A CASE STUDY ON FAILURE OF DRY TYPE TRANSFORMERS IN DISTRIBUTION SYSTEM

by

B.S. RAJPURUHIT, GAURAV SAVLA, NAUSHAD ALI, P.K. PANDA, S.K. KAUL, H. MISHRA*

ENGINEERING SERVICES GROUP, BHABHA ATOMIC RESEARCH CENTRE (BARC)

e-mail *: hmishra@barc.gov.in
Possible causes cited for failure of the dry type transformers are:

- Heating due to load or harmonic loading.
- Voltage Surges.
- Persistent over voltage.
- Unequal distribution of voltage stress among coils.
- Partial discharges.
- Insulation degradation due to environmental conditions like dust, moisture etc.
Failure due to heating and hot spot is found to be very rare because:

- Tendency to over design or over specify
  – *Activate moisture due to low temperature.*

- Ventilation of coil compartment to remove heat
  – *Allow ingress of dust.*
Case study 1:

Rating of transformer: 2000KVA, 33KV/433V

Maximum load recorded before failure: 180KVA

Nature of load: construction power supply equipments, lighting and control systems

Type of fault annunciated: Short circuit detected by numerical relay

Case study 2:

Rating of transformer: 300KVA, 11KV/433V

Maximum load recorded before failure: 30KVA

Nature of load: lighting and ventilation

Type of fault annunciated: Short circuit detected by numerical relay
Single line diagram
2000 KVA, 33/0.433 KV Transformer

2000 KVA, 33/0.433 KV Transformer
300 KVA 11/0.433 KV, Tr 300 KVA 11/0.433 KV, Tr
Causes of Failure

- **Overloading**: The maximum loads recorded are 180 kVA and 179 kVA. Failure due to overload induced heating may be excluded.

- **Harmonics heating**: The loads on transformer are conventional lighting and motor loads. Harmonic induced heating may be excluded.

- **Voltage surge**: There were no immediate VCB operation before the fault. The MOV surge arresters provided near 33 kV were found healthy. Switching induced voltage surge may be excluded.

- **Persistent overvoltage**: Voltage were regularly monitored by maintenance staff and also HV winding tap selection was at (-1.5%) for lighting loads. Overvoltage was not a concern.
• **Partial discharges**: Failure due to internal partial discharge was also a possibility. It could not be ruled out from visual symptoms after failure. However, partial discharge test at manufacturers works after cleaning of the coils (other than the damaged ones) was found to be well within limit (2pC to 2.5pC).

• **Insulation degradation due to environmental condition**: Failures were during monsoon with humidity averaging 90% and temperature averaging 30 degree C. Construction site atmospheric air was dust laden. Continuous operation of exhaust fan even during light loads ensured ingress of dust and moisture. Visual inspection suggested that tracking on HV cast coil surface might be the cause.

The exposed off line taps (OFTC) can provide the required poles with potential difference for tracking.
Followed up action

• Both the core coil assembly (Tr 2 and Tr 4) were sent to factory for investigation and replacement.

• Healthy transformers (Tr- 1 and Tr-3) were taken for shutdown one after another. Coil surfaces were cleaned thoroughly with vacuum cleaners.

• Additional heater were installed inside transformer rooms. The exhaust fan were switched OFF for light load operation.

• Louvers were provided with coarse filter.

• Regular inspection of enclosure internal and core coil assembly was undertaken.

• Both the transformer along with repaired ones are operating till date.
Simultaneous effect of humidity, dust and low temperature of a Dry type transformers
Recommendation:

- The dry type transformer room should be relatively clean and away from construction site.
- Transformer enclosure should have louvers with filter.
- The transformer room should not have openings for entry of unrestricted air.
- Distance between off circuit tap positions in dry type transformer can be enhanced.
- Dry type transformer also need regular inspection, maintenance and cleaning.
Conclusion

Insulation degradation due to combined effect of dust, humidity and low temperature is a concern to be addressed suitably.

Environment of installation and type of ventilation have role in degradation of insulation.

Dry type transformer is to be used only when demanded due to indoor application or for fire hazard consideration.
Thanks