IEEE/PES TRANSFORMERS COMMITTEE MEETING

PERFORMANCE CHARATERISTICS SC

April 12, 2001

Amsterdam, The Netherlands

9.8 Performance Characteristics - D. J. Fallon

9.8.1 Introduction/Attendance

The Performance Characteristics Subcommittee (PCS) met at 9:30 a.m. on Wednesday, April 11, with 40 members and 41 guests in attendance. 15 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.

9.8.2 Approval of Meeting Minutes

The minutes of the October 17, 2000, PCS Meeting in Niagara Falls, Ontario, Canada, were approved as written.

9.8.3 Chairman's Remarks

9.8.3.1 Administrative Subcommittee Notes

1) Items which are covered by other parts of the minutes have been deleted by the secretary for editorial purposes.

2) All WG Chairs are requested to update their Rosters and forward to the PCS Chair by June 30. Lack of attendance or participation for 4 consecutive meetings should result in removal from the membership roster unless there are extenuating circumstances. Members with that record should be contacted regarding the status of their membership.

3) Separate E-mails were discussed at meeting time (and have been sent during May) to PCS members and guests distributing valuable information from Naeem Ahmad of IEEE related to web accessed information on the balloting and standards development process, and forwarding Committee Vice-Chair Jin Sim's encouragement for paper submission and sponsorship of technical sessions for the 2002 Winter Power Meeting.

9.8.3.2 Membership

15 new members were added to the PCS Roster:

Norman Field, Ferranti-Packard
Alan Forrest, Teshmont Consultants, Inc.
Robert Ganser, Transformer Consulting Services
William Griesacker, Pennsylvania Transformer
Peter Heinzig, Siemens AG
Marion Jaroszewski, Delta Star
Brian Klaponski, Carte International, Inc.
Don MacMillan, Tech-Tran Corp.
Mike McDermott, MJ McDermott & Associates
Guy Morrissette, VATECH Ferranti-Packard
Jim Nielson, Pauwels Canada, Inc.

Gustav Preininger, Consultant
Einar Purra, ABB Transformers AB
Raman Subramanian, Pennsylvania Transformer Tech.
Giuseppe Termine, PECO Energy

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 they will be welcome to renew their participation and rejoin the group.

9.8.4 Agenda Changes

None

9.8.5 Working Group Reports

9.8.5.1 Tap Changer for De-Energized Operation (Off-Circuit Tap-Changer) Specification and Test – Phil Hopkinson, Chair; John Gauthier, Secretary

The WG met at 8:00 AM on April 10, 2001. There were 20 members and 14 guests present, and 6 of those guests requested membership in the WG. The Minutes of the meeting held on 16 October 2000 were approved, and it was noted that these minutes were included in the IEEE Transformer Committee report.

The Chairman reaffirmed the task to develop a document to deal with off-circuit tap-changers. He noted that the IEC document is IEC 60214 that contains references to both on-load resistance and reactance type tap changers as well as off-circuit tap-changers. He noted that the IEC document has undergone some revisions recently, and these were subject of letter ballot review.

PCS Chair's note: The WG Chair used the IEC terminology "off-circuit tap-changer" during the meeting. IEEE terminology in the recent ballot of C57.12.80 is "tap changer for de-energized operation". The WG Chair agreed in discussion to modification of the Minutes to incorporate the IEEE terminology. The IEC terminology is included as well for the information of PCS members.

The Chairman briefly reviewed the specifics of the task noting that tap change devices are used as integral parts of transformers, liquid-filled and air-insulated. He noted that the tap changers for de-energized operation (off-circuit tap-changers) could be mounted on core clamps, inside a cabinet but not on the core clamp, or in a separate cabinet. These options require close communications between the user and the manufacturer so that satisfactory performance is achievable.

He noted that Tap Changers needed to have a rating in terms of their maximum continuous current. He noted that if the tap changer ran at rated load it could operate in excess of twenty years. Members engaged in a brief discussion of the expected life of the tap changer – twenty years or higher and how this may or may not be achieved. The standard is intended to

communicate the requirements for the tap changer, including load cycles up to twice rated load daily, elevated temperatures, acceptable fluids, and short circuits. These application considerations have particular impact on the proper choice of the electrical contacts. The tap-changer manufacturer needs to understand the expectations of his product and provide uniform rating information to the user.

The Chairman briefly discussed the suitability of the tap-changer in synthetic insulating liquids (Silicone), noting that faster oxidation of the contacts is experienced in these environments. Satisfactory thermal stability and contact life needs to be demonstrated by the tap-changer manufacturer for Silicone as well as for mineral oil and/or air if any or all of these environmental conditions are to be rated.

The WG briefly reviewed the routine (r) and type (t) tests: proposed for the tap change manufacturer: resistance (r), spring pressure (r), dielectric integrity (r), functional life (t), short circuit (t), mechanical endurance (t), operating torque (t) and seal (r). These tests may all be classed as type tests (instead of routine), but should be audited frequently to assure that current production is still in compliance.

The Chairman briefly discussed the temperature rise of contact test. He noted that the tests would most likely be conducted in the brand new state, but the temperature rises seen at that stage may not continue after some period of operation if the contacts are unstable. The functional life test should be conducted as a type test to assure stability over a 20-30 year period. A brief review of testing on six samples of contact materials ensued: silver versus silver in silicone (the most stable contacts in the most aggressive environment); silver versus nickel in silicone; silver versus copper in silicone (not as stable as silver versus silver); copper versus tin in silicone (canceled because of unfavorable results); copper versus copper in mineral oil and copper versus copper in silicone. Silver versus silver demonstrated the greatest stability and exhibited no change in resistance in both a short-term (30 day) and a long-term (6 months) test. He noted that unstable contacts are often detected by the presence of hydrogen gas that proceeds to ethylene and ethane and eventually leads to acetylene that is caused by arcing. Such arcing produces gas bubbles that may cause dielectric flashover and loss of a coil. The conclusion is that the tap-changer must be functional life-tested to verify its stability as a type test.

The Chairman noted that the IEC standard, IEC 60214, contained sketchy rating information. As a result, the US comments on the current revision of the document contained recommendations to include continuous rating information, transient rating information, and suitable environment information.

It was recommended that the IEEE document contain the aforementioned rating information as well as call for the functional life test. It was noted that good communications between the tap changer manufacturer and the user plays a significant role in the delivery of a correct product.

It was inquired if the document would address switches. It was agreed that dual voltage off-circuit switches and delta-wye switches should be addressed.

Members engaged in a brief discussion on the need to ensure harmonization between the IEEE and the IEC standards. It was noted that harmonization means that both documents should not provide conflicting information; they are not necessarily identical documents. Functional

requirements, not construction (design) specific criteria, should be in standards. A document that addresses only temperature rise and not stability is not sufficiently complete, it was noted. It was recommended that the IEC method of calculation of temperature rise, based on 1.2 times rated current, should be considered. It was proposed that the IEC requirements be reviewed and presented at the next meeting of the WG. Mr. Bengt Stenestam agreed to provide such a review.

It was noted that temperature rise at 1.2 x rated load; and also at 2 x rated load would be addressed in the document

The Chairman summarized the need for the document: to establish a communication link between the tap change manufacturer and user. He proposed to offer some language to change C57.131. It was noted that the WG should develop a PAR, since the task has been refined. It was proposed that the proposed revision be presented to the WG preparing the revision of C57.131. Both tasks will be undertaken.

There being no additional business, the meeting was adjourned at 9:20 AM

9.8.5.2 PCS Revisions to C57.12.90 – Bruce Forsyth, Chair; submitted by Neil Kranich

The Working Group met on Tuesday, April 10, 2001 with 19 members and 15 guests present. There were 10 requests for new membership in the working group. Neil Kranich chaired the meeting in Bruce Forsyth's absence. Minutes from the October 16, 2000 meeting in Niagara Falls were approved as written.

Proposed wording for new test procedures that had been submitted by Subhash Tuli and Dan Perco were handed out to the group for discussion. The wording on DGA testing submitted by Roland James was not available for distribution at this time.

Dan Perco's rewording of the note in clause 4.3 was intended to address an issue raised that the note led to undue concern for the potential of damage during testing. There was a lengthy discussion of both the note and the proposed revision, after which the working group voted to eliminate the note in clause 4.3 completely. Removal of this note leaves the sequence of tests, other than the dielectric tests, unspecified and therefore subject to either the manufacturer's practice or the purchaser's specification.

The proposed wording for Operational Tests of all Devices Operated from the Control Box (Not including LTC Mechanisms), Operational Testing of Load Tap Changers, and Low Frequency Dielectric Test for Low Voltage Control Wiring, Associated Auxiliary Control Equipment, and Current Transformer Secondary Circuits, on Class II Transformers were discussed and approved with minor editorial changes. At this point the meeting ran out of time. Neil announced that Bruce will e-mail the proposed and revised wording of all the new test procedures in survey form within four weeks, in an effort to get everything cleaned up as quickly as possible.

The meeting adjourned at 10:45 AM.

9.8.5.3 PCS Revisions to C57.12.00 – Steve Snyder, Chair; Dennis Marlow, Secretary

The Working Group met on Tuesday, April 10 at 1:30 PM. There were 17 members and 20 guests in attendance. The following 3 guests requested membership, and are welcomed into the

Working Group:

Don Fallon	Public Service Electric & Gas
Marion Jaroszewski	Delta Star Inc.
Raman Subramanian	Pennsylvania Transformer Technology

The minutes from the October 16 Niagara Falls meeting were approved as submitted. Dennis Marlow has agreed to be the Working Group secretary.

An electronic survey of PCS and the WG was conducted in February 2001 addressing various comments received during the balloting of C57.12.00. 125 members were surveyed and 30 returns were received. A total of 23 items were included in the survey; 8 items were approved without comment, 5 items approved with comment, and 10 items were not approved. The purpose of this meeting was to review the comments and resolve as many issues as possible.

The following items were resolved:

1) Clause 4.3.3 note (k), regarding unusual service conditions, will remain as it appears in the present version of C57.12.00.

2) Clause 5.5.3 concerning the ratings of transformer taps, will be revised as follows: "Whenever a transformer is provided with taps from a winding for de-energized operation, they shall be full-capacity taps. Transformers with load tap-changing equipment may have reduced capacity taps unless specified otherwise, for taps below rated winding voltage. When specified, other capacity taps may be provided. In all cases, the capacity shall be stated on the nameplate."

   The group also discussed whether there was any interest in changing the IEEE / ANSI requirements to specify full-capacity taps on LTC transformers for taps below rated voltage. Unanimously, those present voted against considering this change.

3) Clause 4.3.3 note (g) will be revised as follows: "Unusual duty or frequency of operation, or high current short duration loading."

   Due to time constraints, the remaining items could not be addressed during the meeting. Work will continue via e-mail and telephone to resolve as many of these issues as possible before the next ballot of C57.12.00.

5 items of new business have been submitted for future consideration by the appropriate committee or working group:

1) Dennis Marlow, clause 5.11.1, winding temperature rises.

2) Dennis Marlow, clause 5.11.2, conditions under which temperature limits apply.

3) Don Platts, table 10, note 8, accuracy requirements for nameplate & drawing weights.

4) Jerry Corkran, table 13, note (a), phase-to-phase clearances.

5) Jerry Corkran, clause 5.1, cooling classes of transformers.

In addition, during the meeting the following items were brought before the Working Group:

6) Subhash Tuli, requested that a new section be added to C57.12.00 to address instruction manuals, sound levels, and the correction of a switching surge level listed in table 6.

7) Leon Plaster pointed out that the existing ANSI standards do not define a limit on corona for class I transformers, and requested the appropriate committee review this.

The meeting adjourned at 2:47 PM.

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

11 members and 18 guests attended, 4 requested membership.

The first report was from Eddy So on the TF meeting on "Guide of Low P.F. Power Measurements". The complete draft of the guide was discussed. The TF Chairman will send the document to the members of the WG and TF for review. He will discuss the feedback and will make the necessary changes to the document for the Fall meeting. (PCS Chair's Note: This Guide is sponsored by PSIM, but the application is here. If any PCS member wishes to assist in review of this document, please contact Eddy So at eddy.so@nrc.ca)

The next item reported was the status of the "Loss Measurement" Guide. The Guide was sent for balloting right after the Niagara Falls Fall meeting. The closing date of the ballot is April 11, 2001. As of April 9, 2001, 100 returns were received out of 146 total ballots. Out of the 100, 94 were affirmative, 1 was negative and 5 were abstention. The Chairman reported that there were a great number of good comments, mostly editorial, but there were about 10 comments that were of a technical nature which were discussed and resolved at the WG meeting. Once all the ballots have been received, the plan is to make all the changes agreed upon and get approval for reversing the negative ballot(s). The changes will then be sent for re-balloting.

The meeting was adjourned at 5:45 p.m.

9.8.5.5 Switching Transient 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 8:05 AM on Wednesday April 11, 2001. There were 31 Members and 8 Guests present. After introductions, the agenda for the meeting was reviewed, followed by approval of the Minutes from the October 17, 2000, meeting in Niagara Falls, Canada. Draft 2 of the guide,

minutes, and copies of the overheads presented were distributed.

The PAR, PC57.142 for this working group has been approved.

Tom Tobin of the IEEE Switchgear committee contributed to the working guide by providing a perspective of breaker / transformer interaction from the breaker point of view. He suggested that definitions for this guide need to be consistent with those of the breaker community. In addition, he indicated the switchgear committee has looked at this problem from the dV/dt and high voltage point of view at the terminals of the transformer. However, they agree this issue has not been addressed in terms of internal resonant voltages.

The group discussed the need for reproducing information relative to understanding the system external to the transformer since it exists in several existing guides and publications, for example CIGRE Report #50 and C37 and IEC standards. The general consensus of the group was to use the results of these guides without reproducing the derivations.

Jeewan Puri provided an update of activities at CIGRE in this area. They propose a workshop in 2002, and to provide a tutorial / guide in the future for understanding interaction phenomena. The present effort is looking to define risk factors for potential problems, and provide a guide to users to determine if further study or mitigation components are needed. A copy of the last CIGRE meeting minutes will be distributed with these minutes.

The table of contents of the existing draft were reviewed to determine if the level of content is sufficient and that all the information needed is included in the guide. As the table of contents was reviewed, the working group looked for volunteers to draft unwritten sections. Various discussions during this review expressed concerns for mitigation methods, transformer sizes impacted, risk analysis, and the economics of study versus mitigation.

The meeting adjourned at 9:16 AM.

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

The WG did not meet in Niagara Falls. The PCS Chair reported status. The Ballot is expected to go out very shortly. There is an urgent need to return this document to active status. All members of the Ballot Group are urged by PCS to consider voting affirmative, and to note comments with their ballot if there are areas for suggested enhancement of the document. The Short Circuit Test Guide is presently out of publication, as the Annex originally covering this subject has been removed from the revision of C57.12.90. If concerns for the Ballot on C57.133 can be expressed as comments to an approved ballot, then this needed document will be published. PCS will then initiate a new PAR for revision work to cover any topics that arise in the ballot process.

9.8.6 Project Reports

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

The reaffirmation process, which was expected to have been in motion at the time of this meeting, experienced some communication difficulties. The process has been initiated, and

reaffirmation is expected prior to the next meeting. Peter Balma will handle the reaffirmation for PCS. In the Dry Type Reactor WG, Richard Dudley, with assistance from others, has prepared a Draft for an Annex to C57.21 covering specification and testing of thyrister controlled shunt reactors for static VAR Compensators. As reported at the last meeting, Richard Dudley and Peter Balma have both volunteered for leadership roles in the updating of C57.21 after the reaffirmation process is complete. Specific responsibilities will be defined based in part on the needs identified in the reaffirmation ballot.

9.8.7 Old Business

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

This document expires in 2002. The Transformer Committee considers that PCS will have the responsibility for updating and maintenance of this document. PCS will work with Tom Prevost to review responsibility, as this document had been administered by the Surge Protective Devices Committee, and review of that Committee's website indicates their plan to "Prepare new standard C62.91 which will be a revision and updating of existing standard IEEE 32.1972." At the very least, input from the Transformers Committee is appropriate. Steve Schappell has volunteered to Chair a new WG to discuss updating IEEE 32, and a meeting will be scheduled for this WG in Orlando. Volunteers are needed to work with Steve on this project. If you have experience or interest, please contact Steve at (Steven.Schappell@WaukeshaElectric.spx.com).

9.8.7.2 Inrush Current Tutorial

An Inrush Current Tutorial will be scheduled for the Orlando Committee Meeting, building from Phil Hopkinson's and Ramsis Girgis' presentations at the Nashville Meeting. Glen Swift has volunteered to discuss impact of inrush current on differential relaying. Fred Elliott has agreed to discuss BPA experience in dealing with inrush effects. Others considering possible participation (especially utilities with practice in response to inrush issues) are asked to contact either Phil Hopkinson (hopkinsp@squared.com), as Phil has agreed to coordinate the organization of this Tutorial, or myself.

9.8.7.3 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 as related to the topic of a National Energy Policy

These potential topics will be forwarded on to the Committee Chair. Volunteers who would be interested in developing these ideas further can contact the PCS Chair.

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

At the last meeting, Don Platts requested a review of the scope of C57.12.00 regarding applicability to 25Hz transformers, and an understanding of the terminology "special transformers". The topic was raised as no action had been taken since the last meeting. Ramsis Girgis commented that there would be work in his WG on conversion of losses, noise, and excitation current from 60Hz to 50 Hz, and that this could provide a basis of discussion of the 25Hz topic.

There were no other items of new business.

9.8.9 Next Meeting

The next PCS meeting is expected to be scheduled for Wednesday, October 17, 2001, in Orlando, Florida.

The meeting adjourned at 10:35 a.m.

Respectfully submitted,

Donald J. Fallon

PCS Chair 5/31/01

(donald.fallon@ieee.org)