

**MEETING MINUTES**  
*IEEE / PES Transformers Committee*  
*Performance Characteristics Subcommittee*

**WG to Investigate the Interaction between Substation Transients  
And Transformers in HV and EHV Applications and Revision  
of C57.142**

**Anaheim, CA**  
**Tuesday, March 26, 2019**  
**3:15 PM – 4:30 PM**  
**California Ballroom B**

**Chairman – Jim McBride**  
**Vice Chair – Xose Lopez-Fernandez**  
**Secretary – Tom Melle**

- 1) Meeting called to order at 3:15 PM.  
Welcome and Chair's Remarks
- 2) Circulation of Attendance Sheets  
97 Attendees were present (54 Guests)  
43 of 53 Members present (quorum was achieved)
- 3) No essential patent claims made
- 4) Approval of Agenda (motion by Pierre Riffon and 2<sup>nd</sup> by Deepak Kumaria) and meeting minutes from Fall 2018 (motion by Klaus Pointner and 2<sup>nd</sup> by Akash Joshi) without objection.
- 5) Status of Current Draft and Comments – Jim McBride  
The present draft of the Guide is posted on the Working Group website

Review of C57.142 Draft 6 – The Chair noted that editorial changes continue, but the WG members and guests have not provided many comments since Draft 5. Some additional editing / cleanup may be needed and continued review by the WG is appreciated. Additional examples are included in D6 (GSU in backfeed mode, failing autotransformers, instrument transformers, and reactor switching).

The chair requested that the members and guests please continue to review and comment on the existing draft over the next few weeks before the draft is handed to the IEEE Switchgear Committee for review.

- 6) Status of Task Force Paper – Jim McBride  
IEEE requested the TF paper be reformatted to include CV's for the paper authors. This will be handled by WG Vice Chair Xose Lopez-Fernandez.
- 7) Mitigation Methods Task Force Update – Phil Hopkinson

In the past, EHV reactors that were failing in the field were passing factory test levels. Special Terminated Lightning Impulse Tests (STLI) were then incorporated and failures reduced dramatically.

Phil requested manufacturers data using RSG (recurrent surge testing) in order to understand the stresses on windings. Phil reminded the WG that many old transformers had electrostatic shields. Line shields increase series capacitance and greatly reduce capacitance to ground. In the past (for 34.5 kV and below) static shields added to the winding seemed to increase probability of surviving re-strikes

Shielding solves many issues with series resonance and is relatively easy to apply. The conclusion is that increasing the series capacitance and reducing the capacitance to ground should improve the design. Phil urged the group to focus on improving transformer designs and developing new test methodologies.

Mitigation methods with some success have included: higher BIL, open terminal special impulse test, and fast-front switching surge with a long tail time.

The Chair added that more communication is required between the end-user of the transformer and the manufacturer with regard to the potential for exposure to high-energy transients in the field. Advanced modeling will be necessary in order to mitigate these issues. Experts who can model/analyze disc and layer winding designs are necessary in order to move the WG efforts forward. Multiple mitigation methods are also being discussed and will be addressed in the Guide.

- 8) STLI Presentation by Mike Spurlock of AEP (will be posted on the WG website) using standard impulse waveforms (1.2 x 50 us)

Pierre Riffon asked if arrestors are used in the testing (on the X terminal) and if full voltage is applied on the H terminal. No arrestors were used and full voltage was applied.

Phil Hopkinson commented there was significant focus on the current traces in the presentation, but pointed out some significant collapse on the non-impulsed terminals. The chair commented that the significant point is how quickly the voltage appears on the non-impulsed terminals and that the arrestors are clamping.

Mike Spurlock added that the manufacturers tests show the stresses are higher and deeper into the winding than a standard impulse test. The chair added the STLI test better represents how the transformer is connected in service. Phil agreed this assessment matches prior failure modes and mitigation. Discussion by Amitabh Sarkar and others ensued regarding various testing arrangements (open versus terminated windings for example).

Manush Safar asked a question regarding whether an opening breaker versus closing breaker scenarios have been investigated and included in the Guide. Phil commented that different phenomena (pre-strike and re-strike?) cause different stresses when opening or closing. The energy following a strike/restrike tends to move back-and-forth between the internal inductance and capacitance. The Chair added that re-strike/re-ignition can cause severe issues and several examples are included in the draft guide.

Phil Hopkinson suggested shielded versus unshielded winding designs should be modeled and studied and further tested with the different STLI test configurations to gather more data. Mike Spurlock further commented that rather than arrester terminated, testing with capacitor terminated windings can be used to better simulate certain circuits (GSU's for example).

- 9) Switchgear Liaison Update – Dave Caverly  
The C57.142 Guide is a co-sponsored document between Switchgear and Transformers and run by Transformers Committee.  
The last Switchgear liaison meeting was held with 50 people present, There is now an official liaison TF between the Switchgear and Transformers committees. The next IEEE Switchgear Committee Meeting will be held April 28-May 2, 2019 in Burlington, VT.

- 10) JWG A2/C4.52 HF TDSF Modeling principles – Xose Lopez-Fernandez/Jim McBride  
TDSF for Transformer Modeling has been added to the monitoring circuit utilized by Jim McBride for High Frequency Transient Measurements.

Presentation topics included transformer modeling during Transformer Impulse Transients. Measured transients were then imposed on a detailed model of the transformer. The presentation will be posted on the WG website.

- 11) New Business: none
- 12) Next Meeting: (Columbus, OH)
- 13) Adjournment at 4:35 PM without objection

Respectfully,  
Thomas R. Melle  
Secretary