IEEE/PES TRANSFORMERS COMMITTEE MEETING

PERFORMANCE CHARATERISTICS SC

October 17, 2001

Orlando, Florida

9.5 Performance Characteristics Subcommittee
Meeting Minutes – Orlando, Florida – October 17, 2001

9.5.1 Introduction/Attendance

The Performance Characteristics Subcommittee (PCS) met at 11:00 a.m. on Wednesday, October 17, with 63 members and 39 guests in attendance. 14 of those guests requested membership in PCS. All members and guests were requested to provide E-mail addresses, as E-mail will be the primary means of communication of PCS minutes and other documentation.

The meeting was initiated with a moment of silence in memory of those lost during the tragic events of September 11, 2001.

9.5.2 Approval of Meeting Minutes

The minutes of the April 11, 2001, PCS Meeting in Amsterdam, the Netherlands, were approved as written.

9.5.3 Chairman's Remarks

9.5.3.1 Administrative Subcommittee Notes

1) Next meeting locations are as follows: Spring 2002 – Vancouver, British Columbia; Fall 2002 – Oklahoma City, Oklahoma. Further details included with Committee Minutes. Potential hosts for future meetings should contact Greg Anderson (gwanderson@ieee.org).
2) After discussion, the Administrative SC agreed with Greg Anderson's proposal to prepare guidelines for allowing vendors, or others, to sponsor meeting breaks as a cost cutting measure.
3) Jim Harlow spoke as a representative of PES management in emphasizing PES's desire and request that Technical Committee meetings be held in conjunction with General Meetings (Winter or Summer Power Meetings, T&D Conference). This request is part of an effort to promote greater interaction and exchange of ideas between Committees. Jim also noted that John Estey, the new head of PES, has indicated his first priority is to reverse the trend of diminishing support of employers for volunteer technical work.
4) Per the Committee O&P Manual, all Subcommittee Chairs must be members of the Main Committee, and all WG Chairs must be members of both IEEE and PES. Also, IEEE requires Standards Association (SA) membership to ballot, and all new PAR's must list a WG Chair who is an SA member. In view of these items, the Administrative SC voted to require all WG Chairs to be SA members.
5) All individuals who wish to receive invitations to ballot on IEEE Standards have the responsibility to make sure their correct e-mail address is on file with IEEE. Status can be checked on the following website, or adjacent related websites: http://standards.ieee.org/db/balloting/ballotform.html
6) Each SC has been requested to supply a representative for the new Meeting SC WG on Web Page Development. Barry Beaster volunteered to attend the initial meeting as the PCS representative.
7) Jin Sim noted that recently there have been occasions where Frequency Response Analysis (FRA) testing has been required in user specifications, both at the factory and upon arrival at the rail siding. In some cases this testing is required in the context of an acceptance test. The concern expresses is that acceptance criteria do

not appear to be clearly defined. Jin asked for discussion, particularly in PCS and in the Dielectric Test and Power Transformer SC's, on whether there is sufficient support, based on available knowledge, to form a WG to develop standard or guide material related to FRA testing and possible acceptance criteria. This topic will be covered in the New Business section of the PCS meeting

8) Bipin Patel will retire as Committee Chair, as of January 1, 2002. Jin Sim will move up to Chair's position, and Ken Hanus will move up to Vice-Chairman. It was also announced that PCS Chairman Don Fallon will move into the Committee Secretary's position. At this time I expressed my thanks for the support of all PCS members, and all those contributing to PCS activities, for the support they have provided me during my tenure as PCS Chair, and asked for continuing support for the good work done by PCS. (Note: A successor as PCS Chair had not been determined by meeting time; subsequently PCS members were notified via e-mail of my great pleasure that Ramsis Girgis, of ABB, had agreed to take on this role, and were requested to provide him the same support that had been shown to me.)

9.5.3.2 Membership

14 new/return members were added to the PCS Roster:

Sam Aguirre, FAA
Jeffrey Britton, Phenix Tech.
Alvaro Cancino, Industrias IEM
Larry Coffeen, Georgia Tech./Neetrac
Don Duckett, Florida Power
Joe Foldi, ABB
Dave Kendrick, Black & Veatch
Joe Melanson, J. Melanson, Inc.
Harold Moore, H. Moore & Associates
Manuel Silvestri, Efacec Energia
Craig Swinderman, Mitsubishi Electric
Loren Wagenaar, AEP
Albert Walls, Federal Pacific
Jim Zhang, Mitsubishi Electric

The Membership roster will be reviewed shortly. Members who have not attended any of the last 4 meetings will be contacted regarding their removal from the PCS roster – thanking them for past participation, and indicating that with renewal of participation they will be welcome to rejoin the group.

9.5.4 Agenda Changes

None

9.5.5 Working Group Reports

9.5.5.1 PCS Revisions to C57.12.90 – Bruce Forsyth, Chair; submitted by Bob Ganser

The Working Group met on Monday at 11:00 a.m. Bob Ganser and Don Fallon co-chaired the meeting on behalf of the Chairman, Bruce Forsyth who was not able to attend due to travel restrictions. There were 44 persons in attendance.

The minutes of the Amsterdam meeting were read for approval. The minutes were approved with exception. Subash Tuli cited additional items that in his opinion were discussed at Amsterdam and should have been included. These items will be relayed to Bruce and he is asked to revise the minutes as necessary.

The results of a survey on 10 items related to specific revision of C57.12.90 conducted during the summer were reviewed. Three of the ten items were referred to other committee groups for final resolution. These items were:

- Item 1: regarding RIV vs. PD references was referred to the Dielectric Test Subcommittee;
- Item 4: regarding use of "average liquid temperature" was referred to the Insulation Life Subcommittee;
- Item 10: regarding wording for low frequency dielectric test for control equipment was referred to the Dielectric Test Subcommittee.

Two items were approved as submitted. These were:

- Item 2: updating cooling designations;
- Item 5: retain the use of T_K=234.5.

The remaining 5 items were opened for discussion with the bulk of the discussion time devoted to Item 3, rewording of the note under clause 4.3. As noted in the Amsterdam minutes, the level of concern for removal of the note was expressed again in the WG. Several members were opposed to the elimination of the note which would result in the elimination of Clause 4.3 entirely and thus eliminate any "Sequence of Test" requirement or recommendation.

Items 6 and 7 were accepted by the WG. Item 8 was discussed with floor acceptance by a negative vote. However, the negative voter acknowledged that he had not been contacted for resolution of objections as a follow up to the survey. The Chairmen will deal with item 9 in a follow up email because of the many negative responses.

It was decided to send these Items, 3,8 and 9 back to the Chairmen for reconciliation of the negative opinions.

On new business, Subash Tuli requested that the WG revise the Zero Sequence Section of C57.12.90. The acting Chair asked Subash to put his request and justification in writing to the Chairman of the WG.

There being no further business, the meeting was adjourned at 12:15 p.m.

Post Script: The Dielectric Test Subcommittee met after the WG and also had surveyed the question of removal of the note under clause 4.3. The result of their WG discussion was strongly in favor of retaining the note. Based on this and the discussion in the C57.12.90 WG, it appears that the note will be retained.

9.5.5.2 PCS Revisions to C57.12.00 - Steve Snyder, Chair; Dennis Marlow, Secretary

The Working Group met on Monday, October 15 at 1:45 PM. There were 18 members and 45 guests in attendance. The following 12 guests requested membership, and are welcomed into the Working Group:

Alan Darwin	Alstom T & D Transformers
Ray Nicholas	ABB Power T & D
Hemchandra Shertukde	University of Hartford
Robert Thompson	Duke Engineering
Jim McIver	Nevada Power
Manual Silvestra	EFACEC Energia, S.A.
Eduardo Garcia	VA Tech - Ferranti Packard De Mexico
Roger Hayes	VA Tech - Ferranti Packard
Robert Hartgrove	Carolina Power and Light
Tommy McGee	Howard Industries
Tommy Spitzer	Texas Utilities
Jeewan Puri	Consultant

The minutes from the April 10 Amsterdam meeting were approved as submitted.

An electronic survey of the *Performance Characteristics Subcommittee* and this Working Group was conducted in February 2001 addressing various comments received during the balloting of C57.12.00. Several issues were resolved at the Amsterdam meeting and various emails and personal discussions resolved others. C57.12.00 is expected to go out for ballot this year, with the 2001 year designation, and it will incorporate these resolved issues. The purpose of this meeting was to address the outstanding comments, resolving as many issues as possible, and then to introduce new items for discussion.

The following items were resolved:

1) **WG item 22, Table 10, note 11 (c)**, regarding nameplate information for tank, pressure and liquid data. After a lengthy discussion, the WG agreed that this note is not applicable to conservator type transformers, and that there would be **no changes to the existing wording**. There still is some interest in developing information about liquid level changes versus temperature for conservator type transformers.

2) **WG item 25, Table 10, Note 8**, concerning nameplate information for transformer weights. The Working Group agreed to add the following note:

   f) Original shipping weight, if different than total weight.

3) **WG item 32, Table 10, Note 8**, concerning nameplate information for transformer weights. A request was made that tolerances be specified for the weights shown on the nameplate and other drawings. After much discussion that the proposed tolerances were too small, it was determined that tolerance information should **not** be specified, and **no changes made to the existing document**.

4) **WG item 38**. Subhash Tuli has requested that a section be added to C57.12.00 to address instruction manuals. The Working Group agreed this would be a useful addition. Dennis Marlow volunteered to provide a copy of similar information from the Canadian standard CSA C88-M90 to Subhash and Steve Snyder, to initiate the writing of this section.

<u>NEW BUSINESS</u>

1) Dave Kendrick commented that a note may need to be added requiring autotransformer nameplates to indicate their suitability for both step up and step down operation.

2) A number of other items have been received by this WG that properly belong in other subcommittees, that are being forwarded on.

The meeting adjourned at 3:02 PM

9.8.5.3 DETC Specification and Test – Phil Hopkinson, Chair; John Gauthier, Secretary

The Working Group met on Monday, October 15, with 19 members and 13 guests registering (estimated > 60 total attendance). The minutes of the meeting held 14 April 2001, in Amsterdam, The Netherlands were approved as submitted.

The chairman noted that the mission of the WG is to develop an off-circuit tap changer standard. He briefly reviewed the task and work needed to be accomplished and the kinds of information needed to provide users on how tap changers should operate in service. For most applications, the de-energized tap-changer is placed in a position and never moved again for the thirty years of expected transformer life. Contact stability is extremely important to achieving long and trouble-free life. In order to assure that good and reliable tap-changers are produced, the Standard needs to clearly delineate the expectations, duty-cycles, and proof tests that will assure a good success. The purpose of the functional life test seeks to answer the latter requirement. This test provides accelerated aging and uses changes in resistance or lack thereof to detect unstable versus stable contacts. This discussion needs to be pursued and that is one of the purposes of the work of the WG.

OLD BUSINESS

The chairman reviewed the documents that have an impact or an influence on the work of the WG:

a. Existing C57.131 Requirements for De-energized Tap changers

   The chairman noted that this standard is currently under review and would be the likely document to include the functional life test that the WG had been tasked to develop. He briefly reviewed the basis for the pursuit of the standard and the considerations promoting its consideration. He demonstrated the very stable test results of silver-plated pairs of contacts. He also showed how thermal runaway can quickly occur with unstable contacts such as tin-plated copper mated on plain copper. Included among those matters were discussions of duty cycles that allow for regular overloads as well as the necessity to verify dielectric capability. He also addressed the needs of determining suitability for synthetic insulating liquid (different behavior than mineral oil and the need the manufacturer to establish ratings), routine and type test requirements and functional life tests. An extended discussion ensued on the results of life tests conducted on tap changers with various metallic contacts.

b. Draft IEC 60214

The chairman noted that the IEC document did not have a functional life test and that the members of the IEC committee responsible for the document, TC14, have resisted inclusion of the test. The failure to include such a test will result in a continued negative vote from the US. It was noted that IEC TC 14 circulated a CDV for IEC 60214 revision; that ballot closed in early August but the USNC failed to cast a vote on the document. This was a missed opportunity for the US influence the contents of this document.

Bengt Stenestam, a member of IEC TC14, reported on the questions raised during IEC TC14's consideration of the US proposal to add the functional life test to its document. He indicated that generally the IEC working group members could find no compelling reason for including the test in the document.

Mr. Stenestam presented a brief discussion of a comparison of the contents of IEC and IEEE standards on load- and off-circuit (no load) tap changers. He pointed out that the current IEC standard on load tap changers contains a thermal design test are similar to that in the new IEEE document. He noted that no IEC standard exists for off-circuit tap changers because few problems have been encountered; however, a new standard is under development that would incorporate a thermal design test based on values from the manufacturer. He noted that the US proposed standard would be more comprehensive. He noted that the IEC views the US proposal for functional life tests as interesting, but lacking an identified need – there has been no substantive professional studies published to date on the matter and what too few tests have been conducted to validate a need for a standard. He noted that discussions in IEC technical meetings concluded that the extra cost and effort to conduct routine tests on contacts was not matched by the need. In IEC discussions about including the dielectric test as a routine test concluded that very few transformer failures would be avoided with a dielectric test but that they could be included as special tests performed by agreement between the manufacturer and user.

Members engaged in an extended discussion concerning the need for the functional life test. The chairman reviewed key provisions and elements indicating a need for such a test. **In fact, at a meeting of the Association Of Electric Illuminating Companies in New Orleans that the chairman attended in 1996, coked contacts of de-energized tap-changers were cited as the biggest problem with liquid-filled transformers!!** By a vote of 24 to 9, members agreed that the development of a proposed test should be pursued and offered for inclusion in C57.131. In further discussion, it was noted that the WG's recommendation and draft should be presented to the appropriate IEEE subcommittee for a determination of how the proposed test should be disposed.

c. Future Work

The chairman noted that the task remains for the WG to develop a proposal for consideration by the IEEE subcommittee distribution transformers.

There was no new business. The meeting was adjourned at 4:40 pm.

9.8.5.4 Switching Transients Induced by Transformer/Breaker Interaction - Bob Degeneff, Chair; Peter Balma, Secretary

The Working Group on Switching Transients Induced by Transformer/Breaker Interaction was called to order at 8:02 AM on Tuesday October 16, 2001. There were 28 Members and 22 Guests present. After introductions, the agenda for the meeting was reviewed, followed by approval of the Minutes from the April 11, 2001, meeting in Amsterdam, Netherlands. Draft 1.3 of the guide, minutes, letters from R. K. Smith and Nigel McQuin, and copies of the overheads presented were distributed.

1) The current draft of the guide (1.3) was revised to be more general in nature, and to clarify terminology utilized. For example, the use of terms such as transient recovery voltage versus transient terminal voltage were reviewed.

2) A discussion of the Supply Characteristics Clause of the guide suggested that rather than rewriting existing published data, the guide should only reference the material. A concern that the references be readily available was made and acknowledged. Finally, Bill Griesacker volunteered from the working group and offered to prepare a draft for the clause and will consider both approaches.

3) Currently the Circuit Breaker Clause has not been drafted, however, input from letters by R. K. Smith and Nigel McQuin were reviewed and discussed. It is clear that there is need for a model from the switchgear/breaker community to assist in understanding the interaction problem. The group concluded there is a need to increase the liaison activities between the IEEE Switchgear and Transformer Committees, and suggested that a joint tutorial on this subject should be presented at the Vancouver meeting.

4) Examples of documented transformer and breaker interaction situations or failures were requested from the group. It is the intent that the guide contain at least three examples and to date only one example is available. This request will also be made to the Performance Characteristics Sub-committee.

5) Jeewan Puri provided an update of activities at CIGRE in this area. The CIGRE Joint working group consists of members from Study Committees 12, 13 and 23.21. A workshop is planned and will be followed by a summary document, and tutorial in this area. The joint group is also working to assemble a list of risk factors to be considered. Additional information is available on the CIGRE website.

6) The guide will be revised prior to the Vancouver meeting, and will be discussed in detail at that time in preparation for review by the Subcommittee in the fall of 2002.

The meeting adjourned at 9:04 AM.

9.8.5.5 Loss Tolerance and Measurement - Ramsis Girgis, Chair; Ed teNyenhuis, Secretary

Ramsis Girgis was unable to attend the meeting due an urgent family matter, so Ed teNyenhuis, the WG secretary, chaired the meeting in his place.

12 members and 19 guests attended, with 4 guest requesting membership.

Minutes from the Amsterdam meeting, held April 10, 2001, were read and approved.

TF meeting on “Guide of Low P.F. Power Measurements”

- Bill Henning reported on the meeting, in place of Eddy So, who was unable to chair the meeting.
- 7 members were in attendance.
- The guide is complete and has been released.
- Comments on the guide were discussed.

C57.123 Loss Measurement Guide

- The balloting for Draft 7 closed on April 11, 2001. 118 returns were received out of 146 total ballots. Out of the 118, 112 were affirmative, 1 was negative and 5 were abstention. This was a 99% affirmation.
- Draft 8 has been prepared that includes resolution of the negative ballot. As well, all of the comments, mostly editorial, given in the affirmative ballots were also included. A re-circulation letter has been prepared and members will be voting on the changes within a few weeks.
- Resolution of the negative ballot was reported upon.
- Comments from Eddy So to clarify the section on high impedance source measurements were presented and the pertaining changes to the guide were indicated.

Presentation of Paper "Proposed Standards for Frequency Conversion Factors of Transformer Performance Parameters"

- This is a paper prepared for the IEEE 2001 Atlanta T&D conference. The paper summarizes the investigations done and measurements performed to develop frequency conversion factors.
- The paper was presented which showed analytical work and supporting measurements for conversion factors for no load loss, exciting current, load loss and noise.
- Ernst Hanique noted that it was not clear to him that data provided by WG members would be used in a paper. This will be discussed in a phone call with Ramsis Girgis after the meeting.
- It will be discussed further at the next meeting in Vancouver as to the need for such conversion factors and the next steps in developing this into a possible guide.

The meeting was adjourned at 11.55 a.m

9.5.6 Project Reports

9.5.6.1 C57.133 Guide for Short Circuit Testing - Nigel McQuin

The WG did not meet in Orlando. It had been expected the balloting would be complete and this document would be moving towards publication by the time of this meeting, but difficulties continue. There were editorial problems with figures, and work is continuing to resolve one negative ballot. The PCS Chair will work with the WG Chair to move this document towards publication.

9.5.6.2 Status of C57.21, 1990 (R1995) Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500Kva

The reaffirmation ballot was out, and was then cancelled due to the discovery that the scanning process during IEEE editorial preparation of the ballot had resulted in significant errors in the document. The IEEE editorial staff plans to continue review after

the meeting with the intent to re-issue the ballot shortly. IEEE will set up a review process to avoid such problems with future reaffirmations.

The Dry-Type Reactor WG has already completed Drafts of Annex sections to C57.21 covering reactor switching, and the specification and testing of thyrister controlled shunt reactors for static VAR Compensators.

9.5.6.3 Inrush Current Tutorial

Ed teNyenhuis from ABB (co-author Ramsis Girgis was unable to attend), Glenn Swift from APT Power Technologies, Gary Kobet from TVA, and Phil Hopkinson from Square D conducted a Tutorial on Inrush Current on Monday afternoon, October 15. Interest was generated by the initial Tutorial in Nashville, and this second Tutorial presented a wider range of perspectives and went into considerably more depth of material. The following topics were treated:

- Fundamentals of Inrush
- Variables that affect Inrush
- The effect of kVA size, phases and phase angles, and source impedance
- Harmonics, especially the 2nd harmonic
- Impact of harmonics on metering

The authors presented good dynamic models that are capable of predicting inrush currents for use in preventing annoyance tripping. Discussion will continue on the possibility of additional inrush topics for future tutorial sessions.

PCS appreciates the work of the authors in preparation and presentation of this excellent Tutorial.

9.5.7 Old Business

9.5.7.1 Status of IEEE 32, 1972 (R1997) Standard Requirements, Terminology, and Test Procedure for Neutral Grounding Devices

This document expires in 2002. The Surge Protective Devices Committee has an active project to revise/supersede this document (PC62.91). PCS will not form a WG at present, as had been initially discussed, but contribution by PCS members is appropriate. Steve Schappell will assist in the PCS review. Additional volunteers may be needed; if you have experience or interest, please contact Steve at (Steven.Schappell@WaukeshaElectric.spx.com).

9.5.7.2 Topics for Future Technical Presentations / Panel Discussions / Tutorials

1) Review of the work of Bob Degeneff's WG on Switching Transients Induced by Transformer/Breaker Interaction.
2) Discussion on Loss Measurement, sponsored by Ramsis Girgis' WG on Loss Tolerance and Measurement.
3) Discussion on the variability (tolerances) of performance parameters for similar transformers, including parameters such as noise, thermal performance, core loss, excitation, inrush, etc.).
4) Energy Efficiency, and background for NEMA TP1 loading studies for distribution transformers.

These potential topics will be forwarded on to the Committee Chair. Volunteers who would be interested in developing these ideas further can contact me (donald.fallon@ieee.org).

9.5.7.3 Scope of C57.12.00 as Related to 25Hz Transformers

At an earlier meeting, a review was requested of the scope of C57.12.00 regarding applicability to 25Hz transformers, and an understanding of the terminology "special transformers". No action has yet been taken since the last meeting. Ongoing work in the WG on Loss tolerance and Measurement on conversion of losses, noise, and excitation current from 60Hz to 50 Hz will provide a basis of discussion of the 25Hz topic.

9.5.8 New Business

9.5.8.1 Frequency Response Analysis (FRA) Testing

Per Jin Sim's concerns noted in the Chairman's Remarks section of these Minutes, the issue of FRA testing was raised to assess interest for a WG to consider development of related standard or guide material. Considerable interest in the topic was expressed by PCS members. Discussers included:

- Alan Wilson – summarizing his experience over many years with the National Grid (U.K.) and more recently with Doble; noting that there is a large volume of data but that considerable expertise is still required in interpretation.
- Larry Coffeen – reviewed Neetrac's experience and interest.
- Mark Perkins – indicating increasing number of instances of FRA requirements in user specifications.

The consensus of the group discussion was that there was a need additional data collection. The group also affirmed the need to move towards inclusion in IEEE Standards and Guides. In addition to those named above, volunteers expressing interest in participating in future work on this topic included Bipin Patel, Loren Wagenaar, Bob Degeneff, Jin Sim, Gustav Preininger, Jeff Britton, Rowland James, Thang Hochanh, and Tom Spitzer.

Meeting time will be requested in Vancouver for an informal Task Force Meeting to discuss this topic and provide recommendations to PCS for action.

9.5.8.2 Transient Recovery Voltage for Transformer Limited Faults

A letter on this subject dated May 8, 2001, from Mel Smith, Chairman of a WG in the IEEE Switchgear Committee, was forwarded to the PCS Chair. A WG was forming during the summer of 2001 to review the subject in relation to requirements for breaker equipment. The WG is interested in collecting data during the testing of new transformers. This work appears to be aligned with the work of the PCS WG on Switching Transients Induced by Transformer/Breaker Interaction. Mr. Smith's letter will be forwarded to Bob Degeneff, Chair of the PCS WG, and to the Dielectric Test SC, and the main Committee officers. In the meantime, those interested in participating with Mr. Smith in this effort, either at future meetings or through correspondence, can contact him at mel.smith@ptd.siemens.com

9.5.9 Next Meeting

The next PCS meeting is expected to be scheduled for Wednesday, April 17, 2002, in Vancouver, British Columbia, Canada.

The meeting adjourned at 12:18 p.m.

Respectfully submitted,
Donald J. Fallon
PCS Chair 02/02/02

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