**Question: How to Identify a Proven Transformer Explosion Prevention Device?**

**Answer:**

When an electrical arc occurs, a huge volume of explosive gas is created during the first millisecond, 2.3 m³ (81.2 ft³) for the first mega joule. This gas generation creates a First Dynamic Pressure Peak with an amplitude potentially greater than 10 bars (145 psi), which travels in the tank at the speed of sound inside oil, 1,200 m/s (3,937 ft/s). The First Dynamic Pressure Peak reflects on components inside the tank, increasing the static pressure inside the tank within 10 to 100 milliseconds, depending on the size of the transformer. As transformers are not designed to withstand a steady-state relative pressure greater than 1 bar atm (14.5 psi), these tanks quickly explode within 200 to 400 milliseconds of the static pressure increase.

Protection of transformers against explosion is not an easy challenge. Since 1995, SERGI followed exhaustive and constant investigations for discovering the fundamental parameters to prevent transformer tank explosions, which involves very high level non-conventional mechanics and physics. SERGI has published 59 scientific articles around those topics since 1999. The list of articles is available upon request.

**As it is not easy for customers to understand all phenomena surrounding the generation of the dynamic pressure, the resulting increase in the static pressure and the fast depressurization systems without a large investment of time, some companies are falsely claiming to sell technologies that avoid transformer explosions.**

Therefore, customers willing to install Explosion Prevention systems on transformers should be aware of the key parameters to identify technologies that may not be capable of avoiding transformer explosions.

The appended table is intended to help evaluating Transformer Explosion Prevention technologies to assist the appraiser in evaluating whether the proposed system complies with the basic Fast Depressurization technical specifications during a transformer short-circuit.

**TABLE FOR IDENTIFYING A PROVEN FAST TANK DEPRESSURIZATION DEVICE**

|  |  |  |  |
| --- | --- | --- | --- |
| ***No*** | ***DESCRIPTION*** | ***REQUIRED*** | ***GUARANTEED*** |
|  |  |  |  |
|  | ***Explosion Prevention System on Transformers and Reactors*** |  |  |
|  |  |  |  |
| ***A*** | ***Fast Depressurization System*** | ***Yes*** |  |
| ***A.1*** | ***Complies with NFPA 850, 2015 Edition*** | ***Yes*** |  |
| ***A.2*** | ***"Passive - Mechanical" activated without sensors or electrical actuators*** | ***Yes*** |  |
| ***A.3*** | ***The Company manufacturing Fast Depressurization systems should at least have 10 years of experience in transformer explosion prevention*** | ***Yes*** |  |
|  |  |  |  |
| ***B*** | ***Depressurization Set (DS) with Rupture Disk (RD) for all transformer or reactor elements***  | ***Yes*** |  |
| ***B.1*** | ***Tank*** | ***Yes*** |  |
| ***B.2*** | ***On Load Tap Changer (OLTC)*** | ***Yes*** |  |
| ***B.3*** | ***Oil Cable Box (OCB) / Oil Bushing Cable Box (OBCB) or Bushing Turrets (BT)*** | ***Yes*** |  |
|  |  |  |  |
| ***C*** | ***Additional depressurization functions to avoid the bazooka effect*** | ***Yes*** |  |
| ***C.1*** | ***Inert Gas Injection Set (IGIS)*** | ***Yes*** |  |
| ***C.2*** | ***Oil-Gas Separation Tank (OGST)*** | ***Yes*** |  |
| ***C.3*** | ***Explosive Gas Evacuation Pipe (EGEP)*** | ***Yes*** |  |
|  |  |  |  |
|  | ***Mathematical Modeling of Transformer Explosion Physics and Explosion Prevention Technology*** |  |  |
|  |  |  |  |
| ***D*** | ***A multiphysics model, developed based on live arcing tests, which can determine the depressurization time for a transformer tank, given a specific electrical arc energy*** | ***Yes*** |  |
| ***D.1*** | ***Computational Fluid Dynamics (CFD) simulations to model the pressure rise due to an arc, and depressurization of the tank by the explosion prevention system*** | ***Yes*** |  |
| ***D.2*** | ***Fluid Structure Interaction (FSI) simulations to account for energy dissipated by the tank structure, and determine whether the tank is likely to rupture*** | ***Yes*** |  |
|  |  |  |  |
| ***E*** | ***Certification of tests with electrical arcs inside oil-filled, sealed transformers or reactors by an independent High Voltage Laboratory from a country different than the country of the manufacturer*** | ***Yes*** |  |
| ***E.1*** | ***Twenty - Five (25) Successful Live Tests*** | ***Yes*** |  |
| ***E.2*** | ***Three (3) Tests must be with electrical arcs of more than 1 Mega Joule*** | ***Yes*** |  |
|  |  |  |  |
|  | ***Successful Activations during the transformer or reactor operation*** |  |  |
|  |  |  |  |
| ***F*** | ***Successful Activation Certificates signed by the owner of the transformer or reactor*** | ***Yes*** |  |
| ***F.1*** | ***Eight (8) Certificates from at least six (6) different countries***  | ***Yes*** |  |
|  |  |  |  |
|  | ***Insurance Policy*** |  |  |
|  |  |  |  |
| ***G*** | ***Insurance Policy for more than ten (10) million US dollars (USD) for the entire life of the Fast Depressurization System covering damages in case of transformer or reactor explosion equipped with the Fast Depressurization System.*** | ***Yes*** |  |