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## TECHNICAL AUDIT REPORT SHIKARPUR 220KV GRID STATION

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## TECHNICAL AUDIT REPORT

# SHIKARPUR 220KV GRID STATION

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# Technical Audit of Shikarpur 220kV Grid Station

## Introduction:

This report covers the technical audit of Shikarpur 220kV Grid Station (GS) located in the western part of Shikarpur city, Sindh. This GS was commissioned on June 02, 2005. It has a transformation capacity of 480MVA connected to the grid and feeds a vast area of Shikarpur district.

There are three (03) 160MVA-220/132kV autotransformers and two (02) 13MVA-132/11kV power transformers installed at the GS which are owned and maintained by NTDC. Four (04) 220kV and five (05) 132kV circuits link this station to others. The GS is connected to Guddu and Uch thermal power stations and new Rohri 220kV GS through 220kV circuits. For 220kV switchyard, one and a half breaker scheme whereas for 132kV switchyard double bus single breaker scheme is used. Single line key diagram is attached (Annex-A).

EPP audit team comprising transmission and protection experts visited this GS from December 02, 2014 to December 10, 2014. This report reflects their findings and prioritized fixes.

## Findings:

Observations of technical experts are as below:

- 1) The loading condition of the transformers is tabulated below:

Transformer No.	Rating			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	680	97.1
T-2	220/132/11	160	420/700	700	100
T-3	220/132/11	160	420/700	700	100
T-4	132/11.5	13	56.8/653	425.8	65
T-5	132/11.5	13	56.8/653	115	17.6

From above, it is evident that all 220/132kV transformers are loaded above the prescribed limits 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 loading beyond its nameplate ratings. Exceeding this limit, the expected useful life of transformers is reduced in proportion to the amount and duration of overload. The commissioning of new Rohri 220kV GS will share the load on transformers at this GS.

- 2) Three (03) 132kV transmission circuits Shikarpur-Garhi yasin, Shikarpur-Larkana and Shikarpur-Humayun circuits are overloaded. The 220kV Shikarpur-Uch circuit is loaded

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above the prescribed limits per NEPRA grid code i.e. 80%.

- 3) One (01) 220kV circuit breaker (CB) is out of service since December 16, 2013 due to operational problems. Remote operation of one (01) 132kV CB is not functional.
- 4) The following tests have not been performed as required per SOPs for grid system operation and maintenance:
  - a. Dissolved gas analysis (DGA) test and detailed oil testing for transformers
  - b. Opening/closing time & Contact resistance test of CBs
  - c. Capacitance and dissipation factor (C&DF) test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs)
  - d. LCM test of Lightning arrestors (LAs)
  - e. Earthing test of 220kV and 132kV switchyards
- 5) Major maintenance of eleven (11) 220kV and fourteen (14) 132kV CBs (SF6 gas) will become due in the near future. Spares parts for overhauling of such breakers are not available at the GS. (for details see Annex-B)
- 6) Oil seepage exists in primary terminal of nine (09) 132kV CTs.
- 7) For Secured Metering System (S.M.S) dedicated CT and PT are not installed for transformer T-3 while the CTs and PTs installed for T-1 and T-2 are not commissioned yet.
- 8) Thermovision survey of 220kV transmission lines, 132kV transmission lines, 220kV switchyard and 132kV switchyard have not been done.
- 9) The clearance of 220kV transmission line is critical between tower no. 55/56, 56/57 and 124/125 for Shikarpur-Guddu Line and between tower no. 625/626, 630/631, 670/671, 748/749, 775/776 and 780/781 for Shikarpur-Uch line. Optic Fiber Ground Wire (OPGW) is missing from tower No. 38 to 84, 121 to 135, 154 to 174 and 192 to 206 while peaks at tower no. 68 to 77 have not been provided for 220kV Shikarpur-Rohri-1 and Rohri-2.
- 10) The facility for direct transfer trip (DTT) is not available. This DTT order requires the missing tele-protection facility. Tie line (stub) protection is also not available on both 220kV transmission circuits.
- 11) Auto-reclosers on all 220kV and 132kV transmission lines are blocked. Auto-reclosers can significantly reduce the outage time, reduce transmission line damages and thus provide higher service continuity.

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- 12) HV connection, LV connection and rough balance differential relays are not installed on 220/132kV transformers T-1 and T-2 to sectionalize the differential zones. (For details see Annex-B).
- 13) The following relays are not installed on 220/132kV and 132/11kV transformers:
- Four (04) thermal overload protection
  - One (01) overload (current based) protection
  - Four (04) closing supply supervision
  - Three (03) tertiary earth fault relay
  - Two (02) neutral Over Current relay
- 14) Cross trip protection facility is not available on all 220/132kV transformers. Cross trip scheme is implemented in some sections of the system to avoid total or partial collapse.
- 15) Sequential event recorders and fault recorders are not functional due to non-availability of updated software and poor maintenance. Voltage and power recorders are out of service since commissioning, due to lack of maintenance. This data helps engineers to check proper functioning of the protection system and identify components that failed to operate in the event of a fault.
- 16) Tie line protection is not installed on all 220kV circuits. Closing and alarm supply supervision relays are not installed on 220kV Shikarpur-Rohri 1 and Rohri-2 transmission lines.
- 17) Differential protection and its CT circuit monitoring protection are not installed on 132kV bus-1 and bus-2.
- 18) List of missing relays and other defective equipment is attached. (Annex-D)

### **Recommendations:**

Transmission and Grid			
Sr. No.	Findings	Recommendations	Remarks
1	Loading of 220/132kV transformers is above the prescribed criteria per NEPRA grid code i.e. 80%	Proper load flow study needs to be conducted keeping in view the commissioning of new Rohri 220kV GS.	
2	The loading of 132kV and 220kV Shikarpur-Uch transmission circuits is above the prescribed limits per NEPRA grid code i.e. 80%	For 132kV circuits matter needs to be taken up with SEPCO. Proper load flow study need to be conducted to address loading on Uch circuits.	
3	DGA test and detailed oil testing for transformers, Opening/closing time and	All these tests should be carried out regularly to ensure healthiness of the equipment.	

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	Contact resistance test of CBs, LCM test of lightning arrestors, C and DF test of CTs, PTs and CVTs are not done		
4	S.M.S dedicated CT and PT are no installed for transformer T-3	Dedicated CT and PT need to be installed.	
5	One 220kV CB is out of service due to operational problems.	The problem should be rectified on top priority.	
6	Unavailability of Spare parts for eleven (11) 220kV and fourteen (14) 132kV CBs for future overhauling.	Spares need to be arranged.	

<b>Protection</b>			
Sr. No.	Findings	Recommendations	Remarks
1	In-operative tele-protection on all 220kV circuits and direct transfer trip (DTT) of 220kV system.	System Protection and telecommunication departments of NTDC" should look into the matter to enable "Carrier aided facility" at either ends of the transmission lines for quick clearing of the faults.	
2	Absence of sequential event recorders and fault recorders and voltage/power recorders for 220kV system.	It is strongly recommended to install sequential event recorders, fault recorders and voltage/power recorders. 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 all 220/132kV and 132/11kV transformers and over load (current based) protection relays on 132/11kV transformers.	Thermal overload and overload (current based) protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely.	
4	Absence of HV connection, LV connection and rough balance differential relays on all 220/132kV transformers.	Needs to be installed to sectionalize the differential zones.	

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5	Differential protection for 132kV bus-1 and bus-2 is not installed.	Recommended to be installed for rapid isolation of bus bar faults.	
6	Absence of cross trip scheme on all 220/132kV transformers.	Recommended to be installed for protecting the system from total collapse due to overloading. NTDC needs to look into the issue for system stability.	
7	Replacement of faulty, blocked and missing relays (for details see Annex-B)	Needs replacement with latest version.	
8	Blocked auto-reclosers on all 220kV and 132kV transmission lines.	This can significantly reduce the outage time, reduction in transmission line damages and thus providing higher service continuity.	

General			
Sr. No.	Findings	Recommendations	Remarks
1	Thermovision survey of all 220kV transmission lines, 220kV and 132kV switchyards have not been done.	Thermovision survey needs to be done.	
2	Inadequate clearance of 220kV transmission line which is critical between tower no. 55/56, 56/57 and 124/125 for Shikarpur-Guddu Line and between tower no. 625/626, 630/631, 670/671, 748/749, 775/776 and 780/781 for Shikarpur-Uch line. OPGW from tower No. 38 to 84, 121 to 135, 154 to 174 and 192 to 206 is missing while peaks at tower no. 68 to 77 have not been provided for 220kV Shikarpur-Rohri-1 and Rohri-2.	Adequate clearance can be attained by installation of extended towers and re-routing of the line to avoid any mishap. Missing OPGW and Peaks of Shikarpur-Rohri-1 and Rohri-2 needs to be provided.	

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