7.3 POWER TRANSFORMERS

The Power Transformers Subcommittee met Wednesday afternoon at 1:00 pm with 45 members, 14 new members and 54 guests in attendance.

The minutes from the Oklahoma City meeting were approved before the various working groups and task forces reported.

7.3.1 WORKING GROUP AND TASK FORCE REPORTS

7.3.1.1 TASK FORCE FOR REVISION OF C57.17, ARC FURNACE TRANSFORMERS – Dom Corsi, Chairman

Robert Ganser reported that the Task Force on revision of C57.17, Arc Furnace Transformers, was called to order at 8:00 am on Monday, March 17, 2003. There were 19 attendees.

Dom Corsi then presented the Agenda. The first order of business was review and approval of the minutes from the October, 2002, meeting that was held in Oklahoma City.

Dom Corsi announced that it was his intention to submit a PAR for this activity by the end of April 2003. In addition, the draft template for the revision work will be available in Word format one week after the meeting.

The Work Scope statement of the Standard was presented for review. The TF recommended that the term "ferrous" be removed from the Scope. This would open the Standard to all arc furnace transformer applications for various service applications and duties. A method for describing these applications and service duty requirements will be addressed within the revised Standard.

The revisions to Section 4 (Impedance Voltage) and Section 7 (Construction) were accepted.

The topic of Insulation Levels led to a discussion of the common failure mechanisms of arc furnace transformers. Some members suggested that a section on transformer protective requirements be considered for inclusion in the revision. The group agreed in principle that protection techniques such as snubbers, capacitors and relaying schemes would be better placed in an Appendix and as a Guide.

In addition, the group recommended a review of C37 for any requirements specifically related to switchgear application to the primary of arc furnace transformers.

Under New Business, the Chair will be contacting individual TF members to participate in the writing of the revision. Each section and Appendix of the draft will be authored by one individual member of the group.

Mr. Tom Slovik provided additional recommendation, requirements and inclusions to the Standard that he, Mr. Ugo Piovan and Mr. Giovanni Testin discussed in February 2003. The comments were provided in written form to the Chair.

Being no further business to discuss, the meeting adjourned at 9:00 am.

7.3.1.2 TASK FORCE ON A GUIDE FOR STANDARD CONTROL CABINET DESIGNS – Joe Watson, Chairman

The task force met at 11:00 am on Monday, March 17, 2003, with 36 in attendance. There were 18 members and 18 guests.

The chairman checked with the group to ascertain whether all group members were receiving the group correspondence by e-mail. A couple of people were recorded as not receiving the email, and they will be contacted further to determine the source of the problem.

The next discussion concerned the results of the Control Cabinet Survey. Ten users and 6 manufacturers responded. The results will help us to understand what should be considered as a standard item. It was noted that manufacturers and users sometimes differed on what is rare and what is frequently required, such as vibration reduction mounting.

C37.21 was brought up again, and many sections of the latest draft were mentioned as to having applicability to the Guide for Standard Control Cabinet Designs. It was questioned as to whether we want to create a stand-alone standard, or use C37.21. It was decided that C37.21 does not contain all of the information that the group feels is needed, so it will be used as a resource to us.

The chairman mentioned that we need to be able to provide users with standard designs for units without forced-air ratings, units with forced-air ratings, and forced oil units. LTC and non-LTC versions of each will be provided. Brent Hayman volunteered to provide 8 ½ x 11 drawings of a non-LTC, non forced-air unit in PDF format to the chairman for distribution to the group as a starting point.

It was mentioned that C37.91 and C57.12.10 should be utilized for descriptions and functionality of components.

The standard control drawings, as well as the C37.21 standard, will be emailed to the group over the next few months.

The meeting adjourned at 11:50 am.

7.3.1.3 WORKING GROUP ON LOAD TAP CHANGER PERFORMANCE - William Henning, Chairman

The Working Group on Load Tap Changer Performance met on Monday, March 17, at 1:45 pm with 17 members and 33 guests attending. The minutes of the previous meeting of October 21, 2002 were approved as written.

The business of the WG was to discuss the need for a general revision of C57.131-1995, Standard Requirements for Load Tap Changers. There are three sources of proposals for revision.

- Comments received during the IEEE re-affirmation ballot of C57.131-1995.
- Input from the De-Energized Tap Changers (DETC) Specification and Test WG, which has now become the Task Force to develop a functional life test for DETC's.
- A review of IEC 60214-1, Tap Changers Part 1: Performance Requirements and Tests.

The WG discussed a new title, new scope, and new purpose for the document. These items were modified to include DETC's as well as load tap changers (LTC's).

The WG then discussed IEC tap changer standards. There are two relevant documents:

- IEC 60214-1, Tap Changers- Part 1: Performance Requirements and Tests
- IEC 60214-2, Tap Changers- Part 2: Application Guide

The first document is an approved IEC Standard that has been published. The second is completely written, but not yet approved.

These two IEC documents are parallel to two IEEE projects assigned to this WG. IEEE PC57.131, Standard Requirements for Tap Changers, covers the same material as IEC 60214-1 and IEEE PC57.141, Tap Changer Application Guide is a parallel document to IEC 60214-2.

The WG discussed the possibility of IEEE simply adopting the existing IEC Standards. This would be accomplished by conducting a formal ballot to adopt these IEC Standards as IEEE Standards. If approved, they would become IEEE Standards.

Some felt that this may not be possible because changes might be required to reflect US practices. The WG agreed, though, to attempt to simply adopt the new IEC Standards as a first step.

The meeting was adjourned at 2:45 pm. After the meeting, some discussions continued about the IEC documents. One suggestion was for IEEE to assign numbers of C57.131.1 and C57.131.2 and to title them Part 1 and Part 2 like the IEC Standards. Another suggestion was to schedule two timeslots at the next and subsequent meetings to develop both documents at the same time.

7.3.1.4 WORKING GROUP ON C57.140 "GUIDE FOR THE EVALUATION AND RECONDITIONING OF LIQUID IMMERSED POWER TRANSFORMERS" - Rowland James, Chairman.

William Bartley reported that the Working Group on C57.140, the Guide for the Evaluation and Reconditioning of Liquid Immersed Power Transformers, met at 3:15 pm Tuesday, March 18th, with 100 in attendance. There were 60 members and 40 guests. 14 of the guests requested membership.

After introductions, a brief discussion of the latest draft's status was held. The chairman reported that an extension to the PAR has been requested. Tom Prevost will advise us on the status of the request.

The draft is essentially complete with the exception of six articles. Numerous volunteers were recruited to complete the document. We hope to obtain those sections within 60 days. The Guide will then be edited/reorganized into a more logical sequence. The next draft should be issued by early to mid-summer.

Discussion from the floor:

- There was a discussion on off-line and on-line dry out methods. Concern was voiced with the article on the on-line method. It will be revised to make it more general in nature with proper precautions.
- A discussion of Furan analysis vs. DP testing was also held. The consensus of the group was tha Furan analysis can not be related to DP values.

The meeting was adjourned at 4:30 pm.

7.3.1.5 WEST COAST WORKING GROUP - Michael Lau, Chairman

Michael Lau reported that the West Coast Working Group met on Tuesday, March 18, 2003 at 8:00 am with 8 members and 2 guests present. One guest requested membership.

The chairman provided a summary on the last meeting and the intention of the group to write a supplementary guide to IEEE 690, Recommended Practice for Seismic Design of Substations. A discussion was held on the sudden pressure relay and the potential false tripping of such during seismic events. It was concluded that despite this outstanding issue with the sudden pressure relay there is inadequate justification for a supplemental guide.

The group then discussed other potential projects. This includes: step-up transformers for wind turbine and other distributed generation applications, operation of transformers in severe conditions such as extremely high or extremely low temperatures and problems associated with shipping of transformers.

At the end, no decision was made and the West Coast WG still has no active projects. The meeting adjourned at 9:19 am.

7.3.1.6 WORKING GROUP FOR THE REVISION OF C57.93, INSTALLATION OF LIQUID-FILLED TRANSFORMERS - Michael Lau, Chairman

Mike Lau reported that the Working Group on the Installation of Liquid-filled Transformers was called to order at 9:35 am on Monday, March 17, 2003. There were 35 attendees; 18 members, 13 guests and 4 requesting membership. The agenda for the meeting was reviewed followed by approval of the minutes from the October meeting in Oklahoma City. The minutes, a new draft of the Guide, copies of the overheads presented and a table prepared by Paulette Payne on vacuum processing and filling were distributed.

Contributors to-date were recognized for their input.

A summary of key points from the last meeting included the need for a revised PAR to include maintenance in the Guide, and that the Guide' format will most likely change to merge the large and small transformer sections together to avoid duplication. It was suggested that Clause 4 for large transformers be completed first, and then could be used as a guide to blend into Clause 3 for small transformers.

The next draft of the Guide will be placed on the Transformer Committee's website, and will be accessible with the Transformer Committee's password. In addition, the next revision of the Guide will be e-mailed to participants approximately one week prior to the next meeting.

Procedurally, it was decided that each clause of the Guide would be reviewed once by the WG, and would not be revisited at future meetings. An informal subcommittee ballot will be held prior to a formal ballot of the Transformers Committee to provide an additional opportunity for input.

A review of Draft 2 was started. Clause 1 (Scope) and Clause 2 (References) were reviewed without comment. The review then moved to Clause 4 and the following items were recommended and discussed.

- A common clause to describe cautions and concerns for entry of personnel into transformers is needed. It should recognize local and national requirements and/or the absence of requirements and provide the sufficient information for this work to be performed safely. Joe Watson volunteered to prepare a draft.
- Clause 4.2.2.6, (impact recorders) will provide additional clarification on the capability of electronic recorders that are now available, and additional guidance that the impact recorder attached to the transformer should be left on the transformer until the transformer is rigged into its final location.
- The discussion of rough handling during shipment and receiving should be expanded to include the levels and durations of impacts that the manufacturer and user should be aware of. These are not design values but rather values for discussion. Suggested values were:

Type of Impact	Levels for Discussion
Longitudinal	3g
Vertical	2g
Transverse	2g

- The need for Clause 4.6 (Preliminary liquid filling) was discussed, and the group voted to eliminate the clause. Consensus was that the clause resulted from historical needs, and that the state of the art had advanced to where it is no longer required.
- Clause 4.7.1 (Assembly – General) will be modified to include a statement relative to grounding bushings as soon as they are installed, and also to avoid unnecessary atmospheric exposure of the core and coils.
- Clause 4.7.2 (Bushings) will be modified to discuss bushings that require the capacitance tap to be grounded or ungrounded, and the impact of adding a bushing monitoring system. In addition, additional clarification of the testing of C1 and C2 with and without a tap present will be discussed.

General guidelines for the review of a clause of the document were shared, and volunteers to review the clauses were as follows:

- Clause 3.1 & 4.2 (General & Shipping): Wes Kunth
- Clause 3.5 & 4.7 (Assembly): Wayne Hansen
- Clause 4.11 (Tests): Paulette Payne

A suggestion was made to add storage guidelines to Clause 4, for larger transformers.

Paulette Payne provided an update of Doble's activities in the area and shared a comparison of key vacuum processing levels and times for consideration of the group. It was recommended that any tables related to processing should clearly delineate voltage classes of equipment to which they apply.

Under Old Business, a reminder was made to add a clause relative to cold weather dewpoint testing.

There was no other Old or New Business, and the meeting adjourned at 10:44 am.

7.3.1.7 WORKING GROUP ON ON-LINE MONITORING OF LIQUID IMMERSED TRANSFORMERS - Donald Chu and Andre Lux, Co-Chairpersons

Donald Chu reported that the Working Group for the Guide for Application of Monitoring to Liquid-Immersed Transformers and Components met Tuesday, March 18th at 3:15 pm. There were 56 attendees; 20 members, 36 guests and 7 requesting membership.

After introductions, a brief discussion was held on the status of the Guide. Restructuring was done because there were many overlaps between clauses. Sections were also reorganized.

Since the revised Guide was distributed at this meeting, there were no discussions or comments on the Guide. Discussions were held on how to get the Guide "back on track" and expedite receipts of comments. A small group will meet at the IEEE Summer Meeting with a survey scheduled for this summer.

Since there were no other discussions, the Chairman asked if any utility would discuss the status and philosophy of monitoring. Con Edison of New York discussed how monitoring was being used to perform predictive maintenance, in lieu of scheduled maintenance.

The meeting adjourned at 4:00 pm.

7.3.1.8 TASK FORCE FOR FUNCTIONAL LIFE TESTS OF DE-ENERGIZED TAP CHANGERS – Phil Hopkinson, Chairman

Phil Hopkinson reported that the d-energized tap changer functional life test Task Force met at 9:30 am on Tuesday, March 18. The meeting was attended by 24 members and 20 guests.

The scope of this Task Force has been changed from a full specification for de-energized tap changers to a functional life test development that will demonstrate contact stability of de-energized tap changers.

The chairman proposed an accelerated test that applies 2 times rated current for 8 hours in a 130°C bath, followed by 16 hours off. The test is replicated for 30 days. Pass/fail criteria are resistance that does not change by more than 25% and stability at the end of the test.

Reinhausen, ABB and Cooper Industries volunteered to perform the test and to report progress at the October meeting. The chairman is also seeking other authors for the report.

The meeting adjourned at 10:45 am.

7.3.1.9 WORKING GROUP FOR REVISION OF C57.12.10 - Javier Arteaga, Chairman

David Aho reported that the Working Group met at 1:45 pm on March 18th with 17 members, 10 guests and 6 new members. The minutes from the Oklahoma City meeting were reviewed and approved.

For now, the document will proceed with dual dimensions as appropriate.

Since the scope of this document us solely for Power Transformers, all references to Distribution Basic Impulse Level (BIL) will be removed. This change will impact a number of accessory items currently identified in the document.

The wording, with respect to accessory applications, will need to be reviewed. For some accessories, their application is dependent on the type of transformer construction (i.e. sealed tank, conservator). A separate Table will be developed to define specific accessory requirements.

Since the scope of the PAR has no upper limit on either kVA or voltage, the document will need to be revised to handle ratings beyond the current version of C57.12.10. Also, each style of tank construction (i.e. sealed tank, inert gas pressure, conservator and gas-liquid seal) must be addressed.

All transformers will require a manual "pressure relief valve" along with a cover mounted pressure relief device (PRD). The rating of the PRD will need to be addressed.

Table 11, Basic Standard Construction Features, will need to be modified due to elimination of distribution BIL's and exceeding the 60 MVA rating.

The LTC section was briefly discussed. Jim Harlow had revised this section well over a year ago and it needs to be reviewed by the WG. This section will be reviewed in detail at the next meeting. The one item discussed had to do with the physical location of the tap switch position indicator drag hand reset provisions and whether the provisions are electrical or mechanical. The reset provisions must be at a reasonable height for someone to operate from ground level. A suggestion was made to limit the height to around 2 meters (80"-84").

A number of other miscellaneous issues and comments were addressed for gauges and valves.

The draft document will be circulated for additional comments. Volunteers will be needed to critique specific sections.

With no further business, the meeting adjourned at 3:00 pm.

7.3.2 OLD BUSINESS

Tom Lundquist reported that a new TF will be formed for revision of C57.135, the Phase Shifting Transformer Guide.

Red Hager initiated a discussion on the need for more volunteers and the responsibilities of WG and SC members.

7.3.3 NEW BUSINESS

Don Cash reported that C57.117, the Guide for Reporting Transformer Failure Data and C57.125, the Guide for Failure Investigation were both due to expire this year. Wally Bender has volunteered to see these 2 Guides through the reaffirmation process.

Tom Lundquist reported on tests to measure the natural frequency of transformers to determine capacitance values as a modeling tool for Transient Recovery Voltage calculations. Mr. Lundquist offered all users who would like to also have this information a section to add to their transformer specifications to perform these tests if they would e-mail him requesting the section..

The meeting adjourned at 2:15 pm.