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TECHNICAL AUDIT REPORT SHAHI BAGH 220KV GRID STATION

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TECHNICAL AUDIT REPORT

SHAHI BAGH 220KV GRID STATION

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Technical Audit of Shahi Bagh 220kV Grid Station

Introduction:

This report covers the technical audit of Shahi Bagh 220kV Grid Station (GS), located on Peshawar-Charsadda Mardan road, about 12.3km from Peshawar, KPK. This GS was commissioned on February 28, 2006. It has a total of 480MVA transformation capacity connected to the grid and is feeding a large portion of Peshawar city and its surrounding areas.

There are four (04) 160MVA-220/132kV autotransformers and two (02) 10/13MVA-132/11kV power transformers at this GS that are owned and maintained by NTDC. The GS is fed from Ghazi Barotha via Mardan 220kV GS and Sheikh Muhammadi 500kV GS through 220kV single circuits. Two (02) 220kV and four (04) 132kV transmission lines link this station to others. For 220kV switchyard, one and half breaker 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 May 14, 2014 to May 23, 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	626	89.42
T-2	220/132/11	160	420/700	626	89.42
T-3	220/132/11	160	420/700	626	89.42
T-4	220/132/11	160	420/700	N/A (damaged)	N/A
T-5	132/11.5	13	57/653	545	83.46
T-6	132/11.5	13	57/653	635	97.24

From above, it is evident that all transformers are loaded above the prescribed criteria 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 transformer above 80% at ambient temperature equal to or above 40°C, prohibits the transformer's short time overloading beyond its nameplate ratings. Exceeding this limit reduces the expected useful life of transformers in proportion to the amount and duration of overload.

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- 2) Both circuits from Ghazi Barotha hydro power station are not directly connected to this station due to right of way issue near the grid station and one of the circuits has been diverted to Sheikh Muhammadi 500kV GS by linking to an already existing 220kV circuit between Shahibagh and Sheikh Muhammadi. Due to this right of way problem the existing sources are not properly utilized as per original design of the system.
- 3) All four (04) 132kV circuits are overloaded.
- 4) Two (02) 220kV and two (02) 132kV circuit breakers are operated locally in the switchyard. Major maintenance of twelve (12) 220kV and eleven (11) 132kV circuit breakers will be due in near future. (For details see Annex-B)
- 5) Fourteen (14) 220kV and ten (10) 132kV isolators are operated locally in the switchyard. Spares are also required.
- 6) The following tests have not been performed as required per SOPs for grid system operation and maintenance:
 - a. Detailed oil testing and Dissolved Gas Analysis (DGA) test of oil of all transformers - In the absence of these tests, the quality of transformer oil cannot be ascertained in view of the contents of various undesired gases in the oil and other important parameters such as moisture content, flash point, kinematic viscosity, interfacial tension, acidity and tangent delta etc., resulting in breakdown of transformers
 - b. Leakage current measurement (LCM) test of lightning arresters
 - c. Capacitance & dissipation factor (C&DF) test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs)
 - d. SF6 purity and moisture content test for 220kV and 132kV circuit breakersIt is necessary to conduct all tests timely to ensure healthiness of the equipment.
- 7) Tie line/stub protection function available in distance protection relay is not active on both 220kV circuits. Also, tele-protection and direct transfer trip (DTT) are out of circuit in 220kV system.
- 8) On all 220kV and 132kV circuits auto-reclosers are blocked apparently due to occurrence of heavy break downs and excessive tripping.
- 9) Rough balance differential relays and cross trip scheme are not installed on all the 220/132kV transformers. (For details see Annex-D).
- 10) Four (04) thermal overload protection relays on 220/132kV transformers and two (02) on 132/11kV transformers are not installed. Also, two (02) overload protection relays (current based) are not installed on both 132/11kV transformers.

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- 11)** For 220/132kV transformer T-4, auxiliary control panel is not installed for remote control and monitoring. Three (03) tap position indicators of transformers are defective. Two (02) HV winding temperature protection, two (02) oil temperature protection (mechanical) and two (02) remote oil temperature indicators are not installed on both 132/11kV transformers.
- 12)** Sequential event recorder and fault/disturbance recorder look satisfactory but due to non-availability of updated software, these are not functional. Voltage and power recorders are out of circuit since long due to lack of maintenance. Such data help engineers to ensure proper functioning of the protection system and identifies the components which fail to operate as required per scheme.
- 13)** For SCADA system, control signals, status indications, protection alarms and measurements are not being sent to NPCC.
- 14)** List of missing relays and other defective equipment is attached. (Annex–D)

Recommendations:

Transmission and Grid			
Sr. No.	Findings	Recommendations	Remarks
1	Right of way problem in Ghazi Barotha-Shahi Bagh double circuit transmission line.	The right of way problem needs to be resolved to properly utilize the existing sources per system design.	
2	All 220/132kV transformers are loaded above NEPRA grid code i.e. 80%	Proper load flow studies need to be conducted. Autotransformer (T-4) which is lying damaged needs to be replaced to share the load of the other transformers.	
3	Detailed oil testing, DGA and C and DF test for all transformers are due. LCM test for all lightning arresters and C and DF test for all CTs and CVTs and SF6 purity and moisture content test for 220kV and 132kV CBs are due	These tests need to be done on priority basis to ascertain quality of oil, healthiness of the transformer and its insulation. All other tests should be carried out per the SOPs to ensure healthiness of the equipment.	
4	Overloaded 132 kV transmission circuits	NTDC must take up the matter of overloaded lines with PESCO.	
5	Local operation of two (02) 220kV and two (02) 132kV circuit breakers	The remote operation needs to be set right.	
6	Requirement of spare parts for major maintenance of twenty three (23) circuit breakers in future.	Spares for twelve (12) 220kV and eleven (11) 132kV circuit breakers are required for their major maintenance in future.	

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7	Local operation of fourteen (14) 220kV and ten (10) 132kV isolators in the switch yard.	The remote operation needs to be set right.	
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Protection			
Sr. No.	Findings	Recommendations	Remarks
1	In-operative tele-protection on both 220kV circuits and in-operative direct transfer trip (DTT) 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.	
2	Tie line protection is not available on 220kV transmission circuits	Recommended to be installed.	
3	Replacement of faulty, blocked and missing relays. (for details see Annex-B and D)	All missing relays need to be installed for proper protection.	
4	Inoperative sequential event recorders, fault recorders and voltage recorders for 220kV system.	It is strongly recommended to make sequential event recorders, fault recorders and voltage recorders operative. Such data helps engineers to check proper functioning of protection system and identify the components which failed to operate as expected.	
5	Absence of cross trip scheme on all 220/132kV transformers.	Recommended to be installed for protecting the system from total collapse due to over-loading.	
6	Absence of thermal overload protection relays on all transformers and absence of overload (current based) protection relays on 132/11kV power transformers	Thermal overload and overload (current based) protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely.	
7	Auto-reclosers are blocked on all 220kV and 132kV 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.	

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8	Absence of rough balance differential relays on all 220/132kV transformers.	Needs to be installed as a back up to the main differential.	
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General			
Sr. No.	Findings	Recommendations	Remarks
1	In-operative SCADA system.	Needs to be completed and commissioned.	
2	Non-availability of testing equipment.	Needs to be provided for appropriate testing of protection system.	

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