



USAID
FROM THE AMERICAN PEOPLE



USAID ENERGY POLICY PROGRAM

TECHNICAL AUDIT REPORT RAVI ROAD 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

RAVI ROAD 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 Ravi Road 220kV Grid Station

Introduction:

This report covers the technical audit of Ravi 220kV Grid Station (GS) located on the Lahore ring road near river Ravi bridge, Punjab. This GS was commissioned during 1970 at 132kV level and upgraded to 220kV level on March 21, 1994. It has a total of 750MVA transformation capacity and feeds major portion of Lahore where load demand is growing rapidly.

There are three (03) 250MVA-220/132kV autotransformers and two (02) 20/26MVA-132/11kV power transformers installed at this GS that are owned and maintained by NTDC. Four (04) 220kV and twelve (12) 132kV circuits link this station to others. The GS is connected to Sheikhpura 500kV GS and Atlas power house through 220kV single circuits and to Kala Shah Kaku (KSK) 220kV GS through 220kV double circuit. A new 220kV Shalamar GS is under commissioning and will be linked via one of the 220kV KSK circuits to it soon. For 220kV (GIS) and 132kV (AIS) switchyard double bus single breaker scheme is used. Single line diagram is attached (Annex-A).

EPP audit team comprising transmission and protection experts visited this GS from October 31, 2013 to November 12, 2013. 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	220/132/11	250	656/1095	940	85.84
T-2	220/132/11	250	656/1095	990	90.4
T-3	220/132/11	250	656/1095	990	90.4
T-4	132/11.5	26	113/1305	1320	101.1
T-5	132/11.5	26	113/1305	1320	101.1

From above, it is evident that all 220/132kV autotransformers are loaded above the prescribed limits and both 132/11kV 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 reduces the expected useful life of transformers in

Technical Audit of Ravi Road 220kV Grid Station

proportion to the amount and duration of overload. A new 220kV Shalamar GS is under commissioning and will be linked via one of the 220kV KSK circuits to it soon. It will share the loading of transformers at this GS.

2. Gas leakage exists in the chamber of 220kV breaker D6Q1 and isolator D6Q11. NTDC has no expertise and spare parts to resolve such problems. Approximately 3 kg gas is being refilled after every three days.
3. The 220kV Ravi - KSK and Ravi – Sheikhpura circuits are passing through the bed of river Ravi and the towers are in deteriorated condition. The conductor is damaged and braces are also missing.
4. Major maintenance of all 220kV and three (03) 132kV 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. For all 220kV isolators (GIS), overhauling is required. Also, all 132kV isolators are operated manually in the switchyard due to defective motor drive system or old manually operated type isolators. Alignment of some 132kV isolators is also improper.
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 arrestors.
 - b. Capacitance & dissipation factor (C&DF) test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs).All these tests are essential to ensure healthiness of the equipment.
7. The 132kV switchyard was commissioned in 1970 and most of the equipment is old and has completed its useful life. Also, the 11kV control room needs to be extended to accommodate all the panels properly. The bus bars for some panels have been linked through cables, which get damaged from time to time.
8. Tele-protection is out of circuit on both 220kV KSK circuits. Also, direct transfer trip (DTT) facility is not available in 220kV system.
9. The following relays are either not installed or blocked on 220kV and 132kV circuits:
 - a. Four (04) synchro check relays are not installed on 220KV circuits.
 - b. Two (02) distance to fault locators (set-2) are not installed on 220kV circuits.

Technical Audit of Ravi Road 220kV Grid Station

- c. Two (02) distance protection relays (set-2) installed on 220kV circuits and one (01) one 132kV circuit are defective.
 - d. Eight (08) back up earth fault relays are not installed on 132kV circuits.
 - e. Six (06) trip circuit supervision relays are not installed on 132kV circuits.
 - f. Three (03) PT supply supervision relays on 132kV circuits.
- 10.** Auto-reclosers are blocked on all 220kV and 132kV circuits. Auto-reclosers can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity.
- 11.** 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)
- 12.** The following relays or equipment on 220/132kV and 132/11kV transformers are either defective or not installed (for details see Annex-B and D):
- a. Three (03) neutral over current relay
 - b. Three (03) thermal overload protection
 - c. Three (03) over excitation relays are very old and sluggish
- 13.** For 220kV bus bar-2, no relay for differential protection is installed.
- 14.** Sequential event recorders, fault recorders, power and voltage recorders are installed but not in 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 as required per scheme.
- 15.** The SCADA system is installed but incomplete, therefore is not functional.
- 16.** List of old and missing relays and other defective equipment is attached. (Annex–D)

Recommendations:

Transmission and Grid			
Sr. No.	Findings	Recommendations	Remarks
1	Gas leakage in 220kV GIS	Overhauling of GIS is required.	
2	Deteriorated condition of some spans of 220kV Ravi - KSK and Ravi –Sheikhupura circuits	The lines pass through the river bed of Ravi and needs to be checked thoroughly for repairs of foundations, towers and conductor. Normal disc insulators need to be replaced with fog-type discs.	

Technical Audit of Ravi Road 220kV Grid Station

3	Overloading of all 220/132kV and both 132/11kV transformers.	Proper load flow study is required keeping in view the commissioning of new Shalimar 220kV GS for shifting of load of this GS.	
4	Delay in overhauling of eight (08) 220kV and three (03) 132kV circuit breakers.	Spare parts are required for three (03) 132kV circuit breakers and complete overhauling of 220kV GIS is recommended.	
5	Old 132kV switchyard and congested 11kV control room.	Remodeling of 132kV switchyard is recommended and new 11kV room needs to be constructed to accommodate the panels properly.	
6	Leakage current measurement (LCM) test of lightning arrestors and 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	Manual operation of all 132kV isolators. Also improper alignment of some 132kV isolators.	Remote operation system needs to be made functional and those with no provision of motor drive system need to be replaced. Also, improper alignment of 132kV bus bars isolators needs to be set right.	
Protection			
Sr. No.	Findings	Recommendations	Remarks
1	In-operative tele-protection on both KSK 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 in order to clear faults rapidly.	
2	Sequential event recorders, fault recorders, power and voltage recorders are installed but not in service since long due to lack of maintenance.	Need to be made operative for proper monitoring of the system.	

Technical Audit of Ravi Road 220kV Grid Station

3	Two (02) missing distance protection relays (Set-2) on 220kV circuits and one (01) defective on 132kV circuits.	Recommended to be installed or replaced for proper clearance of fault.	
4	Absence of thermal overload and neutral overcurrent protection relays on all 220/132kV transformers.	Thermal overload and neutral overcurrent protection relays protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely.	
5	Blocked auto-reclosers on all 220kV and 132kV transmission lines.	System protection and system operation departments have to review the matter and take appropriate action for restoration of auto-reclosers. This can significantly reduce the outage time, reduction in transmission line damage and thus provide higher service continuity.	
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	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.	
8	Missing differential protection relay on 220kV bus bar-2.	Installation of dedicated relay is recommended to extract the benefits of double bus bar scheme.	
9	Old and sluggish over excitation relays installed on 220/132kV transformers.	The relay is very old and need to be replaced with latest numerical relay to ensure the safety of transformer against sustained over fluxing.	
10	Replacement of old/sluggish, blocked and missing relays.	Needs replacement with latest version. (for details see Annex-B)	

Technical Audit of Ravi Road 220kV Grid Station

General			
Sr. No.	Findings	Recommendations	Remarks
1	Inoperative SCADA system.	Need to be made operative.	
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