



USAID
FROM THE AMERICAN PEOPLE



USAID ENERGY POLICY PROGRAM

TECHNICAL AUDIT REPORT GAKHAR 220KV 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

GAKHAR 220KV 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 Gakhar 220kV Grid Station

Introduction:

This report covers the technical audit of Gakhar 220kV Grid Station (GS) located near G.T. Road, about 85km from Lahore, Punjab. This GS was commissioned at 220kV level on June 11, 1982. It has 640MVA transformation capacity connected to the grid, feeding Gujranwala and its surrounding areas.

There are four (04) 160MVA-220/132kV autotransformers and two (02) 26MVA-132/11kV power transformers installed at this GS which are owned and maintained by NTDC. Four (04) 220kV and thirteen (13) 132kV transmission circuits link this station to others. This GS is connected to Mangla hydro power station, Nokhar 500kV GS and Sahuwala (Sialkot) 220kV GS through 220kV circuits. For both 220kV and 132kV switchyards double bus single breaker scheme is used. Single line key diagram is attached (Annex-A).

EPP audit team comprising technical experts visited this GS from February 11, 2014 to February 21, 2014. The report reflects their findings and prioritized fixes.

Findings:

Observations of technical experts are given below:

- 1) Loading condition of the 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-1	220/132/11	160	420/700	650	92.85
T-2	220/132/11	160	420/700	630	90.00
T-3	220/132/11	160	420/700	690	98.57
T-4	220/132/11	160	420/700	685	97.85
T-5	132/11.5	26	113/1305	1310	100.38
T-6	132/11.5	26	113/1305	1280	98.08

From above, it is evident that all 220/132kV transformers are loaded above the prescribed loading 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 a 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. The addition of Nokhar 500kV GS significantly shared the load of Gakkhar 220kV GS, but after a period of two to three years, this GS is getting overloaded again due to the growing load demand of industries and population in the area.

Technical Audit of Gakhar 220kV Grid Station

- 2) Major maintenance of seven (07) 220kV and sixteen (16) 132kV circuit breakers (CBs) is pending due to unavailability of spare parts. Timely overhauling of circuit breakers is essential for smooth running of the system. Remote operating system of one (01) 132kV CB is not working and is operated locally in the switch yard. (For details see Annex-B)
- 3) Seven (07) 132kV current transformers (CTs) are outdated and due to their deteriorated condition need replacement.
- 4) Motor drive system of twelve (12) 220kV and thirteen (13) 132kV isolators is not working. Also, there are twenty four (24) 132kV isolators having manual operating mechanism and have no provision for remote operations.
- 5) Current transformers (CTs) and potential transformers (PTs) for secured metering system (SMS) are not installed on power transformer T-4. Need to be installed for secured and accurate recording of energy. Also, lightning arrestors are not installed on 220kV transmission circuits.
- 6) The following tests are not being performed as required per SOPs for grid system operation and maintenance:
 - a. Leakage current measurement (LCM) test of lightning arresters
 - b. 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.

- 7) High level bus bar for 220kV Nokhar and Mangla-2 circuits are of single conductor. Need to be doubled to enhance the capacity and ensure stability of the system.
- 8) Tele-protection facility for some 220kV transmission lines is inoperative. Also, auto-reclosers installed on 220kV and 132kV transmission lines are kept blocked.
- 9) Breaker failure scheme installed has not been modified and updated with time. Breaker failure relays are not installed on 220kV circuit breaker for bus-coupler and 132kV circuit breaker for LV side of 220/132kV, 160MVA transformer T-3. Also, direct transfer trip facility is not in circuit.
- 10) Sequential event recorder, fault/disturbance recorder with CPU and printer, voltage and power recorders are not operative. Such data helps engineers to ensure proper functioning of the protection system and identifies the components which fail to operate as required per scheme.

Technical Audit of Gakhar 220kV Grid Station

- 11) On all 220/132kV transformers HV connection, LV connection and rough balance differential relays are not installed to sectionalize the differential zone. Also, cross trip scheme on 220/132kV transformers is not installed. (For details see Annex-D)
- 12) Thermal overload protection relays and AVR relays are not installed on all 220/132kV transformers. Three (03) remote winding temperature indicators and six (06) remote oil temperature indicators are not installed/ defective. Oil temperature protection is not installed on transformer T-2. (For details see Annex-B)
- 13) List of other missing relays and defective equipment is attached in Annex-D.
- 14) Synchronizing facility is not available for 220kV system.
- 15) 11kV capacitor bank installed on transformer T5 is disconnected whereas all the capacitors cells of T6 are missing. Both the banks are required to be made operative.
- 16) With the addition of Nandipur power plant, the current flow during normal and short circuit conditions will increase per the planning studies therefore up-gradation of old and underrated equipment especially the 132kV grid stations is required on priority. NTDC should take up with GEPCO.

Recommendations:

Transmission and Grid			
Sr. No.	Finding	Recommendations	Remarks
1	Loading above prescribed criteria per NEPRA grid code of all 220/132kV transformers.	Proper load flow study is required for load sharing between Gakkhar 220kV, Nokhar 500kV and Sahowala 220kV taking into consideration energization of Nandipur power plant in the near future.	Nandipur power house is expected to be operational by the end of the year and 220KV Gujrat GS during year 2014-2015 will give relief to GEPCO network. The completion of both projects, the transformers will operate within safe limits due to shifting of their load to other stations.
2	Overhauling of seven (07) CBs is due and spare parts for sixteen (16) CBs are not available.	One (1) CB of 220kV and six (06) CB of 132kV need spare parts on urgent basis for major maintenance.	NTDC have trained staff and workshop facilities for overhauling and repair of CBs

Technical Audit of Gakhar 220kV Grid Station

3	Seven (07) 132kV current transformers (old and deteriorated).	Needs to be replaced with new ones.	
4	Gakkar-Sahuwala (Sialkot) 220kV circuit gets loaded above 80%.	Proper load flow studies need to be conducted to analyse the system as construction of four new circuits is in progress and also a new Gujrat 220kV GS is under construction.	
5	Capacitance and Dissipation Factor (C&DF) test for all CTs and CVTs is due	All these tests should be carried out to ensure proper healthiness of equipment	
6	Lightning arrestors are not installed on 220kV transmission circuits.	220kV Lightning arrestors need to be installed.	
7	Up-gradation of old and underrated equipment especially the 132kV grid stations of GEPCO due to addition of Nandipur power station	NTDC should take up with GEPCO on priority basis.	
8	Twenty four (24) 132kV isolators are manual and motor drive of twelve (12) 220kV isolators and thirteen (13) 132kV isolators is inoperative.	Need to be replaced with appropriate ones.	

Protection			
Sr. No.	Finding	Recommendations	Remarks
1	Teleprotection (carrier aided) tripping facility is missing on almost all 220kV lines.	“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 in order to clear faults rapidly	

Technical Audit of Gakhar 220kV Grid Station

2	Inoperative Sequence Event Recorder (SER) for 220kV 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 GSs. Input of NTDC "Technical Services Group" and "System Protection" and "Grid System Operation" departments would be required for devising a workable "SOP".	
3	Fault Recorders for 220kV system are inoperative	It is strongly recommended to install fault and disturbance recorders for proper monitoring of the system	
4	Defective remote temperature indicators on transformers	It is strongly recommended to replace the defective indicators or calibrate them for proper monitoring of transformer temperatures.	
5	Absence of thermal overload protection relays on all 220/132kV transformers. Absence of LV winding temperature protection relay (electro mechanical)	Thermal overload and HV winding temperature protection relays have a vital role against sustained overloading in transformers. Therefore are strongly recommended to be installed and configured precisely.	
6	Tie protection is not active on all 220kV circuits	It is strongly recommended to make it active	
7	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.	

Technical Audit of Gakhar 220kV Grid Station

8	Breaker failure scheme installed has not been modified and updated with time. Breaker failure relays are not installed on 220kV circuit breaker for bus-coupler and 132kV circuit breaker for transformer T-3. Also, direct transfer trip (DTT) system is inoperative .	Needs to be made operative in consultation with System Protection department of NTDC.	
9	Replacement of faulty, blocked and missing relays.	Needs replacement with latest version. List of relays is attached in Annex-D	
10	Auto reclosing is inactive for all 220kV and 132kV transmission lines.	"System Protection" and "System Operations" departments have to 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	
11	Non-existence 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.	

General			
Sr. No.	Finding	Recommendations	Remarks
1	Thermovision survey of GS is not done	Thermovision survey needs to be carried out to avoid any major breakdowns	
2	Non-availability of testing equipment.	Universal testing sets need to be provided for appropriate testing of protection system.	

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