

Task Force on Tank Pressure Coordination

April 11, 2011

3:15 PM – 4:30 PM

Catamaran Resort Hotel San Diego, California

Chair: Carlos Gaytan

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Secretary: Justin Pezzin



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Old Business

Summary of Fall 2010 meeting in Toronto:

- Static Pressure Requirements:
 - Comparison table of Static Pressure and PRV requirements for Distribution Transformer Standards
 - Editorial and unit notation inconsistencies resolved
 - Based on C57.144-2004, IEEE Guide for Metric Conversion of Transformer Standards
 - Defined proposed standardized text for PRV requirements
 - Research on Tank withstand and transformer internal pressures
 - Motion approved to complete TF work as informative annex
 - Discussion on PRV flow for large distribution transformers
- Dynamic Pressure Requirements:
 - Marcel Fortin volunteered to present a summary of the current internal arcing fault test protocols and their applications.

Old Business

- Static Pressure Requirements (Update):
 - Comparison table: Added the following standards:
 - C57.12.36-2007 Distribution Substation
 - C57.12.10-2010 Power Transformers (published Jan. 2011) 
 - C57.12.36 requires PRV for 2500 kVA and below and PRD for above 2500 kVA
 - C57.12.10 requires only PRD
 - No other Distribution Standard requires PRD
 - PRD are mainly specified by users on transformers 1000 kVA and larger
 - Significant difference between PRV and PRD flow rates 
 - Distribution Transformer Standard with scopes for larger units:
 - C57.12.34-2009 Increased scope from 2500 kVA to 5 MVA. Plan to have PAR approved to further increase scope to 10 MVA

Old Business

- Static Pressure Requirements (Proposed Next Steps):
 - Provide recommended editorial changes to WG Chairs of Distribution Standards:
 - For Pressure Relief (PRV and PRD)
 - Include consideration of PRD on new PAR of C57.12.34, based on definition of C57.12.36
 - Evaluate Flow rate requirements. Request participation of representatives of PRV/PRD as well as transformer manufacturers
 - For Tank Withstand:
 - Provide specific inputs for editorial and unit notation corrections
 - Complete documentation of research as informative annex (or Guide). Request for Volunteers to review before Fall 2011 meeting

New Business:

a) Dynamic Pressure Requirements:

i. Presentation: Arcing test in distribution transformers

b) Coordination with WG Tank Rupture & Mitigation PC57.156

New Business:

b) Coordination with WG Tank Rupture & Mitigation PC57.156

- Task Force formed in 2005 to discuss transformer tank design to limit risk of tank rupture due to internal faults.
- Published paper: "Power Transformer Tank Rupture and Mitigation—A Summary of Current State of Practice and Knowledge by the Task Force of IEEE Power Transformer Subcommittee" Dated Oct. 2009
- In Nov. 2010 PAR was approved. Objective of WG is to develop a guide to form a bridge between users and manufacturers
- Steve Shull asked Bill Bartley (Stds. SC Chair) whether there could be a conflict of scope or if DTs should be considered on the scope of the WG
- Today held first Meeting as a WG:
 - Current draft of the guide was discussed
 - A lot of discussion. What data should the users specify about fault energy levels for each voltage class?
 - Recognized that some users were well informed, while the majority not
 - Consultants stressed the fact that the guide was much needed
 - Determination of the energy levels is critical

Next Meeting

- Fall 2011: October 30 to November 3 - Boston, Massachusetts USA
- Pending Tasks to be completed by next meeting:
 - Static Pressure:
 - Report on proposed wording inputs to WG chairs
 - Evaluation of Flow rate requirements for PRV and PRD
 - Review first draft of informative annex (or Guide)
 - Dynamic Pressure:
 - Additional discussion on arcing test in distribution transformers
 - Potential Next Steps (User survey?)
 - Present summary of draft from WG Tank Rupture & Mitigation
 - Main factors being considered
 - Synergy opportunities for this DT Task Force

Current Requirements on Distribution and Power Transformers Standards

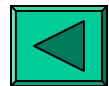
Standard	Static Pressure	Pressure relief device
<p>Overhead type C57.12.20-2005</p>	<p>7.2.5.2 Cover assembly A cover assembly designed to relieve excess pressure in the transformer tank shall remain effectively sealed for overloads and external secondary short circuits of the magnitude and duration allowed by industry standards and loading guides. The assembly shall relieve pressure at a minimum of 56 kPa (gage) (8 psig) if designed to reseal, or at a minimum of 138 kPa (gage) (20 psig) if designed for pressure relief without resealing. Such operation shall occur before other components of the tank are ruptured or displaced, and the cover shall remain in position. Manual means of venting the tank before removal of the cover shall be provided. The flow rate shall be at least equal to that of the pressure-relief device specified in 7.2.5.1.</p> <p>7.2.6.1 Static pressure The completely assembled transformer enclosure shall be of sufficient strength to withstand an internal pressure of 49 kPa (gage) (7 psig) without permanent distortion to the enclosure. The enclosure shall also be of sufficient strength to withstand an internal pressure of 138 kPa (gage) (20 psig) without rupturing or displacing components (excluding the cover gasket and gasket oil leaks) of the transformer</p>	<ul style="list-style-type: none"> - Venting pressure = 69 kPa (10 psig) ± 13 kPa (gage) (2 psig) - Resealing pressure = 42 kPa (gage) (6 psig) minimum - Zero leakage from reseal pressure to -56 kPa (gage) (8 psig) - Flow at 103 kPa (gage) (15 psig) = 16.5 L/s (35 Standard Cubic Feet per Minute {SCFM}) minimum, corrected for air pressure of 101 kPa (14.7 psi) (absolute) and air temperature of 21 °C.
<p>Single phase Padmounted Type C57.12.38-2009</p>	<p>10.2 Strength The tank shall be of sufficient strength to withstand a gage pressure of 50 kPa (7 psig) without permanent distortion and 103 kPa (15 psig) without rupturing or affecting cabinet security as described in IEEE Std C57.12.28.</p>	<p>Venting pressure = 69 kPa ± 13 kPa (10 psig ± 2 psig) Resealing pressure = 42 kPa (6 psig) minimum Zero leakage from resealing pressure to -56 kPa (-8 psig) Flow at 103 kPa (15 psig) = 16.5 L/s (35 SCFM) minimum of air at a standard temperature and pressure. Standard temperature is 21 °C and standard pressure is 101 kPa (14.7 psig).</p>
<p>Three phase Padmounted Type C57.12.34-2009</p>	<p>8.10 Tanks 8.10.1 Strength The tank shall be of sufficient strength to withstand a gage pressure of 50 kPa (7 psig) without permanent distortion, as well as a gage pressure of 103 kPa (15 psig) without rupturing or affecting cabinet security as described in IEEE Std C57.12.28.</p>	<p>Cracking pressure: 69 kPa(gage) ±13 kPa(gage) (10 psig ± 2 psig) Resealing pressure: 42 kPa(gage) (6 psig) minimum Zero leakage from resealing pressure to -56 kPa(gage) (-8 psig) Flow at 103 kPa (gage): 16.5 L/s minimum of air at a standard temperature and pressure. Standard temperature is 21°C and standard pressure is 101 kPa (absolute) (Flow at 15 psig: 35 SCFM minimum where SCFM is flow at cubic feet per minute, corrected for an air pressure of 14.7 psi and an air temperature of 21°C.)</p>

Current Requirements on Distribution and Power Transformers Standards

Standard	Static Pressure	Pressure relief device
<p>Three phase Submersible type C57.12.24-2009</p>	<p>7.5.2 Tank integrity The transformer shall be of sealed-tank construction as defined in IEEE Std C57.12.80-2002. The transformer shall remain effectively sealed for a top oil temperature range of $-5\text{ }^{\circ}\text{C}$ to $+120\text{ }^{\circ}\text{C}$ under operating conditions as described in IEEE Std C57.91-1995. The completely assembled transformer tank shall be of sufficient strength to withstand a static internal pressure of 50 kPa gauge (7 psig) without permanent distortion and 103 kPa gauge (15 psig) without rupturing. The completely assembled transformer shall be tested for leaks at a minimum of 50 kPa gauge (7 psig) measured above the static head of liquid for not less than six hours. Alternative methods for leak detection such as helium leak detector method may be used.</p>	<p>7.3 Accessories A 1/2 in or larger NPT fitting sized for specified minimum flow rate shall be provided for the installation of a pressure-relief device.</p>
<p>Single phase Underground type C57.12.23-2009</p>	<p>7.5 Transformer tank integrity The completely assembled transformer tank shall be of sufficient strength to withstand a static internal pressure of 50 kPa gauge (7 psig) without permanent distortion and 140 kPa gauge (20 psig) without rupturing.</p>	<p>7.3 Accessories A 1/2 in or larger National Pipe Thread (NPT) or National Coarse (NC) thread fitting with gasket shall be provided for pressure relief. The pressure relief fitting shall allow slow release of pressure without completely removing the fitting.</p>

Current Requirements on Distribution and Power Transformers Standards

Standard	Static Pressure	Pressure relief device
<p>Distribution Substation Transformers C57.12.36-2007</p>	<p>5.10 Tanks 5.10.1 Pressure withstand Maximum operating pressures (positive and negative) for which the transformer is designed shall be indicated on the nameplate. The tank shall be of sufficient strength to withstand a gauge pressure of 50 kPa (7 psi) without permanent distortion and 104 kPa (15 psi) without rupturing.</p>	<p>5.1.7 Pressure relief A replaceable valve (PRV) shall be provided on transformers 2500 kVA and below to provide automatic relief of pressures that build up slowly in excess of normal operating pressures. ... Venting and sealing characteristics shall be as follows: a) Cracking pressure: 69 kPa(gauge) ± 13 kPa(gauge), (10 psig ± 2 psig). b) Resealing pressure: 42 kPa(gauge) (6 psig) minimum. c) Zero leakage from resealing pressure to -56 kPa(gauge) (-8 psig). d) Flow at 103 kPa(gauge): 16.5 L/s minimum of air at a standard temperature and pressure. Standard temperature is 21 °C, and standard pressure is 101 kPa(absolute). (Flow at 15 psig: 35 SCFM minimum where SCFM is flow at cubic feet per minute, corrected for an air pressure of 14.7 psi and an air temperature of 21 °C.) A pressure-relief device (PRD) shall be provided on the cover for transformers rated above 2500 kVA or having an insulation level above 200 kV BIL. The minimum pressure relief rating for cover-mounted devices should be 5000 SCFM at 69 kPa (10 psi). In addition to the cover-mounted pressure relief device, the tank shall also have provisions to relieve tank pressure manually.</p>
<p>Power Transformers C57.12.10-2010</p>	<p>5.8 Tanks 5.8.1 Pressure design Maximum operating pressures (positive and negative) for which the transformer is designed shall be indicated on the nameplate. The completely assembled transformer shall be designed to withstand, without permanent deformation, a pressure 25% greater than the maximum operating pressure. 5.8.2 Vacuum filling Tanks shall be designed for vacuum filling (external pressure of one atmosphere, essentially full vacuum) in the field.</p>	<p>5.1.7 Pressure relief device A pressure relief device shall be provided on the cover of the transformer, with a minimum pressure relief rating of 142 m³/min (5000 CFM) at 69 kPa (10 lb/in²). This relief rating (rate of release) applies for all pressure relief devices regardless of pressure setting.</p>





Pressure-relief valve (PRV)
Mounting $\frac{1}{4}$ "-18 NPT
Flow at 103 kPa (gage): 16.5 L/s
(Flow at 15 psig: 35 SCFM)
Equal to **1.0 m³/min**



Pressure-relief device (PRD)
Mounting: Flange Opening: 171.5 mm (6.75 in)
Flow at 69 kPa (10 psig): **142 m³/min** (5000 CFM)

