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# USAID ENERGY POLICY PROGRAM

## TECHNICAL AUDIT REPORT TM KHAN ROAD HYDERABAD 220KV GRID STATION

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## TECHNICAL AUDIT REPORT

## TM KHAN ROAD

## HYDERABAD 220KV GRID STATION

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# Technical Audit of TM Khan Road Hyderabad 220kV Grid Station

## Introduction:

This report covers the technical audit of TM Khan Road Hyderabad 220kV Grid Station (GS) located on Hyderabad – TM Khan Road about 7km from Hyderabad, Sindh. The GS was commissioned on September 30, 2000. It has a total of 320MVA transformation capacity connected to the grid station and feeds a large portion of Hyderabad and its surrounding areas.

There are two (02) 160MVA-220/132kV autotransformers and two (02) 10/13MVA-132/11kV power transformers installed at this GS that are owned and maintained by NTDC. Two (02) 220kV and five (05) 132kV circuits link this station to others. The GS is fed radially from Jamshoro 500kV GS through 220kV double circuit. For 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).

The 220kV equipment of bay I and II (CBs, DSs, CTs, and CVTs etc.) were energized on September 9, 2000 by energizing ABB make transformers from LV side, through a 132kV transmission circuit coming from NTPS 132kV GS. It continued on till the replacement of ABB transformers with XIAN (China) make transformers in 2004, subsequently commissioning of 220kV circuit-I and II in 2006.

EPP audit team comprising technical experts visited this GS from November 25, 2014 to November 29, 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.	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	700A	100
T-2	220/132/11	160	420/700	700A	100
T-4	132/11.5	13	57/653	460A	70.44
T-5	132/11.5	13	57/653	600A	91.88

From above, it is evident that both 220/132kV 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 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.

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2. The critical issue in need of immediate attention is the water drainage during heavy rains. The switchyard is at a lower level than the surroundings and thus there is no proper arrangement to block the inflow of water from industrial surroundings. Also the GS is located in a place where there is a huge problem of salinity and water logging due to which the switchyard equipment become corroded.
3. The 132kV TM Khan Road Hyderabad-Hyderabad circuit is overloaded.
4. Major maintenance of two (02) 220kV and five (05) 132kV circuit breakers (CBs) is pending due to unavailability of spare parts. Moreover, major maintenance of four (04) 220kV and five (05) 132kV CBs will be due in near future. (For details see Annex-B)
5. The following tests are not being performed as required per SOPs for grid system operation and maintenance:
  - a. Leakage current monitoring (LCM) test of lightning arresters
  - b. SF6 purity & moisture content test for CBs
  - 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.
6. Oil seepage exists in blue phase unit of CT installed on LV side of transformer T-2.
7. Tele-protection is out of circuit on both 220kV circuits. Also, direct transfer trip (DTT) facility is not available in 220kV system.
8. The following relays are not installed or out of circuit on 220kV and 132kV circuits:
  - a. Tie line protection is not installed on both 220kV circuits.
  - b. Two (02) backup Earth Fault protection relays are not installed on 220kV circuits.
  - c. Distance to fault locator (set-1 and 2) are not installed on both 220kV circuits.
  - d. Closing Supply Supervision Relay is not installed on both 220kV circuits.
  - e. Five (05) backup earth fault relays are not installed on all 132kV circuits and one (01) on 132kV spare bay (for future use).
  - g. Five (05) Alarm/Annunciation supply supervision relays are not installed on all 132kV circuits and one (01) on 132kV spare bay (for future use).
9. 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.

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10. HV connection, LV connection and rough balance differential relays are not installed on all 220/132kV transformers to sectionalize the differential zones. Also, cross trip scheme is not installed on all 220/132kV transformers. (For details see Annex-B)
11. The following relays are not installed on 220/132kV and 132/11kV transformers:
  - a. Two (02) overload (current based)
  - b. Two (02) Tertiary earth fault relay
  - c. Neutral over current relay
  - d. Four (04) alarm supply supervision
  - e. Four (04) closing supply supervision
12. The following equipment on 220/132kV and 132/11kV transformers are defective or blocked (for details see Annex-B & D):
  - a. Two (02) remote oil temperature indicating meters
  - b. Two (02) remote winding temperature indicating meters
  - c. Four (04) AVR relays
  - d. Five (05) Backup earth fault relays (For 11kV outgoing feeders)
13. On one (01) 11kV outgoing feeder, USAID sponsored energy meters which are used for remote data transfer to HESCO are not installed.
14. The following relays on 132kV bus bars and bus coupler are not installed (for details see Annex-B and D):
  - a. Differential Protection 132kV Bus-1 & 2
  - b. CT Circuit monitoring of Differential Protection 132kV Bus-1 & 2
  - c. Trip lockout relay for Differential protection 132kV Bus-1 & 2
  - d. Closing Supply Supervision Relay
  - e. Alarm/Annunciation supply Supervision Relay
15. Sequential event recorders and fault/disturbance recorders are not functional due to non-availability of updated software and poor maintenance. Voltage and power recorders are out of circuit 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.
16. The SCADA system is installed but it is incomplete and has not been made functional.
17. List of missing relays and other defective equipment is attached. (Annex-D)

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### Recommendations:

<b>Transmission and Grid</b>			
Sr. No.	Findings	Recommendations	Remarks
1	Inappropriate drainage system during heavy rains.	The suitable solution is forced drainage system of reasonable size to cater for heavy rains and secondly to block inflow of water from surroundings all around.	
2	Salinity and water logging problem.	Proper adhesive painting is required for equipment and structures to avoid rusting and corrosion	
3	Loading of transformers is above the prescribed limits per NEPRA grid code i.e. 80%.	Proper load flow study needs to be conducted. At least one transformer to be augmented.	
4	Delay in overhauling of two (02) 220kV and five (05) 132kV CBs.	Two (02) 220kV and five (05) 132kV CBs need spare parts for major maintenance.	NTDC have trained staff and workshop facilities for overhauling of CBs.
5	Overloaded 132kV TM Khan road Hyderabad-Hyderabad transmission circuit.	NTDC needs to take up the matter with HESCO.	
6	SF6 purity and moisture content test of CBs, Leakage current monitoring (LCM) test of lightning arrestors, C&DF test of CTs, PTs and CVTs are not being done.	All these tests should be carried out to ensure healthiness of the equipment.	
7	Requirement of spare parts for major maintenance of four (04) 220kV and five (05) 132kV CBs in near future.	Spares for four (04) 220kV and five (05) 132kV circuit breakers are required for their major maintenance in near future.	
<b>Protection</b>			
Sr. No.	Findings	Recommendations	Remarks
1	In-operative tele-protection on all 220kV circuits and 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.	

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2	Tie line protection is not installed on both 220kV circuits.	Need to be installed.	
3	In-operative sequential event recorders, fault/disturbance recorders, power and voltage recorders for 220kV system.	Need to be made operative for proper monitoring of the system.	
4	Absence of over load (current based) protection relays on 220/132kV transformers.	Overload (current based) protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely.	
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	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.	
7	Replacement of faulty and missing relays.	Needs replacement with latest version.	
8	Blocked auto-reclosers on all 220kV and 132kV transmission lines.	This can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity.	
<b>General</b>			
Sr. No.	Finding	Recommendations	Remarks
1	Testing of earth mesh switchyard	Earth mesh has not been tested since 2006 due to unavailability of the test set. Needs to be tested to ensure its healthiness.	
2	In-operative SCADA system	The installed equipment must be made functional.	
3	Thermo vision survey of transmission lines are not done	Thermo vision survey needs to be carried out on priority basis to avoid any major breakdowns	

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