



USAID
FROM THE AMERICAN PEOPLE



USAID ENERGY POLICY PROGRAM

TECHNICAL AUDIT REPORT DADU 500KV GRID STATION

January 2015

This program is made possible by the support of the American people through the United States Agency for International Development (USAID)

USAID ENERGY POLICY PROGRAM

TECHNICAL AUDIT REPORT DADU 500KV GRID STATION

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

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

©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

DISCLAIMER

The contents of this report are the sole responsibility of Advanced Engineering Associates International Inc. (AEAI) and do not necessarily reflect the views of USAID or the United States Government.

Technical Audit of Dadu 500kV Grid Station

Introduction:

This report covers the technical audit of Dadu 500kV Grid Station (GS), located in the southern part of Dadu city, Sindh. The GS was commissioned on February 19, 1987. It has a total of 900 MVA transformation capacity connected to the grid and is the main source for feeding Dadu district.

There are two (02) 450MVA-500/220KV autotransformers, three (03) 160MVA-220/132kV autotransformers that are owned and maintained by NTDC. Four (04) 500kV, two (02) 220kV and seven (07) 132kV transmission lines link this station to others. This GS is connected to Guddu thermal power station and Jamshoro 500kV GS through 500kV circuits and to Khuzdar 220kV GS through 220kV circuits. For 500kV and 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).

EPP technical audit team comprising transmission and protection experts visited this station from November 10, 2014 to November 21, 2014. The 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-2	525/231/23	450	495/1125	830	73.77
T-4	525/231/23	450	495/1125	510	45.33
T-1	220/132/11	160	420/700	670	95.72
T-3	220/132/11	160	420/700	670	95.72
T-5	220/132/11	160	420/700	N/A	N/A

From above, it is evident that two 160MVA-220/132kV transformers T-1 and T-3 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. A new Khuzdar 220kV GS commissioned recently will share the load of 220/132kV transformers at this GS.

Technical Audit of Dadu 500kV Grid Station

2. The reclaimed 160MVA-220/132kV transformer T-5 was installed along with allied equipment and commissioned on no-load on December 26, 2012 but it was de-energized due to operational problems of its controlling circuit breakers which have not been rectified till to-date.
3. Tap changers of 500/220kV transformer T-2 and 220/132kV transformers T-1 and T-5 are operated locally in the switchyard.
4. Major maintenance of fourteen (14) 500kV, five (05) 220kV and four (04) 132kV circuit breakers (CBs) is pending due to unavailability of spare parts. Remote operating system of one (01) 500kV and one (01) 220kV circuit breakers is not working and those are operated locally in the switchyard.
5. Major maintenance of seven (07) 220kV and seven (07) 132kV circuit breakers will be due in near future. (For details see Annex-B.)
6. Shunt Reactors installed on 500kV Dadu-Jamshoro-1 and Dadu-Guddu-1 lines are out of circuit due to damaged B-phase and R-phase units of these circuits respectively.
7. Remote operation of twenty (20) 500kV, eight (08) 220kV and eighteen (18) 132kV isolators is not working and are operated locally in the switchyard.
8. The following tests are not being 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 & dissipation factor (C&DF) test of power transformers, current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs).
 - c. SF6 purity and moisture content, opening/closing time and contact resistance test for circuit breakers
 - d. Leakage current measurement (LCM) test of lightning arrester
 - e. Thermovision survey of GS and all transmission lines.

It is necessary to conduct all tests timely to ensure healthiness and smooth operation of the equipment.
9. The earth testing of 500kV, 220kV and 132kV equipment, gantries and structures has not been carried out since 2004.
10. The 132kV Dadu-Moro transmission line is overloaded.

Technical Audit of Dadu 500kV Grid Station

- 11.** For Secured Metering System (S.M.S), dedicated CTs and PTs are not installed for transformer T-1 and T-3.
- 12.** Cracks have developed in a number of tower foundations of both 500kV Dadu-Jamshoro circuits and Dadu-Guddu circuits. The stubs and main members of the twenty one (21) towers are rusted which need replacement to avoid any mishap.
- 13.** The newly constructed 220kV Dadu-Khuzdar circuit is full of discrepancies throughout the line length such as shortage of braces, missing split pins, arcing horns, phase plates, number plates, danger plates, nuts/bolts, joint boxes of OPGW and other accessories at various locations.
- 14.** Tie line protection is not installed on all 500kV and 220kV transmission lines. Breaker failure scheme for 132kV systems is not installed.
- 15.** The facility for direct transfer trip (DTT) is not available on 220kV system. This DTT order requires the missing tele-protection facility.
- 16.** Auto-reclosers on all 220kV transmission lines are blocked. Auto-reclosers can significantly reduce the outage time, reduce transmission line damages and thus provide higher service continuity.
- 17.** HV connection, LV connection and rough balance differential relays are not installed on 220/132kV transformers T-1 and T-3 to sectionalize the differential zones. (For details see Annex-B).
- 18.** The following relays are not installed on 500/220 and 220/132kV transformers:
 - a. Three (03) thermal overload protection
 - b. One (01) overload (current based) protection
 - c. Two (02) Over excitation relays
 - d. Eight (08) DC supply supervision relays
 - e. Four (04) tertiary earth fault relays
 - f. Twenty four (24) Trip circuit supervision sets
- 19.** Cross trip protection facility is not available on all 500kV, 220kV transmission lines and 500/220kV, 220/132kV transformers. Cross trip scheme is implemented in some sections of the system to avoid total or partial collapse. Some transmission lines and transformers do not have contingency cover, so under heavy load conditions if outages occur due to fault or overloading, possibility of cascaded outages of other transmission circuits can lead the power system to total collapse.

Technical Audit of Dadu 500kV Grid Station

20. The following relays are not installed on 500 and 132kV transmission lines:

- a. Four (04) distance to fault locator
- b. Four (04) Switch Synchronizing relays
- c. Twenty eight (28) DC supply supervision relays
- d. Eight (8) Alarm supervision relays
- e. Twenty eight (28) Trip circuit supervision sets

21. Sequential event recorders and Disturbance fault recorders are not functional since commissioning apparently due to improper configuration besides lack of updating of software. Voltage and power recorders are also out of order since commissioning.

22. Busbar differential protection is not installed on 132kV bus-1 and bus-2.

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

Recommendations:

Transmission and Grid			
Sr. No.	Findings	Recommendations	Remarks
1	Damaged shunt reactors on Dadu-Jamshoro-1 and Dadu-Gudu-1.	Damaged shunt reactors should be replaced for smooth operation of system.	
2	Loading above prescribed criteria per NEPRA grid code of 220/132kV transformers.	Proper load flow study needs to be conducted to share the load keeping in view the commissioning of new Khuzdar 220kV GS.	
3	Inoperative 160MVA 220/132kV transformer T-5.	Fault need to be rectified to give relief to other 220/132kV transformers.	
4	DGA test and detailed oil testing for transformers, SF6 purity and moisture content, Opening/closing time & Contact resistance 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 regularly to ensure healthiness of the equipment.	
5	Overhauling of twenty three (23) CBs is pending due to unavailability of spare parts.	Spare parts for fourteen (14) 500kV, five (05) 220kV and four (04) 132kV CBs should be arranged.	

Technical Audit of Dadu 500kV Grid Station

6	Remote operation of one (01) 500kV CB and one (01) 220kV CB is not working.	Needs to be set right. (for details see Annex-B)	
7	S.M.S dedicated CTs and PTs are no installed for transformer T-1 and T-3.	Dedicated CT and PT need to be installed.	
8	Local operation of tap changers of 500/220kV transformer T-2 and 220/132kV transformers T-1 and T-5.	Remote operation should be made operative for smooth operation of the transformers.	
9	Remote operation of many isolators is not working.	Remote operation of twenty (20) 500kV, eight (08) 220kV and eighteen (18) 132kV isolators should made operative.	

Protection			
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 the matter to enable "Carrier aided facility" at either ends of the transmission lines for quick clearing of the faults.	
2	Inoperative sequential event recorders and fault recorders and voltage/power recorders for 500kV and 220kV system.	It is strongly recommended to install and make sequential event recorders, fault recorders and voltage/power recorders operative. Such data helps engineers to check proper functioning of protection system and identify the components which failed to operate.	
3	Tie line protection is not installed on all 500kV and 220kV transmission lines. Breaker failure scheme for 132kV systems is not installed	Need to be installed.	
4	Absence of thermal overload protection relays on transformer T-1, T-2 and T-3 and over excitation relay on T-1 and T-3.	Thermal overload and over excitation protection has a vital role against sustained overloading and over fluxing. Hence recommended to be	

Technical Audit of Dadu 500kV Grid Station

		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	Differential protection for 132kV bus-1 and bus-2 is not installed.	Recommended to be installed for rapid isolation of bus bar faults.	
7	Absence of cross trip scheme on all 500kV, 220kV transmission lines and 500/220kV, 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.	
8	Replacement of faulty, blocked and missing relays.	Needs replacement with latest version. (for details see Annex-B)	
9	Blocked auto-reclosers on all 132kV transmission lines.	This can significantly reduce the outage time, reduction in transmission line damages and thus providing higher service continuity.	

General			
Sr. No.	Findings	Recommendations	Remarks
1	Thermovision survey of all transmission lines and GS has not been done.	Thermovision survey needs to be done.	
2	Cracks developed in numerous tower foundations on both Dadu-Jamshoro circuits and Dadu-Guddu circuits	Appropriate measure should be taken to repair the affected foundations.	
3	The newly constructed 220kV Dadu-Khuzdar circuit is full of discrepancies such as shortage of braces, missing split pins, arcing horns, phase plates, number plates, danger plates, nuts/bolts, joint boxes of OPGW and other accessories at various locations	Need to be addressed.	

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