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## TECHNICAL AUDIT REPORT NISHATABAD 220KV GRID STATION

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## TECHNICAL AUDIT REPORT

# NISHATABAD 220KV GRID STATION

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## Technical Audit of Nishatabad 220kV Grid Station

### Introduction:

This report covers the technical audit of Nishatabad 220kV Grid Station (GS), located at Shahkot road in Faisalabad, Punjab. This GS was commissioned on March 3, 1960. It has 287 MVA transformation capacity connected to the grid, feeding Faisalabad and its surrounding areas.

There is one (01) 160MVA-220/132kV, four (04) 63.5MVA-220/132kV autotransformers (out of which two (02) 63.5MVA are damaged), two (02) 37.5MVA-132/66kV and one (01) 13MVA-132/11kV power transformers at this GS that are owned and maintained by NTDC. Four (04) 220kV, eleven (11) 132kV and six (06) 66kV circuits link this station to others. The GS is connected to Gatti 500kV GS and Summandry Road 220kV GS through 220kV circuits. For 220kV, 132kV and 66kV switchyard double bus single breaker scheme is used. Single line diagram is attached (Annex-A).

EPP audit team comprising of technical experts visited this GS from March 03, 2014 to March 11, 2014. This report reflects their findings and prioritized fixes.

### Findings:

Observations of technical experts are as under:

- 1) 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-1	220/132/11	63.5	167/282	Damaged	NA
T-2	220/132/11	63.5	167/282	Damaged	NA
T-3	220/132/11	63.5	167/282	280	97.9
T-4	220/132/11	63.5	167/282	280	97.9
T-5	220/132/11	160	420/700	595	85
T-6	132/66/11	37.5	164/328	320	97.6
T-7	132/66/11	37.5	164/328	320	97.6
T-8	132/11.5	13	57/653	Minor Auxiliary Load of Steam Power Station	NA

From above, all 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 transformer above 80% at ambient temperature equal to or above 40°C, prohibits the

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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 transformers T1 and T2 are lying damaged and need to be replaced with higher capacity transformers i.e. 160MVA along with their auxiliary panels. All other allied equipment such as isolators, current transformers (CTs) and surge arresters (SAs) on both 220kV and 132kV side of the transformers need replacement as they are under-rated. In the meanwhile, one 100 MVA-220/132 kV General Electric make transformer is present at Nishatabad GS that may be installed in place of damaged T1 or T2 temporarily. Reinforcement and extension of existing earthing mesh is needed. Also, modification in the existing control panels of transformers T1 and T2 will be needed to accommodate higher capacity transformers.

- 2) The foundations of old existing transformers and other equipment are not adequate for installation of higher capacity transformers and their allied equipment. New foundations for two (02) higher capacity transformers, six (06) 220kV surge arresters, six (06) 220kV CTs, four (04) sets of 220kV bus bar isolators, six (06) 132kV surge arresters, six (06) 132kV CTs and four (04) sets of 132kV bus bar isolators for T1 and T2 need to be constructed.
- 3) Twenty-four (24) 220kV, fifteen (15) 132kV and six (06) 66kV current transformers (CTs) are outdated and under-rated.
- 4) Fifteen (15) 220kV, twenty-four (24) 132kV and six (06) 66kV surge arresters are old and under-rated and need replacement.
- 5) The following tests have not been 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)
  - c. SF6 purity and moisture content test for 220kV and 132kV circuit breakersIt is necessary to conduct all tests timely to ensure healthiness of the equipment.
- 6) Seventeen (17) 220kV and forty-four (44) 132kV isolators are under-rated and need replacement.
- 7) Detailed oil testing reports show abnormal moisture content in the oil of transformers T4 and T5 which is hazardous for the life of the transformers.
- 8) Both Gatti-Nishatabad 220kV circuits are loaded above 80% during peak load season.

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- 9) Sequential event recorders and fault recorders are not functional. Voltage and power recorders are out of circuit 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.
- 10) Tele-protection (PLC aided) and direct transfer trip (DTT) is not available on 220kV transmission circuits. DTT is required for remote end tripping on “Breaker Failure Scheme” when there is no guarantee that relaying at remote line terminals will actuate quickly enough to minimize consequential damage.
- 11) Around two hundred and ninety nine (299) important relays such as distance to fault locator, thermal overload protection, back-up earth fault protection, neutral over-current and trip lockout relay, etc are not installed at the GS. The existing relay panels are short of space to house additional relays, wiring, ancillary equipment, etc. (For details see Annex B and D). It is recommended that NTDC may draw up a plan aimed at “Remodeling” the entire grid station with specific attention given to the “Switchgear” and “Protective gear”.
- 12) Auto-reclosers on almost all 220kV and 132kV transmission lines are blocked. Auto-reclosers can significantly reduce the outage time, reduce transmission line damage and thus provide higher service continuity.
- 13) Spare parts are not available for seven (07) 220kV CBs and eighteen (18) 132kV CBs for future overhauling.
- 14) Thermovision survey of the GS has not been carried out. Both the 220kV bus bars are under-rated and need replacement with Hawthorn twin bundle conductor along with all connectors and other hardware in all 220kV line and transformer bays. The existing 10 meter high gantry columns of both 220kV bus bars will have to be extended by 3 meter along with replacement of existing beams with 18.5 meter beams per design specifications. PT and CVT of bus bar are outdated and need replacement with CVTs of appropriate capacity.
- 15) Tower No. 2, 3, 4, 5, 7 and 8 of 220kV Nishatabad - Gatti circuit 1 and 2 require retaining walls for protection of tower foundations that are affected due to water flow and encroachment of residents as the line passes through thickly populated area. Thermo vision survey of all the transmission lines emanating from this GS has not been carried out.
- 16) The clearance of 220kV Nishatabad-Summandry road circuit 1 and 2 is inadequate and dangerous in the spans of tower No. 597/598, 599/600, 610/611 & 611/612 which needs

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to be improved by installation of additional or extended towers or tubular poles. The line from tower No. 590 to 616 passes through thickly populated area and needs re-routing using tubular poles. The tower foundations at location No. 579, 580 & 587 are vulnerable and require protection walls.

### Recommendations:

<b>Transmission and Grid</b>			
Sr. No.	Finding	Recommendations	Remarks
1	Overloading of 220/132kV transformers. Transformers T1 and T2 are lying damaged	Proper load flow studies need to be conducted. The damaged T1 and T2 need to be replaced with higher capacity transformers i.e. 160MVA along with their auxiliary panels. For interim arrangement, one 100 MVA- 220/132 kV General Electric make transformer is present at Nishatabad GS that may be installed in place of damaged T1 or T2.	It is recommended that NTDC may draw up a plan aimed at "Remodeling" the entire grid station with specific attention given to the "Switchgear" and "Protective gear".
2	Detailed oil testing report shows abnormal moisture content in the oil of transformers T4 and T5	Hazardous for the life of the transformers. Recommended for dehydration on priority	
3	The foundations of existing transformers and other equipment are not adequate for installation of higher capacity transformers and their allied equipment.	New foundations/ rehabilitation for transformers and all allied equipment need to be constructed.	
4	Twenty four (24) 220kV, fifteen (15) 132kV and six (06) 66kV current transformers (CTs) are very outdated and under-rated. C&DF test for all CTs and CVTs has also not been done.	All the CTs are required to be replaced with appropriate capacity. All these tests should be carried out to ensure healthiness of equipment.	
5	Fifteen (15) 220kV, twenty four (24) 132kV and six (06) 66kV surge arresters are very old and under-rated. LCM test of all the surge arresters has not been done.	All the surge arresters need replacement with appropriate capacity. All necessary tests should be carried out to ensure healthiness of equipment.	

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6	Seventeen (17) 220kV and forty four (44) 132kV isolators are under-rated.	All the isolators need replacement with appropriate capacity.	
7	SF6 purity and moisture content test for 220kV and 132kV circuit breakers not done	It is necessary to conduct all tests timely to ensure healthiness of the equipment.	
8	The Gatti-Nishatabad 220kV circuits are loaded above prescribed limits i.e. 80% per NEPRA grid code during peak load season	Proper load flow studies need to be conducted and necessary action to be taken to reduce this loading.	
9	Spare parts for twenty five (25) CBs are not available for future overhaul.	Spare parts for seven (07) 220kV CBs, and eighteen (18) 132kV CBs should be arranged for future internal inspection/major overhaul.	
10	Retaining walls are missing for six (06) towers of 220kV Nishatabad-Gatti circuit 1 & 2. Thermovision survey of all transmission lines is not done.	Retaining walls for these towers should be constructed to safeguard the tower foundations against flowing water. Thermovision survey needs to be carried out on priority basis to avoid major breakdowns.	
11	Clearance in four spans of 220kV Nishatabad-Summandry road circuit 1 & 2 is dangerous. Retaining wall is missing for three towers and some portion of line is passing through thickly populated area.	Clearance needs to be improved by extended towers or tubular poles. Retaining wall at required locations should be constructed and the portion of line passing through thickly populated area needs rerouting.	

<b>Protection</b>			
Sr. No.	Finding	Recommendations	Remarks
1	Tele-protection (carrier aided) tripping facility is missing on almost all 220kV lines. Inoperative direct transfer trip (DTT) 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	

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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 make them operative. 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	Absence of thermal overload protection relays on transformers	Thermal overload protection has a vital role against sustained overloading. Hence recommended to be installed and configured precisely.	
5	Replacement of faulty, blocked and missing relays.	Approximately two hundred and ninety nine (299) important relays are missing at this GS. It is recommended that NTDC may draw up a plan aimed at "Remodeling" the entire grid station with specific attention given to the "Switchgear" and "Protective gear".	
6	Auto reclosing is inactive for all 132kV circuits.	"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	
7	Tie protection is not active on all 220kV circuits	It is strongly recommended to make it active	
8	Cross trip scheme is blocked.	Recommended to be installed for protecting the system from total collapse due to overloading. NTDC needs to look into the issue for system stability.	

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General			
Sr. No.	Finding	Recommendations	Remarks
1	Thermovision survey of GS is not done. Both the 220kV bus bars are under rated along with PTs. Gantry columns of same bus bars are also not up to the mark.	Thermovision survey needs to be carried out to avoid any major breakdowns	

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