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USAID –OEGI
Tarakhil Power Plant Water Piping System
WO-LT-0070

Specifications

Submitted to:

USAID Office of Infrastructure, Engineering and Energy (OEGI-AESP)
Café Compound
U.S. Embassy Great Massoud Road Kabul, Afghanistan

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SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.

2. Work covered by Contract Documents.

3. Construction schedule.

4. General requirements of Contract.

5. Owner-furnished products.

6. Access to site.

7. Coordination with occupants.

8. Work restrictions.

1.3 PROJECT INFORMATION

A. Project Identification: Tarakhil Power Plant Water Piping System.

1. Project Location: Tarakhil Power Plant, Kabul, Afghanistan.

B. Owner: Da Afghanistan Breshna Sherkat (DABS)

C. Owner's Representative: Owner's Representative will be appointed by Owner.

1. Owner's Representative will provide assistance in administering the Contract between Owner and Contractor, according to provisions of Division 01 Section, "Project Management and Coordination."

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work is defined by the Contract Documents and consists of the following:

1. Replacement of the underground fire suppression water piping including all excavation, removal, replacement connections, and site repairs as further described in the Contract Documents.

2. Connection of the heat tracing system, with insulation and aluminum jacket, from the new building connections to the underground elbow of the fire water pipe. The insulation, heat tracing, and aluminum jacket shall extend into the ground to a minimum depth of 1100mm.

3. Installation of a temporary fire suppression system for use during construction of the permanent fire suppression system.

4. Installation of a lifting hoist in the well house for removal of the pump.

5. Project cleanup.

CONSTRUCTION SCHEDULE

B. The Work shall be conducted in accordance with the following schedule:

1. Commencement of construction date: Spring 2014.

2. Substantial Completion date: Fall 2014.

3. Final completion date: Fall 2014.

4. The Work shall be conducted in phases, with each phase substantially complete as indicated:

a. Phase 1 - Installation of temporary system: Installation of temporary water supply system. Work of this phase shall commence by Spring 2014 and be substantially complete within 30 days of the start of work.

b. Phase 2 – Installation of permanent water supply: The remaining Work shall be substantially complete by Fall 2014.

1.5 GENERAL REQUIREMENTS OF CONTRACT

A. Electric power service from existing system: Electric power from existing system is available for use on site.

1.6 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Contractor's Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.

B. Owner-Furnished Products:

1. As specified in the BOQ.

1.7 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.

b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.8 COORDINATION WITH OCCUPANTS

A. Owner Occupancy: Owner will occupy site during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner’s Representative and approval of authorities having jurisdiction.

2. Maintain in operation all life safety provisions and devices (including, but not limited to, fire alarms, fire extinguishers, smoke detectors, heat sensors, emergency and exit lighting, defibrillators, and similar items).

3. Notify Owner’s Representative not less than 48 hours in advance of activities that will affect Owner's operations.

1.9 WORK RESTRICTIONS

A. On-Site Work Hours: Limit work to normal business working hours of 7 a.m. to 5 p.m., Saturday through Thursday, except as otherwise indicated. Movement of materials is not permitted in Owner-occupied areas during normal business hours.

1. Other Weekday Hours: 7 a.m. to 5 p.m. Friday, dawn to dusk any day subject to Owner’s permission.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner's Representative not less than 48 hours in advance of proposed utility interruptions.

2. Obtain Owner's Representative's written permission before proceeding with utility interruptions.

C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner's Representative not less than 48 hours in advance of proposed disruptive operations.

2. Obtain Owner's Representative's written permission before proceeding with disruptive operations.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General, Supplementary and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action Submittals are those submittals indicated in individual Specification Sections as "Action Submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "Informational Submittals."

1.4 SUBMITTALS

A. Action Submittals:

1. Submittal Schedule: Submit a schedule of submittals indicating scheduled date for each submission. Factor time required for review, ordering, manufacturing, fabrication, and delivery when establishing submission dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

a. Submit concurrently with the first complete submittal of Contractor's construction schedule.
b. Format: Arrange the following information in a tabular format:

1) Specification Section number and title.
2) Architect/Engineer (A/E) Number.

a) Engineer will furnish Contractor with unique “A/E Number” designation for each required submittal.

3) Submittal Category: Action, Informational.
4) Submittal Type: Product Data, Shop Drawings, Samples, etc.

5) Description of the Work Covered.
6) Scheduled Date for First Submittal.
7) Contractor Tracking Number.
8) Government Action.

B. Informational Submittals:

1. Within 30 days after date of Notice of Award, submit a complete list of proposed manufacturers and complete product designations (i.e. model, grade, series, product line, etc.) for each item requiring color selection by Engineer.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Where indicated, submit all submittal items required for each Specification Section concurrently.

3. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Processing Time: Allow sufficient time for submittal review, including time for resubmittals. No time extension of the Contract will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

C. Identification and Information: Place a cover sheet on each submittal item for identification. Do not combine different submittals under same cover sheet.

1. Cover Sheet: Use facsimile of sample form included in Project Manual. Complete each item on form, sign and date.

D. Transmittal: Assemble each submittal package appropriately for transmittal and handling. Transmit each submittal package using a transmittal form. Engineer will return submittals, without review, received from sources other than Contractor.

1. Transmittal Form: Provide locations on form for the following information:

a. Date.
b. Engineer’s project name and number.
c. Contractor’s name, address and telephone number.
d. List of submittals included.
e. Identify options requiring selection by the Engineer.
f. Remarks.

g. Specification section number and description of item.
h. Contractor tracking number.

E. Resubmittals: Make resubmittals in same form and number of copies as the initial submittal.

1. Note date and content of revision in label or title block and clearly indicate extent of revision.

2. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.

F. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, and installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

G. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Action Submittals: Submit an electronic copy of each submittal, unless otherwise indicated. Engineer will return one copy.

1) The contactor may submit paper copies of Shop Drawings, instead of an electronic copy, subject to approval of the Engineer.

2. Informational Submittals: Submit an electronic copy of each submittal, unless otherwise indicated. Engineer will not return copies.

1) The contactor may submit paper copies of Shop Drawings, instead of an electronic copy, subject to approval of the Engineer.

3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. Mark each copy of each submittal to show which products and options are applicable.

2. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Statement of compliance with specified referenced standards.

c. Testing by recognized testing agency.

3. For equipment, include the following in addition to the above, as applicable:

a. Printed performance curves.
b. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of dimensions established by field measurement.
e. Relationship and attachment to adjoining construction clearly indicated.
f. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on A4 size sheets, but no larger than Contract Documents.

3. Submit Shop Drawings in the following format:

a. An electronic copy of each submittal. Engineer will return one copy.

1) The contactor may submit paper copies of shop drawings, instead of an electronic copy, subject to approval of the Engineer.

D. Samples: Submit Samples for review of kind, a check of characteristics with other elements, and a comparison of these characteristics between submittal and actual components as delivered and installed.

1. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.

2. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

3. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit two (2) full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from

manufacturer's product line. Engineer will return one submittal with options selected.

4. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, physically identical with material or product proposed for use, and that shows full range of color and texture variations expected. Samples include, but are not limited to, the following:

   a. Partial sections of manufactured or fabricated components.
   b. Small cuts or containers of materials.
   c. Complete units of repetitively used materials.
   d. Swatches showing color, texture, and pattern.
   e. Color range sets.
   f. Components used for independent testing and inspection.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product: Include unique identifier for each product indicated in the Contract Documents.

2. Manufacturer and product name, and model number if applicable.

3. Number and name of room or space.

4. Submit product schedule in the following format:

   a. An electronic copy of product schedule, unless otherwise indicated.

F. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.

3. Submit subcontract list in the following format:

   a. An electronic copy of subcontractor list, unless otherwise indicated.

I. Key Personnel Names: No later than 15 days after date of Notice of Award, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project

site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including emergency, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

J. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

K. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.

N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed

before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

Y. Warranty: Provide manufacturer’s standard guarantees and warranties for items submitted by the contractor.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Identify any deviations from Contract Document requirements. Mark cover sheet with approval stamp before submitting to Engineer.

1. Sign and date statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. Final Unrestricted Release: Where the submittal is marked "Approved," the Work covered by the submittal may proceed provided it complies with the Contract Documents. Final acceptance will depend on that compliance.

2. Final-but-Restricted Release: Where the submittal is marked "Approved as Noted," the Work covered by the submittal may proceed provided it complies both with Engineer's notations and corrections on the submittal and the Contract Documents. Final acceptance will depend on that compliance.

3. Resubmit: Where the submittal is marked "Approved, Revise and Return Corrected Copies," the Work covered by the submittal may proceed provided it complies both with Engineer's notations and corrections on the submittal and the Contract Documents. Revise submittal according to Engineer's notations and corrections and return corrected copies. Final acceptance will depend on that compliance.

4. Rejected: Where the submittal is marked "Rejected," do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.

5. Incomplete - Resubmit: Where the submittal is marked "Submit Additional Information," do not proceed with the Work covered by the submittal. Prepare additional information requested, or required by the Contract Documents, that indicates compliance with requirements, and resubmit.

C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION

Submittal Transmittal Form

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read instructions prior to initiating this form.)	Date:	☐ New Submittal ☐ Resubmittal

Section I Request For Acceptance of the Following Items *(This section to be initiated by Subcontractor)*

To:	From:	Task Order No.:	Submittal No. Previous Submittal No.
Specification Sec. No. *(Cover only one section with each Submittal)*		Project Title and Location:	

				Contract Reference Document		
Item No. a.	Description of Item Submitted (Type, size, model number, etc.) b.	MFG. or Contr. Cat., Curve Drawing, or Brochure No. *(See Instruction #4)* c.	No. of Copies d.	Spec. Paragraph No. e.	Drawing Sheet No. f.	Contractor Action Code* *(See Instruction #5)* g.

Remarks:

I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor:

Section II **Reviewed and Accepted**

Enclosures Returned (List by Item No.):	Title and Signature:	Date:

Review of this document with or without comments is only for general conformance with the design documents and for confirmation of physical interface of items shown with related systems. Such review shall in no way relieve Subcontractor from entire responsibility for engineering, design, conformance with applicable codes and standards, workmanship, material, performance of the equipment and the material, or any other liability under the contract.

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer or Owner’s Representative are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions before, during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer or Owner’s Representative.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

E. Installer: Contractor or another entity engaged by Contractor as an Employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

F. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five (5) previous projects similar in nature, size, and extent to this Project; and being familiar with special requirements indicated.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.5 SUBMITTALS

A. Informational Submittals:

1. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

2. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

   a. Specification Section number and title.
   b. Entity responsible for performing tests and inspections.
   c. Description of test and inspection.
   d. Identification of applicable standards.
   e. Identification of test and inspection methods.
   f. Number of tests and inspections required.
   g. Time schedule or time span for tests and inspections.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.

2. Project title and number.

3. Name, address, and telephone number of testing agency.

4. Dates and locations of samples and tests or inspections.

5. Names of individuals making tests and inspections.

6. Description of the Work and test and inspection method.

7. Identification of product and Specification Section.

8. Complete test or inspection data.

9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking, testing, and inspecting.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.

12. Name and signature of laboratory inspector.

13. Recommendations on retesting and re-inspecting.

1.7 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated using ASTM E 329 as a guide; and with additional qualifications specified in individual Sections.

C. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Engineer.

2. Notify Owner’s Representative seven days in advance of dates and times when mockups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Obtain Engineer's or Owner’s Representative approval of mockups before starting work, fabrication, or construction.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

6. Demolish and remove mockups when directed unless otherwise indicated.

1.8 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services. Perform quality-control services required of Contractor, whether specified or not.

2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

C. Technical Services: Where indicated, engage a technical representative, familiar with the proper installation and approved by the Engineer, to observe and inspect the Work. Technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

D. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Associated Services: Cooperate with the Engineer performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

4. Facilities for storage and field curing of test samples.

5. Preliminary design mix proposed for use for material mixes that require control by testing agency.

6. Security and protection for samples and for testing and inspecting equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Engineer, Owner Representative testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.

2. Description of the Work tested or inspected.

3. Date test or inspection results were transmitted to Engineer.

4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's, Owner’s Representative reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 CHARGES

A. General: Installation and removal of and or temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, USAID, testing agencies, and authorities having jurisdiction.

1.4 SUBMITTALS

A. Informational Submittals:

1. List of equipment and material to be stored at the site.

1.5 QUALITY ASSURANCE

A. Electric Service: Install service to comply with NFPA 70.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, All: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

1. Ventilation system shall be designed to use 100 percent outside make-up air.
2. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

B. Storage Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.
2. Directly vent all combustion gases to the exterior.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sanitary Facilities: Provide temporary toilets and wash facilities for use of construction personnel.

C. Drinking Water: Provide continual supply of bottled drinking water for use of construction personnel.

D. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Maintain dust partitions during the Work. Isolate limited work within occupied areas using portable dust-containment devices.

2. Perform daily construction cleanup and final cleanup.

E. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Connect temporary service to Owner's existing power source, as directed by Owner. Maintain equipment in a condition acceptable to Owner.

2. Service Requirements:

a. Capacity to accommodate maximum electric power and lighting requirements during construction.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that are noncombustible.

2. Maintain support facilities until Substantial Completion.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.

C. Traffic Controls:

1. Protect existing site improvements to remain including curbs, pavement, and utilities.

D. Parking: Use designated areas of Owner's existing motor vehicle and bicycle parking areas for construction personnel.

E. Dewatering Facilities and Drains: Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.

F. Snow and Ice Removal: Remove snow and ice as required to minimize accumulations in all areas of construction operations.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations.

H. Shoring and Bracing: Provide and maintain shoring, bracing, and structural supports required to preserve stability and prevent movement, settlement, or collapse of construction and to prevent unexpected or uncontrolled movement or collapse of construction.

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control:

1. General Soil Erosion and Sediment Control Measures.

a. Take precautions to prevent mud from construction site accumulating on adjoining public roads and sidewalks and Owner's roads and sidewalks. Clean accumulations of mud from public roads and sidewalks and from Owner's roads and sidewalks when required by public authorities and when directed by Architect.

b. Plan and execute construction by methods to control surface drainage from cuts and fills and from borrow areas, and to prevent erosion and sedimentation.

1) Minimize amount of bare soil exposed at one time.

2) Provide temporary measures and erosion control devices or methods appropriate to conditions at site.

3) Construct fills and waste areas by selective placement to avoid erosive surface silts or clays.

D. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses.

1. Prohibit smoking.

2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor.

2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Examination of conditions.
2. Preparation for construction.
3. Construction layout.
4. Field engineering and surveying.
5. Installation of the Work.
6. Cutting and patching.
7. Progress cleaning.
8. Starting and adjusting.
9. Protection of installed construction.
10. Correction of the Work.

1.3 DEFINITIONS

A. Cutting: Removal of in-place materials necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 SUBMITTALS

A. Informational Submittals:

1. Engineering Survey: Survey of project condition to determine cutting and patching of structural elements.

    a. Extent: Describe reason for and extent of each occurrence of cutting and patching of structural elements.
    b. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements.
    c. Products: List products to be used for patching.

B. Closeout Submittals:

1. Certificates: Submit certificate signed by Engineer certifying that location and elevation of improvements comply with requirements.

2. Certified Surveys: Submit two (2) copies signed by Engineer.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Engineer Qualifications: An engineer who is qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Operational Elements: Do not cut and patch operating elements of existing equipment in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

2. Other Construction Elements: Do not cut and patch areas not shown on the plan

3. Visual Elements: Cut and patch construction in a manner that results in neat and uniform lines where concrete is patched.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials.

2.2 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, fuel lines, utility trench, and other utilities.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine areas, and conditions, with workmen and equipment operators present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for electrical systems to verify actual locations of connections before equipment and fixture installation.

2. Verify clearance of underground utilities at all crossings.

C. Proceed with installation only after satisfactory conditions have been confirmed. Proceeding with the Work indicates acceptance of conditions.

2.3 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction such as DABS.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Engineer and USAID according to requirements in Division 01 Section "Project Management and Coordination."

2.4 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer, Construction Manager, and USAID promptly.

B. General: Engage Engineer to lay out the Work using accepted surveying practices.

1. Establish any additional benchmarks and control points necessary to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.

4. Check the location, level and plumb, of every major element as the Work progresses.

5. Notify Engineer, Construction Manager, and USAID when deviations from required lines and levels exceed allowable tolerances.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer, Construction Manager, and USAID.

2.5 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points

promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish additional benchmarks for the basis of all elevations where necessary and show on the drawings.

1. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

2. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

2.6 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

D. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

E. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

F. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

2.7 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of work as necessary.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

E. Cutting: Cut in-place construction by sawing, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.

1. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

2. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

3. Water Services: Cut off pipe to be removed. Remove, cap, valve, or plug and seal remaining portion of pipe to prevent entrance of moisture or other foreign matter after cutting.

4. Proceed with patching after construction operations requiring cutting are complete.

F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

2.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees Fahrenheit (27 degrees Celsius).

2. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

F. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls."

G. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

H. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

I. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous or damaging, exposure during the construction period.

2.9 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

2.11 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, and properly adjusting operating equipment.

B. Engineer may issue “Construction Deficiency Report” for items identified by Engineer as needing correction. Promptly repair or remove and replace defective construction identified in Construction Deficiency Report. Provide written notification to Engineer when identified item has been corrected.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

END OF SECTION

SECTION 01 74 19 – CONSTRUCTION AND WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.

1.2 RELATED WORK

A. Section 02 41 16, STRUCTURE DEMOLITION.

B. Section 01 00 00, GENERAL REQUIREMENTS.

1.3 QUALITY ASSURANCE

A. Contractor shall practice efficient waste management when sizing, cutting and installing. Processes shall be employed to ensure the generation as little waste as possible. Construction/Demolition waste includes products of the following:

1. Excess or unusable construction materials.

2. Packaging used for construction products.

3. Poor planning and/or layout.

4. Construction error.

5. Mishandling.

6. Breakage.

B. Contractor shall develop and implement procedures to recycle construction and demolition waste to maximum extent possible.

C. Any revenues or savings obtained from salvage or recycling shall accrue to the Owner.

D. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by government regulations.

E. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

F. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, reuse and return methods to be used by all parties during waste generating stages.

1.4 SUBMITTALS

A. Prepare and submit submittals in accordance with Section 01 33 00, SUBMITTAL PROCEDURES.

B. Prepare and submit to the Resident Engineer a written demolition debris management plan. The plan shall include, but not be limited to, the following information:

1. Procedures to be used for debris management.

PART 2 - PRODUCTS

2.1 MATERIALS

A. List of each material and quantity to be salvaged, recycled, and/or reused.

B. List of each material and quantity proposed to be taken to a landfill.

2.2 OWNERSHIP

A. Ownership of salvage/waste material generated as part of this project shall be in accordance with the following table.

Material	**Owner**
Concrete demolition and waste	Contractor
Excess soil excavation material not used as backfill material	Contractor
Existing pipe removed from the ground	Owner
Existing valves hydrants and fittings	Owner
Extra new material purchased by DABs for this project	Owner

PART 3 - EXECUTION

3.1 COLLECTION

A. Provide all necessary containers, bins, and storage areas to facilitate effective waste management.

B. Clearly identify containers, bins, and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.

C. Hazardous wastes shall be separated, stored, disposed of in accordance with applicable requirements.

3.2 DISPOSAL

A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.

B. Construction or demolition materials with no real practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

END OF SECTION

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.

2. Final completion procedures.

3. Warranties.

4. Final cleaning.

5. Repair of the Work.

1.3 SUBSTANTIAL COMPLETION PROCEDURES

A. Submittals Prior to Substantial Completion: Complete the following before Contract-scheduled date of Substantial Completion:

1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, property surveys, and similar final record information.

2. Submit closeout submittals specified in individual Specification Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

3. Submit maintenance material submittals specified in individual Specification Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number where applicable. Procedures Prior to Substantial Completion: Complete the following before Contract-scheduled date of Substantial Completion:

4. Complete startup and testing of systems and equipment.

5. Perform preventive maintenance on equipment used prior to Substantial Completion.

6. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

7. Advise Owner of changeover in heat and other utilities.

8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

9. Complete final cleaning requirements, including touchup painting.

10. Repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: No later than seven days after Contract-scheduled date of Substantial Completion, Engineer, USAID, and Construction Manager will proceed with inspection. Engineer will identify and notify Contractor of items that must be completed or corrected before Substantial Completion Certificate will be issued. If all is in compliance, USAID will prepare a Substantial Completion Certificate.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

a. Costs for such reinspections will be deducted from sums otherwise due the Contractor.

2. Results of completed inspection will form the basis of requirements for final completion.

1.4 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment.

2. Submit copy of Engineer's Substantial Completion inspection list of items to be completed or corrected. The copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

A. Inspection: No later than seven days after Contract-scheduled date of Substantial Completion, Engineer, USAID, and Construction Manager will proceed with inspection. Engineer will identify and notify Contractor of items that must be completed or corrected before certificate will be issued. If all is in compliance, USAID will prepare a Final Completion Certificate.

B. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

a. Costs for such re-inspections and rework will be at the Contractor’s expense.

1.5 SUBMITTAL OF PROJECT WARRANTIES

A. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive standard letter size paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

B. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Sweep concrete floors broom clean in unoccupied spaces.
h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
i. Remove labels that are not permanent.
j. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
k. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 50 00 “TEMPORARY FACILITIES AND CONTROLS “and Section 01 74 19 “CONSTRUCTION WASTE MANAGEMENT.”

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to condition acceptable to the Engineer.

1. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.

END OF SECTION

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals.

1.3 SUBMITTALS

A. Closeout Submittals:

1. Operation and Maintenance Manuals:

a. Format: Submit two (2) copies of operations and maintenance manuals.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title Page: Include the following information:

a. Subject matter included in manual.
b. Name and address of Project.
c. Date of submittal.
d. Name and contact information for Contractor.

2. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

a. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

3. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

B. Manuals, Paper Copy: Submit manuals in the form of paper and electronic copy, the paper copy bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold standard letter size paper; with clear plastic sleeve on spine to hold label describing contents.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 OPERATION AND MAINTENANCE MANUALS

A. Operation Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.

a. Product name and model number. Use designations for products indicated on Contract Documents.
b. Manufacturer's name.
c. Equipment identification with serial number of each component.
d. Equipment function.
e. Complete nomenclature and number of replacement parts.

2. Operating Procedures: Include the following, as applicable:

a. Startup procedures.
b. Routine and normal operating instructions.
c. Regulation and control procedures.
d. Normal shutdown instructions.
e. Seasonal and weekend operating instructions.
f. Special operating instructions and procedures.

3. Emergency Procedures: Include the following, as applicable:

a. Instructions on stopping.
b. Shutdown instructions for each type of emergency.
c. Operating instructions for conditions outside normal operating limits.
d. Special operating instructions and procedures.

4. Wiring diagrams.

5. Control diagrams.

6. Piped system diagrams.

a. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

7. Precautions against improper use.

8. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

B. Maintenance Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, manufacturers' maintenance documentation, maintenance and service schedules, spare parts list and source information, maintenance service contracts, repair materials and sources, and warranties and bonds, as described below.

1. Source Information: List each product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

2. Product Information: Include the following, as applicable:

a. Product name and model number.
b. Manufacturer's name.
c. Color, pattern, and texture.
d. Material and chemical composition.
e. Reordering information for specially manufactured products.

3. Maintenance Procedures: Include manufacturer's written recommendations and the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Schedule for routine cleaning and maintenance.
e. Repair instructions.

4. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

   a. Standard maintenance instructions and bulletins.
   b. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   c. Identification and nomenclature of parts and components.
   d. List of items recommended to be stocked as spare parts.

5. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

   a. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   b. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

6. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

7. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

8. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

9. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

   a. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

B. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

C. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals. Submittals: Include copy of each product submittal approved by Engineer.

D. Comply with Section 01 77 00 "CLOSEOUT PROCEDURES" on schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 02 41 16 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of concrete.

2. Removing below grade construction.

3. Disconnecting, capping or sealing, and abandoning in place, removing site utilities.

4. Salvaging items for reuse by Owner.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 REQUIRED SUBMITTALS

A. Provide the following submittals:

1. Other Submittals:

a. Schedule of Building Demolition Activities: Indicate the following:

1) Detailed sequence of demolition work, with starting and ending dates for each activity.
2) Temporary interruption of utility services.

3) Shutoff and capping or re-routing of utility services.

b. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be mistaken as damage caused by demolition operations. Submit before Work begins.

1) Provide unaltered digital photographs to accurately record physical conditions prior to start of demolition. Identify date, time and location of each image in file name.

c. Inventory and Conditions List: Submit an inventory of items that were removed and salvaged, and delivered to the Owner.

1) Include condition of the items.
2) Include digital photographs of damaged items showing existing damage prior to removal.

1.6 QUALITY ASSURANCE

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be demolished.

2. Review and finalize demolition schedule.

3. Review and finalize protection requirements.

4. Review items to be salvaged and returned to Owner.

1.7 PROJECT CONDITIONS

A. Buildings immediately adjacent to the demolition area will be occupied. Conduct demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than seven days notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

B. Owner assumes no responsibility for structures to be demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

2. The Contractor shall remove and salvage, and deliver to the Owner the following items:

a. All existing pipe, gate valves, and fire hydrants that are to be removed as part of replacement of the existing fire water piping system, up to all existing building connections.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Engineer, Owner, and USAID. Hazardous materials will be removed by Owner under a separate contract.

a. Contractor shall move his operations to Projects areas where there are no materials suspected of containing hazardous materials and continue working.
b. Contractor shall return to area where suspected hazardous materials were encountered only upon written direction from the Engineer or Owner and complete structure demolition work.

D. On site storage or sale of removed items or materials is not permitted.

1.8 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Inventory and Conditions List: Inventory and record the condition of items to be removed and salvaged, and delivered to the Owner. Take digital photographs of conditions that might be mistaken as damage caused by salvage operations prior to removal of item.

3.2 PREPARATION

A. Existing Utilities: Locate, identify, disconnect, indicated utilities to be demolished.

1. Arrange to shut off indicated utilities with Owner.

2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that maintain continuity of service to buildings and structures.

B. Existing Utilities: Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

1. Strengthen or add new supports when required during progress of demolition.

C. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.

4. Transport items to storage area designated by Owner.

5. Protect items from damage during transport and storage.

3.3 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities, unless authorized in writing by Owner.

2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner.

C. Temporary Protection: Erect temporary protection, such as driveways, walks, fences, railings, canopies, and covered passageways, where required by the Engineer.

1. Protect adjacent buildings and facilities from damage due to demolition activities.

2. Protect existing site improvements, appurtenances, and landscaping to remain.

3.4 DEMOLITION, GENERAL

A. General: Demolish indicated pavements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire suppression devices during flame cutting operations.

2. Maintain fire watch during flame cutting operations and for at least four hours after flame cutting operations stop.

3. Maintain adequate ventilation when using cutting torches.

B. Site Access and Temporary Controls: Conduct building demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Explosives: Use of explosives is not permitted.

3.5 SITE RESTORATION

A. Below Grade Areas: Completely fill below grade areas and voids resulting from demolition operations with soil materials in accordance with the plans and compacted according to backfill requirements in Section 31 20 00 "EARTHWORK".

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.6 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations, at the Contractor’s expense.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from the Project site and legally dispose of the demolition waste materials off site.

1. Do not allow demolished materials to accumulate on site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

1. Clean roadways of debris caused by debris transport.

END OF SECTION

SECTION 03 30 53 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including reinforcement, dowels, concrete materials, mixture design, accessories, placement procedures, finishes, protection and curing, for the following:

1. Slabs-on-grade.
2. Walkway pavement.
3. Concrete Trench Repair
4. Other concrete items shown on the Drawings.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

B. Cold Weather: A period of more than three (3) consecutive days when the average daily outdoor temperature is less than 4.4 degrees Celsius. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 10 degrees Celsius (50 degrees Fahrenheit) occur during more than half of any 24 hour duration, the period will no longer be considered as cold weather.

C. Formwork: Formwork, including similar terms such as “form” and “forms”, is called “shuttering” in the Afghanistan construction vocabulary.

D. Hot Weather: Hot weather is any combination of high ambient temperature, high concrete temperature, low relative humidity, wind speed (drying winds), and direct sunlight that tends to impair the quality of freshly mixed or hardened concrete by speeding up the rate of moisture loss and rate of cement hydration, or otherwise causing harmful effects.

1.4 REQUIRED SUBMITTALS

A. Provide the following submittals:

1. Shop Drawings

2. Product Data: For each type of product indicated.

    a. Preformed Joint Filler.
    b. Joint Sealants and Related Materials.
    c. Curing Compounds.
    d. Concrete Sealants.

3. Other Submittals:
    a. Qualification Data:

        1) Ready-Mix-Concrete Manufacturer: Submit list of completed projects using products proposed for this Project demonstrating compliance with applicable requirements specified in “Quality Assurance” article.
        2) Installer: Submit list of completed projects using products proposed for this Project demonstrating compliance with applicable requirements specified in “Quality Assurance” article.

    b. Design Mixtures: For each concrete mixture.

        1) Indicate amounts of mixing water to be withheld for later addition at Project site.
        2) Include compressive strength test reports.
        3) Include all ingredient certifications.

    c. Written description of the procedures and a list of the equipment to be used for the measuring, mixing, transporting, placing, and finishing of concrete including under cold weather and hot weather conditions, cold weather and hot weather protection, and curing.

    d. Material Certificates: For each type of the following, signed by manufacturers:

        1) Cementitious materials.
        2) Preformed Joint Filler.
        3) Dowels.

    e. Material Test Reports: For the following indicating compliance with requirements:

        1) Coarse aggregates and fine aggregates (alkali aggregate reactivity).

            a) Submittal of substantial service record data in place of material test reports is permitted.

        2) Vapor barrier.

    f. Procedures for curing and cold/hot weather concrete protection.

1.5 QUALITY ASSURANCE

A. The Contractor shall prepare a written description of the procedures and a list of the equipment to be used for the measuring, mixing, transporting, placing and finishing of concrete including under cold weather and hot weather conditions, cold weather and hot weather protection, and curing. The procedures and equipment shown shall be used for the work required by this Section.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment. The manufacturer shall have a minimum of 3 years experience and have furnished ready-mix-concrete on a minimum of 5 projects of similar size and scope as this Project.

B. Installer Qualifications: A qualified installer who employs, on Project, personnel qualified as flatwork technician and finisher, and a supervisor who is an experienced concrete flatwork technician. Installer shall have provided concrete work on a minimum of 5 projects of similar size and scope to this Project.

C. Testing Agency: An independent testing agency shall perform alkali reactivity testing of coarse aggregate and fine aggregate in accordance with ASTM C 1260 material evaluation tests and design concrete mix designs mixtures, and perform field testing quality control and inspections.

1. The independent testing agency shall have been reviewed within the last **12** months by the United States Army Corps of Engineers (USACE) and have received a satisfactory or better rating, or similar rating status.

2. Personnel performing laboratory tests shall have at least 1 year of experience as concrete strength testing technician and/or concrete laboratory testing technicians. Testing agency laboratory supervisor shall have at least 5 years of experience as a concrete laboratory testing technician.

D. Comply with tolerances in ACI 117, or equivalent industry standard, and as follows:

1. Flatwork and Formed Surfaces Vertical Deviation: Plus or minus 13 mm.

2. Cross Sectional Thickness Dimension: Plus 25 mm; minus 19 mm.

E. Compatibility with Substrate: Verify that each of the sealants are compatible for use with joint substrates.

F. Provide joint tolerances in accordance with manufacturer's printed instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 32 degrees Celsius (90 degrees Fahrenheit) or less than 4 degrees Celsius (0 degrees Fahrenheit).

PART 2 - PRODUCTS

2.1 FORMWORK

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips 19 mm by 19 mm, minimum.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2. Furnish ties that, when removed, will leave holes no larger than 25 mm in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Plain-Steel Welded Wire Fabric: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and dowels in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:

1. Portland cement: ASTM C 150 Type II (moderate sulfate resistant or moderate heat of hydration required), or equivalent industry standard.

B. Normal-Weight Aggregates:

1. Provide aggregates from a single source. Coarse aggregate and fine aggregate shall be free of materials with harmful reactivity to alkali in cement.

   a. Submit substantial service record data indicating absence of harmful expansion of concrete due to alkali aggregate reactivity.
   b. Perform potential alkali reactivity testing in accordance with ASTM C 1260, “Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)”, or equivalent industry standard. Test sample expansions greater than 0.20 percent, at 16 days, when tested in accordance with ASTM C 1260, will be considered unacceptable.

2. ASTM C 33, or equivalent industry standard, coarse aggregate.

   a. Aggregate shall be double washed with clean water. The washed aggregate shall contain no unsuitable material.

3. ASTM C 33, or equivalent industry standard, coarse aggregate for exterior concrete.

   a. Aggregate shall be double washed with clean water. The washed aggregate shall contain no unsuitable material.

4. Maximum Coarse-Aggregate Size:

   a. Slabs on Grade: 38 mm nominal.
   b. All Other Concrete: 25 mm nominal.

5. Fine Aggregate: Fine aggregate shall conform to the following graduation requirements:

   a. Fine aggregate shall be natural aggregate or manufactured aggregate or a combination of natural and manufactured aggregate.
   b. The aggregate shall consist of hard, tough grains and shall be free of organic material, clay, loam and other harmful materials.
   c. The aggregate shall conform to the following gradation:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
9.5 mm	100
4.75 mm	95 to 100
2.36 mm	80 to 100
1.18 mm	50 to 85
600 µm	25 to 60
300 µm	5 to 30
150 µm	0 to 10

C. Water: Potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260, or equivalent industry standard. An admixture that is used as an ingredient of the concrete, added before or during batch mixture, for entraining air in the concrete mix.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A (water-reducing admixture), or equivalent industry standard.

2. Retarding Admixture: ASTM C 494/C 494M, Type B (retarding admixture), or equivalent industry standard.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D (water-reducing and retarding admixture), or equivalent industry standard.

4. Mid-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type A or Type F (mid-range, water-reducing admixture), or equivalent industry standard.

   a. Water content reduction to be greater than 7 percent.

5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F (high-range, water-reducing admixture), or equivalent industry standard.

6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G (high-range, water-reducing and retarding admixture), or equivalent industry standard.

7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II (plasticizing and retarding admixture), or equivalent industry standard.

2.6 RELATED MATERIALS

A. Joint Sealants

1. Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2. All joints will be sealed with a suitable sealant to prevent infiltration of surface water and solid substances. A jet-fuel resistant (JFR) sealant will be used in the joints of slabs where diesel fuel or other lubricants may be spilled during the operation, parking, maintenance, and servicing of vehicles and shall conform to ASTM D7116 or equivalent industry standard.

B. Joint Bond Breaker

a. Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

C. Joint Backstops

a. Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

D. Slab Control Joint Sealer: Two-component, self-leveling, flexible, 100 percent solids, epoxy resin and adhesive with a Type A shore durometer hardness of 80 per ASTM D 2240 and conforming to ACI 302.1R, 5.12-Joint Materials.

E. Grout: ASTM C 1107, factory-packaged, shrinkage-resistant, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

F. Joint-Filler Strips:

1. ASTM D 1751, or equivalent industry standard, asphalt-saturated cellulosic fiber. Thickness shall be 13 mm (1/2 inch).

2. ASTM D 1752, or equivalent industry standard, cork or self-expanding cork. Thickness shall be 13 mm (1/2 inch).

G. Bonding Agent: ASTM C 1059/C 1059M, Type II (non-redispersible), or equivalent industry standard, acrylic emulsion or styrene butadiene. Minimum bonding strength shall be 8.6 MPa (1,250 psi).

2.7 SEALED CONCRETE

A. Sealer: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ChemMasters; Chemisil Plus.
   b. ChemTec Int'l; ChemTec One.
   c. Conspec by Dayton Superior; Intraseal.
   d. Curecrete Distribution Inc.; Ashford Formula.
   e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
   f. Edoco by Dayton Superior; Titan Hard.
   g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
   h. Kaufman Products, Inc.; SureHard.
   i. L&M Construction Chemicals, Inc.; Seal Hard.
   j. Meadows, W. R., Inc.; LIQUI-HARD.
   k. Metalcrete Industries; Floorsaver.
   l. Nox-Crete Products Group; Duro-Nox.
   m. Symons by Dayton Superior; Buff Hard.
   n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
   o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.

2.8 CURING MATERIALS

A. Moisture-Retaining Cover: ASTM C 171, or equivalent industry standard, clear or white opaque polyethylene film or white burlap–polyethylene sheet, used in conjunction with potable water.

1. Minimum thickness of the polyethylene film shall be 0.10 mm (4 mil).

2. White burlap-polyethylene sheet shall be made of burlap weighing 305 grams/square meter (9 ounces/square yard) on one side with white opaque polyethylene sheet on the other side. The polyethylene sheet shall be securely bonded to the burlap. Minimum thickness of the polyethylene film shall be 0.10 mm (4 mil).

B. Absorptive Cover: Burlap cloth or cotton mats conforming to the following:

1. Burlap Cloth:

   a. Made from kenaf or jute.
   b. Plain weave.
   c. Minimum weight of 305 grams/square meter (9 ounces/square yard).
   d. Minimum width of 1016 mm (40 in).
   e. Minimum length of 23 m (75.5 ft).
   f. Selvages (edges) shall be firm and straight and contain a cotton yarn to prevent unraveling.

2. Cotton Mats:

   a. Made of a filling material of cotton “bat” or “bats.”
   b. Minimum weight of 400 g/sm (11.8 ounces/square yard).
   c. Covered with unsized cloth of 200 g/sm (5.9 ounces/square yard), minimum, weight.
   d. Tufted or stitched to maintain stability.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1-D (clear with fugitive dye), Class B (resin type), dissipating, or equivalent industry standard.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301M, “Specifications for Structural Concrete,” or equivalent industry standard.

1. Use an independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures. See “Quality Assurance” article in this Section for additional requirements.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

1. Fly Ash: 25 percent, but if used, a minimum of 15 percent.

2. Combined Fly Ash and Pozzolan: 25 percent.

3. Ground Granulated Blast-Furnace Slag: 50 percent.

4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

5. Silica Fume: 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in all concrete. Design mix for optimum placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use a mid-range, water-reducing admixture, all concrete slabs (including concrete walks), concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

E. Exterior Concrete: For concrete elements including but not limited to slabs, proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 31 MPA (4,500 psi) at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.45.

3. Slump Limit: 100 mm (4 in) plus or minus 25 mm (1 in); or 200 mm (8 in) for concrete with verified slump of 50 (2 in) to 100 mm (4 in) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 25 mm (1in).

4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 38 mm (1.5 in) nominal maximum aggregate size.

F. All Other Concrete: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 27.6 MPa (4,000 psi) at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.50.

3. Slump Limit: 100 mm (4 in) plus or minus 25 mm (1 in); or 200 mm (8 in) for concrete with verified slump of 50 (2 in) to 100 mm (4 in) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 25 mm (1 in).

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 25 mm (1 in) nominal maximum aggregate size.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, or equivalent industry standard, and furnish batch ticket information.

1. When air temperature is between 30 and 32 degrees Celsius (86 and 89.6 degrees Fahrenheit), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 32 degrees Celsius (89.6 degrees Fahrenheit), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M, or equivalent industry standard. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 0.76 cubic meters (26.8 cubic feet) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 0.76 cubic meters (26.8 cubic feet), increase mixing time by 15 seconds for each additional 0.76 cubic meters (26.8 cubic feet).

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.11 REPAIR MATERIALS

A. Repair Mortar: Site-mixed Portland-cement mix for vertical and overhead surfaces. Mix dry-pack repair mortar, consisting of one part shrinkage-compensating, Portland cement to two and one-half parts fine aggregate passing a 1.18 mm (0.05 in) sieve by damp, loose volume, using only enough water for handling and placing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade conditions are satisfactory prior to forming or pouring concrete.

1. Owner’s Testing Agency will inspect roadway pavements slab on grade etc. prior to placing concrete.

2. Notify Owner a minimum of 2 days in advance of concrete placement to allow for testing agency notification.

B. Verify that formwork is complete and properly secured prior to placing concrete.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301M, or equivalent industry standard, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117, or equivalent industry standard.

C. Limit unacceptable concrete surface irregularities including, but not limited to, bugholes, blowholes, honey combing, offsets, fins, and variations from a planar surface or true curvature, as follows:

1. Class A, 3.2 mm (0.1 in) for smooth-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.

2. Do not use rust-stained steel form-facing material.

F. Set edge forms for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.3 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with the following tolerances:

   a. The variation in dimension between the centers of any two anchor rods within an anchor-rod group shall be equal to or less than 3 mm (0.1 in).
   b. The variation in dimension between the centers of adjacent anchor-rod groups shall be equal to or less than 6 mm (0.2 in).
   c. The variation in elevation of the tops of anchor-rod groups shall be equal to or less than plus or minus 13 mm (0.5 in).
   d. The accumulated variation in dimension between centers of anchor-rod groups along the column line or other base line, through multiple anchor-rod groups shall be equal to or less than 2 mm per 10,000 mm (0.08 in per 394 in), but not to exceed a total of 25 mm (1 in).
   e. The variation in dimension from the center of any anchor-rod group to the column line, or other base line, through that group shall be equal to or less than 6 mm (.2 in).

f. Unless otherwise shown on the Drawings, anchor rods shall be set with their longitudinal axis perpendicular to the bearing surface.

2. Install leveling plates, bearing plates, railing sleeves, brackets, and all other embedded steel items shown on Drawings.

3. Install sleeves for pipe, conduit and other items passing through cast-in-place structural concrete. Coordinate with other trades for sleeve details, invert elevations, locations, and sizes.

3.4 REMOVING AND REUSING FORMS

A. General: Formwork for sides of walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 10 degrees Celsius (50 degrees Fahrenheit) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for slabs and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28 day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Locate and install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Construction joints may be keyed as indicated on the drawings.

2. Construction joints may be doweled as indicated on the drawings. Drill and grout dowel bars into existing slab and install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

C. Control Joints in Slabs-on-Grade: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3.2 mm (0.1 in) wide joints into concrete when cutting action will not tear abrade, or otherwise damage surface and before concrete develops random contraction cracks. Space joints as shown on Drawings or, if not shown, at 3.5 m (11.5 ft) average spacing and not exceeding 4.5 m (14.75 ft). Locate joints to align with existing joints where possible.

D. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as foundation walls and other locations, as indicated.

1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.6 JOINT SEALANTS

A. Surface Preparation: Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

B. Sealant Preparation: Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

C. Backstops: Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified.

D. Bond Breaker: Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

E. Sealants: Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and cannot be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer

F. Protection: Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

G. Final Cleaning: Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

1. Immediately scrape off fresh sealant that has been smeared and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

3.7 SEALED CONCRETE

A. Sealer: Prepare, apply, and finish sealer according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than 28 days old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, potable water may be added at Project site, subject to the following limitations:

1. With each concrete mixture submittal, indicate amounts of potable mixing water to be withheld for later addition at Project site. The amount of potable mixing added at the Project site shall not exceed the indicated amount of mixing water withheld.

2. Water added must not increase the water-cement ratio past the approved mix design ratio.

3. Add additional water reducer or plasticizer to mix instead of adding water to achieve flowable, workable concrete. Do not add water to concrete after adding these admixtures to mixture.

4. Do not add water after truck is more than half empty.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

3. Thoroughly work concrete around reinforcement and embedded items and into corners of forms eliminating stone pockets and air pockets that may cause honeycombing, pitting and planes of weakness.

4. Immersion type vibrators with non-metallic heads shall be used when reinforcement is epoxy coated.

5. Consolidate placed concrete with mechanical vibrating equipment.

6. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 150 mm (6 in) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures. Comply with the following:

1. When average high and low temperature is expected to fall below 4.4 degrees Celsius (39.9 degrees Fahrenheit) for three consecutive days, as stated in the definition of “Cold Weather”, under “Definitions” Article in Part 1, maintain delivered concrete mixture temperature so that delivered concrete has a minimum temperature immediately after placement as shown below. The temperature of concrete as placed shall not exceed these values by more than 11 degrees Celsius (51.8 degrees Fahreinheit).

   a. 13 degrees Celsius (degrees Fahrenheit) for sections with the least dimension being less than 300 mm (11.8 in).
   b. 10 degrees Celsius (degrees Fahrenheit) for sections with the least dimension being 300 to 900 mm (11.8 to 35.5 in).
   c. 7 degrees Celsius (degrees Fahrenheit) for sections with the least dimension being 900 to 1800 mm (35.5 to 71 in).
   d. 5 degrees Celsius (degrees Fahrenheit) for sections with the least dimension being greater than 1800 mm (71 in).

These minimum requirements may be terminated with the approval of the Engineer when temperatures above 10 degrees Celsius (50 degrees Fahrenheit) occur during more than half of any 24 hour period.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with the following:

1. Maintain concrete temperature below 32 degrees Celsius (89.6 degrees Fahrenheit) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. When temperature is greater than 49 degrees Celsius (120.2 degrees Fahrenheit), fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Remove standing water before concrete placement. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

4. Loss of slump, flash set or cold joints as a result of the temperature of the concrete when placed will not be acceptable.

G. Concrete Trench Repair Joints

1. Locate construction joints as indicated or approved. Construction joints in slabs on grade shall be keyed or doweled as shown. Control joints shall in accordance with Section 3.5 Part C and shall be sealed similar to the construction joints.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections that exceed specified limits of formed surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections that exceed specified limits of formed surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

3.10 FINISHING UNFORMED SURFACES

A. General: Comply industry standard, for screeding, restraightening, and finishing operations for concrete surfaces, and the following as a minimum. Do not wet concrete surfaces.

1. Screeding:

   a. Strike off concrete above requires elevation or shape to a predetermined slope.

      1) Finish shall be similar to existing finish

2. Restraightening:

   a. During the finishing process, create and maintain a flat surface.
   b. Use a straightedge (rigid, straight piece of wood or metal) or a mechanical screed. Minimum length of straightedge shall be 3 meters (9.8 ft), with a minimum width of 50 mm (2 in) and minimum depth of 100 mm (4 in).

B. Nonslip Broom Finish: Apply a nonslip broom finish to concrete surfaces indicated. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

C. Exterior Concrete Walks and Slabs: Apply penetrating, silane sealer per manufacturer's instructions.

3.11 FINISHING EXTERIOR SLABS

A. General: Comply with ACI 302.1R recommendations for scree ding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

C. Broom Finish: Apply a broom finish.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the following for cold-weather protection and hot-weather protection during curing.

1. Cold-Weather Placement Protection: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with the following:

   a. Cold Weather Protection:

      1) The minimum temperature of concrete during the protection period shall be as shown in column “b” of the table below titled, “Concrete Temperature.” Maintain temperatures shown in the “Concrete Temperature” Table during the protection period. The temperature shall be taken at a concrete surface. Measure the temperature in the early morning and late afternoon with a thermometer having an accuracy of plus or minus 1 degree Celsius (33.8 degrees Fahrenheit). Submit temperature log to the Engineer.
      2) The maximum measured temperature decrease at the concrete surface in a 24 hour period shall not exceed the values shown in column “c” of the following Table.

         a) The temperature limits shall not be exceeded until the concrete surface temperature is within 11 degrees Celsius (51.8 degrees Fahrenheit) of the ambient or surrounding temperature.
         b) When the concrete surface temperature is within 11 degrees Celsius (51.8 degrees Fahrenheit) of the ambient or surrounding temperature protection may be removed.

      3) Combustion Heaters:

         a) Combustion heating units shall be vented to the outside of enclosures to permit flue gases from accumulating within the enclosures.
         b) Combustion heaters and ducts shall be placed and directed to avoid overheating or drying areas of the concrete surface.

      4) Concrete surfaces shall not be exposed during the protection period to air of a temperature more than 11 degrees Celsius (51.8 degrees Fahrenheit) above the values shown in column “b” of the “Concrete Temperature” Table.
      5) The duration of the protection period shall be equal to the specified curing period.
      6) During period not meeting the definition of “cold weather”, but when freezing temperatures may occur, protect concrete surfaces against freezing for the first 24 hours after placement of the concrete.

Concrete Temperature

a	b	c
Least dimension of section, mm (in)	Minimum temperature of concrete maintained during the protection period, degrees Celsius	Maximum gradual decrease in surface temperature during any 24 hours after end of protection, degrees Celsius
Less than 300 mm (Less than 11.8 in)	13	28
300 mm to 900 mm (11.8 in to 35.5 in)	10	22
900 mm to 1800 mm (35.5 in to 71 in)	7	17
Greater than 1800 mm (Greater than 71 in)	5	11

2. Hot-Weather Protection: Comply with the following when hot-weather conditions exist, as stated in the definition of “Hot Weather”, under Part I, Section 1.3, “Definitions:”

   a. Protect concrete from high ambient temperature, high concrete temperature, low relative humidity, drying winds and direct sunlight.
   b. Commence hot weather protection as work areas of the concrete placement are completed.
   c. Keep forms and exposed surfaces of the concrete continuously moist.
   d. The duration of the protection period shall be equal to the specified curing period.

B. Slabs: Protect slabs within building from precipitation accumulation. Immediately remove water, snow or ice from surface of slabs within building regardless if source is from precipitation, construction activities, etc.

C. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 1 kg/square meter x h (23.7 pound/square foot x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

E. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

F. Cure concrete by one of the following methods:

   1. Moisture Retaining Cover Curing: Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 300 mm (11.8 in), and sealed by waterproof tape or adhesive. Cure for not less than

seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

a. Use moisture retaining covers to cure all interior slabs on grade.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Ensure compatibility of curing compounds with finish flooring and adhesives, prior to use, otherwise provide curing method such as continuous sprinkling, or remove curing compound through blast-tracking or similar method prior to installation of flooring.

3. Cold Weather and Hot Weather Curing Procedures:

a. Cold Weather Curing:

1) Maintain temperature of concrete during the protection period.
2) Use moist curing method when the temperature is above 0 degrees Celsius (32 degrees Fahrenheit).
3) Use membrane-forming curing compound when the temperature is below 0 degrees Celsius (32 degrees Fahrenheit).
4) Allow wet surfaces to dry before exposing to freezing temperatures.
5) Do not expose saturated concrete to cycles of freezing and thawing.
6) Cure for a minimum of 3 days.

b. Hot Weather Curing:

1) Use moist curing method with moisture retaining cover or membrane-forming curing compound.
2) Cure for a minimum of 7 days.

3.13 JOINT SEALING

A. Prepare, clean, and install slab control joint sealer according to manufacturer's written instructions.

1. Defer joint sealing until concrete has aged at least 1 month. Do not seal joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified testing agency to perform field tests and inspections, and prepare test and inspection reports.

B. Contractor to supply all batch tickets to Owner's testing agency. Batch tickets to note water to cement ratio and amount of water allowed to be added at Project site.

C. Inspections:

1. Subgrades:

a. Slab and footing subgrade prior to placement of reinforcement and concrete.

2. Verification of use of required design mixture.

3. Concrete placement, including conveying and depositing.

4. Curing procedures and maintenance of curing temperature.

D. Concrete Tests: Testing of composite samples of fresh concrete shall be performed according to the following requirements:

1. Procedures for obtaining representative samples of fresh concrete for testing shall be in accordance with the following, as a minimum:

a. Elapsed time shall be 15 minutes, maximum, between obtaining first and last composite samples. Sample size shall be approximately 28 L (1 cubic foot). Ensure that enough concrete is taken for the sample so that all of the tests required can be performed.
b. Move samples to testing location. Samples shall be combined and remixed with a shovel to provide uniformity and consistency. Do not over remixed samples when combining into one sample.
c. Tests for slump, temperature and air content shall be started within 5 minutes of obtaining the last composite sample. Complete these tests within 10 minutes of starting tests.
d. Cylinders for compressive strength tests shall be made immediately upon completion of the other tests.
e. Do not reuse the same concrete for different tests.

2. Testing Frequency: Obtain at least one composite sample for each 76 cubic meters (2,700 cubic feet) or fraction thereof of each concrete mixture placed each day, nor less than once per each 465 square meters (5,000 square feet) of surface area of walls or slabs.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Include corresponding design mix with each test report.

4. Indicate amount of water added to batch at Project site.

5. Slump: Perform a slump test in accordance with ASTM C 143/C 143M; "Slump of Hydraulic Cement Concrete", or equivalent industry standard, one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to

change. Measure after slump adjustment. Pumped concrete is to be tested at point of placement, with an additional slump test taken at point of delivery**.**

6. Air Content: Perform an air content test in accordance with ASTM C 231, "Air Content of Freshly Mixed Concrete by the Pressure Method", or equivalent industry standard, pressure method, for normal-weight concrete; ASTM C 173/C 173M, "Air Content of Freshly Mixed Concrete by the Volumetric Method", or equivalent industry, standard, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Concrete Temperature: Determine concrete temperature in accordance with ASTM C 1064/C 1064M, "Temperature of Freshly Mixed Hydraulic Cement Concrete", or equivalent industry standard; one test hourly when air temperature is 4.4 degrees Celsius (39.9 degrees Fahrenheit) and below and when 27 degrees Celsius (80.6 degrees Fahrenheit) and above, and one test for each composite sample.

8. Compression Test Specimens: Make and cure compression test specimens in accordance with ASTM C 31/C 31M, "Making and Curing Concrete Test Specimens in the Field", or equivalent industry standard.

   a. Cast and standard cure six cylinders for each composite sample.

      1) Standard curing:

         a) Storage: Place cylinders on a firm level surface. Surface slope shall be no greater than 20 mm per meter (0.25 in per foot). Protect cylinders from damage.
         b) Initial Curing: For first 48 hours, store cylinders at a temperature range of 16 to 27 degrees Celsius (60.8 to 80.6 degrees Fahrenheit). Prevent cylinder moisture loss. When cardboard molds are used, protect the cardboard molds from contact with wet items.
         c) Final curing: After 48 hours, remove the molds. Within 30 minutes of mold removal, immerse concrete cylinders in 21 to 25 degrees Celsius (69.8 to 77 degrees Fahrenheit) water.

   b. Cast and field cure two standard cylinders for each composite sample.

      1) Field curing:

         a) Storage: Place cylinders on a firm level surface. Surface slope shall be no greater than 20 mm per meter (0.25 in per foot). Protect cylinders from damage.
         b) Curing: Place the cylinders near the pour from which the sample was taken and used to make the cylinders. Cure the cylinders within the curing envelope of the pour so that the cylinders receive the same curing environment as the concrete they represent.

9. Compressive Strength Tests: Perform compressive strength tests in accordance with ASTM C 39/C 39M, or equivalent industry standard. The test method requires the application of a compressive axial load to molded cylinders at a predetermined rate until

failure of the cylinder. The compressive strength of the cylinder is determined by dividing the load at the time of failure by the cross sectional area of the cylinder.

a. Test two standard cured cylinders at 7 days, three cylinders at 28 days, and retain one cylinder for testing at 56 days as deemed necessary by Engineer.
b. Test two field cured cylinders at 28 days.
c. A compressive strength test shall be the average compressive strength from a set of two cylinders obtained from same composite sample and tested at age indicated.
d. If one cylinder in the test shows evidence of improper sampling, molding or testing, discard the cylinder and consider the strength of the remaining cylinders to be the test result. If more than one cylinder in a test shows any defects, discard the entire test.

10. When strength of field cured cylinders is less than 85 percent of companion laboratory cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing concrete.

11. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive strength tests equals or exceeds specified compressive strength and no compressive strength test value falls below specified compressive strength by more than 3.4 MPa (500 psi).

12. Test results shall be reported in writing to Engineer within 48 hours of testing. Reports of compressive strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28 day tests.

13. Nondestructive Testing: Impact-echo, ultrasonic methods, or other nondestructive methods may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

14. Additional Tests: Testing agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M, “Obtaining and Testing Drilled Cores and Sawed Beams of Concrete”, or equivalent industry standard, or by other methods as directed by Engineer.

15. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

16. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Field Test and Inspection Reports:

1. Submit test and inspection reports.

3.15 REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Repairing Formed Surfaces: Surface defects include, but are not limited to, texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 13 mm (0.5 in) in any dimension to solid concrete. Limit cut depth to 19 mm (0.75 in). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with repair mortar before bonding agent has dried. Fill form-tie voids with repair mortar secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, repair mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

C. Repairing Unformed Surfaces: Test unformed surfaces for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.25 mm (0.01 in) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with thin coat patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair overlayment. Cut out low areas to ensure a minimum repair overlayment depth of 6 mm (0.25 in) to match adjacent floor elevations. Prepare, mix, and apply repair overlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 25 mm (1 in) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 19 mm (0.75) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish, as to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 25 mm (1 in) or less in diameter with repair overlayment. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete. Place repair overlayment before surface has dried. Finish, as to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

END OF SECTION

SECTION 26 00 00 00 20 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. ASTM INTERNATIONAL (ASTM)

   a. ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

2. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

   a. IEEE C2 (2007; Errata 2006 & 2007; INT 44-56 2007; INT 47, 49, 50, 52-56 2008; INT 57, 58, 51, 48, 59 2009) National Electrical Safety Code
   b. IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

3. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

   a. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

4. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

   a. NFPA 70 (2008; AMD 1 2008) National Electrical Code - 2008 Edition Conformité Européenne
   b. CE Standard for Pressure meter
   c. CE Standard for Delta Programmable Device (DAC-304)

1.2 RELATED DOCUMENTS

A. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

A. Electrical characteristics for this project shall be 400/230 V, three phase, four wire, grounded neutral, 50 Hz, to single phase, two wire.

1.5 ADDITIONAL SUBMITTALS INFORMATION

A. Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

B. Shop Drawings (SD-02)

1. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

C. Product Data (SD-03)

1. Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements

1. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the USAID Implementing Partner. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

B. Standard Products

1. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

2. Alternative Qualifications

a. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

3. Material and Equipment Manufacturing Date

a. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

A. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel.

B. The operating instructions shall include the following:

1. Wiring diagrams, for each principal system and item of equipment.

2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

3. Safety precautions.

4. The procedure in the event of equipment failure.

5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

C. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

A. ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 3 mm (0.125 inch) thick, white with black center

core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm (one by 2.5inches). Lettering shall be a minimum of 6.35 mm (0.25 inch) high normal block style.

1.11 WARNING SIGNS

A. Not required.

1.12 ELECTRICAL REQUIREMENTS

A. Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.13 INSTRUCTION TO OWNER'S PERSONNEL

A. Where specified in the technical sections, furnish the services of competent instructors to give full instruction to personnel designated by the USAID Implementing Partner in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the facility owner for regular operation.

B. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

PART 2 - PRODUCTS

2.1 FACTORY APPLIED FINISH

A. Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 or equal corrosion-resistance test.

2.2 PRESSURE METER

A. Pressure meter shall be WIKA Tronic UT-10 Transducer 4292341, 0 to 25 PSI or equal.

B. Pressure meter shall have the followings specs:

1. Type UT-10 UniTrans Universal Pressure Transducer

2. Transmitter Output: 4-20 mA Two-Wire, Local Digital Display

3. Pressure Range: 0 to 25 PSI, Accuracy: ≤±0.1% Span

4. Temperature Range: Ambient: -4° to 158° F, Media: -22° to 221° FProcess Connection: 1/2" NPT Male

5. Materials: Body: Fiberglass-Enforced PBT Plastic, Wetted Parts: Stainless Steel

6. Input Voltage: 12-36 VDC, Electrical Connection: M20 x 1.5 Cable Gland with Internal Terminal Block

7. Area Classification: IP65

2.3 DELTA PROGRAMBLE DEVICE (DAC-304)

A. Delta programmable device shall have the following specs

1. Inputs: 3 Universal inputs - 10 bit (supporting 0-5v, 0-10V, 10kΩ, 4-20mA)

2. Outputs: 4 Binary triac outputs

    a. Jumper selection for internal or external power on binary outputs
    b. LED status indication of each output

3. Technology

    a. 32-bit processor
    b. 1 MB (8 megabit) Flash memory
    c. 127 KB SRAM (for database)
    d. LED indication of CPU and SCAN status

4. Device Addressing

    a. Set via DIP switch and jumpers, or software setup

5. Communications Ports

    a. Main LAN (NET1)
    b. BACnet MS/TP @ 9600, 19200, 38400 or 76800 bps (default) (maximum of 99 devices per BACnet MS/TP segment)
    c. SubLAN (NET2)
    d. Delta LINKnet @ 76800 bps (maximum 4 devices on LINKnet, with no more than 2 DFM devices)

6. Connectors

    a. Removable screw-type terminal connectors
    b. Wiring Class 2
    c. Power 24 VAC, 6VA, 54VA maximum with fully loaded BO's

7. Ambient

    a. 32° to 131°F (0° to 55°C)
    b. 10 - 90% RH (non-condensing)
    c. Dimensions 7 5/8 x 4 x 1 7/8 in. (19.2 x 10.2 x 4.8 cm) with housing
    d. 0.551 lb. (250 g) with housing

8. Compliance

a. CE
b. FCC

9. Listings

a. C-UL Listed
b. UL 916 Listed
c. BTL Listed

2.4 POWER SUPPLY

A. 90 watts with input voltage of 230 Vac and output voltage of 24 Vdc.

PART 3 - EXECUTIONS

3.1 FIELD APPLIED PAINTING

A. Paint electrical equipment as required to match original finish of equipment surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

A. Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

END OF SECTION

SECTION 26 05 00.00 40 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM INTERNATIONAL (ASTM)

a. ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

B. INTERNATIONAL CODE COUNCIL (ICC)

a. ICC/ANSI A117.1 (2003; Errata 2007) Accessible and Usable Buildings and Facilities

C. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

a. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

b. NEMA FB 1 (2007) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

c. NEMA RN 1 (2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

d. NEMA TC 2 (2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit

e. NEMA TC 3 (2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

D. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

a. NFPA 70 (2008; AMD 1 2008) National Electrical Code

E. UNDERWRITERS LABORATORIES (UL)

a. UL 489 (2009) Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

b. UL 797 (2007) Electrical Metallic Tubing – Steel

1.2 SUBMITTALS

A. Contractor shall submit the following using submittal procedures as specified in the Contract Documents.

B. SD-03 Product Data

1. Submit manufacturer's catalog data for the following items:

   Conduits, Raceways and Fittings
   Wire and Cable
   Splices and Connectors
   Outlets, Outlet Boxes, and Pull Boxes
   Circuit Breakers
   Pressure meter
   Programmable device (DAC-304)

C. SD-06 Test Reports

1. Continuity Test

   Insulation Resistance Test

D. SD-08 Manufacturer's Instructions

1. Submit Manufacturer's Instructions.

1.3 PREVENTION OF CORROSION

A. Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.4 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

1.5 GENERAL REQUIREMENTS

A. Submit Material, Equipment, and Fixture Lists for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

B. Submit Manufacturer's Instructions including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

C. Submit Certification required installing equipment components and system packages.

1.6 POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

1. Wiring diagrams for each principal system and item of equipment.

2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

3. Safety precautions.

4. The procedure in the event of equipment failure.

5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

1.7 MANUFACTURER'S NAMEPLATE

A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.8 FIELD FABRICATED NAMEPLATES

A. ASTM D 709 or equal. Provide laminated plastic nameplates for each equipment enclosure, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 3 mm thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm. Lettering shall be a minimum of 6.35 mm high normal block style.

PART 2 PRODUCTS

2.1 MATERIALS

A. Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

A. Not required.

2.1.2 Electrical Metallic Tubing (EMT)

A. EMT shall be in accordance with UL 797 or equal and be zinc coated steel.

B. Couplings and connectors shall be zinc-coated, rain tight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3 Flexible Metallic Conduit

A. Not required.

2.1.4 Intermediate Metal Conduit (IMC)

Intermediate metal conduit shall comply with UL 1242 and be galvanized.

2.1.5 Rigid Nonmetallic Conduit

A. Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40 or equals.

2.2 WIRE AND CABLE

A. Conductors installed in conduit shall be copper 600-volt type (NYA) H05V-U. All conductors shall be solid single core. Conductors that are going to be installed in cable tray must be cable tray rated.

2.3 SPLICES AND CONNECTORS

A. Make all splices in 3.15 millimeter diameter and smaller with approved insulated electrical type connectors.

B. Make all splices in 4.1 millimeter diameter and larger with bolted clamp-type connectors. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 SWITCHES

A. Not required.

2.5 RECEPTACLES

A. Not required.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

A. Outlet boxes for use with conduit systems shall be in accordance with NEMA FB 1 or equal and be not less than 40 millimeter deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 PANELBOARDS

A. Not required.

2.8 CIRCUIT BREAKERS

A. Circuit-breaker interrupting rating shall be not less than those indicated in the drawings. Molded case circuit breakers shall be bolt-on type conforming to UL 489 or equal and be comparable with existing panelboard.

2.9 LAMPS AND LIGHTING FIXTURES

A. Not required.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

A. Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

B. Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

C. Conduit and raceway runs above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

3.1.1 Rigid Steel Conduit

A. Not required.

3.1.2 Electrical Metallic Tubing (EMT)

A. EMT shall be grounded in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.1.3 Flexible Metallic Conduit

A. Not required.

3.1.4 Intermediate Conduit

A. Not required.

3.1.5 Rigid Nonmetallic Conduit

A. Rigid PVC conduit shall be direct buried.

B. A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end.

C. Grounding wires shall be sized in accordance with NFPA 70.

3.2 WIRING

A. Conductors up to and including 6.5 millimeter diameter shall be manufactured with colored insulating materials. Conductors larger than 6.5 millimeter diameter shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

B. Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated. Where several

feeders pass through a common pull box, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.3 WIRING DEVICES

A. Not required

3.4 BOXES AND FITTINGS

A. Furnish and install pull boxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 30 meter or with more than three right-angle bends shall have a pull box installed at a convenient intermediate location.

B. Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

3.5 LAMPS AND LIGHTING FIXTURES

A. Not required

3.6 IDENTIFICATION PLATES AND WARNINGS

A. Furnish and install identification plates for lighting and power panelboards, all line voltage heating and ventilating control panels, and magnetic starters. Process control devices and pilot lights shall have identification plates.

B. Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 400 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.7 PAINTING

A. Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned.

3.8 FIELD TESTING

A. Submit Test Reports in accordance with referenced standards in this section.

B. After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

C. Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

D. Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

E. Perform Insulation-Resistance Test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and

1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable.

F. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

G. Perform Continuity Test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the USAid Implementing Partner prior to acceptance of the repair.

H. Conduct Phase-Rotation Tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

I. Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the USAid Implementing Partner.

END OF SECTION

SECTION 26 05 19.00 10 - INSULATED WIRE AND CABLE

PART 1 GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

a. AEIC C8 (2000) Extruded Dielectric Shielded Power Cables Rated 5 through 46 kV

b. AEIC CS8 (2000) Extruded Dielectric Shielded Power Cables Rated 5 through 46 kV

2. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

a. IEEE Std 383 (2003) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004

3. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

a. NEMA WC 70 (2009) Standard for Non-Shielded Power Cable 2000 V or Less for the Distribution of Electrical Energy IEC Standard for Heat Trace Cable

1.2 SUBMITTALS

A. Contractor shall submit the following using procedures as specified in the Contract Documents.

B. SD-03 Product Data

1. Installation Instructions

2. Cable manufacturing data as requested.

C. SD-06 Test Reports

1. Tests, Inspections, and Verifications

2. 6 certified copies of test reports.

1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous cable without splices.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Wire Table

A. Furnish wire and cable in accordance with the requirements of the wire called for in the drawings, conforming to the detailed requirements specified herein.

2.1.2 Rated Circuit Voltages

A. All wire and cable shall have minimum rated circuit voltages in accordance with NEMA WC 70 or equal

2.1.3 Conductors

2.1.3.1 Material for Conductors

A. Conductors shall conform to all the applicable requirements of NEMA WC 70 or equal, as applicable, and shall be annealed copper. Copper conductors may be bare, or tin- or solid lead-alloy-coated, if required by the type of insulation used.

2.1.3.2 Size

A. Minimum wire size shall be 2.5 mm2 for power circuits.

2.1.3.3 Stranding

A. Conductor stranding classes cited herein shall be as defined in NEMA WC 70 or equal, as applicable. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding.

2.1.3.4 Conductor Shielding

A. Use conductor shielding conforming to NEMA WC 70 or equal, as applicable, on power cables having a rated circuit voltage above 500 volts.

2.1.3.5 Separator Tape

A. Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.4 Insulation

A. (NYA) H05 V-U Insulated wire.

2.1.5 Jackets

A. Not required.

2.1.6 Metal-Clad Cable

A. Not required.

2.1.7 Heat Trace cable with accessories

2.1.7.1 Heat Trace Cable

A. Heat trace cable shall have the following characteristics for XTV family or shall be equivalent:
   - For hazardous and nonhazardous locations
   - Trace surface type shall be metal
   - Supply voltage shall be 200-277 Vac
   - Maximum maintain or continuous exposure temperature (power on)shall be 250°F (121°C)
   - shall have minimum bend radius @ 68°F(20°C): 0.5 in (12.7mm)
   - weight shall be 1.1lb per 10ft
   - bus wire size shall be 14 AWG
   - outer jacket Red
   - heating cable dimensions shall be 0.46 in x 0.3 in (11.7mm x 7.6mm)

B. Heat trace cable characteristics for 10BTV shall be as follow or equivalent:
   - For hazardous and nonhazardous locations
   - Trace surface type shall be metal/plastic
   - Supply voltage shall be 200-277 Vac
   - Maximum maintain or continuous exposure temperature (power on)shall be 150°F (65°C)
   - shall have minimum bend radius @ 68°F(20°C): 0.5 in (12.7mm)
   - weight shall be 1 lb per 10ft
   - bus wire size shall be 16 AWG
   - outer jacket black
   - heating cable dimensions shall be 0.65 in x 0.26 in (16.5mm x 6.6mm)

2.1.7.1 Heat Trace cable Power connector

A. <u>Product Specifications</u>
   - Heating cable capability XTV-CT, BTV-CR, BTV-CT.
   - Ingress protection NEMA 4X.
   - Entries 1x3/4 inch.
   - Minimum installation temperature -40°F (-40°C).
   - Minimum ambient temperature -75°F (-60°C).
   - Maximum ambient temperature 132°F (56°C).
   - Maximum pipe temperature 500°F (260°C).
   - Terminal Spring Clamp, 2 lines, 1 ground.
   - Maximum conductor size 8 AWG.
   - Maximum operating voltage 480 Vac.
   - Maximum circuit breaker rating 50A.

     <u>Materials</u>
   - Enclosure Electrostatic charge-resistant glass-filled engineered polymer, black.
   - Weight 3.5lb (1.6 kg)
   - Catalog number JBS-100-L-A

B. <u>Product contents</u>
   - The kit has a junction box with one through hole.
   - The kit has a stand assembly.
   - It has a core sealer.
   - It has a green/yellow tube.
   - It has a cable tie.

2.1.7.2 Heat Trace Cable End Seal

A. Product Specifications
- Heating cable capability XTV-CT, BTV-CT, BTV-CR
- Ingress protection NEMA 4X (IP66)
- Minimum installation temperature -40°F (-40°C).
- Minimum usage temperature -60°F (-50°C).
- Maximum pipe temperature 420°F (215°C).
- Maximum Operating voltage 277 Vac.
- Weight 0.6lb (0.3kg)
- Catalog number E-150

2.2 CABLE IDENTIFICATION

2.2.1 Color-Coding

A. Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with NEMA WC 70, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Power cable color-coding shall be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included. Other individual conductors shall be color-coded as indicated on the contract drawings but such color-coding may be accomplished by applying colored plastic tapes or sleeving at terminations.

2.2.2 Shielded Cables Rated 2,001 Volts and Above

A. Not required.

2.2.3 Cabling

A. Not required.

2.2.4 Dimensional Tolerance

A. The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

A. Install all conductors as per manufacturer’s recommendation.

3.2 TESTS, INSPECTIONS, AND VERIFICATIONS

3.2.1 Cable Data

A. Purchase of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

3.2.2 Inspection and Tests

A. Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be witnessed by the USAid Implementing Partner, unless waived in writing.

B. The USAid Implementing Partner may perform further tests before or after installation. Testing in general shall comply with NEMA WC 70 or equal.

END OF SECTION

SECTION 26 05 71.00 40 - LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

a. NEMA AB 1 (2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures

b. NEMA AB 3 (2001) Molded Case Circuit Breakers and Their Application

2. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

a. NFPA 70 (2008; AMD 1 2008) National Electrical Code - 2008 Edition

3. UNDERWRITERS LABORATORIES (UL)

a. UL 489 (2009) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

1.2 SUBMITTALS

A. Contractor shall submit the following using procedures as specified in the Contract Documents.

B. SD-01 Preconstruction Submittals

1. Prior to the beginning of construction, submit manufactures equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.
Circuit Breakers

C. SD-02 Shop Drawings

1. Submit Connection Diagrams and Fabrication Drawings for the following items in accordance with paragraph entitled, "General Requirements," of this section. Submit Installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

2. Circuit Breakers

D. SD-03 Product Data

1. Submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

E. SD-07 Certificates

1. Submit certificates for Circuit Tests including dielectric tests.

F. SD-08 Manufacturer's Instructions

1. Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

2. Circuit Breakers

G. SD-10 Operation and Maintenance Data

1. Submit Operation and Maintenance Manuals for the following equipment: Circuit Breakers

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.
Submit Connection Diagrams showing the relations and connections of protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another and internal tubing, wiring, and other devices.
Submit Fabrication Drawings for protective devices consisting of fabrication and assembly details to be performed in the factory.

PART 2 PRODUCTS

2.1 MOTOR CONTROL

A. Not required.

2.2 INSTRUMENT TRANSFORMER

A. Not required.

2.3 ENCLOSURES

A. Not required.

2.4 CIRCUIT BREAKERS

A. Provide circuit breakers with GFI that conform to UL 489, NEMA AB 1, and NEMA AB 3 or equals.

2.4.1 Molded-Case Circuit Breakers

A. Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

B. Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit

protection. Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

C. Provide sufficient interrupting capacity of the branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals.

D. Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 40 degrees C. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

2.4.2 Enclosed Molded-Case Circuit Breakers

A. Not required.

2.5 FUSES

A. Not required.

2.6 CONTROL DEVICES

A. Not required.

2.7 FACTORY TESTING

A. Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

B. Conduct short-circuits tests in accordance with Section 2 of NEMA ICS 1 or equal.

2.8 INDICATING LIGHTS

A. Not required.

2.9 FINISH

A. Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor and outdoor installations.

PART 3 EXECUTION

A. Install circuit breakers as per manufacturer’s recommendation and existing conditions of panel boards.

END OF SECTION

SECTION 26 20 00 - INTERIOR DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. ASTM INTERNATIONAL (ASTM)

a. ASTM B 8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

b. ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

2. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

a. IEEE 100 (2000; Archived) the Authoritative Dictionary of IEEE Standards Terms

b. IEEE C2 (2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5) National Electrical Safety Code

3. INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

a. NETA ATS (2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

4. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

a. ANSI C80.3 (2005) American National Standard for Electrical Metallic Tubing (EMT)

b. ANSI Z535.4 (2007) American National Standard for Product Safety Signs and Labels

c. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

d. NEMA TC (2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit

e. NEMA TC 3 (2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

f. NEMA WD 1 (1999; R 2005) Standard for General Color Requirements for Wiring Devices

g. NEMA WD 6 (2002; R 2008) Dimensions for Wiring Devices

5. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

a. NFPA 70 (2008; AMD 1 2008) National Electrical Code

b. NFPA 70E (2009; Errata 09-1) Standard for Electrical Safety in the Workplace

6. TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

a. TIA J-STD-607-A (2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

7. U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

8. UNDERWRITERS LABORATORIES (UL)

a. UL 1063 (2006) Standard for Machine-Tool Wires and Cables

b. UL 44 (2005; R 2005) Thermoset-Insulated Wires and Cables

c. UL 467 (2007) Grounding and Bonding Equipment

d. UL 486A-486B (2003; R 2004 thru 2009) Standard for Wire Connectors

e. UL 486C (2004; R 2009) Splicing Wire Connectors

f. UL 489 (2009) Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

g. UL 5 (2004; R 2007 thru 2009) Standard for Surface Metal Raceways and Fittings

h. UL 510 (2005; R 2008) Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

i. UL 514A (2004; R 2005 thru 2009) Metallic Outlet Boxes

j. UL 514B (2004; R 2006 thru 2009) Conduit, Tubing and Cable Fittings

k. UL 651 (2005; R 2006 thru 2008) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

l. UL 719 (2006; R 2006 thru 2007) Standard for Nonmetallic-Sheathed Cables

m. UL 797 (2007) Electrical Metallic Tubing – Steel

n. UL 83 (2008) Thermoplastic-Insulated Wires and SECTION 26 20 00 Page 4 Cables

o. UL 869A (2006) Reference Standard for Service Equipment

p. UL 943 (2006; R 2008) Ground-Fault Circuit-Interrupters

1.2 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

1.3 SUBMITTALS

A. Contractor shall submit the following using submittal procedures as specified in the Contract Documents.

1. SD-02 Shop Drawings

   a. Include installation details of equipment indicating proposed location, layout and arrangement, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

2. SD-03 Product Data

   a. Circuit breakers

   b. Conduit and boxes

   c. Wires and cables

   d. Pressure meter

   e. Delta programmable device

   f. Power supply (inverter)

   g. Submittals shall include performance and characteristic curves.

3. SD-06 Test Reports

   a. All test reports for above products shall be submitted for review.

4. SD-07 Certificates

5. SD-09 Manufacturer's Field Reports

6. SD-10 Operation and Maintenance Data

1.4 QUALITY ASSURANCE

1.4.1 Fuses

A. Not required.

1.4.2 Regulatory Requirements

A. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the USAid Implementing Partner. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.3 Standard Products

A. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 Alternative Qualifications

A. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date

A. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 MAINTENANCE

1.5.1 Electrical Systems

A. Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

1. Single line diagram of the "as-built" building electrical system.

2. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

A. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7 SEISMIC REQUIRMENTS

A. Not required.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials, equipment, and devices shall, as a minimum, meet requirements of UL or equal, where UL standards are established for those items, and requirements of NFPA 70 or equal.

2.2 CONDUIT AND FITTINGS

A. Shall conform to the following:

2.2.1 Rigid Nonmetallic Conduit PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2, UL 651 or equals.

2.2.2 Electrical, Zinc-Coated Steel Metallic Tubing (EMT) UL 797, ANSI C80.3 or equals.

2.2.3 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit UL 514B or equal. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B or equal.

2.2.3.1 Fittings for EMT Die cast compression type.

2.2.4 Fittings for Rigid Nonmetallic Conduit NEMA TC 3 for PVC and UL 514B or equals.

2.3 SURFACE RACEWAY

A. Not required.

2.4 OUTLET BOXES AND COVERS

A. UL 514A or equal, cadmium or zinc-coated, if ferrous metal. UL 514C or equal, if nonmetallic

2.5 CABINETS, JUNCTION BOXES, AND PULL BOXES

A. Sheet steel volume greater than 1640 mL, UL 50 or equal, hot-dip, zinc-coated.

2.6 WIRES AND CABLES

A. As indicated in section 26 05 19

2.7 SPLICES AND TERMINATION COMPONENTS

A. UL 486A-486B or equal for wire connectors and UL 510 or equal for insulating tapes or equal.

B. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A-486B or UL 486C or equals (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

PART 3 EXECUTION

3.1 INSTALLATION

A. Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces, shall conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Underground Service

A. Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

A. Not required.

3.1.3 Wiring Methods

A. As indicated in 26 05 19

3.1.4 Conduit Installation

A. All conduits shall be installed exposed and fasten securely after each 90cm the conduit shall be tied by clamps.

3.1.4.1 Restrictions Applicable to Aluminum Conduit

A. Not required.

3.1.4.2 Restrictions Applicable to EMT

A. Do not install underground.

B. Do not encase in concrete, mortar, grout, or other cementations materials.

C. Do not use outdoors.

3.1.4.3 Restrictions Applicable to Nonmetallic Conduit

A. PVC Schedule 40 and PVC Schedule 80

1. Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

2. Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

B. Electrical Nonmetallic Tubing

1. Not required.

3.1.4.4 Directional Changes in Conduit Runs

A. Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in

conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.5 Locknuts and Bushings

A. Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.6 Flexible Connections

A. Provide flexible steel conduit between 915 and 1830 mm (3 and 6 feet) in length where the EMT conduit passes any building possible expansion joints.

3.1.5 Boxes, Outlets, and Supports

A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type surface mounted on interior walls exposed up to 2135 mm above floors and walkways and when specifically indicated. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel.

3.1.5.1 Boxes

A. Boxes for use with raceway systems shall be minimum 40 mm (1 1/2 inches) deep, except where shallower boxes required by structural conditions are approved.

3.1.5.2 Pull Boxes

A. Not required

3.1.5.3 Extension Rings

A. Not required.

3.1.6 Mounting Heights

A. As indicated in drawings.

3.1.7 Nonmetallic Sheathed Cable Installation

A. As indicated in 26 05 19.

3.1.8 Mineral Insulated, Metal Sheathed (Type MI) Cable Installation

A. Not required.

3.1.9 Conductor Identification

A. Provide conductor identification within each enclosure where tap, splice, or termination is made.

3.1.10 Splices

A. Make splices in accessible locations. Make splices in conductor's No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.11 Terminating Aluminum Conductors

A. Not required.

3.1.12 Covers and Device Plates

A. Not required.

3.1.13 Electrical Penetrations

A. Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings.

3.1.14 Grounding and Bonding

A. Provide In accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to electrical device.

3.1.15 Equipment Connections

A. Connect equipment with existing ground bus in panel board by equipment ground conductor.

3.1.16 Repair of Existing Work

A. Any damage to the existing facilities due to the installation of new system shall be repaired as its initial condition.

-- End of Section –

SECTION 31 20 00 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Soil classifications for excavation and backfill under structures, pavements, concrete pads, etc.

2. Submittals.

3. Excavating and backfilling trenches for utilities and pits for buried utility structures.

4. Warning and identification tapes.

1.3 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

C. Imported Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Onsite Borrow Soil: Satisfactory soil excavated from existing trenches for use as fill or backfill.

E. Sub base: Granular aggregate layer supporting the slab-on-grade on pavement.

F. Engineer: Owners Representative.

G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices, if specified, or changes in the Work.

2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Engineer. Unauthorized excavation, as well as remedial work directed by Engineer shall be without additional compensation.

H. Utilities: On-site underground pipes, conduits, ducts, and cables.

1.4 REQUIRED SUBMITTALS

A. Product Data:

1. Geotextiles.

2. Warning and identification tapes.

B. Samples:

1. Backfill and Bedding Course: 2000 cubic centimeters of each type of material in sturdy container of each type of fill, naming source for each material.

2. Warning and Identification Tapes: 300 mm (12 inches) long; of each type and color.

C. Other Submittals:

1. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

a. Classification according to ASTM D 2487 (See Section 2.1 Soil Materials).
b. Liquid limit and plastic limit according to ASTM D4318.
c. Laboratory compaction curve according to ASTM D 1557 or ASTM D 698.

1.5 DEWATERING AND CONTROL OF WATER

A. Prepare and submit a written dewatering and control of water plan two weeks prior to construction.

B. Prevent water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas.

2. Do not allow water to accumulate in excavations.

3. Do not use excavated utility trenches as temporary drainage ditches.

4. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Qualified Installers as defined below:

1. Earthwork Contractor Experience Requirements: Provide a list of at least four Earthwork projects of comparable size, scope, and quality completed successfully by the proposed Sub Contractor within the past two years that includes the date completed, project owner's name and current contact information, including telephone numbers and e-mail addresses.

B. Contractor's Testing Agency:

1. Soil classification, laboratory compaction curves sieve analyses and other required soil testing shall be performed by an independent testing agency for both off-site and on-site soil materials.

2. The independent testing agency shall have been reviewed within the last 9 months by the United States Army Corps of Engineers (USACE) and have received a satisfactory or better rating, or similar rating status.

C. Civil/Structural Preconstruction Conference: Attend Civil/Structural Preconstruction Conference.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide imported soil materials when sufficient satisfactory soil materials are not available from onsite excavations.

B. Hazardous Materials:

1. Provide materials that are not contaminated with petroleum product, hazardous waste, chemical waste, industrial waste, construction waste, sanitary waste, commercial/office waste or general household waste.

2. Materials with a visible sheen or petroleum odor shall be rejected.

C. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups. Satisfactory soils are to meet the additional requirements noted below and to be free of topsoil, asphalt, concrete rubble, wood, debris, clay, overburden, and other deleterious materials.

1. General descriptions (Group Name) for satisfactory soils Soil Classification Groups are as follows:

Soil Classification Group	General Description (Group Name)
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
SW	Well graded sand

SP	Poorly graded sand
SM	Silty sand

2. Suitable Material

   a. Submittal shall be provided demonstrating that on-site soil material meets the criteria outlined in this Section for use as non-granular fill material.
   b. Obtain approval of Engineer before proceeding with use of on-site material.
   c. Material is to have no particles greater than 400 mm (16 in) maximum dimension, no more than 70 percent by weight passing the 425 µm (0.02 in) sieve and no more than 20 percent passing the 75 µm sieve. Testing shall be performed in accordance with ASTM C 136, Standard Test Method for Sieve analysis of Fine and Coarse Aggregates
   d. Testing submitted is to demonstrate that proper compaction can be achieved as required in Part 3, Execution.

D. Unsuitable Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsuitable soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

2. General descriptions (Group Name) for unsuitable soils Soil Classification Groups are as follows:

Soil Classification Group	General Description (Group Name)
GC	Clayey gravel
SC	Clayey sand
CL	Lean clay
ML	Silt
OL	Organic silt
CH	Fat clay
MH	Elastic silt
OH	Organic clay
PT	Peat

E. Structural Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand meeting the gradation shown below.

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
75 mm	100
50 mm	70 to 100
19 mm	50 to 95
4.75 mm	30 to 60
300 mm	5 to 25
75 µm	5 to 12

F. Granular Backfill: Granular fill consists of stone, sand, and gravel, or blends of these materials, free of slag, meeting the gradation shown below.

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
50 mm	100
6.3 mm	30 to 65
425 um	5 to 40
75 µm	0 to 10

G. Pea Gravel:

1. Pea gravel shall be natural gravel or manufactured gravel or a combination of natural gravel and manufactured gravel.

2. The pea gravel shall consist of round, hard, tough particles and shall be free of organic material, clay, loam, and other harmful materials.

3. The pea gravel shall conform to the following gradation:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
12.5 mm	100
9.5 mm	90 to 100
4.75 mm	20 to 55
2.36 mm	5 to 30
1.18 mm	0 to 10
300 µm	0 to 5

2.2 WARNING AND IDENTIFICATION TAPES

A. Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified below, with a minimum thickness of 0.10 mm (0.004 in), and a minimum strength of 10.3 MPa (1,500 psi) lengthwise and 8.6 MPa (1,250 psi) crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 920 mm (36 in) deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

B. Provide tape on rolls, conforming to the width and color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Magnetic Warning and identification to read, “AS SPECIFIED BELOW” or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Magnetic Warning and Identification Tape for PVC Piping:

Utility	Color	Width	Thickness	Strength	Minimum Detection Depth	Verbiage
Water	Blue	150 mm	0.10 mm	10.3 Mpa (1,500 psi) lengthwise 8.6 Mpa (1,250 psi) crosswise	920 mm 36 in	CAUTION BURIED WATER LINE BELOW

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which earthwork is to be accomplished. Notify the Engineer in writing of any deviations and/or conditions not consistent with the Drawings. Do not proceed with earthwork until the Engineer has confirmed the reported deviations and/or inconsistencies in writing which would impact the project and has provided written direction to the Contractor.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

1. Contractor is entirely responsible for strength and adequacy of bracing and shoring, and for safety and support of construction from damage or injury caused by lack of adequate protection or by movement or settlement. Bracing and shoring shall be in accordance with specification 31 23 00.

B. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

C. Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner.

D. Maintain vehicle and pedestrian traffic at all times.

1. Coordinate all road closures with the Owner.

2. Provide alternate routes around closed or obstructed traffic ways meeting the approval of the Owner.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth excavation.

1. Earth excavation includes excavating pavements and obstructions visible on the surface; underground structures, utilities, and other items indicated to be removed;

together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm (1 in). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. See Section 31 23 00 Excavation, Trenching, and Backfilling.

C. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 300 mm (11.8 in) higher than top of pipe or conduit unless otherwise indicated on the Drawings.

1. Clearance: 300 mm (11.8 in) each side of pipe or conduit.

3.8 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If the Engineer determines that unsuitable soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices (if applicable) or changes in the Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation.

1. Fill unauthorized excavations under other construction, pipe, or conduit in accordance with this Section using granular fill unless otherwise directed by Engineer.

B. Replace materials removed during unauthorized excavations using gravel borrow, unless otherwise directed by the Engineer. Placement of the material shall be in 150 mm (6 in)

lifts with 95 percent of maximum dry density compaction. Compaction shall be as specified in this Section.

C. Contractor shall not receive compensation for fill of unauthorized excavation.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrows soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations.

2. Do not stockpile soil materials against buildings or structures.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Surveying locations of underground utilities for Record Documents.

2. Testing and inspecting underground joints and valves.

3. Removing concrete formwork.

4. Removing trash and debris.

5. Removing excess water and allowing material to dry.

6. Removing temporary shoring and bracing, and sheeting.

7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

A. See Section 31 23 00 Excavation, Trenching, and Backfilling.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 200 mm (8 in) in loose depth for material compacted by heavy compaction equipment, and not more than 150 mm (6 in) in loose depth for material compacted by hand operated tampers,

3.15 DEGREE OF COMPACTION:

A. Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, ASTM, DIN, BS, EN or EBCS standards, abbreviated as percent laboratory maximum density. Required moisture range is plus 2 percent and minus 1 percent of optimum moisture content. Minimum degree of compaction shall be 95%, as determined by a Modified Proctor Test.

A. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Grade to cross sections, lines, and elevations indicated on the Drawings.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. The Contractor shall allow the testing agency to inspect and test subgrades and each fill or backfill layer. The Contractor shall proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Inspections and tests:

1. Geotechnical observations: Proof rolling procedures, site preparation, unsuitable soils removal, excavations, footing bearing, and fill placement.

2. Field Density Testing:
   a. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

      1) Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 50 meters (160 ft) or less of trench length, but no fewer than two tests per trench, divided even along the trench.

b. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3. Laboratory testing for on-site fills:

a. Testing shall be performed in accordance with ASTM D 1557 Modified Proctor compaction curve including sieve analysis.

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing, at the Contractor's expense.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property

END OF SECTION

SECTION 31 23 00 – EXCAVATION, TRENCHING, AND BACKFILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work under this Section covers the material selection, excavation, placement and compaction of fill materials used under and around utility conduits and structures.

1.3 SUBMITTALS

A. Contractor shall submit proposed source of borrow material, proof of soil classification, and soil samples to the Engineer for approval.

B. Name and address of testing service for approval by the Site Engineer.

C. Test reports on excavating, filling and grading:

1. Submit copies of the following reports directly to Engineer from the independent testing agency:

   a. Test reports on borrow materials and stone.
   b. Verification of subgrade.
   c. Field density test reports.
   d. One optimum moisture-maximum density curve for each type of soil encountered.

1.4 DELIVERY STORAGE AND HANDLING

A. Material shall be kept in neat piles and managed to prevent unsatisfactory materials soils from mixing with satisfactory material and to prevent material from being washed offsite.

1.5 QUALITY ASSURANCE

A. All material will be placed to the lines, grades, and thicknesses shown on the plans.

B. Provide independent soil testing and inspection service for quality control testing during earthwork operations. All testing shall be performed by a firm specializing in soil testing and who is acceptable to the Engineer.

1. The independent testing agency shall have been reviewed within the last 9 months by the United States Army Corps of Engineers (USACE) and have received a satisfactory or better rating, or similar rating status.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials used for shall match the descriptions shown on the plans. Materials are defined in SECTION 31 20 00, EARTHWORK.

PART 3 - EXECUTION

3.1 Existing utility services are shown based on observations of observable features and may be different than shown on the plan. The Contractor shall verify and mark the locations of existing waterlines and utility crossings.

3.2 SURFACE TREATMENT

A. Surface stone on landscaped areas to be excavated shall be removed and stockpiled for reuse prior to excavation. Stone shall be washed before it is replaced.

3.3 EXCAVATION

A. Excavation shall be performed to the lines and grades indicated. Excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 600 mm (23.6 in).

B. Excavated material not required or not satisfactory for backfill shall be stockpiled and removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized over excavation shall be backfilled in accordance with Section 3.8, Backfilling and Compaction, of this Specification at no additional cost to the Owner.

C. Trench Excavation Requirements: The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Special attention shall be given to slopes which may be adversely affected by weather or moisture content.

1. Bottom Preparation: The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be hand excavated to the necessary size at each joint or coupling to eliminate

point bearing. Stones of 75 mm (3 in) or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

2. Removal of Unyielding Material: Where over depth is not indicated and unyielding material is encountered in the bottom of the trench, such material shall be removed 150 mm (6 in) below the required grade and replaced with suitable materials. Backfill adjacent to any and all types of structures shall be compacted to at least 95 percent of maximum density as determined by Modified Proctor Test within minus 1 percent to plus 2 percent of optimum moisture content for cohesive or for cohesion-less materials to prevent wedging action or eccentric loading upon or against the structure.

3. Removal of Unsuitable Material: where material is encountered in the bottom of the trench, material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in Section 3.8, BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor at no additional cost to the Owner.

D. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

E. Shoring and Sheeting: Provide shoring, bracing, cribbing, trench boxes, underpinning, and sheeting where necessary to prevent the following negative impacts:

1. Undermining of pavements, foundations and slabs.

2. Slippage or movement in banks or slopes adjacent to the excavation.

3. The shoring and sheeting plan is to include provisions to prevent these negative impacts.

3.4 EXCAVATION FOR APPURTENANCES

A. Excavation for valve boxes or similar structures shall be sufficient to leave at least 300 mm (11.8 in) clear between the outer structure surfaces and the face of the excavation or support members. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.5 JACKING, BORING, AND TUNNELING

A. Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Engineer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.6 STOCKPILES

A. Stockpiles of satisfactory and unsatisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment. Excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Owner. Locations of stockpiles of satisfactory materials shall be subject to approval of the Engineer.

3.7 DRAINAGE AND DEWATERING

A. Drainage surface water shall be directed away from excavation. Diversion ditches, dikes, and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained and in accordance with Specification 31 20 00, Earthwork.

3.8 BACKFILLING AND COMPACTION

A. Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 150 mm (6 in) loose thickness for compaction by hand operated machine compactors, and 200 mm (8 in) loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for all soils, unless otherwise specified.

B. Trench Backfill

1. Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 600 mm (23.6 in) above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

2. Replacement of Unyielding Material - Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3. Replacement of Unstable Material - Unstable material removed from the bottom of the trench or excavation shall be replaced with granular backfill material placed in layers not exceeding 150 mm (6 in) loose thickness.

4. Bedding and Initial Backfill - Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height as shown in the detailed drawings. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough

compaction of the fill under the haunches of the pipe. Care should be taken that the instruction of pipe manufacturer recommendation for the initial backfilling and tamper compaction must be considered.

5. Final Backfill - The remainder of the trench, except for special materials for roadways, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

   a. Roadways: Backfill shall be placed up to the elevation as shown on the plans and in accordance with the requirements in Specification 31 20 00, Earthwork. Water flooding or jetting methods of compaction will not be permitted.
   b. Unpaved and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 200 mm (8 in) loose thickness, and compacted to 95 percent maximum density for all soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

C. Backfill for Appurtenances

1. After the valve box or similar structure has been constructed and the concrete has been allowed to cure for 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.9 SPECIAL REQUIREMENTS

A. Special requirements for both excavation and backfill relating to the specific utilities are as follows:

1. Utility Conflicts

   a. Utility crossings (water, sewer or electrical) shall be excavated by hand to expose the existing utility. Machine excavation shall not be performed within 1.5 m (4.9 ft) of existing utilities.
   b. Electrical conduits shall be uncovered by hand and a determination has been made regarding any potential conflict between the electric conduit and the waterline. The crossing shall be exposed for inspection by Engineer prior to backfill.
   c. In no case shall a waterline joint be located within 1.5 m (4.9 ft) of a utility crossing. If the utility crossing falls within 1.5 m (4.9 ft) of a waterline joint a shorter section of pipe shall be used to provide the clearance.

2. Water Lines

   a. Trenches shall be of a depth to provide a minimum cover of 1100 mm (3.6 ft) as shown on drawings from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3. Plastic Marking Tape

a. Warning tapes shall be installed directly above the pipe, at a height of 300 mm (11.8 in).

3.10 INSPECTION

A. Inspection shall be the responsibility of the Contractor and shall be performed at no additional cost to the Owner.

B. After trench backfill has been compacted to 600 mm (23.6 in) above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Engineer. Pipes shall be inspected by shining a light between manholes or manhole locations. If, in the judgment of the Engineer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Owner.

END OF SECTION

SECTION 33 11 00 - WATER MAINS AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. All temporary and permanent piping as shown on the Drawings and as directed by the Engineer.

2. The work of this section includes the furnishing of all labor, tools, equipment, and materials necessary to perform all operations required for the construction of water mains, fittings, valves, and other related items necessary to complete the work as specified.

3. All products and materials shall conform to appropriate AWWA standards and/or as otherwise specified hereinafter.

1.3 REQUIRED SUBMITTALS

A. Provide the following submittals:

1. Product Data:

   a. Pipe and fittings.
   b. Mechanical restraint connections
   c. Gaskets.
   d. Valves.
   e. Valve Boxes.
   f. Hydrants
   g. Testing Plan.

2. Samples:

   a. Pipe and fittings.
   b. Mechanical restraint connections
   c. Gaskets
   d. Valves.
   e. Valve Boxes.
   f. Hydrants.

3. Other Submittals:

   a. Qualification Data: For Contractor’s qualified testing agency.

1) United States Army Corps of Engineers Review: Submit a copy of the independent testing agency's latest review documentation showing a satisfactory or better rating, or similar rating status.

b. Require sieve analysis to be submitted under this Section if not submitted under another Section such as SECTION 31 20 00, Earthwork for the following:

1) Pea gravel for bedding material.
2) Structural fill.
3) Suitable fill.

c. Inspection reports.

1.4 QUALITY ASSURANCE

A. The contractor shall review installation materials necessary to become familiar with the proper installations. Review materials shall include but not be limited to installation instructions, installation videos, manufacturer's recommendations, and other available information as necessary to familiarize Contractor's staff in the proper connection of these assemblies.

B. Prior to beginning the pipe installation, Contractor shall prepare a test assembly to demonstrate an understanding of the connection systems. The assembly shall:

1. The assembly shall be constructed at ground level.

2. Utilize a minimum of two (2) fittings, one (1) valve, and two (2) straight joints. All joints will be connected in accordance with the Drawings and manufacturers' recommendations.

3. The assembly shall remain attached for a minimum of three (3) weeks during the pipe installation for use as a reference.

C. Contractor's Testing Agency:

1. The independent testing agency shall have been reviewed within the last 9 months by the United States Army Corps of Engineers (USACE) and have received a satisfactory or better rating, or similar rating status.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Upon delivery, the contractor shall inspect all parts and materials for damage and compliance with the Drawings and Specifications. Any damaged or non-compliant materials shall be reported to the Engineer.

B. Care shall be taken so as not to damage the pipe or appurtenant materials. Dropping of materials such as pipe, special castings, and valves directly from the trucks upon the ground will not be permitted. Suitable effective buffers or runners shall be provided.

C. Metal chain shall not be used for lifting materials.

D. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of the sunlight or delivered to the site so that no pipe is exposed to sunlight for more than 60 days. Temporary shading as required to meet this requirement shall be provided.

E. Handle and store products according to manufacturer's written instructions.

F. Contractor shall be responsible for replacing materials improperly handled and cared for at no additional cost to the Owner.

1.6 NOTICES

A. Preconstruction Conference: The Contractor shall meet with the Engineer on a daily basis to coordinate site work and operations.

B. When the site has been stabilized, the Contractor will notify the Engineer, in writing, that a final inspection may be performed.

1.7 INSPECTIONS AND MAINTENANCE

A. The Engineer will inspect the site including excavation, temporary systems, pipe installation, backfill, and compaction. The Engineer and the Contractor will meet and discuss the Engineer’s findings, including recommended repairs and improvements.

B. The contractor shall provide scheduled maintenance of protective measures and other controls, during construction.

C. Perform corrective measures within three (3) calendar days of the Engineer's report, at no cost to the Owner. Failure by the Contractor to perform corrective work within this schedule automatically authorizes the Owner to hire others and deduct from the Contract Sum the costs incurred by the Owner for the performance of this Work.

PART 2 - PRODUCTS

2.1 AWWA C900 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

A. Material

1. All pipes shall be made from quality PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 as defined in ASTM D1784.

B. Hydrostatic Proof of Testing

1. Each standard length of pipe is tested up to 2.1 Mpa (305 psi) for pressure Class 305; a minimum of 5 seconds. The integral bell shall be tested with the pipe.

C. Standard Laying Lengths

1. Standard laying lengths are 6 m (20 ft) for all sizes.

D. C900 PVC Pipe:

1. All pipe shall be bell and gasket push on joint pipe suitable for use as a pressure conduit. Provisions must be made for expansion and contraction at each joint with an elastomeric gasket. The bell shall consist of an integral wall section with a factory installed, solid cross section Rieber® or other elastomeric gasket, which meets the requirements of ASTM F477. The bell section shall be designed to be at least as hydrostatically strong as the pipe barrel and meet the requirements of AWWA C900. The joint design shall meet the requirements of ASTM D3139 under both pressure and 75.5 kpa (22 in. hg) vacuum. Sizes and dimensions shall be as shown in this specification and shall meet the requirements of AWWA Standard C900, "Polyvinyl Chloride (PVC) Water Distribution Pipe. Pipe installation and usage shall be in compliance with JM Eagle™ publication JME-03B, "Blue Brute™, Big Blue™ and Ultra Blue™ C900/C905/C909 installation guide" and Uni-Bell® publication Uni-PUB-08-07, "tapping guide for PVC pressure pipe" or approved manufacturer's installation instructions.

E. Quick Burst Test

1. Samples shall be randomly selected for testing in accordance with AWWA C900 and UL 1285 and shall withstand, without failure, a pressure of 3.5 Mpa (500 psi) for 70 seconds.

F. Drop Impact Test

1. Pipe shall withstand, without failure, a TUP and Flate Rate holder "B" impact energy of 135 Nm (100 ft-lbf) at a temperature of 22.8 degrees Celsius (73 degrees Fahrenheit) for all pressure Class of 100 mm to 300 mm (4 to 12 in) trade sizes. There shall be no visible evidence of shattering or splitting when the energy is imposed.

2.2 FITTINGS (ELBOWS AND TEES) FOR C900 PVC PIPE

A. All changes in direction of PVC pipe shall be made with ductal iron fittings and mechanical joints, as shown on the plans.

B. Materials

1. Mechanical joint water main fittings with accessories, 150 mm (3 in) through 1200 mm (48 in) shall be manufactured from Ductile Iron in accordance with and meet all applicable terms and provisions of standards ANSI/AWWA C153/A21.53 ANSI/AWWA C111/A21.11 (current revisions).

2. All coated fittings meet requirements of NSF-61.

3. Fittings shall be cement lined and seal coated in accordance with ANSI/AWWA C104/A21.4.

C. Product

1. Mechanical Joint Fittings

a. Mechanical Joint Fittings shall be Tyler Union Mechanical Joint C153 Ductile Iron Compact Fittings or approved equal.

b. Ductile Iron Mechanical Joint Fittings 150 mm (3 in) through 600 mm (24 in) shall be rated for 2.4 Mpa (350 psi) working pressure.
c. All fittings shall connect to C900 PVC pipe using Megalug Series 2000PV Mechanical Joint Restraint or approved equal.
d. Mechanical joint fittings shall connect to ductile iron pipe using Megalug series 1100 Mechanical joint restraint or approved equal.

2. Flanged Fittings

a. Flanged Joint Fittings shall be Tyler Union C110 Flanged Ductile Iron Fittings or approved equal.
b. Ductile Iron Flanged Fittings 76 mm (3 in) through 600 mm (24 in) shall be rated for 2.4 Mpa (350 psi) working pressure.

2.3 MECHANICAL RESTRAINTS FOR C900 PVC PIPE

A. All straight PVC joints shall include both bell end pipe with elastomeric gasket and be harnessed with a Megalug Series 1900 Restraint harness or approved equal.

B. Materials

1. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.

2. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.

3. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.

4. Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.

C. Traceability

1. An identification number consisting of year, day, plant and shift (YYYYMMDD) (plant designation) (Shift number), shall be cast into each gland body.

2. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. These Material Traceability Records (MTR's) are to be made available, in hard copy, to the purchaser that requests such documentation and submits his gland body identification number.

3. Production pieces that are too small to accommodate individual numbering, such as fasteners and wedges, shall be controlled in segregate inventory until such time as all quality control tests are passed. These component parts may then be released to a general inventory for final assembly and packaging.

4. All components shall be manufactured and assembled in the United States. The purchaser shall, with reasonable notice, have the right to plant visitation at his/her expense.

D. Restraint Coating Systems

1. Coating for restraint devices shall consist of the following:

    a. All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
    b. All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.
    c. The coating system shall be MEGA-BOND by EBAA Iron, Inc. or approved equal. Requests for approved equal must submit coating material and process details for review prior to bid.

E. Product

1. Restraint devices for mechanical joint fittings and appurtenances conforming to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53, shall conform to the following:

    a. Restraint devices for mechanical joint connections shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
    b. The devices shall have a working pressure rating equal to the full pressure rating of the pipe. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.
    c. Mechanical joint restraint shall be Series 2000PV produced by EBAA Iron Inc. or approved equal. Contractor shall submit to the Designer of Record certified calculations from EBBA Iron Inc. or approved equal demonstrating the restraint model and location of mechanical joint restraint.

2. Restraint Harness at AWWA C900 Push on Joint Pipe

    a. A split serrated ring shall be used to grip the plain-end of the pipe. A split serrated ring shall also be used to grip the barrel of the pipe behind the bell, and a sufficient number of bolts shall be used to connect the restraint rings. The combination shall be the EBAA Iron, Inc., Series 1900 or approved equal.
    b. Contractor shall submit to the Designer of Record certified calculations from EBBA Iron Inc. or approved equal demonstrating the restraint model and location of AWWA C900 push on joint restraint.

F. Design

1. Restraint devices for nominal pipe sizes 150 mm (3 in) through 900 mm (36 in) shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.

2. The devices shall have a working pressure rating equal to the full pressure rating of the pipe. Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.

G. Installation

1. Restraints shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly.

2. Proper actuation of the gripping wedges or split serrated ring shall be ensured with torque limiting twist off nuts or torque wrenches as required per device.

H. Approvals

1. Restraints shall be listed by Underwriters Laboratories in the 100 mm (4 in) through 300 mm (12 in) sizes.

2. Restraints shall be Factory Mutual Approved in the 100 mm (4 in) through 300 mm (12 in) sizes.

3. Restraints, 100 mm (4 in) through 600 mm (24 in), shall meet or exceed the requirements of ASTM F1674 of the latest revision.
4. Ductile Iron Pipe

a. Pipe: AWWA C151/A21.51, Thickness Class 52.
b. Fittings: AWWA C110/A21.10 or AWWA C153/A21.53.

1) Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

c. Joints and Jointing Material:

1) Joints: Joints for pipe and fittings shall be mechanical Joints

2) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

2.4 DUCTILE IRON PIPE

A. Pipe: AWWA C151/A21.51, Thickness Class 52.

B. Fittings: AWWA C110/A21.10 or AWWA C153/A21.53.

1. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

C. Joints: Joints for pipe and fittings shall be mechanical Joints.

1. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

2.5 HYDRANTS

A. Hydrants shall be Mueller Super Centurion 250A-421 Fire Hydrant with mechanical joints, or equivalent, as shown on the plans.

B. Components

1. Fire hydrants purchased or installed shall meet or exceed all applicable requirements and tests of ANSI and the latest revision of AWWA Standard C502. Fire hydrants shall meet all test requirements of and be listed by Underwriters Laboratories Inc. Fire hydrants shall meet all test requirements and have full approval of Factory Mutual. Fire hydrants shall meet the following requirements:

   a. The operating nut shall be a one piece design, manufactured of ASTM B-584 bronze. It shall be pentagon/square in shape and the nut dimensions shall be as specified by the Owner. The operating nut shall be affixed to the bonnet by means of an ASTM B-584 bronze hold down nut. The hold down nut shall be threaded into the bonnet in such a manner as to prevent accidental disengagement during the opening cycle of the hydrant. The use of Allen head set screws as a means of retention is unacceptable. A resilient weather seal shall be incorporated into the hold down nut, for the purpose of protecting the operating mechanism from the elements.
   b. The bonnet assembly shall provide an oil reservoir and lubrication system that automatically circulates lubricant to all stem threads and bearing surfaces each time the hydrant is operated. This lubrication system shall be sealed from the waterway and any external contaminants by use of “o” ring seals. An anti-friction washer shall be in place above the thrust collar to further minimize operating torque. The oil reservoir shall be factory filled with a low viscosity, FDA approved non-toxic oil lubricant which will remain fluid through a temperature range of negative 350 degrees Celsius (–600 degrees Fahrenheit) to 800 degrees Celsius (1500 degrees Fahrenheit).
   c. The operating stem shall consist of two pieces, not less than 31 mm (1.25 in) diameter (excluding threaded or machined areas) and shall be connected by a stainless steel safety coupling. The safety coupling shall have an integral internal stop to prevent the coupling from sliding down into the lower barrel when the hydrant is struck. Screws, pins, bolts, or fasteners used in conjunction with the stem couplings shall also be stainless steel. The top of the lower stem shall be recessed 50 mm (2 in) below the face of the safety flange to prevent water hammer in the event of a “drive over” where a vehicle tire might accidentally depress the main valve.
   d. The lower barrel shall be an integrally cast unit. The use of threaded on or mechanically attached flanges is deemed unacceptable. The hydrant bury depth shall be clearly marked on the hydrant lower barrel.
   e. Composition of the main valve shall be a molded rubber having a durometer hardness of 95 +/- 5 and shall be reversible in design to provide a spare in place. Plastic (polyurethane) main valves are unacceptable. The main valve shall have a cross section not less than 1 in.
   f. The upper valve plate, seat ring and drain ring (shoe bushing) must be ASTM B-584 bronze and work in conjunction to form an all bronze drain way. A minimum of two (2) internal and two (2) external drain openings are required. Drains ported through an iron shoe must be bronze lined.
   g. The bronze seat ring shall thread into a bronze drain ring (or shoe bushing) providing a bronze to bronze connection. Seat rings shall be “o” ring pressure sealed.

C. Product

1. Fire hydrants shall be rated for a working pressure of 1.7 Mpa (250 psi).

2. Fire hydrants shall be of the compression type, opening against the pressure, and closing with the pressure.

3. Fire hydrants shall have a minimum 115 mm (4.5 in) main valve opening and a minimum inside lower/upper barrel diameter (inside diameter) of 150 mm (6 in) to assure maximum flow performance. Pressure loss at 63 liter/second (1,000 GPM) shall not exceed the following values: 115 mm (4.5 inch) Pumper Nozzle: 0.03 Mpa (4.75psi)

4. Fire hydrants shall be three-way in design, having one pumper nozzle 115 mm (4.5 in) and two 65 mm (2.5 in) hose nozzle(s). Nozzle thread type shall be left turn. Nozzles shall thread counterclockwise into hydrant barrel utilizing "o" ring seals. A suitable nozzle lock shall be in place to prevent inadvertent nozzle removal.

5. One of the two 65 mm (2.5 in) hose nozzles will be retrofit with a brass gate wye (65 mm x 38 mm x 38 mm) (2.5 in 1.5 in x 1.5 in) with male National Standard Thread (NST) outlets. Brass caps with chains shall also be furnished and attached to each of the 38 mm (1.5 in) outlets.

6. The direction of the opening shall be left turn. An arrow shall be cast on the bonnet flange to indicate the specified opening direction.

7. The hydrant bonnet shall be attached to the upper barrel by not less than eight bolts and nuts and sealed by an "o" ring.

8. Hydrants shall be a "traffic-model" having upper and lower barrels joined at the ground line by a separate and breakable "swivel" flange providing 3600 rotation of upper barrel for proper nozzle facing. This flange shall employ not less than eight bolts. The safety flange segments shall be located under the upper barrel flange to prevent the segments from falling into the lower barrel when the hydrant is struck. The pressure seal between the barrels shall be an "o" ring. The proper ground line shall be cast clearly on the lower barrel and shall provide not less than 450 mm (18 inch) of clearance from the centerline of the lowest nozzle to the ground.

9. Hydrants shall be equipped with (2) two drain valves which drain the barrel when the hydrant is closed and seal shut when the hydrant is opened. These drain valves shall be an integral part of the one piece bronze upper valve plate. They shall operate without the use of springs, toggles, tubes, levers or other intricate synchronizing mechanisms.

10. The shoe inlet size and connection type shall be 150 mm (6 in) mechanical joint (MJ), having ample blocking pads for sturdy setting and the MJ connection must have two strapping lugs to secure the hydrant to piping. A minimum of six bolts and nuts is required to fasten the shoe to the lower barrel.

D. Coating

1. The interior of the shoe including the lower valve plate and stem cap nut shall have a protective coating that meets the requirements of AWWA C-550. If a stem cap nut is utilized, it must be locked in place by a stainless steel lock washer or similar non-corrosive device that will prevent the cap nut from backing-off during normal use.

E. Warranty

1. Hydrants shall be warranted by the manufacturer against defects in materials or workmanship for a period of ten years (10) from the date of manufacture. The manufacturing facility for the hydrant must have current ISO certification

2.6 GATE VALVES FOR C900 PVC PIPE

A. Gate valves shall be Mueller Series a 2360 resilient wedge Gate valves, with mechanical joints, or equivalent, as shown on the plans.

B. All valves shall have a 50 mm x 50 mm operating nut, mechanical joint and shall conform to AWWA C509. The Contractor shall supply a minimum of four "T" wrenches to the Owner at no additional cost.

C. Materials

1. The resilient wedge gate valves shall fully comply with the latest revision of AWWA C509, and shall also be UL listed and FM approved. The valves shall be tested and certified to ANSI/NSF 61.

2. The valves shall have bolts and nuts for the stuffing box and bonnet with one of the following compositions:

   a. Steel, ASTM A-307, Grade B zinc plated.
   b. Type 304 stainless steel.
   c. Type 316 stainless steel.

3. The valve stem shall be made of bronze ASTM B-132 alloy C67600 bar stock material. The stem shall have at least one "anti-friction" thrust washer above and below the stem collar to reduce operating torque. The design of the NRS valve stem shall be such that if excessive input torque is applied, stem failure shall occur above the stuffing box at such a point as to enable the operation of the valve with a pipe wrench or other readily available tool. The stem material shall provide a minimum 480 Mpa (70,000 psi) tensile strength with 15% elongation and yield strength of 200 Mpa (30,000 psi). Valves with cast stems or two piece stem collars are not acceptable.

4. The valve body, bonnet, stuffing box, and disc shall be composed of ASTM A-126 Class B grey iron or ASTM A395 or A536 ductile iron. The body and bonnet shall also adhere to the minimum wall thickness as set forth in Table 2, section 4.3.1 of AWWA C509. Wall thickness less than that in Table 2 are not acceptable.

5. The valve disc and guide lugs must be fully (100%) encapsulated in SBR ASTM D2000 rubber material. The peel strength shall not be less than 75 pounds per inch. Guide caps of an acetal bearing material shall be placed over solid guide lugs to prevent abrasion and to reduce the operating torque.

D. Product

1. The valve shall have a 1.7 Mpa (250 psi) working pressure.

2. The valve type shall be NRS (non-rising stem) for all valves below grade.

3. The valve shall have an arrow cast on the operating nut or handwheel showing opening direction. The direction of opening shall be left turn.

4. The NRS valves shall be provided with a 50 mm (2 in) square operating nut. The bolt that attaches the operating nut to the stem shall be recessed into the operating nut so as not to interfere with valve wrench operation.

5. The NRS valves shall have a stuffing box that is o-ring sealed. Two o-rings shall be placed above and one o-ring below the stem thrust collar. The thrust collar shall be factory lubricated. The thrust collar and its lubrication shall be isolated by the o-rings from the waterway and from outside contamination providing permanent lubrication for long term ease of operation. Valves without a stuffing box are unacceptable. Valves without at least three stem o-rings are also unacceptable.

6. The valves shall be MUELLER® A2360 series or approved equal.

E. Coating

1. The valves shall have all internal and external ferrous surfaces coated with a fusion bonded thermosetting powder epoxy coating of 10 mm (0.4 in) nominal thickness. The coating shall conform to AWWA C550.

F. Warranty

1. The valves shall be warranted by the manufacturer against defects in materials or workmanship for a period of ten (10) years from the date of manufacture. The manufacturing facility for the valves must have current ISO certification.

2.7 EXPANSION JOINTS

A. Flexible coupling will be neoprene cover. Flexible coupling 600 mm (23.5 in) inside diameter or less shall be single sphere, furnished with a set of floating galvanized steel flanges with recessed grove to interlock to rubber connectors raised face flange bead. Flange bead will be wire reinforced. Flanges will be drilled 125/150# ANSI. Flexible expansion fittings to accommodate approximately 38 mm (1.5 in) to 50 mm (2 in) of settlement. Fitting to be resistant to UV exposure and comply with pipe testing requirements as stated elsewhere in this specification.

2.8 VALVE BOXES

A. Valve box parts shall be made of gray cast iron (CI) in accordance with ASTM A 48, Class 35B. The use of an aluminum alloy as a casting material is not acceptable.

B. Valve boxes shall be the three-piece adjustable screw type with a 400 mm (16 in) top section, 450 mm (18 in) extension, 600 mm (24 in) stem, and 750 mm (30 in) bottom and base. The minimum weight of the components shall be:

Components	Minimum Weight Kg (Pounds)
Lid	5.9 (13)
Water Lid	5.9 (13)

400 mm (16 in) Top Section	15.4 (34)
Water Top Section	19 (42)
460 mm (18 in) Extension	13.2 (29)
600 mm (24 in) Stem	15.9 (35)
750 mm (30 in) Bottom	17.2 (38)
Base	30.8 (68)

C. The 150 mm (6 in) Valve Box shall be Tyler Union 6860 Series or approved equal.

D. Components shall be de-burred and machined so that final dimensions are within plus or minus 1.6 mm (0.06 in) of the specified dimensions. Components shall be provided with the manufacturer's standard rust preventative coating.

E. The manufacturer shall furnish a sworn statement that the inspection and all specified tests have been completed and that results comply with the requirements of these Standards. Three (3) copies of the Certification shall be provided to the Designer of Record.

2.9 HIGH DENSITY POLYETHELENE PIPE (HDPE)

A. Minimum acceptable standard of all HDPE Pipe shall be Class PE 80, Nominal Pressure (PN 16) 1.6 MPa (230 psi) and Standard Dimensions Ratio (SDR) 11 with the minimum strength at 20 degrees Celsius.

B. Dimensions and workmanship shall be as specified by ASTM D3035. HDPE fittings and transitions shall meet ASTM D3261.

C. If rework compounds are required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

D. The pipe Manufacturer must certify compliance with the above requirements.

2.10 FITTINGS FOR HDPE PIPE

A. All fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are connected.

B. The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein. No Contractor fabricated fittings shall be used.

C. All fittings shall be installed using butt-fused fittings and shall conform to ASTM D3261, thermo-fused fittings/couplings, or flanged adapters and must be approved by the Engineer.

D. Tees, elbows, stubs and all pressure pipe directional changes shall be provided with thrust blocks as necessary for restraint. Valves shall be anchored into concrete thrust blocks using steel rods

2.11 RESILIENT SEATED GATE VALVES FOR HDPE PIPE

A. Valves shall be manufactured in compliance with the content and intent of this specification. Valves shall be ductile iron body, with 50 mm (2 in) operating nut, mechanical joint and shall conform to AWWA C509. Valves shall be designed for ten (10) bars working pressure and shall be hydrostatically tested with the specified rated pressure applied to one side of the gate and zero (0) pressure on the other side. Gate valves shall open right.

B. When mechanical joint ends are specified for use, the gasket seating areas shall be machined to fixed dimensions and tolerances as per AWWA specifications. All valves shall be provided with "O" rings. The design of the valve shall be such that the seal plate can be fitted with new "O" rings while the valve is under pressure in a fully open position.

2.12 TEMPORARY PIPE RESTRAINTS FOR HDPE PIPE

A. Temporary Pipe Restrains shall be fixed within 300 mm (1 ft) of fused joints for tees, elbows valves, hydrants and along the temporary pipe spaced a sufficient distanced to prevent movement during the flow test.

B. Temporary Pipe Restrains will be generally in accordance with “Detail 2 Temporary System Restraint” Sheet C-201 unless otherwise approved by the Engineer.

2.13 STEEL PIPE FOR TEMPORARY SYSTEM

A. Pipe: ASTM A53 Grade B or A106 Grade B, Schedule 40 working pressure 1700 psi with a wall thickness of 0.145 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions of the existing site, proposed system, building connections, connection to existing water connections, penetration though concrete utility structure, and other such areas as may present unique difficulties to the completions of this project. The Contractor shall notify the Engineer of any differences between the plans and actual field conditions.

3.2 INSTALLATION

A. Installation begins with proper receipt and storage of materials and accessories in accordance with ANSI/AWWA C600 latest revision. It is the recipient’s duty to review and approve all materials at time of delivery in accordance with AWWA C600 as well as the Terms and Conditions of the supplier.

B. All pipe, fittings, accessories, and appurtenances shall be installed and tested in accordance with ANSI/AWWA C600 latest revision. Assistance is available and should be immediately sought from the manufacturer and/or supplier of the materials in the event of any questions, concerns, or deviations of any kind from the standardized procedures or appearances of the same.

C. Where specified by the plans or otherwise required in written notifications, the pipeline shall be encased in low-density 8-mm (0.3 in) polyethylene wrap in accordance with ANSI/AWWA C105/A21.5 latest revision.

D. Pressure washing of cement lined interior surfaces of the pipe before, during, or after installation is not recommended due to the likelihood of damage to the lining from such variant procedures. Any such cleansing or debris removing procedures and the potential resultant damages are and remain the sole responsibility of the individual or contractor performing the operations. There are specific guidelines available to minimize the potential of damage in such operations yet these do not abate operator responsibility not do they create or compel separate liability upon the manufacture of the pipe or lining.

PART 4 - GENERAL REQUIREMENTS

A. Pipes shall be stored, transported and handled with care to prevent damage, cracking or damage to the ends of the pipes. Pipes shall be stored on sand, clean level ground or wooden sleepers. Interior surface of pipes shall be free of cuts, gouges or scratches; maximum allowable depth of scratch on exterior of pipe is 5% of wall thickness. Dirt, debris, birds, etc shall be prevented from entering pipes during storage. All pipes and fittings shall be thoroughly cleaned before installation.

B. Temporary watertight plugs shall be utilized at the end of each working day to prevent the intrusion of silt, debris, and water into the pipes. When working in areas with a high potential for flooding the pipe from groundwater, streams, storm drains, sewers or other water pipes, the temporary plug shall be provided on each pipe length.

C. When joined together, pipes shall form a continuous line and grade on straight sections.

D. Pipe shall be joined and laid in accordance with the manufacturer's latest published instructions.

E. Pipe shall not be laid with deflection of more than one-half (1/2) the maximum deflection as recommended by the manufacturer.

F. Where underground pipe installation is shown on the plans the pipe shall be installed in accordance with Section 31 23 00 Excavation, Trenching, and Backfilling. Backfill shall be placed on both sides of the pipe and compacted simultaneously with approved tamping bars for the full length of pipe. Joints shall not be “pulled” or “cramped”.

G. Joints shall not be installed directly under existing utilities or structures. Use the appropriate lengths to avoid such conditions.

H. Pipe shall not be installed in areas where excavations have been carried below trench grade, or where water conditions create unstable bottoms, until such time as the trench is excavated, refilled, and compacted as specified.

I. If a defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner.

4.2 TESTING

A. The pipe shall be tested for compliance as specified herein. The Contractor shall furnish all necessary equipment and labor for the pressure test and leakage test on the pipelines. All tests shall occur a minimum of 5 days after installation.

B. Submit test procedures and method to the Engineer for review. Testing shall be conducted in accordance with AWWA C600 or per the Manufacturer's recommendations and shall be the responsibility of the Contractor. Care shall be taken to isolate existing pipe sections prior to conducting the test.

C. All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 1.4 Mpa (200 psi) or 0.4 Mpa (50 psi) in excess of the system working pressure, whichever is greater, and shall maintain that pressure 0.04 Mpa (±5 psi) for 2 hours.

D. All valves and valve boxes shall be properly located and installed and operable prior to testing. Bulkheads shall be provided with a sufficient number of outlets for filling and draining the line and for venting air.

E. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the Contractor. Provide means for measuring the quantity of water required to maintain this pressure. The amount of water required is a measure of the leakage.

F. The leakage rate shall not exceed those indicated in AWWA C600. Allowable leakage per 305 meters (1000 ft) of pipeline in liters/hour:

1. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

2. Duration of pressure test shall not be less than 1 hour. The leakage test may be concurrent with the pressure test and shall not be less than 2 hours duration. All leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves, and accessories shall be:

Pipe Size (mm) (in)	Allowable Leakage (L/hr) (g/hr)
25 (1)	1.00 (0.25)
50 (2)	1.00 (0.25)
75 (3)	1.00 (0.25)
100 (4)	1.25 (0.33)
150 (6)	2.00 (0.50)
200 (8)	2.50 (0.66)

END OF SECTION

Tarakhil Power Plant Water Piping System
Kabul, Afghanistan

EXAMPLE MANUFATURER'S INSTALLATION GUIDES

Some of the materials called for in this project may differ from those used locally the typical manufacturer's installation, therefore guides are being provided as reference to aid in the planning of this project. The below manufacturer's installation guides are included to give the contractor an idea as to the standard of construction that will be required. Actual manufacturer specifications may differ.

C900 Pipe

http://jmeagle.com/pdfs/installation/BIG_BLUE-BLUE_BRUTE-ULTRA_BLUE_Installation_Guide_03-2011_web.pdf

Mechanical Joint Fittings

http://www.tylerunion.com/UCAT5AWeb2012%20Revised.pdf

Mechanical Joint Restraints

http://www.ebaa.com/PDF/Brochure.19MJ00.pdf

http://www.ebaa.com/PDF/Brochure.2100.pdf

C900 Pipe Tools

http://173.254.28.123/~propipes/EagleClawOperationGuide.pdf

END OF SECTION

Tarakhil Power Plant Water Piping System
Kabul, Afghanistan

PREFERRED VENDORS

Below is the list of preferred vendors

All other vendors shall meet the requirements of specification section 33 11 00 Water Mains and Appurtenances and submit a shop drawing to the Engineer for approval.

- C900 Pipe – JM Eagle or Northern Pipe Products Inc
- Ductile Iron Pipe and Fittings – Tyler Union or US Pipe or AMERICAN (American Cast Iron Pipe Company)
- Gate Valves– Mueller or AMERICAN (American Cast Iron Pipe Company) or Nibco
- Fire Hydrants – Mueller or AMERICAN (American Cast Iron Pipe Company)
- Mechanical Joint Restrainers – EBAA Iron MEGALUG or STAR Pipe Products
- Spherical Expansion Joint-Metraflex
- Steel Flange Connection-Coastal Flange
- Insulation materials-Knauf Insulation

END OF SECTION