9.11 Performance Characteristics Subcommittee

9.11.1 Introduction/Attendance

The Performance Characteristics Subcommittee (PCS) met at 11:00 A.M. on Wednesday, October 8,2003 with 68 members and 24 guests in attendance. 6 of those guests requested membership in PCS.

9.11.2 Approval of Meeting Minutes

The minutes of the March 19, 2003, PCS Meeting in Raleigh were approved as written.

9.11.3 Chairman's Remarks

9.11.3.1 Administrative Subcommittee Notes

1) Next Standards meeting dates and locations are as follows:
   Spring 2004: March 7 – 11, San Diego, CA
   Fall 2004 is Sept 19 – 23 in Edinburgh, Scotland

2) Next year's IEEE PES meeting will be held in Denver, Colorado, from June 6–12, 2004.

3) It was emphasized that when balloting for reconfirmation, a negative vote should not be cast unless the proposed changes are significant. When the proposed changes are either minor, or editorial in nature, that the vote should be "approved with proposed changes"

4) We need to get the S.C. Guide through ASAP. The chairman will contact Nigel MQuin and IEEE to finalize the issues involved. Tom Prevost will provide help.

5) The Administration committee is looking into the possibility of a different format for the Thursday Transformer Standards Committee meeting.

6) At the end of this year, Jin Sim who is the present chairman of the transformer committee will complete his two-year tenure. As of January 1st., Kenneth Hanus, the present vice president, will assume the chairmanship, Don Fallon, the present secretary will be the vice chair, and Tom Prevost will be the secretary.

7) Minutes of this meeting should be sent to Don Fallon before November 21, 2003.

8) Note: Individuals who wish to receive invitations to ballots 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

9.11.3.2 Membership

6 new members asked for membership and were added to the PCS Roster:

Frank Damico, Tamini	Gene Blackburn, Consultant
Ron Daubert, Finley Engineering Co	Bob Tillman, Alabama Power Co
Christoph Ploetner, Siemens	Greg Anderson, Consultant

The Membership roster will be reviewed, and 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.

9.11.4 Agenda Changes

The report on activities of the Semi-conductor Rectifier Transformer – C57.18.10 WG – Sheldon Kennedy, Chairman, was added to the Agenda and report on the activities of the DETC Specifications and Test TF – Phil Hopkinson, Chairman, was removed from the Agenda as this TF now is part of the LTC Performance C57.131 WG reporting to the "Power" SC.

9.11.5 Working Group and Task Force Reports

9.11.5.1 PCS WG for Continuous Revision to C57.12.90 – Bruce Forsyth, Chairman; Rowland James, Secretary

The PCS working group for Revisions to test code C57.12.90 met in Pittsburgh, Pennsylvania on October 6, 2003 at 9:30 A.M. There were 40 members and 20 guests in attendance. The following 3 guests requested membership, and are welcomed into the Working Group, bringing total membership to 92:

Gary King	Howard Industries
Dana Basel	ABB
Hem Shertukde	University of Hartford

After introductions, the minutes from the March 17, 2003 meeting were reviewed. A motion to accept as written was made by Bob Hartgrove and seconded by Subhash Tuli. The motion passed unanimously. The Agenda was then reviewed and no changes were requested.

The Chairman announced that as a result of a recent ruling by the IEEE regarding the use of metric and imperial units in standards, IEEE Std C57.12.90 will be re-balloted in mid-November. Any new items to be included in the ballot must be submitted no later than October 31, 2003.

The Chairman announced that there are currently 7 open items (5 old and 2 new) for the WG to consider.

Old Business

Before addressing the first item under Old Business, the chairman asked the WG to consider a new item, WG Item 18, "Proposed Wording for 50-60 Hz Frequency Conversion Factors" which was presented to this WG by the WG Loss Tolerance and Measurement. The proposal provided wording for clauses affecting no-load loss and excitation current, load loss, and audible sound level. The WG offered a number of technical and editorial changes in the text. Also, it was suggested to examine the effect of a series reactor on the conversion factors for no load loss. Ed teNyenhuis will take the comments raised during the discussion to the WG Loss Tolerance and Measurement for their consideration. . A revised text will be submitted in the San Diego meeting, including text on the thermal and S.C. tests.

The next item, Draft 2 of WG Item 11, "Single-Phase Excitation Tests," was discussed at length. A few minor errors were identified for immediate correction. Several changes to a table under clause 1.4 "Test Procedure" were recommended. The main substantive changes were as follows:

1. The word "should" will be changed to "shall."

2. The word "Recommended" will be changed to "Required."

3. The list of optional tests will be eliminated since the WG felt the document should only include requirements.

4. The requirement to test every DETC tap position will be changed to required only the rated DETC tap position be tested.

5. A note will be added to describe the additional tests required when the regulating voltage winding design does not have equal voltage between each tap.

Since time was running out, the Chairman ended the discussion and informed the WG that a copy of the revised wording for WG Item 11 would be emailed to WG members shortly along with wording for WG Item 9, "Operational Tests of Load Tap Changers" for review, and hopefully resolution, prior to the next meeting.

Finally, the chairman announced that during the PCS meeting in Raleigh, there was a consensus that the WG for Continuous Revisions to C57.12.90 would be the WG to develop the test procedure for the DGA test with input from the WG for C57.12.00 and the Insulating Fluids Subcommittee. Based on this, the Chairman will re-open WG Item-14 and make the necessary contacts with the chairmen of these WG and SC.

9.11.5.2 PCS WG for Continuous Revision to C57.12.00 - Steve Snyder, Chairman; Dennis Marlow, Secretary

The Working Group met on Monday, October 6 at 1:45 PM. There were 29 members and 51 guests in attendance. The following guest requested membership, and is welcomed into the Working Group, bringing the total membership to 64 members :

Allen Mitchell: ABB, St. Louis, Mo.

Following introductions, the minutes from the March 17, 2003 Raleigh meeting were approved as submitted.

Subhash Tuli reported that as a result of the recent IEEE decision to allow dual dimensioning on Transformers Committee documents, C57.12.00 will be re-balloted, probably as soon as mid November 2003. This ballot will also capture all the pending changes accumulated since the previous ballot.

The Working Group then began discussing the topics of old business, as follows :

WG Item 49, Section 7.1.5.2 Asymmetrical current used for short circuit calculations. Comments received from the draft 3 ballot of C57.12.00 – 2000 stated that the x/r ratio for the user's system is greatly different than the recommendations in the standard, and that they differ from those values used in IEEE C37.04 and IEC 56. This comment is directed at the statement in the standard : "When the system impedance is included in the fault-current calculation, the x/r ratio of the external impedance shall be assumed equal to that of the transformer, when not specified."

Following the spring meeting, Ramsis Girgis researched this topic and provided data on over 100 transformers, revealing a range of x/r ratios as follows :

	Range of x/r Ratio
Small Power Transformers	15 to 40
Medium Power Transformers	35 to 70
Large Power Transformers	40 to 125

He also received input from the ABB power systems engineering group, and found that x/r ratios for power systems varied approximately as follows :

765 kV Lines	21
500 kV Lines	15
345 kV Lines	12
230 kV Lines	10
161 kV Lines	9.7

This data was widely discussed among the WG members and guests, with the final conclusion that since the system x/r is much smaller than the transformer x/r, it will have little impact upon the asymmetrical peak current calculation. The effect it will have is to make the design slightly more conservative. By a vote of 38 –2, the WG voted to not change the standard, except to add a note explaining this rationale.

WG Item 50, Section 7.1.5.3 System characteristics for short-circuit calculations. **A c**omment received from the draft 3 ballot of C57.12.00 – 2000 stated that the default value of X0/X1 = 2.0 as given in the standard is too high. The user suggested a value between 0.60 and 0.40 .

After a great deal of discussion, the WG determined that more data needs to be collected from other users to make a more informed decision. The chairman will survey the PCS committee and WG to collect additional **system values** of x0/x1, and the discussion will resume at the next meeting based on the collected data.

WG Item 52, Section 9.2 Tolerances for Impedance. A comment received from the draft 3 ballot of C57.12.00 – 2000 stated that the user felt the impedance tolerances given in the standard were not clear, and that the tolerances were too great. The suggestion was to cut in half the present tolerances, and to add a tolerance on tap position.

The chairman reported that a survey of the PCS committee and this WG conducted during July/August 2003, to determine opinion on this request, **produced the following results :**

168 surveys sent	Question 1) 39 No	12 Yes
52 responses	Question 2) 37 No	14 Yes
28 manufacturers	Question 3) 41 No	7 Yes
13 utilities		
11 consultant / other		

This discussion began with some users explaining how a reduced variation in impedance could provide benefits to them, particularly with respect to paralleling transformers with mismatched impedances. An opinion also was expressed that users believe manufacturers can easily reduce this tolerance without much difficulty because of the availability today of accurate impedance calculations based on advanced magnetic field calculations. It was pointed out that this section applies to all transformers manufactured according to C57.12.00, including distribution transformers which normally incorporate rectangular construction, and that construction variables are especially onerous with rectangular coils. Some manufacturers reported that after reviewing historical data, the proposed reduced tolerances would be hard to meet. A more reasonable reduction may be feasible..

At this point the meeting time had expired, so this discussion will be continued at the next meeting. For the sake of a proper decision on this item, more data is encouraged from transformer manufacturers.

9.11.5.3 Loss Tolerance and Measurement - Ed teNyenhuis, Chairman; Andy Steineman, Secretary

- 16 members and 8 guests attended, with 1 guest requesting membership.
- Minutes from the Raleigh meeting, Mar 18, 2003, were read and approved.
- Because of the absence of Eddie So, the TF meeting for “Guide of Low Power Factor Power Measurements” was canceled and thus there was no report. A status report on the guide will be requested from Eddy So.
- Frequency Conversion Factors of Transformer Performance Parameters
  - Wording from the Raleigh meeting had been sent to the C57.12.90 WG and was presented in the WG meeting on Oct 6. The WG for C57.12.90 suggested some editorial changes and requested that the sections on the frequency conversion factor should be presented again at a later meeting once the revisions are completed, including the sections on the temperature-rise and short circuit tests.
  - The WG discussed the suggested change by WG for C57.12.90 to add the phrase “upon agreement with the customer at the time of quotation”. The WG agreed that this wording was not consistent with the rest of the C57.12.00 or the C57.12.90. It was decided that the wording should be revised to “upon mutual agreement with the customer”.
  - Revised wording in C57.12.90 Section 8.6 (No load loss and exciting current) – The WG agreed to revise the wording as follows:

  - Change the "B<1.4T" to "B=1.4T"
  - Remove "rated" from "rated flux density"
  - Move the sentence "Since the value of these conversion factors is an average value …" to the end of the section
- Revised wording in C57.12.90 Section 9.4.3 (Load Loss) – The WG agreed and discussed the following:
  - Move the sentence "Since the value of these conversion factors is an average value …" to the end of the section
  - Add wording on converting the measured impedance voltage to the rated frequency for the next meeting.
  - It was shown that the impedance voltage is nearly proportional to frequency. The error of using a frequency ratio can be 0.5% for small transformers (< 50MVA) but the error is negligible for large transformers.
  - Verification data from 6 units measured at both 50 Hz and 60Hz was shown. Except for 1 unit, the error was less than 1% on the total loss. This 1 unit had a very high stray loss relative to the total loss and perhaps there was some temperature effect on the measurement.
- Revised Wording in C57.12.90 Section 13.3.7 (Sound Level) – The WG agreed to revise the wording as follows:
  - Remove "rated" from "rated flux density"
  - Move the sentence "Since the value of these conversion factors is an average value …" to the end of the section
- Short Circuit Test – The WG discussed how the test could be done at a different frequency than the rated frequency:
  - The voltage applied would be nearly the ratio of the frequency (as per the discussion on impedance voltage)
  - The WG agreed to investigate the necessity of converting the K factor for a different frequency. A statement should be given in the standard.
  - The WG agreed on the need to examine the effect of performing a 50 vs 60 Hz s.c. test on a transformer relative to the number of cycles and energy applied to the transformer.
- Temperature Rise Test – The WG agreed to the following:
  - The current must be adjusted to provide the correct rated frequency total heat run loss
  - The manufacturer must have a supply to operate the cooling at the rated frequency
  - Conversion factors must be developed to convert the measured winding rise and tank/structural parts rise to the temperature rise for rated frequency. This will be developed for the next meeting.
  - The tank / structural parts would have a few degrees greater temperature rise than at rated frequency. The manufacturer must ensure there is sufficient margin in the temperature rise of these parts to avoid gas generation during the temperature rise test.
- Distribution Transformers – The WG agreed to the following:
  - Oil-filled distribution transformers are covered by C57.12.90. Once the work is completed for frequency conversion factors, a review should be made to ensure that it is applicable for distribution transformers.
  - There should be a need for frequency conversion factors for dry type transformers. The chairman of the C57.12.91 WG will be notified of this so that appropriate wording is added to that standard.

9.11.5.4 Switching Transients Induced by Transformer / Breaker Interaction, PC57.142 - Robert Degeneff, Chairman; Peter Balma, Secretary

The Working Group on Switching Transients Induced by Transformer/Breaker Interaction was called to order at 8:02 AM on October 7, 2003. There were 75 attendees, 37 members, 5 requesting membership, and 33 guests. The agenda for the meeting was reviewed, and the Minutes from the March 18, 2003, meeting in Raleigh, North Carolina were approved. The minutes, and a new draft of the guide were also distributed.

1. Status of the guide was reviewed. Draft 1.5 includes comments from several reviewers, and was sent to IEEE Editorial staff for comments. The comments from IEEE and some additional input as described below, will be included, so that an informal survey of the subcommittee can be held in the next two to three months.

2. Additional items to be added to the guide include the following:

• Frequency Response Analysis (FRA)	Larry Coffen
• Additional definitions	
• Discussion of damping	Phil Hopkinson
• Breaker Section	Switchgear Committee
• Additional example	Robert Degeneff

3. A question was raised as to what frequencies are of concern, is it just the first two resonant frequencies to be considered, or all frequencies. Discussion of this topic pointed out that the anecdotal evidence reviewed by the group has seems to indicate lower frequencies are of greatest concern. Higher frequencies however can occur, but typically are attributed to the proximity of gas insulated systems. In addition, it was indicated that higher frequencies tend to be quickly damped.

4. Contributors (Phil Hopkinson, Bob Degeneff, and Tom Tobin) were thanked for their effort to prepare and present the tutorial session held on this subject at the Raleigh meeting.

5. Thomas Tobin made a presentation to the group titled “Switching Resonance Load Circuit Investigation on Creation of Re-ignitions.” The following items briefly summarize the key topics of the presentation, which will be made available electronically to the working group.

5.1. Assumptions
- Transformer terminal model

5.2. Circuits
- Magnetizing current is not a problem

5.3. Load circuit
- Resistive, higher power factor, and electronic loads to be considered

5.4. Vacuum circuit breaker
- Ability to interrupt and chop high frequencies

5.5. Base cases
- Distribution of re-ignitions versus frequency considered

5.6. Cable length impacts

5.7. Loads
- Motor loads not difficult duty
- Electronic / rectifier loads need investigation

5.8. Three phase models

- Greater complication and inter-phase capacitance is a driver and seems to be important.

5.9. Three phase cases

- Virtual current interruptions occur in phases where contacts have not yet parted

5.10. Future work

- Transformer model to be used
- Rectifier / electronic load models
- Risk or probability of re-ignition

6. Discussion after the presentation considered the impact of load current / chopping current and the likelihood of repeated re-ignitions. Further, the types of transformer and or rectifier load models that could be used were also discussed, along with the impact of higher loads.

7. It was requested if the Switchgear Committee (Tom Tobin) could provide additional characteristics for vacuum breakers. In addition, the working group was asked to review the guide in general, and to provide any guidance to enhance the content of the guide.

8. There was no new or old business.

9.11.5.5 Semi-Conductor Rectifier Transformers, C57.18.10 – Sheldon Kennedy, Chairman

The Working Group met on Monday, October 6, 2003 at 3:15 PM with 16 members and 4 guests present. Sheldon Kennedy chaired the meeting.

C57.18.10 is due for reaffirmation. The standard was balloted for reaffirmation. There were 44 votes with one abstention for an 84 % return, meeting the 75 % requirement. There were 41 affirmative votes with two negatives with comments.

The negative votes agreed to remove their negatives and vote affirmative if the working group would agree to begin a revision to discuss the comments.

The working members present voted unanimously to accept the motion that this standard is worthy of reaffirmation, but that the comments received would improve the standard. A new work should be started to incorporate the comments through a corrigenda to the standard.

Besides the editorial comments, there was interest in commenting about the possibility of ferroresonance with some of the ungrounded wye circuits from a utility. A user was interested in including comments about the use of electrostatic ground shields in windings and their potential test problems. Some other comments received were somewhat vague and need further discussion and explanation from the commenters.

It was agreed that a task force would be formed at the next meeting in San Diego to resolve the comments into a corrigenda to this standard. This will be produced after the reaffirmation.

9.11.5.6 Neutral Grounding Devices, PC57.32 – Steve Schappell, Chairman

The working group met at 3:15 pm on Monday, October 6, with 16 in attendance. There were 6 members and 10 guests. One of the guests requested membership, and will be accepted.

Edgar Taylor, past chair of PC62.91 (IEEE 32), was introduced. Edgar spoke briefly about the need for the neutral grounding devices standard, as well as its history. He provided copies of several documents, including letters with suggestions for the standard, a conference paper on thermal ratings and temperature limits for neutral grounding devices, and a marked-up rough draft of PC62.91.

The group discussed the Definitions and Terminology section. It was suggested by Edgar that many of the definitions could be removed, as they are provided elsewhere.

The group discussed the different types of grounding devices, and agreed that the ones in common use today are resistors, reactors, and transformers. Capacitors and ground-fault neutralizers were deemed rare, and will be moved to an annex.

Richard Dudley said that he would talk to Christoph Plotner, Chairman of IEC60076 Reactors, to determine if our working group would benefit from their work on grounding transformers and suppressive reactors.

Tom Prevost said that he would check on the status of IEEE 32 to determine if it should be renewed, so that the standard would not die before the new standard comes out.

Steve Schappell volunteered to produce a new draft of PC57.32 and email it to the members and guests by the end of October.

9.11.5.7 TF on Frequency Response Test Standard/Guide – Rowland James, Chairman; Charles Sweetser, Secretary

The PCS task force met for the development of a guide for Frequency Response Analysis (FRA) in Pittsburgh, Pennsylvania on October 7, 2003 at 3:15 P.M. There were 40 persons in attendance, 10 members and 30 guests of which 13 guests requested membership.

Rowland James made a brief report on the development of the draft. Charles Sweetser presented a newly condensed outline consisting of six sections. The sections are as follows:

Section 1 - SCOPE AND APPLICATION
Section 2 - FRA TEST PARAMETERS
Section 3 - MAKING AN FRA MEASUREMENT
Section 4 - TEST RECORDS
Section 5 - ANALYSIS AND INTERPRETATION
Section 6 - APPENDIX: FRA THEORY

Members were assigned for contribution according to their expertise for each section.

The following members were assigned:

Responsibility	Section 1	Section 2	Section 3
Primary	Mark Perkins	Ernst Hanique	Charles Sweetser
Secondary	Joe Watson	Richard Breytenbach	Paulette Payne
Secondary	Jin Sim	May Wang	Jeff Brittton
Secondary	Rowland James	Larry Coffeen	
	Section 4	**Section 5**	**Section 6**
Primary	Barry Ward	Charles Sweetser	Bob Degeneff
Secondary	Bertrand Poulin	Larry Coffeen	
Secondary		Richard Breytenbach	

Fred Elliott of BPA presented a short report on experience of FRA testing. The report focused primarily on the transportation of transformers and reactors. Fred's examples included apparatus with and without oil. All of the results indicated that no shipping damage had occurred.

It is planned that the assigned primaries will be approached by Chuck Sweetser to have them review and add to the sections of the present document. Once this is completed, the different sections will be sent to the Secondaries for their input and comments. This is planned to be completed, and a more complete draft, submitted before the FRA TF meeting in SanDiego.

After some general comments the meeting was adjourned at 4:10 P.M.

9.11.6 Project Reports

9.11.6.1 Status of C57.133 - Guide for Short Circuit Testing - Nigel McQuin, Chairman

Chairman not present. Nothing to report

9.11.6.2 Status of Revision of C57.110-1998 - IEEE Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents – Rick Marek, Chairman

Nothing to report

9.11.6.3 Status of Revision of C57.21, 1990 (R1995) - Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500kVA – Richard Dudley, Chairman

A meeting was held in the Reflections Room of the Sheraton Station Square Hotel in Pittsburgh, PA in the 8:00 a.m. to 9:15 a.m. time slot to establish W.G. membership and commence work on the revision of C57.21. Note that the time slot was shared with the Dry Type Reactor T.F. At future IEEE Transformer Committee meetings the W.G. for the Revision of C57.21 will meet in a separate time slot. The Chairman of the W.G. for the Revision of C57.21, Richard Dudley, asked for volunteers to join the W.G. Fourteen of those present requested membership. The following are the highlights of the ensuing discussions.

1. The Chairman informed those present that a PAR for the revision of C57.21 had been approved at the Sept. meeting of the IEEE Standards Board. The scope of the revision work will be to address issues raised in ballot comments during the recent reaffirmation process for the current version of C57.21 and to add two annexes; one on thyristor controlled reactors used in SVCs and the other on dielectric stresses imposed on shunt reactors during switching. The W.G. will report to the Performance Characteristics S.C.

2. The reaffirmation of the current version of C57.21 is at recirculation ballot stage and the process should be completed by the end of 2003; including IEEE Standards Board approval.

3. The Chairman informed attendees of his difficulties in obtaining from IEEE a usable copy of the current version of C57.21 in WORD format. This subject was raised at the Administrative S.C. meeting and IEEE staff attendees promised to address this issue. An IEEE staff member in attendance promised to provide a suitable WORD formatted copy of C57.21 by the end of November 2003. The Chairman will continue to follow up with Noelle Humenick of IEEE.

4. The subject of iron losses in oil-immersed shunt reactors was reviewed. Although the equation submitted by Peter Heinzig, to replace the current equation in NOTE 15, is technically correct, Pierre Riffon has demonstrated by example calculation that it is not practical due to inherent tolerances in the measured data (temperature and measured total losses) used in the calculation process. In Pierre's example the error was 50% using the proposed equation vs the values for iron losses calculated by the manufacturer. Consensus was that calculated iron losses provided by the manufacturer should be used. NOTE 15 of Clause 10.4.4.1 will be rewritten. "Iron losses will be provided by the shunt reactor manufacturer; calculated iron losses."

5. Pierre Riffon's draft modification to Clause 10.3.3 was discussed; partial discharge measurements during the one hour low frequency over voltage test for oil immersed shunt reactors will be based on apparent charge and units of pico Coulombs vs RIV and micro volts. Pierre used the current test methodology for power transformers as his guide; magnitude of partial discharge does not exceed 500 pC (old method 200 μ volts), increase in partial discharge does not exceed 150 pC and no steadily rising trend in partial discharge actively. It is also recommended to use ultrasonic transducers to help discriminate between internal and external partial discharge sources. Partial discharge measurements are not applicable to oil immersed shunt reactors rated 69 kV and below. Pierre's proposal was accepted.

6. The only issue arising out of discussions of Pierre's proposal for Clause 10.5.3. was whether the current Tables 5A (oil immersed) and 5B (dry type) should be combined into one table covering both oil immersed and dry type SRs. Consensus was reached that this should be done and Pierre Riffon agreed to produce a first draft. Issues of note re this exercise are.

    - Insulation test levels for oil immersed only or dry type only should be specifically noted.

- Since oil immersed and dry type shunt reactors are used interchangeable in the power system, test values should be common for the same dielectric test methodology.

- The current Table 5A contains multiple test levels for the various voltage classes. This reflects the practice for power transformers. Is it applicable for shunt reactors? Acceptable BILs for SRs for a specific system voltage class will differ from those for power transformers due to the high number of switching operations that SRs are exposed to. A note will be added to the combined table re this issue and the reader will be referred to ANNEX B which discusses dielectric stresses to which SRs are exposed during switching.

- Ramon Garcia raised the issue of how to handle system voltage classes not specifically listed in the table. The current NOTE (2) provides some guidance re the low frequency overvoltage test. BIL's are normally specified by the purchaser.

- The number of system voltage classes will be reduced but will cover a range as is done in bushing standards.

7. Greg Polovick's comment re Pierre's draft of Clause 10.3.3 was discussed. If a single phase test is performed in lieu of a 3 phase test (based on agreement between purchaser and manufacturer) due to equipment limitations, Greg proposes that a second single phase supply be used to ensure stressing of the interphase insulation. This may not always be possible. Per Pierre a single phase test has been the practice especially on EHV SRs. The phase to phase insulation is stressed but not at operating voltage levels. To take into consideration Greg's comment a NOTE will be added "A single phase test does not fully stress the interphase insulation. However, if a second single phase supply is available it is possible to fully stress the interphase insulation".

8. The Chairman agreed to prepare Draft #4 of ANNEX B taking into consideration the comments from IEC MT 32 and Pierre Riffon's rebuttal. Inputs from other W.G. members was requested as soon as possible. Hopefully input from the IEEE Switchgear Committee will be available for consideration. It was agreed to keep the discussion in the second paragraph of B.3.3. as is. The dv/dt description will be replaced by "high rate of change voltage excursion" as it is more appropriate and meaningful.

9. The Chairman agreed that he would prepare a first draft of the revision of C57.21 based on the above discussion, the draft annexes prepared by the Dry Type Reactor T.F. and previous discussions (Raleigh) of comments received during the reaffirmation balloting process. This should be available in early 2004.

10. Peter Balma has submitted to IEEE a marked up copy of the version of C57.21 that was balloted during the reaffirmation process correcting all the OCR errors. Many thanks to Peter.

9.11.6.4 Panel Discussion "Power System Over-voltage Requirements and their Impact on Transformer Design" – Ramsis Girgis Chairman

The tutorial contained the following items:

- Influence of system conditions on excitation of transformer cores, presented by Dr. Gustav Preininger
- Influence of core excitation on core design, presented by Dr. Ramsis Girgis
- Over-voltage requirements and system operating parameters for GSUs and Autos, presented by Mr. Bipin Patel and Mr. Donald Chu
- Experience with Utilities specifications, system operations, and impact on core over-excitation, presented by Mr. Harold Moore
- Recommendations, by Mr. Harold Moore

Subsequent to this tutorial, the participants on the tutorial were selected to form the nucleus of the TF of representatives from users, manufacturers, and consultants to decide on what changes to what specific Standards are necessary. The TF will also develop the text for the changes agreed upon by the TF. The first meeting of this TF will be held in the SanDiego meeting. Mr. Craig Stiegemeier was selected to be the chairman of this TF.

9.11.7 Old Business

A discussion was held whether or not to expand the scope of C57.12.00 to cover 25 Hertz transformers. It was decided that these are "specialty" transformers and therefore do not need to be covered at this time when there are a number of more pressing items which need to be attended to.

9.11.8 New Business

A Tutorial session will be arranged for the San Diego meeting to discuss accurate measurement of zero-sequence impedance for interconnected transformers. Subsequent to the meeting a Task Force will be formed to develop the standard test.

9.11.9 Next Meeting

The next meeting is scheduled for March 10, 2004, in San Diego, CA.

Attendance at this Pittsburgh Meeting

MEMBERS

1. David Aho
2. Stephen Antosz
3. James Antweiler
4. Peter Balma
5. Ronald L. Barker
6. Israel Barrientos
7. Dana Basel
8. Barry L. Beaster
9. Steve Beckman
10. William Boettger
11. Jeffrey Britton
12. Carl Bush
13. Alvaro Cancino
14. Bill Chiu
15. Larry Coffeen
16. Jerry L. Corkran
17. John C. Crouse
18. Alan W. Darwin
19. Robert Degeneff
20. Dieter Dohnal
21. Richard F. Dudley
22. Fred E. Elliott
23. Donald J. Fallon
24. Reto Fausch
25. Joe Foldi
26. Bruce Forsyth
27. Andreas Garnitschnig
28. Ramsis S. Girgis
29. Myron Gruber
30. Ernst Hanique
31. Tom Harbaugh
32. Bob Hartgrove
33. Roger R. Hayes
34. Peter Heinzig
35. William Henning
36. Thang Hochanh
37. John Holland
38. Philip Hopkinson
39. Tim Huff
40. Rowland James
41. Sheldon Kennedy
42. Vladimir Khalin
43. Boyd Leuenberger
44. Allen Mitchell
45. Guy Morrissette
46. Van Nhi Nguyen
47. Klaus Papp
48. Bipin K. Patel
49. Paulette A. Payne
50. Donald W. Platts
51. Gustav Preininger
52. Jeewan Puri
53. Jean-Christophe Riboud
54. Mark Rivers
55. Marnie Roussell
56. Ewald Schweiger
57. Devki Sharma
58. H. Jin Sim
59. Steve Snyder
60. Andy Speegle
61. Craig Steigemeier
62. Raman Subramanian
63. Charles Sweetser
64. Giuseppe Termini
65. Robert Thompson
66. Subhash Tuli
67. Loren Wagenaar
68. Waldemar Ziomek

GUESTS

1. Pritpal Singh
2. Michael Williams
3. Wes Patterson
4. Frank Damico *
5. Bruse Fairris
6. Ron Daubert *
7. Jane Ann Verner
8. Brent Hayman
9. Al Traut
10. Jayant Patwardhan
11. C. J. Kalra
12. Ramon Garcia
13. Batrik Mimailovic
14. Tom Jauch
15. P. Riffon
16. Marcel Fortin
17. Christoph Ploetner *
18. Bob DelVecchio
19. Matt McCormack
20. Gene Blackburn*
21. Bob Tillman *
22. Ken Hanus
23. Sue McNelly
24. Greg Anderson *

* Guests requesting Membership.