



**USAID**  
FROM THE AMERICAN PEOPLE



# USAID ENERGY POLICY PROGRAM

## TECHNICAL AUDIT REPORT SUMMANDRY ROAD 220KV GRID STATION

January 2015

*This program is made possible by the support of the American people through the United States Agency for International Development (USAID)*

# USAID ENERGY POLICY PROGRAM

## TECHNICAL AUDIT REPORT

# SUMMANDRY ROAD

# 220KV GRID STATION

Contract No: AID-EPP-I-00-03-00004

Order No: AID-391-TO-12-00002

©USAID Energy Policy Program  
House 4, Street 88, Sector G-6/3  
Ataturk Avenue, Islamabad, Pakistan  
Tel: +92 (51) 835 7072, Fax: +92 (51) 835 7071  
Email: [jhicks@aeai.net](mailto:jhicks@aeai.net)

### DISCLAIMER

The contents of this report are the sole responsibility of Advanced Engineering Associates International Inc. (AEAI) and do not necessarily reflect the views of USAID or the United States Government.

# Technical Audit of Summandry Road 220kV Grid Station

## Introduction:

This report covers the technical audit of Summandry Road 220kV Grid Station (GS), located 20km south of Faisalabad, Punjab. This GS was commissioned on October 12, 1995. It has 480MVA transformation capacity connected to the grid and feeds Faisalabad and its surrounding areas.

There are three (03) 160MVA-220/132kV autotransformers and two (02) 13MVA-132/11kV power transformers that are maintained and owned by NTDC. There are four (04) 220kV and six (06) 132kV transmission circuits linking this station to others. The GS is connected to Multan 500kV GS and Nishatabad 220kV GS through 220kV circuits. A new T.T. Singh 220kV GS is under commissioning and will be linked through both 220kV Summandry Road-Multan circuits soon. For 220kV switchyard one and half breaker scheme whereas for 132kV switchyard double bus single breaker scheme is used. Single line diagram of the GS is attached (Annex-A).

EPP audit team comprising of technical experts visited this GS from March 13, 2014 to March 25, 2014. This report reflects their findings and prioritized fixes.

## Findings:

Observations of technical experts are below:

- 1) Loading condition of transformers is tabulated below:

Transformer No.	Ratings			Max. Load Current Recorded (A)	Max. Percentage Loading of transformers (%)
	Voltage Ratio (kV/kV/kV)	Power (MVA)	HV/LV Current (A)		
T-1	220/132/11	160	420/700	725	103.57
T-2	220/132/11	160	420/700	770	110
T-3	220/132/11	160	420/700	770	110
T-4	132/11.5	13	56/653	560	85.76
T-5	132/11.5	13	56/653	410	62.79

All 220/132kV transformers are overloaded per NEPRA grid code clause OC 4.9.5 supported by IEC (International Electro-technical Commission) which allows up to 80% loading of transformers. According to IEC Standard 60354, continuous loading of transformer above 80% at ambient temperature equal to or above 40°C, prohibits the transformer's short time overloading beyond its nameplate ratings. Exceeding this limit reduces the expected useful life of transformers in proportion to the amount and duration of overload. The prevailing overloading of the transformers at this GS is due to damaging of two (02) 63.5MVA-220/132kV transformers at Nishatabad 220kV GS. These damaged transformers need to be replaced with

## Technical Audit of Summandry Road 220kV Grid Station

---

160MVA-220/132kV transformers available in NTDC network. Also, a new T.T. Singh 220kV GS is under commissioning in the vicinity and is expected to share the loading of 220/132kV transformers at this GS.

- 2) The following tests have not been performed as required per SOPs for grid system operation and maintenance:
  - a. Detailed oil testing and Dissolved Gas Analysis (DGA) test of oil of all transformers - In the absence of these tests, the quality of transformer oil cannot be ascertained in view of the contents of various undesired gases in the oil and other important parameters such as moisture content, flash point, kinematic viscosity, interfacial tension, acidity and tangent delta etc., resulting in breakdown of transformers
  - b. Leakage current measurement (LCM) test of lightning arresters
  - c. Capacitance & dissipation factor (C&DF) test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs)
  - d. SF<sub>6</sub> purity and moisture content test for 220kV and 132kV circuit breakersIt is necessary to conduct all tests timely to ensure healthiness of the equipment.
- 3) Overhauling of six (06) 220kV circuit breakers (CBs) and five (05) 132kV CBs is pending due to unavailability of spare parts. Moreover, spare parts are not available for five (05) 220kV CBs and seven (07) 132kV CBs for future overhauling (for details see Annex-B)
- 4) The chemical gases and fumes from the sewerage drain passing nearby the GS has caused erosion of the earth risers of all the equipment in the switchyard and ungalvanized nuts/bolts of the equipment structures, which may cause serious mishap at any time.
- 5) Alignment of fourteen (14) 220kV isolators and three (03) 132kV is out of order in this GS. Remote operation of most 132kV and eleven (11) 220kV isolators is out of order. Both the problems affect the smooth operational performance of the equipment.
- 6) Performance of 220V battery set No.4 is satisfactory but with a deficit of five cells in the battery. The battery set No.3 is also deficit of four cells. The condition of the battery is very poor due to cracks in the cell containers, shedding of active material and deterioration of positive and negative terminals in a number of cells.
- 7) Tele-protection (PLC aided) and direct transfer trip (DTT) is not available on 220kV transmission circuits. DTT is required for remote end tripping on "Breaker Failure Scheme" when there is no guarantee that relaying at remote line terminals will actuate quickly enough to minimize consequential damage.

## Technical Audit of Summandry Road 220kV Grid Station

---

- 8) Sequential event recorders and fault recorders are not operative/defective. Voltage and power recorders are out of circuit since long due to lack of maintenance. This data helps engineers to check proper functioning and settings of the protection system and identify components that failed to operate in the event of a fault.
- 9) Auto-reclosers on almost all 220kV and 132kV transmission lines are blocked. Auto-reclosers can significantly reduce the outage time, reduce transmission line damage and thus provide higher service continuity.
- 10) Tie Line/Stub protection is not available for all 220kV circuits. There are short sections of the current path within a grid station that are not properly protected by the general protection. These sections are called stubs and they are usually between the circuit breaker and the current transformer and also section between the circuit breakers and the open line isolator. The stub protection is used to detect the fault current in the "blind spots" and to generate a quick trip command to the respective CBs.
- 11) The GS is missing around thirty-four (34) important relays such as: (For details see Annex-B and D).
  - a. Three (3) Thermal overload protection relays on transformers
  - b. Three (03) Tertiary earth fault relays on transformers
  - c. two (02) Trip lock out relays
  - d. Three (03) Neutral over current relays on 220/132kV transformers
  - e. Three (03) Rough balance differential protection low impedance relays on 220/132kV transformers
  - f. Six (06) HV and LV connection differential protection relays on 220/132kV transformers
  - g. Three (03) back up earth fault relays - AC Series Trip
  - h. One (01) Distance to fault locator on one transmission circuit
- 12) The loading of 220kV Summandry Road-Nishatabad circuits is above the prescribed limits by NEPRA i.e. 80% during summer season. The 132kV Gojra 1 and 2 circuits are running overloaded.
- 13) Thermovision survey of the GS and all TLs emanating from this GS has not been carried out.
- 14) Clearance of 220kV Summandry Road-Nishatabad circuits is inadequate and dangerous in the spans of tower No. 597/598, 599/600, 610/611 and 611/612, which needs to be improved by installation of additional/extended towers or tubular poles. The T/L from tower No. 590 to 616 passes through thickly populated area and needs re-routing using tubular poles. The tower foundations at location No. 579, 580 and 587 are vulnerable and require protection walls. Thermovision survey needs to be done.

## Technical Audit of Summandry Road 220kV Grid Station

- 15) Clearance of 220kV Summandry Road-Multan circuits is inadequate and very dangerous in the spans of tower No. 306/307, 317/318, 422/423, 513/514 & 521/522 and needs to be improved by using extended towers.

### Recommendations:

Transmission and Grid			
Sr. No.	Findings	Recommendations	Remarks
1	All 220/132kV transformers are overloaded per NEPRA grid code	The prevailing overloading of the transformers at this GS is due to damaging of two (02) 63.5MVA-220/132kV transformers at Nishatabad 220kV GS. These damaged transformers need to be replaced with 160MVA-220/132kV transformers available in NTDC network. Proper load flow studies need to be conducted keeping in view the commissioning of new T.T. Singh 220kV GS in the vicinity.	
2	Detailed oil testing, Dissolved Gas Analysis and C and DF test for all transformers are due. LCM test for all lightning arresters and C and DF test for all CTs and CVTs is due.	These tests need to be done on priority basis to ascertain quality of oil, healthiness of the transformer and its insulation. All other tests should be carried out per the SOPs to ensure healthiness of the equipment.	
3	Overhauling of six (06) 220kV circuit breakers (CBs) and five (05) 132kV CBs is pending due to unavailability of spare parts	Spare parts should be arranged for major maintenance of these CBs	NTDC have trained staff for overhauling of CBs and workshop facilities for repairing of CBs
4	The loading of 220kV Summandry Road-Nishatabad circuits is above the prescribed limits by NEPRA i.e. 80% during summer season. The 132kV Gojra 1 & 2 circuits are overloaded.	Proper load flow studies need to be conducted and loading of these circuits to be reduced accordingly. For 132kV overloaded circuits, FESCO needs to be intimated to take action to reduce loading.	
5	The chemical gases and fumes from the sewerage drain nearby the GS has caused erosion of the earth risers of all the equipment in the switchyard and un-galvanized nuts/bolts of the equipment structures.	Silicon grease or other appropriate adhesive should be used for protection of earthing risers and rusted nuts and bolts need to be replaced with galvanized ones.	

## Technical Audit of Summandry Road 220kV Grid Station

6	Performance of 220V battery set No.4 is satisfactory but with a deficit of five cells in the battery. The battery set No.3 is also deficit of four cells. The condition of the one battery is poor due to cracks in the cell containers, shedding of active material and deterioration of positive and negative terminals in a number of cells.	One battery needs replacement and its healthy cells can be used in the other healthy battery to make up the deficiency of the cells.	
7	Alignment of fourteen (14) 220kV isolators and three (03) 132kV is out of order. Remote operation of most 132kV and eleven (11) 220kV isolators is defective.	The defective remote control operation and alignment problem of the isolators needs to be set right	
8	Spare parts are not available for five (05) 220kV CBs and seven (07) 132kV CBs for future overhauling.	Spare parts need to be arranged.	

<b>Protection</b>			
Sr. No.	Findings	Recommendations	Remarks
1	Tele-protection and direct transfer trip (DTT) facility is out of circuit on most 220kV circuits.	“System Protection and telecommunication departments of NTDC” should look into it and make concerted efforts to enable “Carrier aided facility” at either ends of the transmission lines in order to clear faults rapidly.	
2	Tie line protection is not available for all 220kV transmission lines.	Recommended to be installed.	
3	The following equipment on transformers is not installed: three (3) thermal overload protection relays on transformers, three (03) tertiary earth fault relays on transformers, three (03) Neutral over current relays on transformers.	Thermal overload and overload (current based) protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely. All other missing and defective relays need to be installed. (for details see Annex-B and D)	
4	Thirty-four (34) important relays are missing at this GS. (for details see Annex-B and D)	All missing and defective relays need to be installed with latest version.	

## Technical Audit of Summandry Road 220kV Grid Station

5	Inoperative sequential event recorders, fault recorders and voltage recorders for 220kV system.	It is strongly recommended to make sequential event recorders, fault recorders and voltage recorders operative. Such data helps engineers to check proper functioning of protection system and identify the components which failed to operate as expected.	
6	Auto-reclosers are blocked on all 220kV and 132kV lines	"System Protection" and "System Operations" departments have to review the matter and take appropriate action for restoration of auto-reclosers. This can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity.	
7	HV connection, LV connection and rough balance differential relays are not installed on 220/132kV transformers to sectionalize the differential zones.	Needs to be installed to sectionalize the differential zones.	

General			
Sr. No.	Findings	Recommendations	Remarks
1	Thermovision survey of GS and T/Ls is not done.	Thermovision survey needs to be carried out to avoid any major breakdowns	
2	Clearance of 220kV Summandry Road-Nishatabad circuits is inadequate in the spans of tower no. 597/598, 599/600, 610/611 and 611/612. The T/L from tower No. 590 to 616 passes through thickly populated area and needs re-routing. The tower foundations at location No. 579, 580 and 587 are vulnerable. Dangerous clearance in five spans of 220kV Summandry road-Multan circuits.	Clearance should be improved by installation of additional/extended towers / tubular poles and re-routing of the concerned portion of the line. Retaining walls for three towers should be constructed.	

[www.ep-ep.com.pk](http://www.ep-ep.com.pk)  
[info@ep-ep.com.pk](mailto:info@ep-ep.com.pk)