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## TECHNICAL AUDIT REPORT DAUD KHEL 220KV GRID STATION

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## TECHNICAL AUDIT REPORT

# DAUD KHEL 220KV GRID STATION

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# Technical Audit of Daud Khel 220kV Grid Station

## Introduction:

This report covers the technical audit of Daud Khel 220kV Grid Station (GS), located on Mari Indus road, Punjab. This GS was commissioned on September 25, 1995. It is an important station due to its linkage to Chashma Nuclear power plant and Jinnah hydro power station as well as to Tarbela and Ghazi Barotha hydro power stations through Sheikh Muhammadi Peshawar 500kV GS. With a by-pass arrangement at Chashma Nuclear power station, it can be linked directly to Ludewala 220kV and further to Gatti 500kV GSs. It has a total of 320MVA transformation capacity and is the main source for feeding the areas around Daud Khel (Punjab) and Kohat (KPK).

There are two (02) 160MVA-220/132kV autotransformers and one (01) 10/13MVA-132/11kV power transformer that are owned and maintained by NTDC. Six (06) 220kV and six (06) 132kV transmission circuits link this GS to others. It is connected to Sheikh Muhammadi 500kV GS, Chashma Nuclear power plant and Domail Bannu 220kV GS is through 220kV transmission circuits whereas to Jinnah hydro power station through 132kV circuits. 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).

EPP audit team comprising transmission and protection experts visited this GS from June 2, 2014 to June 13, 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 under:

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	725A	103.57
T-2	220/132/11	160	420/700	725A	103.57
T-3	132/11.5	13	57/653	141A	21.59

From above, it is evident that all 220/132kV 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, the expected useful life of transformers is reduced in proportion to the amount and duration of overload.

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- 2) The 220kV Daud Khel-Chashnup and Daud Khel-Domail Bannu circuits are overloaded per NEPRA grid code that allows up-to 80% loading.
- 3) Leakage exists in the top plate and tertiary bushing of transformer T-2. Also, there is slight seepage in the top plate of transformer T-1.
- 4) Some control and protection cables of transformer T-1 and T-2 are deteriorated which make the remote/local operations unreliable.
- 5) Major maintenance of twelve (12) 220kV and ten (10) 132kV circuit breakers (CBs) is pending due to unavailability of spare parts. Timely overhauling of circuit breakers is essential to ensure healthiness and reliability of the system.  
Also, gas leakage exists in one (01) 220kV and one (01) 132kV circuit breakers. (For details see Annex-B)
- 6) Sixteen (16) 220kV and twenty eight (28) 132kV isolators are operated manually in the switchyard due to weak mechanical strength of porcelains and few due to improper alignment.
- 7) The 132kV circuits for Kohat are maintained by FESCO and PESCO jointly. Due to poor coordination between these DISCOs the line is poorly maintained.
- 8) The following tests have not been performed as required per SOPs for grid system operation and maintenance:
  - a. Capacitance and dissipation factor (C&DF) test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs)
  - b. Leakage current measurement (LCM) test of lightning arrestersIt is necessary to conduct all tests timely to ensure healthiness of the equipment.
- 9) Tele-protection is out of circuit on all 220kV circuits except Chashnup-I and 2. Moreover, direct transfer trip scheme (DTT) on 220kV dia. 1, 2 and 3 is out of circuit.
- 10) Tie line protection is not installed on three (03) 220kV circuits and blocked on both Bannu circuits. Also, back up earth fault relays are not installed on all 220kV and five (05) 132kV circuits.
- 11) Auto-reclosers on all 220kV and 132kV transmission lines are blocked apparently due to occurrence of heavy break downs and excessive tripping as re-try can damage the equipment which is already in vulnerable condition.
- 12) On 132kV transmission lines, one (01) distance relay is defective and two (02) energy meters are not installed.

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- 13) HV connection, LV connection and rough balance differential relays are not installed on 220/132kV transformers T-1 and T-2 to sectionalize the differential zone. Also, cross trip scheme is not installed on T-1 and T-2 transformers. (For details see Annex-B)
- 14) Three (03) thermal overload protection relays and one (01) overload (current based) relay are not installed on 220/132kV and 132/11kV transformers. On 132/11kV transformer T-3, one (01) remote winding temperature indicator and one (01) energy meter are not installed. On 132/11kV transformers, six (06) ampere meters, two (02) kV meters and one (01) AVR relay is not installed. (For details see Annex-B and D)
- 15) Testing sets for protection relays are not available at the grid station.
- 16) Control signals, status indications, protection alarms and measurements of SCADA system are being sent to NCC/RCC but final testing and commissioning is pending.
- 17) Sequential event recorders are not installed. Fault/disturbance recorder, voltage and power recorders are out of circuit since long. Such data helps engineers to ensure proper functioning of the protection system and identifies the components which fail to operate as required per scheme.
- 18) On 220kV, 132kV and 11kV system, under frequency relays are not installed. Also synchro-check for 220kV system is not working.
- 19) List of missing relays and other defective equipment is attached. (Annex-D)
- 20) Retaining walls at locations 6, 26, 34, 281, 282, 283, 299,330, 337, 338, 339, 342, 344 and 345 of 220kV Daud Khel-Sheikh Muhammadi transmission line need to be constructed. Braces are also short at certain locations of 220kV transmission lines emanating from this grid station.

### Recommendations:

Transmission and Grid			
Sr. No.	Finding	Recommendations	Remarks
1	Overloading of 220/132kV transformers.	Both the 160MVA transformers are running in parallel and exceed their full loading capacities during peak load hours. Proper load flow study needs to be conducted and transformers to be augmented accordingly.	

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2	The 220kV Daud-khel-Chashnup and Daud Khel-Domail Bannu circuits are overloaded per NEPRA grid code that allows up-to 80% loading.	Proper load flow studies need to be conducted and the matter needs to be addressed accordingly.	
3	Delay in overhauling of twelve (12) 220kV and ten (10) 132kV circuit breakers (CBs) due to lack of spare parts.	Twelve (12) 220kV and ten (10) 132kV circuit breakers need spare parts for major maintenance (overhauling).	NTDC have trained staff for overhauling of C.Bs
4	C and DF test of current transformers (CTs), potential transformers (PTs) and capacitor voltage transformers (CVTs) and LCM test of lightening arresters is not done per SOPs	These tests need to be done on priority basis to ascertain the healthiness of equipment.	
5	Deteriorated condition of control and protection cables of T-1 and T-2	These cables need to be replaced.	
6	Leakage in the top plate and tertiary bushing of T-2 and seepage in the top plate of T-1	Needs to be attended.	
7	Forty four (44) isolators are operated manually in the switchyard due to weak mechanical strength of porcelains	Porcelain post of sixteen (16) 220kV and twenty eight (28) 132kV needs to be replaced with appropriate ones.	

<b>Protection</b>			
Sr. No.	Finding	Recommendations	Remarks
1	Tele-protection is out of circuit on all 220kV circuits except Chashnup-I and 2. Moreover, direct transfer trip (DTT) on 220kV dia. 1, 2 and 3 is out of circuit.	“System Protection and Telecommunication departments of NTDC” should make concerted efforts to enable “Carrier aided facility” at either ends of the transmission lines in order to clear faults rapidly.	

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2	Sequence Event Recorder (SER) for 220kV system is not installed. Fault recorders are out of service since long.	It is strongly recommended to make sequential event recorders, fault recorders and voltage recorders operative. Such data helps engineers to check proper functioning of protection system and identify the components which failed to operate as expected.	
3	Tie line protection is not installed on three (03) 220kV circuits and blocked on both Bannu circuits.	It is strongly recommended to install and make it active.	
4	Absence of thermal overload protection relays on all 220/132kV and 132/11kV transformers and absence of over load (current based) protection on 132/11 kV transformer.	Thermal overload protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely.	
5	On 132kV transmission lines, one (01) distance relay is defective and two (02) energy meters are not installed.	Recommended to be replaced for proper clearance of fault.	
6	HV connection, LV connection and rough balance differential relays are not installed on 220/132kV transformers T-1 and T-2 to sectionalize the differential zone. Also, cross trip scheme is not installed on T-1 and T-2 transformers.	Needs to be installed to sectionalize the differential zones.	
7	Replacement of all missing and defective relays (for details see Annex-B and D)	All relays need to be installed for proper protection of system	
8	Non-existence of back up earth fault relay on all 220kV and 132kV circuits except 132kV Jinnah Hydro Power-1	Back up earth fault relay is recommended to be installed as backup to clear the line to ground faults in case of failure of distance protection.	

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9	Auto reclosing is inactive for all 220kV and 132kV transmission lines.	"System Protection" and "System Operations" departments should 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	
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General			
Sr. No.	Finding	Recommendations	Remarks
1	Control signals, status indications, protection alarms and measurements of SCADA system are being sent to NCC/RCC but final testing and commissioning is pending.	The installed equipment must be commissioned properly.	
2	Retaining walls at locations 6, 26, 34, 281, 282, 283, 299,330, 337, 338, 339, 342, 344 and 345 of 220kV Daud Khel-Sheikh Muhammadi transmission line need to be constructed. Braces are also short at certain locations of 220kV transmission lines emanating from this GS	Construction of retaining walls is recommended.	
3	Non-availability of testing equipment.	Universal testing sets need to be provided for appropriate testing of protection system.	

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