NTPC TANDA WELCOMES

DELEGATES OF O&M CONFERENCE-2013
GENERATOR TRANSFORMER #2 REFURBISHMENT
ABSTRACT

# Generator transformer - critical component of any gen unit.

# Reliability and availability must be as high as possible, since without the generator transformer, unit output cannot be made available to the transmission network.

# Causes of failure – External & Internal.

# External causes – mainly to grid conditions normally beyond control.
ABSTRACT

# Internal causes – like bushing failure, ageing of solid & liquid insulation, internal faults in winding, leads or core etc.

# LV tests – mainly indicates healthiness from electrical side.
ABSTRACT

# RLA test – DP, SFRA, Furfural Analysis, DGA, Paper moisture assessment etc indicates mechanical integrity and insulation healthiness.

# Though the above test generally ensure healthiness other reasons may also cause failure of GT as in this case.
# NTPC TANDA - 4 x 110 MW UNITS

# NGEF MAKE - 125 MVA, 220KV GRADE, GEN TRF.

# RLA TESTS & DGA CARRIED OUT FOR ALL GT’S.

# NO MAJOR DEVIATION IN RLA TESTS.
CASE STUDY – GT2 FAILURE

# Generator Transformer#2 tripped on buchholz operation on 20/08/2011.

# High acetylene content was found in Gas & DGA sample.

# This indicated suspected Internal fault with high temp arcing. Internal inspection decided.
INTERNAL INSPECTION
FINDINGS

# Internal Inspection carried out jointly with TELK (NTPC JV).

# Charred insulation paper was observed on the inner edge of the stress suppressing shield of R-phase HV bushing on both ends.
INTERNAL INSPECTION

FINDINGS contd....

# Dark coloured particles were observed at the top of the upper hoof, tap changer and in lower tank.

# Open cylinder (outer cylinder) and axial spacers were found loosen.
OBSERVATIONS

# LV tests were carried out on the Transformer. The values were same as the previous results.

# This indicated that Transformer was electrically healthy with regard to winding/core etc.
ROOT CAUSE ANALYSIS

#Insulation failure of HV bushing Stress shield was caused due to Localized heating by high eddy currents.

#Localized high eddy currents were caused due to high concentration of magnetic flux in that area.
ROOT CAUSE ANALYSIS

#Magnetic flux concentration will be localised in particular area if the current carrying conductor is very near compared to other portions.

#The current carrying conductor is bushing lead which is flexible and normally held firmly in center position of stress shield by clamping bolts.
ROOT CAUSE ANALYSIS

# Localised concentration of magnetic flux caused due to misalignment of bushing lead from the center of Corona shield.

# Lead got misaligned from the center due to loosening of clamping bolts of stress shield.
Refurbishment Activities

#Refurbishment carried out in association with TELK. Windings/core and inner tank were thoroughly washed with hot transformer oil to remove carbon dust/sludge/dirt etc.

#Outer insulating cylinders were tightened with new tetron tapes and strings. Axial spacers positions were corrected and tightened.
Refurbishment Activities contd..

# Re-insulation of R-Phase Stress shield was done with dried and impregnated crape paper.

# Tightness of clamping bolts of stress shield with clamping structure ensured after placement of shield in position.

# Further, at the time of Bushing Erection, it was ensured that bushing lead is in middle position.
# Refurbishment Activities

- All the old gaskets were replaced with new ones.

- Leakage test of transformer was done at a pressure of 0.3 ksc with Nitrogen gas for 24 hours.

- Trapped moisture removal of winding was done by vacuum pulling.
Low vapour pressure under vacuum, evaporates trapped moisture of winding gradually. The evaporated moisture is further absorbed by moisture deficient nitrogen. (Dew point less than minus 40 deg at the time of filling)

After 24 hours, the dew point of nitrogen is measured and the rise in dew point indicates the moisture condition inside transformer winding.
# The left out moisture was removed through oil filtration process after filling the oil inside transformer.

# Transformer was made ready for service after oil filtration and electrical testing.

# Transformer has been put in service during Unit#2 Major R&M in Sep 2012 and since then, it is working satisfactorily.
LEARNINGS

- RLA Tests Like DP, SFRA etc & DGA reflect the general healthiness of transformer. But they are not enough to assure continuous operational reliability.

- Internal inspection is advised to assess the conditions which are not reflected in RLA, DGA specially during capital O/H after a period of 10 years of Operation.
LEARNINGS

✓ Internal inspection also helps to take preventive measures for prospective problems like loose insulating axial spacers as in this case.

✓ Measurement of various vital clearances should be taken during dismantling or replacement of major components like bushings etc.

✓ These clearances shall be maintained during reassembly to ensure reliable operation of transformer.
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THANK YOU
INSULATION DAMAGE AT OUTER EDGE
INSULATION DAMAGE AT INNER EDGE
INSULATION REMOVED AT BOTH EDGES
TETRON TAPES, TYING INSULATING CYLINDERS
LOCALISED HOT SPOT DUE TO EDDY CURRENT

HV LEAD MISALIGNED FROM CENTER

CLAMPING BOLTS OF STRESS SHIELD
INSULATION DAMAGED DUE TO LOCALISED HEATING
ELECTRICAL TESTS

1. INSULATION RESISTANCE
2. TURN RATIO
3. MAGNETISING CURRENT
4. MAGNETIC BALANCE
5. SHORT CIRCUIT TEST
5. TAN DELTA
6. WINDING RESISTANCE