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## TECHNICAL AUDIT REPORT LUDEWALA 220KV GRID STATION

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## TECHNICAL AUDIT REPORT

# LUDEWALA 220KV GRID STATION

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# Technical Audit of Ludewala 220kV Grid Station

## Introduction:

This report covers the technical audit of Ludewala (Sargodha) 220kV Grid Station (GS), located on Sargodha-Gujrat road, about 195 km from Lahore, Punjab. This GS was commissioned on May 1, 2005. It is an important grid due to its linkage to 500kV Gatti, ChashNUP and Daud Khel 220kV GS through ChashNUP. It has a total of 480MVA transformation capacity connected to the grid and is the main source for feeding Sargodha and its surrounding areas.

There are three (03) 160MVA-220/132kV autotransformers and one (01) 10/13MVA-132/11kV power transformer at this GS that are owned and maintained by NTDC. Four (04) 220kV and six (06) 132kV transmission lines link this GS to other stations. It is linked to 500kV Gatti GS and Chashma Nuclear power station through 220kV transmission circuits. For 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 transmission and protection experts visited this GS from March 25, 2014 to April 3, 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 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	760A	108.57
T-2	220/132/11	160	420/700	760A	108.57
T-3	220/132/11	160	420/700	760A	108.57
T-4	132/11.5	13	57/653	372A	56.96

From above, it is clear that 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 power transformers. According to IEC standard 60354, continuous loading of a 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 reduces the expected useful life of transformers in proportion to the amount and duration of overload. Also, a transformer bay complete in all respects (except for the transformer) exists and can be utilized in future to fulfill the load demand of the area.

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- 2) Tap changers of 132/11.5kV transformers are operated locally in the switchyard. Remote operation of tap changer is safer and the international standard, which needs to be implemented.
- 3) The Ludewala-Gatti 220kV circuits and Joharabad, old Ludewala-1 and old Ludewala-2 132kV circuits are loaded above the prescribed limits i.e. 80% per NEPRA grid code during summer season.
- 4) Major maintenance of five (05) 132kV circuit breakers (CBs) is pending due to unavailability of spare parts. Timely overhauling of circuit breakers is essential to ensure reliability of the system. Also, major maintenance of eleven (11) 220kV and six (06) 132kV circuit breakers will be due in near future.
- 5) The following tests are not being performed as required per SOPs for grid system operation and maintenance:
  - a. Leakage current measurement (LCM) test of lightning arresters
  - b. SF6 purity and moisture content test for circuit breakers
  - c. 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.
- 6) Tie line/stub protection is not installed and tele-protection is out of circuit on both Ludewala-Gatti 220kV circuits. Moreover, back up earth fault relay and closing and alarm supply supervision relays are not installed on 220kV Ludewala-Gatti-1 and 2 and all 132kV transmission circuits. Direct transfer trip (DTT) is out of circuit on dia. 4, 5 and 6 of 220kV system.
- 7) Auto-reclosers on all 220kV and 132kV transmission lines are blocked. The re-try can damage the equipment which is already in vulnerable condition.
- 8) HV connection, LV connection and rough balance differential relays are not installed on transformers T-1 and T-2 to sectionalize the differential zones. Also, cross trip scheme is not installed on T-1 and T-2. (For details see Annex-D)
- 9) Thermal overload protection relays are not installed on all 220/132kV and 132/11kV transformers. Closing/alarm DC supply supervision relays are not installed on all transformers except transformer T-3. On transformers T-1 and T-2, oil temperature protection-1 and 2 (electronic) are defective. HV winding temperature protection (electromechanical), oil temperature protection (mechanical) and AVR are not installed on 13MVA-132/11kV power transformer. (For details see Annex-B)
- 10) ISKRA meter of T-3 installed in the control room is fed from CTs/PTs of the bay and not from SMS CTs/PTs and data is being sent to FESCO on the basis of bay CTs/PTs.

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- 11) Testing equipment for protective relays is not available at the GS.
- 12) For SCADA system, control signals, status indications, protection alarms and measurements are not being sent to NCC/RCC.
- 13) Sequential event recorders and fault recorders are out of circuit since long. Voltage and power recorders are out of circuit since long due to lack of maintenance. This data helps engineers to check proper functioning of the protection system and identify components that failed to operate.
- 14) List of missing relays and other defective equipment is attached. (Annex-D)

### **Recommendations:**

<b>Transmission and Grid</b>			
<b>Sr. No.</b>	<b>Finding</b>	<b>Recommendations</b>	<b>Remarks</b>
1	Overloading of 220/132kV transformers.	All 160MVA transformers are running in parallel and exceed their full loading capacities during peak load hours. At least one transformer needs to be augmented or added.	
2	The Ludewala-Gatti 220kV circuits and Joharabad, old Ludewala-1 and old Ludewala-2 132kV circuits are loaded above the prescribed limits i.e. 80% during peak load season	Proper load flow studies to be done. The loading of these circuits need to be reduced. Conductor capacity needs to be enhanced or additional circuits need to be constructed. The matter should be taken up with FESCO for 132kV circuits	
3	Delay in overhauling of five (05) circuit breakers (CBs)	Five (05) 132kV circuit breakers need spare parts for major maintenance.	NTDC have trained staff for overhauling of C.Bs and workshop for repairing of CBs.
4	Leakage current measurement (LCM) test of lightning arresters, C&DF test for all CTs and CVTs is due	All these tests should be carried out to ensure proper healthiness of equipment	
5	Requirement of spare parts for major maintenance of seventeen (17) circuit breakers in future.	Spares for eleven (11) 220kV and six (06) 132kV circuit breakers are required to be arranged for their major maintenance in future.	

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6	Local operation of tap changer of 132/11.5kV transformer.	Tap changer operations are done locally in the switchyard. Remote operation should be made functional.	
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Protection			
Sr. No.	Finding	Recommendations	Remarks
1	Teleprotection (carrier aided) tripping facility is out of circuit on 220kV Ludewala-Gatti circuits. Inoperative direct transfer trip (DTT) system on dia. 4, 5 and 6 of 220kV system.	“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. Tele-protection is out of circuit on 220kV Ludewala-Gatti circuits. Direct transfer trip (DTT) is out of circuit on dia. 4, 5 and 6 of 220kV system. Needs to be made operative.	
2	Inoperative Sequence Event Recorder (SER) and Fault Recorders for 220kV system	Needs to be made operative so that data can be used to ensure proper working of system protection and to identify components which fail to operate.	
3	Absence of thermal overload protection relays on all transformers. On transformers T-1 and T-2, oil temperature protection-1 and 2 (electronic) are defective. HV winding temperature protection (electromechanical) and oil temperature protection (mechanical) are not installed on 132/11kV transformer	Thermal overload and HV winding temperature protection relays have a vital role against sustained overloading in transformers. Therefore are strongly recommended to be installed and configured precisely.	
4	Absence of tie line/stub protection	It is strongly recommended to be installed on both 220kV Ludewala-Gatti circuits.	
5	Absence of back up earth fault relay on 220kV Gatti-1 and 2 and all 132kV circuits.	Back up earth fault relay is recommended to be installed as backup to clear the line to ground faults in case of failure of distance protection.	

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6	Absence of HV connection, LV connection and rough balance differential relays on transformers T-1 and T-2.	Needs to be installed to sectionalize the differential zones.	
7	SMS CTs and PTs of T-3 are not connected to ISKRA meter for data transmission.	For accurate metering of T-3, ISKRA meter should be shifted to SMS room and connect to CTs and PTs meant for SMS.	
8	Replacement of faulty, blocked and missing relays.	Needs replacement with latest version. (for details see Annex-B)	
9	Auto reclosing is inactive for all 220kV and 132kV transmission lines.	"System Protection" and "System Operations" departments have to review the matter and take appropriate action for restoration of autoreclosers. This can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity	
10	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.	

<b>General</b>			
Sr. No.	Finding	Recommendations	Remarks
1	For SCADA system, control signals, status indications, protection alarms and measurements are not being sent to NCC/RCC.	Re-test the communication links and commission SCADA properly	
2	Thermovision survey of GS is not done	Thermovision survey needs to be carried out to avoid any major breakdowns	
3	Non-availability of testing equipment.	Universal testing sets need to be provided for appropriate testing of protection system.	

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