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TECHNICAL AUDIT REPORT

BUND ROAD 220KV GRID STATION

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BUND ROAD 220KV GRID STATION

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Introduction:

This report covers the technical audit of Bund Road 220kV Grid Station (GS) located south-west of Lahore city, adjacent to Lahore-Islamabad motorway, Punjab. The GS was commissioned on June 24, 1988 and the site selected was located on a landfill near the sewerage drain. The ground of 132kV switchyard could not be leveled and compacted to the required extent, therefore, the foundations of 132kV equipment are settling down affecting their alignment. It has a total of 640MVA transformation capacity and feeds the thickly populated area of Lahore and the industrial area where the load demand is growing rapidly.

There are four (04) 160MVA-220/132kV autotransformers and two (02) 26MVA-132/11kV power transformers at this GS that are owned and maintained by NTDC. There are eight (08) 220kV and ten (10) 132kV transmission circuits linking this station to others. This GS is connected to Lahore Sheikhupura 500kV GS, Kala Shah Kaku 220kV GS and New Kot Lakpat 220kV GS through 220kV circuits. For 220kV switchyard one and half breaker scheme whereas for 132kV switchyard double bus single breaker scheme is used.

EPP audit team comprising technical experts visited this GS from 30 September, 2013 to 08 October, 2013. This report reflects their findings and prioritized fixes.

Findings:

Observations by technical experts are as under:

1) The loading conditions of transformers are tabulated as under:

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	700	100.00
T-2	220/132/11	160	420/700	695	99.29
T-3	220/132/11	160	420/700	700	100.00
T-4	220/132/11	160	420/700	695	99.29
T-5	132/11.5	26	113/1305	1255	96.17
T-6	132/11.5	26	113/1305	1230	94.25

From above, it is evident that all 220/132kV 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 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 reduces the expected useful

life of transformers in proportion to the amount and duration of overload. A PC-1 was approved in 2010 for the augmentation of all four 160 MVA transformers to 250MVA transformers; so far one 250MVA transformer has arrived for augmentation purpose.

2) Due to severely polluted environment of the surroundings, exposed copper components of equipment and isolator blades have been affected badly. Particularly, the grounding conductor risers have corroded and somewhat lost their properties. The contacts of isolators are losing their grip and being damaged frequently.

3) The foundations of equipment in the 132kV switchyard are sinking due to poor compaction of the ground at the time of construction. The 132kV bus bars have tilted causing improper alignment of the equipment. Due to this very reason, 132kV isolators are operated manually in the switchyard.

4) Both 220kV Bund Road - NKLP circuits are loaded above the prescribed limits i.e. 80% per the NEPRA grid code during summer season. These circuits were commissioned in early 1970's, so the condition of conductor and allied material of the line have deteriorated.

5) Oil seepage exists in the radiator of T-1, T-2, T-4 and T-6 and in the top plate of transformer T-5 and T-6.

6) Major maintenance of eighteen (18) 220kV and sixteen (16) 132kV circuit breakers is pending due to unavailability of spare parts. Timely overhauling of circuit breakers is essential to ensure healthiness and reliability of the system. The scheduled and unscheduled load shedding has affected the operating mechanism, contacts of circuit breaker and has reduced the reliability of the equipment.

7) The Capacitance & dissipation factor (C&DF) test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs) is not being done as per SOPs for grid system operations and maintenance.

8) The conductor of 132kV Bund Road - Ravi transmission line is missing from some spans. The conductor was removed during construction of the Lahore Ring Road in 2005. This transmission line is a vital 132kV link between Bund Road and Ravi 220kV grid stations.

9) Most protection relays at Bund Road GS are old electromechanical type and have not been maintained as required. Being electromechanical in construction, they have outlived their useful life.

10) Auto-reclosers are blocked on all 220kV lines except 220kV NKLP-Bund Road Circuit-II. Auto-reclosers can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity.

11) The following relays are either not installed or out of circuit on 220kV and 132kV circuits (for details see Annex-B and D):

a. Four (04) synchro-check relays are not installed on 220kV circuits.
b. Four (04) distance to fault locators are defective and four (04) are not installed on 220kV circuits.
c. Four (04) distance protection relays on 220kV circuits and four (04) on 132kV circuits are defective.
d. One (01) PT supervision relay is defective

12) HV connection, LV connection and rough balance differential relays are not installed on all 220/132kV transformers to sectionalize the differential zone. Also, cross trip scheme is not installed on all 220/132kV transformers. (For details see Annex-B)

13) The following relays or equipment are not installed or defective on 220/132kV and 132/11kV transformers:

a. Four (04) thermal overload protection relays are not installed.
b. Four (04) neutral over current relays are not installed.
c. Four (04) over excitation relays are defective.
d. Two (02) HV and two (02) LV winding temperature protection relays
e. One (01) overload (current based) protection
f. Three (03) oil temperature protection (Mechanical)
g. One (01) oil temperature protection (Electronic)

14) Sequential event recorders, fault recorders, power and voltage recorders are not functional at the grid station due to lack of maintenance. This data helps engineers to check proper functioning of the protection system and identify components that failed to operate as required per scheme.

15) Capacitor banks on both 132/11kV transformers are inoperative due to missing capacitor cells and fuses.

16) Testing equipment for protective relays is not available at the grid station.

17) List of missing relays and other defective equipment is attached. (Annex-D)

Recommendations:

Transmission and Grid			
Sr. No.	**Findings**	**Recommendations**	**Remarks**
1	Sinking of 132kV switchyard due to poor compaction of ground.	In the prevailing situation of polluted environment, the 132kV AIS switchyard needs to be shifted and converted to GIS at the space available adjacent to the 220kV switchyard.	NTDC has prepared a layout of shifting the 132kV switchyard to an alternate location adjacent to the 220kV switchyard.
2	Loading of both 220kV Bund Road - NKLP circuits is above the prescribed limits i.e. 80% per the NEPRA grid code during summer season. The condition of conductor and some towers is critical.	The capacity of conductor needs to be enhanced and proper load flow studies need to be conducted. These circuits were commissioned in early 1970's; the condition of conductor and towers is critical. The old critical thirty-two (32) towers need to be replaced with tubular poles	
3	Loading of all 220/132kV transformers is above the prescribed criteria per NEPRA grid code i.e. 80%	At least two autotransformers need to be augmented with 250MVA transformers.	A PC-1 was approved in 2010 for the augmentation of all four transformers at this GS.
4	Missing conductor from some spans of 132kV Bund Road - Ravi double circuit transmission line.	Being a vital 132kV link between the two stations, the missing spans need to be completed.	
5	Major maintenance of eighteen (18) 220kV and seventeen (17) 132kV circuit breakers is pending due to unavailability of spare parts	Spare parts need to be arranged.	NTDC have trained staff for overhauling of CBs and workshop facilities for repairing of CBs
6	Corroded earth risers and un-galvanized nuts and bolts due to chemical gases and fumes emitting from the sewerage drain adjacent to the GS.	Need proper adhesive for protection of earth risers and replacement of rusted nuts and bolts with galvanized ones	Alternately, shifting and converting 132kV switchyard into GIS.
7	The C&DF test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs) is not being done	All the tests need be carried out as per the SOPs	
8	Improper alignment of 132kV isolators due to sinking of 132kV switchyard and tilting of 132kV bus bars.	Shifting and converting AIS 132kV switchyard to GIS at the available space adjacent to 220kV switchyard.	

9	In-operative capacitor banks on both 132/11kV transformers due to missing capacitor cells and fuses.	The missing cells need to be replaced and the capacitor bank brought back in service.	

Protection			
Sr. No.	**Findings**	**Recommendations**	**Remarks**
1	Most protection relays at Bund Road GS are old electromechanical type and have not been maintained as required. Being electromechanical in construction, they have outlived their useful life.	Relays and other protection equipment should be tested and repaired or replaced with the latest version of numerical relays	
2	Sequential event recorders, fault recorders, power and voltage recorders are not functional at the grid station.	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.	
3	The following relays are not installed or defective on transformers: four (04) thermal overload protection relays, four (04) neutral over current relays, four (04) over excitation relays are defective, two (02) HV and two (02) LV winding temperature protection relays, one (01) overload (current based) protection, three (03) oil temperature protection (Mechanical), one (01) oil temperature protection (Electronic)	Thermal overload and overload (current based) protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely. All other missing and defective relays need to be installed. (for details see Annex-B and D)	
4	HV connection, LV connection and rough balance differential relays are not installed on all 220/132kV transformers to sectionalize the differential zone. Also, cross trip scheme	Needs to be installed to sectionalize the differential zones.	

	is not installed on all 220/132kV transformers.		
5	The following relays are either not installed or out of circuit on 220kV and 132kV circuits (for details see Annex-B and D): four (04) synchro-check relays are not installed on 220kV circuits, four (04) distance to fault locators are defective and four (04) are not installed on 220kV circuits, four (04) distance protection relays on 220kV circuits and four (04) on 132kV circuits are defective.	All missing and defective relays need to be installed. (for details see Annex-B and D)	
6	Auto-reclosers are blocked on all 220kV lines except 220kV NKLP-Bund Road Circuit-II.	"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.	

General			
Sr. No.	**Findings**	**Recommendations**	**Remarks**
1	Thermovision survey of GS and TLs is not done.	Thermovision survey needs to be carried out to avoid any major breakdowns	

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