## 8.12 POWER TRANSFORMERS – TOM LUNDQUIST, CHAIRMAN

The Power Transformers Subcommittee met at 1:30 pm, on Wednesday, October 26th with 64 members and 51 guests. 3 of the Guests requested membership.

The minutes from the Jackson, MS meeting were approved with no changes or corrections.

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

### 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

The TF Chairman, Mr. Dom Corsi, called the meeting of the Task Force to order. at 8:00am. There were 16 attendees, 8 TF members and 8 Guests. Dom Corsi presented the power point statement of the IEEE By-laws and a reading of the By-laws concerning Patents. There were no expressions among the attendees concerning patent issues.

The minutes of the last TF meeting, held in Las Vegas, October 25, 2004 were presented for approval. The minutes were approved as read.

Copies of the Draft of C57.17 were distributed to those attendees who did not receive the copies, which were distributed also via email. The copies of the Draft will be made available again but via the IEEE email messenger service.

Dom Corsi asked for discussion on the wording of Section 4.1.1, "Cooling Water Temperature Limits". It was decided to allow more time to clarify concerns on this important issue and Mr. Frank D'Amico, a TF member volunteered to rewrite this section, addressing the concerns of some members of the TF.

One attendee asked if the EAF Standard addressed Dry Type Transformers. Members of the TF suggested that the standard is applicable to Liquid Immersed Electric Arc Furnace Transformers and as such, Dry Type Transformer applications would be out of the scope of this standard. It was suggested that if Electric Arc Furnace applications are common in the Dry Type Transformer Product, that product group should address the application.

Under New Business, Dom Corsi asked for volunteers to review several sections of the Draft. The sections and the volunteer reviewers are:

- Section 6: Laszlo Kadar;
- Section 7: Bill Bartley;
- Section 8: Bob Ganser;
- Section 9: To be determined;
- Appendix E: Bill Bartley, Laszlo Kadar, User input;

Dom Corsi suggested to the TF that it was his goal to have the Draft ready for final review at the next TF meeting.

With no further business, the meeting was adjourned.

### 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 October 24, 2005 Memphis, TN

- 87 members and guests were in attendance.
- Patent issue was mentioned with no one presenting an issue.
- Appointment of Tony Pink as Secretary.
- Revisions received were correlated into Draft 15 which was circulated approximately 2 weeks prior to this meeting. Each revision resulting in Draft 15 was reviewed during the meeting.
- Summary of Draft 15 Revisions includes:
    - Revisions to the definition section
    - Move some technology specific details to an Annex including:
        - Creating a new Annex for: Fiber Optic Winding Hot Spot Temperature Monitoring Technologies/Monitoring Methods
    - Significant Changes to the following sections:
        - Section 2.3 Bushings
        - Section 3.2 Dissolved Gas In Oil Analysis
        - Section 3.6 Winding Temperatures
        - Section 4.1 Monitoring System Description
    - Net Result of changes from Draft 14 to Draft 15:
        - Several missing sections were completed
        - One new annex added
        - Body of the document is reduced by 8 pages
        - Total document length including Annex sections increased by only 6 pages
- Before the next meeting the following revisions will need to be completed.
    - Conversion to comply with IEEE standards formatting.
    - Cross check definitions in document with IEEE standard definitions: C57.12.80.
    - Check C37.10 standard for duplication of scope and eliminate those sections which overlap scope already covered in another standard.
    - Move all remaining technology specific details to an Annex including:
        - DGA Technologies/Monitoring Methods
        - Partial Discharge Technologies/Monitoring Methods

- All additional feedback received before the next session will be consolidated into the next draft and will be circulated prior to the spring meeting.

- The meeting adjourned at 10:45.

### 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, October 23, 2005, with 40 in attendance. There were 21 members in attendance and 19 guests. Four of the guests requested membership. Working group chair Joe Watson and vice-chair Steve Schappell were unable to attend, so member Greg Anderson facilitated the meeting.

The roster was handed out and introductions made. 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.

The standard document is presently at Draft 4 status. This draft was previously sent to the working group using the AM System. It was noted that Saurabh Ghosh submitted comments that were not incorporated. We will continue to refine the text and standard drawings and perform a straw vote soon. It is planned to submit for a full SA ballot before the Fall 2006 Meeting. The document will be revised and posted on the website.

A few standard cabinet drawings were previously prepared and submitted by Fred Joyner from ABB. We appreciate ABB's contribution and Fred's work. These drawings will be used as a basis of the drawings incorporated into the standard. The standard is schedule to be balloted soon. There was little comment on these drawings other than we need to revise the title blocks and perhaps simplify them more (simpler is better!).

It was decided to not provide too many details on overvoltage and overcurrent protection because fuse curves, etc. are readily available on the website. Circuit breaker and overcurrent issues are well defined in NEC, section 110-16. We need to ensure there is no conflict. Saurabh Ghosh offered to help with sections on ground bus and terminal blocks.

Preliminary control drawings provided by ABB include: OA design without LTC, OA/FA without LTC, and OA/FA with LTC. We need to add drawings and text to address oil pump controls.

Any additional comments should be referred to Joe Watson or Steve Schappell.

The meeting adjourned at 12:15 am.

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

The working group met on 10/24/05 with 17 members and 26 guests present.

The working group chairman asked if anyone had information on any patents that may be related to the work of this working group. It was noted that no one present at the meeting expressed knowledge of patents related to our work.

Next, minutes of the previous meeting in Jackson, MS wre approved as written.

There were two remaining agenda items: 1) revision of C57.131 2) development of an application guide.

Regarding revision of C57.131, we are at the stage where we have conducted a WG survey that covered all the issues regarding changes to C57.131. We have tallied the results of the survey and used that tally to form the basis for each change in the document. Then we produced a draft document PC57.131/D1.0, 10/27/05.

We distributed it to WG members and posted it on the WG web page. After discussion at the meeting, the working group believes the document is ready for a straw vote.

The working group then moved its attention to the application guide. Annex E of C57.131 already contains some application information. A discussion took place on wether we should expand annex E with additional information or create a new separate document. There see to be advantages and disadvantages to both approaches. It was decided to proceed with the development of the text and to defer a decision on what to di with annex E.

The working group chairman will create a topic outline for review by the WG and then writing assignments will be made.

The meeting adjourned at 2:25 p.m.

### 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.

No minutes received.

### 8.12.1.6 IEEE C57.120-1991, IEEE LOSS EVALUATION GUIDE FOR POWER TRANSFORMERS AND REACTORS REAFFIRMATION REPORT - Michael Lau

Number of Balloters – 131

Response rate – 75.6%
Approval rate – 100%
Abstain -- 6.1%

5 comments were received. 4 editorial; and 1 technical.

The technical comment indicates the "text in Sub Clause 5.1 appears to be text from 1991, if not from a previous edition" – the current version is indeed a 1991 version.

Editorial comments are:
1. Change the FOA / FOW cooling designation to current standard.
2. Delete reference to temperature change in core loss.
3. Revise some of the engineering economics jargons to more up-to-date financial terms.
4. The References are all out of date and should be revised.

### 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 –Greg Anderson, Chairman

The Working Group for Transportation Issues Guide, PC57.150, met at 3:20 pm, Tuesday, October 25, 2005. There were 23 members present with 54 guests and 3 guests requesting membership in the WG. Those requesting membership were: Jane Ann Verner, Bill Boettger, Ed teNyenhuis

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 March meeting was requested. The minutes were approved. We will copy the portion on shipping from the Installation Guide to our document. It will also be left in the Installation Guide for now to prevent holding up progress on that guide with the present expectation that it will eventually reference the Transportation Guide so that the information will be in one place only. There will likely be more discussion on this required.

Assignments:

1. **RFQ, Specification**

   Transportation relevant data:

   **Assignment**

| | |
|---|---|
| UCC vs Incoterms (see Installation Guide) | Will take from the Installation Guide |
| Exact address, contacts, status of site (existing, under construction) | Users requested to send in spec requirements |

**2. Design**

| | **Assignment** |
|---|---|
| Vertical / Longitudinal / Lateral direction | Users requested to send in spec requirements |

**3. Shipping preparation (XFMR – Main Tank)**

| | **Assignment** |
|---|---|
| Gas Filling - Dry air supply, # of bottles; Pressure; Regulator | Open |

**4. Shipping preparation (Accessories)**

**Crates / Boxes / Containers**

| | **Assignment** |
|---|---|
| Special requirements | Open |
| Material legal compliance (treatment of lumber, etc) | Open |
| Refer to §5.1 Paper "Heavy Hauling, transportation and Rigging Guidelines for PT" - TF for Truck Rigging&Crane | Open |

**5. Shipping**

| | **Assignment** |
|---|---|
| Forwarder – Selecting subcontractors, checklist | Open |
| Barge and ocean vessels - Age of equipment, Registration, Lashing | Phil Sherman, Kipp Yule, Dave Kirshner |
| Others – Airplanes | Open |
| Oil | Open |

**6. Arrival (Receipt) Inspection**

| | **Assignment** |
|---|---|
| Electrical Tests - FRA (specify tests – transformer oil filled y/n, before after testing, with or without bushings) | Jane Ann Verner and Jerry Murphy |
| Mechanical Tests - Ratio, Winding resistance, dielectric Power Factor, Insulation Resistance, No load excitation at 60Hz and 110% rated voltage, Induced voltage test, and DGA | Jane Ann Verner and Jerry Murphy |

Don Chu will be asked for input to several of the sections. Tom Lundquist and Dave Wallach also volunteered to work on the specification portion. Roger Verdolin has also offered to help with several sections. Craig Swinderman will review and work on definitions.

In general, good progress is continuing to be made on the document.

Meeting was adjourned at 4: pm.

### 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 08:00 AM on Tuesday October 25, 2005. There were 35 attendees, 10 members, 3 requesting membership, and 22 guests. After introductions, the agenda for the meeting was reviewed, and the minutes, current draft of the guide, and this meetings presentation were distributed. Minutes from the March 15, 2005, meeting in Jackson, Mississippi, were reviewed and approved without comment.

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

2) A straw vote was conducted among the Power Transformer subcommittee members and many editorial comments and some technical comments were received. The editorial comments have all been incorporated into Draft 9 and posted on the web. The technical comments were discussed during the meeting and consensus was obtained among the group on the following items.

3) The frequency for routine DGA sampling will be revised to be a minimum of once annually and more frequently if required and at the discretion of the users for more important and higher rating units.

4) A sentence will be added in the Introduction of the Guide to advise the users that it would be desirable to engage the experts of the manufacturer during the initial installation and on problems over the serviceable life of the transformer.

5) The term Swept Frequency Response Analysis (SFRA) will be revised to a more generic term – Frequency Response Analysis (FRA).

6) The Group recommended no changes to the Table on Level of Impacts for discussion in Clause 4.3.1.

7) The Group also recommended no changes to Clause 4.8.2 with respect to vacuum level and no changes to the recommended filling rate of 12.5mm per minute.

8) It has been decided to retain the sections on Shipping and Receiving until such time the new Transportation is available.

9) Ewald Schweiger, Paulette Payne Powell, and Jane Verner volunteered to review the contents of the Annex, Figures and Appendix ( sources and examples ).

The meeting adjourned at 09:30 am.

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

The Task Force met on Tuesday, October 25 at 9:30 AM. There were 115 members and guests in attendance.

Following introductions, the minutes from the March 15, 2005 Jackson meeting were approved as submitted.

The chairman then quickly reviewed the IEEE patent disclosure requirements. No guests or members present indicated knowledge of any patent activity applicable to our work at this meeting.

The Task Force then began discussing the topics of old business, as follows:

All material associated with the task force has been placed on the DETC website. This includes the original technical paper created by Phil Hopkinson. A new draft of this paper is in the process of being drawn up. It will include the latest tests that were performed using FR3, a natural ester fluid, as the medium. FR3 fluid versus mineral oil seems to add stability to sets of contacts during the life cycle testing. Tests were reviewed with the task force.

A panel session set for the IEEE T&D conference in New Orleans regarding the testing of de-energized tap changers with various contact material arrangements in FR3 was delayed to the cancellation of the conference.

Phil provided a description of the functional life cycle tests that he would like to see included in the IEC and IEEE tap changer standards. Phil attended the IEC TC14 Power Transformer meeting in South Africa. It was stated that the tap changer-working group would plan to initiate revising the present 60214-1 standard in 2007.

Super temperature calculations of various contact material arrangements were reviewed, with acknowledged corrections from the vigilant work of Dr. Axel Kramer (Reinhausen). Formula was correct but calculations needed revised due to an error found.

Axel Kramer presented a status of the life cycle testing being done by Reinhausen. Slides presented are available for review, and will be posted on the Working Group site.

Central Moloney presented a status of the life cycle testing that they have performed on their small no load switches using a tin plating over a copper contact matching up with a copper contact. Similar results to tests performed by Quality switch were found. Slides presented are available for review. Additional testing on a 100-amp switch that uses tin plated copper on both sets of contacts will be performed. Results of these tests will be provided at the next meeting, Spring 2006.

Phil Hopkinson asked for volunteers to co-author an update of the technical paper he created on the subject of life cycle testing of de-energized tap changers. This would show support from the tap changer development industry and assist in getting a life cycle tests into the IEC and IEEE tap changer standards. Cooper Power Systems, Central Moloney, Reinhausen, ABB and Quality Switch have agreed to assist in this endeavor. This draft will be available for review by the next meeting, Spring 2006

The meeting adjourned at 10:45 AM.

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

Chairman Jim McIver also served as acting secretary (due to Joe Watson's absence during hurricane Wilma.).

- 10 members, 15 guests were in attendance with 6 requests for membership.
- Patent issue was mentioned and no items were brought forward.
- Approval of minutes from the prior meeting will be via electronic inquiry.
- Status of items for WG review and comment:
    - Pdf copy of present guide posted on TC website for WG reference
    - Joe Watson has re-created original figures of Sect. 4 (McIver will distribute electronically to TF members for reformatting/revision.)
    - To date, few comments received requesting editorial revisions (McIver will solicit additional comments from Pwr Transformer Sub-committee.)
- The structure of anticipated revisions and necessary TFs was re-affirmed:
    - TF for Section 4 (Theory)
        Walter Seitlinger (TF chair)
        Gustav Preininger (corresponding member)
        Bipin Patel
        Tim Raymond
    - TF for Section 5 (Service Conditions) & Section 7 (Construction)
        Jim McIver (TF chair)
        Bipin Patel
        Bob Veitch.
- A PAR to officially initiate the revision process is being submitted by the chair. McIver will attempt to "fast-track" the PAR for NesCom approval before year-end.
- The PST guide is now designated as a dual Logo guide with IEC; the first such TC standard to require this interface with IEC. PAR approval will require close work with the SA staff to insure the new dual revision process is successful.
- The meeting was adjourned at 11:30 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 October 25, 2005 from 1:45 PM to 3:00 PM. In attendance were 14 members and 7 guests.

Minutes of the previous meeting in the spring of 2005 where approved as written.

Draft 2.0 of this standard was reviewed during this session. Standard transformer Kilovolt-ampere ratings in table 1 will be expanded to include single phase transformers and table 2 for typical transformer Kilovolt-ampere ratings will be modified accordingly.

Standard impedances for transformers with BILs larger than 750 kV were discussed, indicating that the standard proposed values are to be used if the user does not specify this. The group decided to keep the values indicated in current draft 2 of document.

The standard impedance values proposed for autotransformers as a function of its co-ratio was agreed with the addition of a note indicating that the impedance for these units will not be higher than the values indicated in table 4, which is only a function of the transformer high voltage BIL. A clarification will be made indicating that this is not an equivalent autotransformer impedance. In addition, the autotransformer co-ratio will defined in this section of the standard.

Current standard covers the standard construction for load tap changers (LTC) with the regulating winding located in the low voltage winding to regulate this winding. It was agree to add a section to recognize the use of LTC in the HV winding to regulate either the low voltage or the high voltage windings. This section will include the effects of this application in the performance characteristics of the transformer as impedance variation, sound level, variation on core losses, and others in order to guide the user in this application. Saurabh Ghosh and Stephen Scroeder will outline this section.

With no more time for discussions the meeting adjourned.

### 8.12.1.11 IEEE STD 638-1992, IEEE STANDARD FOR QUALIFICATION OF CLASS 1E TRANSFORMERS FOR NUCLEAR POWER GENERATING STATIONS REAFFIRMATION – Tom Lundquist, Ballot Designee

Shawn Galbraith and Craig Swinderman volunteered to be WG chair for the revision of this document.

### 8.12.1.12 C57.116 Reaffirmation Report – Tim Raymond

Reaffirmation ballot was sent out early Fall, 2005, only one negative editorial comment was received. Submitted to IEEE for approval, waiting for response on approval status.

### 8.12.2 OLD BUSINESS

A. REAFFIRMAION C57.117-1986 (R1998) (PE/TR) IEEE Guide for Reporting Failure Data for Power Transformers and Shunt Reactors on Electric Utility Power Systems – Reaffirmation of C57.117-1986 (R1998) was approved by the IEEE-SA Standards Board on 10 May 2005.

B. REAFFIRMATION C57.125-1991 (R1998) (PE/TR) IEEE Guide for Failure Investigation, Documentation, and Analysis for Power Transformers and Shunt Reactors – Reaffirmation of C57.125-19991 (R1998) was approved by the IEEE-SA Standards Board on 10 May 2005.

**8.12.3 NEW BUSINESS**

Discussion on transformer tank design to limit risk of tank rupture due to internal faults. Voted to establish task force to address this, Peter Zhao volunteered as Chairman to lead the newly formed task force to investigate tank rupture.

The meeting adjourned at 2:45 pm.