8.12 POWER TRANSFORMERS – TOM LUNDQUIST, CHAIRMAN

The Power Transformers Subcommittee met at 1:30 pm, on Wednesday, March 16th with 55 members and 54 guests. 9 of the Guests requested membership.

The minutes from the Las Vegas meeting were approved with no changes or corrections.

The chairman asked if anyone was aware of any patent conflicts, none were voiced.

Requested backup for secretary position.

8.12.1 WORKING GROUP AND TASK FORCE REPORTS

8.12.1.1 TASK FORCE FOR REVISION OF C57.17, REQUIREMENTS FOR ARC FURNACE TRANSFORMERS – Dominic Corsi, Chairman

Meeting was cancelled.

8.12.1.2 WORKING GROUP FOR DEVELOPMENT OF PC57.143, GUIDE FOR APPLICATION OF MONITORING TO LIQUID IMMERSED TRANSFORMERS AND COMPONENTS- Donald Chu and Andre Lux, Co-Chairmen

Meeting Minutes for Working Group on PC57.143 Transformer monitoring. 9:30 AM
March 14, 2005 Jackson MS
Acting Chair -Tom Lundquist

- 18 members, 37 guests were in attendance with 4 requests to become members.
- Patent issue was mentioned with no one presenting an issue.
- Minutes from prior meeting were approved.
- No discussion was held on the draft document.
- 4 people volunteered to become secretary to provide an active backup for meetings.
    - Remi Pages – requesting membership
    - Luiz Cheim – requesting membership
    - Tony Pink
    - Terrance Martin – requesting membership.
- Discussion of another TF group meeting during the Doble conference was opened and a list of 12 people indicated interest in such a meeting. This information will be passed on to Don Chu the chair for planning.
- A short presentation of an ESKOM paper on advantageous of monitoring transformer fault gas was presented by Stan Lindgren following the discussion and a request by Luiz Cheim was granted to present a discussion of transformer evaluations.
- The meeting adjourned at 9:50.

8.12.1.3 WORKING GROUP FOR DEVELOPMENT OF PC57.148, STANDARD FOR CONTROL CABINETS FOR TRANSFORMERS – Joe Watson, Chairman

The working group met at 11:00 a.m. on Monday, March 14, 2005, with 29 in attendance. There were 13 members in attendance and 16 guests. None of the guests requested membership. Working group chair Joe Watson was unable to attend so working group vice-chair Steve Schappell led the meeting with Scott Digby filling in to keep the minutes.

The roster was handed out and introductions made. Copies of Draft 3 of the Standard, which had been previously e-mailed to working group members, were available at the meeting. The minutes from the previous meeting were approved without comment. The group was again asked if there was any knowledge of any patents that may be essential to the implementation of the Standard. There were no responses regarding this issue.

A note from Joe Watson was reviewed indicating his disappointment in the participation from the working group members, citing a lack of input for Draft 3. It was noted that the PAR for this working group requires a much more complete draft of the Standard by the Memphis meeting in Fall 2005.

The scope and purpose of the document were reviewed. It was noted that significant time during the last meeting was devoted towards the construction of the actual cabinet and that the working group now needs to focus on the details of the modular designs for layouts and components stated in the purpose. It was noted that several manufacturers had submitted "standard" cabinet layouts/designs and that circuit and cabinet layout diagrams still need to be added to the draft based on the information received.

Another note from Joe Watson was reviewed suggesting that the system designating the cabinet type code based on transformer type may not work well with the draft in its current form but that 3 to 4 layout versions that a user may select from may be a better approach. This prompted some discussion to reduce the cabinet types referenced in the table in Section 8 with the conclusion being to simplify to two basic types, non-LTC and LTC, with no reference to cooling classes. An ONAN transformer would simply have the same basic layout as an OANN/ONAF transformer only without that added cooling equipment, and similarly for OFAF. This proposal was later voted upon and approved 15 to 1.

The question was raised as to the general feel for the modular concept. Input was received that standard terminal point designations, and general location of items within the cabinet would be very helpful to users in making user's interface less manufacturer dependent, however, exact dimensional locations may not be explicitly necessary. It was also stated that a similar approach had been used within the circuit breaker standards group and that IEEE C37.11 could be reviewed.

A comment was made that this Standard should reference the specific wire that should be used for certain applications within the cabinet (i.e., CT wiring, power circuits, etc.), including the wire gauge and wire insulation. Another question was raised as to whether color-coding should be required or not.

There were discussions regarding the ratings of the specific components listed in Section 5.

It was recommended to reduce power terminal block rating requirement for voltage and current rating to 1.25 times the auxiliary power voltage and maximum auxiliary power load current (from 2 times).

It was recommended to restate circuit breaker ratings listed within section 5.4 to state that: "Circuit breakers should be coordinated with the load, accounting for motor starting inrush, etc", leaving it as manufacturers responsibility to properly size the breaker according to application.

The section on contactors may need to be broadened as there are other devices that are not NEMA type devices that will perform the same function adequately. Should NEMA or IEC contactors be required, or dual-rated? There was a call for volunteers to complete this section but no one came forth.

It was noted that the 4-hole bolt pattern requirement for switches would disallow certain switches that may be acceptable for certain applications and the recommendation was made to delete this requirement.

For the section on Heaters, Cabinet Fans, Ventilation and Drains, there needs to be a provision or option for deletion of heaters or vents for certain applications since certain applications may disallow such features (ex. NEMA 4X enclosure). There was also a request for some guidelines regarding heater application, such as recommended watt density ranges. Such recommendations could be tied also to the specific climate, possibly referencing 2 or 3 difference climates.

Some sample cabinet layout drawings (a non-LTC set and an LTC set) were passed out as reference material.

It was stated that any additional comments be referred to Joe Watson or Steve Schappell.

Meeting adjourned at 12:15.

8.12.1.4 WORKING GROUP FOR DEVELOPMENT OF PC57.131, STANDARD REQUIREMENTS FOR TAP CHANGERS - William Henning, Chairman

The Working Group on LTC Performance met on Monday, March 14 with 16 members and 31 guests present.

At the beginning of the meeting, a request was made that if anyone present was aware of essential patents or patent applications that would apply to C57.131 or to the application guide, they should make it known so it can be reported to IEEE. No one in the room reported knowledge of any essential patents.

Minutes of the previous meeting in Las Vegas were approved as written.

The Working Group is preparing a complete revision of C57.131. Nearly all clauses of the document are candidates for some revision. Ordinarily, a document being circulated for revision is presented with the original text highlighted and the revision shown nearby. In this case we are comparing the IEEE document C57.131 with the corresponding IEC document 60214-1. So excerpts are given of IEEE C57.131-1995, along with the corresponding text of IEC 60214-1.

Because the outline structures of the two documents are different, this initial document is sequenced by subject matter rather than the final sequence of the outline.

The second source of proposals for revision is the C57.131 IEEE reaffirmation ballot, which produced negative votes and affirmative votes with comments that are being addressed. Also, other proposals have surfaced. These proposals are addressed in a second section of the WG survey document.

Approximately 50 pages are devoted to differences between IEEE C57.131-1995 and IEC 60214-1. About 20 pages are devoted to the ballot results of the IEEE reaffirmation ballot. The closing date for this WG ballot (survey) is April 30, 2005. This document can be found on the LTC Working Group Web Page at the Transformers Committee Web site.

While the Working Group has focused attention on revision of C57.131, it also has the assignment to produce an application guide. IEC already has approved an application guide, numbered as 60214-2. So far, this Working Group has not produced a first draft of an application guide. It has worked on the C57.131 revision.

There appear to be two paths we can pursue to produce an application guide. One is to wait until the C57.131 is far enough along that we have time to work on the guide. That is the path that this Working Group has taken. If the Power Transformers Subcommittee feels we need to start on the guide sooner, the Working Group feels we need to establish a Task Force for this application guide. To do that we would need:

1. Find a volunteer to chair the task force.
2. Find volunteer members for this task force.
3. Find a meeting room time slot in the schedule.

The meeting adjourned at about 3:00 pm.

8.12.1.5 WORKING GROUP FOR DEVELOPMENT OF PC57.140, GUIDE FOR THE EVALUATION AND RECONDITIONING OF LIQUID IMMERSED POWER TRANSFORMERS - Rowland James, Chairman.

The Working Group met at 3:15 PM on Monday, March 15, 2005 in Jackson, MS. There were 94 in attendance, 39 members and 55 guests.

After introductions of members and guests, Co-chair Rowland James reviewed the Standards Association's slides pertaining to IEEE's Patent Requirements for standards under development. Two slides provided by the Transformers Committee were presented on the screen and an opportunity was provided for WG members to identify or disclose patents that may be essential for the use of this standard. **No responses were received.**

Rowland James also reviewed the IEEE policy on inappropriate discussion topics, such as licensing terms, product pricing, market share and ongoing litigation. The co-chair also instructed the audience to strenuously object, if any inappropriate topics were brought up.

Co-chair W. Bartley reviewed the progress of the Guide. Draft 13 of this Guide was distributed electronically to the WG in December '04, and comments were received. Those comments were incorporated into Draft 14, which was distributed to the WG in mid -January '05, along with a Straw Ballot, which was due March 1. Co-Chair W.Bartley announced that even more comments were received and the results of the straw ballot were favorable. Draft 15 was distributed electronically on March 8th. Hard copies of Draft 15a (along with Errata #2) were available at the meeting for all in attendance.

The remainder of the meeting was devoted to changes in Draft 15a. Those topics included:

1. Clause 4.5 Low Density vs High Density Paper, and Thermally Upgraded vs Non-Thermally Upgraded Paper.

   Tom Prevost agreed to rewrite this Clause.

2. Clause 5.3 Furan Analysis - A discussion followed on furan analysis. It was a consensus of the group that the *limitations* of this test were not stressed enough.

   T.V.Oomen agreed to rewrite this Clause.

3. Clause 6.1.2 Core Reclamping – After considerable discussion it was agreed that both the core-form and shell-form paragraphs needed to be rewritten.

Mike Lau, Rowland James, Steve Antosz and Robert Thompson aged to rewrite this clause.

CoChair Rowland James set a target date of June 1 for distribution of Draft #16.

The meeting adjourned at approximately 4:30pm

8.12.1.6 WEST COAST WORKING GROUP - Michael Lau, Chairman

The West Coast Working Group met Tuesday, March 15th , 2005 with six members present.

The chairman indicated that there is currently no active assignment for this working group. However, prior to this meeting, the working group was asked to handle the reaffirmation of two standards that are due to expire at the end of the year.

1. IEEE C57.120-1991, IEEE Loss Evaluation Guide for Power Transformers and Reactors.

2. IEEE STD 638-1992, IEEE Standard for Qualification of Class 1E Transformers for Neuclear Power Generating Stations.

Since these two documents are not applicable to only the West Coast users, the purpose and function of the West Coast Working Group was discussed. The original reason for setting up the West Coast Working Group was 1) mainly to reduce the amount of travelling, which is not as significant, and 2) the unique problems, such as seismic activities, has been adequately addressed with the seismic guide.

After the discussion with the Chariman of the Power Transformer Subcommittee, it was agreed that the Working Group be converted to a Task Force to serve as a liason between this committee and other West Coast Substation Committees.

8.12.1.6.1 WORKING GROUP FOR DEVELOPMENT OF PC57.150, GUIDE FOR THE TRANSPORTATION OF TRANSFORMERS AND REACTORS RATED 10,000 KVA OR LARGER – Tom Lundquist, Chairman

The Working Group for Transportation Issues Guide, PC57.150, met at 9:45 am, Wednesday, March 16, 2005.

There were 18 members present with 26 guests and 7 requesting membership in the WG. Those requesting membership were:

James Gardner
Jorge Guerra
Don Angell
Tommy Spitzer
Dave Keithly
Peter Zhao
Steve Beckman

The IEEE Patent disclosure requirements were discussed and a request was made for disclosure of any patents that may be related to the work of the WG. There were no responses to the request for disclosure.

Approval of minutes from the October meeting was requested. The minutes were approved.

First order of business will be to develop a table of contents (outline) for the new Guide. An initial working outline is as follows:

1. RFQ, Specification
2. Design
3. Shipping preparation (XFMR – Main Tank)
4. Shipping preparation (Accessories)
5. Shipping – General
6. Arrival (Receipt) Inspection

Shipping:

Task force for Truck Rigging & Crane: Craig Swinderman, TF Chair, submitted a significant amount of information for the Heavy Hauling, Transportation and Rigging Guidelines section.

Task force for Rail Shipment: Mike Lau has started work on this section and forwarded information to his task force for review. The next step is to try and get the rail companies involved and to contribute if possible. It is not sure whether they will participate. Les Recksiedler offered to look into writing a portion of this section as they have rail specialists in their company.
Tommy Spitzer indicated that there is already a railroad shipping instructions standard by the ARA (American Railroad Association).
Greg will contact Phil Sherman who volunteered as a liaison to this WG with RICA (Railroad Industrial Clearance Association) and SC&RA (Specialized Carriers & Rigging Association) and try and make sure he is at the next meeting.

Task force for specific issues related to Barge and Ship Transport: Philip Sherman and Kipp Yule volunteered at the October meeting as TF co Chairs. Dave Kirshner offered to help with this section as well. They will work on special concerns for barge and ship transportation that can be used by vendors and users to specify risk to equipment reductions. No progress has been made on this section.
Joe Kelly indicated that Juan Thierry may be able to help us with transportation issues for large shell form units.

Forwarder Section: Tom Lundquist, Ewald Schweiger, Kipp Yule, and Dave Kirshner will look at this and work on this section.

Design: Joao Paulo Sousa and Min Jea Lee offered to work on this section

Shipping Preparation: There may be some overlap from the Installation Guide for this section. Mike Lau indicated that the information that has been prepared for the Installation Guide (C57.93) could be transferred to this guide to avoid this overlap. There would still need to be information in the installation guide that would then direct the user to the Transportation Guide. Peter Balma indicated that he can work on taking the information from the Installation Guide and revising it as appropriate for this guide.

Crating: Much of this has been covered in information provided by Craig Swinderman and can be taken from that section.

Impact Recorders: This maybe a good topic for one of the technical presentation. This topic may also be covered in the Installation Guide. Craig Swinderman and Dave Wallach volunteered to take on this section.

Arrival (Receipt) Inspection: Jane Ann Verner and Jerry Murphy offered to take on this section. They will look at other Guides and Standards that may already cover this and see how much should or shouldn't be covered in this guide.

Oil Transportation: Tom Lundquist indicated that each state has different requirements, but perhaps some general statements regarding the shipping of oil or transformers shipped with oil. Some of this is also covered in the Installation Guide (C57.93) and the Oil Guide (C57.106). We need to set a demarcation that this guide will cover from the point the transformer leaves the manufacturer or departure site until it hits the pad. The inspection check can be done before the unit is removed from the shipping railcar or trailer and, therefore, should be included. Shipping terminology from the Installation Guide should also be moved into this guide.

Bibliography reference information: Greg requested that the members review their files and references for this section. Suggestion was made to provide a checklist of things to look for and take care of when doing a transformer move.

Meeting was adjourned at 10:45 am.

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

The Working Group for The Installation of Liquid-filled Transformers was called to order at 3:15 PM on Tuesday March 15, 2005. There were 41 attendees, 17 members and 23 guests;1 requested membership. After introductions, the agenda for the meeting was reviewed, and the minutes and the current draft of the guide were distributed. Minutes from the October 26, 2004, meeting in Las Vegas, Nevada, were reviewed and approved.

1) IEEE patent policy was reviewed and the group was asked if there were any disclosures. There were none.

2) All comments received were placed in Draft 6, which is being reviewed today.

3) The first clause discussed was Clause 3 (Internal inspection), which indicates that the breathable dry air to be utilized for inspections should have a dewpoint of -45°C or -49°F. There was considerable discussion of this topic and it was decided that several members of the group would contact their suppliers to see what dew point levels can be supplied. In addition, it was suggested that ASTM D3283 may supply some guidance and could be a reference document for this clause. Moreover, it may be important to consider that ASTM D2029 outlines four methods for determining dewpoint, and should be reviewed for applicability.

4) Next, Clause 4.2 (Shipping), and specifically Clause 4.2.2 (Shipping Terminology), which discuss shipping and shipping terms, were highlighted. The question was raised as to whether to maintain these clauses in the guide or move them to the new Transportation Guide that has been started. After discussion it was decided to leave them in this document and consider their movement to the transportation guide in the next revision cycle.

5) The working group was asked to consider the appropriate processing for a transformer if it was going to be filled with oil for long-term storage, i.e. greater than six months. The consensus of the group was that the processing should be the same as if the transformer was going to be placed in service. Clauses 4.14 (Storage) will be reviewed relative to the consensus reached at this meeting.

6) A discussion of clause 4.2.4 (Truck Shipment) determined that impact recorders could be used for truck shipment when required, but might require different calibration to provide more meaningful results. The general consensus was that an impact recorder is typically placed on a transformer at the factory and would stay in place until the transformer was placed in its final destination. In the transportation process a transformer may see barges, trains, trucks, cranes and rigging, and an impact recorder can provide valuable information in all of these situations. Clauses 4.2.4(Truck Shipment) and 4.2.3.6 (Impact Recorders) will be revised to clarify the intent of this guidance.

7) A review of Clause 4.7.3 (Heat Exchangers and Piping) determined it would be revised to reflect both coolers and radiators, as well as the potential need to pre-flush either with oil prior to assembly to the transformer. Some situations that might warrant this step are contaminated radiators or coolers unsealed in shipment, or those which were never assembled to the transformer in the factory.

8) Clauses 3.9.1(Insulating Liquid) and Clause 4.13.1.1 (Recently Energized Transformers) will be revised to clearly indicate gas-in-oil sampling for the first days and months of operation and, in addition, that this data may be used to calibrate on-

line monitoring devices which may also assist in watching recently commissioned units. Twenty-four hour, one week, and first month sampling will be considered.

9) It was presented to the working group that a survey ballot be conducted in the near future. The group agreed, and also indicated that the Power Transformer Sub-committee will also be asked to participate in the survey ballot if agreed to at the subcommittee meeting on March 16, 2005.

10) There was no New or Old Business.

The meeting adjourned at 4:28 PM.

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

Meeting began at 9:30 AM, Tuesday, March 15, 2005

Approximately 70 people attended the session.

Phil went over the mission. Goal is to be able to finalize a type test on De-energized tap changer that simulates the life of the tap changer. Present testing per IEC is not sufficient to indicate a possible problem over time. There is a need to have a test that simulates Service life. Phil has experience in these areas. Axel (Reinhausen) went over their testing. They have just been reviewing their results. They believe similar data can be gathered at higher currents at lower temperatures. They are concerned about the maximum temperature (130C) that Phil suggests is need for the load cycle testing.

This fall at the T&D Phil is planning a presentation of no-load tap changers in mineral oil and Natural esters. A paper will also be presented with Phil, Axel and possibly Darren Barnett of Central Maloney as possible authors. Phil has never seen contacts that passed the test that failed later in the field. Phil went over the FR3 testing with various contact materials. Test is intended to demonstrate contact stability with de-energized tap changers in FR3. Phil went over the test setup, procedures and recordings for the testing of the de-energized tap changer in FR3.Same type of tap changer was used for all of the testing using the different fluids and contact materials

All contacts had a copper base with silver and tin plating used in various circumstances. Thermal cycling is an important part of the test. Bulk temperature of around 150C is the goal at the peak load part of the cycling. This is obtained using twice load in a bathe of 130C fluid.

Only silver on silver maintained stability in mineral oil. Silver on silver and silver on copper in FR3 was shown in graphs that Phil created. Good trends established. Copper on silver went unstable in mineral oil and Silicone but not in FR3. Graphs showed results for the entire test even including when a heater relay was stuck in position causing high temperature in the initial phase of the test. Conclusion: FR3 caused stability in various

contact materials used. FR3 appears to prevent or minimize contact corrosion. Silicone was the most aggressive fluid used.

Theory is that FR3 removes moisture in the area of the contacts. FR3 – lower relative humidity. We don't know the results yet of tin/copper in FR3. (Future test?) Someone suggested that tin on tin should be tested in FR3 and mineral oil. FR3 is only one of the natural Esters available in the market place. Suggestion was made that other Natural Esters may have the same results**.** Jerry Corkran made a statement that FR3 absorbs moisture out of the air at a lower rate than mineral oil. Duke was successful in establishing a correlation of gas ratios with a contact problem in tap changers in their power transformers.

A paper needs to be drawn up by a number of authors to justify the type test and provide a reliable source and justification of moving it into the standard. Majority of people present feel it should be in a standard for tap changer tests. Central Maloney (Darren Barnett) has offered to test per Phil's test involving tin on tin contacts in mineral oil. Phil believes that contact geometry places a small role with contact pressure and materials used playing a stronger role.

Meeting adjourned at 10:40 AM

8.12.1.9 WORKING GROUP FOR REVISION OF C57.135, GUIDE FOR THE APPLICATION, SPECIFICATION AND TESTING OF PHASE-SHIFTING TRANSFORMERS – Tom Lundquist, Chairman

Working Group Meeting Minutes for Dual Logo Phase Shifting Transformer Guide C57.135 - Revision Jackson MS March 15, 2995 at 11AM.
Tom Lundquist was acting chair.

- 6 members, 17 guests were in attendance with 7 requests for membership.
- Patent issue was mentioned and no brought forward any items.
- Minutes from the prior meeting were approved.
- Sanjay Patel volunteered to be the vice chairmen of the working group.
- Peter Balma has several suggestions regarding changes in the PST Guide and he will send them to the WG chair Jim McIver.
- Joe Watson has redrawn the figures for section 4 and they will be distributed to the WG members for comment at the next meeting.
- The PST guide is now a dual Logo guide with IEC and revision of the guide will take on a new approach with the PST guide being the first to go through these new processes that will require interface with the IEC.
- A PAR will be generated during the next few weeks by the chair to start the revision process. This will require close work with the SA staff to insure the new dual revision process is attempted.
- It was mentioned that little work was accomplished by the two acting task forces and that this must change to keep the revision process on schedule.
- The meeting was adjourned at 11:50 AM.

8.12.1.10 WORKING GROUP FOR REVISION OF C57.12.10, STANDARD REQUIREMENTS FOR LIQUID IMMERSED POWER TRANSFORMERS - Javier Arteaga, Chairman

The WG met on March 15, 2005 from 1:45 PM to 3:00 PM. In attendance were 16 members and 11 guests. Two guests requested membership and were welcomed.

After the introductions were made, the WG chair advised the group members to identify or disclose patents that may be essential for the use of this standard, and no patent was brought to working group's attention.

Minutes of the previous meeting in the fall of 2004 where approved as written.

Draft 1.0 was reviewed to assess if it is ready for ballot. Several items were identified for modification and draft 2 will be prepared before the end of March and send to the WG members for review. Comments will be expected by the end of May.

The scope of the standard was reviewed at beginning of meeting to keep the WG focused. In the references section of IEC/IEEE combined dictionary to the terminology will be reviewed for possible addition. Tom Lundquist will provide copies of this document.

Forced cooling capacities will be 115% of ONAN capacity for transformer of 2500 KVA and less, 125% up to 10 MVA, and two cooling stages at 133% and 167% for transformers larger than 10 MVA. The group decided against standardization at 133% for 10 MVA and below.

This product standard includes one BIL for each nominal system voltage. This will provide guidance to users on the levels that are considered good practice, and it was noted that there exist additional levels for each nominal system voltage as indicated in IEEE C57.12.00

A note will be added indicating that the high voltage de-energized taps shall be +/-2 x 2.5% unless otherwise specified. It was noted that the standard requirements can be override by user specification.

Required impedance values will be added for higher BILs (>750 kV) following the same sequence for lower BILs. Additional required values will added for autotransformers base on their co-ratio and the existing table. If definition of co-ratio is not present on IEEE C57.12.80, this will be added to document.

New draft will be posted on Transformers Committee website and notification to WG members for revision will be made using the AMS system.

With no more time for discussions the meeting adjourned.

8.12.2 OLD BUSINESS

None

8.12.3 NEW BUSINESS

C57.116 is up for reaffirmation, Tim Raymond volunteered to oversee this guide through the process.

The West Coast Working Group was officially dissolved and will now be a Task Force headed by Mike Lau.

The meeting adjourned at 2:45 pm.