Two Decades Experience on Nitrogen Injection based Explosion Prevention and Fire Extinguishing System

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By:
A. H. Bhardwaj
Two Decades Experience on Nitrogen Injection based Explosion Prevention and Fire Extinguishing System

- CIGRE 537, GUIDE FOR TRANSFORMER FIRE SAFETY PRACTICES A2.33 PUBLISHED IN JUNE 2013.

- NFPA 70/ NFPA 850/ NFPA 851

- POWER TRANSFORMER STANDARDIZATION MANUAL OF IEEMA (INDIAN ELECTRICAL AND ELECTRONICS MANUFACTURERS ASSOCIATION).

- MANUAL OF TRANSFORMER BY CBIP (CENTRAL BOARD OF IRRIGATION AND POWER)
Explosion Or Explosive Failure Is A Technical Term Often Used In Connection With Transformer Failure, Resulting From A Pressure Build Up From Short Circuit /Arcing Causing Rupture Of Bushing Porcelain, A Cable Box , A Tapchanger Or The Transformer Tank.
Two Decades Experience onNitrogen Injection based Explosion Prevention and Fire Extinguishing System
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Technologies Available world wide:

- Rupture Disc Technology
- Differential Based Technology
- ARC Sensor based Technology
- High velocity water spray system Technology
Figure 18: Transformer equipped with a 40 rupture discs depressurization system
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If we summarised the concept using multiple rupture discs, it is observed that 8 rupture discs are required to reduced 30% of the peak pressure:

Table 15: Pressure reducing effect of multiple rupture discs

<table>
<thead>
<tr>
<th>Arcing position</th>
<th>Tap changer</th>
<th>Upper winding part</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exhausted pressure (kPa)</td>
<td>Peak pressure on the tank wall (kPa)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1480</td>
</tr>
<tr>
<td>2</td>
<td>70</td>
<td>1410</td>
</tr>
<tr>
<td>4</td>
<td>250</td>
<td>1230</td>
</tr>
<tr>
<td>6</td>
<td>286</td>
<td>1194</td>
</tr>
<tr>
<td>8</td>
<td>446</td>
<td>1034</td>
</tr>
</tbody>
</table>
6.7.4 Tank Protection Systems Based on Rupture Discs and Nitrogen Injection

One supplier of transformer fire protection equipment which has carried out extensive research into transformer fire protection offers a combined transformer pressure relief/fire protection system. The pressure relief part of their system utilizes a single or multiple rupture discs for pressure relief on main tank (depending on customer willingness to invest) and separate rupture discs for pressure relief on the tap changer tank and each cable box. The system comprises, a conservator shut-off valve, pipe work and a holding/separation tank for collection and separation of the vented oil and explosive gases, and nitrogen injection equipment for injection of nitrogen into the base of the main tank for evacuation of the explosive gas after the tank explosion has been avoided. The purpose of the nitrogen injection is to also to stir the oil and extinguish a fire, in the event the tank has ruptured and a fire has been initiated. The size and the number of the rupture discs will vary depending of fault level and tank design parameters, but each rupture disc is generally less than 30 cm in diameter because it is difficult to adapt larger discs to standard transformer tank design.
A.5.1.4.2(9) Oil-filled transformer explosions and fires can be prevented in some cases by the installation of a passive mechanical system designed to depressurize the transformer a few milliseconds after the occurrence of an electrical fault. This fast depressurization can be achieved by a quick oil evacuation triggered by the dynamic pressure peak generated by the short circuit. The protection technology activates within milliseconds before static pressure increases, therefore preventing transformer explosion and subsequent fire. However, since these devices do not eliminate a fire potential resulting from all forms of transformer failure (e.g., transformer bushing failure), they should be considered as a possible supplement to passive protection features such as physical barriers or spatial separation, not as an alternative to these features.

NFPA 850 2015 Edition:
Transformer is the origin of the fire: Where a transformer may catch fire, i.e. causing the fire.

Transformer as a Fire Victim: The transformer can become a victim to a fire started elsewhere. If an external fire is given sufficient time to heat up the transformer liquid so much that the liquid is spilled over via the conservator, then the external fire will be strengthened if the transformer is oil filled or contains other combustible liquid.

SOURCE: CIGRE 537 GUIDE FOR TRANSFORMER FIRE SAFETY PRACTICES
Guideline and recommended practices to be followed to avoid:
TRANSFORMER TANK AND OLTC
SYSTEM FOR TRANSFORMER TANK AND OIL FILLED CABLE BOXES
Features:

- **Auto Prevention Mode**
- **Auto Extinguishing Mode**
- **Remote manual Mode**
- **Local manual Mode**
Performance of Fire Protection:

Recent Incident of System operation

System operated at 220kv Sub-station Patpargunj DTL.

System operated at 220kv GSS Mehrauli.
SYSTEM COMPRISES OF

- Cubicle
- Control Box
- Signal box
- Transformer Conservator
- Isolation Valve
- Fire Detectors

REF NR :
Inner view of Fire Extinguishing Cubicle (FEC)
CONTROL BOXES
TRANSFORMER CONSERVATOR ISOLATION VALVE
FIRE DETECTOR
60MVA INDONESIA
INSTALLATION IN MALAYSIA
INSTALLATION IN MALAYSIA
INSTALLATION IN MALAYSIA
INSTALLATION IN PERU
INSTALLATION IN SYRIA
INSTALLATION ON GT IN VENEZUELA
INSTALLATION IN SYRIA
INSTALLATION IN ECUADOR
SOME MAJOR CUSTOMERS
Thank you
Ashish Bhardwaj
9982741872
CTR Mfg Ind Ltd
jfp11233@ctr.in