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TECHNICAL AUDIT REPORT BURHAN 220KV GRID STATION

January 2015

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TECHNICAL AUDIT REPORT

BURHAN 220KV GRID STATION

Contract No: AID-EPP-I-00-03-00004

Order No: AID-391-TO-12-00002

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Technical Audit of Burhan 220kV Grid Station

Introduction:

This report covers the technical audit of Burhan 220kV Grid Station (GS) located at Burhan District Attock, about 80km from Islamabad. This GS was commissioned on June 1, 1977. It has a total of 640MVA transformation capacity connected to the grid and feeds some portions of KPK and Rawalpindi.

There are four (04) 160MVA-220/132kV transformers and one (01) 13MVA-132/11kV power transformer installed at the GS which are owned and maintained by NTDC. Four (04) 220kV and eleven (11) 132kV circuits link this station to others. The GS is connected to Tarbela hydro power station and ISPR 220kV GS through 220kV transmission circuits. For 220kV switchyard, one and a half breaker scheme whereas for 132kV switchyard double bus single breaker scheme is used. Single line key diagram attached (Annex-A).

EPP audit team comprising transmission and protection experts visited this GS from May 27, 2014 to June 6, 2014. This report reflects their findings and prioritized fixes.

Findings:

Observations of technical experts are as below:

- 1) The loading condition of the transformers is tabulated below:

Transformer No.	Ratings			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	760	108.6
T-2	220/132/11	160	420/700	720	102.9
T-3	220/132/11	160	420/700	720	102.9
T-4	220/132/11	160	420/700	760	108.6
T-5	132/11.5	13	57/653	410	62.8

From above, it is evident that all 220/132kV transformers are overloaded as 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, the expected useful life of transformers is reduced in proportion to the amount and duration of overload. It was informed that this overloading of transformers was due to breakdown of one 160MVA-220/132kV transformer at Mardan 220kV GS.

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- 2) Loading of Tarbela-Burhan 220kV transmission circuits and Burhan-ISPR 220kV transmission circuit is loaded above NEPRA prescribed criteria i.e. 80%.
- 3) Severe oil leakage exists from the main tank and radiators of transformer T1, T2 and T3.
- 4) The following tests have not been performed as required per SOPs for grid system operation and maintenance:
 - a. Dissolved gas analysis (DGA) test and detailed oil testing for transformers
 - b. Capacitance and dissipation factor (C&DF) test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs)
 - c. SF6 purity and moisture content test for circuit breakers
 - d. Leakage current measurement (LCM) test of lightning arrestersIt is necessary to conduct all tests timely to ensure healthiness of the equipment.
- 5) Five (05) 132kV BBC make Minimum Oil Circuit Breakers (M.O.C.B) are excessively leaking, very old and worn out beyond repairs due to unavailability of spares as those have become obsolete. The CBs are also under-rated and in deteriorated condition.
- 6) Most isolators in 132kV switchyard are being operated manually. Two (02) line isolators in 220kV switchyard having pneumatic operating mechanisms are operated locally as and when needed to avoid air leakage in the compressed air distribution system. No spares are available for maintenance. (For details see Annex-B)
- 7) Spares are unavailable for twelve (12) 220kV and twelve (12) 132kV SF6 gas CBs for overhauling that is due in near future. Spares should be arranged for internal inspection and major maintenance of the CBs when it is due.
- 8) Dedicated current transformer (CT) and potential transformer (PT) for secured metering system (SMS) of T-4 have not been installed. It should be provided for accurate measurements of energy delivered at the interconnection point.
- 9) Four (04) 220kV and two (02) 132kV CTs are leaking. The leakage should be attended to avoid their damage. (For details see Annex-B).
- 10) Pole mounted 200kVA auxiliary transformer with bare live joints is lying on the ground that is prone to flashovers or any other hazard.
- 11) The facility for direct transfer trip (DTT) is not available. This DTT order requires the missing tele-protection facility. Two (02) back up earth fault protection relays on 220kV circuits and seven (07) back up earth fault protection relays on 132kV circuits are not installed. Also, fourteen (14) closing and alarm supply supervision relays are not installed on 220kV and 132kV circuits. (for details see Annex- B and D)
- 12) Two (02) distance protection relays on 132kV circuits are defective. (for details see Annex-B)

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- 13)** HV connection, LV connection and rough balance differential relays are not installed on three (03) 220/132kV transformers to sectionalize the differential zones.
- 14)** The following relays are not installed on 220/132 kV and 132/11 kV transformers:
- Four (04) thermal overload protection relays
 - Four (04) overload (current-based) protection relays
 - Four (04) differential protection relays
 - One (01) alarm supply supervision relay
 - One (01) closing supply supervision relay
- 15)** The following equipment on 220/132kV and 132/11kV transformers are either defective or not installed (for details see Annex-B and D):
- Four (04) remote oil temperature indicators
 - One (01) remote winding temperature indicator
 - Four (04) AVR relays
- 16)** Auto-reclosers on all 220kV and 132kV transmission lines are blocked. Auto-reclosers can significantly reduce the outage time, reduce transmission line damage and thus provide higher service continuity.
- 17)** Cross trip protection facility is not available. Cross trip scheme is implemented in some sections of the system in order to avoid total or partial collapse. Some transmission lines and transformers do not have contingency cover, so under heavy load conditions if they trip due to fault or overloading, there is a possibility of cascaded outage of other transmission circuits which may lead to power system collapse.
- 18)** Sequential event recorders and fault recorders out of circuit. Voltage and power recorders are out of service 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 in the event of a fault.
- 19)** The equipment for SCADA system is installed but has not been made functional.
- 20)** List of missing relays and other defective equipment is attached. (Annex-D)
- 21)** Retaining walls are required at tower Nos. 33, 42, 52 and 72 of Burhan-Tarbela double circuit line and at tower No. 7 and 36 of 220kV Burhan-ISPR Line. The conductor from tower Nos. 9 to 11 is in deteriorated condition and requires attention.

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Recommendations:

Transmission and Grid			
Sr. No.	Finding	Recommendations	Remarks
1	Overloading of 220/132kV transformers.	It was informed that the overloading is due to breakdown of one 220/132kV transformer at Mardan 220kV GS. Efforts should be made to shift load to adjacent GSs. Proper load flow studies need to be conducted to maintain loading of transformers per NEPRA grid code.	
2	Overloading of Tarbela-Burhan 220kV circuits and Burhan-ISPR 220kV circuit	These circuits are loaded above 80% i.e. per NEPRA prescribed limits	
3	Dissolved Gas Analysis (DGA) and detailed oil testing of all transformers are due	These tests need to be done on priority basis to ascertain the quality of oil and healthiness of transformer and its insulation.	
4	Five (05) 132kV Minimum oil circuit breakers (M.O.C.B) are leaking besides being underrated and deteriorated.	To be replaced with SF6 gas CBs.	
5	Requirement of spare parts for major maintenance of twelve (12) 220kV and twelve (12) 132kV SF6 gas CBs in future.	Adequate spares to be arranged for major overhaul of these CBs.	
6	Leakage of oil from transformers T-1, T-2, T-3.	Outage on transformers needs to be availed in order to properly seal the seepage points.	
7	A number of 220kV and 132kV CTs are leaking.	Leakage should be fixed to avoid damage to CTs.	
8	Pole mounted 200kVA auxiliary transformer with bare live joints lies on the ground.	To be replaced with pad mounted transformer to avoid any mishap.	
9	Remote control operation of 220kV and 132kV isolators is defective.	The defective remote control operation of the isolators should be fixed.	

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Protection			
Sr. No.	Finding	Recommendations	Remarks
1	Tele-protection (carrier aided) tripping facility is missing on almost all 220kV lines. Inoperative direct transfer trip (DTT) system.	“System Protection and Telecommunication departments of NTDC” should 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 and 132kV 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	Cross trip scheme is not available.	Recommended to be implemented for protecting the system from total collapse due to overloading. NTDC needs to look into the issue for system stability.	
4	Absence of thermal overload protection relays on transformers	Thermal overload protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely.	
5	Tie protection is not active on all 220kV circuits	It is strongly recommended to make it active	
6	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.	
7	Replacement of faulty, blocked and missing relays.	Needs replacement with latest version. List of relays is attached in Annex-D	

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8	Defective synchro-check relays on 220kV and 132kV system.	Recommended to be made operative for safe reclosing of the breakers.	
9	Auto reclosing is inactive for all 220kV and 132kV transmission lines.	"System Protection" and "System Operations" departments should 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	

General			
Sr. No.	Finding	Recommendations	Remarks
1	In-operative SCADA system.	The installed equipment must be made functional.	
2	Thermovision survey of GS is not done.	Thermovision survey needs to be carried out to avoid any major breakdowns	
3	Retaining walls for tower nos. 33, 42, 52 and 72 of Burhan-Tarbela double circuit line and tower No. 7, 36 of 220kV Burhan-ISPR Line are required. Moreover, conductor from tower Nos. 9 to 11 of Burhan-ISPR line is deteriorated.	Construction of retaining walls is recommended for protection of towers and for avoiding sabotage. The deteriorated conductor should be replaced for reliable power transmission.	
4	Non-availability of testing equipment.	Universal testing sets need to be provided for appropriate testing of protection system.	

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