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TECHNICAL AUDIT REPORT SHEIKHUPURA 500KV GRID STATION

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TECHNICAL AUDIT REPORT

SHEIKHUPURA 500KV GRID STATION

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©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

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Technical Audit of Sheikhpura 500kV Grid Station

Introduction:

This report covers the technical audit of Sheikhpura 500kV Grid Station (GS), located on Sheikhpura-Sharaqpur road, about 40km from Lahore, Punjab. This GS was commissioned on June 5, 1992. It has a total of 2400MVA transformation capacity connected to the grid and is the main source for feeding Lahore ring where the load demand is growing rapidly.

There are four (04) 600MVA-500/220KV autotransformers, three (03) 160MVA-220/132kV autotransformers and one (01) 20MVA-220/11kV power transformer that are owned and maintained by NTDC. Four (04) 500kV, eight (08) 220kV and eight (08) 132kV transmission lines link this station to others. This GS is connected to Nokhar 500kV, Gatti 500kV and Yousafwala 500kV GSs through 500kV transmission circuits. It is connected to NKLP 220kV GS, Wapda Town 220kV GS, Bund Road 220kV GS, Atlas thermal power station and Ravi 220kV GS through 220kV transmission circuits. 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 technical audit team comprising transmission and protection experts visited this station from January 21, 2014 to February 4, 2014. The 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	500/220/132	600	693/1575	1325	84.12
T-2	500/220/132	600	693/1575	1325	84.12
T-3	500/220/132	600	693/1575	1325	84.12
T-4	500/220/132	600	693/1575	1295	82.22
T-5	220/132/11	160	420/700	820	117.14
T-6	220/132/11	160	420/700	740	105.71
T-7	220/132/11	160	420/700	690	98.57
T-8	220/11.5	20	53/1005	For Aux only	For Aux only

From above, it is evident that 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

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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. The 220/11.5kV transformer is feeding two (02) 630KVA station transformers which are used for auxiliary supply of the grid station. One of its 11kV outgoing feeders is also used as standby source in emergency for residential colony of the grid station.

- 2) Tap changers of 220/132kV transformers are operated locally in the switchyard. Remote operation of tap changer is safer and the international standard and should be implemented.
- 3) Major maintenance of ten (10) 500kV, twenty one (21) 220kV and eleven (11) 132kV circuit breakers (CBs) is pending due to unavailability of spare parts. Moreover, Leakage occurs frequently in controlling valves of eighteen (18) 220kV pneumatic circuit breakers. Timely overhauling of circuit breakers is essential for reliable operation of the system. Remote operating system of three (03) 500kV and one (01) 220kV circuit breakers is not working and they are operated locally in the switchyard.

Major maintenance of three (03) 500kV, three (03) 220kV and one (01) 132kV circuit breakers will be due in near future. (Details are attached in Annex-B.)

- 4) Shunt Reactors installed on 500kV Sheikhpura-Nokhar-2 and Yousafwala circuits are out of circuit due to in-operative B-phase and R-phase units respectively. On shunt reactor of Nokhar-2, buchholz alarm indications usually appear on B-phase due to accumulation of air in the tank which leads to its tripping.

On Sheikhpura-Yousafwala transmission line no circuit breaker is installed for shunt reactor and is operated simply through an isolator.

- 5) Four (04) 500kV, ten (10) 220kV and two (02) 132kV isolators are operated locally in the switchyard. Also, thirty (30) 132kV isolators are operated manually in the switchyard.
- 6) 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.

- 7) 132kV Sheikhpura-Bhikhi-1 and Bhikhi-2 transmission lines are overloaded.

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- 8) Tele-protection (PLC aided) and direct transfer trip (DTT) is not available on 220kV Sheikhpura-Bund Road Circuit-2. 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.
- 9) Tie line protection is not installed on all 500kV and 220kV transmission lines. Also, on 500kV Gatti, Nokhar-1 and Nokhar-2 circuits and 500/220kV, 220/132kV and 220/11.5kV transformers, cross trip scheme is blocked. For circuit breaker B4Q2 controlling 500/220kV autotransformer (TB-04) synchro-check relay is not installed.
- 10) Thermal overload protection relays are not installed on all shunt reactors, 500/220kV and 220/132kV and 220/11.5kV transformers. Also, twelve (12) remote winding temperature indicators, eight (08) remote oil temperature indicators, six (06) tap position indicators are defective. (For details see Annex-B and D)
- 11) HV connection differential, LV connection differential and rough balance differential relays are not installed on any 220/132 kV transformer in order to sectionalize the differential zone.
- 12) Three (03) distance protection relays of 220kV NKLP, Bund-Road-2 and Bund Road-3 circuits are defective and recommended to be repaired or replaced.
- 13) Three (03) VT supply supervision relays of 220kV Ravi, Bund-Road-2 and Bund-Road-3 circuits are defective.
- 14) On all 132kV circuits, auto-reclosers are blocked apparently due to occurrence of heavy break downs and excessive tripping.
- 15) Sequential event recorders (Siemens E420) and fault/ disturbance recorders (Siemens P530) along with CPU and printer installed on 500kV and 220kV system are out of service since 2002. Voltage and power recorders installed on 500kV and 220kV systems are also defective since 2001. Such data helps engineers to ensure proper functioning of the protection system and identifies the components which fail to operate as required per scheme.
- 16) Other missing relays and defective equipment are listed in Annex-D.

Recommendations:

Transmission and Grid			
Sr. No.	Finding	Recommendations	Remarks
1	Overloading of 220/132kV transformers.	Proper load flow studies need to be conducted after taking into account the commissioning of New Lahore 500kV and Bandala 220kV GSs.	

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2	Overhauling of forty two (42) circuit breakers (CBs) is pending due to unavailability of spare parts.	Ten (10) 500kV, twenty one (21) 220kV and eleven (11) 132kV circuit breakers need spare parts for major maintenance.	NTDC have trained staff and workshop facilities for overhauling and repair of CBs
3	Inoperative shunt reactors on 500kV Nokhar-2 and Yousafwala circuits.	Both shunt reactors should be repaired and made functional.	
4	Leakage in controlling valves of eighteen (18) 220kV pneumatic CBs	Spares are required for the replacement of these valves.	
5	Leakage current measurement (LCM) test of lightning arresters, SF6 purity and moisture content test for circuit breakers and capacitance and dissipation factor (C&DF) test of CTs, PTs and capacitor voltage transformers (CVTs) is not done	These tests need to be done on priority basis to ascertain and ensure healthiness of the equipment.	
6	Overloaded 132 kV transmission circuits.	132kV Sheikhpura-Bhikhi-1 and Bhikhi-2 transmission lines are overloaded. NTDC needs to discuss the matter with LESCO.	
7	No circuit breaker is installed for shunt reactor on Yousafwala transmission line.	Circuit breaker should be installed on Sheikhpura-Yousafwala transmission line.	
8	Local operation of tap changer of 220/132kV transformers.	Remote operation should be made functional.	
9	Local operation of three (03) 500kV and one (01) 220kV circuit breakers	Remote operation should be made functional.	
10	Major maintenance of three (03) 500kV, three (03) 220kV and one (01) 132kV circuit breakers will be due in near future.	Spare parts to be arranged for major maintenance.	

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11	Sixteen (16) isolators are operated locally in the switchyard. Also there are thirty (30) 132kV isolators which are operated manually in the switchyard.	The defective remote control operation of the isolators should be set right.	
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Protection			
Sr. No.	Finding	Recommendations	Remarks
1	Inoperative tele-protection (carrier aided) tripping facility and direct transfer trip (DTT) system on 220kV SKP-Bund Road Circuit-2	"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	Inoperative Sequence Event Recorder (SER) for 220kV system	SERs are important for analysis of the events with time-tagged sequential information, therefore it is strongly recommended to support NTDC not only for installation of latest version of "Sequential Event Recorder (SER)" but also for its in-depth training to engineers, thus making them responsible to maintain it at all 220kV and 500kV GSs. Input of NTDC "Technical Services Group" and "System Protection" and "Grid System Operation" departments would be required for devising a workable "SOP".	
3	Fault Recorders for 220kV system are inoperative	It is strongly recommended to install fault and disturbance recorders for proper monitoring of the system	
4	Absence of thermal overload protection relays on shunt reactors, 500/220kV, 220/132kV and 220/11.5kV power transformers. Also, defective remote temperature indicators on transformers	Thermal overload protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely. It is strongly recommended to replace the defective indicators or calibrate them for proper monitoring of transformer temperatures.	

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6	Tie protection is not active on all 220kV circuits	It is strongly recommended to make it active	
7	Three (03) distance protection relays are defective	Recommended to be replaced or repaired for proper clearance of fault.	
8	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.	
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 132kV circuits.	"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	
11	Cross trip scheme is blocked on 500kV Gatti, Nokhar-1 and Nokhar-2 circuits and 500/220kV, 220/132kV and 220/11.5kV power 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	Thermovision survey of GS is not done	Thermovision survey needs to be carried out to avoid any major breakdowns	

www.ep-ep.com.pk
info@ep-ep.com.pk