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## TECHNICAL AUDIT REPORT JARANWALA 220KV GRID STATION

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## TECHNICAL AUDIT REPORT

# JARANWALA 220KV GRID STATION

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## Technical Audit of Jaranwala 220kV Grid Station

### Introduction:

This report covers the technical audit of Jaranwala Road (Faisalabad) 220kV Grid Station (GS) located on Faisalabad-Jaranwala road, about 193 km from Lahore, Punjab. This GS was commissioned on December 08, 1982. It has a total of 640MVA transformation capacity connected to the grid, feeding a large portion of Faisalabad city and its surrounding areas.

There are four (04) 160MVA-220/132kV autotransformers and two (02) 20/26MVA-132/11kV power transformers at this GS that are owned and maintained by NTDC. Two (02) 220kV and eight (08) 132kV transmission circuits link this station to others. The GS is being fed radially from Gatti 500kV GS through 220kV circuits. For both 220kV and 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 11, 2014 to March 20, 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	695	99.28
T-2	220/132/11	160	420/700	692	98.85
T-3	220/132/11	160	420/700	692	98.85
T-4	220/132/11	160	420/700	692	98.85
T-5	132/11.5	26	113.8/1305	1295	99.23
T-6	132/11.5	26	113.8/1305	1290	98.85

From above, it is clear that all 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 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.

- 2) Tap changers of 132/11.5kV transformers are kept on one fixed tap position and have not been operated so far. Tap changer's operations are required for the regulation of output voltage to desired levels.

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- 3) The Jaranwala Road - Gatti 220kV circuits are loaded above prescribed limits per NEPRA grid code i.e. above 80% during peak load season.
- 4) Major maintenance of six (06) 220kV and five (05) 132kV circuit breakers (CBs) is pending due to unavailability of spare parts. Timely overhauling of circuit breakers is essential to ensure healthiness and reliability of the system. Also, major maintenance of one (01) 220kV and ten (10) 132kV circuit breakers will be due in near future. (For details see Annex-B)
- 5) Lightning arresters are not installed on Jaranwala Road - Gatti 220kV transmission circuits to protect the line from the damaging effects of lightning and other faults.
- 6) Transformer CVTs are not installed on three 220/132kV transformers and input voltage for operation of over excitation relay has been managed from 132kV bus bar potential transformers (PTs).
- 7) Ten (10) 220kV and ten (10) 132kV isolators are operated locally along with eight (08) 220kV and thirty (30) 132kV isolators being operated manually in the switchyard.
- 8) The 132kV circuits for Garh Fateh Shah, Satiana and old thermal are overloaded.
- 9) Three (03) capacitor cells in the bank of 132/11.5kV transformer T-5 are leaking.
- 10) 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.
- 11) Tele-protection is inactive on both Jaranwala Road - Gatti 220kV circuits. Moreover, VT fuse failure/VT supervision relay, synchro check relay, distance to fault locator, backup O/C & E/F protection and closing/alarm supply supervision relays are not installed on both Gatti 220kV circuits. Also, back up earth fault relay is not installed on Gatti 220kV circuits and six (06) 132kV circuits. Moreover, trip circuit supervision relays are not installed on both 220kV circuits, 132kV bus coupler and six (06) on 132kV circuits. (For details see Annex-B and D)

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- 12)** Auto-reclosers installed on all 220kV and 132kV circuits are very old and blocked due to occurrence of heavy break downs and excessive tripping as re-try can damage the equipment which is already in vulnerable condition.
- 13)** HV connection, LV connection and rough balance differential relays are not installed on all 220/132kV transformers to sectionalize the differential zone. (For details see Annex-D)
- 14)** The following is not installed and defective on 220/132kV and 132/11kV transformers:
- Thermal overload protection relays on all 220/132kV and 132/11kV transformers is not installed.
  - Overload protection (current-based) relay installed on 220/132kV transformers is inactive except on transformer T-4 and is not installed on 132/11kV transformers.
  - HV winding temperature protection (electromechanical) on both 132/11kV transformers and oil temperature protection (mechanical) is not installed on transformer T-6.
  - Five (05) remote winding temperature indicators and three (03) remote oil temperature indicators are defective.
  - Five (05) ampere meters, four (04) kV meters, one (01) MW meter, one (01) MVAR meter, one (01) power factor meter, three (03) energy meter (kWh + kVARh). (For details see Annex-B)
  - The AVR relay is out of circuit on all transformers.
- 15)** For 220kV synchronizing system and 220kV bus coupler protection panels are not installed. Differential relay on 220kV bus bar-2 and under frequency relays are not installed for 132kV system.
- 16)** Breaker failure relays are not installed on 220kV bus coupler circuit breaker and on LV side breakers of transformers T-1, T-2, T-3 and T-4. Also, direct transfer trip (DTT) is out of circuit for all 220kV system.
- 17)** List of missing relays and other defective equipment is attached. (Annex-D)
- 18)** Sequential event recorders, fault recorders, voltage and power recorders are not installed. Such data helps engineers to check proper functioning of the protection system and identify components that failed to operate.
- 19)** Testing equipment for protective relays is not available at the grid station.

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### Recommendations:

Transmission and Grid			
Sr. No.	Finding	Recommendations	Remarks
1	Overloading of 220/132kV transformers.	Proper load flow studies need to be conducted. Two (02) new stations i.e. Bandala and T.T. Singh 220kV GSs are being constructed in the vicinity which will help in sharing the load of this GS. However, augmenting two (02) 220/132kV transformers can provide reasonable relief.	
2	Gatti-Jaranwala Road 220kV and three (03) 132kV circuits loaded above prescribed limits per NEPRA grid code i.e. 80% in peak season.	Proper load flow studies need to be conducted. It is recommended to enhance the conductor capacity or at least one additional 220kV circuit be added from any source other than Gatti in order to share load. For the 132kV circuits, NTDC must take up the matter with FESCO.	
3	Delay in overhauling of eleven (11) circuit breakers due to unavailability of spares	Six (06) 220kV and five (05) 132kV circuit breakers need spare parts for major maintenance.	NTDC have trained staff for overhauling of C.Bs and workshop for repairing 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	Lightning arresters not installed on Gatti-Jaranwala Road 220kV circuits.	Needs to be installed to ensure protection against surges on the line.	
6	CVTs are not installed on three 220/132kV transformers	Independent CVTs need to be installed to operate the over excitation relay.	
7	Requirement of spare parts for major maintenance of eleven (11) circuit breakers in future.	Spares for one (01) 220kV and ten (10) 132kV circuit breakers are required for their major maintenance in future.	

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8	Inoperative tap changers of 132/11.5kV transformers	Needs to be made operative to regulate the output voltage to desired levels.	
9	Three (03) damaged capacitor cells of T-5	Needs replacement with healthy ones.	
10	Local operation of ten (10) 220kV and ten (10) 132kV isolators and manual operation of eight (08) 220kV and thirty (30) 132kV isolators in the switchyard.	The remote operation needs to be fixed. Manually operated isolators need to be replaced with motor drive ones.	

<b>Protection</b>			
Sr. No.	Finding	Recommendations	Remarks
1	Tele-protection (carrier aided) tripping facility is out of circuit on Gatti-Jaranwala road 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	Absence of Sequence Event Recorder (SER), fault recorders and voltage and power recorders for 220kV system	Needs to be installed and 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. Absence of HV winding temperature protection relay (electro mechanical) on both 132/11kV transformers and oil temperature protection on T-5. Also, there are some defective remote temperature indicators on transformers	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. Also, five (05) remote winding temperature indicators and three (03) oil temperature indicators are defective. It is recommended to replace the defective indicators and calibrate them for proper monitoring of transformer temperatures.	
4	Tie protection is not active on 220kV circuits	It is strongly recommended to make it active	

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5	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.	
6	Non-existence of trip circuit supervision relays on controlling breakers	Recommended to be installed for the healthiness of the trip circuit.	
7	Absence of 220kV synchronizing panel and 220kV bus coupler protection panels.	Panels with all relays and meters need to be installed for system stability.	
8	Breaker failure relays are not installed for 220kV bus coupler circuit breaker and LV side breakers of T-1, T-2, T-3 and T-4	Recommended to be installed to make breaker failure scheme useful. Also DTT (direct transfer trip) facility needs to be made operative.	
9	Replacement of faulty, blocked and missing relays.	Needs replacement with latest version. List of relays is attached in Annex-D	
10	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 auto-reclosers. This can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity	
11	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.	

General			
Sr. No.	Finding	Recommendations	Remarks
1	Non-availability of testing equipment.	Universal testing sets need to be provided for appropriate testing of protection system.	

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