

WG: C37.09 - IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers  
Rated on a Symmetrical Current Basis (Under Revision)

Chair: Xi Zhu  
Vice Chair: Victor Hermosillo  
Secretary: Mike Skidmore

**Session 1 – September 22, 2014 (10:15 AM to 12:00 PM)**

Location: Asheville  
Participants: 31 Members  
16 Guests

- 1.) The meeting started with the chair introduction and introductions of the attendees. The chair asked all attendees to sign the roster and provide affiliation if not noted on the roster.
- 2.) The agenda for the meeting was shown on a projector and the chair reviewed the agenda for the meeting and the expected timeline. Refer to Doc. 041 for agenda presented.
- 3.) The chairman reviewed the minutes of the meeting (MOM) from Orlando. The MOM from Orlando was distributed to all committee members and guests of C37.09 on 5-19-2014 after the spring meeting with an e-mail from the secretary (Mike Skidmore). The draft MOM was also e-mailed by Mike Skidmore on 9-4-14, to all members and guests of C37.09. The minutes of the meeting from Orlando were shown again to the participants on the projector. The Chairman asked if anyone had questions.
- 4.) The chairman entertained a motion from Ken Edwards to approve the MOM from Orlando. Carl Schuetz seconded the motion. The motion passed unanimously. Refer to Doc. 016 for MOM.
- 5.) The chairman discussed the structure of the meetings for C37.09. He said 3 sessions will be held on 9-22-14. Each session will be 1 hour and 45 minutes so topics will be about 12 min each. He will ask for updates of topics from previous meeting and what has been completed to date.
- 6.) The Chairman proceeded to discuss the project timeline, stressing that timely submission of contributions and completion of tasks was essential to meet the following timeline:  
Project Timeline Reminder PAR expiration: Dec. 2017 (last meeting: Fall 2017)
  - All contributions to chair by 12-05-14
  - Draft 1 out by 3-1-15 – according to IEEE template (Doc. 042)
  - WG comments between 3-1-15 to next meeting
  - Discussion of WG comments in Spring 2015 meeting
  - Initiate ballot and close ballot by Fall 2015
  - Resolution of Ballot comments Fall 2015 – Fall 2017

The Chair indicated that currently there are a total of 27 topics on the table. Of these, three are closed and 24 topics remain which will be discussed during three sessions allocated to the committee. Closed topics include:

001 PAR

002 Critical current

022 Out-of-phase switching duty elimination

The Chair asked for any comments, none were received.

#### 7.) Topic #3 - 800% service capability – condition check (Sushil Shinde, John Webb)

Doc. 039 was reviewed at the meeting. IEC provides guidance regarding the equivalence of tests at various current levels so that 800% can be obtained from several different tests performed on the circuit breaker (Table 3, IEC 62271-310)...

IEC requires dielectric condition checks after specific power tests (for example L90). This is different from what is being proposed for IEEE.

Preferred method is to use synthetic circuit to perform the dielectric condition check since there is no need to move the circuit breaker to a HV laboratory which may involve SF6 gas reclaiming, possible disassembly, transportation and refilling.

There was discussion how to calculate a total of 800%. Should we use full T100a/T100s shots or can there be a sum of other interruptions? Additionally, we should review if any information will be added to C37.04. .04 should define what the rating is and .09 will determine how to test.

John Webb will review this topic and provide information to the chair.

Denis is to show how IEC calculates the accumulation of sc currents towards the 800%.

#### 8.) Topic #4 Splitting of Test Duties (D. Dufournet)

Doc. 043 was reviewed and discussed at the meeting. Text and graphics have been submitted by D. Dufournet to cover power tests in which a breaker is subjected to TRV conditions and arcing windows for the first, second, and third pole to clear for non-effectively grounded and grounded networks. This information will be added to the draft to be circulated for comments.

This testing method is an alternative to “umbrella testing” in which the same TRV parameters are used for demonstration of minimum, medium, and maximum arcing times. The splitting method requires the demonstration of separate windows for the first, second and third poles to clear and requires more shots for a full demonstration in a single-phase test.

#### 9.) Topic #5 (1). Making and Breaking Test Duties; (2).C37.081, 081a, 083 (M. Aristizabal, D. Dufournet)

A comparison table (see Doc 024) for power test duties included in IEEE C37.09 and IEC 62271-100 has been submitted by D. Dufournet as well as proposals to reduce differences and avoid inconsistencies that may arise from references to IEC 62271-101 that could be included in C37.09. There was a proposal to integrate these in the test duty table and reflect them in the associated sections.

Removal of asymmetrical current test shot requirement for T10, T30 and T60 is included in the proposal. The WG discussed and agreed to make this change. The information will be included in the draft and can be discussed at ballot if needed.

The WG discussed the additional T100a test for single phase ground fault which IEC does not have. The WG decided to keep this test in the test duty.

IEC has an additional requirement for double earth fault that is not included.

Laboratories are fully capable of O-t-CO-t'-CO demonstration for all terminal fault duties.

An additional O is proposed for OP1/OP2 with the purpose of demonstrating a full arcing window for each duty. IEEE currently only requires two O. A third O allows minimum, medium and maximum arcing times to be tested.

References to IEC 62271-101 to be added, where possible, as replacement for C37.081, 081a, 083 references. M. Aristizabal was absent, so no specifics of this action were covered.

#### 10.) Topic #6 Piecewise Testing (Ken Edwards)

Document not received but K. Edwards to send a write-up in the next two months. The write-up will provide information for what is considered a major or minor change, but how to address the change should be reviewed by the committee. Examples of changes will include: tank, interrupter, mechanism, etc...

D. Swing provided information for alternative mechanism tests (see doc. 047).

The use of alternative mechanisms is to be integrated in the standard. This includes the use of a reference travel curve, travel curve envelopes (-5%/+5%, -0%/+10%, -10%/+0%) and additional test requirements to qualify alternative mechanisms adopted from IEC 62271-100.

#### 11.) Topic #7 Multi-Part Testing (Denis Dufournet)

Document (043) was submitted by D. Dufournet to add multi-part testing to the standard as a testing alternative in cases in which laboratory restrictions require separate testing of the first and second reference point in a four-parameter TRV. This text will be added to the draft to be circulated for comments.

Practical examples of cases were mentioned including: special TRV tests, tests on single break circuit breakers that require TRV parameters that exceed laboratory capabilities. Laboratories continuously improve and upgrade their facilities. Nevertheless, such limitations do occur.

There were various comments from the committee that the wording should say the "preferred" test is a test with complete TRV, instead of two separate TRV test shots combined. However, an alternative test is acceptable.

#### 12.) Topic #8 Inductive Current Switching (Sushil Shinde)

Only verbal information was presented by Sushil at the meeting. The proposal is to add references to IEC 62271-110 for inductive switching. This standard includes a detailed test procedure consisting of four test duties. IEEE existing standards only include an application guide that does not specify a test procedure.

References to IEC 62271-110 and explanatory text will be added to C37.09. Inductive current switching will not be added as a basic test but rather as a reference for testing circuit breakers for such applications.

Later in the week, Sushil provided a survey to the UGT (Utility Group) members to gain a better understanding of inductive devices on a utility system. Sushil desires to add better information, instead of just looking for re-ignition and chopping behavior for inductive load switching. Xi caution there may not be sufficient time to collect the information. He reminded him that all information needs to be provided by 12-5-2014.

IEC 62271-110 may need to be added at the end of the PAR in the appropriate section. Xi to review.

#### 13.) Topic #9 Fast TRV C37.06.1 (Sushil Shinde)

This topic will be covered in detail during the specific session. Fast TRV (i.e. transformer limited faults) to have the same test procedure of T10 and T30. This topic can be closed because it does not affect how we do the test.

#### 14.) Topic #10 CT Testing C57.13 (Gilbert Carmona)

Gilbert said information and references to C57.13.1 and IEC 60044-1 will be added into C37.09. (see doc. 044)

There was some general discussion, if manufactures should test the breaker with the BCT on the equipment.

Doc. 044 also included additional information such as references to SF6 handling. Xi said the additional information will be reviewed but asked Gilbert to stay focused on the topic "CT Testing C57.13"

15.) The working group committee agreed to adjourn the session. Work will resume after lunch.

### **Session 2 – September 22, 2014 (1:30 PM to 3:15 PM)**

Location: Asheville  
Participants: 27 members  
21 guests

#### 16.) Topic #11 NEMA SG4 (Gil Carmona)

Applicable sections of SG4 have been integrated into the document (See Doc. 044). Concerns were voiced about the wording used relative to several test specimens. Clarification was made that several tests exhaust the breaker endurance. Test reports specify the initial condition of the test specimen before the test.

Some commented that section 4.18 (noise sound level tests) only need to reference the new standard (62271-37-082-2012)

For RIV limits no table is needed since there is only one limit value. A paragraph should be added to C37.04 to define this limit. References made should be checked to confirm that multiple values are not quoted. Section 4.20.10 may not be necessary and Xi asked Gilbert to confirm the information.

Xi also asked Gilbert to confirm the entire list provided by Ted Olson several years ago and in previous .09 meeting is include in doc. 044. Gilbert said it was but he will confirm again.

17.) Topic #12 Cold temperature test method (V. Hermosillo, J. Webb)

Victor presented information (see doc. 052) for Low Temperature Operating Test for section 4.13.2. First draft of test procedure presented according to the list of proposed improvements presented during the last meeting. The second draft of the procedure will be submitted after receiving input from J. Webb, regarding medium-voltage breakers, and S. Shinde, regarding high-voltage breakers. Measurement of ambient temperature for tests can be a common requirement with other test procedures as well as the definition of the reference travel and timing parameters to be taken before and after the test.

Discussion regarding consideration of indoor, outdoor temperature ranges referred to C37.04.

18.) Topic #13 Seismic Qualification for General and Nuclear Applications (Xi Zhu)

Xi reviewed doc. 051 with committee. Seismic standard maintenance resides in the committee associated with IEEE 693. Reference to the applicable standards added. Additional standards include C37.81. IEEE 323 for safety and C37.82 (specific to nuclear facilities) was included.

19.) Topic #14 C37.04 and C37.06 (Mike Crawford)

M. Crawford not present in the meeting at this time. Close communication and interaction needed between C37.09 and this group.

20.) Topic #15 C37.09a, 09b, 04a (Anne Bosma)

C37.09a and C37.09b will be integrated into C37.09. Definitions and ratings will be taken by C37.04. Please note: that C37.09 may only need to reference C37.100.2 since C37.09a should be included in C37.100.2. This decision may depend on the timing and the release of these documents. The committee should make sure that all necessary parts of .09a are included in C37.100.2. For now it may be best to pull in C37.09a into .09. (See doc. 049 and 048)

Discussion followed regarding capacitive switching classes C0, C1, C2. A historical perspective was presented on the evolution of capacitive switching ratings by Arben Bufi. Two alternatives were presented: first is to take the ratings as currently in C37.09a, second is to take approach from IEC in which C0 was omitted. (See doc. 023)

Benefit to C0 is to classify a breaker that has multiple failed shots in a C1 attempt. Still demonstrates a degree of capability (fall-back rating from C1). It is important to define capability for medium voltage equipment.

Existing installed circuit breakers cannot be reclassified unless they are retested.

NERC is requesting a definition for the probability of restrike associated with each class for minimum approach distances. The probability of restrike for each class reflects the value for the test but this may be different from the probability of restrike during the service life of the circuit breaker.

The option to reference C37.100.2 was left open.

#### 21.) Topic #16 C37.017 (Stan Billings)

See Doc. 045. References added to IEEE Std. 4 for dielectric tests including AC dry, AC wet, BIL including definition of the test sequence.

#### 22.) Topic #17 Summary Table for all Test Duties (Ken Edwards)

A summary table of basic tests will be prepared (K. Edwards). Purpose of this table is to verify that tests performed on the circuit breaker are complete. Possible inclusion of older versions of the test table in the appendix. Xi reminded Ken that information is needed 12-5-14. The following members offered to help Ken Edwards with this assignment: Carl Schuetz, Dave Lemmerman, and Eldridge Byron.

#### 23.) Topic #18 Measurement Tolerance Table (Gilbert Carmona)

(See Doc. 054). Summary table presented by G. Carmona with suggestions for each item. Xi reminded Gilbert that specific information is needed 12-5-14 in word format.

#### 24.) Topic #19 Sharing of WG Documents (Xi Zhu)

The chair sent e-mail with link to website containing all documents and information. About 60% of invitees accessed the site and signed-up, the remaining 40% did not. Additional members requested invitations. The invitation was sent by the secretary to additional members on 9-22-14 after the meeting. E-mail with link was sent to the addresses provided.

#### 25.) Topic #20 Load Switching Test (Eldridge Byron)

See Doc. 046. E. Byron prepared wording to make load switching a conditional test. Suggestion is that if two adjacent terminal fault test duties have minimum arcing times that differ by ½ cycle or more then load switching test will be required. Text needs to be revised to indicate this.

26.) The working group committee agreed to adjourn the session.

**Session 3 – September 22, 2014 (3:45 PM to 5:30 PM)**

Location: Asheville  
Participants: 23 members  
14 guests

27.) Topic #21 IEC62271-100s, T100a testing, arcing window (Denis Dufournet)

See Doc. 043. Text and graphics presented by D. Dufournet for demonstration of arcing times for 100% terminal fault symmetrical and asymmetrical tests. Targets are defined for various arcing times. Text and formulae are included. Graphic demonstrate major/minor loop, extended loop for asymmetrical current. Three contribution(s) will be added to standard. Wording has to be changed from “earthed” to “grounded”. Xi request a word format document is necessary with text, equations and graphics (only pdf available at this time) for the latest version.

Denis provided the word document to the committee on 9-24-14 after the meeting with updates to definitions and items discussed in the meeting.

28.) Topic #23 M1 M2 Mechanical Endurance Test (John Webb)

See doc. 050. J. Webb presented IEC 62271-100 excerpts related to mechanical endurance test and M1 M2 classification. Applicable sections to be added to C37.09.

29.) Topic #24 C37.09 Errata - 2007 April 18 (Xi Zhu)

All errata to C37.09 to be incorporated into the C37.09 draft.

30.) Topic #25 C37.09 Corrigendum - 2007 (Xi Zhu)

All corrigenda to C37.09 to be incorporated into the C37.09 draft.

31.) Topic #26 Arc-resistant testing for outdoor breakers (John Webb)

See Doc. 053. Presentation of testing for medium voltage outdoor circuit breakers. Related to C37.20.7 for arc-resistant circuit breakers. Indicators placed in vertical position but not in horizontal position. Proposal to add horizontal indicators. Proposal includes indicators below and above exhaust vents. Lower indicators to determine protection for personnel, above for protection to other equipment.

This topic is not in current scope of standard.

It should not be a problem to include this new topic in C37.09 but Xi reminded John that information is needed 12-5-14.

32.) Topic #27 Editing of Graphs and Formulae (Xi Zhu)

Chair requested volunteers to edit graphs and formulas in C37.09. Tom Mulcahy and Robert Foster volunteered to help correct, redraw and rewrite some of the graphs and formulas. Example of some corrections needed are on Page 11, 17-19, 3132, 37-38, 61 etc.

33.) A final reminder of the schedule for project and request for timely submission of contributions. **All information to be included in C37.04 needs to be to the chair by 12-5-14.**

34.) The working group committee agreed to adjourn the meeting.



Meeting Roster for Session #1, #2, #3 – Asheville NC

				Asheville Meeting Sessions 9/22/2014		
First Name	Last Name	Role	Company	#1	#2	#3
Syed Shahab Uddin	Ahmed	Guest	Siemens Energy Inc	X	X	
Roy	Alexander	Member	RWA Engineering	X	X	
Mauricio	Aristizabal	Member	ABB			
Roy	Ayers	Guest	Nashville Electric Service	X	X	X
Katrin	Baeuml	Guest	Schneider Electric			
William	Bane	Guest	Nashville Electric Service			
Amildo	Barrio	Guest	Parsons			
Jerry	Baskin	Guest	Federal Pacific			
George	Becker	Guest	Electric Power Research Institute			
Jean-Marc	Biasse	Guest	Schneider Electric			
Stan	Billings	Member	Mitsubishi Electric PP	X	X	X
Anne	Bosma	Member	ABB AB	X	X	X
Cody	Brehm	Guest				
Steven	Brown	Guest	Allen & Hoshall			
Arben	Bufi	Member	Hitachi HVB, Inc.	X	X	X
Eldridge	Byron	Member	Schneider Electric	X	X	X
Donald	Cantrelle	Guest	Georgia Power	X	X	X
Gilbert	Carmona	Member	Southern California Edison	X	X	X
Stephen	Cary	Member	Eaton Corporation	X	X	X
Steven	Chen	Member	Eaton Corporation			
Wayne	Cheng	Member	B C Hydro			
Vincent	Chiodo	Guest	HICO			
Jeonghwan	Cho	Guest	HICO America			
Chih	Chow	Member	PEPCO	X	X	X
Michael	Christian	Guest	ABB			
Roggero	Ciofani	Guest	Altalink			
Lucas	Collette	Member	Mitsubishi Electric	X	X	X
Dave	Collette	Guest	Mitsubishi Electric	X	X	X
Lee	Cox, Jr.	Guest	Efacec			
Andrew	Crane	Guest	Consumers Energy			
Michael	Crawford	Member	Mitsubishi Electric	X	X	
David	Dart	Guest	NOJAPower			
Jerod	Day	Guest	Vacuum Interrupters, Inc.			
Patrick	Di Lillo	Member	Consolidated Edison Co. of NY, Inc.			
Denis	Dufournet	Member	Alstom Grid	X	X	X
John	Eastman	Guest	INCON	X	X	

Ken	Edwards	Member	Bonneville Power Administration	X	X	
Doug	Edwards	Guest	Siemens Industry, Inc.			
Tanner	Esco	Guest	Eaton Corporation			
Leslie	Falkingham	Member	Vacuum Interrupters Limited			
Thomas	Field	Member	Engergy			
Sergio	Flores	Guest	Schneider Electric Inc. USA		X	X
Robert	Foster	Guest	Megger	X	X	X
Paul	Fox	Guest	Schneider Electric			
Didier	Fulchiron	Guest	Schneider-Electric		X	X
Sivakumar	Ganesh	Member	ENMAX Corporation			
Douglas	Giraud	Member	Powell Electrical Systems	X	X	X
Paul	Grein	Member	Circuit Breaker Sales, Co, Inc, - GroupCBS			
John	Hall	Guest	Tennessee Valley Authority			
Jeffrey	Hanson	Guest	Schneider Electric			
Helmut	Heiermeier	Member	ABB	X	X	X
Charles	Hendrickson	Guest	Arizona Public Service Company	X	X	
Victor	Hermosillo	Vice- Chair	Alstom Grid	X	X	X
Jingxuan (Joanne)	Hu	Member	RBJ Engineering Corporation			
Roy	Hutchins	Member	Southern Company Services	X	X	X
Todd	Irwin	Member	Alstom Grid Inc	X	X	X
Carlos	Isaac	Guest	Oncor Electric Delivery			
Anton	Janssen	Guest	Liander			
Jacob	Joseph	Member	Toshiba International Corporation	X		
Mangu	Kang	Guest	HICO America			
Sandeep	Kulkarni	Guest	CG			
Carl	Kurinko	Guest	ABB Inc.			
Stephen	Lambert	Guest	Shawnee Power Consulting, LLC			
Carl	LaPlace	Guest	GE Industrial Solutions		X	
Matthew	Lawrence	Guest	Doble Engineering			
David	Lemmerman	Guest	PECO/Exelon		X	
Werner	Lesse	Guest	Siemens AG	X	X	
Wangpei	Li	Guest	Eaton			
Hua Ying	Liu	Member	Southern California Edison	X	X	X
Li	Liu	Member	Eaton			
Albert	Livshitz	Member	CE Power Solutions			
Bjorn	Lofgren	Member	Siemens Energy			
Russell	Long	Member	Retired	X		
Antonio	Mannarino	Guest	PSE&G			
Vincent	Marshall	Guest	Southern Company Services	X	X	X
Gary	Martin	Member	Entergy	X		
Ricardo	Martinez	Member	CFE-LAPEM			
Peter	Marzec	Guest	S&C Electric Co.		X	X

Neil	McCord	Guest	Southern States			
Timothy	McGee	Guest	Siemens Energy			
Dave	Mitchell	Guest	Dominion	X		
Terry	Monahan	Guest	Schneider Electric			X
Tom	Mulcahy	Guest	Dominion	X	X	X
Volney	Naranjo	Guest	Megger			
Jeffrey	Nelson	Member	Tennessee Valley Authority			
Joachim	Oemisch	Guest	Siemens AG			
Miklos	Orosz	Member	Schneider Electric		X	X
Molson	Parvin	Guest	CB&I			
Shawn	Patterson	Guest	US Bureau of Reclamation			
Thomas	Pellerito	Member	DTE Energy			
Alan	Peterson	Guest	Utility Service Corporation			X
Lise	Phan	Member	Parcific Gas and Electric Company			
Iulian	Profir	Member	Rockwell Automation			
Syed	Rahman	Member	The United Illuminating Company			
Samala Santosh	Reddy	Guest	Powell Industries			
Frank	Ricard	Member	FirstPower Group LLC			
Anthony	Ricciuti	Member	Eaton Corporation			
Dave	Riffe	Guest	Westinghouse Electric Company			
Brian	Roberts	Guest	Southern States, LLC			
Jon	Rogers	Member	Siemens Energy, Inc			
Ben	Rosenkrans	Guest	Eaton Corporation			
Roderick	Sauls	Member	Southern Company Services	X	X	X
Carl	Schuetz	Member	American Transmission Company (ATC)	X	X	
Jon	Schumann	Member	American Transmission Company	X	X	
Devki	Sharma	Member	Consultant	X		
Sushil	Shinde	Member	ABB Inc.	X	X	X
John	Shullaw	Guest	GE Energy Management		X	
Dean	Sigmon	Member	Eaton Corporation	X		
Sunita	Singh	Guest	Bechtel OG&C			
Michael	Skidmore	Secretary	AEP	X	X	X
Robert	Smith	Member	Eaton Corporation			
Hongbiao	Song	Guest	GE			
Erin	Spiewak	Guest	IEEE	X		
Don	Steigerwalt	Guest	Duke Energy			
Donald	Swing	Member	Powell Industries	X	X	X
Dragan	Tabakovic	Guest	Hitachi HVB			
Humayun	Tariq	Member	American Electric Power	X	X	X
Vernon	Toups	Member	Siemens	X		
Richard	Trussler	Guest	Schneider Electric		X	X
James	van de Ligt	Member	CANA High Voltage Ltd.			
Wes	Wadsworth	Member	Hitachi HVB, Inc.			
John	Webb	Member	ABB	X	X	X

Casey	Weeks	Guest	Siemens Energy			
Matthew	Williford	Guest	Schneider Electric		X	X
Terry	Woodyard	Member	Siemens Industry Inc.	X	X	
Lisa	Yacone	Guest	IEEE-SA			
Dong Sun	Yoon	Guest	HICO America			
Richard	York	Guest	GE Digital Energy			
Jiong	Zhang	Member	MEPPI			
Wei	Zhang	Guest	Hitachi HVB, Inc.	X	X	X
Xi	Zhu	Chair	GE Energy Management	X	X	X

“X” - individual was at the meeting in Asheville