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TECHNICAL AUDIT REPORT GUDDU 500KV GRID STATION

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TECHNICAL AUDIT REPORT

GUDDU 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 Guddu 500kV Grid Station

Introduction:

This report covers the technical audit of Guddu 500kV Grid Station (GS) located on Kashmore – Guddu road in the vicinity of Guddu thermal power station about 160 km from Sukkur, Sindh. This GS was commissioned on December 16, 1986. It has a total of 1350MVA transformation capacity and links major 500kV grid stations of Sindh and Punjab.

There are three (03) 450MVA-500/220kV autotransformer banks installed at this GS that are owned and maintained by NTDC. This GS is being directly fed from Guddu thermal power station at 220kV level and dispatches the power to other grids by stepping up to 500kV level. This GS is connected to Dadu 500kV GS, D.G. Khan 500kV GS, Muzaffargarh 500kV GS and new Guddu (747MW) through 500kV transmission circuits. It is connected to Uch thermal power station, Sibbi 220kV GS and Shikarpur 220kV GS through 220kV transmission circuits from GENCO 220kV switchyard. The 220kV switchyard is owned and maintained by GENCO. For 500kV switchyard, one and half breaker scheme is used. Single line diagram is attached (Annex-A).

EPP audit team comprising transmission and protection experts visited this GS from November 24, 2014 to December 1, 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 transformer (%)
	Voltage Ratio (kV/ kV/ kV)	Power (MVA)	HV/LV Current (A)		
T-1	525/231/22	450	495/1125	480	96.96
T-2	525/231/22	450	495/1125	480	96.96
T-3	525/231/22	450	495/1125	480	96.96

From above, it is evident that all 500/220kV autotransformers 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 reduces the expected useful life of transformers in proportion to the amount and duration of overload.

2. Oil leakage or seepage exists in the following transformers and shunt reactors:

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- a. Seepage in radiator-body junction and bushing of Blue-phase unit of transformer T-3.
 - b. Seepage in buchholz relay and radiator-body junction of shunt reactor's yellow phase unit installed on 500kV Guddu - Dadu-2.
 - c. Leakage in radiator to body junctions of shunt reactor's yellow and blue phase units installed on 500kV Guddu - D.G. Khan circuit.
 - d. Seepage in radiator to body junction of shunt reactor's yellow phase unit installed on 500kV Guddu - Dadu circuit-1.
3. Circuit breaker and lightning arrestors are not installed on shunt reactors of the following circuits:
- a. 500kV Guddu - Dadu circuit-2
 - b. 500kV Guddu - D.G. Khan circuit
 - c. 500kV Guddu - Dadu circuit-1
4. Major maintenance of thirteen (13) 500kV circuit breakers is pending due to unavailability of spare parts. Timely maintenance of circuit breakers is essential to ensure healthiness and reliability of the system. (For details see Annex-B)
5. Sixteen (16) 500kV isolators are operated locally in the switchyard. Such isolators involve human risks and cause time delay during the operations. (For details see Annex-B)
6. The following tests are not being performed as required per SOPs for grid system operation and maintenance:
- a. Dissolved gas analysis and detailed oil testing of transformers.
 - b. Capacitance & dissipation factor (C&DF) test of current transformers (CTs) and capacitor voltage transformers (CVTs).
- All these tests are essential to ensure healthiness of the equipment.
7. One (01) 220kV Guddu - Uch circuit is overloaded.
8. Discrepancies observed on 500kV and 220kV transmission circuits are given below:
- a. **500kV Guddu - Dadu circuit-1:**
Line to ground clearance between locations 325 - 326 has decreased due to construction of Sukkar - Shikarpur road. Several foundations are in the vicinity of fish farms. Braces are also short at several locations. Thermovision survey is not being carried out regularly.
 - b. **500kV Guddu - Dadu circuit-2:**

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Line to ground clearance between locations 454 - 455 has decreased due to construction of Sukkur - Shikarpur road. Most of the foundations are in the vicinity of fish farms. Conductor gets damaged occasionally between locations 557 to 563 due to heavy firing between two rival tribes. Also, braces are short at several locations. Thermovision survey is not being carried out regularly.

c. **220kV Guddu-Sibbi and Guddu-Uch circuits:**

Sky wire is missing between locations 39 to 43, 61 to 73, 100 to 102, 140 to 145 and 164 to 167. Peaks of the towers at locations 72 and 165 are also slightly tilted. The loading of 220kV Guddu-Uch circuit is above the prescribed limits per NEPRA grid code i.e. 80%

d. **220kV Guddu-Shikarpur circuit:**

Fifty percent guy wires of the line are missing and clearance of the line between spans 56-57, 124-125 and 625-626 has decreased due to heaps of soil beneath the line which were dumped during digging of a new canal in the area for irrigation purposes.

9. Following protection relays & instruments are either not installed or defective on 500/220kV autotransformers:

- a. Two (02) over excitation relays
- b. Two (02) rough balance differential relays
- c. Two (02) HV connection differential relays
- d. Two (02) over load protection relays
- e. Three (03) thermal over load relays
- f. Three (03) cross trip relays
- g. Three (03) closing supply supervision relays
- h. Three (03) alarm supply supervision relays
- i. Six (06) remote winding temperature indicators
- j. Three (03) remote oil temperature indicators
- k. 1x9 window annunciation block

10. Following protection relays are either not installed or defective on 500kV circuits:

- a. Four (04) distance to fault locators
- b. Five (05) tie line protection relays
- c. Five (05) closing supply supervision relays
- d. Five (05) alarm supply supervision relays

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11. Auto-reclosers with set-2 protection are not installed on New Guddu, Dadu-2 and D.G Khan 500kV circuits. Auto-reclosers can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity.
12. Following protection relays are not installed on 500kV shunt reactors:
 - a. Four (04) closing supply supervision relays
 - b. Four (04) alarm supply supervision relays
13. Event recorders, fault recorders and voltage recorders for 500kV system are defective since commissioning. Power recorders are not installed. This data helps engineers to check proper functioning of the protection system and identify components that failed to operate.
14. Problem of DC grounding in 220kV switchyard also exists which can cause false tripping.
15. List of missing relays and other defective equipment is attached. (Annex-D)
16. SCADA system is installed but final testing and commissioning is pending.

Recommendations:

Transmission and Grid			
Sr. No.	Findings	Recommendations	Remarks
1	Overloading of all 500/220kV autotransformers.	Transformer augmentation is required. Also, load flow study needs to be conducted.	
2	Seepage in the shunt reactors of 500kV Dadu circuit-2, D.G Khan and Dadu-1 circuits.	Seepage needs to be attended. Immediate action is required.	
3	Seepage in the B-phase unit of transformer T-3.	Seepage needs to be attended. Immediate action is required.	
4	Non-existence of circuit breaker and lightning arrestors on three (03) shunt reactors.	Need to be installed for system reliability and safety.	
5	Delay in overhauling of thirteen (13) circuit breakers.	Thirteen (13) 500kV circuit breakers need spare parts for major maintenance.	NTDC have trained staff and workshop facilities for overhauling and repair of C.Bs.
6	Local operation of sixteen (16) 500kV isolators.	Sixteen (16) 500kV isolators are operated locally in the switchyard. Such switches should be made functional for remote operations.	
7	Dissolved gas analysis test of	All these tests should be carried out to ensure healthiness of the	

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	transformer's oil, detailed oil testing of transformers and C&DF test of CTs and CVTs are not being done.	equipment.	
8	Overloading of 220kV Guddu - Uch circuit.	Conductor capacity needs to be upgraded.	
9	Discrepancies observed on 500kV Guddu - Dadu circuit-1 & 2 and 220kV Guddu-Sibbi, Guddu-Uch and Guddu-Shikarpur circuits.	All the discrepancies need to be rectified.	
Protection			
Sr. No.	Findings	Recommendations	Remarks
1	Tie line protection is not installed on all 500kV circuits.	It is strongly recommended to be installed on all 500kV circuits.	
2	Absence of Rough Balance and HV connection differential relays on autotransformer T-1 and T-2.	Needs to be installed to sectionalize the differential zones.	
3	Absence of cross trip scheme on all 500/220kV autotransformers.	Recommended to be installed 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 all transformers and over load (current based) protection relays on T-1 & T-2.	Thermal overload and overload (current based) protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely.	
5	Sequential event recorders, fault recorders and voltage recorders for 500kV system are not functional and absence of power recorders.	It is strongly recommended to install new sequential event recorders, fault recorders, voltage recorders and power recorders. Such data helps engineers to check proper functioning of protection system and identify the components which failed to operate as expected.	
6	Missing auto-reclosers on three (03) 500kV transmission lines.	System protection and system operations departments have to review the matter and take appropriate action for installation of missing auto-reclosers. This can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity.	

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7	Replacement of faulty, defective and missing relays.	Needs replacement with latest version. List of relays is attached in Annex-D.	
8	DC grounding in 220kV switchyard.	The concerned staff has checked 500kV switchyard thoroughly and found it clear. Now the issue is pending with GENCO which needs to be resolved.	
General			
Sr. No.	Findings	Recommendations	Remarks
1	Inoperative SCADA system.	SCADA system needs to be made functional.	

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