Safe, Reliable & Efficient DT - The Quality Journey of CESC

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Importance of DT

• Distribution transformers are by far the most numerous and varied types of transformers used on the electricity supply network.
• Nearest to the Consumer & any failure will affect the customer first.
• Since mostly installed in public places, the safety aspect is very important.
Present Scenario

• For smaller units, manufacturing methods are like mass production industries.
• The industry is highly competitive and the margin is very small.
• Maintaining quality is a major issue.
• Three things must be ensured –
  – SAFETY
  – RELIABILITY
  – EFFICIENCY
SAFETY

3 People Taken to Hospital

A major fire took place in the first floor of a building in Delhi. The fire alarm was triggered by a short circuit in the electrical system. The fire department was called and they quickly extinguished the fire. However, three people were taken to the hospital due to smoke inhalation and minor burns.

Safety measures:
- Always follow the fire evacuation plan.
- Keep emergency exits clear and unobstructed.
- Use smoke detectors and fire alarms to alert everyone in case of a fire.
- Practice fire drills regularly to ensure everyone knows what to do in case of an emergency.
“Safety First” - Why

Impact of an Accident –

• Loss of life / injuries.
• Impact on Society and Environment.
• In many cases serious accidents resulted in negative consequences for the employees and the general public.
• Financial losses to industry.
• Loss of image / goodwill of an organization.
Ensuring Safety for DT

- Fully covered design with no exposed part
- Coordinated Fuse protection between HT & LT
- Dry type DT / Retro-filling with Ester oil
- Strengthening of Tank – sheet thickness, less welded joints, stiffener for large body surfaces.
- PRV / Vent Pipe / Splash Guard / Air vents
- Strong HT door with multiple locking
- Providing Safety Guard Railing
Fully Covered Design

DRY TYPE

OIL TYPE
HT & LT Fuse

HT Fuse Fixing Arrangement (HT FFA)

LT Combined Fuse Switch Unit (LT CFS)
Ester Oil Filled DTR

1) Increased Fire Safety
K-Class high fire point (>300°C)
100% fire safety record

2) Higher Performance
More moisture tolerant
No corrosive sulphur

3) Environmental Protection
Biodegradable
Non-toxic and less hazardous
Strengthening of Body
Pressure Relief

- Vent Pipe
- Explosion Vent
- Cable Box Air Vent
- Splash Guard
- PRV
- Wire Mesh
Safety Railing

Earlier Practice - Unsafe

Present Practice – More Safe
Society is highly dependent upon electricity.

Customers are reacting even to a short period of outage, specifically in urban areas.

Awareness on power quality has increased.

Media is highlighting small disturbances also.

Reliability cannot be added to a system at a later stage, it has to be incorporated from the procurement / installation stage itself.
Improving Reliability

- Proper specification for new as well as for repairs. Standardisation of drawings / spares.
- Vendor evaluation before placing orders.
- Inspection & testing (Routine/Type) at stages during manufacturing & after delivery. Warranty for 5 years.
- Audit / checking after installation at site.
- Condition Monitoring & timely rectification.
- RCA for each failure and carry out CAPA.
Specification & Standardisation

• Proper drawings. Capacity 315 -> 400 -> 500 kVA
• Standard spares – Bushings, Connectors, etc.
• Active part – M4 or better core, Cu winding, Current density < 2.8 A / mm², Nomex paper (class-C), Insulation class-H, 8 Tie rods, Proper Core clampings, etc.
• Temp. rise 115⁰C above 50⁰C ambient (Dry type).
• Stainless steel hinges, Zinc plated nut-bolts.
• Gaskets / conical washers of reputed make.
• Outside (Epoxy) & inside (Oil resistant) painting.
Vendor Evaluation

- Checking the credentials, customer feedback.
- Factory inspection – Infrastructure, Manpower, Quality Assurance, Housekeeping.
- Financial strength. BIS certification
- Delivery capability. Distance from the city.
- Execution of a trial order.
- Quarterly review meeting with the Vendors.
- Internal rating system based on preset criteria.
Inspection & Testing

• Stage inspection – (1) Tank & Active part : not for all batches (2) After assembly.
• Routine Test at works for all DTs & sample Temperature Rise Test for one batch.
• 100% acceptance test after delivery at CESC.
• Sample Temperature Rise Test at Godown.
• For a new design, sample Short Circuit Test at 3rd party Lab (CPRI / ERDA) at CESC’s cost. If failed, the DT should be repaired FOC & cost of the next test will be borne by the vendor.
Installation at Site

After installation at site, following to be confirmed:

- Proper plinth / structure for the DT.
- All nut bolts fitted properly (no case of missing).
- Body Earthing is properly done.
- Cables are properly clamped and there is no openings through the gland plate.
- No oil leak, oil level OK and breather is healthy.
- No corroded parts, painting is satisfactory.
- Metering system is working properly.
Monitoring & Maintenance

• Annual schedule – Physical checking, Partial Discharge measurement & Thermal Imaging.
• Attending the defect, within time, as per SLA.
• External painting at site - once in 7 years.
• On-line Load & PF monitoring / reporting.
• Breakdown maintenance, on immediate basis.
• After return from site - Overhauling at godown or repair at works, as per the requirement.
RCA & CAPA

• Reason behind each fault is being analysed.
• Corrective actions taken on immediate basis.
• Preventive actions are planned and communicated to all concerned for rectification within a definite timeframe.
• The issues are being discussed in the sectional review meetings (monthly) and in the review meetings with the Vendors (Quarterly).
• Modifications are incorporated in the spec.
Growth Chart & Failure Rate

Population Growth Rate of Distribution Transformer-Year wise

Failure Rate of Distribution Transformer-Year wise

HT Fuse incorporation
Specifications elaborated
Spares standardised
First Dry DT
Detailed Drg. prepared
Life Cycle Mgmt. System Developed
Regular CBM started
EFFICIENCY

• Distribution Transformers contribute almost 30% of the distribution loss.
• There is a scope of huge savings by reducing the loss through efficiency improvement.
  – 19% reduction in loss is possible.
  – Till 2030 annual energy savings will be 95 TWh.
  – Cumulative savings is in the tune of Rs. 56,000 Cr.
  – 13.3 million tons annual reduction of CO2
What We Did

• Standardised Cu winding. Checking of Cu quality / certificates from the suppliers.
• Loss Capitalisation.
• Regular Loss measurement on random basis.
• BIS Level-2 losses for Dry type DT.
• Reduction of losses for repaired transformers.
• Reduce overloading / unbalanced loading through constant monitoring.
• Installing APFCs at areas with low PF (< 0.85)
Copper Winding

- Inherent low loss material.
- Better Conductivity, Low Resistance, Good Thermal Conductivity, etc.
- More capable to withstand short circuit force, improves reliability of the transformer.
- Easy availability with competitive pricing.
- Can be re-used / re-cycled.
- At the end of life, will have a resale value.
Loss Capitalisation

• Procurement based on Total Owning Cost.
• Life of a transformer assumed as 25 years.

Regular Loss Measurement

• Done on a regular basis at godowns.
• Temperature rise test also carried out to verify the capacity.
Loss for new DRY type DT

• Level-2 loss, as mentioned in IS 1180.
• As an effect, the size of the tank could be reduced slightly.

Loss for repaired OIL type DT

• Try to replace the old core (with high loss).
• If core is renewed the same Level-2 losses are applicable.
• Otherwise the losses will reduced as far as practicable.
Load Monitoring

DT Metering System

KARUNAMOYEE GHAT RD (S) P/T [400 Kva]
Source Code: 0244830
Meter No.: 55477075
Meter Reading Date: 03/11/2018
Meter Installation Date: 24/08/2018
Meter Removal Date: NA

Chart Option

Mode: Custom
Period from 17/07/2018 to 24/08/2018

Voltage
- R ✓ 227
- B ✓ 232
- Y ✓ 230

Current
- R ✓
- B ✓
- Y ✓
- 420
- 386
- 430

Demand
- kW ✓ 279
- KVA ✓ 289

Date / Time
- 19/07/18 (21:30)
APFC

Sensing through CT

Load to Compensate

The APFC Panel
The Journey Continues

Hermetically sealed transformers -
   – The oil cannot come into contact with the air
   – Reduced maintenance
   – They occupy smaller space.

Transformers without taps -
   – Eliminated the weakest part
   – Short circuit strength increased

Compact Transformer –
   – Less joints, less chances of corrosion
   – Space saving with a better aesthetic look
Sealed Type Transformer

Compact Transformer
The Journey Continues

Online Monitoring for Critical DTRs (Trialed successfully) –