabul and Kandahar. Much of this corridor is currently being affected by high levels of violence from anti-government elements (AGE). Accordingly, development of the NEPS-SEPS Transmission project may be subject to high security risk. The risk to the Project is during the construction phase, e.g. attacks on construction workers, surveyors, construction equipment, basically attempts to disrupt and delay the construction works.

The rationale behind such attacks is not clear given the significant social and economic benefits that the Project would bring, Attacks may occur when contractors appear out of nowhere and start work that residents are completely unaware of. Plans have been discussed between DABS and USAID of how best to notify the public of the PTEC activities to educe this security issue. In conjunction with more traditional security measures USAID have proposed the development of a Media Campaign which aims to reduce security issues by delivering messages to the local community outlining the aims and objectives of the Project, its benefits, and more specifically, that this is a project constructed by the Afghan Government for the Afghan People. The fact that this project is being implement through 'on-budget' funds means that DABS, an Afghan government department, will have a key role in the implementation of this Project. It is envisaged that by spreading this message to the local communities they may be empowered to take responsibility for their own Project rather than destroying it. It is also recommended to downplay USG assistance and minimize USAID branding/marking requirements.

C.2 Methodology

The Media Campaign will be finalized during the design phase of the Project between DABS and USAID, As such, at this stage of the Project it has been proposed that an outline plan of the Media Campaign be established that can be taken forward by DABS and USAID into the future phases of the Project.

Initial discussions (September, 2012) have been undertaken with DABS and USAID (and informally with other Stakeholders, see **Section 5**) to initiate the Media Campaign. The following section provides a summary of how the Campaign may evolve.

C.3. The Media Campaign

The media campaign itself can be divided into two components:

- The Message – i.e. what do we want to tell the local community to help develop a safe and secure project?
- Distribution Methods – i.e. how should the message be delivered to the local community?

C.3.1 Message

The message sent to the local communities does not have to be one thought, or idea, it can be several thoughts or statements about the Project that enable the community to understand the scope of the Project, its benefits, its impacts and that the Project belongs to the people of Afghanistan. Initial discussions with DABS concluded that the most important piece of information would be timescale, i.e. letting the people know when the Project construction phase would start, when it would finish and when the lines would become operational. DABS felt that this information was critical in order to prevent people becoming dispirited with what they may perceive as a lack of Project progress. DABS also indicated that the following issues would be an important part of the message:

- Information that the Project will be implemented segment by segment and that power will be provided to each segment as they are completed.
- Price of electricity will reduce from 30 Afs to around 2-5 Afs per kilowatt hour.
- The Project will reduce poverty and increase living standards.

A follow up meeting was held between the Consultant and DABS where the Consultant gave a presentation of other potential items the message might want to contain. The meeting included DABS COO, CEO, the Commercial Department and Regional Managers. The conclusions of the meeting were that the message should contain at least the following:

- **Project Benefits** – to include:
    - Cheaper power;
    - Construction phase job creation;
    - Operational phase job creation through expansion of agriculture and industry;
    - Improvements to health and educational facilities; and
    - Improved access to media.
- **Potential negative construction related impacts** - such as air quality and noise;
- **Ownership** - The people need to take ownership of the Project, if the people commit to the Project they can help reduce security concerns during construction and prevent damage to infrastructure during the operational phase.
- **Timescale for construction and completion of the project**;
- **Decreased poverty and increased security**; and
- **Limits of the Network** - Indication that power distribution will be limited to areas around substations.

It was decided by DABS that the issue of load shedding should not be part of the Media Campaign.

C.3.2 Distribution of Message

The general consensus among Stakeholders regarding distribution methods was that TV, Radio and Leaflets would be the best methods along with a verbal message delivered through elders and Mullahs at Mosques.

DABS indicated that they had experience of advertising and as such felt that they had the necessary experience to mange this program independently of any other agency. They proposed several distribution methods:

- Radio (through some kind of drama program);
- Roadside Advertising (Billboards along the A1 highway (with example slogans to include “power is your property”));
- Posters at Mosques; and
- Information programs at schools.

DABS suggested that they were happy for the PRTs to be part of the Media Campaign, but in the role of identifying affected communities, not through actual message distribution.

Given the comments above, it is recommended that an initial program is developed using the following distribution methods:

- Radio Program – Developed and managed by DABS. The program would run through the design and construction phases of the Project;
- Roadside Advertising along A1 urban areas - Developed and managed by DABS;
- Information Program at Schools – Schools identified by PRTs with DABS managing the Information Program;
- Verbal Message through Mullahs and Village Elders – The PRTs will identify the relevant potentially affected locations and their community leaders. DABS will then discuss the Media Campaign with Provincial Governors and ask them to arrange meetings between DABS and the identified community leaders. DABS will then undertake a series of meetings with community leaders informing them of the impacts of the Project and outlining ways to inform their community of the benefits of the Project.

C.3 Conclusions

It is noted that security within the Project corridor may be a significant risk to the short and long term success of the Project. The Media Campaign has been identified as a method to reduce potentially significant security issues within the corridor. Although at an early stage, consultations with USAID, DABS and other stakeholders have revealed certain ideas that should be taken forward with the campaign. It is recommended 1) that DABS form a working group with USAID to continue to develop the campaign and build on the initial recommendations above and 2) that USAID branding/marking requirements are waived for the transmission line and substation construction.

Appendix D – Preparation of a Waste Management Plan

Waste management plans (WMP) shall be prepared by the Contractor prior to construction to ensure that waste disposal measures will be undertaken to reuse and recycle all materials wherever possible minimize the generation of waste. With the proper implementation of an appropriate waste disposal plan, there will be no residual risk due to improper waste disposal. It is recommended that the Contractor follow international best practice in the form of IFC EHS Guidelines for Waste Management[44] during the preparation of this Plan. The IFC Guidelines indicate that the following issues should be considered:

D-1. Waste Management Planning

Facilities that generate waste should characterize their waste according to composition, source, types of wastes produced, generation rates, or according to local regulatory requirements. Effective planning and implementation of waste management strategies should include:

- Review of new waste sources during planning, siting, and design activities, including during equipment modifications and process alterations, to identify expected waste generation, pollution prevention opportunities, and necessary treatment, storage, and disposal infrastructure.
- Collection of data and information about the process and waste streams in existing facilities, including characterization of waste streams by type, quantities, and potential use/disposition.
- Establishment of priorities based on a risk analysis that takes into account the potential EHS risks during the waste cycle and the availability of infrastructure to manage the waste in an environmentally sound manner.
- Definition of opportunities for source reduction, as well as reuse and recycling.
- Definition of procedures and operational controls for on- site storage.
- Definition of options / procedures / operational controls for treatment and final disposal.

D-2. Waste Prevention

Processes should be designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated in accordance with the following strategy:

- Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes.
- Applying manufacturing process that convert materials efficiently, providing higher product output yields, including modification of design of the production process, operating conditions, and process controls.
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs.
- Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials.
- Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed.

[44] Environmental, Health and safety (EHS) Guidelines, General EHS Guidelines: Environmental. Waste Management. IFC, 2007.

D-3 Recycling and Reuse

In addition to the implementation of waste prevention strategies, the total amount of waste may be significantly reduced through the implementation of recycling plans, which should consider the following elements:

- Evaluation of waste production processes and identification of potentially recyclable materials.
- Identification and recycling of products that can be reintroduced into the manufacturing process or industry activity at the site.
- Investigation of external markets for recycling by other industrial processing operations located in the neighborhood or region of the facility (e.g., waste exchange).
- Establishing recycling objectives and formal tracking of waste generation and recycling rates.
- Providing training and incentives to employees in order to meet objectives.

D-4 Treatment and Disposal

If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of and all measures should be taken to avoid potential impacts to human health and the environment. Selected management approaches should be consistent with the characteristics of the waste and local regulations, and may include one or more of the following:

- On-site or off-site biological, chemical, or physical treatment of the waste material to render it non- hazardous prior to final disposal
- Treatment or disposal at permitted facilities specially designed to receive the waste. Examples include: composting operations for organic non-hazardous
- wastes; properly designed, permitted and operated landfills or incinerators designed for the respective type of waste; or other methods known to be effective in the safe, final disposal of waste materials such as bioremediation.

D-5 Hazardous Waste Management

Hazardous Waste Management is discussed as part of **Appendix E**.

Appendix E – Preparation of a HazMat Plan

The Contractor shall be responsible for preparing a HazMat Plan prior to the commencement of construction works. The document shall include provisions for the safe transport, storage, handling and disposal of all hazardous materials on site. It is recommended that the Contractor follow international best practice in the form of IFC EHS Guidelines for Hazardous Materials Management[45] during the preparation of this Plan. The guidelines recommend that Projects which manufacture, handle, use, or store hazardous materials should establish management programs that are commensurate with the potential risks present. The main objectives of projects involving hazardous materials should be the protection of the workforce and the prevention and control of releases and accidents. These objectives should be addressed by integrating prevention and control measures, management actions, and procedures into day-to-day business activities. Potentially applicable elements of a management program include the following:

- Hazard Assessment
- Management Actions
- Preventative Measures
- Control Measures

A typical Table of Contents for a HazMat Plan[46] is provided as **Exhibit E-1**

[45] Environmental, Health and safety (EHS) Guidelines, General EHS Guidelines: Environmental. Hazardous Materials Management. IFC, 2007.

[46] Extracted from: Construction, Operation and Maintenance Plan for the Southwest Intertie Project 500kV Transmission Line, Bureau of Land Management, Arizona,2008

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- 2.2 Facilities Description and Inventory of Material A7- 4

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- 3.2 Refueling and Servicing A7- 6
- 3.3 Transportation of Hazardous Materials A7- 6
- 3.4 Storage of Hazardous Materials A7- 7
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Exhibit E1: Format of a HazMat Plan

Appendix F – Preparation of a Health and Safety Plan

Contractors are obliged to implement all reasonable precautions to protect the health and safety of workers through; eliminating the hazard by removing the activity from the work process; Controlling the hazard at its source through use of engineering controls; Minimizing the hazard through design of safe work systems and administrative or institutional control measures, and providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE. Accordingly, it is recommended that the Contractor prepare a Health and Safety Plan (HSP) to implement these conditions. It is recommended that the Contractor follow international best practice in the form of IFC EHS Guidelines for OHS[47] during the preparation of this Plan.

At a minimum the plan should include sections relating to the following:

- General Facility Design and Operation
  - Integrity of Workplace Structures
  - Severe Weather and Facility Shutdown
  - Workspace and Exit
  - Fire Precautions
  - Lavatories and Showers
  - Potable water supply
  - Clean eating area
  - Lighting
  - Safe Access
  - First Aid
  - Work environment temperature
  - Communications and Training
  - OHS Training
  - New employee and contractor training
  - Area signage
  - Labeling of equipment
- Physical Hazards
  - Rotating and moving equipment
  - Noise
  - Vibration
  - Electrical
  - Eye Hazards
  - Welding / Hot work
  - Industrial driving and site traffic
  - Manual handling
  - Working at heights
  - Illumination
- Chemical Hazards
  - Air Quality
  - Fire and Explosions
  - Corrosive, oxidizing and reactive chemicals
  - Asbestos containing materials
- Biological Hazards
- Radiological hazards
- Personal Protective Equipment
- Monitoring

[47] Environmental, Health and safety (EHS) Guidelines, General EHS Guidelines: Environmental. OHS. IFC, 2007.

- Accidents and Diseases Monitoring

To prevent impacts to the local population during Project works Community Health and Safety considerations should be incorporated into the HSP by the Contractor. The HSP should follow international best practice in the form of IFC EHS Guidelines for Community Health and Safety[48]. The guidelines specify the following:

F-1 Water Quality

Drinking water sources, whether public or private, should at all times be protected so that they meet or exceed applicable national acceptability standards or in their absence the current edition of WHO Guidelines for Drinking-Water Quality.

F-2 Water Availability

The potential effect of groundwater or surface water abstraction for project activities should be properly assessed through a combination of field testing and modeling techniques, accounting for seasonal variability and projected changes in demand in the project area.

F-3 Structural Safety of Project

Infrastructure Hazards posed to the public while accessing project facilities may include:

- Physical trauma associated with failure of building structures
- Burns and smoke inhalation from fires
- Injuries suffered as a consequence of falls or contact with heavy equipment
- Respiratory distress from dust, fumes, or noxious odors
- Exposure to hazardous materials Reduction of potential hazards is best accomplished during the design phase when the structural design, layout and site modifications can be adapted more easily.

F-4 Life and Fire Safety (L&FS)

Applicability and Approach All new buildings accessible to the public should be designed, constructed, and operated in full compliance with local building codes, local fire department regulations, local legal/insurance requirements, and in accordance with an internationally accepted life and fire safety (L&FS) standard.

F-5 Communicable Diseases

Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with large development projects are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. Communicable diseases of most concern during the construction phase due to labor mobility are sexually-transmitted diseases (STDs), such as HIV/AIDS. Recognizing that no single measure is likely to be effective in the long term, successful initiatives typically involve a combination of behavioral and environmental modifications.

F-6 Vector-Borne Diseases

Reducing the impact of vector-borne disease on the long-term health of workers is best accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease.

F-7 Emergency Preparedness and Response

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergencies do not normally include safe

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[48] Environmental, Health and safety (EHS) Guidelines, General EHS Guidelines: Environmental. Community Health and Safety. IFC, 2007.

work practices for frequent upsets or events that are covered by occupational health and safety. All projects should have an Emergency Preparedness and Response Plan that is commensurate with the risks of the facility

Appendix G – Preparation of a Blast Plan

To prevent impacts arising from potential blasting activities a Blast Plan should be prepared by the Contractor. There are no specific IFC guidelines for blasting, but the following **Exhibit H-1**, provides a table of contents for a Blast Plan prepared for an Electricity Transmission Line Project in the US[49].

Exhibit H-1: ToC for a Blast Plan

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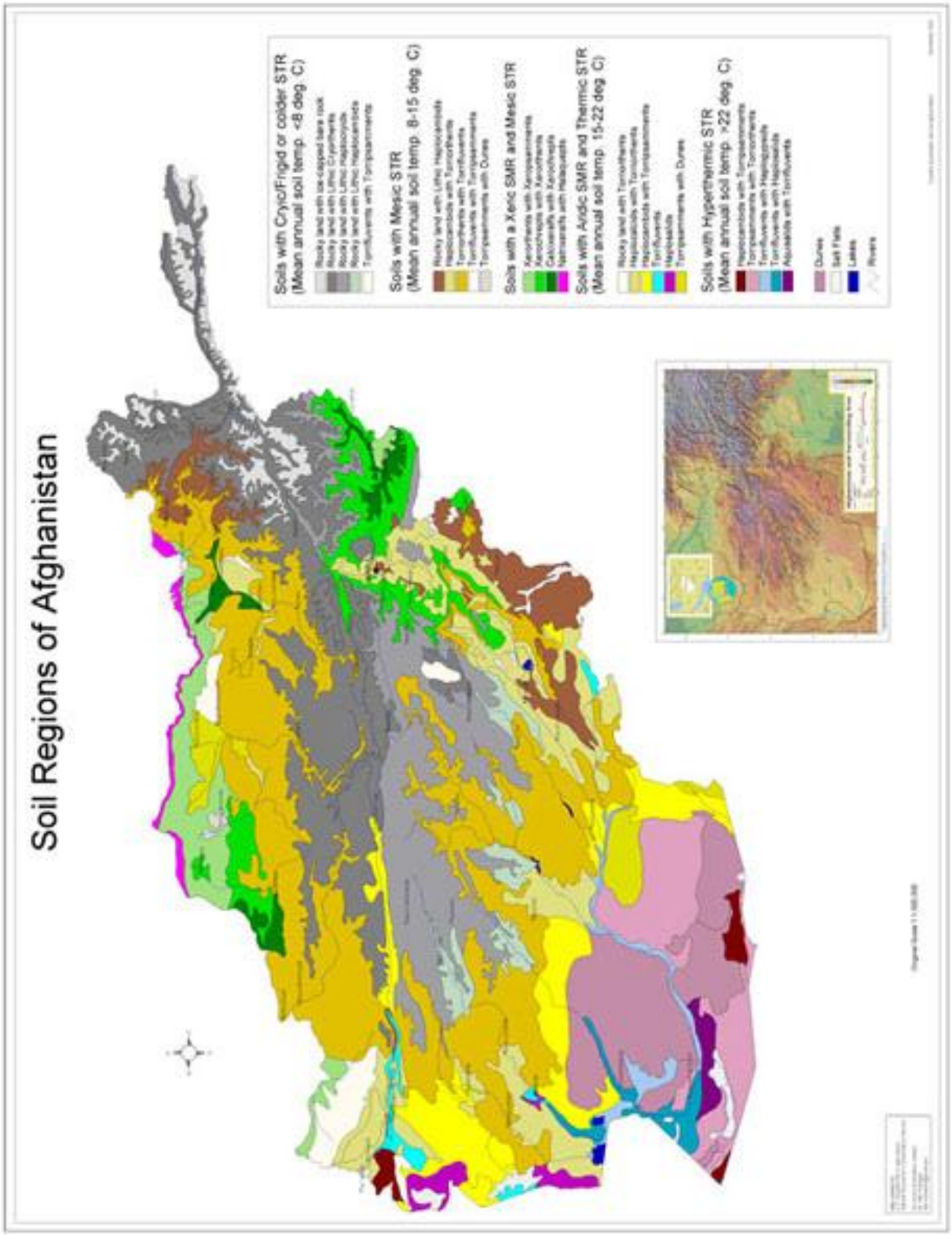
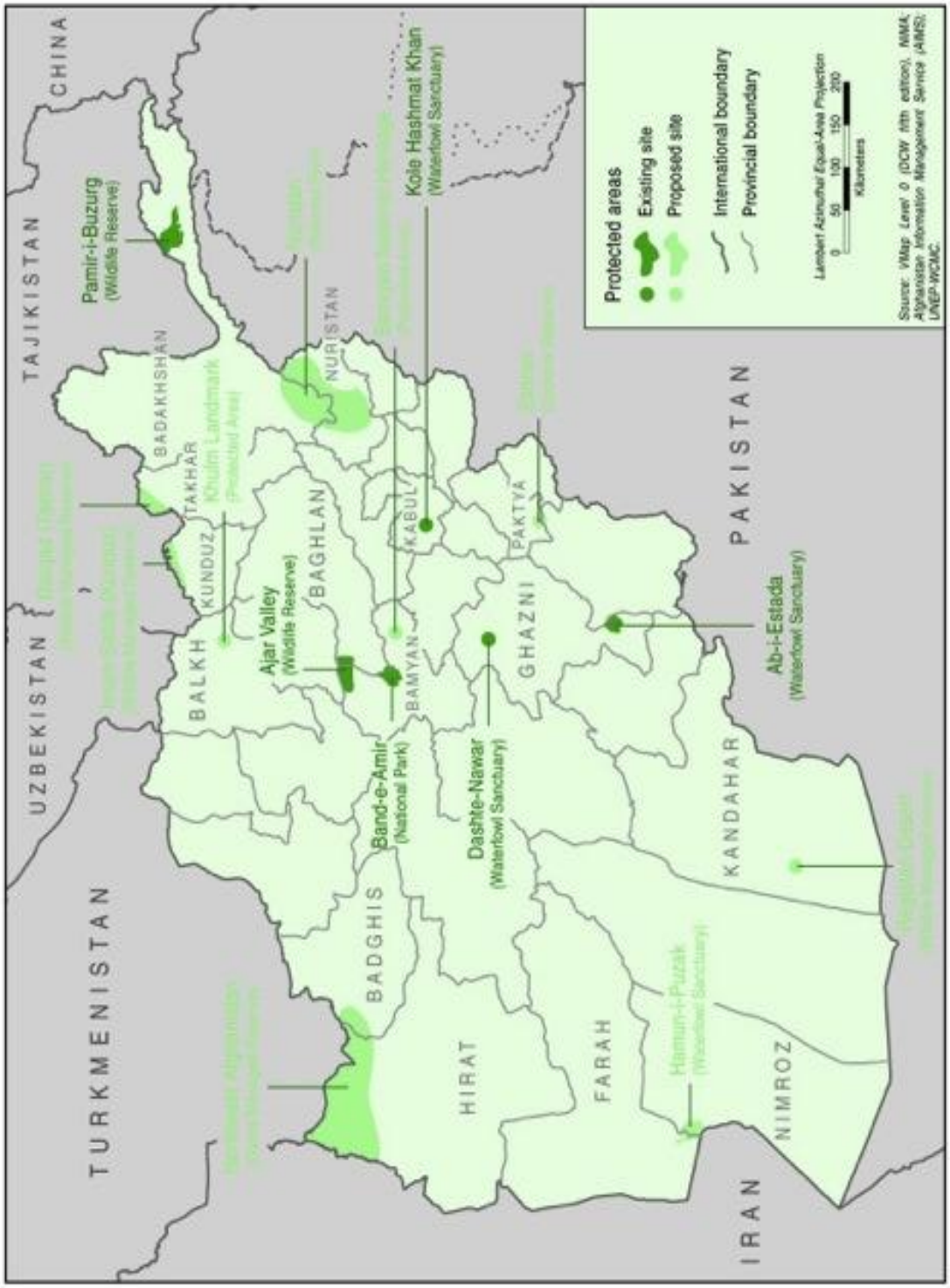
A3-1 Blasting Avoidance Periods A3-7

[49] Construction, Operation and Maintenance Plan for the Southwest Intertie Project 500kV Transmission Line, Bureau of Land Management, Arizona,2008


Soil Regions of Afghanistan
Soils with Cryic/Frigid or colder STR
(Mean annual soil temp. <8 deg. C)
Rocky land with ice-capped bare rock
Rocky land with Lithic Cryorthents
Rocky land with Lithic Haplocryolls
Rocky land with Lithic Haplocambids
Torrifluvents with Torripsamments
Soils with Mesic STR
(Mean annual soil temp. 8-15 deg. C)
Rocky land with Lithic Haplocambids
Haplocambids with Torriorthents
Torriorthents with Torrifluvents
Torrifluvents with Torripsamments
Torripsamments with Dunes
Soils with a Xeric SMR and Mesic STR
Xerorthents with Xeropsamments
Xerochrepts with Xerorthents
Calciorthids with Xerorthents
Natrargids with Haplosalids
Soils with Aridic SMR and Thermic STR
(Mean annual soil temp. 15-22 deg. C)
Rocky land with Torriorthents
Haplosalids with Torriorthents
Haplocambids with Torripsamments
Torrifluvents
Haplosalids
Torripsamments with Dunes
Soils with Hyperthermic STR
(Mean annual soil temp. >22 deg. C)
Haplocambids with Torripsamments
Torripsamments with Torriorthents
Torrifluvents with Haplosalids
Torrifluvents with Haplosalids
Aquisalids with Torrifluvents
Dunes
Salt Flats
Lakes
Rivers

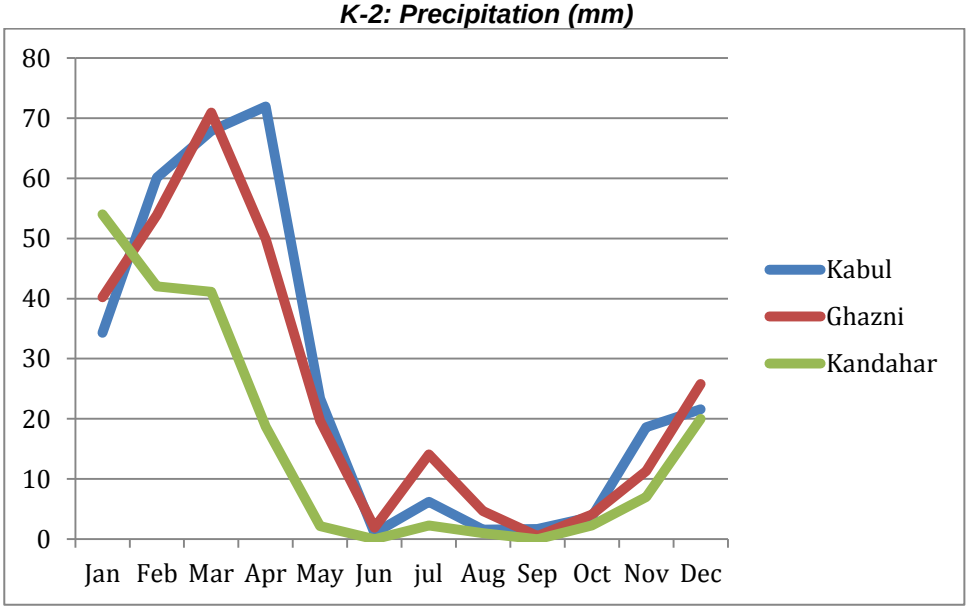
Appendix I – Protected Areas of Afghanistan[50]



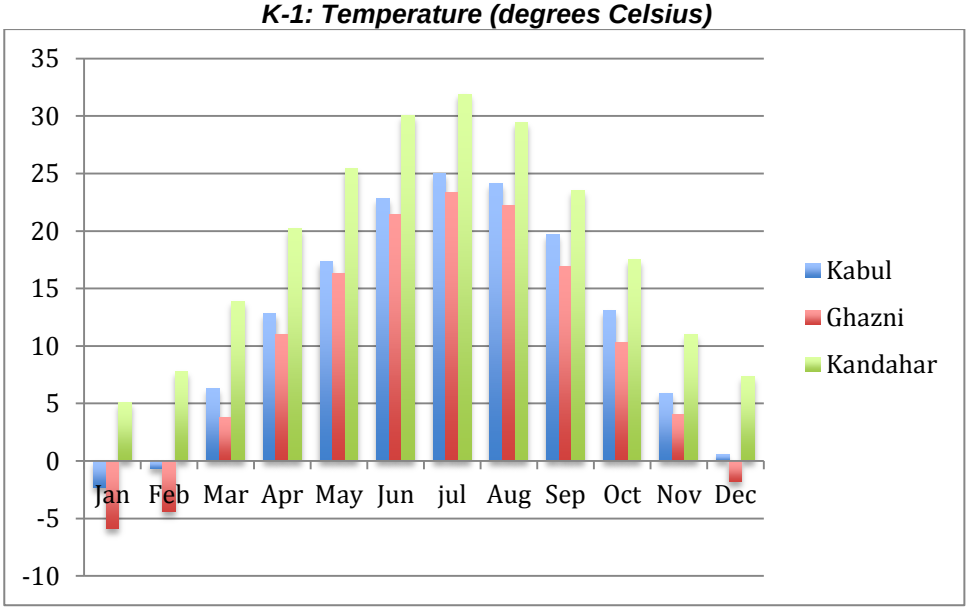
[50]Watershed Atlas of Afghanistan, FOA/AIMS, 2004.

Appendix J – Climate Data[51]

K-2: Precipitation (mm)

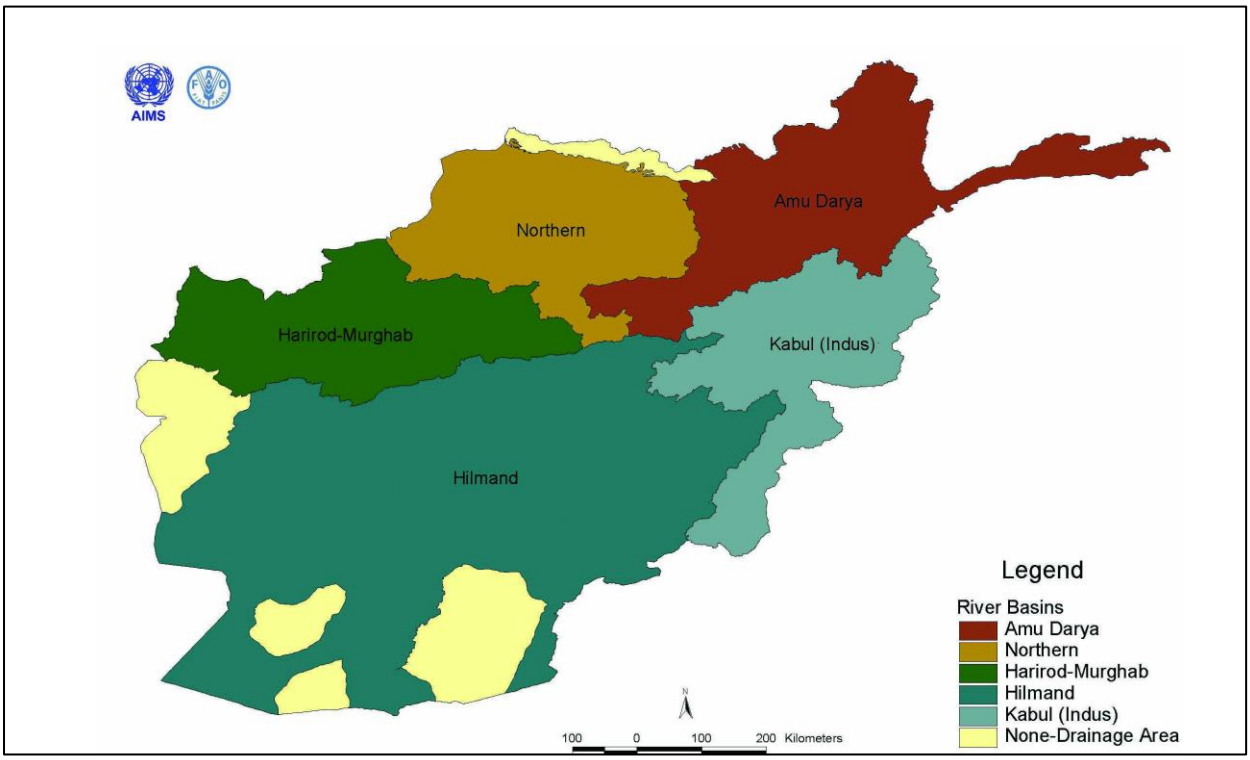


K-1: Temperature (degrees Celsius)



[51] http://www.climate-charts.com

Appendix K – River Basins of Afghanistan[52]



[52] Watershed Atlas of Afghanistan, FOA/AIMS, 2004.

Appendix L – Kareze Network[53]

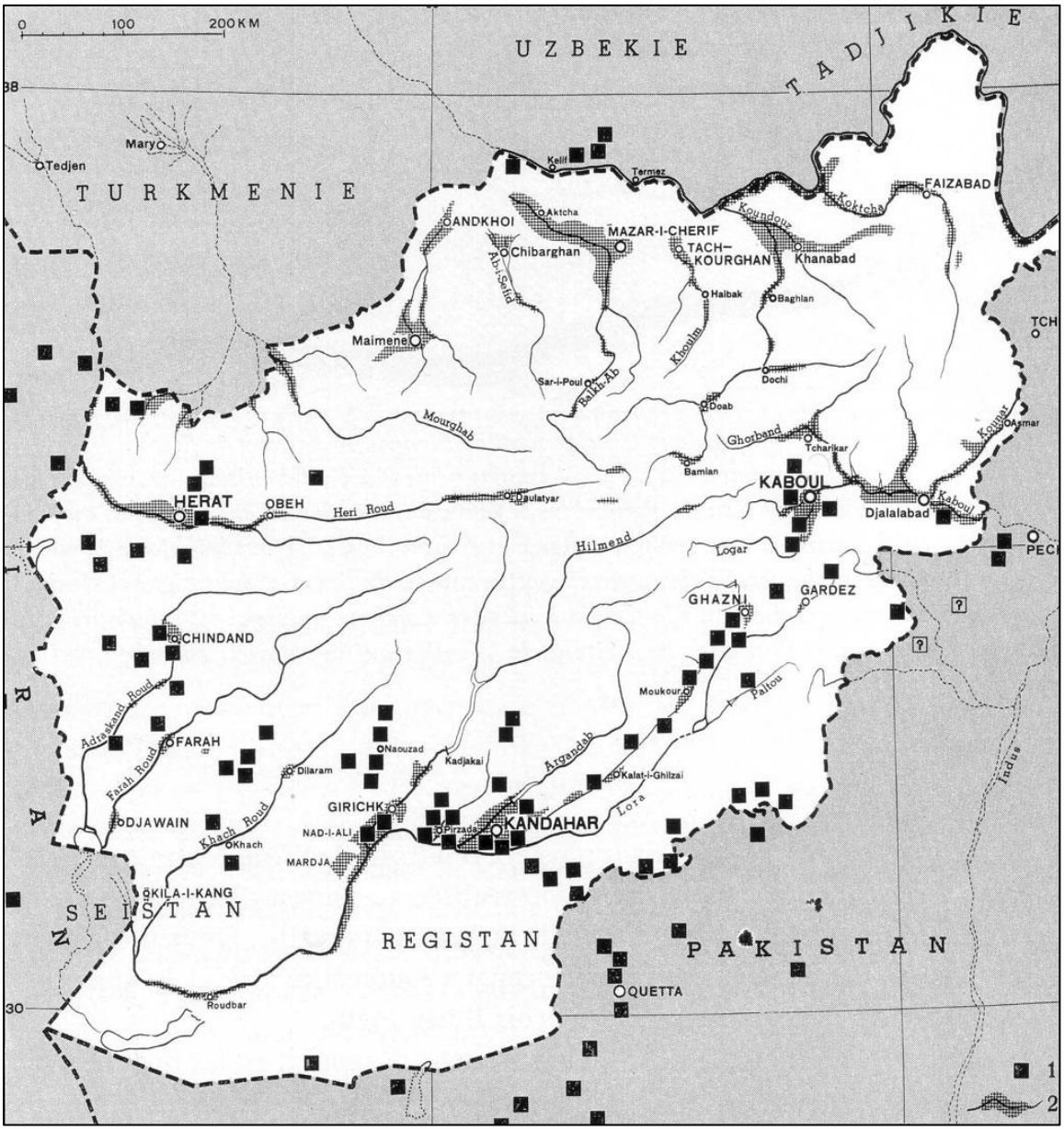


Exhibit M-1: Kareze Locations (indicated by black squares)

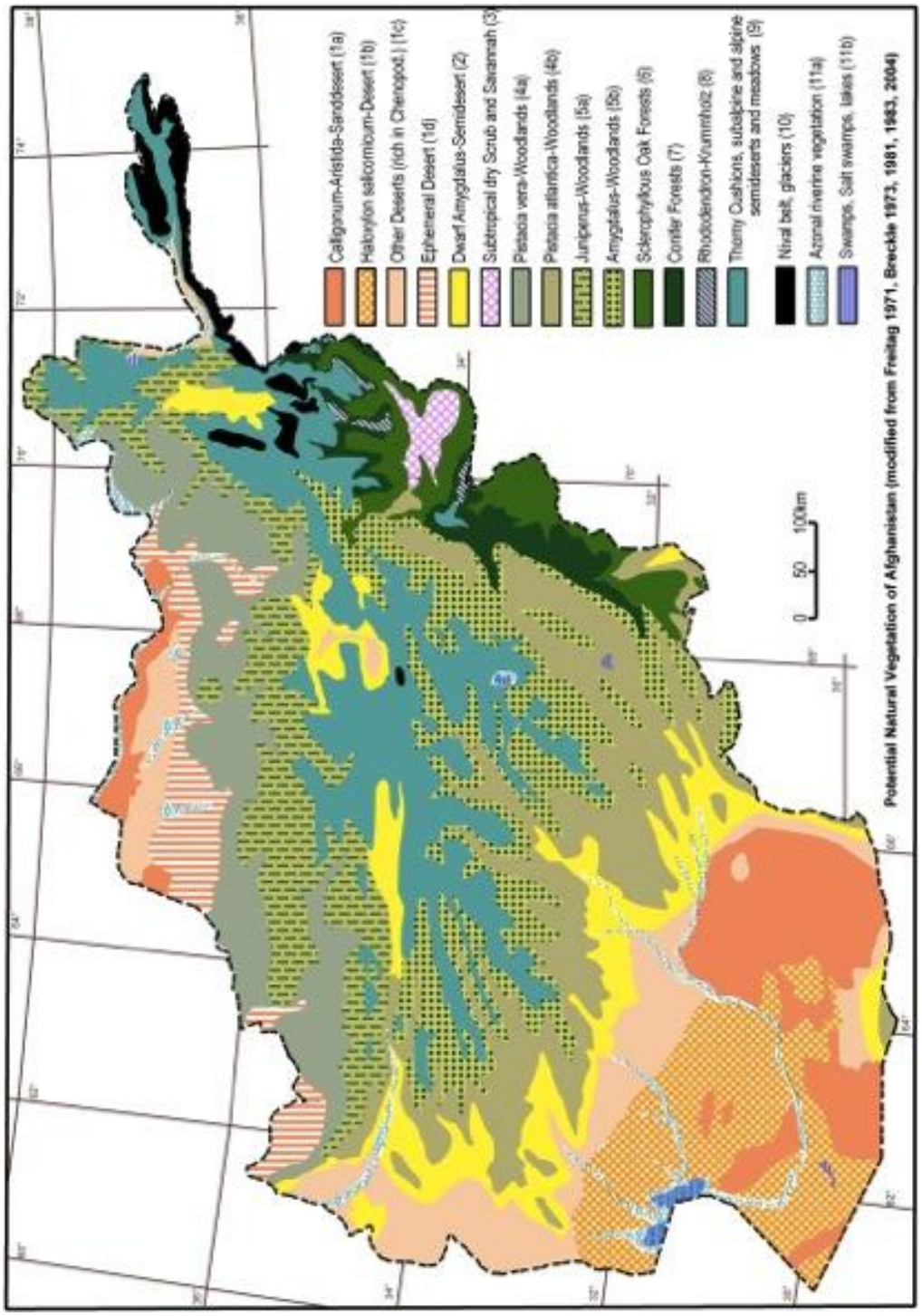
Karezes (called *qanat* in Iran) are gently sloping tunnels dug nearly horizontally into an alluvial fan until the water filters into the channel, runs down its gentle slope, and emerges at the surface as a stream. Water from karezes is used for irrigation and household consumption. In excavating these tunnels, diggers must have air and tunnel spoils must be removed, so the tunnels are connected to the surface with a series of vertical shafts spaced every 50 to 150 meters along its course. The top of these shafts are rimmed by piles of excavated dirt to form a “chain of wells” on the surface, a distinctive feature of the arid Afghan landscapes.

The maximum gradient in a short Kareze is approximately 1:1,000 or 1: 1,500; in a long Kareze, the

[53] Watershed Atlas of Afghanistan, FOA/AIMS, 2004.

canal is almost horizontal. If the gradient is too steep, the tunnel will erode the walls and soon destroy it. See, English, P. W., “The *Origin and Spread of Qantas in the Old World”,* Proceedings American Philosophical Society, Vol. 112, No 3, June, 1968. Dug by local craftsmen from shafts at close intervals, they are small in size but may be many kilometers in length. Karezes typically are constructed and maintained by a specialized group of artisans called karezkan. The task is demanding and dangerous, and karezkan are generally well paid by local standards.

Appendix M – Flora of Afghanistan[54]



[54] Flora and Vegetation of Afghanistan, Seigmar Breckle, 2004

Appendix N – Socio-Economic Data[55]

X-1 Zabul Socio-Economic Data

Zabul Geography
Zabul borders Uruzgan in the north, Kandahar in the west, Ghazni and Paktika in the east, and has an international border with Pakistan in the south. The province covers an area of 17293 km^2. Two-fifths of the province is mountainous or semi mountainous terrain (41%) while more than one quarter of the area is made up of flat land (28%), as the following table shows:

	Topography type					
	Flat	Mountainous	Semi Mountainous	Semi Flat	Not Reported	TOTAL
%	28.1%	22.7%	17.9%	11.2%	19.2%	100.0%

Source: CSO/UNFPA Socio Economic and Demographic Profile

The province is divided into 8 Districts. The provincial capital is Qalat which has a population of about 36,560 inhabitants.

Zabul Demography and Population
Zabul has a total population of 244,899. There are 34,259households in the province and households on average have 6 members. The following table shows the population by district.

	Population by District		
District	Number of males	Number of females	Total population
Ghalat_ Zabool Center	18645	17915	36560
Shah Joi	36215	35133	71348
Mizan	11010	10152	21162
Tarang va Jaldak	9552	9465	19017
Shinki	14329	14015	28344
Atghar	7021	6952	13973
Shamal Zaei	16475	16876	33351
Nobahar	10923	10221	21144
Total	124170	120.729	244899

Source: CSO/UNFPA Socio Economic and Demographic Profile

Around 96% of the population of Zabul lives in rural districts. Around 51% of the population is male and 49% is female. The major ethnic groups living in Zabul province are Tohki, Hotak, Suliman Kheyl, Khaker, Popalzai, Naser, Shamulzai, Ludin and Kuchi. Pashto is spoken by four persons out of five. The second most frequent language is Dari. Out of 1068 villages visited, three with a population of 583 speak Dari.

Zabul province also has a population of Kuchis or nomads whose numbers vary in different seasons. In winter 53.030 Kuchi stay in Zabul province. 80% of these Kuchi are short range migratory and 20% are long-range migratory. All of these are in fact only partially migratory, and on average 30% of these households remain behind in their winter area during the summer. The summer areas for the short range migratory Kuchi are in Day Chopan, Shamulzayi and Shah Jui districts of Zabul province and the most important summer areas for the long range migratory Kuchi are Qarabagh and Muqur districts of Ghazni province. The Kuchi population in the summer is 46,022 individuals.

Zabul Infrastructure and Natural Resources

[55] Food Security Atlas, FAO - http://www.foodsecurityatlas.org/afg/country/provincial-Profile/Zabul

The provision of basic infrastructure such as water and sanitation, energy, transport and communications is one of the key elements necessary to provide the building blocks for private sector expansion, equitable economic growth, increased employment and accelerated agricultural productivity. Around nine-tenths (87%) of households in Zabul province have direct access to their main source of drinking water within their community, however nearly one in ten households (9%) have to travel for up to an hour to access drinking water and for 1% travel to access drinking water can take up to 6 hours as the table below shows:

	Time required accessing main source of drinking water			
	In community	Less than 1 hour	1-3 hours	3-6 hours
%	87	9	3	1

Source: NRVA 2005

The following table shows the kinds of toilet facilities used by households in the province:

		Toilet facilities used by households				
	None/ bush open field/	Dearan / Sahrah (area in compound but not pit)	Open pit	Traditional covered latrine	Improved latrine	Flush latrine
%	12	5	0	83	0	0

Source: NRVA 2005

On average 2% of households in Zabul province have access to electricity with the majority of these relying on public electricity. In rural areas only 1% of households have access to electricity.

The transport infrastructure in Zabul is reasonably well developed with 39% of roads in the province able to take car traffic in all seasons and 38% able to take car traffic in some seasons. However, in a small part of the province (5%) there are no roads at all, as shown in the following table:

		Road Types		
District	Cars all season	Cars some seasons	No roads	Not Reported
Ghalat_ Zabool Center	50.5%	47.3%	1.1%	1.1%
Shah Joi	56.8%	35.5%	.0%	7.7%
Mizan	2.0%	58.6%	39.4%	.0%
Tarang va Jaldak	63.5%	34.0%	1.3%	1.3%
Shinki	19.0%	12.1%	.9%	68.1%
Atghar	21.6%	78.4%	.0%	.0%
Shamal Zaei	40.3%	32.1%	.4%	27.2%
Nobahar	13.0%	41.3%	4.3%	41.3%
TOTAL	38.9%	37.6%	4.5%	19.0%

Source: CSO Provincial Profiles (AIRD Analysis)

The following table indicates road travel times between the provincial capital, Qalat and the major district centres in the province, and other key provincial centres in the region.

		Road Travel Times	
From	To	Time	Road Condition
Qalat	Kandahar City	Approximately 2 hrs -150 kms	Excellent (Route 1 – bitumen road)
Qalat	Shinkay	Approximately 3hrs summer / up to 4.5hrs winter - 100 kms	Fair (hard packed gravel road constructed by the US Corps of Engineers)
Qalat	Shahjoy	Approximately 1.5 – 110 kms	Excellent (Route 1 – bitumen road)

Qalat	Mizan	Approximately 3hrs summer / up to 4.5hrs winter - 75 kms	Extremely poor (dirt tracks)

Source: UNAMA

As far as telecommunications are concerned, Roshan and AWCC mobile networks are active in Qalat with patchy, but improving coverage. They are also active on the Kandahar – Kabul high way.

Zabul Economic Governance and Private Sector Development

Creating the conditions in which a dynamic and competitive private sector can flourish, is key to promoting economic growth, employment creation and poverty reduction. Zabul is an agricultural province. The majority of commercial activity in Zabul is related to trade in agricultural products and animal husbandry, and transport companies for import/export. Trafficking of narcotics also plays a significant role in the economy in the Province

Agriculture is a major source of revenue for 50% of households in Zabul province, including 52% of rural households. Around half (49%) of rural households own or manage agricultural land or garden plots in the province. More than one-third of households earn some income through non-farm related labour (37%). Trade and services accounts for some income for one-sixth of households (16%) as the following table shows:

Sources of income reported by households			
Source of income	Rural (%)	Urban (%)	Total (%)
Agriculture	52	-	50
Livestock	15	-	20
Opium	4	-	4
Trade and Services	17	-	16
Manufacture	4	-	5
Non-Farm Labour	38	-	37
Remittances	1	-	1
Other	0	-	0

Source: NRVA 2005

The major industrial crops grown in Zabul are tobacco, produced in 150 villages and sesame in 58. Shah Joy is a major producer of both commodities and Tarank Wa Jaldak is a major producer of tobacco. Sugar extracts are produced in total of 19 villages, 18 of which are located in Shah Joy.

The sector of small industries in Zabul is practically inexistent. Only 15 villages have some kind of production and none of the eight districts specializes in any particular industry.

Handicrafts also are scarce in Zabul. A total of 111 villages produce these. Shah Joy stands out in relation to rugs (22 villages out of 23), Jewelry (13 out of 65), and shawls (12 out of 13). Mizan is the largest producer of jewelry (43 villages out of a total of 65).

Zabul Agriculture and Rural Development

Enhancing licit agricultural productivity, creating incentives for non-farm investment, developing rural infrastructure, and supporting access to skills development and financial services will allow individuals, households and communities to participate licitly and productively in the economy. As agriculture represents the major source of income for half the households in the province, rural development will be a key element of progress in Zabul. The most important field crops grown in Zabul province include wheat, maize and potatoes. The most common crops grown in garden plots include fruit and nut trees and grapes.

Three quarters (76%) of households with access to fertilizer use this on field crops and to a much lesser degree on garden plots (9%), although nearly one-sixth of households use fertilizer on both field and garden (15%). The main types of fertilizer used by households in the province are shown in the following table:

	Main Types Of Fertilizer Used By Households				
Human	Animal	Urea			DAP
%	%	%	Average Kg per Household	%	Average Kg per Household
20	82	75	171.3Kg	67	152.7Kg

Source: NRVA 2005

On average more than four fifths (85%) of households in the province have access to irrigated land, and nearly one fifth (18%) of rural households have access to rainfed land.

Households (%) access to irrigated and rainfed land			
	Rural	Urban	Average
Access to irrigated land	84	-	85
Access to rainfed land	18	-	19

Source: NRVA 2005

Sixty one percent of rural households and 94% of Kuchi households in the province own livestock or poultry. The most commonly owned livestock are sheep, goats, donkey, cattle and camel as the following table shows:

	Households (%) owning poultry and livestock			
Livestock	Kuchi	Rural	Urban	Average
Cattle	50	41	-	46
Oxen	2	5	-	6
Horses	31	5	-	18
Donkey	83	31	-	57
Camel	83	6	-	45
Goats	88	40	-	64
Sheep	90	43	-	67
Poultry	54	25	-	40

Source: NRVA 2005

Zabul Education

Ensuring good quality education and equitable access to education and skills are some of the important ways to raise human capital, reduce poverty and facilitate economic growth. The overall literacy rate in Zabul province is 1%, which comprises 1% of men and a small number of women. In the population aged between 15 and 24 the situation for women for women improves slightly with a literacy rate of just 0.5%, but the figure falls to a small number of men.

Very few children between 6 and 13 are enrolled in school, on average 0.1% of children including 0.2% for boys. Overall there are 168 primary and secondary schools in the province catering for 35720 students. Boys account for 99% of students and 98% of schools are boys' schools. There are 866 teachers working in schools in the Zabul province, 3% of whom are women.

	Primary and Secondary Education					
	Schools		Students		Teachers	
	boys	girls	boys	girls	male	female
Primary	147	1	33930	3239	-	-
Secondary	18	2	1464	30	-	-
Total	165	3	35394	326	838	28

	168	35720	866

Source: CSO Afghanistan Statistical Yearbook 2006

Primary schools exist in 51 villages out of 1.068, which represents 5% of the villages and 4.4% of the population. Just over one fifth of students must travel up to five kilometers to reach the closest primary school. However, two fifths of students (43%) have to travel more that 10kms to reach their nearest primary school. Secondary schools exist in 23 villages, home to 3% of secondary school students and three fifths of students must travel more than 10km to reach their nearest secondary school. Only 8 villages have high schools, and these are home to just 1.4% of high school students. Around one in ten students (11%) have a high school within 5 kms while around two thirds have to travel more than 10km to reach their nearest high school.

Zabul Health

Ensuring the availability of basic health and hospital services, and developing human resources in the health sector is essential to reduce the incidence of disease, increase life expectancy and enable the whole population to participate in sustainable development. A basic infrastructure of health services exists in Zabul province. In 2005 there were 7 health centers and 2 hospitals with a total of 80 beds. There were also 24 doctors and 66 nurses employed by the Ministry of Health working in the province, which represented a 60% increase in the number of doctors (up from 15) and a 45% increase in the number of nurses (up from 45) compared to 2003. The major health facilities in the province identified in 2007 are shown in the following table:

Health Services			
Hospitals		Clinics	
Name	Location	Name	Location
Qalat Hospital (refurbished by the Government of the UAE)	Qalat	Charsade clinic	Charsade
Shahjoy Hospital	Shahjoy	Dulainau clinic	Dulainau
		Lal Sar Jangal clinic	Lal Sar Jangal
		Daulatyar clinic	Daulatyar
		Taiwara clinic	Taiwara
		Passaband clinic	Passaband
		Saghar clinic	Saghar
		Tolak Clinic	Tolak
		Shahrak clinic	Shahrak

Source: UNAMA

The province also has 62 pharmacies of which 51 are owned privately and 11 are run by the government.

Very few communities have a health worker present. All the men's and women's shura reported that there was no community health worker present, and both groups most commonly said that the closest health care facility is a clinic without beds (Basic Health Centers). Only 1.4% of the population has a health centre in-village and 1.3% has a dispensary. More than sixty percent of people seeking medical attention must travel more than 10kms to reach a health centre, dispensary or drugstore. In addition, given the nature of the terrain it may take more time to reach the closest health unit than distances would suggest.

Zabul Social Protection

Building the capacities, opportunities and security of extremely poor and vulnerable Afghans through a process of economic empowerment is essential in order to reduce poverty and increase self-reliance. The level of economic hardship in Zabul is reasonably high. Around four in six households

(61%) in the province reported having problems satisfying their food needs up to three times a year and one in six (17%) face this problem at least 3 – 6 times a year, as the following table shows:

	Problems satisfying food need of the household during the last year				
	Never	Rarely (1-3 times)	Sometimes (3-6 times)	Often (few times a month)	Mostly (happens a lot)
Households (%)	14	61	17	3	5

Source: NRVA 2005

Thirty eight percent of the population in the province is estimated to receive less than the minimum daily caloric intake necessary to maintain good health, and nearly the whole population has low dietary diversity and poor or very poor food consumption (93%) as shown below:

	Food consumption classification for all households			
	Low dietary diversity		Better dietary diversity	
Households (%)	Very poor food consumption	Poor food consumption	Slightly better food consumption	Better food consumption
Rural	50	47	2	1
Total	43	50	1	2

Source: NRVA 2005

X-2 Kandahar Socio-Economic Data

Kandahar Geography

Kandahar province is located in the southern region of the country and has borders with Zabul in the East, Uruzgan in the North, Helmand in the West and an international border with the Balochistan Province of Pakistan in the South. The province covers an area of 47676 km^2. More than four-fifths of the area is made up of flat land (84.5%) while nearly a tenth of the province is mountainous or semi mountainous terrain (7.6%) as the following table shows:

		Topography type				
	Flat	Mountainous	Semi Mountainous	Semi Flat	Not Reported	TOTAL
%	84.5%	2.6%	5.0%	6.8%	1.1%	100.0%

Source: CSO/UNFPA Socio Economic and Demographic Profile

The province is divided into 16 official and 2 unofficial districts. The provincial capital is Kandahar which has a population of 468200.

Kandahar Demography and Population

Kandahar has a total population of 990100. There are approximately 14445 households in the province, and households on average have 7 members. The following table shows the population by district.

Population by District			
District	Male	Female	Total
Kandahar City	243600	224600	468200
Daman	12700	12100	24800
Arghistan	14800	14100	28900
Arghandab	26400	25200	51600
Panjwai	42400	40400	82800

Maywand	20900	19800	40700
Khakrez	9900	9300	19200
Ghorak	4100	3900	8000
Spin Boldak	21000	20000	41000
Shorabak	4900	4700	9600
Registan	800	800	1600
Maruf	14200	13500	27700
Shah Wali Kot	18700	17700	36400
Zherai	25500	2400	49500
Niesh	5800	5500	11300
Miyanasheen	6500	6100	12600
Dand			
TakhtaPul			

(Source UNAMA / CSO data)

Around 68% of the population of Kandahar lives in rural districts while 32% lives in urban areas. Around 51% of the population is male and 49% is female. The major ethnic group living in Khandahar province is Pashtoons. This includes major tribes such as Barakzai, Popalzai, Alkozai, Noorzai and Alezai. Pashtu is spoken by more than 98% of population and in more than 98% of villages. Dari is spoken in six villages by 4000 people and Balochi is spoken by 8000 people in two villages. 19000 people in nine villages speak some other unspecified language.

Kandahar province also has a population of Kuchis or nomads whose numbers vary in different seasons. In winter 79,949individuals, or 3.3% of the overall Kuchi population, stay in Kandahar. Only one percent of them are short-range partially migratory, and 51% are long-range partially migratory and the remaining 48% are settled. In the winter, migratory Kuchi households stay in one place and don't move around during the season. In the summer season, long range migratory Kuchi households go to Ghazni, Uruzgan and Zabul provinces. The Kuchi population in the summer is 39,082 individuals.

Kandahar Infrastructure and Natural Resources

The provision of basic infrastructure such as water and sanitation, energy, transport and communications is one of the key elements necessary to provide the building blocks for private sector expansion, equitable economic growth, increased employment and accelerated agricultural productivity. In Kandahar province, on average only 64% of households use safe drinking water. This rises to 99% in the urban area, and falls to 50% in rural areas. More than four fifths (87%) of households have direct access to their main source of drinking water within their community, however one in ten households has to travel for up to an hour to access drinking water (10%), as the table below shows:

	Time required accessing main source of drinking water			
	In community	Less than 1 hour	1-3 hours	3-6 hours
%	87	10	3	0

Source: NRVA 2005

On average only 22% of households have access to safe toilet facilities. The situation is better in the urban area where 57% of households have safe toilets, but this is true for only 7% of rural households. The following table shows the kinds of toilet facilities used by households in the province:

		Toilet facilities used by households				
	None/ bush open field/	Dearan / Sahrah (area in compound but not pit)	Open pit	Traditional covered latrine	Improved latrine	Flush latrine

%	6	20	3	49	19	3

Source: NRVA 2005

On average 27% of households in Kandahar province have access to electricity with the majority of these relying on public electricity. Access to electricity is much greater in the urban area where 85% of households have access to electricity, however this figure falls to just 2% in rural areas, and only half of these (1%) have access to public electricity.

The transport infrastructure in Kandahar is well developed, with 76.8% of roads in the province able to take car traffic in all seasons, and 19.1% able to take car traffic in some seasons. However, in a very small area of the province (3.3%) there are no roads at all, as shown in the following table:

		Road Types		
Name of District	Cars all season	Cars some seasons	No roads	Not Reported
Arghandab	93.2%	6.8%	.0%	.0%
Khakreez	97.1%	1.4%	1.4%	.0%
Mivand	72.4%	23.1%	3.8%	.6%
Jheri	88.2%	10.0%	1.8%	.0%
Panjvaei	85.5%	13.6%	.9%	.0%
Sepin Boldek	56.7%	34.5%	6.9%	2.0%
Total	76.8%	19.1%	3.3%	.7%

Source: CSO (Analysis by AIRD)

The following table indicates road travel times between the provincial capital, Kandahar City and the major district centres in the province, and other key provincial centres in the region.

		Road Travel Times	
From	To	Time	Road Condition
Kandahar City	Spin Boldak	Approximately 2 hrs 150 kms	Excellent/good (Route 4 – bitumen road)
Kandahar City	Qalat	Approximately 2 hrs 190 kms	Excellent/good (Route 1 – bitumen road)
Kandahar City	Lashkergah	Approximately 2 hrs 200 kms	Excellent/good (Route 1 – bitumen road)
Kandahar City	Tirin Kot	Approximately 3 hrs 200 kms	Good (hard packed gravel)

Source: UNAMA

As far as telecommunication is concerned, the three main mobile networks, AWCC, Roshan and Areeba are accessible in Kandahar City and on Main Roads.

Kandahar Economic Governance and Private Sector Development

Creating the conditions in which a dynamic and competitive private sector can flourish, is key to promoting economic growth, employment creation and poverty reduction. Kandahar is both an agricultural and an industrial province. The majority of commercial activity in Kandahar is related to trade and services, and agricultural and livestock products.

Agriculture is a major source of revenue for 28% of households in Kandahar province, including 38% of rural households and 8% of households in the urban area. Thirty two percent of rural households and 1% of urban households own or manage agricultural land or garden plots in the province. However, just under half of households in the urban area (43%) and a little more than one quarter of households in rural areas (29%) derive some income from trade and services. More than a third of households in rural areas (37%) and more than one quarter of households in urban areas (27%) earn income through nonfarm related labour. Livestock also accounts for income for less than one tenth of rural households (8%) as the following table shows:

	Sources of income reported by households		
Source of income	Rural (%)	Urban (%)	Total (%)
Agriculture	38	8	28
Livestock	8	1	8
Opium	6	1	4
Trade and Services	23	43	29
Manufacture	3	2	2
Non-Farm Labour	37	27	34
Remittances	7	0	5
Other	5	21	10

Source: NRVA 2005

In 2005 there were 109 Agricultural cooperatives active in Kandahar involving 4700 members. This was five times more people than in 2003 when the figure was only 942 members. In 2005 agricultural cooperatives controlled a total of 37015 Ha of land and achieved a surplus of products for sale of 45,000 tons. As a result of this, each member held a share in the capital of the cooperative to the value of 2,640,700Afs.

The major industrial crops grown in Kandahar are tobacco produced in 82 villages, cotton in 59 villages, and sugar extracts in 24 villages. Maiwand District is the major producer of all these products particularly cotton and tobacco. Spin Boldak, Kandahar, and Panjwayee produce Tobacco. Sugar extracts are concentrated in Zherai and Maiwand.

The sector of small industries is almost absent in the province. Three villages in Zherai District produce honey and karakul and sugar candy is produced in Panjwayee. Handicrafts is not a well-developed sector either. Jewellery and rugs are mentioned in this regard. Out of 61 villages producing jewellery, forty one are in Zherai District and out of 10 villages producing rugs, three are in Zherai and three others are in Maiwand Districts.

In 2005, 33% of households in Kandahar reported taking out loans. Of these households, a small percentage used these loans to invest in economic activity such as business investment (6%), agricultural inputs (5%) and buying land (1%).

Kandahar Agriculture and Rural Development

Enhancing licit agricultural productivity, creating incentives for non-farm investment, developing rural infrastructure, and supporting access to skills development and financial services will allow individuals, households and communities to participate licitly and productively in the economy. As agriculture represents the major source of income for more than a quarter of the households in the province, rural development will be a key element of progress in Kandahar. The most important field crops grown in Kandahar province include wheat, potatoes, melon and watermelon and maize as well as opium. The most common crops grown in garden plots include grapes (54%) and fruit and nut trees (34%). Wheat (4%) and vegetables (3%) are also sometimes grown in garden plots in the province.

More than one third of households with access to fertilizer use this on field crops (38%) and to a higher degree, nearly half of households use fertilizer on garden plots (48%). One in six (15%) households uses fertilizer on both field and garden. The main types of fertilizer used by households in the province are shown in the following table:

	Main Types Of Fertilizer Used By Households				
Human	Animal	Urea			DAP
%	%	%	Average Kg per Household	%	Average Kg per Household
47	48	81	234.0 Kg	65	128.4Kg

Source: NRVA 2005

On average 46% of households in the province have access to irrigated land. The figure is much higher in the urban areas where all households (100%) have access to irrigated land as opposed to only 45% of rural households whereas one sixth of rural households (17%) have access to rainfed land as shown in the following table:

Households (%) access to irrigated and rainfed land			
	Rural	Urban	Average
Access to irrigated land	45	100	46
Access to rainfed land	17	0	17

Source: NRVA 2005

Fifty five percent of rural households, 91% of Kuchi households and 1% of households in urban areas in the province own livestock or poultry. The most commonly owned livestock are sheep, goats, donkey, camel and cattle as the following table shows:

	Households (%) owning poultry and livestock			
Livestock	Kuchi	Rural	Urban	Average
Cattle	15	29	1	15
Oxen	0	8	1	3
Horses	15	1	0	5
Donkey	76	18	0	31
Camel	48	1	0	16
Goats	73	27	1	33
Sheep	76	35	1	37
Poultry	73	51	1	42

Source: NRVA 2005

Kandahar Education

Ensuring good quality education and equitable access to education and skills are some of the important ways to raise human capital, reduce poverty and facilitate economic growth. The overall literacy rate in Kandahar province is 16%, however, while more than a quarter of men are literate (26%), this is true for just one twentieth of women (5%). In the population aged between 15 and 24 the situation for men is slightly lower with 22.5% literacy, whereas for women the figure if halved to just 2.7%. The Kuchi population in the province has particularly low levels of literacy with just 3% of men and no women (0%) able to read and write.

On average 23% of children between 6 and 13 are enrolled in school, however, the figure is around one third of boys (33%) and just over one tenth of girls (12%). Amongst the Kuchi population, none of the boys or girls attend school in either the winter or the summer months in Kandahar province.

Overall there are 271 primary and secondary schools in the province catering for 150342 students. Boys account for 82% of students and 97% of schools are boys' schools. There are nearly 2478 teachers working in schools in the Kandahar province, less than one tenth of whom are women (7.4%).

	Primary and Secondary Education					
	Schools		Students		Teachers	
	boys	girls	boys	girls	male	female
Primary	192	2	113102	25862	-	-
Secondary	70	7	10877	501	-	-
Total	262	9	123979	26363	2294	184

	271	150342	2478

Source: CSO Afghanistan Statistical Yearbook 2006

Primary schools are the most easily accessible for students followed by secondary schools and high schools. Around forty percent of students have a primary school located less than five kilometers away, but 28% of students have to travel more than 10 kilometers to reach their closest primary schools. Over a quarter of students have to travel up to five kilometers to reach their nearest secondary schools and for forty percent this distance is more than ten kilometers. Accessiblilty to high schools is even more limited with only 12% of students having their closest high schools less than 5 kms away. Two-thirds of students, on the other hand, have to travel more than ten kilometers to reach their closest high schools.

Kandahar province also has a number of higher education facilities. The University of Kandahar has four faculties including medicine, engineering, agriculture and training and education. In 2005 there were 808 students enrolled at the university 795 men (98.4%) and 13 women (1.6%). Of those, 151 students were in their first year. These included 150 men (99.4%) and 1 woman (0.6%). Six hundred and forty male students live in dormitories provided by the University.

There is also a teacher training institute which had 72 students in 2005, 70% of whom were men and 30% women. Nineteen new teachers graduated from Kandahar teacher training institute in 2005, of which 58% were women and 42% were men.

Kandahar Health

Ensuring the availability of basic health and hospital services, and developing human resources in the health sector, is essential to reduce the incidence of disease, increase life expectancy and enable the whole population to participate in sustainable development. A basic infrastructure of health services exists in Kandahar province. In 2005 there were 20 health centers and 8 hospitals with a total of 375 beds. There were also 140 doctors and 288 nurses employed by the Ministry of Health working in the province, which represented nearly twice as many doctors (up from 77) and 50% more nurses (up from 188) since 2003. The major health facilities in the province are shown in the following table:

	Health Services (Hospitals and Clinics by District)			
District	No. Of Health posts	Basic Health Center	Comprehensive Health Center	Provincial/ District Hospital
Kandahar City	0	9	2	1
Spin Boldak	17	3	0	1
Takhta Pul	5	0	1	0
Dand	28	2	1	0
Daman	11	1	1	0
Arghistan	16	0	1	0
Khakrez	6	1	0	0
Ghorak	0	1	0	0
Neish	4	0	1	0
Shorabak	0	0	0	0
Registan	0	0	0	0
Arghandab	10	1	2	0
Panjwai	14	0	1	0
Maiwand	14	0	1	0
Zherai	13	0	1	0
Shah Wali Kot	27	1	1	0

Source: UNAMA

The province also has 94 pharmacies of which 92 are owned privately and 2 are run by the government. Drugstores are present only in 46 villages and 45% of the population has to travel more than ten kilometers to reach to the nearest drugstore.

The majority of communities do not have a health worker permanently present in their community. Thirty nine percent of men's shura and 59% of women's shura reported that there was no community health worker present, and both groups most commonly said that a basic health center or clinic without beds is their nearest health facility. Only 3.5% of the population has a health center and 4.2% has a dispensary within their village. Around half the population seeking medical attention must travel more than ten kilometers (55% for health centers and 51% for dispensaries).

Kandahar Social Protection

Building the capacities, opportunities and security of extremely poor and vulnerable Afghans through a process of economic empowerment is essential in order to reduce poverty and increase self-reliance. The level of economic hardship in Kandahar is reasonably high. Around one third of households in the province report having problems satisfying their food needs at least 3 – 6 times a year (33%), and more than a fifth of households face this problem up to three times a year (22%), as the following table shows:

Problems satisfying food need of the household during the last year					
	Never	Rarely (1-3 times)	Sometimes (3-6 times)	Often (few times a month)	Mostly (happens a lot)
Households (%)	38	22	33	4	3

Source: NRVA 2005

Around a third of the population in the province is estimated to receive less than the minimum daily caloric intake necessary to maintain good health. This figure is smaller for the rural population (26%) than for people living in the urban area (37%). In both rural and urban areas nearly three quarter of households (73%) has low dietary diversity and poor or very poor food consumption as shown below:

	Food consumption classification for all households			
	Low dietary diversity		Better dietary diversity	
Households (%)	Very poor food consumption	Poor food consumption	Slightly better food consumption	Better food consumption
Rural	28	36	22	15
Total	26	47	20	17

Source: NRVA 2005

Ghazni Socio-Economic Data

Ghazni Geography

Ghazni Province is located in the Central Region of Afghanistan and bordered by Paktya and Logar in the north-east, Paktika in the south-east, Zabul in the south-west, Daikundy and Bamyan in the northwest, and Wardak in the north. The province covers an area of 23,378 km^2. Over half the province (59.8%) is mountainous or semi mountainous terrain while just over a third of the area (35.7%) is made up of flat land, as the following table shows:

Topography Type					
Flat	Mountainous	Semi Mountainous	Semi Flat	Not Reported	Total
35.7%	41.0%	18.8%	4.1%	0.4%	100.0%

Source: CSO/UNFPA Socio Economic and Demographic Profile

The province is divided into 19 districts and 3,109 villages including the provincial capital, Ghazni City, which has a population of about 154,618 inhabitants.

Ghazni Demography and Population

Ghazni has a total population of 1,080,843. There are 163,638 households in the province, and households on average have 6 members. The following table shows the population by district:

Population by District and Gender			
District	Number of males	Number of females	Total population
Provincial Center-Ghazni	78,190	76,428	154,618
Deh Yak	22,589	21,797	44,386
Zanakhan	8,862	8,656	17,518
Khwaja Omari	8,746	8,729	17,475
Rashidan	6,220	6,059	12,279
Wali Mohammad Shahid Khuqyani	8,546	8,062	16,608
Jaghatu	14,912	14,466	29,378
Waghaz	18,740	17,791	36,531
Qara Bagh	67,466	64,708	132,174
Giro	19,945	18,165	38,110
Andar	61,921	58,356	120,277
Nuwar	41,365	40,544	81,909
Ajristan	12,840	12,025	24,865
Malistan	35,409	36,375	71,784
Jaghuri	76,992	75,170	152,162
Muqur	24,753	22,672	47,425
Aab Band	13,627	12,497	26,124
Gelan	26,736	25,337	52,073
Nawa	2,734	2,413	5,147
Total	550,593	530,250	1,080,843

Source: CSO/UNFPA Socio-Economic and Demographic Profile

Around nine people in ten (89%) in Ghazni province live in rural districts while 11% live in urban areas. Around 51% of the population is male and 49% is female. The main tribes in the province are Andar, Tajik, Suleman Khail, Taraki, Kharoti, Niazi, Sulemanzi, Alikhail, Hazara, Daptani, Durani, Miya Khail, Bayat, Jalalzai, Khogiani, Musa Khail, Hotak and Wardak. The most commonly spoken languages are Pashtu, which is spoken by about half (51%) of the population, and Dari which is spoken by 47%. In addition Uzbeki is spoken by about 1,000 residents (0.1%), and about 23,000 people in 53 villages speak some other language.

Ghazni province also has a population of Kuchis or nomads whose numbers vary in different seasons. In winter the kuchi population in Ghazni are quite small with just 31,230 individuals, but in summer this figure rises to 121,356, representing nearly 5% of the total Kuchi population. A total of 8.339 households currently migrate to Ghazni in the summer from provinces such as Kandahar, Nangarhar, Zabul, Uruzgan, Helmand and Khost.

Ghazni Infrastructure and Natural Resources

The provision of basic infrastructure such as water and sanitation, energy, transport and communications is one of the key elements necessary to provide the building blocks for private sector expansion, equitable economic growth, increased employment and accelerated agricultural productivity. In Ghazni province, on average only 35% of households use safe drinking water and the figure slightly increases to 37% in rural areas. Over four in five households (86%) have direct access

to their main source of drinking water within their community, however one in ten households (11%) has to travel for up to an hour to access drinking water, and for 2% travel to access drinking water can take up to 3 hours as the table below shows:

Time required accessing main source of drinking water			
In community	Less than 1 hour	1-3 hours	3-6 hours
86%	11%	2%	0%

Source: NRVA 2005

On average only 1% of households has access to safe toilet facilities. The following table shows the kinds of toilet facilities used by households in the province:

	Toilet facilities used by households				
None/ bush/ open field	Dearan/Sahrah (area in compound but not pit)	Open pit	Traditional covered latrine	Improved latrine	Flush latrine
3%	2%	6%	87%	1%	0%

Source: NRVA 2005

In terms of meeting the basic requirements for energy there is a power supply company based in the province. On average 37% of households in Ghazni province have access to electricity but only 2% are supplied with public electricity.

The transport infrastructure in Ghazni is quite well developed. Just over a third (38.2%) of roads in the province are able to take car traffic in all seasons, and more than half (58.4%) are able to take car traffic in some seasons. However, in 3.2% of the province there are no roads at all, as shown in the following table:

	Road Types			
District	Cars All Season	Cars Some Seasons	No Roads	Not Reported
Provincial Center, Ghazni	81.1%	17.6%	0%	1.4%
Deh Yak	30.8%	67.7%	1.5%	0%
Zanakhan	35.1%	64.9%	0%	0%
Khwaja Omari	91.4%	8.6%	0%	0%
Rashidan	66.7%	33.3%	0%	0%
Wali Mohammad Shahid Khuqyani	74.6%	25.4%	0%	0%
Jaghatu	53.7%	46.3%	0%	0%
Waghaz	82.4%	17.6%	0%	0%
Qara Bagh	47.2%	50.2%	2.3%	0.2%
Giro	17.0%	80.9%	2.1%	0%
Andar	63.7%	36.3%	0%	0%
Nuwar	0.6%	83.2%	11.0%	0.2%
Ajristan	34.5%	60.0%	5.5%	0%
Malistan	15.8%	79.9%	4.2%	0%
Jaghuri	32.0%	65.3%	2.5%	0.2%
Muqur	42.1%	57.9%	0%	0%
Aab Band	43.5%	56.5%	0%	0%
Gilan	43.6%	52.9%	3.6%	0%
Nawa	46.9%	53.1%	0%	0%
Total	38.2%	58.4%	3.2%	0.1%

Source: CSO (analysis by AIRD)

As far as telecommunications is concerned, all the main mobile telephone operators; Roshan, AWCC and Areeba are present in the province. The provincial capital and its surrounding areas are covered by the signal of all these operators.

Ghazni Economic Governance and Private Sector Development

Creating the conditions in which a dynamic and competitive private sector can flourish, is key to promoting economic growth, employment creation and poverty reduction. Ghazni is both an agricultural and an industrial province, and it is rich with minerals yet to be exploited. In terms of industry, one salt factory and a chocolate factory are working in the province. The majority of commercial activity in Ghazni is related to trade in agricultural and livestock products.

Agriculture is the major source of revenue for 57% of households in Ghazni province, including 60% of rural households. More than two thirds (69%) of rural households own or manage agricultural land or garden plots in the province. In addition, nearly one in five households (18%) in rural areas derive income from trade and services. More than a quarter of households (29%) in both rural and urban areas earn income through non-farm related labor. Livestock also accounts for some income for almost half of rural households (47%) as the following table shows:

Sources of income reported by households (%)				
Source of income	Rural	Urban		Total
Agriculture	60	-		57
Livestock	47	-		49
Opium	0	-		0
Trade and Services	18	-		17
Manufacture	2	-		2
Non-Farm Labor	29	-		28
Remittances	19	-		18
Other	7	-		7

Source: NRVA 2005

In 2005 there were 25 agricultural cooperatives active in Ghazni Province involving 2,451 members. This was more than three times more people in 2003 when the figure was only 799 members. In 2005 agricultural cooperatives controlled a total of 9,384 Hac of land and achieved a surplus of products for sale of 3,000 tons. As a result of this, each member held a share in the capital of the cooperative to the value of 314,500Afs.

Out of 2,809 villages producing wheat, close to half are located in the districts of Jaghuri, Nawur and Qara Bagh. The same pattern of spatial concentration occurs for corn and maize as well. The district of Andar is also a major producer of corn, beans and vetch. These same districts are also the major producers of vegetables such as potatoes, onions, tomatoes, with Nuwar District being the major producer of potatoes and carrots, Andar being the major producer of onions, tomatoes, carrots and spinach, and Muqur a producer of a large quantity of tomatoes and beans. The same districts are also known for their production of fruits and animal products, with Jaghuri District home to nearly three quarters (73%) of all the villages producing walnuts, and Andar leading in the production of animal products.

Industrial commodities such as cotton, sugar, sesame, tobacco, olives and sharsham are produced in around 7% of villages in the province. However, more than half the villages in the province (55%) are engaged in the production of handicrafts, the most common being rugs (427 villages), jewelry (379 villages), carpets (152 villages) and shawls. They are mainly concentrated in Jaghuri (391 villages), Malistan (243 villages), Nuwar (164 villages), Jaghatu (125 villages) and Qara Bagh (82 villages), in total representing more than four in five villages engaged in handicrafts.

In 2005, 38% of households in Ghazni reported taking out loans. Of these loans, a small percentage was used to invest in economic activity such as agricultural inputs (10%) and business investment (3%).

Ghazni Agriculture and Rural Development

Enhancing licit agricultural productivity, creating incentives for non-farm investment, developing rural infrastructure, and supporting access to skills development and financial services will allow individuals, households and communities to participate licitly and productively in the economy. As agriculture represents the major source of income for more than half the households in the province, rural development will be a key element of progress in Ghazni. The most important field crops grown in Ghazni Province include wheat (94%), alfalfa/clover/other fodder (58%), barley (35%) and potatoes (14%). The most common crops grown in garden plots included grapes (56%) and fruit/nut trees (17%).

Two out of three households with access to fertilizer use this on field crops (69%) and to a much lesser degree on garden plots (8%), although nearly a quarter of households use fertilizer on both field and garden (24%). The main types of fertilizer used by households in the province are shown in the following table:

		Main types of fertilizer used by households			
Human	Animal	Urea		DAP	
%	%	%	Average Kg per Household	%	Average Kg per Household
16	54	80	199.1 Kg	69	161.4Kg

Source: NRVA 2005

On average more than four fifths (85%) of households in the province have access to irrigated land, and nearly a third (29%) of rural households have access to rain-fed land.

Households (%) access to irrigated and rain-fed land				
	Rural	Urban		Average
Access to irrigated land	85	-		85
Access to rain-fed land	29	-		29

Source: NRVA 2005

Around three quarters (76%) of rural and 88% of Kuchi households in the province own livestock or poultry. The most commonly owned livestock are sheep, cattle, poultry and goats as the following table shows:

Households (%) owning poultry and livestock				
Livestock	Kuchi	Rural	Urban	Average
Cattle	28	57	-	55
Oxen	0	10	-	10
Horses	2	1	-	1
Donkey	59	38	-	39
Camel	64	0	-	4
Goats	61	45	-	46
Sheep	86	60	-	61
Poultry	53	55	-	55

Source: NRVA 2005

Ghazni Education

Ensuring good quality education and equitable access to education and skills are some of the important ways to raise human capital, reduce poverty and facilitate economic growth. The overall literacy rate in Ghazni province is 35%, however, while nearly half of men are literate (48%), this is true for just over one-fifth of women (21%). In the population aged between 15 and 24 the situation for men is significantly better with 60.3% literacy, whereas for women the figure rises to just over one quarter (26%). The Kuchi population in the province has particularly low levels of literacy with just 1.4% of men and almost no women (0.1%) able to read and write.

On average 39% of children between 6 and 13 are enrolled in school, however, again the figure is around half of boys (47%) and under one-third of girls (30%). Amongst the Kuchi population of the province, only 1% of boys attend school during the winter months and 5% of boys attend during the summer months, however no Kuchi girls attend school in the province in either season.

Overall there are 405 primary and secondary schools in the province catering for 205,591 students. Boys account for 69% of students and 82% of schools are boys' schools. There are 4,330 teachers working in schools in the Ghazni province, nearly one-fifth of whom are women (18%).

	Primary and Secondary Education					
	Schools		Students		Teachers	
	Boys	Girls	Boys	Girls	Male	Female
Primary	171	25	118,750	56,377	-	-
Secondary	161	48	67,84	23,680	-	-
Total	332	73	142,430	63,161	3,568	762
	405		205,591		4,330	

Source: CSO Afghanistan Statistical Yearbook 2006

Primary schools exist in 265 villages of the total 3,109 (8.5%): 15% of primary school students must travel more than 10 kilometers and around half must travel more than 5 kilometers to reach their closest school. Secondary schools exist in 154 villages (4.9%): one quarter of secondary school students must travel more than 10 kilometers, and two in five must travel more than 5 kilometers to reach their closest secondary school. High school exist in only 77 villages (2.4%): Just under half (47%) of high school students must travel more than 10 kilometers, while a quarter must travel between 5 and 10 kilometers to reach their closest high school.

Ghazni Province also has a higher education facility, although there is currently no governmental or private university in the province. There is a Teacher Training Institute in Ghazni which had 183 students in 2005, 79% of whom were men and 21% women. It has a staff of 12 teachers, including 33% women and 67% men.

Ghazni Health

Ensuring the availability of basic health and hospital services, and developing human resources in the health sector is essential to reduce the incidence of disease, increase life expectancy and enable the whole population to participate in sustainable development. A basic infrastructure of health services exists in Ghazni province. In 2005 there were 33 health centers and 4 hospitals with a total of 225 beds. There were also 38 doctors and 89 nurses employed by the Ministry of Health working in the province, which represented a decrease of about 22% in the number of doctors and 7% decrease in the number of nurses compared to 2003. The major health facilities in the province identified in 2007 are shown in the following table:

	Health Services		
Basic Health Center (BHC)	Comprehensive Health Center (CHC)	District Hospital (DH)	Provincial Hospital (PH)
28	29	3	1

Source: UNAMA

The province also has 157 pharmacies of which 155 are owned privately and 2 are run by the government.

The majority of communities do not have a health worker permanently present in their community. Seventy six percent of men's shura and 82% of women's shura reported that there was no community health worker present, and while the males most commonly said that their closest health facility was a Comprehensive Health Centre (CHC) clinic with beds, the females most commonly said that a Basic Health Centre (BHC) clinic without beds was their closest health facility. Health centers exist in only 2% of villages and dispensaries only in 3% of villages. More than half the population (52%) must travel more than 10 kilometers to get medical attention to either type of health units. However, given the nature of the terrain, it may take much more time be much more difficult to reach health facilities than the simple distances would suggest.

Ghazni Social Protection

Building the capacities, opportunities and security of extremely poor and vulnerable Afghans through a process of economic empowerment is essential in order to reduce poverty and increase self-reliance. The level of economic hardship in Ghazni is reasonably high. More than a third of households in the province (35%) report having problems satisfying their food needs at least 3–6 times a year and a further third of households (32%) face this problem up to three times a year, as the following table shows:

Problems satisfying food need of the household during the last year					
	Never	Rarely (1-3 times)	Sometimes (3-6 times)	Often (few times a month)	Mostly (happens a lot)
Households (%)	23%	32%	35%	7%	4%

Source: NRVA 2005

One quarter of the population in the province (25%) is estimated to receive less than the minimum daily caloric intake necessary to maintain good health, and nearly four-fifths of the population (79%) has low dietary diversity and poor or very poor food consumption as shown below:

	Food consumption classification for all households			
	Low dietary diversity		Better dietary diversity	
Households (%)	Very poor food consumption	Poor food consumption	Slightly better food consumption	Better food consumption
Rural	31	47	12	9
Total	30	49	11	11

Source: NRVA 2005

Wardak Socio-Economic Data

Wardak Geography

Wardak province is situated on the southern outcrops of the Hindu-Kush mountain range. It is a strategic province in the Central Region of Afghanistan sharing borders with Parwan and Bamyan to the north, Kabul and Logar in the east, and Ghazni to the south and west. The province covers an area of 9,023 km^2. More than four-fifths of the province (84.1%) is mountainous or semi mountainous terrain while a little more than one-tenth of the area (11.4%) is made up of flat land, as the following table shows:

		Topography Type			
Flat	Mountainous	Semi Mountainous	Semi Flat	Not Reported	Total
11.4%	63.4%	20.7%	3.6%	.7%	99.8%

Source: CSO/UNFPA Socio Economic and Demographic Profile

The province is divided into 8 districts. The provincial capital is Maidan Shahr which has a population of about 35,008 inhabitants.

Wardak Demography and Population

Wardak has a total population of 529,343. There are around 83,984 households in the province, and households on average have 6 members. The following table shows the population by district:

	Population by District		
District	Number of males	Number of females	Total population
Maidan Shar,Provincial Centre	17,659	17,659	35,008
Jalrez	22,680	22,193	44,873
Hissa-i-Awali-Bihsud	12,537	12,542	25,079
Markazi-Bihsud	47,387	46,941	94,328
Daimirdad	14,593	14,272	28,865
Jaghatu	23,699	22,968	46,667
Chaki Wardak	42,733	40,643	83,376
Sayed Abad	58,752	56,041	114,793
Nirkh	29,066	27,288	56,354
Total	268,331	259,419	529,343

Source: CSO Provincial Profiles

Nearly all of the population of Wardak (99%) lives in rural districts. Around 51% of the population is male and 49% is female. The major ethnic groups living in Wardak Province are Pashtoons, follwed by Tajiks and Hazaras. The most frequently spoken languages are Pashtu which is spoken by 70% of the population and Dari which is spoken by 27%.

Wardak province also has a population of Kuchis or nomads whose numbers vary in different seasons. In winter 10,670 individuals, 0.4% of the overall Kuchi population, stay in Wardak. The vast majority (89%) of these are settled. Of the remaining 11%, 35 households are short-range migratory and 105 households are long-range migratory. However, amongst these migratory communities only about a third migrates. In the winter both groups stay mostly in one area and don't move around during the season. The summer area for the long range migratory Kuchis from Wardak is Kabul Province, while long-range migratory Kuchis from the provinces of Nangarhar, Logar, and Laghman, and to a lesser extent Kabul, Khost, Kunar and Parwan move to Wardak in the summer, mostly the districts of Bihsud and Jalrez.. The Kuchi population in the summer is 122,810 individuals, 5.1% of the total Kuchi population.

Wardak Infrastructure and Natural Resources

The provision of basic infrastructure such as water and sanitation, energy, transport and communications is one of the key elements necessary to provide the building blocks for private sector expansion, equitable economic growth, increased employment and accelerated agricultural productivity. In Wardak Province, on average only 22% of households use safe drinking water. Nearly nine in ten households have direct access to their main source of drinking water within their community, however around one in ten of households (12%) has to travel for up to an hour to access drinking water, as the table below shows:

Time required accessing main source of drinking water			
In community	Less than 1 hour	1-3 hours	3-6 hours
87%	12%	2%	0%

Source: NRVA 2005

On average only 4% of households have access to safe toilet facilities. The following table shows the kinds of toilet facilities used by households in the province:

	Toilet facilities used by households				
None/bush/ Open field	Dearan/Sahrah (area in compound but not pit)	Open pit	Traditional covered latrine	Improved latrine	Flush latrine
9%	10%	14%	62%	4%	0%

Source: NRVA 2005

In terms of meeting the basic requirements for energy, there is one electric dam on the Logar River at Chak producing 3,300 kilowatts of electricity with only one of its three turbines operating. On average 9% of households in Wardak province have access to electricity but only 1% of households have access to public electricity.

The transport infrastructure in Wardak is quite well developed, with around a quarter (27%) of roads in the province able to take car traffic in all seasons, and over half (57%) able to take car traffic in some seasons. However, 16% of the province has no roads at all, as shown in the following table:

	Road Types			
District	Cars All Season	Cars Some Seasons	No Roads	Not Reported
Maidan Shar, Provincial Centre	42.2%	56.3%	0%	1.6%
Jalrez	73.4%	9.7%	16.9%	0%
Hissa-i-Awali-Bihsud	12.8%	69.1%	18.1%	0%
Markazi-Bihsud	12.1%	56.9%	29.1%	1.9%
Daimirdad	29.6%	65.2%	4.3%	0.9%
Jaghatu	63.2%	36.8%	0%	0%
Chaki Wardak	35.5%	59.5%	5.0%	0%
Sayed Abad	58.4%	41.0%	0.6%	0%
Nirkh	6.1%	91.9%	2.0%	0%
Total	26.6%	56.6%	15.9%	0.9%

Source: AIRD Provincial Profiles

As far as telecommunications is concerned, there is a partial coverage form the AWCC and Roshan mobile networks in Maidan Shar, Jaghato, Sayedabad, Jalrez and Nirkh.

Wardak Economic Governance and Private Sector Development

Creating the conditions in which a dynamic and competitive private sector can flourish, is key to promoting economic growth, employment creation and poverty reduction. Wardak is both an agricultural and an industrial province, and minerals such as gems and marble are found in the mountains of the provincial center and Narkh District, although the Government has banned the extraction of these resources. In terms of industry, one marble factory is working in the province, and there are marble mines in the provincial centre and Sayed Abad District although no mining is currently undertaken there due to the government ban. The majority of commercial activity in Wardak is related to trade in agricultural and livestock products, although stone quarrying is also a growing business in the area. The people from Wardak are also expert in Karez cleaning and repair and go to other parts of the country for this purpose.

Agriculture is a major source of revenue for 43% of households in Wardak province. Four fifths (79%) of rural households own or manage agricultural land or garden plots in the province. However, nearly a quarter (24%) of households in the province derive income from trade and services, and around half (45%) of households earn some income through non-farm related labor. Livestock also accounts for the income of one fifth (21%) of households as the following table shows:

Sources of income reported by households (%)	

Source of income	Rural	Urban	Total
Agriculture	46	-	43
Livestock	16	-	21
Opium	1	-	1
Trade and Services	27	-	24
Manufacture	1	-	1
Non-Farm Labor	46	-	45
Remittances	18	-	16
Other	5	-	6

Source: NRVA 2005

In 2005 there were 14 agricultural cooperatives active in Wardak involving 3,359 members. This was an increase of more than 130% from 2003 when the figure was only 1,455 members. In 2005 agricultural cooperatives controlled a total of 5,068 Hac of land and achieved a surplus of products for sale of 20,000 tons. As a result of this, each member held a share in the capital of the cooperative to the value of 489,300Afs.

Unlike agricultural or animal products, there is not a very large production of industrial products in Wardak. Tobacco is produced in 94 villages of the total 1,989 mainly in Chaki Wardak, Markazi-Bihsud, Sayed Abad and Jaghatu districts. Sugar extracts are produced in 32 villages, 19 of which are located in Sayed Abad.

The sector of small industries is dominated by one commodity, honey, which is produced in 68 villages, 55 of which are located in the district of Chaki Wardak. There is also a significant production of handicrafts mostly related to rugs, carpets, jewelry, and shawls concentrated mainly in two districts, Markazi-Bihsud and Hissa-i-Awali-Bihsud. More than 90% of these four handicrafts are produced in these two districts.

In 2005, 42% of households in Wardak reported taking out loans. Of these households, a small percentage used these loans to invest in economic activity such as business investment (2%) and agricultural inputs (1%).

Wardak Agriculture and Rural Development

Enhancing licit agricultural productivity, creating incentives for non-farm investment, developing rural infrastructure, and supporting access to skills development and financial services will allow individuals, households and communities to participate licitly and productively in the economy. As agriculture represents the major source of income for nearly half the households in the province, rural development will be a key element of progress in Wardak. The most important field crops grown in Wardak province include wheat, barley, maize, rice and rapeseed. The most common crops grown in garden plots include fruit and nut trees and produce such as vegetables, potatoes, beans and alfalfa, clover or other fodder.

Around two-thirds of households with access to fertilizer use this on field crops (65%) and to a lesser degree on garden plots (15%), although one-fifth of households use fertilizer on both field and garden (20%). The main types of fertilizer used by households in the province are shown in the following table:

			Main types of fertilizer used by households		
Human	Animal		Urea	DAP	
%	%	%	Average Kg per Household	%	Average Kg per Household
43	59	54	115.5 Kg	45	135.9Kg

Source: NRVA 2005

On average four fifths (83%) of households in the province have access to irrigated land, and around one fifth (18%) of households have access to rain-fed land.

Households (%) access to irrigated and rain-fed land			
	Rural	Urban	Average
Access to irrigated land	83	-	83
Access to rain-fed land	18	-	18

Source: NRVA 2005

Eighty eight percent of rural households and 94% of Kuchi households in the province own livestock or poultry. The most commonly owned livestock are sheep, goats, donkey, poultry and cattle as the following table shows:

Households (%) owning poultry and livestock				
Livestock	Kuchi	Rural	Urban	Average
Cattle	35	51	-	29
Oxen	4	14	-	6
Horses	6	0	-	2
Donkey	78	35	-	38
Camel	21	2	-	8
Goats	94	35	-	43
Sheep	90	61	-	50
Poultry	32	80	-	37

Source: NRVA 2005

Wardak Education

Ensuring good quality education and equitable access to education and skills are some of the important ways to raise human capital, reduce poverty and facilitate economic growth. The overall literacy rate in Wardak province is 25%, however, while more than one third of men are literate (38%), this is true for just over one tenth of women (10%). In the population aged between 15 and 24 the situation for men is slightly better with 43% literacy, whereas for women the figure shows a decrease to 8%. The Kuchi population in the province has particularly low levels of literacy with just 2.4% of men and a tiny number of women able to read and write.

On average around a third (31%) of children between 6 and 13 are enrolled in school, however the figure is 41% of boys and 20% girls. Amongst the Kuchi population, one in four boys (25%) and no girls attend school in Wardak during the winter months and 19% of boys and no girls attend school in the province during the summer.

Overall there are 251 primary and secondary schools in the province catering for 105,358 students. Boys account for 80% of students and 83% of schools are boys' schools. There are 2,909 teachers working in schools in the Wardak province, 6% of whom are women.

	Primary and Secondary Education					
	Schools		Students		Teachers	
	Boys	Girls	Boys	Girls	Male	Female
Primary	133	40	67,643	21,177	-	-
Secondary	75	3	16,176	362	-	-
Total	208	43	83,819	21,539	2,744	165
	251		105,358		2,909	

Source: CSO Afghanistan Statistical Yearbook 2006 Page 9 of 13

Around one in ten of primary school students (10%) have a primary school in their village, but this is true for only 4% of secondary school students and only 2% of high school students. On the other hand, nearly two-thirds (64%) of High school students, a quarter (25%) of secondary students and one tenth (12%) of primary students have to travel more than 10kms to reach their nearest school.

Wardak province also has a higher education facility. Although there is no Government-run or private university, there is a Teacher Training Institute.

Wardak Health

Ensuring the availability of basic health and hospital services, and developing human resources in the health sector is essential to reduce the incidence of disease, increase life expectancy and enable the whole population to participate in sustainable development. A basic infrastructure of health services exists in Wardak province. In 2005 there were 46 health centers and 4 hospitals with a total of 187 beds. There were also 35 doctors and 155 nurses employed by the Ministry of Health working in the province, which represented an increase of almost twice the number doctors and one and a half times the number of nurses compared to 2003. The major health facilities in the province identified in 2007 are shown in the following table:

Health Services			
Hospitals		Clinics	
Name	Location	Name	Location
Provincial Hospitals (4)	Maydan Shar, Behsud II, Chak, Sayed Abad	Comprehensive and Basic Health Centers (37)	All districts

Source: UNDSS Provincial Assessment 2007 provided by UNAMA

The province also has 100 pharmacies of which 87 are owned privately and 13 are run by the government.

The majority of communities do not have a health worker permanently present in their community. Out of 1,989 villages, only 42 have a health centre or dispensary within their boundaries. Access to health care is difficult for many people in the province with nearly one out in three people (29%) having to travel more than 5km to reach their nearest health facility. More than two-fifths of the population (43%) has to travel over 10 kilometers to get medical attention in either a health centers or a dispensary.

Wardak Social Protection

Building the capacities, opportunities and security of extremely poor and vulnerable Afghans through a process of economic empowerment is essential in order to reduce poverty and increase self-reliance. The level of economic hardship in Wardak is reasonably high. More than one in ten the households in the province (12%) report having problems satisfying their food needs at least 3–6 times a year, and a further one third of households (33%) face this problem up to three times a year, as the following table shows:

Problems satisfying food need of the household during the last year					
	Never	Rarely (1-3 times)	Sometimes (3-6 times)	Often (few times a month)	Mostly (happens a lot)
Households (%)	46	33	12	7	2

Source: NRVA 2005

More than two fifths (41%) of the population in the province is estimated to receive less than the minimum daily caloric intake necessary to maintain good health, and on average, around three-quarters (72%) of the population have low dietary diversity and poor or very poor food consumption, as shown below:

	Food consumption classification for all households

	Low dietary diversity		Better dietary diversity	
Households (%)	Very poor food consumption	Poor food consumption	Slightly better food consumption	Better food consumption
Rural	33	41	18	7
Total	31	41	17	9

Source: NRVA 2005

In 2005, 9% of the population of Wardak province received allocations of food aid, which reached a total of 77,608 beneficiaries. In addition, of the 42% of households who reported taking out loans, more than half (54%) said that the main use of their largest loan was to buy food. A further 9% used the money to cover expenses for health emergencies.

Appendix O – Hydrological Data for the NEPS – SEPS Project Corridor[56]

The following table summarizes the key features of each basin:

River Basin	Amu Darya	Harirod-Murghab	**Hilmand**	**Kabul**	Northern
Area (km^2)	90,692	77,604	**262,341**	**76,908**	70,901
Settled Population	2,968,122	1,722,275	**5,887,571**	**7,184,974**	2,783,033
Population Density	33	22	**22**	**93**	39
Water Bodies	62	13	**2,271**	**25**	33
Marshlands	678	127	**2,284**	**264**	205
Irrigated Land	3,540	1,725	**4,758**	**3,060**	2,378
Rain fed Land	13,156	9,371	**2,344**	**1,554**	18,747
Rangeland	56,643	52,481	**113,258**	**37,152**	32,148
Forest Cover	648	99	**114**	**12,141**	64

The Project is located within the Hilmand and Kabul basins. The following is a short summary of both basins characteristics:

Hilmand Basin - Hilmand means 'abundant water' in old Persian and is the largest basin in Afghanistan covering almost half of the country. The basin covers the southern half of the country from the Province of Herat to Gardez all the way down to the Sistan depression bordering Iran. Most of Afghanistan's Karezes are located in the Hilmand Basin. Water from Karezes flows freely via underground tunnels from alluvial aquifers for surface irrigation. Dug for over centuries by local craftsmen from shafts at close intervals, karezes are usually small in dimension but maybe many kilometers in length. Kareze water is used for both irrigation and drinking water. No Kareze systems were located within the vicinity of the Project Road. The Hilmand basin is divided into fifteen watersheds:

- Adraskan Rod (River)
- Farah Rod
- Khuspas Rod
- Khash Rod
- Upper Hilmand (above Kajakai Dam)
- Middle Hilmand
- Lower Hilmand
- Sistan – Hilmand
- Chagay
- Upper Arghandab
- Lower Arghandab
- Tarnac Rod
- Arghistan Rod
- Sardeh wa Ghazni Rod
- Dasht-I Nawur

Sardeh wa Ghazni Rod watershed	
Area (km^2)	17252
Settled Population	1868342
Population Density	108.3
Water Bodies (km^2)	146.2
Marshlands (km^2)	30.0
Irrigated Land (km^2)	1065
Rain fed Land (km^2)	337
Rangeland (km^2)	11791
Forest Cover (km^2)	35

[56] Watershed Atlas of Afghanistan, FAO / AIMS, 2004

The first portion of the Project is located in the Sardeh wa Ghazni Rod watershed. Waters draining from the Spin Gar Mountains in Paktya flow through Gardez before filling in the Sardeh Dam Reservoir and expelling in the Jilga River (also known as the Sardeh Rod).

The Jilga River takes the majority of its flow from the Spin Gar Mountains and therefore has a seasonal flow that peaks in late spring. Flow rates for the Jilga are low ranging from 0.1 cubic meters per second in January rising to a peak of approximately 1.5 meters per second in May / June. The extent to which water from the river is used for agricultural purposes is unknown although given the low flow rates for the river and the presence of kereze systems in the vicinity of Gardez (but not within the vicinity of the Project Road) it is assumed that most water used for agricultural purposes around Gardez is ground water.[ii]

The Jilga meets with the Ghazni Rod in Giro district and flows into the Abi-I Istada salty lake. Abi-Istada is a large saline lake located approximately 2,000 m above msl in the southern corner of Ghazni Province. The site is important for the migrating greater flamingos that arrive at the high water level in late spring, breeding in the summer and departing during low water level in the autumn. More than 100 other bird species are present in the area. It was also once an important stopover for the Siberian Crane (the last observed Siberian Crane at Abi-Istada was shot dead by a hunter in 1986). When the lake overflows in good rainfall years in the spring, the water drains into the Lora River of the Arghistan watershed which contributes to the Hilmand River.

Kabul Basin - The second portion of the Project is located within the Kabul (Indus) Basin. The Kabul basin includes all Afghan rivers that join the Indus River in Pakistan which eventually empty into the Arabian Sea of the Indian Ocean. The basin covers 12% of the national territory, but alone it drains 26% of the total annual water flow of Afghanistan. As such, the basin has major hydropower potential which is already partly developed including the Darunta Dam and the Bandi Naghlu Dam. The Kabul basin is divided into eight main watersheds:

- Kabul
- Chak wa Logar Rod
- Ghorband wa Panjshir
- Alingar
- Kunar
- Shamal
- Gomal
- Pishin Lora

Appendix P – Afghan Ambient Air Quality Standards (draft)

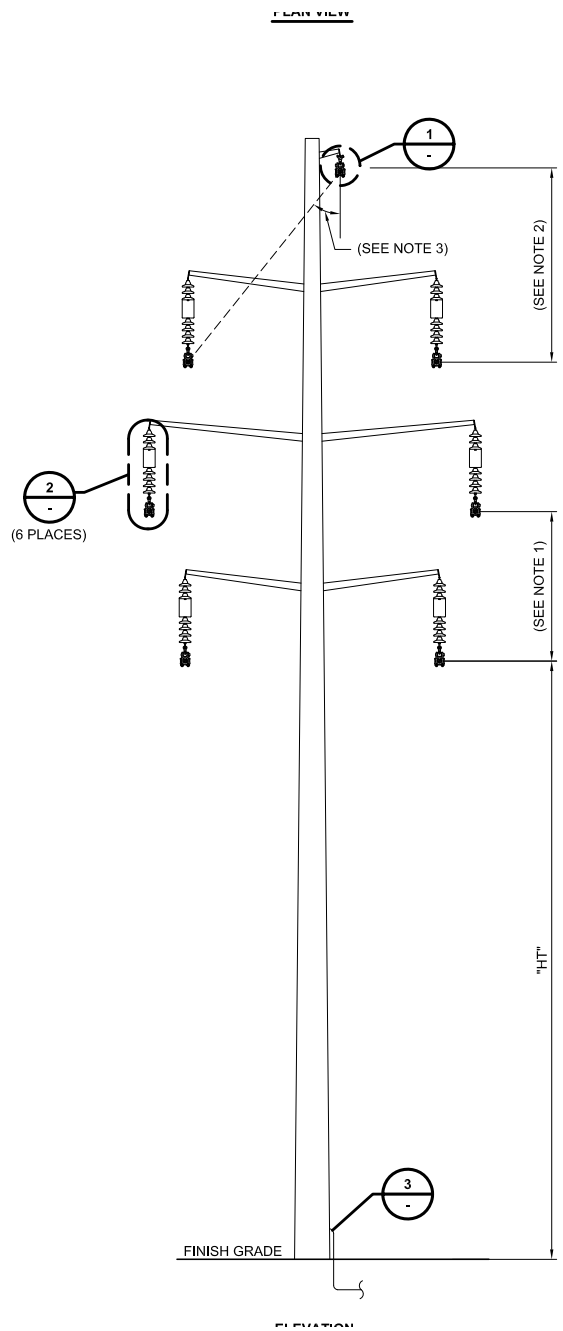
Table 3: National Ambient Air Quality Standard for Afghanistan

Parameter	Unit	Time Weighted Average	Concentration in Ambient Air, maximum	Method of Measurement
TSP	µg/m3	Annual		High Volume Sampling (avg flow ≥ 1.1 m3/min
		24-hour	300	
		8-hour		
PM10	µg/m3	Annual	70	Low volume sampler or β- Ray Absorption Method
		24-hour	150	
		8-hour		
PM2.5	µg/m3	Annual	35	Low volume sampler or β- Ray Absorption Method
		24-hour	75	
		8-hour		
Oxides of Nitrogen (as NO2)	µg/m3	Annual	40	Diffusive Sampling or Gas Phase Chemiluminescence
		24-Hour	80	
		1-Hour		
Sulfur Dioxide (SO2)	µg/m3	Annual		Diffusing Sampling or Ultraviolet Fluorescence method
		24-Hour	50	
		1-Hour		
Ozone (O3)	µg/m3	24-hour		Non dispersive UV absorption method
		8-Hour	100	
		1-Hour		
Carbon Monoxide (CO)	µg/m3	8-hour	10	Non Dispersive Infra Red (NDIR) method
		1-hour	30	
		30-minute	60	
Lead (Pb)	µg/m3	Annual	0.5	ASS Method after using EPM 2000 or equivalent filter paper
		24-Hour		
		1-Hour		

Note:

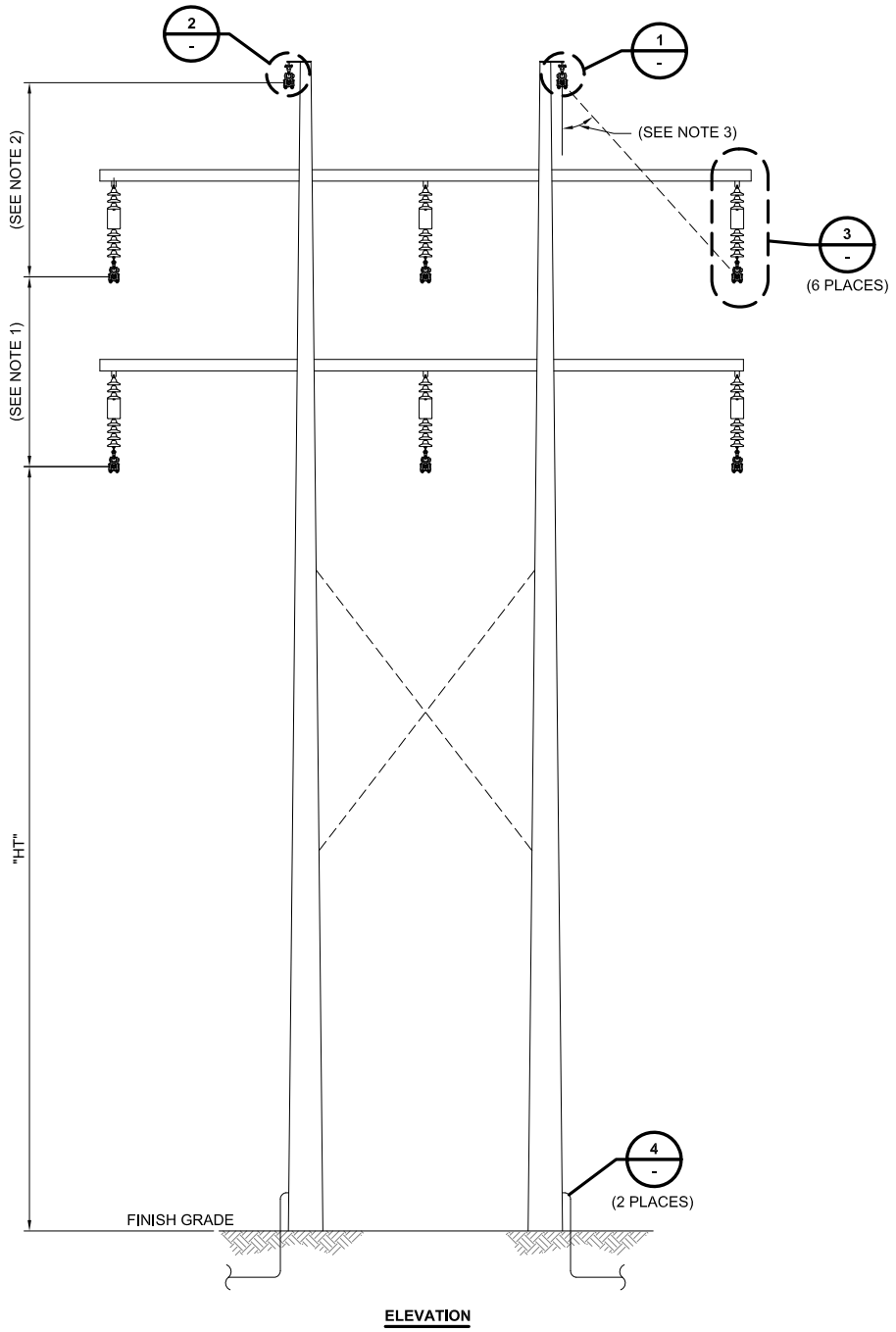
Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform intervals

24 hourly values shall be met 95% of the time in a year. 18 days per calendar year the standard may

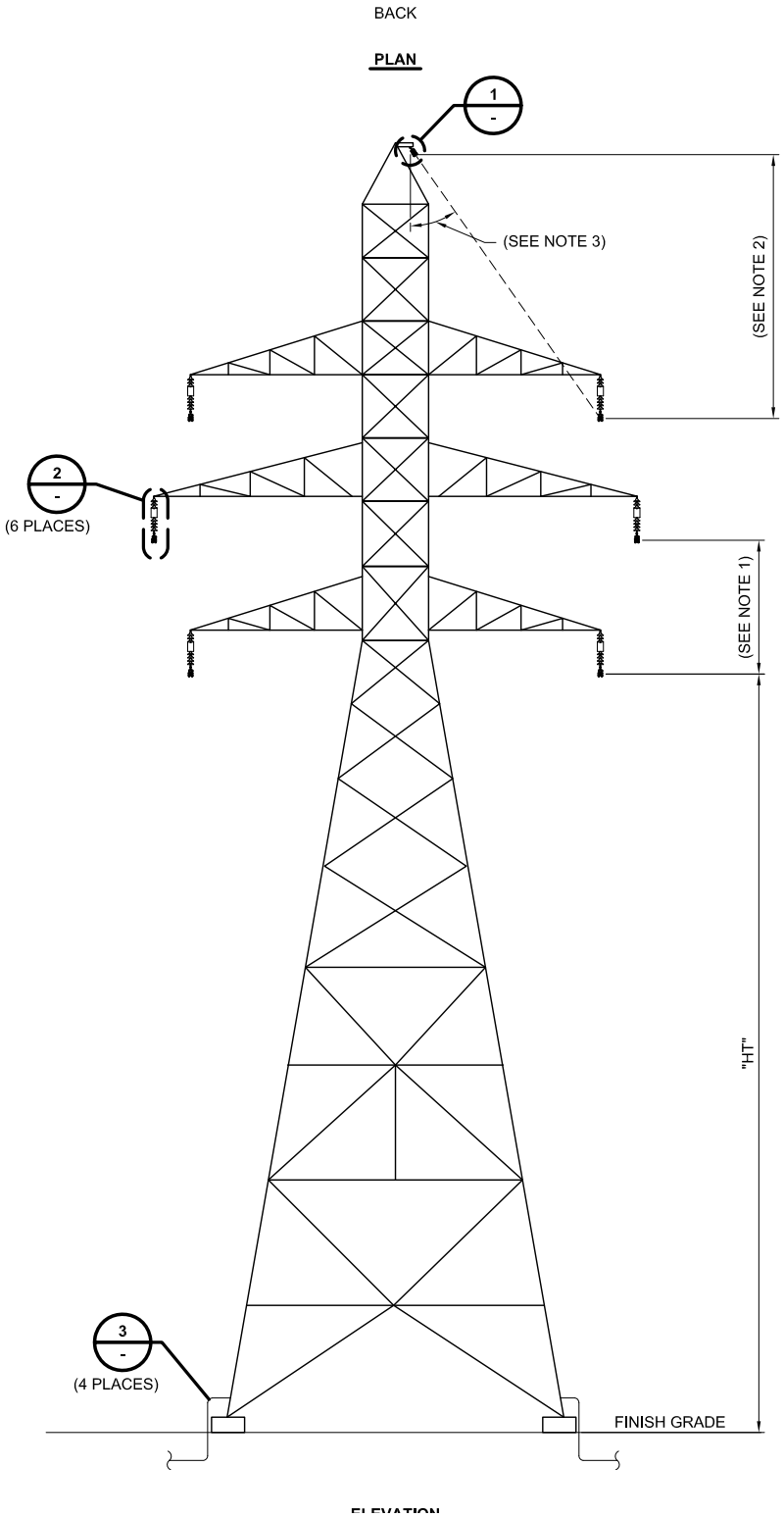


T-1: Monopole

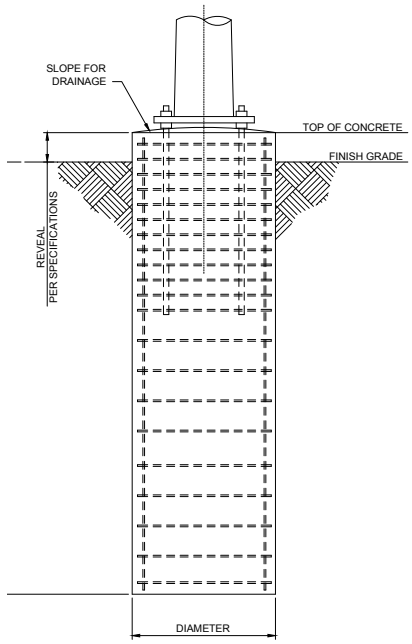
[57] NEPS Electrical Transmission Projects, Design Build RFP, USACE, 2011


2
-
1
-
(SEE NOTE 3)
(SEE NOTE 2)
3
-
(6 PLACES)
(SEE NOTE 1)
"HT"
4
-
(2 PLACES)
FINISH GRADE
ELEVATION

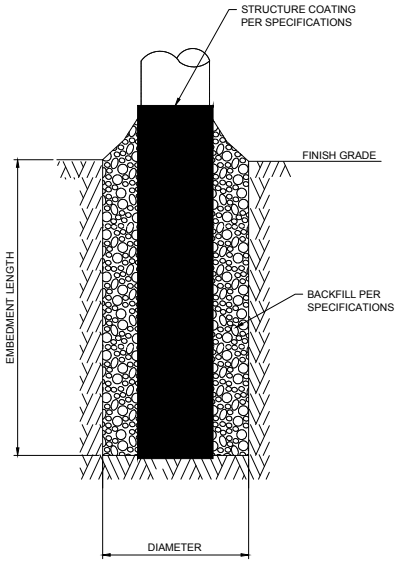
T-2: H-Frame



T-3: Lattice Tower



DRILLED SHAFT DETAIL



DIRECT EMBEDMENT DETAIL

T-4: Typical Foundation Unit

Appendix R – Typical Hazardous Materials Used in Construction[58]

TABLE 1.7-3 Hazardous Materials Typically Used for Transmission Line Construction

2-cycle oil (contains distillates and hydrotreated heavy paraffinic)	Gasoline treatment
ABC fire extinguisher	Hot stick cleaner (cloth treated with polydimethylsiloxane)
Acetylene gas	Hydraulic fluid
Air tool oil	Insect killer
Ammonium hydroxide	Insulating oil (inhibited, non-PCB)
Antifreeze (ethylene glycol)	Lubricating grease
Automatic transmission fluid	Mastic coating
Battery acid (in vehicles and in the meter house of the substations)	Methyl alcohol
Bottled oxygen	Motor oils
Brake fluid	Paint thinner
Canned spray paint	Propane
Chain lubricant (contains methylene chloride)	Puncture seal tire inflator
Connector grease (penotox)	Safety fuses
Contact Cleaner 2000	Starter fluid
Diesel deicer	Sulfur hexaflouride (within the circuit breakers in the substations)

[58] Design, Construction and operation of Long-Distance High Voltage Electricity Transmission Technologies. Environmental Science Division, Argonne National Laboratory, November, 2007

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Appendix 11c

Ghazni to Kandahar East Transmission Lines

EIA EMMP Items

Ghazni to Kandahar East High Voltage Transmission Lines (110 kv and 220 kv) – Design Phase				
Characteristic	**Impact**	**Mitigation**	**Responsibility & Schedule**	**Monitoring Requirements**
Geology and Seismicity	*The Project Corridor is located in a seismically active region.*	*Seismic loading shall be applied to the transmission tower designs.*	• *Contractor to include seismic loading during design.* • *CMC to approve Contractors designs.*	• *CMC regular inspections of construction works.*
Hydrology	*Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.*	*To mitigate this potential impact it is recommended that designs ensure:* • *Transmission line towers be located at least 50 meters from the river.*	• *Contractor to ensure appropriate locations of towers.*	• *CMC to approve designs.*
	Discharges of liquid waste from general construction works and construction camps.	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP), which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to prepare WMP during design phase* • *Contractor to implement WMP during construction*	• *CMC to approve WMP prior to construction.*
	Runoff and sedimentation from grading for access roads and tower pads, alteration of hydrological patterns due to maintenance roads.	*Designs will require hydrological and drainage impacts during construction to be minimized by early phasing of replacement of culverts and other infrastructure. These plans and designs will be included for in contracts.*	• *Contractor to include mitigation measures in designs.*	• *CMC to review and approve designs.* • *CMC to review works upon completion to assess suitability.*
	Impact to existing irrigation structures.	*During the design phase efforts shall be made to site facilities where they have the least impact to existing irrigation structures. Consultations shall be held between the local community to ensure that critical irrigation systems are identified and avoided.*	• *Contractor to consult with local community during the design phase regarding siting of facilities and camps.*	• *CMC to approve designs.*

Air Quality and Climate	*Construction vehicle and machinery emissions, including batching plants and staging areas.*	*During the design phase of the Project the prevailing wind direction should be considered to ensure that bunkers and conveyors at batching plants are sited in a leeward position to minimize the effects of the wind.*	• *Contractor to assess wind conditions during the design phase and site facilities accordingly.*	• *CMC to approved designs.*
Flora and fauna	*Impacts to Birds and bats*	*The Contractor shall consider the following elements during design:* • *Maintaining 1.5 meter (60-inch)11 spacing between energized components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware;* • *Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters.*	• *Contractor to assess requirements for avian protection during design.*	• *CMC to approve designs.*
Land use	*Land acquisition will be required, both temporary and permanent.*	*MEW or DABS shall be responsible for implementing a Land Acquisition and Resettlement Program (LARP) within the Project Corridor. The LARP shall be consistent with the requirements of WB OP4.12.*	• *MEW to engage consultants to prepare a LARP during the design phase.*	• *USAID MEO & COR, CMC, DABS / MEW to approve LARP prior to construction.* • *DABS to monitor implementation of the LARP and resolve any LARP related conflicts.*
Historical and Cultural Heritage	*Impacts to existing historical and cultural resources, notably around the city of Ghazni.*	*The Contractor shall ensure that during the design phase consultations are undertaken with MOIC to ensure that the routing of the transmission line does not impact upon historical and cultural resources in the Ghazni area. In addition.*	• *Contractor to consult with MOIC at the design phase.*	• *CMC to approve designs.*
		The Contractor shall also avoid siting any permanent and temporary facilities within 50 meters of Graveyards or Mosques.	• *Contractor shall ensure via his design, no impacts to these items*	• *CMC to approve designs.*
Socio-economics	*Community Health and safety may be affected during the construction period and also during any maintenance periods.*	*The Contractor shall include community health and safety aspects within the Health and Safety Plan (HSP). Contractor shall follow IFC guidelines for Community Health and Safety (see **Appendix F**)*	• *Contractor to prepare HSP during design phase* • *Contractor to implement HSP during the construction phase.* • *DABS to implement HSP during the operational phase.*	• *CMC to approve HSP prior to construction.* • *Review of Monthly reports and daily general observational monitoring by the CMC.*

	Health effects and annoyance from electromagnetic radiation.	*The Contractor shall evaluate potential exposure to the public against the reference levels developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Average and peak exposure levels should remain below the ICNIRP recommendation for General Public Exposure.* *If EMF levels are confirmed or expected to be above the recommended exposure limits, application of engineering techniques by the Contractor according to the recommendations of the IFC[1] should be considered to reduce the EMF produced by power lines, substations, or transformers. Examples of these techniques include:* • *Shielding with specific metal alloys* • *Increasing height of transmission towers* • *Modifications to size, spacing, and configuration of conductors*	• *Contractor to evaluate EMF impacts during design.*	• *CMC to review and approve Contractors design.*
Health and Safety	*Occupational Health and Safety Impacts during construction, e.g. working from heights, electrocution, etc.*	*The Contractor shall prepare a Health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to prepare HSP during design phase* • *Contractor to implement HSP during the construction phase.*	• *CMC to approve HSP prior to construction.* • *Review of Monthly reports and daily general observational monitoring by the CMC.*
Noise and Vibration	*Operational impacts including Corona discharge.*	*Corona Discharge noise could become a nuisance if located close to residential areas. However, this issue can be reduced by increasing the spacing between the conductors, increasing the diameter of the conductor, using bundled conductors, or by using corona rings or grading rings.*	• *Contractors to ensure designs include equipment to reduce corona noise.*	• *CMC to review and approve designs.*

[1] Environmental Health and Safety Guidlines, Electrical Power Transmission, IFC, 2007.

	It is possible that blasting and drilling activities will be required during the construction of the foundations for transmission line towers. This may impact upon sensitive receptors, depending on the location of the lines.	*The Contractor should prepare a Blast Plan prior to the commencement of works if blasting is required. The Plan, which shall be approved by the CMC, should ensure that:* - *Before the firing of any blast, the rock to be blasted shall be covered with approved blasting mats, soil, or other equally serviceable material, to prevent fly rock that may result in damage to life or property.* - *The Contractor shall protect all overhead and underground utilities prior to blasting and immediately repair or replace any damaged by the blasting operations.* - *Warning signs and public notification are required to avoid all risks to the public that use the roadway.* - *Blasting shall be restricted to the times specified by the Engineer* - *The Contractor shall use the utmost care so as not to endanger life or property, or disturb materials outside the limits of the excavation.* - *When blasting, ample warning shall be given to all persons within the vicinity prior to blasting. Warning signs shall be erected a minimum of 24 hours prior to the blast time, and workers shall be stationed to warn people before firing any blasts. The warning signs will state the time and date of each blast.*	• *Contractor to prepare Blast Plan during design phase* • *Contractor to implement Blast Plan during the construction phase.*	• *CMC to approve Blast Plan prior to construction.* • *Review of Monthly reports and daily general observational monitoring by the CMC.*

Ghazni to Kandahar East High Voltage Transmission Lines (110 kv and 220 kv) – Construction Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Soils	*Potential soil erosion from grading for access roads and tower pads.*	*The Contractor shall ensure that the following measures are implemented:* • *Schedule work so clearing and grading are done during the time of minimum rainfall.* • *Clear only areas essential for construction.* • *Locate potential area pollutant sources away from steep slopes, water bodies, and other critical areas.* • *Route construction traffic to avoid existing works or newly planted vegetation.* • *Protect natural vegetation with fencing, tree armoring, and retaining walls or tree wells.* • *Stockpile topsoil and reapply to re-vegetate the site.* • *Cover and stabilize topsoil stockpiles.* • *Stockpiles should not be located within 20m of water courses.*	• *Contractor implementation during construction.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

	Spills / Leaks of hazardous liquids during construction.	*Spills and leaks of chemicals and oils could contaminate soils, which could in turn lead to contamination of groundwater. Contract provisions shall be included to ensure that:* • *All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 percent of the volume of tanks.* • *Any construction camp maintenance yard shall be constructed on impervious hardstanding with adequate drainage to collect spills, there shall be no vehicle maintenance activities on open ground.* • *Filling and refueling shall be strictly controlled and subject to formal procedures. Drip pans shall be placed under all filling and fueling areas. Waste oils shall be stored and disposed of by a licensed contractor.* • *All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.* • *The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any soils.* • *All construction camps, temporary and permanent shall be located at least 500 meters away from surface water courses.*	*Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
		If complaints are received relating to spill, or leaks of liquids affecting local water supplies, the incidents and possible sources of water supply disruption will be investigated by the Contractor and where the complaint can be substantiated; water samples will be taken and analyzed based on the baseline monitoring results obtained in the preconstruction stage. Samples will be taken as soon after the complaint as possible and analyses immediately and again two weeks after the complaint to determine if water quality has been restored. The criteria will be based on the national standard.	• *Contractor to investigate complaints, if any, during Construction.* • *Contractor to undertake sampling if required.*	• *CMC to ensure complaint is addressed adequately according to the Contractors Grievance mechanism.*
Topography	*The use of quarried materials will be*	*Only licensed quarries shall be used to source construction materials.*	• *Contractor to select appropriate quarries as and when required.*	• *CMC to approve locations prior to the use of the quarry.*

	required for construction purposes.			
Hydrology	*Construction activities near / in aquatic ecosystems at water crossings of ROW and aquatic habitat alteration.*	*The Contractor shall ensure:* • *Sedimentation facilities be set up at rivers where all working stations are within 100m of streams and rivers, to trap and settle out runoff from the works.* • *Where wet works have to be pumped dry the wastewater should first be passed through a proprietary sedimentation tank (or similar) to remove suspended particles before discharge at a location agreed with the Engineer.* • *Where works cross streams and rivers the preliminary designs for sedimentation facilities such as sediment traps, filter fabric fences, or straw bale barriers should be included as a line item before those new areas are cleared and opened up for construction works.*	• *Contractor to implement mitigation during Construction phase*	• *Review of Monthly reports and daily general observational monitoring by CMC.*
	Discharges of liquid waste from general construction works and construction camps.	*At the locations of general construction works or temporary construction camps portable lavatories or at least pit latrines will be installed and open defecation shall be discouraged and prevented by keeping lavatory facilities clean at all times.*	• *Contractor to provide facilities during construction.*	• *General observational monitoring by the CMC.*
	Dumping of construction site waste into surface watercourses.	*The Contractor shall be responsible for ensuring compliance with his Waste Management Plan.*	• *Contractor to implement WMP during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Requirements for construction related water including potable water for construction workers and camps. These requirements could deplete local resources if not adequately	*The Contractor shall ensure that water extraction permits have been obtained from the MoM prior to the drilling of any boreholes for ground water extraction.*	• *Contractor to obtain Permits prior to construction.* • *MoM to issue permits.*	• *CMC to review permit approvals before start of extraction.*
		If any water is to be taken from local wells, or surface waters, permissions must be sought from the local community by the Contractor with oversight from the CMC.	• *Contractor shall consult with local community prior to any extraction.*	• *CMC to approve extraction locations.* • *Contractor to monitor water availability if requested by local community or CMC.*

	monitored and managed.			
	Impact to existing irrigation structures.	*If the irrigation cannot be maintained Contractors will provide and maintain alternative temporary irrigation structures for the construction phase. At the completion of construction the contractor(s) will re provision the irrigation structures disturbed by construction and agree with the local community if redesign is required or if new structures will be constructed or if the original irrigation structures will be repaired.*	• *Contractor to prepare alternative / temporary irrigation during construction if required.* • *Contractor to re-instate irrigations systems or construct new systems on the completion of project works.*	• *CMC to review designs for temporary / alternative irrigation.* • *DABS to consult with local community at the end of construction to ensure all irrigation is returned to an acceptable standard.*
	Impacts to Kareze networks	*The Contractor shall ensure that, as far as practical, impacts to Kareze systems are avoided. This shall be achieved through sighting construction facilities at least 50 meters from such a system. This will require consultation with Mirabs regarding this issue.*	• *Contractor to consult with Mirabs* • *Contractor to prepare suitable design.*	• *CMC to review and approve designs and provide construction supervision.*
	Concrete batching - Potential pollutants in batching plant wastewater and stormwater include cement, sand, aggregates, chemical admixtures, fuels and lubricants.	*The Contractor shall ensure that the site should be designed and constructed such that clean stormwater, including roof runoff, is diverted to the stormwater discharge system. Process wastewater and contaminated stormwater collected from the entire site should be diverted to a settling pond, or series of ponds, such that the water can be reused in the concrete batching process.*	• *Contractor to design suitable drainage at the design phase.*	• *CMC to approve designs and monitor the completion of satisfactory works during construction of batching plants.*
		Any liquids stored on site, including admixtures, fuels and lubricants, should be stored in accordance with the Hazardous Materials Management Plan.	• *Contractor to prepare Hazmat Plan during design* • *Contractor to implement Hazmat Plan during construction*	• *CMC to approve Hazmat Plan prior to construction.* • *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Wood preservatives contaminating ground water and surface waters.	*The methods for safe management of preservatives will be included within the Contractors Hazardous Materials management Plan.*		

Air Quality and Climate	*Construction vehicle and machinery emissions, including batching plants and staging areas.*	*Specifically relating to concrete batching plants, the Contractor shall ensure that:* • *The use of wheel and truck wash facilities at site exits, and the introduction of vehicle speed limits.* • *Aggregate stored on site in stockpiles should be contained within three-sided storage bunkers with windshields that project 0.5 meter above the bunker wall.* • *Conveyors must be designed and constructed to prevent fugitive dust emissions. This may include covering the conveyor with a roof, installing side protection barriers and equipping the conveyor with spill trays, which direct material to a collection point.* • *Mixer loading areas should be roofed and enclosed on either two (drive-through) or three sides. Water sprays and a robust curtain of suitable design, or an effective air extraction and filtration system, should be installed to suppress dust generated during mixer truck loading.* • *Weigh bins and hoppers should be enclosed on three sides and roofed where a front-end loader is used. The roof should extend 2 meters in front of the bin.* • *An approved fabric filter incorporating a fabric-cleaning device should be installed on each cement storage silo. The quality of the filter media and the design characteristics of the filter system must be capable of ensuring that the maximum concentration of solid particles in residual gases does not exceed 100 mg/m3* • *To prevent overfill and subsequent filter damage, storage silos should be fitted with high-level audible and visual alarms in addition to an automatic delivery shut-down.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
		Relating to general construction activities, the Contractor shall be responsible for ensuring that: • *If the working surfaces become dry and dusty (roads, staging areas, stockpiles, etc), water will be sprinkled on the and exposed surfaces when work is carried out within 50m of sensitive receptors* • *No work will be carried out during the night (2100hrs to 0700hrs).* • *If works give rise to complaints over dust, the contractor*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC*

		shall investigate the cause and review and propose alternative mitigation measures before works recommence. • *All heavy equipment and machinery will be fitted in full compliance with the national and local regulations.* • *Fuel-efficient and well-maintained haulage trucks will be employed to minimize exhaust emissions. Smoke belching vehicles and equipment will not be allowed and will be removed from the project.* • *Vehicles transporting soil, sand and other construction materials will be covered with tarpaulin sheets to avoid impact from dust. Speeds limits will be established for vehicles within the works sites and on unpaved edge areas of the project*		
	Impacts to air quality from open burning.	*The Contractor shall ensure:* • *Cutting and burning trees/shrubs for fuel shall be prohibited. Instead Gas Cylinders should be used in the labor camp for cooking purposes.* • *No open burning shall be allowed.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Flora and fauna	*Clearing of natural vegetation will be required for construction purposes (access road, tower sites, pulling and tensioning areas, and concrete batch plants/laydown areas), clearances for electrical safety, long-term maintenance, and reliability of the transmission line.*	*It will be the Contractor's obligation not to cause any additional destruction to Flora and Fauna of the area by respecting the limits of construction site and not to enter other territories.* *The Contractor shall also ensure that:* • *Within the rights-of-way, mature vegetation will be selectively removed under or near the conductors to provide adequate electrical clearance.* • *No unauthorized tree or bush cutting shall be allowed.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Waste	*General solid*	*The Contractor shall be responsible for the preparation of a*	• *Contractor to*	• *Review of Monthly*

Management and, Hazardous Materials	*waste management – Improper disposal of inert waste, such and general construction waste and domestic waste (foodstuff).*	*Waste Management Plan that will contain provisions for the management of inert waste and its disposal to suitable, licensed locations. The Plan shall ensure that all waste is disposed of at a licensed facility, where this may not be practical, the Contractor, with approval from the CMC and the relevant authorities, shall be responsible for operating his own landfill for inert waste only.*	*implement WMP during construction*	*reports and daily general observational monitoring by the CMC.*
	Spoil Material - There may be some surplus rock and soil based materials. The waste management plan (WMP) will be required to ensure waste from construction is managed properly and to reduce, reuse and recycle waste wherever possible	*The Contractor shall ensure that:* • *Spoil will not be disposed of in rivers and streams or other natural drainage path.* • *Spoil will not be disposed of on fragile slopes, flood ways, wetland, farmland, forest, religious or other culturally sensitive areas or areas where a livelihood is derived.* • *Use surplus spoil for local repair works to fill eroded gullies and depression areas and degraded land in consultation with local community.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Poor management of hazardous waste can have significant impacts to water resources, soils, air quality and the health and safety of workers and the local community.	*The Contractor shall prepare a Hazmat Plan.*	• *Contractor to implement Hazmat Plan during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC Environmentalist.*

	Clean up of construction camps	*At the conclusion of the project, the Contractor shall ensure all debris and waste shall be removed from construction camps, staging areas, etc. All temporary structures, including office buildings, shelters and toilets shall be removed by the contractor and exposed areas shall be planted with suitable vegetation, to the satisfaction of the Engineer.*	• *Contractor to provide site clear up at the end of construction, or at specific sectors as the works finish, e.g. staging areas, temporary construction camps, etc.*	• *CMC to approve site conditions.*
Infrastructure	*Traffic Delays caused by construction vehicle movements and potential blasting.*	*The Contractor shall be responsible for the preparation of a traffic control measures to limit impacts to traffic movements, locally and on the A1. These measures shall be included within the Health and safety Plan. They shall include measures to:* • *Minimize effects on pedestrian movements and amenity;* • *Manage and control vehicular movements to and from the site;* • *Maintain traffic capacity at intersections and in the vicinity of the site;* • *Maintain existing on-street parking in the vicinity of the site where practical;* • *Maintain access to other properties adjacent to the site;* • *Restrict vehicle activity to designated truck routes through the area;* • *Maintain safety for workers;* • *Provide appropriate access to the site for demolition, excavation and construction traffic;* • *Manage and control vehicle activity in the vicinity of the site.*	• *Contractor to implement HSP during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC,*
Historical and Cultural Heritage	*Chance finds of historical and cultural artifacts may be possible.*	*In the event of unanticipated discoveries of cultural or historic artifacts (movable or immovable) in the course of the work, the Contractor shall take all necessary measures to protect the findings and shall notify the CMC and provincial-level representatives of the relevant department within MOIC If continuation of the work would endanger the finding, project work shall be suspended until a solution for preservation of the artifacts is agreed upon.*	• *Contractor to notify the CMC and MOIC in the event of a chance find.*	*N/A*

Socio-economics	*Community Health and safety may be affected during the construction period and also during any maintenance periods.*	*The Contractor shall include community health and safety aspects within the HSP. Contractor shall follow IFC guidelines for Community Health and Safety (see **Appendix F**)*	• *Contractor to implement HSP during the construction phase.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Security	*The Contractor shall be responsible for providing security to workers during construction periods. This shall be implemented through a Security Plan.*	• *Contractor to prepare a security plan.*	*N/A*
Health and Safety	*Occupational Health and Safety Impacts during construction, e.g. working from heights, electrocution, etc.*	• *The Contractor shall prepare a Health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to implement HSP during the construction phase.*	• *Review of Monthly* • *reports and daily general observational monitoring by the CMC.*
Noise and Vibration	*It is possible that blasting and drilling activities will be required during the construction of the foundations for transmission line towers. This may impact upon sensitive receptors, depending on the location of the lines.*	*The Contractor should prepare a Blast Plan prior to the commencement of works if blasting is required. The Plan, which shall be approved by the CMC, should ensure that:* - *Before the firing of any blast, the rock to be blasted shall be covered with approved blasting mats, soil, or other equally serviceable material, to prevent fly rock that may result in damage to life or property.* - *The Contractor shall protect all overhead and underground utilities prior to blasting and immediately repair or replace any damaged by the blasting operations.* - *Warning signs and public notification are required to avoid all risks to the public that use the roadway.* - *Blasting shall be restricted to the times specified by the Engineer* - *The Contractor shall use the utmost care so as not to endanger life or property, or disturb materials outside the limits of the excavation.* - *When blasting, ample warning shall be given to all persons within the vicinity prior to blasting. Warning*	• *Contractor to implement Blast Plan during the construction phase.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

		signs shall be erected a minimum of 24 hours prior to the blast time, and workers shall be stationed to warn people before firing any blasts. The warning signs will state the time and date of each blast.		
		• *The Contractor shall be responsible for all damage to properties, including providing suitable temporary housing to residents or business occupants until repair work is completed.*	• *Contractor to compensate residents/businesses in the event of damage.* •	• *DABS to ensure adequate compensation is paid by the Contractor and disputes are resolved.*
	Noise from construction machinery and general construction activities	*Cooperation between the Contractor and the local residents is essential and it is the responsibility of DABS to arrange meetings between these parties and arrange such matters as work schedules (hours of equipment operation, traffic lanes to be kept open, diversion roads, etc.), locations of work camps and material storage areas, and siting of rock crushers and batch plants. In addition, the Contractor shall be responsible for ensuring the use of:* • *Source Controls, i.e., requirements that all exhaust systems will be maintained in good working order; properly designed engine enclosures and intake silencers will be employed; and regular equipment maintenance will be undertaken;* • *Site Controls, i.e., requirements that stationary equipment will be placed as far from sensitive land uses as practical; selected to minimize objectionable noise impacts; and provided with shielding mechanisms where possible;* • *Work near Sensitive Receptors shall be limited to short term activities. No asphalt plants, rock crushing plants or any long term generators of significant noise shall be allowed within 300 meters of sensitive receptors;* • *Time and Activity Constraints, i.e., operations will be scheduled to coincide with periods when people would least likely be affected; work hours and work days will be limited to less noise-sensitive times. Hours-of-work will be approved by the site engineer having due regard for possible noise disturbance to the local residents or other activities. Construction activities will be strictly prohibited between 10 PM and 6 AM in the residential areas. When operating close to sensitive areas such as residential, nursery, or medical facilities, the Sub-*	• *Contractor to consult with local community prior to the commencement of works in residential areas.* • *DABS to coordinate meetings.* • *Contractor to implement construction phase mitigation.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

		Contractor's hours of working shall be limited to 8 AM to 6 PM; • *Community Awareness, i.e., public notification of construction operations will incorporate noise considerations; methods to handle complaints will be specified. Sensitive receptors will be avoided as possible (i.e., aggregate crushers, operators, etc.).* • *Disposal sites and haul routes will be coordinated with the Engineer.*		

Ghazni to Kandahar East Substations (110 kv and 220 kv) – Design Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Geology and Seismicity	*The Project Corridor is located in a seismically active region.*	*Seismic loading shall be applied to the substation designs.*	• *Contractor to include seismic loading during design.* • *CMC to approve designs.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Hydrology	*Discharges of liquid waste from general construction works and construction camps.*	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP) which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to prepare WMP during design phase*	• *CMC to approve WMP prior to construction.*
Air Quality and Climate	*Construction vehicle and machinery emissions and dust*	*During the design phase of the Project the prevailing wind direction should be considered to ensure that bunkers and conveyors at batching plants are sited in a leeward position to minimize the effects of the wind.*	• *Contractor to assess wind conditions during the design phase and site facilities accordingly.*	• *CMC to approve designs.*
		The Contractor shall ensure switchgear equipment should have a nominal leakage and replacement rate of less than 1% per year.	• *Contractor to prepare suitable designs.*	• *CMC to approve designs.*

Waste Management and Hazardous Materials	*Hazardous waste management and disposal.*	*The Contractor shall be responsible for the preparation of a HazMat Plan.*	• *Contractor to prepare HazMat during design*	• *CMC to approve HazMat prior to construction.*
Land use	*Land acquisition will be required, both temporary and permanent.*	*MEW or DABS shall be responsible for implementing a Land Acquisition and Resettlement Program (LARP) within the Project Corridor. The LARP shall be consistent with the requirements of WB OP4.12.*	• *MEW or DABS to engage consultants to prepare a LARP during the design phase.*	• *USAID MEO & COR CMC, DABS / MEW to approve LARP prior to construction.* • *DABS to monitor implementation of the LARP and resolve any LARP related conflicts.*
Infrastructure	*Interference with other infrastructure, water supply, etc.*	*During the design phase the Contractor shall coordinate with Utilities in the work area to ensure that all construction sites, transmissions towers, staging areas, etc, do not impact upon existing infrastructure.*	• *Contractor to consult with Utilities during the design phase.*	• *CMC to approve designs.*
Health and Safety	*Occupational Health and Safety Impacts during construction.*	*The Contractor shall prepare a health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to prepare HSP during design phase*	• *CMC to approve HSP Plan prior to construction.*
Noise and Vibration	*Transformer noise, or 'hum'.*	*It is possible that transformers may give off a low audible hum. This is unlikely to have significant impacts to the local community, but siting of the substations more than 100 meters from residential properties should make this potential issue moot.*	• *Contractor to site substations more that 100 meters from residential areas.*	• *CMC to approve designs.*
	Corona discharge	*Corona Discharge noise could become a nuisance if located close to residential areas. However, this issue can be reduced by increasing the spacing between the conductors, increasing the diameter of the conductor, using bundled conductors, or by using corona rings or grading rings.*	• *Contractors to ensure designs include equipment to reduce corona noise.*	• *CMC to review and approve designs.*

Ghazni to Kandahar East Substations (110 kv and 220 kv) – Construction Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Soils			•	•
	Potential soil erosion from grading for substation facilities.	*The Contractor shall ensure the following:* • *Schedule work so clearing and grading are done during the time of minimum rainfall.* • *Clear only areas essential for construction.* • *Locate potential area pollutant sources away from steep slopes, water bodies, and other critical areas.* • *Route construction traffic to avoid existing works or newly planted vegetation.* • *Protect natural vegetation with fencing, tree armoring, and retaining walls or tree* • *Stockpile topsoil and reapply to re-vegetate the site.* • *Cover and stabilize topsoil stockpiles.* • *Stockpiles should not be located within 20m of water courses.*	• *Contractor implementation during construction.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Topography	*The use of quarried materials will be required for construction purposes.*	*Contract provisions specified in the EMMP shall ensure that only licensed quarries shall be used to source construction materials.*	• *Contractor to select appropriate quarries as and when required.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Hydrology	*Spills of fuels and lubricants used during construction works.*	*Contract provisions shall be included to ensure that:* • *All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 percent of the volume of tanks.* • *Any construction camp maintenance yard shall be constructed on impervious hardstanding with adequate drainage to collect spills; there shall be no vehicle maintenance activities on open ground.* • *Filling and refueling shall be strictly controlled and subject to formal procedures. Drip pans shall be placed under all filling and fueling areas. Waste oils shall be stored and disposed of by a licensed contractor.* • *All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.* • *The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any soils.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Discharges of liquid waste from general construction works and construction camps.	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP) which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to implement WMP during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Air Quality and Climate	*Construction vehicle and machinery emissions and dust*	*Specifically relating to concrete batching plants, the Contractor shall ensure that:* • *The use of wheel and truck wash facilities at site exits, and the introduction of vehicle speed limits.* • *Aggregate stored on site in stockpiles should be contained within three-sided storage bunkers with windshields that project 0.5 meter above the bunker wall.* • *Conveyors must be designed and constructed to prevent fugitive dust emissions. This may include covering the conveyor with a roof, installing side protection barriers and equipping the conveyor with spill trays, which direct material to a collection point.* • *Mixer loading areas should be roofed and enclosed on either two (drive-through) or three sides. Water sprays and a robust curtain of suitable design, or an effective air extraction and filtration system, should be installed to suppress dust generated during mixer truck loading.* • *Weigh bins and hoppers should be enclosed on three sides and roofed where a front-end loader is used. The roof should extend 2 meters in front of the bin.* • *An approved fabric filter incorporating a fabric-cleaning device should be installed on each cement storage silo. The quality of the filter media and the design characteristics of the filter system must be capable of ensuring that the maximum concentration of solid particles in residual gases does not exceed 100 mg/m3* • *To prevent overfill and subsequent filter damage, storage silos should be fitted with high-level audible and visual alarms in addition to an automatic delivery shut-down.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC*

		Relating to general construction activities, the Contractor shall be responsible for ensuring that: • *If the working surfaces become dry and dusty (roads, staging areas, stockpiles, etc), water will be sprinkled on the and exposed surfaces when work is carried out within 50m of sensitive receptors* • *No work will be carried out during the night (2100hrs to 0700hrs).* • *If works give rise to complaints over dust, the contractor shall investigate the cause and review and propose alternative mitigation measures before works recommence.* • *All heavy equipment and machinery will be fitted in full compliance with the national and local regulations.* • *Fuel-efficient and well-maintained haulage trucks will be employed to minimize exhaust emissions. Smoke belching vehicles and equipment will not be allowed and will be removed from the project.* • *Vehicles transporting soil, sand and other construction materials will be covered with tarpaulin sheets to avoid impact from dust. Speeds limits will be established for vehicles within the works sites and on unpaved edge areas of the project*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC*
Flora and fauna	*Clearing of natural vegetation will be required for construction purposes*	*It will be the Contractor's obligation not to cause any additional destruction to Flora and Fauna of the area by respecting the limits of construction site and not to enter other territories.* *The Contractor shall also ensure that:* • *Within the rights-of-way, mature vegetation will be selectively removed under or near the conductors to provide adequate electrical clearance.* • *No unauthorized tree or bush cutting shall be allowed.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Waste Management and Hazardous	*General waste management.*	*The Contractor shall be responsible for the preparation of a Waste Management Plan that will contain provisions for the management of inert waste and its disposal to suitable, licensed locations. The*	• *Contractor to implement WMP during construction*	• *Review of Monthly reports and daily general observational monitoring by the*

Materials		*Plan shall ensure that all waste is disposed of at a licensed facility, where this may not be practical, the Contractor, with approval from the CMC and the relevant authorities, shall be responsible for operating his own landfill for inert waste only.*		*CMC*
	Hazardous waste management and disposal.	*The Contractor shall be responsible for the preparation of a HazMat Plan.*	• *Contractor to implement HazMat during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Historical and Cultural Heritage	*Chance finds of historical and cultural artifacts may be possible.*	*In the event of unanticipated discoveries of cultural or historic artifacts (movable or immovable) in the course of the work, the Contractor shall take all necessary measures to protect the findings and shall notify the CMC and provincial-level representatives of the relevant department within MOIC If continuation of the work would endanger the finding, project work shall be suspended until a solution for preservation of the artifacts is agreed upon.*	• *Contractor to notify the CMC and MOIC in the event of a chance find.*	*N/A*
Health and Safety	*Occupational Health and Safety Impacts during construction.*	*The Contractor shall prepare a health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to implement HSP Plan during the construction phase.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Ghazni to Kandahar East Substations (110 kv and 220 kv) – Operational Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Soils	*Spills of oils during operational phase*	*In order to comply with best international practice to prevent contamination of soil, groundwater and surface water all the new substations will be designed to include dedicated surface drainage and secondary containment to control residual oil spills from installation, maintenance or decommissioning. The secondary containment (bunding) will seal the surface with concrete and shall be of sufficient capacity to hold 10% of the contents of the bunded equipment in the event of a catastrophic failure with loss of all transformer oil.*	• *Contractor to design substations with suitable drainage and containment measures.*	• *CMC to approve designs and sign off construction works.*

Appendix 11d

Ghazni to Kandahar East Substations

EIA EMMP Items

Ghazni to Kandahar East Substations (110 kv and 220 kv) – Design Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Geology and Seismicity	*The Project Corridor is located in a seismically active region.*	*Seismic loading shall be applied to the substation designs.*	• *Contractor to include seismic loading during design.* • *CMC to approve designs.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Hydrology	*Discharges of liquid waste from general construction works and construction camps.*	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP) which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to prepare WMP during design phase*	• *CMC to approve WMP prior to construction.*
Air Quality and Climate	*Construction vehicle and machinery emissions and dust*	*During the design phase of the Project the prevailing wind direction should be considered to ensure that bunkers and conveyors at batching plants are sited in a leeward position to minimize the effects of the wind.*	• *Contractor to assess wind conditions during the design phase and site facilities accordingly.*	• *CMC to approve designs.*
		The Contractor shall ensure switchgear equipment should have a nominal leakage and replacement rate of less than 1% per year.	• *Contractor to prepare suitable designs.*	• *CMC to approve designs.*
Waste Management and Hazardous Materials	*Hazardous waste management and disposal.*	*The Contractor shall be responsible for the preparation of a HazMat Plan.*	• *Contractor to prepare HazMat during design*	• *CMC to approve HazMat prior to construction.*
Land use	*Land acquisition will be required, both temporary and permanent.*	*MEW or DABS shall be responsible for implementing a Land Acquisition and Resettlement Program (LARP) within the Project Corridor. The LARP shall be consistent with the requirements of WB OP4.12.*	• *MEW or DABS to engage consultants to prepare a LARP during the design*	• *USAID MEO & COR CMC, DABS / MEW to approve LARP prior to construction.*

			phase.	• *DABS to monitor implementation of the LARP and resolve any LARP related conflicts.*
Infrastructure	*Interference with other infrastructure, water supply, etc.*	*During the design phase the Contractor shall coordinate with Utilities in the work area to ensure that all construction sites, transmissions towers, staging areas, etc, do not impact upon existing infrastructure.*	• *Contractor to consult with Utilities during the design phase.*	• *CMC to approve designs.*
Health and Safety	*Occupational Health and Safety Impacts during construction.*	*The Contractor shall prepare a health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to prepare HSP during design phase*	• *CMC to approve HSP Plan prior to construction.*
Noise and Vibration	*Transformer noise, or 'hum'.*	*It is possible that transformers may give off a low audible hum. This is unlikely to have significant impacts to the local community, but siting of the substations more than 100 meters from residential properties should make this potential issue moot.*	• *Contractor to site substations more that 100 meters from residential areas.*	• *CMC to approve designs.*
	Corona discharge	*Corona Discharge noise could become a nuisance if located close to residential areas. However, this issue can be reduced by increasing the spacing between the conductors, increasing the diameter of the conductor, using bundled conductors, or by using corona rings or grading rings.*	• *Contractors to ensure designs include equipment to reduce corona noise.*	• *CMC to review and approve designs.*

Ghazni to Kandahar Substations (110 kv and 220 kv) – Construction Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Soils			•	•
	Potential soil erosion from grading for substation facilities.	*The Contractor shall ensure the following:* • *Schedule work so clearing and grading are done during the time of minimum rainfall.* • *Clear only areas essential for construction.* • *Locate potential area pollutant sources away from steep slopes, water bodies, and other critical areas.* • *Route construction traffic to avoid existing works or newly planted vegetation.* • *Protect natural vegetation with fencing, tree armoring, and retaining walls or tree* • *Stockpile topsoil and reapply to re-vegetate the site.* • *Cover and stabilize topsoil stockpiles.* • *Stockpiles should not be located within 20m of water courses.*	• *Contractor implementation during construction.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Topography	*The use of quarried materials will be required for construction purposes.*	*Contract provisions specified in the EMMP shall ensure that only licensed quarries shall be used to source construction materials.*	• *Contractor to select appropriate quarries as and when required.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Hydrology	*Spills of fuels and lubricants used during construction works.*	*Contract provisions shall be included to ensure that:* • *All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 percent of the volume of tanks.* • *Any construction camp maintenance yard shall be constructed on impervious hardstanding with adequate drainage to collect spills; there shall be no vehicle maintenance activities on open ground.* • *Filling and refueling shall be strictly controlled and subject to formal procedures. Drip pans shall be placed under all filling and fueling areas. Waste oils shall be stored and disposed of by a licensed contractor.* • *All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.* • *The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any soils.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
	Discharges of liquid waste from general construction works and construction camps.	*The contractor shall be responsible for the preparation of a Waste Management Plan (WMP) which will include procedures for the management of liquid wastes from all construction sites. The WMP shall be reviewed and approved by the CMC prior to the start of construction works. The Plan shall include provisions for the inclusion of on site septic tanks and the suitable disposal of sludge from these tanks when they are full.*	• *Contractor to implement WMP during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Air Quality and Climate	*Construction vehicle and machinery emissions and dust*	*Specifically relating to concrete batching plants, the Contractor shall ensure that:* • *The use of wheel and truck wash facilities at site exits, and the introduction of vehicle speed limits.* • *Aggregate stored on site in stockpiles should be contained within three-sided storage bunkers with windshields that project 0.5 meter above the bunker wall.* • *Conveyors must be designed and constructed to prevent fugitive dust emissions. This may include covering the conveyor with a roof, installing side protection barriers and equipping the conveyor with spill trays, which direct material to a collection point.* • *Mixer loading areas should be roofed and enclosed on either two (drive-through) or three sides. Water sprays and a robust curtain of suitable design, or an effective air extraction and filtration system, should be installed to suppress dust generated during mixer truck loading.* • *Weigh bins and hoppers should be enclosed on three sides and roofed where a front-end loader is used. The roof should extend 2 meters in front of the bin.* • *An approved fabric filter incorporating a fabric-cleaning device should be installed on each cement storage silo. The quality of the filter media and the design characteristics of the filter system must be capable of ensuring that the maximum concentration of solid particles in residual gases does not exceed 100 mg/m3* • *To prevent overfill and subsequent filter damage, storage silos should be fitted with high-level audible and visual alarms in addition to an automatic delivery shut-down.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC*

		Relating to general construction activities, the Contractor shall be responsible for ensuring that: • *If the working surfaces become dry and dusty (roads, staging areas, stockpiles, etc), water will be sprinkled on the and exposed surfaces when work is carried out within 50m of sensitive receptors* • *No work will be carried out during the night (2100hrs to 0700hrs).* • *If works give rise to complaints over dust, the contractor shall investigate the cause and review and propose alternative mitigation measures before works recommence.* • *All heavy equipment and machinery will be fitted in full compliance with the national and local regulations.* • *Fuel-efficient and well-maintained haulage trucks will be employed to minimize exhaust emissions. Smoke belching vehicles and equipment will not be allowed and will be removed from the project.* • *Vehicles transporting soil, sand and other construction materials will be covered with tarpaulin sheets to avoid impact from dust. Speeds limits will be established for vehicles within the works sites and on unpaved edge areas of the project*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC*
Flora and fauna	*Clearing of natural vegetation will be required for construction purposes*	*It will be the Contractor's obligation not to cause any additional destruction to Flora and Fauna of the area by respecting the limits of construction site and not to enter other territories.* *The Contractor shall also ensure that:* • *Within the rights-of-way, mature vegetation will be selectively removed under or near the conductors to provide adequate electrical clearance.* • *No unauthorized tree or bush cutting shall be allowed.*	• *Contractor implementation during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Waste Management and	*General waste management.*	*The Contractor shall be responsible for the preparation of a Waste Management Plan that will contain provisions for the management of inert waste*	• *Contractor to implement WMP*	• *Review of Monthly reports and daily*

Hazardous Materials		*and its disposal to suitable, licensed locations. The Plan shall ensure that all waste is disposed of at a licensed facility, where this may not be practical, the Contractor, with approval from the CMC and the relevant authorities, shall be responsible for operating his own landfill for inert waste only.*	*during construction*	*general observational monitoring by the CMC*
	Hazardous waste management and disposal.	*The Contractor shall be responsible for the preparation of a HazMat Plan.*	• *Contractor to implement HazMat during construction*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*
Historical and Cultural Heritage	*Chance finds of historical and cultural artifacts may be possible.*	*In the event of unanticipated discoveries of cultural or historic artifacts (movable or immovable) in the course of the work, the Contractor shall take all necessary measures to protect the findings and shall notify the CMC and provincial-level representatives of the relevant department within MOIC If continuation of the work would endanger the finding, project work shall be suspended until a solution for preservation of the artifacts is agreed upon.*	• *Contractor to notify the CMC and MOIC in the event of a chance find.*	*N/A*
Health and Safety	*Occupational Health and Safety Impacts during construction.*	*The Contractor shall prepare a health and safety plan for all construction related activities. The plan shall be reviewed, approved and monitored by the CMC. It is recommended that the Contractor follows IFC EHS Standards as good practice.*	• *Contractor to implement HSP Plan during the construction phase.*	• *Review of Monthly reports and daily general observational monitoring by the CMC.*

Ghazni to Kandahar Substations (110 kv and 220 kv) – Operational Phase				
Characteristic	***Impact***	***Mitigation***	***Responsibility & Schedule***	***Monitoring Requirements***
Soils	*Spills of oils during operational phase*	*In order to comply with best international practice to prevent contamination of soil, groundwater and surface water all the new substations will be designed to include dedicated surface drainage and secondary containment to control residual oil spills from installation, maintenance or decommissioning. The secondary containment (bunding) will seal the surface with concrete and shall be of sufficient capacity to hold 10% of the contents of the bunded equipment in the event of a catastrophic failure with*	• *Contractor to design substations with suitable drainage and containment measures.*	• *CMC to approve designs and sign off construction works.*

		loss of all transformer oil.		

Appendix 11e

NEPS/SEPS Connector Five Substations from Qarabagh to Kandahar East in One Lot

Environmental Mitigation and Monitoring Plan (EMMP)

The EMMP must be completed by each organization carrying out activities under the USAID/Afghanistan Power Transmission Expansion and Connectivity (PTEC) Program. It will include the organization's own report plus the EMMPs of any sub-awardees, to capture the entire range of activities funded PTEC under the award. Implementing partners of PTEC activities are responsible for ensuring that each sub-awardee completes and submits the EMMP to the prime in a timely fashion. The EMMPs are reviewed and approved by DABS and USAID.

The EMMP consists of 3 parts:

1. The Environmental Verification Form
2. The Mitigation Plan for specific environmental threats carried out by the implementer
3. The Reporting Form

The EMMP Environmental Verification Form

This form indicates the categories of activities carried out by implementing partners (or their sub-awardees) and serves to 'trigger' USAID expectations of mitigation measures.

The EMMP Mitigation Plan

Implementing partners will use the Mitigation Plan to describe the specific actions they will undertake under each category of activity when screening reveals potential environmental threats as outlined in Section 3 of this IEE. In these cases, mitigation will be undertaken as described in Section 5, Table 4 of this IEE. The Mitigation Plan also identifies the person responsible for monitoring compliance with mitigation and the indicator, method and frequency of monitoring.

The EMMP Reporting Form

This form reports on the results of applying the mitigation measures described in the Mitigation Plan and identifies outstanding issues with respect to required conditions. In some cases, digital photos will be the best way to document mitigation and should be included in the report.

EMMP Part 1 of 3: Environmental Verification Form

Name _____

Date of Screening:_____

Name of Prime Implementing Organization:_____

Funding Period for this award: FY____- FY____

Current FY Resource Levels: FY_____

Name of Sub-awardee Organization (if this EMMP is for a sub):
_____

This report prepared by:
Name:_____ Date: _____

Geographic location of USAID-funded activities (Province, District):_____

Date of Previous EMMP for this organization:
_____ (if any)

Indicate which activities your organization is implementing under this funding:

Key Elements of Program/Activities Implemented		Yes	No
1	• education, technical assistance or training programs • design work, analyses, studies, academic or research workshops and meetings; • document and information transfers; • Studies, projects or programs intended to develop the capability of recipient countries to engage in development planning, except to the extent designed to result in activities directly affecting the environment (such as construction of facilities, etc.);		
2	Construction of transmission lines, substations, and/or distribution systems		
3	Rehabilitation of transmission lines, substations, distribution systems, and/or power facilities		
4	Procurement of equipment and/or materials		
5	Other (describe)		

EMMP Part 2 of 3: Environmental Mitigation and Monitoring Plan

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Category of Activity	Describe specific environmental threats of your organization's activities (based on analysis in Section 3 of the IEE)	Description of Mitigation Measures for these activities as required in Section 5 of IEE	Who is responsible for monitoring	Monitoring Indicator	Monitoring Method	Frequency of Monitoring

EMMP part 3 of 3: Reporting form

List each Mitigation Measure from column 3 in the EMMP Mitigation Plan (EMMP Part 2 of 3)	Status of Mitigative Measures	List any outstanding issues relating to required conditions	Remarks

Certification

I certify the completeness and the accuracy of the mitigation and monitoring plan described above for which I am responsible and its compliance with the IEE:

_____ _____
Signature Date

_____
Print Name

_____
Organization

BELOW THIS LINE FOR DABS and USAID USE ONLY

DABS

Project Manager: _____ Date: _____

USAID/Afghanistan

COR or OBM: _____ Date: _____

Mission Environmental Officer: _____ Date: _____

As appropriate: REA, BEO [depending on nature of activity, which potentially may require an EA]

Note: if clearance is denied, comments must be provided to applicant