8.11 Performance Characteristics Subcommittee – Ramsis Girgis, Chairman; Stephen Antosz, Secretary

8.11.1 Introduction / Attendance

The Performance Characteristics Subcommittee (PCS) met on Wednesday, April 22, 2009 with 57 members and 44 guests in attendance. Six of those guests requested membership and were granted membership. Prior to this meeting, the total membership of PCS stands at 117 members; therefore with 57 present, we were 2 shy of a 50% quorum. See last page of these minutes for summary of attendance.

8.11.2 Approval of Meeting Minutes

The minutes of the last meeting in Porto, Portugal were approved as written.

8.11.3 Chairman's Remarks

8.11.3.1 Administrative Subcommittee Notes

- Next Transformer Committee meeting dates and locations are as follows:
  - Fall 2009, October 25 – 29, Chicago, IL
  - Spring 2010, March 7-11, – Location is to be determined.
- IEEE PES Meeting: July 26 – 30, 2009, Calgary, AB, Canada.
  - Panel Session on Natural Ester fluids relative to their use in transformers.
    - 7 papers to be presented
  - Four transformer paper sessions will be held
    - Three paper sessions – 13 papers to be presented
    - One poster session – 3 poster papers
- IEEE T&D Conference & Expo: April 20-22, New Orleans, LA

8.11.4 Working Group (WG) and Task Force (TF) Reports

8.11.4.1 PCS WG on "Test Code C57.12.90" – Mark Perkins, Chairman; Kirk Robbins, Secretary

The PCS Working Group for Revisions to test code C57.12.90 met in Miami, FL on April 20, 2009 at 09:30 A.M. There were 95 persons in attendance, 39 members and 56 guests of which 14 requested membership.

Announcements
The chair asked if anyone had any patent issues relating to this standard. Being none, this discussion was closed. The minutes from the last meeting were then reviewed and approved as written by oral vote.

Old Business

- The previously revised sections of Sections 6 and 7 that were reviewed. There were no additional comments on those sections.
  - A proposed rewording of Section 7.1.4, Three phase transformers with inaccessible neutrals, was presented by M. Perkins. There were three points of discussion:
    - The criteria of 0.5% tolerance on ratio may not be sufficient to identify a turn-to-turn short if there are a large number of turns.
    - The current standard specifies a method different than described, both methods should be included.

- The figure associated with this new method was clarified by adding the phase description for each of the measurements.
- Following discussion, it was decided to include both methods of testing in Section 7.1.4. It should be noted that the user would need to request using the proposed method in order to get data that could be field verified.

  - The revised Sections 6 and 7, including the new proposed method for measuring the ratio of three phase transformers with inaccessible neutrals, will be sent out for a survey of the Performance Characteristics Subcommittee. This was sent out after the meeting.

- A proposal to include a description of measuring ratios using the capacitance bridge method had been made at the F2008 meeting in Porto. The proposed wording was not available. This item will be carried to F2009.

New Business

- Survey of the revised Section 12 on short circuit testing will be sent to the Performance Characteristics Subcommittee. This was sent out after the meeting.

8.11.4.2 PCS WG on "General Requirements C57.12.00" – Steve Snyder, Chairman; Enrique Betancourt, Secretary

The Working Group met on Monday, April 20 at 3:15 PM. There were **24** members and **35** guests present. The following nine guests requested membership, bringing the Working Group membership to **82** members:

Ajith M. Varghese	Waukesha Electric Systems
Baitun Yang	Pennsylvania Transformer
David Wallach	Duke Energy
Dharam Vir	Waukesha Electric Systems
Jane Ann Verner	Pepco
Juan Luis Thierry	GE Energy T&D
Kenneth Skinger	Shaw Group
Shawn Patterson	Bureau of Reclamation
Susmitha Tarlapally	ABB Inc.

Following introductions, the minutes of the Oct 06, 2008 Porto meeting were approved as submitted. Working group members were then asked about any applicable patents pertaining to our work. No patent issues were disclosed by anyone.

The chairman presented an update on the C57.12.00 ballot. Dong Kim is working to address a number of comments from the original ballot, and the first Recirculation ballot should come out soon.

New Business

A. WG Item 86 for C57.12.00 - 2006 Table 10 Nameplate Information, and Section 8 – Testing and Calculations

A change was requested from the Distribution Transformers Subcommittee to add a new requirement for distribution transformer nameplates to state "DOE Compliant" for such transformers, and also add a statement in the Certified Test Data Section 8.6.

After an introduction and explanation of proposed changes by Mr. Stephen Shull, a discussion followed within the Working Group that resulted with a motion to accept the final wording for addition to Table 10 Nameplate Information and an addition to Sect. 8.6

Certified Test Data. The motion was approved unanimously. The chair will forward this request to Dong Kim for insertion into the C57.12.00 Recirculation Ballot.

New text for Table 10 in 5.12.2 Nameplate information:

" 24 DOE Compliant (13) DOE Compliant (13) DOE Compliant (13)

NOTE 13—The nameplate of transformers that must comply with 10 CFR Part 431 shall include this statement ["DOE Compliant"], when the transformer is to be used in the United States or one of its protectorates or territories. Transformers that must meet this Code of Federal Regulation are defined in 10 CFR 431.192."

Addition to 8.6 Certified test data :

"17) DOE Compliant[7]
18) Other special test results (when specified)*.

NOTE 7—If this transformer is to be used in the United States or one of its protectorates or territories and is required to comply with 10 CFR Part 431, this phrase ["DOE Compliant"] shall be included. Transformers that must meet this Code of Federal Regulation are defined in 10 CFR 431.192. At the discretion of the user, the actual calculated efficiency value may be substituted for this phrase."

B. Paragraph for C57.12.00 on Winding Resistance Measurement of Stabilizing Windings.

Having studied the best manner to implement this request in C57.12.00, the chairman remarked that it appears the requirement to conduct this testing is already included within Table 18 (test requirements), but could be expanded upon in section 8.7. Therefore, the Chairman proposed changes in Section 8.7 Certified Test Data, as follows:

"C) Test and calculated data (by individual serial number ; if the results are from…)
2) Winding resistances, including stabilizing winding when two external terminals are available."

The new statement was approved unanimously, including the clarification of applying this requirement only for Stabilizing Windings that have two external terminals available.

C. WG Item 82, Clause 7.1.4.4 Stabilizing Windings- TF Report and discussion

The chairman of TF Stabilizing Windings presented a new (second) progress report, including the new working version for Clause 7.1.4.4 of C57.12.00:

> "7.1.4.4 Stabilizing Windings.
> Stabilizing windings in three-phase transformers (Delta-connected windings with no external terminals) shall be capable of withstanding the transient current duty resulting from any of the system faults specified in 7.1.1, recognizing the system grounding conditions as stated in user's spec. In case users do not specify system grounding conditions, including system zero sequence impedance and type of grounding intended for the transformer or autotransformer, system impedances per IEEE C57.12.00 shall be assumed, as well as solid grounding connection for neutrals of main windings.
>
> If users specifiy impedances from stabilizing winding to main windings, the manufacturer shall provide the appropriate stabilizing winding kVA and voltage. If stabilizing winding impedances are not specified, the manufacturer shall provide appropriate impedance from design, in order to withstand thermal and mechanical effects resultant from transient operating currents."

---- Loading Part (Paragraph on Section 5?)

"Stabilizing windings shall be designed to withstand continuous thermal duty of the circulating current resulting from temporary load and or voltage imbalance on the main windings, as specified by the user. Load currents and supply voltages should be specified in magnitude, angle and duration, to allow verification of compliance with maximum allowable temperatures according to C57.12.00.

In the event no continuous thermal duty for the stabilizing winding can be established from the user´s spec, the manufacturer will use as stabilizing winding continuous kVA a fraction of the transformer´s main rating, as resultant from a full single phase load in the main secondary winding (33.3% of transformer's three phase rating) and infinite bus supply from the primary winding.

The manufacturer shall prepare transient and permanent loading calculations for stabilizing windings, in order to demonstrate adequacy to requirements established in foregoing clauses."

---- Name Plate Part

"Internal reactors used to supplement stabilizing winding impedances to main windings, shall be included in the nameplate. "

An important insight resulting from the work of the TF Stabilizing Windings is that Stabilizing Windings cannot be specified the same way as Tertiary Windings, as the Stabilizing Windings cannot be subjected to conventional three phase loads. Further input from users is requested to clarify the maximum expected thermal loading for Stabilizing Windings, or expected current and voltage imbalance in service (magnitude and duration).

As next steps, the members of the TF Stabilizing Windings will continue to evaluate and assimilate feedback to refine the proposed new wording. The Task Force also believes there is sufficient interest in this subject to conduct a tutorial/informational session at an upcoming meeting.

8.11.4.3 WG on "Loss Tolerance and Measurement" – Ed teNyenhuis, Chairman; Andy Steineman, Secretary

- 10 members and 8 guests attended with 1 person requesting membership.
- IEEE Patent Policy - The policy was reviewed by the WG and an opportunity was provided for WG members to identify or disclose patents that the WG member believes may be essential for the use of that standard. No responses were given.
- Minutes from the Porto Meeting held on Oct 7th, 2008 were reviewed and approved.
- **Frequency Conversion Factors of Transformer Performance Parameters –** The status of the proposed wording for inclusion in C57.12.00 and C57.12.90 was reviewed. The status is as follows:
  - C57.12.00 has been balloted and no comments with regards to the frequency conversion factors have been received from the C57.12.00 WG.
  - C57.12.90 ballot had 4 comments which were reviewed. The response to the comments was given to Steve Antosz who has the responsibility of balloting the latest revision of C57.12.90.
- **C57.123-2002 – Guide for Transformer Loss Measurement –** The status of the Guide was reviewed:
  - The 1st recirculation had 1 negative ballot and 4 comments.

- Negative comment had already been resolved but the balloter did not go into MyBallot in time.
- All other comments were discussed and will be incorporated into the guide.
- In responding to one of the comments recently received on the Guide, the WG discussed the text of section 2.2.7 on "Core Size" and decided to reword it slightly in order to make it more accurate. The Chairman will prepare wording with Ramsis Girgis for the 2nd recirculation.
- The revised document will be sent shortly for a 10-day 2nd recirculation.

- Dual Logo IEEE/IEC document status for the Loss Measurement Guide:
  - At the last IEC TC14 meeting they decided not to support the dual logo status for this guide since they simply do not need the guide. Our WG had made changes to the Guide with regards to previous IEC TC14 comments.
  - There will be no further work by the WG on this.

- New Business
  - Request by Subash Tuli if other tap positions should be in the standards for loss measurement if a Preventative Autotransformer is in the circuit. The C57.12.00 presently indicates rated and extreme tap positions. This item will be taken by the Chairman to the C57.12.00 WG.

- Future of the WG
  - There are no further items to work as the Loss Guide, Frequency Conversion factors and the Dual Logo Loss Guide items are all nearly complete.
  - It was agreed that the WG would no longer meet.
  - Ramsis Girgis, the chairman of the PCS Sub – Committee, thanked Ed for his effort of leading this WG and the work achieved in the past few years.

8.11.4.4 WG on "Switching Transients Induced by Transformer / Breaker Interaction", PC57.142 – Robert Degeneff, Chairman; Bill Griesacker, Secretary

1. There were 61 in attendance.
2. The minutes from the October 7 meeting in Porto, Portugal were approved.
3. Request for any patent issues to be made known, there were none voiced.
4. It was reported that draft 5.1 of C57-142 went to ballot on January 8, 2009 and close on February 7, 2009. 154 were eligible to vote. There were 123 votes cast: 101 affirmative, 9 negative, and 13 abstentions.
5. There were 130 comments submitted by 23 of those that balloted. Of the 130 comments 43 were editorial, 40 general, and 47 technical.
6. The vast majority of the comments have been addressed by modest changes to the text or figures. 12 comments were discussed in the working group meeting and guidance provided to the chair for the next draft.
7. This information will be passed on to the Switchgear Committee with a request for their input (they have a meeting in a few weeks).
8. All changes (both from the transformers and switchgear committee) will be included in draft 6.0 scheduled to be re-circulated by mid-summer.
9. There was no old or new business.

8.11.4.5 WG on "Semi–Conductor Rectifier Transformers", C57.18.10 – Sheldon Kennedy, Chairman

The Working Group met on Tuesday, April 21, 2009 at 3:15 PM with 7 members and 5 guests present. Sheldon Kennedy chaired the meeting.

The IEEE disclosure statement was discussed. There were no patents pertaining to this standards work for which any members had awareness.

The minutes of the October 7, 2008 meeting in Porto were approved.

The Chair announced that the Amendment, C57.18.10a had been approved and published in March 2008. The Errata was produced by IEEE in 2006. Along with C57.18.10 we now have these three documents as a group. C57.18.10 expired in 2008 and was sent out as a Reaffirmation Ballot. The Reaffirmation ballot of C57.18.10 along with the Errata and the Amendment, C57.18.10a were included as a group. This ballot passed with no negative votes and only one affirmative comment. The standard, amendment and errata were sent to REVCOM and approved.

There was a discussion about the standards being written in the Vehicular Transportation Society of IEEE. A traction rectifier transformer standard, rectifier standard and many C37 switchgear standards are being revised by this organization with emphasis on the needs of the transit and rail industry. Concerns about duplication of standards and conflicts in the standards were raised.

The chair announced that the IEC Converter Transformers for Industrial Applications IEC 61378-1 standard is under revision again.

The Working Group has completed its task. There is interest in keeping a Task Force to work on a few special items while we still have the group together. Phase shifted secondary windings with multi-pulse secondary windings such as 18 pulse, 24 pulse, 36 pulse, 48 pulse and 54 pulse are becoming a great part of the motor drive transformer applications. There is no discussion about these in the present C57.18.10 and this will need some work. Electrostatic ground shields are not discussed in the present standard and there is interest in keeping abreast with the Vehicular Transportation rectifier transformer standard and the IEC Converter Transformer standard so that we harmonize with them. There may be some other items that members would like to work on before we try to do a full revision of the original 1998 document, which will need a great deal of work to bring to the newer formats. The Working Group would like to survey the Rectifier Transformer Working Group, the Performance Characteristics Subcommittee and the Dry Type Subcommittee for interest in forming and joining the task force and any other items that may need to be worked on by this proposed Task Force.

8.11.4.6 WG on "IEEE Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices", PC57.32 – Steve Schappell, Chairman; Peter Balma, Vice-Chair

The Neutral Grounding Devices working group was called to order at 9:35 AM on April 21, 2009 and introductions were made. There were 15 attendees, 6 members, 7 guests, and 2 requesting membership. The minutes from the March 18, 2008 meeting in Charlotte, North Carolina were approved (a meeting was not held in the Fall of 2008), and copies of the minutes and Draft 6 of the standard were distributed.

1. IEEE patent policy was reviewed and the group was asked if there were any disclosures. There were none.
2. PAR status was reviewed and indicated that a PAR extension was requested and approved, and that it will expire 12/31/09.

3. The working group then proceeded to review Draft 6 of the document, and the following salient points were discussed:

    a. The normative references have been reduced to two, and the definitions are complete.

    b. Clause 4, Service conditions, was discussed, as the clause does not include lower temperature limits. After review, the group decided to refer the user of the document to the appropriate piece of equipment and to add values for resistors. This information will be presented in a table.

    c. The clause describing the "K" multiplier for peak asymmetrical current will be modified to include an equation and table for the general application of neutral grounding devices, and to add a paragraph and equation to the clause indicating that the application of grounding devices at or near generators or large motors may require a modified "K" multiplier.

    d. The current document utilizes the concept of Insulation Class throughout the document, after review and discussion, the group decided to change this to Nominal System Voltage. The next draft will be revised to reflect this.

    e. The group agreed to update the Dielectric Test Voltage table to include all devices, and to update its contents to match current equipment standards. The new table will also indicate non-standard voltage classes so the group can review classes to be eliminated.

    f. After discussion, it was decided that the Limiting temperature table will be updated to reflect a 40°C ambient temperature, and to reflect 65°C rise transformers (Table 7 of this clause will also be updated to reflect 65°C rise).

    g. The temperature coefficient of resistance for neutral grounding resistors will be changed to 0.0002800. This coefficient reflects a 20% change in the nominal resistance over the operating temperature range for resistors.

    h. It was proposed to modify the Insulation Classes table, (Table 6, column 4), for fault voltage criteria for resistors. Sergio Panetta will draft values for resistors and/or revisions to the associated clause for resistors.

    i. The group decided to remove the Capacitor clause from the standard, as a review of the industry did not find applications of Capacitor ground devices. This will require a modification of the existing PAR, as it is a change in the scope for this standard.

    j. Instead of developing a table for test requirements of Combination grounding devices, the user will be referred to other devices in the standard, and that the user and manufacturer should agree on the tests to be performed.

    k. All equations in the standard will be revised to reflect Metric units.

4. In old business, Richard Dudley asked if the material on ground fault neutralizers was available. As it was not, he indicated he would supply the material to the group.

5. In new business, it was suggested that the document refer to the series of IEEE guides for the application of grounding, i.e. the C62.92 series.

8.11.4.7 PCS WG on "Guide for the Application and Interpretation of Frequency Response Analysis for Oil Immersed Transformers", PC57.149 –– Chairman; Charles Sweetser

WG PC57.149 met for the development of the Frequency Response Analysis (FRA) Guide in Miami, FL on April 6, 2009 at 1:45 PM. There were 84 people in attendance. The FRA Working Group meeting was called to order at 1:45 PM. The first order of business was to show five slides regarding patents, assurances and inappropriate behavior. The minutes from the Porto, Portugal 2008 meeting were approved by unanimous vote.

Working Group Chair Update

Draft 6 was presented to the Working Group, which now includes the Analysis and Interpretation Section. Draft 6 is expected to be internally circulated within the Working Group for a pre-ballot trial.

The Working Group Chair presented a brief report on what had been done in the last six months. It was estimated that the document is over 95% complete. The latest contributions were identified and discussed. It included the following sections.

Edits to Section 5: Analysis and Interpretation - The discussions focused on failure modes and related case studies.

The following contributions regarding failure modes were presented:

1. Radial "Hoop Buckling" Deformation of Winding
2. Axial Winding Elongation "Telescoping"
3. Overall- Bulk & Localized Movement
4. Core Defects
5. Contact Resistance
6. Winding Turn-to-Turn Short Circuit
7. Open Circuited Winding

The discussion focused on how various failure modes affect the following frequency ranges: 20 Hz – 10 kHz, 5 kHz – 100 kHz, 50 kHz – 1 MHz, and > 1 MHz.

During the failure mode discussion, the Greg Anderson indicated that the effect of the reversing switch position be mentioned.

The Working Group chair ask the member for any additional failure mode data regarding floating shields and core defects, especially unintentional core grounds.

Paulette Payne, Peter Werelius, Alexander Kraetge, George Frimpong, Larry Coffeen, Greg Anderson, Anthony McGrail, and Alan Darwin volunteered to review the new contributions to the Analysis and Interpretation Section.

Other Comments

Required versus Optional Test. As a follow-up to the concern raised at the Proto meeting, the Working Group discussed "required versus optional tests."
Several members voiced their concern that there are some transformer designs that quickly go over 18 tests. The feeling is that this may be too time consuming and may be unnecessary. The importance of the open circuit and short circuits tests were discussed. All Working Group members agreed with the requirement of performing

open circuit tests on all available windings. A few members stated perceived limitations with performing short circuit tests, however, other expressed high value. The guide will consider both the open circuit and short circuit tests to be required.

Alexander Kraetge requested that the FRA Working Group investigate the possibility of adopting a universal data format. This may be difficult because information used to link the file to other diagnostic tests may be included in the FRA file. The Working Group agreed to re-open this discussion at the next meeting.

8.11.1 Old Business

None

8.11.2 New Business

Ramsis Girgis announced that he was resigning as Chair of the Performance Characteristics Subcommittee. He has been Chair for 6 years. He will continue to attend the Transformers Committee meetings, and wants to focus on the WG under Audible Sound & Vibration.

Ramsis announced that Stephen Antosz will take over as Chair, after this meeting.

A thank you from the membership was given by a hearty round of applause.

Attendance at this Meeting

MEMBERS

1. Raj Ahuja
2. Dick Amos
3. Stephen Antosz
4. Donald Ayers
5. Barry Beaster
6. EnriqueBetancourt
7. Bill Boettger
8. Jeffrey Britton
9. Alvaro Cancino
10. Donald Chu
11. Jerry Corkran
12. Alan Darwin
13. Bob Degeneff
14. Richard Dudley
15. Don Fallon
16. Bruce Forsyth
17. Marcel Fortin
18. Eduardo Garcia
19. Charles Garner
20. Ramsis Girgis
21. Bill Griesacker
22. Myron Gruber
23. Stan Hatch
24. Roger Hayes
25. William Henning
26. Phil Hopkinson
27. Marion Jaroszewski
28. Stephen Jordan
29. Sheldon Kennedy
30. Alexander Kraetge
31. John Lackey
32. Richard Marek
33. Dennis Marlow
34. John Matthews
35. Martin Navarro
36. Klaus Papp
37. Mark Perkins
38. Donald Platts
39. Jean-Chris Riboud
40. Pierre Riffon
41. Kirk Robbins
42. Marnie Roussell
43. Mathieu Sauzay
44. Steven Shappell
45. Devki Sharma
46. Hem Shertukde
47. Steven Snyder
48. Craig Stiegemeier
49. Ed teNyenhuis
50. Juan Luis Thierry
51. Robert Thompson
52. Bob Tillman
53. Subhash Tuli
54. Peter Werelius
55. Jennifer Yu
56. Jim Zhang
57. Peter Zhao

GUESTS

1. Sergiy Razurayer
2. Don Duckett
3. Brian Klaponski
4. Scott Digby
5. Mark Ashford
6. Ulf Radbrandt
7. Klaus Pointner
8. Jeewan Puri
9. Poorvi Patel **
10. Dan Blaydon
11. DietrichBonmann
12. Dave Ostrander
13. Benjamin Lopez
14. Kerry Livingston
15. Roxana Nilchian
16. Ajith Varghese **
17. Jim McBride **
18. MichaelFranchek
19. Dan Perco
20. Gael Kennedy
21. SaurabhGhosh**
22. Aleksander Levin
23. Shamidra Valencia
24. Sanjib Son **
25. Ryan Thompson
26. Derek Foster **
27. Mike Craven
28. Shull Stephen
29. Jose Gamboa
30. David Goodwin
31. Henry B. Cooke
32. Clarence Bell
33. Sanjay Patel
34. Jean P. Gagnon
35. Trilok Garg
36. Wayne Johnson
37. Juergen Gerth
38. Bruce Fairris
39. Chris Stankowski
40. Guy Morrissette
41. Said Hachichi
42. SusmiltaTarlapally**
43. Lin Tong
44. GeneBlackburn**

** Guests requesting Membership.