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TECHNICAL AUDIT REPORT JAMSHORO 500KV GRID STATION

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TECHNICAL AUDIT REPORT

JAMSHORO 500KV GRID STATION

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Technical Audit of Jamshoro 500kV Grid Station

Introduction:

This report covers the technical audit of Jamshoro 500kV Grid Station (GS) located on Indus Highway adjacent to Jamshoro Thermal Power Station, Sindh. This GS was commissioned on 220kV in 1984 and then upgraded to 500kV level in 1987. It has a total of 900MVA transformation capacity and feeds a large portion of HESCO and some of Karachi K-Electric.

There are two (02) 450MVA-500/220kV and two (02) 160MVA-220/132kV autotransformers installed at this GS that are owned and maintained by NTDC. Four (04) 500kV, six (06) 220kV and six (06) 132kV circuits link this station to others. The GS is connected to Hub Thermal Power Station, NKI 500kV GS and Dadu 500kV GS through 500kV circuits whereas connected to T.M. Khan Road 220kV GS, Hala Road 220kV GS and KDA-33 220kV GS of K-Electric through 220kV transmission circuits. The GS plays a pivotal role for dispersal of power of thermal power stations i.e. Jamshoro and Hub. For 500kV and 220kV switchyard, one and half breaker scheme whereas for 132kV switchyard double bus single breaker scheme is used. Single line diagram is attached (Annex-A).

EPP audit team comprising of transmission and protection experts visited this GS from September 9, 2014 to September 19, 2014. This report reflects their findings and prioritized fixes.

Findings:

Observations of technical experts are given below:

1. The loading condition of transformers is tabulated below:

Transformer No.	Rating			Max. Load Recorded (Amp)	Max. Load Recorded (Percentage)
	Voltage Ratio (kV/kV/kV)	Power (MVA)	HV/LV Current (A)		
T-1	525/231/23	450	495/1125	450	40%
T-2	525/231/23	450	495/1125	450	40%
T-3	220/132/11	160	420/700	446	63.7%
T-7	220/132/11	160	420/700	420	60%

At present no spare single phase unit of T-1 and T-2 is available in case of emergency conditions. In the recent fire hazard of 450MVA-500/220kV transformer bank T-1 in July 2014, a Jeumont Schneider make single phase unit presently lying spare, was affected due to fire. The control cables, wiring and miniature circuit breakers (MCBs) in its control cubical were also damaged.

2. The loading of 220kV Jamshoro - Hala Road circuits is above the prescribed limits per NEPRA grid code i.e. 80%.

Technical Audit of Jamshoro 500kV Grid Station

3. Water storage tank and distribution lines for conventional fire-fighting system of transformers and shunt reactors are damaged.
4. Major maintenance of eight (08) 500kV, fourteen (14) 220kV and six (06) 132kV circuit breakers (CBs) is pending due to unavailability of spare parts. Timely maintenance of CBs is essential to ensure healthiness and reliability of the system. Moreover, major maintenance of eight (08) 500kV, ten (10) 220kV and four (04) 132kV CBs will be due in future. (For details see Annex-B)
5. Remote control operation of many isolators is defective. Moreover, grounding mats of isolators are missing in 500kV and 220kV switchyards which directly affect the safety of an operator.
6. The following tests are not being performed which are required as per SOPs for grid system operation and maintenance:
 - a. Leakage current monitor (LCM) test of lightning arresters.
 - b. SF6 gas purity & moisture content test for CBs.
 - c. Contact resistance test and opening/closing time test of CBs (pending due to defective testing sets).
 - d. Dissolved Gas Analysis (DGA) and detailed oil testing of transformers.
 - e. Capacitance & Dissipation Factor (C&DF) test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs).

It is necessary to conduct all tests timely to ensure healthiness of the equipment.

7. The towers and hardware of first 10 towers from Hub side of 500kV Jamshoro-Hub circuit have rusted due to severe humid environment along the seashore and shield wire is also damaged from tower Nos. 1 to 35. Moreover, at tower locations 390 to 430 of both, 500kV Jamshoro-Hub and 500kV Jamshoro-NKI circuits, spacer dampers are damaged.
8. In 500kV Jamshoro-Dadu circuit 1, cracks have developed in tower foundations at location Nos. 41, 67, 104, 106 and 114. Also stubs and main members (legs) of the tower Nos. 92 and 139 are rusted which may result in catastrophe of tower foundation and the towers themselves.
9. The conductor of 220kV Jamshoro-KDA circuit 1 and 2 is corroded at tower locations 150 to 383 near KDA-33kV GS. Shield wire is also damaged in most of the transmission line sections. The line is facing critical clearance at several locations near Nooriabad and super highway due to construction of houses under the line in various housing societies.

Technical Audit of Jamshoro 500kV Grid Station

10. The 220kV double circuit Jamshoro-Hala Road is in the most critical condition due to many problems listed as under:
 - a. Conductor of the entire line is annealed and corroded and several breakdowns of line have occurred in the past.
 - b. The transmission line is full of mid-span joints all over the length on account of frequent breakdowns. Most of the spans contain one or more joints which warrant deteriorated condition of the line.
 - c. Shield wire is damaged and missing in most of the line sections and stock bridge dampers are also missing. Jumpers at tower locations 1, 2, 5, 12, 14, 18, 34, 35, 36 and 37 are damaged and need replacement.
 - d. The existing EMCO make insulators installed on the line have experienced several breakdowns owing to their mechanical failure.
 - e. The clearance of the line from tower Nos.25 to 34 is very critical due to construction of houses under the line in various housing societies.
11. Clearance of the 220kV Jamshoro-T.M khan Road double circuit is critical at tower location Nos. 8 to 29 due to construction of houses under the line in various housing societies near Indus highway and Jamshoro city.
12. Tele-protection on 220kV circuits whereas direct transfer trip (DTT) and tie line protection (a feature available in distance protection relay) is out of circuit on all 500kV and 220kV circuits.
13. Some important relays are not installed on 500kV, 220kV and 132kV circuits as detailed below:
 - a. Nine (09) distance to fault locator
 - b. Thirty (30) trip circuit supervision relays
 - c. Twenty one (21) DC supply supervision relays
14. Auto-reclosers are blocked on all 220kV and 132kV circuits. Auto-reclosers can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity.
15. HV connection, LV connection and rough balance differential relays are not installed on 220/132kV transformers to sectionalize the differential zones. (For details see Annex-B)
16. Some important relays not installed on 500/220kV and 220/132kV transformers are as below:
 - a. Two (02) tertiary earth fault relays

Technical Audit of Jamshoro 500kV Grid Station

- b. Two (02) tertiary overcurrent relays
- c. Four (04) thermal overload relays
- d. Twenty two (22) trip circuit supervision relays
- e. Eight (08) DC supply supervision relays
- f. Two (02) overload relays (current based)

17. Sequential event recorders and fault recorders are not functional since commissioning apparently due to improper configuration besides lack of updating of software. Voltage and power recorders are also out of order. This data helps engineers to check proper functioning of the protection system and identify components that failed to operate during faults.

18. Under "NPCC upgrading project", most of the SCADA equipment has since been installed and interfaced with the existing system but not yet commissioned properly. Due to SCADA system not being in place, facility of tele-control, tele-signaling, tele-metering, status indications etc., is not available at NPCC.

19. The details of all missing and defective relays are in Annex-B and D.

Recommendations:

Transmission and Grid			
Sr. No	Findings	Recommendations	Remarks
1	No spare single phase unit of T-1 and T-2 is available to meet with emergency conditons	A Jeumont Schenider make 150MVA-500/220kV single phase unit lying at Jamshoro GS needs repairs. A redundant China make 150MVA-500/220kV lying at Gatti 500kV GS may be shifted to Jamshoro if the parameters match with TBEA make transformer T-2.	
2	Water storage tank and distribution lines for fire protection of transformers and shunt reactors are damaged.	Fire protection system of the transformers and shunt reactors to be restored after repair or replacement of damaged water storage tank ans distribution lines.	
3	Overhauling of twenty eight (28) CBs is pending due to unavailability of spare parts.	Spare parts for eight (08) 500kV, fourteen (14) 220kV and six (06) 132kV CBs need to be arranged.	
4	The 220kV Jamshoro-Hala Road double circuit is in critical condition facing problems due to	The conductor of the entire transmission line needs replacement with twin bundle after replacement of certain towers to	

Technical Audit of Jamshoro 500kV Grid Station

	deterioration of conductor. Also, the loading of 220kV Jamshoro - Hala Road circuits is above the prescribed limits per NEPA grid code i.e. 80%.	avoid collapse. Also, the loading on these circuits needs to be reduced.	
5	Towers and hardware of first 10 locations of 500kV Jamshoro-NKI circuit are rusted; shield wire is also damaged at few locations. Spacer dampers are damaged	Appropriate measures are to be taken to avoid collapse of the towers. Damaged shield wire should be replaced.	
6	Dissolved gas analysis (DGA) and detailed oil testing of transformers is pending.	These tests need to be performed on priority basis to ensure healthiness of the transformers.	
7	LCM test of lightning arresters, SF6 purity & moisture content test, contact resistance test and opening/closing time test of CBs and C&DF test of CTs, PTs and CVTs are not done.	These tests need to be performed on priority basis to ascertain and ensure healthiness of the equipment.	
8	Cracks have developed; stubs and main members are rusted at certain locations of 500kV Jamshoro-Dadu circuits	Proper action is required for repair of affected foundations and rusted members to avoid collapse of the towers.	
9	Clearance of 220kV Jamshoro-T.M Khan Road double circuit is critical at certain locations.	The clearance should be improved by installation of extension towers to avoid any mishap.	
10	220kV double circuit Jamshoro-KDA transmission line is facing problems of conductor corrosion, damaged shield wire and tower rusting at certain locations.	Damaged conductor and shield wire need replacement. Proper action is required to replace damaged tower components to avoid collapse of the towers.	
11	Earthing mats of isolators are missing in 500kV and 220kV switchyards. Remote control operation of many isolators is defective.	Missing earthing mats of isolators should be provided and defective remote control operation of the isolators to be set right.	

Technical Audit of Jamshoro 500kV Grid Station

Protection			
Sr. No	Findings	Recommendations	Remarks
1	Tele-protection is missing on almost all 220kV lines. Inoperative DTT and tie line protection (a feature available in distance protection relay) on all 500kV and 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	Sequential event recorders and fault recorders on 500kV and 220kV system are not functional since commissioning apparently due to improper configuration besides lack of updating of software. Voltage and power recorders are also out of order.	It is strongly recommended to make sequential event recorders, fault recorders and voltage recorders functional. Such data helps engineers to check proper functioning of protection system and identify the components which failed to operate as expected.	
3	Absence of thermal overload protection relays on 500/220kV, 220/132kV transformers.	Thermal overload protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely.	
4	Nine (09) distance to fault locator, twenty (20) trip circuit supervision relays, twelve (12) DC supply supervision relays, ten (10) DC trip circuit supervision relays and nine (09) closing supply supervision relays are not installed on 500kV, 220kV and 132kV circuits.	It is strongly recommended to install all these relays for proper protection of circuits.	
5	Absence of HV connection, LV connection and rough balance differential relays on both 220/132kV transformers.	Needs to be installed to sectionalize the differential zones.	
6	Four (04) tertiary earth fault relays, twenty two (22) trip circuit supervision relays, eight (08) DC supply supervision relays and two (02) overload protection	It is strongly recommended to install all these relays for proper protection of transformers.	

Technical Audit of Jamshoro 500kV Grid Station

	(current based) are not installed on 500/220kV and 220/132kV transformers.		
7	Auto reclosing is inactive for all 220kV circuits.	This can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity.	
General			
Sr. No	Findings	Recommendations	Remarks
1	Thermovision survey of GS is not done. Thermovision survey of all transmission lines is pending.	Thermovision survey needs to be carried out to avoid any major breakdowns.	
2	In-operative SCADA system.	The installed equipment must be made functional.	

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