Annex D Dry Type Transformers Subcommittee

April 15, 2015

San Antonio, TX

Chair: Charles Johnson
Secretary: Casey Ballard

D.1 Introductions and Approval of Agenda and Minutes

The Subcommittee met on April 15, 2015 at 1:30 PM in the Live Oak Room of the Hyatt Regency San Antonio Riverwalk Hotel. There were 15 of 23 members present (therefore we had a quorum of 65%), and 13 guests present, 2 guests requested membership. The attendance roster will be kept in the AMS.

The agenda was approved unanimously after a motion from Tim Holdway and a second from Rick Marek.

The minutes of the Washington, DC meeting were approved unanimously after a motion from Roger Wicks and a second from Klaus Pointer.

D.2 Working Group/Task Force Reports

The next order of business was the presentation of the reports of the various working groups and task forces. See the following sections for the individual reports:

D.2.1 IEEE PC57.12.51 – Dry Type Product Standard "> 500kVA Ventilated" Chair Sanjib Som

The working group met in the Pecan Room of the Hyatt Regency Hotel.

The meeting was called to order at 11:00 AM by Chairman Sanjib Som.

The meeting was convened with 12 members (out of 18 – therefore a quorum was reached with 67% attending) and 5 guests present. The attendance will be reported in the AMS.

The agenda was approved unanimously.

Motion: Chuck Johnson
Second: John K. John

The minutes of the Washington DC, October 20, 2014 meeting were approved unanimously.

Motion: Phil Hopkinson
Second: Casey Ballard

Old business

- The Chair thanked Casey Ballard, Shankar Nambi, and Chuck Johnson for their work in comparing C57.12.50 and C57.12.51. Both Casey and Shankar sent to the Chair their comments on a spread sheet on how to incorporate both documents into one.
- Casey stated that he looked at combining these two documents into C57.12.01 but felt there was too many items that needed to be separated. He therefore made a motion to combine C57.12.50 and C57.51. Phil Hopkinson seconded the motion. The motion also included combining C57.12.50 into C57.12.51 and saving the new document as C57.12.51. The motion was passed by a majority and without any negative vote.
- Chuck Johnson stated he would check with Roger Wicks and see how he combined C57.12.56 and C57.12.60.
- It was discussed that the Chair would need to change the PAR, Scope, and Purpose. Chuck Johnson stated that we will need to bring all of this to the Sub Committee
- The Chair said he will send out the spreadsheet with all of the comments from Casey and Shankar. He will also ask for any other comments from the other members
- It was discussed and decided to add 69 kV in C59.12.51, to match C57.12.01.

- Carl Bush made a motion to exclude the kVA and voltage ratings in the new Title. Tim Holdway seconded and the motion was approved with majority in favor and without any negative vote.
- Jose Valencia stated the voltages, the title and the Scope in C57.12.50, C57.12.51, and C57.12.01 documents confused him. He stated that NEMA ST-20 is going to cover up to 1.2 kV voltages and wondered if we may want to move to 1.2kV in our documents. After a discussion, it was decided we will stay with 601 and above for at least one winding in this new combined document.
- The Chair then asked for volunteers to review the comments.
- The Chair stated he will review Clause 1.
- Dhiru Patel, Carl Bush, and Albert Walls will review Clauses 2-7. Dhiru will be the Group leader.
- Casey Ballard, Derek Foster, and Tim Holdway will review Clauses 8-10, with Casey being the Group leader.
- The Chair stated he will be available to help each group. The Groups will submit their sections in a Word document.
- The Chair will look for C57.12.51 in Word and send out to all of the volunteers.

New business

No new business.

With no further business, the meeting was adjourned at 12:15 PM.

Motion: Jose Valencia
Second: Chuck Johnson

Next meeting: Fall 2015, Memphis, TN November1-5, 2015.

Respectfully submitted,

Chairman: Sanjib Som
Vice Chairman: Tim Holdway

D.2.2 IEEE C57.12.01 - Dry Type General Requirements
Chair Tim Holdway

The task force met in the Pecan Room of the Hyatt Regency San Antonio Riverwalk Hotel

The meeting was called to order at 1:42 PM by Chairman Tim Holdway

The meeting was convened with 21 members (out of 29 – therefore a quorum was reached with 72% attending) and 17 guests present. The attendance was reported in the AMS.

The agenda was approved unanimously.

Motion: Sanjib Som
Second: Rick Marek

The minutes of the Washington DC, October 20, 2014 meeting were approved unanimously.

Motion: Alexander Levin
Second: Dave Stankes

Old business

- The chair informed all present that IEEE C57.12.01-2015 had been published and asked if all members had received their copy.

New business

- There was a brief discussion on if the group was a Task Force or a Working Group. The Dry-Type SC Chair was present and agreed to determine the status.
- The Chair then opened the floor for new topics in this revision

- Phil Hopkinson proposed that wording be added to help prevent transformer fires by monitoring the winding temperature and using a relay to send a trip signal to a breaker to remove the energy. He stated this should be used instead of F1 from IEC 60076-11.
    - Charles Johnson added that the F1 test not only included flammability, but also energy contributed, smoke opacity, and toxicity.
    - Dave Stankes added that this was similar to rolling stock standards with smoke toxicity
    - Dhiru Patel confirmed that the F1 test also measures energy released from the transformer
    - Phil agreed to provide a written proposal to the Chair
- Line 30 conversation – the question was based on the conversion factor from lbs to kgs (approx. 2.2) for watts per pound and watts per kilogram. The standard's use of 0.454 is correct per Rick Marek
- Line 31 request needs additional explanation
- Casey Ballard mentioned the use of the words *should, shall, may, can* in 12.00 and proposed that these be considered
- Casey Ballard suggested that 'DOE Compliant' be used when applicable to match 12.00
    - Discussion surrounded around how to mark non-compliant transformers. This is covered in 10CFR Part 431 in the Federal Register and is not in scope for discussion for IEEE
- Rick Marek suggested that the short circuit temperatures used in Table 15 are too high, especially for aluminum conductors. He agreed to put a proposal in writing.
- Rick Marek suggested that we consider the IEC method of calculating the short circuit temperature rise since it is simpler and provides similar results. He agreed to put a proposal in writing.
- The Chair asked for a group of members to review these suggestions and help filter them down before the Fall 15 meeting.
    - David Stankes, Sanjib Som, John K. John, Albert Walls, Tim Holdway, Casey Ballard, Rick Marek agreed to review the suggestions
    - The chair will follow up with each volunteer and coordinate the review
- Sanjib Som suggested that a method be developed to determine the pass/fail of an applied test. He also mentioned that ozone had been produced during this test. His suggestion may be focused on the total current draw and its relative stability during the applied test voltage
    - Several other members commented that this ozone is normal as the test voltages and connections are chosen to only stress the solids by breaking down the air. As the air is over stressed, on purpose, ozone is created.
    - No formal motion was made, as Sanjib agreed to submit a written proposal
- Alexander Levin questioned the wave shape allowed for in note "a" of Table 5.
    - Jim McBride commented that the high inductance of lower voltage, higher current windings will impact the tail time of the impulse. Therefore this exclusion is required.

Next meeting: Fall 2015, Memphis, TN, November 1-5, 2015.

With no further business, the meeting was adjourned at 2:50 PM.

Motion: Sanjib Som
Second: Phil Hopkinson

D.2.3 IEEE PC57.94 - WG Dry Type O&M Guide
Chair Dave Stankes

The working group met in the Pecan Room of the Hyatt Regency Hotel.

The meeting was called to order at 4:45 PM by Chairman David Stankes.

The meeting was convened with 13 out of 22 members (enough for a quorum) and 7 guests present with none requesting membership.

The agenda was proposed by Casey and seconded Chuck Johnson, was approved by voice vote with no opposing or abstaining.

The minutes of the Washington DC (Fall 2014) meeting was approved by unanimous separate voice vote – both proposed by Chuck Johnson and seconded by Jerry Murphy.

The chair discussed the status of Draft 9, which had been submitted to MEC review in anticipation of ballot. Recommendations from MEC review will be incorporated into new Draft 10 and will proceed to ballot. A ballot invitation was started concurrently with MEC review, which has now closed. It is expected that the Sponsor Ballot will begin no later than April 24.

In anticipation of comments from the ballot, the chair requested volunteers for comment resolution. To this Chuck Johnson, Tim Holdway, Jerry Murphy and Derek Foster volunteered. (Target ballot completion is ~ May 24th).

The meeting was adjourned on proposal of Tim Holdway which was seconded by Jerry Murphy.

Chairman: David Stankes
Vice Chairman: Sanjib Som

D.2.4 IEEE C57.12.91 - Dry Type Test Standard
Chair Derek Foster

The working group met in the Pecos meeting room of the Hyatt Regency Hotel.

There were 8 members and 10 guests present with 3 guests requesting membership.

The agenda for meeting was approved unanimously.

Motion: Chuck Johnson
Second: Casey Ballard

The minutes of the October 21, 2014 meeting in Washington DC were approved unanimously.

Motion: Tim Holdway
Second: Casey Ballard

Old business

- Discussion of topics for the new PAR
  - No load loss correction for temperature to support 12.01 note 7 on page 3
    - Casey Ballard's proposal is complete. This was circulated to members of the task force before this meeting
  - Dielectric testing at a different altitude than the installation altitude
    - Tim Holdway and Rick Marek had made a proposal which was circulated to members of the task force before this meeting
  - Sound level measurement in Section 13
    - Casey Ballard had contacted Ramsis Girgis before the meeting to determine the status of the sound testing procedure from 12.90 and 60076-10
      This group is looking at sound power and sound intensity measurements instead of sound pressure. Both of these measurement methods are more accurate, but take more time in the test cell. At this time the existing method will be left in place, but reference will be made to the other two

approaches as alternates based on the final draft of the 12.90 standard when it is published.

- Update of all drawings using new CAD software
  - Casey Ballard has been leading this effort and Mark G., Kerwin S., and Chuck Johnson each provided updated drawings before this meeting. The drawings will be checked and reviewed by members of the group during the next revision.
- Inclusion of environmental testing and shock testing from IEC 60076-11.
  - A discussion was held on this subject and consideration will be given to obtaining permission from IEC to include text from the IEC standards. This will be considered further during the revision process
- Inclusion of calibration requirements
  - The group will investigate how this is handled in C57.12.90.
- Heat run method with non-sinusoidal loads
  - The question was asked why this subject was raised since the transformers referred to in this standard do not include transformers supplying non-sinusoidal loads. This will be further reviewed during the revision process.

New business

- Sanjib Som stated that he would like consideration given to including a sound level test with full rated current as a type test. This will be discussed and considered during the revision process
- Sanjib Som would like the applied voltage test procedure to state if the presence of corona during the test is permitted, and also for the test procedure to include pass/fail criteria
- "Scope" for new PAR.
  - It was decided to remove the word "safety" from the scope, since the use of this word is discouraged by IEEE
  - The products listed as exceptions, will be listed as bullet points to be consistent with other standards.
- "Purpose" for new PAR.
  - It was decided to review the wording of the purpose in C57.12.90, to see how this differs from C57.12.91
  - Tim Holdway volunteered to provide input on the "Scope" and "Purpose" for the new PAR

With no further business, a motion was made by Vijay Tendulkar to adjourn with a second by Martin Navarro. With no objections, the meeting was adjourned at 4:30 pm.

Next meeting: Fall 2015, Memphis, TN, November 1-5, 2015.

Chairman: Derek Foster
Secretary: Kerwin Stretch

D.2.5 IEEE C57.12.60 – TF Thermal Evaluation of Insulation Systems: Dry-Type
Chair Casey Ballard

The task force met in the Chula Vista Boardroom of the Hyatt Regency San Antonio Riverwalk Hotel

The meeting was called to order at 8:03 AM by Chairman Casey Ballard. Introductions were made and attendance sheet was circulated.

The meeting was convened with 12 people in attendance. This was a Task Force meeting, not a formal WG meeting, and Chair reminded the group that membership in the TF does not necessarily carry over into membership of a WG. Task Force was agreed to be governed by Roberts Rules of Order.

The agenda was approved unanimously.

Motion: Tim Holdway
Second: Roger Wicks

No minutes to approve as this is the first meeting of the TF

The goal of the TF was to come up with an acceptable Title, Scope and Purpose that would be used in PAR submission needed for formation of WG.

1. Title

A recommendation to modify title to match C57.12.01 was presented, removing specific classifications of transformers covered by the document. Roger Wicks asked if the title would cover gas insulated (it could).

A motion to approve the new title was made by Chuck Johnson and seconded by Dhiru Patel. The motion was approved unanimously, and the new title reads:

IEEE Standard Test Procedure for Thermal Evaluation of Insulation Systems for Dry-Type Power and Distribution Transformers

2. Scope

A recommendation to modify the current Scope by 1) eliminating "including both open wound technology and solid cast technology", 2) add "and modification of" and 3) add exceptions of transformers that may not be explicitly covered by this standard.

A discussion regarding how the exceptions would be viewed by customers of transformers ("shall" vs. "except"). It was decided the recommended scope is acceptable, but a note should be added in forward or introduction clarifying exceptions.

A motion to approve the new Scope was made by Tim Holdway and seconded by Chuck Johnson. The motion was approve unanimously, and the new Scope reads:

This test procedure for the thermal evaluation of insulation systems of dry-type power and distribution transformers is to be used for determining the temperature classification and modification of the insulation systems. This standard shall apply to all dry-type transformers with a voltage of 601 V or higher in the highest voltage winding except as follows:

a) Instrument transformers
b) Step- and induction-voltage regulators
c) Arc-furnace transformers
d) Rectifier transformers
e) Specialty and general-purpose transformers
f) Mine transformers
g) Testing transformers
h) Welding transformers

3. Purpose

A recommendation to revise current Purpose was submitted. "Providing" was suggested to be eliminated in a) and b) and replaced with "Acquiring". In b) the following was added: "guide such as IEEE C57.96 IEEE Guide for Loading Dry-Type Distribution and Power Transformers". c) was added which reads "Provide a method to modify an established electrical insulation system".

Motion by Chuck Johnson and second by Derek Foster, the motion carried unanimously.

Chair presented a list of suggested topics to investigate.

- **Should PD measurement be included to indicate changes in the solid insulation system – such as cracks or internal separations?**

Groups agree that this is an area that should be investigated, but would most likely be used as a trending test.

- **Is the reference time of 40,000 hours appropriate when compared to the broad range of reference times available for other types of transformers (20,000 up to 180,000)?**

  TF discussed the confusion in the industry regarding reference time, and how 40,000 hour reference time is frequently viewed as not as "good" as liquid filled 180,000 hours.

  Roger Wicks agree to draft an explanation of reference temperature and how it should be interpreted.

- **Should we add 200°C and 240°C systems and correct 150°C to 155°C?**

  Group agreed that 200C and 240C system classes should be added. A correction to temperature rise (150C to 155C) reference will also be made.

- **Add better definition to 'full-size working coils'**

  Discussion on how the standard intended users to view full size working coils vs. "model" coils. Group agreed that a better definition is needed. Chuck Johnson agreed to provide a proposal.

- **Evaluate if representative model or full-size coils are the most accurate method to predict transformer coil life**

  Group discussed pros and cons of using full size working coils vs. "model" coils that have appropriate stress levels that may be found in full size working coils. Casey describes that Thermal Cycling found in large full size units (not heated in oven) may put stress on units that are not found in small model heated in oven. Small models have advantage of being (perhaps) statistically better predictor due to higher number of test units vs. full size working coils. Mark Raymond agreed to review test data to determine if any correlation exists between model and full-size coil aging.

- **Define what major components of the insulation system are and prepare guidelines on what testing should be performed to substitute major insulation**

  Discussion focused primarily on how a new varnish may be substituted for a varnish used in an original system. Discussion on whether a varnish should be considered a major or minor took place. Mark Raymond from UL said a varnish often helps performance of an insulation system, and will allow a system that would normally fail "dry" pass with varnish. Other experience (Casey) told that sometimes a varnish may degrade the performance of an original dry system. Mark Raymond explained that the current CCT Sealed Tube test may not be best test to approve substitution. Offered that perhaps a single point aging test compared to original system may be a better test.

- **Extend the cold shock test to all dry-type transformers since both types are commonly installed outdoors**

  A suggestion to make cold shock test mandatory for all classes of transformers was suggested. It was pointed out by Chuck that many applications where a transformer not intended to have thermal shock does in fact become subjected to thermal shock. An example of high humidity test that is subjected to all transformer classes was raised, but it was pointed out by Ashley that high humidity is intended only to help uncover a failure that has occurred.

- Roger suggested that a topic should be added to review whether or not it was acceptable to ratio up or down stress of a new design relative to stress levels tested in an approved system

Next meeting: Fall 2015, Memphis, TN, November 1-5, 2015.

With no further business, the meeting was adjourned at 9:17AM .

Motion: Tim Holdway
Second: Mark Raymond

Chairman: Casey Ballard
Secretary: Dave Stankes

D.3 Old Business

D.3.1 Dry-Type Standards Status

The chair presented the status of the dry-type standards and noted that a WG chair had been assigned for all documents that were 'at risk'

D.4 New Business

D.4.1 Continuous Revision Process

The chair agreed to follow up with Bill Bartley about how to manage membership for the continuous revision process that is now being used by C57.12.01 and C57.12.91.

D.4.2 C57.12.58 Transient Analysis

Roger Wicks proposed that a PAR be submitted using the existing title and proposed a new Scope and Purpose.

- Scope
  This guide applies to the equipment setup, measurement, and analysis of the transient voltage response of a dry-type transformer coil to impulse voltage.
- Purpose
  Transient voltage analysis is used to determine the response of various parts of the coil to a 1.2 x 50μs impulse wave. This analysis can be made on specially designed prototype coils with imbedded voltage leads. This testing uses significantly lower voltages than the rated BIL to expedite the test time for each data point required.

Once the PAR is approved the chair will form a ballot pool as there were no comments to the contrary from the SC membership. They believe the document is in good shape.
The motion was approved unanimously.
Motion: Roger Wicks
Second: Rick Marek

D.4.3 Use of Word 'Safety'

Casey Ballard summarized an email from Erin Spiewak about the use of the word 'safety' in the IEEE documents. In short, if you are a WG chair that wants to use the word 'safety' talk to Erin or the Transformers Committee leadership first.

D.4.4 Combination of IEEE C57.12.51 and ANSI C57.12.50

Casey Ballard made a motion that the two documents be combined into a single document to remove the burden of updating two separate, but very similar, documents. This discussion started in the IEEE C57.12.51 meeting, but he wanted to have the SC vote since it was outside the scope of the original PAR. He further proposed that the document keep the IEEE C57.12.51 designation since the other document was not a formal IEEE document.

The motion was approved unanimously.

Motion: Casey Ballard

Second: Jim Antweiler

D.4.5 Chair's Comments

- The public comment process starts for all documents going to ballot after July, 6, 2015. Please plan your timelines accordingly so that your PAR or document does not expire.

D.5 Adjournment

Being no further business, the meeting adjourned at 2:45 PM upon the motion from Mike Iman and a second from Jim Antweiler.

Chairman: Charles Johnson
Secretary: Robert Casey Ballard