

## **History of discussions on PD in Bushing / Venting bushings to Pass Transformer Induce Test**

### **Spring 2017**

#### **Concern with bushing PD affecting transformer induce test.**

- A concern was raised in Bushing SC meeting regarding need for bushings to be vented to have transformer pass partial discharge limits during induce test.
- Transformer and bushing manufactures shared their experience and knowledge of this phenomena that seems to appear only at factory testing and has not been seen in the field.
- Steve Antosz recommended this topic can be added to agenda for the TF on The Revision of Low Frequency TF for additional investigation and recommendation, which Chair agreed.

### **RLTF – Fall 2017**

PD in bushings during factory testing.

A study group will be formed to provide a recommendation if there should be additions or changes to standards or guides to address this topic. Users, transformer manufacturers joined but no bushing manufacturers joined. The chair asked the bushing committee for bushing manufacturers to join the study group and three volunteers joined..

### **RLFT - Spring 2018**

Study Group – PD in bushings during factory testing – Dave Geibel

Dave Geibel has agreed to lead the study group on bushing PD during factory testing. A time slot will be requested for the next meeting.

### **RLFT – Fall 2018**

Study Group

PD in bushings during factory transformer testing – Dave Geibel

Proposed text to add to standard C57.12.90 Section 10.8.5:

*“If the partial discharge is observed during the induced testing of the transformer and appears to be generated within an OIP bushing(s), it is permissible to “vent” the bushing(s) to the atmosphere using the bushing manufacturer’s instructions to allow for the dissipation of gas bubbles in the oil. Gas bubbles sometimes form following a temperature rise test during cool down or may be present for other reasons. Reestablishment of the bushing gas space blanket and resealing of the bushing must also be performed in accordance with the bushing manufacturer’s instructions following completion of the induced test.”*

Dave Geibel motioned for the members of the TF to move this text to the Dielectric Test SC, for suggested addition to C57.12.90, section 10.8.5. The motion was 2nd by Hugo Flores.

30 approved

1 Disapproved

0 Abstention

## **Bushing SC - Spring 2021**

### **A.5 New Business**

#### **A.5.1 Continuous Revision to Low Frequency Dielectric Tests, Venting/PD in Bushings – Bill Griesacker**

Mr. Griesacker provided a summary of a survey with proposed text concerning the practice of venting bushings during transformer Induced testing (with PD measurement) at the factory. The text does not have good acceptance based on the survey results. Comments received included that there could be commercial considerations involved (such as delays in or extended time for factory testing) and although there do not seem to be examples of field failures or issues tied to the practice there are unexplained field failures that have occurred. TF is recommending not to use the statement in IEEE test code documents.

There was some general discussion on the topic, with the conclusion being that it is recognized as a generally unresolved issue.

The survey summary is also planned to be reported at the Dielectric Test SC.

## **RLFT – Fall 2021**

### **Review of Survey Results for PD in Bushings During Transformer Factory Testing**

The chair reviewed the history of this survey and provided a detailed summary of the results and comments received. A discussion was held with various individuals providing feedback on their experience with venting bushings during factory testing, with proposed wording to be added to standards.

The proposed wording was as follows:

“If the partial discharge is observed during the induced testing of the transformer and appears to be generated within an OIP bushing(s), it is permissible to “vent” the bushing(s) to the atmosphere using the bushing manufacturer’s instructions to allow for the dissipation of gas bubbles in the oil. Gas bubbles sometimes form following a temperature rise test during cool down or may be present for other reasons. Reestablishment of the bushing gas space blanket and resealing of the bushing must also be performed in accordance with the bushing manufacturer’s instructions following completion of the induced test.”

Eric Weatherbee, Bushing SC chair, joined the meeting at 2:59 PM and was read a synopsis of the discussion, along with proposed wording for addition to standards. Eric suggested Bill Griesacker should present the wording to the Bushing SC on Thursday, 4/28/21. This proposal was accepted.

Further discussion was tabled until feedback is received from the Bushing SC.

## Fall 2022:

### PD in Bushings During Factory Testing

There was discussion on prior survey results from within the TF on proposed changes to allow venting of bushings during factory acceptance testing, which is a common practice by most transformer manufacturers but objected by many users.

The survey had an 86% approval rate, but had significant negative comments that were mainly from users, who are concerned with field performance and others who would like the cause of bushing PD addressed.

The chair agreed to setup another task force with members from the Bushing SC and RLFT to address some of the concerns and negative votes from survey.

## Spring 2023

A study group led by Ajith Varghese, with participants from Bushing Manufacturers, Transformer OEMs and users reviewed comments from 2020 Survey. Study group came up with new text to add to C57.12.90 allowing venting of bushings during Induce test. This text was presented during S23 meeting but no decision was made as chair wanted to improvise the text before proceeding to vote.

### Rev 03 Draft - Presented during S23 Meeting

(Based on Study group recommendation to address comments from Rev2 survey)

“If partial discharge **exceeding agreed limits**, is observed during the induced testing of the transformer and appears to be generated within an OIP bushing(s), it is permissible to “vent” the bushing(s) exhibiting partial discharge to the atmosphere using the bushing manufacturer’s instructions. ~~to allow for the dissipation of gas bubbles in the oil.~~

**Induce test shall be repeated entirely after venting and a note shall be added to the certified test report indicating which bushings were vented during the Induce Test.**

#### Note:

- 1) Partial discharge intended to be addressed by venting the bushing is the low energy discharge arising from partial vacuum created in expansion chamber or gas bubbles generated during the thermal test. Partial vacuum is created in the expansion chamber due to absorption of nitrogen or air into oil, and gas bubbles are formed due to saturation of nitrogen. Partial discharges from these cases get resolved quickly with venting. Continuous gas bubble generation or elevated partial discharge remaining after the venting, may require additional investigation.

- 2) If there are concerns of gas generation from the Temperature rise test causing bushing failure during Impulse or Applied Voltage test, an induce test is allowed before impulse for diagnostic purposes, but a complete Induce test shall be repeated as the last dielectric test.
- 3) Bushings shall not be vented proactively prior to dielectric testing. Venting is only allowed as a mitigation to measured partial discharge.

~~Gas bubbles sometimes form following a temperature rise test during cool down or may be present for other reasons. Reestablishment of the bushing gas space blanket and resealing of the bushing must also be performed in accordance with the bushing manufacturer's instructions following completion of the induced test."~~

During Study group discussion, Egon from Siemens also presented a work done by Siemens testing bushing to simulate cool down and suggested this as possible Type/Special test to identify PD prone bushing. Other bushing manufactures questioned validation of this test and seek time to review. Chair agreed its too early to consider it as test to added to standard, but have it presented during RLFT and Bushing SC meeting at Milwaukee.

Cooldown test was presented during RLFT and Bushing SC, but no decision was made on next steps.