

## **PC57.154 – IEEE Standard for Liquid-Immersed Transformers Designed to Operate at Temperatures Above Conventional Limits Using High-Temperature Insulation Systems**

### **Minutes of Virtual WG Meeting (originally planned in Kansas City, MO, USA) Monday, October 19, 2020**

The meeting was called to order at 12:55PM (CDT) by Chair, Richard Marek. Vice-Chair, Anastasia O'Malley and Secretary, Ewald Schweiger (writer of Minutes) were also present. This was the fourth meeting as a WG. 10 of the total 75 attendees requested membership. A total of 75 people connected to the virtual meeting.

#### Data from the list provided by meeting host:

Number of Members in WG = 58  
Number of Members Present = 34  
Quorum was met with 58.6% of membership present

Rainer Fortscher, Kevin Rapp, Alan Traut, V. Baniroula, Erich Buchgeher, Radoslaw Szewczyk, Dejan Vukovic, Chao Li, David Sundin and Larry Dix requested membership.

Introductions of the Chair, Vice Chair and Secretary were made. Due to the large number of attendees and the new format for this meeting, no individual introductions were made.

The patent slides and the copyright policy had been provided by email before the meeting. A reminder of these slides was given and a call for patents was made, with no response.

The agenda was approved unanimously as well as approval of the minutes from the previous meeting in the fall of 2019.

The chair reported the results of a mid-summer survey ballot on a proposed Annex.

| Valid ballot responses were:           | Ballot results |
|--|----------------|
| a. Add proposed Annex to PC57.154      | 9              |
| b. Amend Annex B in IEEE Std 1276-2020 | 21             |
| c. Abstain                             | 2              |
| Total ballots received                 | 32             |

With 58 members, 32 ballots constitute a quorum and the survey was valid.

The WG decided to recommend that the ILSC initiate a WG or TF to amend Annex B in the recently published IEEE Std 1276-2020 document.

Alan Sbravati reported on TF1 - Defining temperature limits for insulating liquids

- Several test series on aging of three fluids, HyVolt II, FR3, Midel 7131 were performed in four labs at 180°C
- A second round of tests will be performed at two different temperatures: 165°C and 180°C
- Copper wire, aluminum and core steel will be added to the test cells
- The number of monitored key properties for analysis will be reduced
- The properties will be: color, DDF, neutralization number, tension, breakdown voltage and moisture

Kevin Biggie reported on the status of TF2 – Reviewing and suggesting disposition of draft comments

- There was significant initial discussion on Clause 4.1 and Tables 2 & 3 regarding: 'insulation system' thermal class, vs. 'solid insulation' and 'liquid insulation' thermal classes.
- A new proposal for Clauses 4, 5 and 6 was submitted with the following notable changes:
  - Only makes use of the term 'insulation system' thermal class, rather than the terms 'solid' and 'liquid' thermal classes
  - Removes design specific recommendations that are contained in IEEE Std 1276, and instead just

- makes simple descriptions of 'hybrid' and 'high-temperature' insulation systems
- All changes have been incorporated into Draft 3 and the TF will continue reviewing comments after this meeting.

The next topic of discussion was Draft 3, which was distributed before the meeting. The chair noted, that it is the WG intent not to duplicate content in multiple documents. Therefore, content moved to IEEE Std 1276 will only be referenced. The chair emphasized that initially with the first edition, guidance was needed because high temperature was relatively new to the industry. But now it is more common and therefore it is time to concentrate on transformer requirements, leaving informative and tutorial material to IEEE Std 1276. The example given was IEEE C57.12.00. This document covers all different types of transformers from pole mounted to pad mounted to large power and even shell type transformers. Specific winding design detail should be treated as informative and properly belongs in IEEE Std 1276 which is a companion guide.

Comments on Draft 3 were then requested:

Radek Szewczyk made the following comments:

- The thermal class of insulation systems should not focus on the insulation system only. It should consider the characteristics of fluids as well. Alan Sbravati's TF1 is working on defining these limits.
- The thermal class of the highest temperature of the system and not of the complete transformer should be redefined in Table 2
- Radek Szewczyk will propose wording for Clause 4.1 or Clause 3 for Insulation system thermal class and Transformer insulation system thermal class and work with Kevin's TF2.

Attila Gyore commented

- That table 3 should be modified to incorporate an upper limit in addition to a lower limit only, such as 115°C.
- In addition, he suggested adding another table with "typical" liquid temperatures for various material combinations. This will be discussed in Kevin's TF2 meetings. The chair stated that adding a table of "typical" temperatures to this standard would certainly become defined values. He suggested that this might belong more properly in IEEE Std 1276 which is a guide and that a proposal to establish a TF to discuss modification of Annex B of that document will be made at the next ILSC meeting. It would be possible to include this topic as well. Sheldon Kennedy, the chair of ILSC agreed. Jinesh Malde and Alan Sbravati agreed to work on such a table within TF1.

Alan commented that he thinks the hottest spot temperature limits in the tables are too high and TF1 is working on suggestions to limit this temperature suggesting that it should not be higher than the flash point of the fluid.

- The chair said that this might have an impact on other standards as well.
- Kurt Kaineder shared insight of a transformer manufacturer, that lowering the hottest spot would have an impact on the design of transformers

Rainer Frotscher asked about the purpose of a temperature range on the tables and feels it does not make sense. He emphasized that the numbers in Tables ALWAYS indicate MAX or MIN values. In our case they should be MAX values. And this is the only relevant number. Alan will discuss this topic in TF1, since his group will provide a procedure to determine these maximum limits.

There was no additional new business and the meeting was adjourned at 2:10PM (CDT).

Richard Marek  
WG Chair

Anastasia O'Malley  
WG Vice-Chair

Ewald Schweiger  
WG Secretary