C37.09a meeting minutes San Diego, CA October 10, 2023

Welcome/Call to Order
Jan Weisker called the meeting to order at 2:00 pm

Introductions & Membership
The attendees introduced themselves along with their affiliation.

33 members out of 44 were present for the meeting which met the quorum requirements. The total attendance was 73.

Mandatory Information
IEEE Copyright slide was presented. The essential patent claim slide was presented. No essential patent claims were voiced during the call.

Approval of Minutes of last Meeting (Spring 2023 meeting)
Motion to approve – Andy Keels
2nd – Carl Schuetz

A project status update was given summarizing the previous meetings.

Review of the Item List and work done so far
Item #1 – Define time interval between tests
John Webb motioned to approve the proposed language as presented with change from "test plant" to "test lab"
Neil McCord seconded the motion.
The motion carried by unanimous consent.

Item #23 – expand allowance to take advantage of symmetry during chopped wave test
This item is closed with no change necessary.

Item #2 and #19 – test procedure T100a
Ted Burse requested to remove these two items. A task group reviewed these items and recommended the same. There were no objections to withdrawing them.

Item #10
This will be delayed to the next revision.

Item #20
The text presented by Andy Chovanek will be introduced to the Annex C.

Item #3 and #17 – Low and high temperature tests
Andrew Chovanec presented proposed changes to the low temperature testing and high temperature testing
Motion to accept revised proposal as presented – Carl Schuetz
2nd – Neil McCord
The motion carried by unanimous consent.

Possible action item: How to account for solar radiation heating in high temperature test.
Comment from the chair: Will not be considered for amendment 1

There was discussion whether language should be added that lock out is not permitted during temperature testing. Language needs to be added to make it clear.

We will discuss in the next meeting the pass and fail criteria for low and high temperature test.

Item #27 - Voltage condition check
Dan Schiffbauer presented a proposal to harmonize the IEC and IEEE values.
Motion to introduce changes as presented- Mike Crawford
Seconded by Vernon Toups
Motion carried by unanimous consent.

IEC does not require voltage condition check after certain tests and allow a visual inspection – There was agreement with the group that IEEE should still require voltage condition check and not align with IEC.

The group declined to make a motion to approve allow testing across the gap only for live tank breakers.

Item #13 – Vacuum integrity

Checking for vacuum integrity after testing.
The task group proposed to adopt the IEC procedure after short circuit testing.
John Webb made the motion to adopt.
Seconded by Lucas Colette
The motion carried by unanimous consent.

The task group proposed that we add options for testing after mechanical and environmental testing.
John Webb made a motion to allow reduced gap and arc voltage, and reduced power (50%) short circuit testing after mechanical and environmental testing.
Micheal Christian seconded the motion.
The motion carried by unanimous consent.

Item #24
The item was moved to the next meeting.

New Business
Victor Savulyak, Jan Weiker, John Webb volunteered to review whether to allow the vacuum interrupter to be pre-conditioned before performing C1 test.

Victor Savulyak, Samuel Andris and Mauricio will review and come up with proposal to address Item #26.

Time Schedule
A planned time schedule was presented to the working group. The PAR expires December 31, 2025.

Adjourn the Meeting
The agenda was completed and the meeting was adjourned at 3:44 pm

Reported by:

Chris Jarnigan

Attachments:

(1) WG membership and attendance

(2) Agenda

(3) Item List after meeting

<u>Membership and attendance</u>

Role	First Name	Last Name	Company Name	S22	F22	S23	F23
Chair	Jan	Weisker	Siemens Energy	x	x	x	x
Secretary	Christopher	Jarnigan	Southern Company	x	x	x	x
Voting member	Koustubh	Ashtekar	JST POWER EQUIPMENT	x	x	x	x
Voting member	Herman	Bannink	G&W Electric	x	x	x	
Voting member	Arben	Bufi	Meiden America	x	x	x	x
Voting member	Eldridge	Byron	Schneider Electric	x			
Voting member	Stephen	Cary	2 Phase Solutions	x		x	x
Voting member	Steven	Chen	Eaton Corporation	x	x	x	x
Voting member	Andrew	Chovanec	Power Grid Components	x	x	x	x
Voting member	Michael	Christian	ABB	x	x	x	x
Voting member	Lucas	Collette	Duquesne Light Co.	x	x	x	x
Voting member	Michael	Crawford	Mitsubishi Electric	x	x	x	x
Voting member	Sergio	Flores	Schneider Electric US, Inc.	x	x	x	x
Voting member	Robert	Hanna	JST Power Equipment	x	x		x
Voting member	Jeremy	Hensberger	Mitsubishi Electric	x	x	x	x
Voting member	Jennifer	Hunter	MEPPI		x	x	x
Voting member	Todd	Irwin	GE Grid Solutions	x		x	
Voting member	Thomas	Keels	kEElectric Engineering,	x	x		x
Voting member	Carl	Kurinko	Hitachi Energy	x	x	x	x
Voting member	Vincent	Marshall	Southern Company	x	x	x	x
Voting member	Steven	May	Southern Company		x	x	x
Voting member	Neil	Mc Cord	KEC Precision LLC	x	x	x	x
Voting member	Kevin	McGlown	JST Power Equipment	x			
Voting member	Sumitabha	Pal	Schneider Electric	x	x	x	x
Voting member	Craig	Polchinski	Mitsubishi Electric Power	x			

Voting member	Anthony	Ricciuti	EATON	x	x	x	x
Voting member	Leonel	Santos	Schneider Electric	x		x	x
Voting member	Victor	Savulyak	KEMA	x	x	x	x
Voting member	Carl	Schuetz	ATC	x	x	x	x
Voting member	Jeffrey	Scott	Ameren	x	x	x	x
Voting member	Devki	Sharma	Self affiliated	x		x	
Voting member	Michael	Skidmore	AEP	x	x	x	
Voting member	Donald	Steigerwalt	Duke Energy		x	x	x
Voting member	Vernon	Toups	Siemens Energy Inc	x	x	x	x
Voting member	Jacob	Walgenbach	Siemens	x	x	x	x
Voting member	John	Webb	ABB	x	x	x	x
Voting member	Casey	Weeks	Siemens Energy, Inc.	x	x	x	x
Voting member	Terry	Woodyard	Siemens Industry, Inc.	x	x	x	x
Voting member	Richard	York	Mitsubishi Electric	x	x	x	x
Voting member	Marcus	Young	Mitsubishi Electric		x	x	x
Voting member	Samuel	Zaharko	MEPPI	x	x	x	
Non-voting member	Anatoly	Akhunov	HICO America			x	
Non-voting member	Samuel	Andris	KEMA Labs		x	x	x
Non-voting member	Mauricio	Aristizabal	Hitachi Energy		x	x	x
Non-voting member	Ganesh	Balasubramanian	Eaton			x	
Non-voting member	Andreas	Bartels	Powell Industries			x	x
Non-voting member	Andy	Beckel	Xcel Energy			x	x
Non-voting member	George	Becker	Power Engineers Inc.		x	x	x
Non-voting member	Bob	Betti	JST POWER EQUIPMENT			x	
Non-voting member	Elizabeth	Bray	Southern Company	x			
Non-voting member	Jeff	Brodgen	Georgia Transmssion			x	
Non-voting member	Adam	Brooks	Duke Energy			x	x
Non-voting member	John	Brunke	Power Engineers	x			
Non-voting member	Craig	Bryant	Duke Energy		x	x	
Non-voting member	Ted	Burse	Powell Industries, Inc.		x		
Non-voting member	Dave	Collette	Mitsubishi Electric			x	
Non-voting member	Jason	Cunningham	Southern States, LLC	x	x	x	
Non-voting member	Patrick	Di Lillo	Consolidated Edison Co.	x	x		x
Non-voting member	Federico	Di Michele	CESI SpA		x	x	
Non-voting member	Jeff	Door	H-J			x	
Non-voting member	Max	Eastman	Black & Veatch			x	

Non-voting member	Leslie	Falkingham	VIL			x	
Non-voting member	Bruce	Fennell	Nashville Electric Service	x			
Non-voting member	Peter	Glaesman	PCORE Electric Company		x		
Non-voting member	Nadia	HASNAOUI	GE		x		
Non-voting member	Victor	Hermosillo	GE Grid Solutions		x		x
Non-voting member	Benjamin	Hohnstadt	DTE	x			
Non-voting member	Roy	Hutchins	Georgia Power Company	x	x		
Non-voting member	Bharatwaj	Jagadeesan	Southern States LLC	x			
Non-voting member	Darin	Jensen	Meiden American		x		x
Non-voting member	Dave	Johnson	Self affiliated			x	
Non-voting member	Hyoungjin	Joo	Hyundai Electric & Energy		x		
Non-voting member	SangTae	Kim	HICO America		x	x	x
Non-voting member	Yun Seong	Kim	KERI			x	
Non-voting member	Dwight	Krause	Black & Veatch			x	
Non-voting member	Patil	Lalit	Eaton			x	x
Non-voting member	Chang Hoon	Lee	HYOSUNG	x	x	x	x
Non-voting member	Yong Woo	Lee	KERI			x	x
Non-voting member	Leo	Lopez	WIKA Instrument	x	x	x	x
Non-voting member	Adrian	Lopez	Powell Industries		x		
Non-voting member	Peter	Marzec	S&C Electric	x			
Non-voting member	Paul	Masterson	Meiden America	x		x	x
Non-voting member	Kenneth	McKinney	Underwriters		x		
Non-voting member	David	Mitchell	Southern States	x	x	x	
Non-voting member	Andrew	Monroe	Southern Company	x			
Non-voting member	Raj	Nayar	Siemens	x		x	
Non-voting member	Fernando	Ordein	Dominion Energy			x	
Non-voting member	Miklos	Orosz	Circuit Breaker	x	x		
Non-voting member	John	Owen	Powertech Labs			x	
Non-voting member	Mark	Pattison	H-J			x	
Non-voting member	Thomas	Pellerito	DTE ENERGY	x			
Non-voting member	Mark	Peterson	Xcel Energy			x	
Non-voting member	Isaac	Pounders	Meiden			x	x
Non-voting member	Rakesh	Ranjan	Esgee Technologies Inc.	x			
Non-voting member	Aaron	Rexroad	Meiden			x	x
Non-voting member	Brian	Roberts	Southern States			x	x
Non-voting member	Ryan	Rowe	TCI			x	

Non-voting member	Oscar	Salas	Duke Energy			x	
Non-voting member	Alex	Salinas	Doble/Vanguard			x	
Non-voting member	Jennifer	Santulli	IEEE-SA	x			
Non-voting member	Daniel	Schiffbauer	Toshiba International	x	x	x	x
Non-voting member	Aleksandr	Serguyenko	Tavrida			x	
Non-voting member	Matthew	Siena	Duke Energy	x			
Non-voting member	Hall	Sigmon	Siemens			x	
Non-voting member	R Kirkland	Smith	TCARA		x		
Non-voting member	Ben	Sux	Nashville Electric Service			x	
Non-voting member	Donnie	Swing	Powell			x	
Non-voting member	Truett	Thompson	Siemens		x		
Non-voting member	Joseph	Usner	AEP	x	x	x	
Non-voting member	Jeffrey	Ward	Doble Engineering Co			x	
Non-voting member	Dan	Wolfe	MEPPI		x	x	x
Non-voting member	Mina	Youssef	Eaton Corporation		x		x
Non-voting member	Li	Yu	EATON		x	x	
Non-voting member	Lukas	Zehnder	Hitachi Energy	x			
Non-voting member	Gigi	Zhang	HICO America			x	
Non-voting member	Xin	Zhou	Eaton		x		
Non-voting member	Danish	Zia	UL LLC	x			
Guest	Anatoly	Akhunov	HICO				x
Guest	Dan	Benedict	PPL				x
Guest	Brian	Berner	Power Grid				x
Guest	Sankey	Bolar	Oncor				x
Guest	Sundarshan	Byreddy	Burns & McDonald				x
Guest	Ivan	Contreras	ABB				x
Guest	Andrew	Fernandes	Trayer				x
Guest	Mauricio	Gonzalez	Avangard				x
Guest	Jeff	Jordan	Southern States				x
Guest	Chunning	Ma	Burns & McDonald				x
Guest	Henning	Milnikel	Siemens AG				x
Guest	Stephanie	Montoya	MKI				x
Guest	Anthony	Natale	HICO				x
Guest	Conrad	Pecile	Myers Power Products				x
Guest	Frank	Richter	50 Hz Transmission				x
Guest	Jon	Rogers	Siemens Energy Inc				x
Guest	Jun	Seo	HD Hyundai Electric				x
Guest	John	Sestito	Hyundai				x
Guest	John	Tarleton	Southern States				x

PC37.09 Standard Test Procedure for AC High-Voltage Circuit Breakers with Rated Maximum Voltage above 1000V - Amendment 1

Chair: Jan Weisker

Secretary: Chris Jarnigan

IEEE Switchgear Committee Meeting, October 10, 2023 – San Diego/CA

Introduction & Membership

Chair: Jan Weisker

Secretary: Chris Jarnigan

Members

Koustubh	Ashtekar
Harm	Bannink
Craig	Bryant
Arben	Bufi
Eldridge	Byron
Stephen	Cary
Steven	Chen
Andrew	Chovanec
Michael	Christian
Lucas	Collette
Michael	Crawford
Frederico	Di Michele
Sergio	Flores
Robert	Hanna
Jeremy	Hensberger
Jennifer	Hunter
Todd	Irwin
Thomas	Keels
Carl	Kurinko
Vincent	Marshall
Steven	May
Neil	Mc Cord
Kevin	McGlown
Sumitabha	Pal
Craig	Polchinski
Anthony	Ricciuti
Leonel	Santos
Victor	Savulyak
Carl	Schuetz
Jeffrey	Scott
Devki	Sharma
Michael	Skidmore
Donald	Steigerwalt
Vernon	Toups
Jacob	Walgenbach
John	Webb
Casey	Weeks
Terry	Woodyard
Richard	York
Marcus	Young
Li	Yu
Samuel	Zaharko

44 Members - Quorum = 22

Red names officially excused

Agenda

- Welcome/Call to Order
- Introductions & Membership
- Mandatory Information
- Approval of Minutes of last Meeting
- Review of the Item List
- New business
- Time Schedule
- Adjourn the Meeting

Mandatory Information

https://development.standards.ieee.org/myproject/Public/mytools/mob/slideset.pdf

https://standards.ieee.org/wp-content/uploads/2022/02/ieee-sa-copyright-policy.pdf

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  - IEEE SA Copyright Policy, see
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- IEEE SA Copyright FAQs
  - https://standards.ieee.org/faqs/copyrights/
- IEEE SA Best Practices for IEEE Standards Development

http://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/best_practices_for_ieee_standards_development_051215.pdf

- Distribution of Draft Standards (see 6.1.3 of the SASB Operations Manual)
  - https://standards.ieee.org/about/policies/opman/sect6.html

PARTICIPANTS HAVE A DUTY TO INFORM THE IEEE

- Participants <u>shall</u> inform the IEEE (or cause the IEEE to be informed) of the identity of each holder of any potential Essential Patent Claims of which they are personally aware if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents

- Participants <u>should</u> inform the IEEE (or cause the IEEE to be informed) of the identity of any other holders of potential Essential Patent Claims

Early identification of holders of potential Essential Patent Claims is encouraged

WAYS TO INFORM IEEE

- **Cause an LOA to be submitted to the IEEE SA (patcom@ieee.org); or**
- **Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible; or**
- **Speak up now and respond to this Call for Potentially Essential Patents**

If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance, please respond at this time by providing relevant information to the WG Chair

OTHER GUIDELINES FOR IEEE WORKING GROUP MEETINGS

- **All IEEE SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.**
  - **Don’t discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don’t discuss specific license rates, terms, or conditions.**
    - Relative costs of different technical approaches that include relative costs of patent licensing terms may be discussed in standards development meetings.
      - **Technical considerations remain the primary focus.**
  - **Don’t discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don’t discuss the status or substance of ongoing or threatened litigation.**
  - **Don’t be silent if inappropriate topics are discussed. Formally object to the discussion immediately.**

For more details, see *IEEE SA Standards Board Operations Manual*, clause 5.3.10 and *Antitrust and Competition Policy: What You Need to Know* at http://standards.ieee.org/develop/policies/antitrust.pdf

PATENT-RELATED INFORMATION

The patent policy and the procedures used to execute that policy are documented in the:

- *IEEE SA Standards Board Bylaws*
  (http://standards.ieee.org/develop/policies/bylaws/sect6-7.html#6)
- *IEEE SA Standards Board Operations Manual*
  (http://standards.ieee.org/develop/policies/opman/sect6.html#6.3)

Material about the patent policy is available at
http://standards.ieee.org/about/sasb/patcom/materials.html

If you have questions, contact the IEEE SA Standards Board Patent Committee Administrator at patcom@ieee.org

Approval of MoM

Minutes of **C37.09 Amendment 1 Working Group**
Spring 2023 meeting
April 18, 2023, Clearwater, Florida

Attendance 84 people were in attendance.
31 members participated (of 36 at that date)

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Welcome/Call to Order
Jan Weisker called the meeting to order at 2:00 pm

Introductions & Membership
The attendees introduced themselves along with their affiliation.

84 people attended the meeting.
31 members out of 36 were present for the meeting which met the quorum requirements.

Item 24
Mike Crawford proposed to add language of clarifying accessible spots for temperature measurements.

There was discussion regarding this item. There was an example given that some designs require damaging the device to take measurements.

There was a question whether it should be specified how close to the joint the measurement should be taken. Discussion was held that it is not possible to uniformly define a distance used to differences in breaker designs.

- Mike Crawford and John Webb volunteered to rephrase the wording together with Jake Walgenbach.

Project Status PC37.09 Amd1

1) First Meeting, April 12, 2022, Orlando/FL
2) Proposals for several items received
3) Second Meeting, October 18, 2022, Burlington/VT
   Proposals discussed and some already agreed
4) Further proposals received
5) Third Meeting, April 18, 2023, Clearwater/FL
   Proposals discussed and some already agreed
6) Further proposals received

Item List Review

#1

1	Technical	Define Time interval between tests	as per IEC 62271-100; 6.106.1 (future 7.106.1)	Ted Burse	Jan Weisker

Introduce in 4.8.1 General after d)

Due to test laboratory ~~plant~~ limitations, the time interval t'_r may not be achieved. If so, the test shall be performed with the shortest achievable time interval t'_r. The time interval achieved shall be stated in the report. If it is longer than 10 min the reason for the delay shall be stated additionally.

b) Test current I is equal to the maximum rated rms symmetrical interrupting current

c) Time t_r is equal to

   1) 15 s for circuit breakers that are not rated for reclosing duty

   2) 0.3 s for circuit breakers rated for reclosing duty

d) Time t_r' is equal to 3 min

e) Time T is equal to the specified time shown in IEEE Std C37.04 under the subclause for "Rated closing, latching, and short-time current-carrying capability"

#23

23	Technical	4.5.2 i)	expand allowance to take advantage of symmetry during chopped wave test	Mauricio

i) The configuration of the circuit breaker may cause a test on one terminal to produce the same electric stress distribution as a test on one or more of the other terminals. When this situation prevails, and test procedure B of IEEE Std 4 (e.g., "15/2 method") is being used, it shall be necessary to apply voltage only to those terminals that produce different distributions of electric stress. When test procedure C of IEEE Std 4 (e.g., "3 × 9 method") is being used, all three poles must be tested.

As long as 15/2 is applied advantage of symmetry can be taken.
No matter if LI, SI or chopped LI

#2 + #19

2	Technical			T100a procedure is generally accepted	but give more guidance if circuit-breaker is not stable for min arcing time
19	Technical			consider appropriateness of determining minimum clearing time	align .09 with -100 as related to min arcing time

Hello Jan,

I respectfully request that item 10 be removed from the list. C37.09 and 62271-100 are harmonized with respect to using the minimum arcing time of T100S when determining the minimum clearing time of T100A.

Although I still strongly disagree that the minimum arcing time obtained during T100S truly represents the minimum possible arcing time for many circuit breakers, I believe any change in this area would be much larger than what an amendment to .09 could address.

Regards,

Ted

#10

10	Technical	Double Earth Fault in IEEE	Test necessary?

Task group agreed to postpone to new revision

#20

20	Technical			formulas for calculating assymetrical %DC for T100a 1ph need to be clarified	T100a 1ph needs to be clarifed as compared to TD 7 defintion in 1999 version	Sergio Flores	S. Flores, J. Webb, A. Chovanec

No final decision if

- to move to C37.010
- Or to create an on informative annex

To close the item, chair proposes:

- Included prepared content in Annex C

Annex C

(informative)

Revised test procedure for T100a

C.1 General

#3 + #17

3	Technical	84	4.3.18	Low-Temp Test – TL and TLL are neither defined in .09 or referenced in .04	Define TL and TLL
17	Technical	87	4.14	mention of high temp tests but not defintion/procedure	Check C37.016-2018, clause 7.11.5.3 for common clause

Proposed changes to Environmental Testing Procedure

IEEE PES Switchgear Meeting - October 2023

Proposed changes to Environmental Test Procedure

Steps added for qualifying 2nd Temperature Rating (T_{L2})

Table 13—Low-temperature test sequence

Item	Description	Operating sequence	Dataset (see Table 10)	Supply voltage	Operating energy	Number of operating sequences
a	Pretest Checks	—	3	—	—	—
b	Pretest Operations [b]	O, C, O–t_r–CO	2	Minimum	Rated	2
				Maximum	Rated	2
				Rated	Rated	2
c	Circuit Breaker CLOSED – Cool Down					
d	Tightness Test					
e	Low Temperature Operations	O, C, O–t_r–CO	4	Rated	Rated	Variable [c]
f	Auxiliary Heaters OFF					
	Minimum Density Operation [d]	O	4	Rated	Rated	0.5
	Auxiliary Heaters ON					
g	Circuit Breaker OPEN					
h	Tightness Test					
i	Low-Temp Operations [a]	C–3 min–O	4	Rated	Rated	1
		CO–3 min	4			3
		C–t_a–O–t_a	None			46
j	Rising Temperature Operations [a]	C–t_a–O–t_a–C–30min–O–t_a–C–t_a–O–30min	4	Rated	Rated	Variable [e]
k	Posttest Operations [b]	O, C, O-t_r–CO	2	Minimum	Rated	2
				Maximum	Rated	2
				Rated	Rated	2
l	Posttest Checks	—	3	—	—	—

An additional low-temperature (T_{L1}) may be tested within the same sequence by following Figure 16. However, note that the test object configuration shall not be altered in any way.

- **Added specific steps to follow if qualifying breaker for a 2nd low-temperature rating**
- Added exception to allow change to amount of heat applied

Table 13—Low-temperature test sequence

Item	Description	Operating sequence	Dataset (see Table 10)	Supply voltage	Operating energy	Number of operating sequences
a	Pretest Checks	—	3	—	—	—
b	Pretest Operations [b]	O, C, O–t_r–CO	2	Minimum	Rated	2
				Maximum	Rated	2
				Rated	Rated	2
c	Circuit Breaker CLOSED – Cool Down to T_{L1}					
d	Tightness Test at T_{L1}					
e	Low Temperature Operations	O, C, O–t_r–CO	4	Rated	Rated	Variable [c]
f	Auxiliary Heaters OFF					
	Minimum Density Operation [d]	O	4	Rated	Rated	0.5
	Auxiliary Heaters ON					
g	Circuit Breaker OPEN					
h	Tightness Test at T_{L1}					
i	Low-Temp Operations [a]	C–3 min–O	4	Rated	Rated	1
		CO–3 min	4			3
		C–t_a–O–t_a	None			46
	Steps j through p only required for dual low-temperature rating					
j	Circuit Breaker CLOSED – Heat Up to T_{L2}					
k	Tightness Test at T_{L2}					
l	Low Temperature Operations	O, C, O–t_r–CO	4	Rated	Rated	Variable [c]
m	Auxiliary Heaters OFF					
	Minimum Density Operation [d]	O	4	Rated	Rated	0.5
	Auxiliary Heaters ON					
n	Circuit Breaker OPEN					
o	Tightness Test at T_{L2}					
p	Low-Temp Operations [a]	C–3 min–O	4	Rated	Rated	1
		CO–3 min	4			3
		C–t_a–O–t_a	None			46
q	Rising Temperature Operations [a]	C–t_a–O–t_a–C–30min–O–t_a–C–t_a–O–30min	4	Rated	Rated	Variable [e]
r	Posttest Operations [b]	O, C, O-t_r–CO	2	Minimum	Rated	2
				Maximum	Rated	2
				Rated	Rated	2
s	Posttest Checks	—	3	—	—	—

An additional low-temperature (T_{L2}) may be tested within the same sequence by including steps j through p following Figure 16. However, note that the test object configuration shall not be altered in any way, with the exception of the amount of heat applied.

Proposed changes to Environmental Test Procedure

Steps added for qualifying 2nd Temperature Rating (T_{L2})

- The only difference is that only 8 hours of soak time is required for the 2nd test at T_{L2}
- Added back in tightness test after comments in Spring meeting

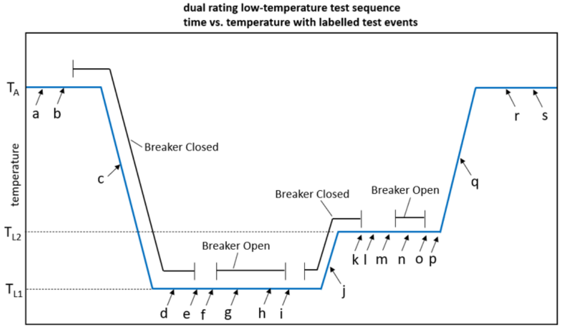


Figure 16—Dual-rating, low-temperature test sequence

i) After 24 h at T_{L1}, the low-temperature operation sequence shall be performed.

Steps j through p need only be performed if a dual low-temperature rating test is being performed. Otherwise, proceed to step q.

j) With the circuit breaker in the closed position and all heater circuits energized, the test cell temperature shall be increased at approximately 10 °C per hour to the second minimum test temperature (T_{L2}). The circuit breaker shall remain in the closed position for a minimum of 8 h after the test cell temperature has stabilized at T_{L2}.

k) After a minimum of 8 h at T_{L2}, a tightness test shall be performed (if applicable).

l) After a minimum of 8 h at T_{L2}, the low-temperature operation sequence shall be performed.

m) With all test object thermocouples and density monitors stabilized, all auxiliary heater circuits are de-energized for 2 h. As the test object approaches minimum functional density (if applicable), perform a single O operation. Record the occurrence of alarm and block operation conditions (if applicable). Record temperature conditions within the mechanism and control enclosures. Reenergize all heater circuits. Record the recovery from block operation and alarm conditions (if applicable). Record the temperature recovery within mechanism and control enclosures.

n) The circuit breaker shall remain in the open position for a minimum of 8 h at T_{L2}.

o) After a minimum of 8 h at T_{L2}, a tightness test shall be performed (if applicable).

p) After a minimum of 8 h at T_{L2}, the low-temperature operation sequence shall be performed.

q) After completion of the test operation sequence, the test cell temperature shall be increased to ambient temperature at approximately 10 °C per hour. During this time, alternating C–t_a–O–t_a–C–30 min–O–t_a–C–t_a–O–30 min operations shall be performed.

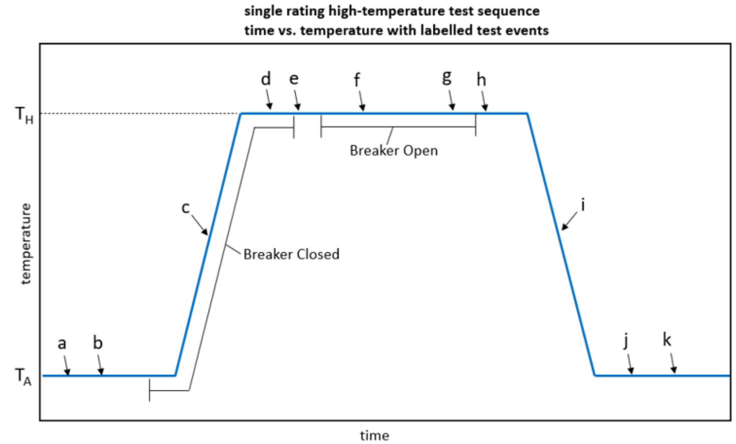
Proposed changes to Environmental Test Procedure

Addition of High-Temp Testing

- Mimicked procedure from Low-temp tests
- Did not include a dual rating option for high temperature testing – did not seem necessary
- Specified a maximum allowable leakage rate of 3 x F_P for high-temperature tests 40°C and above
  - Matches requirement from IEC 62271-1 (2017)
- Incorporated references to High-temperature tests in sections:
  - 4.13.7 - "Low and high-temperature test object and conditions"
  - 4.13.10 - "Low and High-temperature qualification criteria"
  - 4.13.11 - "Low and high-temperature test report requirements"

Table 14—High-temperature test sequence

Item	Description	Operating sequence	Dataset (see Table 10)	Supply voltage	Operating energy	Number of operating sequences
a	Pretest Checks	—	3	—	—	—
b	Pretest Operations [b]	O, C, O–t_r–CO	2	Minimum	Rated	2
				Maximum	Rated	2
				Rated	Rated	2
c	Circuit Breaker CLOSED – Heat Up					
d	Tightness Test					
e	High Temperature Operations	O, C, O–t_r–CO	4	Rated	Rated	Variable [c]
f	Circuit Breaker OPEN					
g	Tightness Test					
h	High Temperature Operations [a]	C–3 min–O	4	Rated	Rated	1
		CO–3 min	4			3
		C–t_a–O–t_a	None			46
i	Decreasing Temperature Operations [a]	C–t_a–O–t_a–C–30min–O–t_a–C–t_a–O–30min	4	Rated	Rated	Variable [d]
j	Posttest Operations [b]	O, C, O-t_r–CO	2	Minimum	Rated	2
				Maximum	Rated	2
				Rated	Rated	2
k	Posttest Checks	—	3	—	—	—



Proposed changes to Environmental Test Procedure

Other proposed changes:

- Updated standard references
- Changed T_{LL} & T_L to T_{L1} and T_{L2}
- Added wording to give guidance to decreasing temperature at approximately 10°C per hour to avoid thermal shock

c) With the circuit breaker in the closed position and all heater circuits energized, the test cell temperature shall be decreased to the minimum test temperature (T_{L1}) at approximately 10 °C per hour. The circuit breaker shall remain in the closed position for 24 h after the test cell temperature has stabilized at T_{L1}.

Maximum allowable leakage rates:

Gas tightness (if applicable) shall conform to the manufacturer's permitted leakage rate F_P. Absolute low and high-temperature leakage rate shall meet the following:

1) Maximum leakage rate of $3 \times F_P$ for low-temperature tests down to and including -40°C
2) Maximum leakage rate of $6 \times F_P$ for low-temperature tests below -40°C
3) Maximum leakage rate of $3 \times F_P$ for high-temperature tests 40°C or above

Item List Review

#27

27	Technical	A closely related item is the voltage condition check defined in IEEE Std C37.09 (2018) and IEC 62271-100 (2017). They are not the same. I wanted to ask for some discussion during the meeting about why they are not the same and if we could consider alignment with -100.	Dan Schiffbauer	Input from Dan

- "A closely related item is the voltage condition check defined in IEEE Std C37.09 (2018) and IEC 62271-100 (2017). They are not the same. I wanted to ask for some discussion during the meeting about why they are not the same and if we could consider alignment with -100. "

Several opportunities exist to align the voltage condition check parameters between IEC and IEEE.

	IEC 62271-100 (2017)					IEEE C37.09 (2018)					
	6.2.11 Voltage test as a condition check after making breaking switching					4.8.5.4.3 Condition check after meeting service capability tests					4.8 Short circuit making and breaking 4.8.6 Condition of circuit breaker tested 4.8.6.7 Voltage withstand tests
U_r	Rated Dry Power Frequency Withstand	Rated Lightning Impulse	Rated Switching Impulse	Waveform	Series	Rated Dry Power Frequency Withstand	Rated Lightning Impulse	Rated Switching Impulse	Waveform	Series	
< 72.5	80%	-	-	-	1 min	80%	-	-	-	1 min	
72.5	80%	-	-	-	1 min	-	80%	-	Std	5x ±	
						-	60%	-	T10	5x ±	
123	-	60%	-	Std or T10	5x ±	-	80%	-	Std	5x ±	
						-	60%	-	T10	5x ±	
145	-	60%	-	Std or T10	5x ±	-	80%	-	Std	5x ±	
						-	60%	-	T10	5x ±	
170	-	60%	-	Std or T10	5x ±	-	80%	-	Std	5x ±	
						-	60%	-	T10	5x ±	After L90 or
245	-	60%	-	Std or T10	5x ±	-	80%	-	Std	5x ±	
						-	60%	-	T10	5x ±	
300	-	-	80%	Std or T10	5x ±	-	80%	-	Std	5x ±	
						-	60%	-	T10	5x ±	
362	-	-	80%	Std or T10	5x ±	-	-	80%	Std or T10	5x ±	
420	-	-	80%	Std or T10	5x ±	-	-	80%	Std or T10	5x ±	
550	-	-	90%	Std or T10	5x ±	-	-	80%	Std or T10	5x ±	
800	-	-	90%	Std or T10	5x ±	-	-	80%	Std or T10	5x ±	
> 800	-	-	90%	Std or T10	5x ±	-	-	80%	Std or T10	5x ±	

Correct the inequality to agree with IEC.

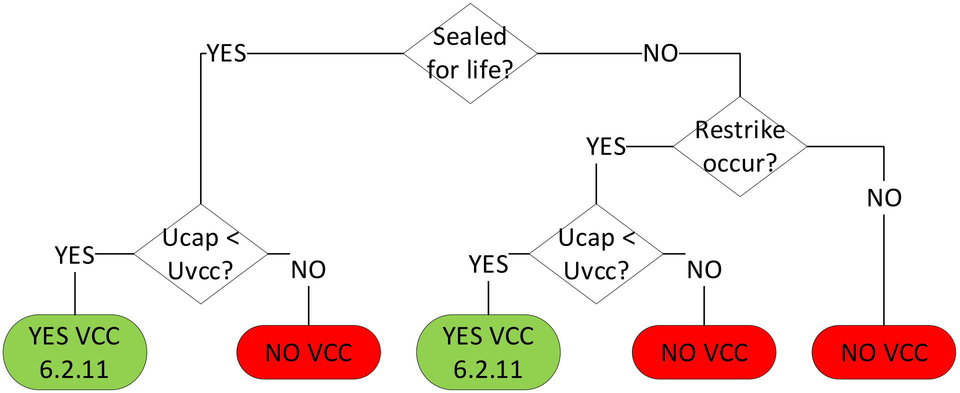
Align with IEC voltage peak and waveform options.

Correct the inequality to agree with IEC.

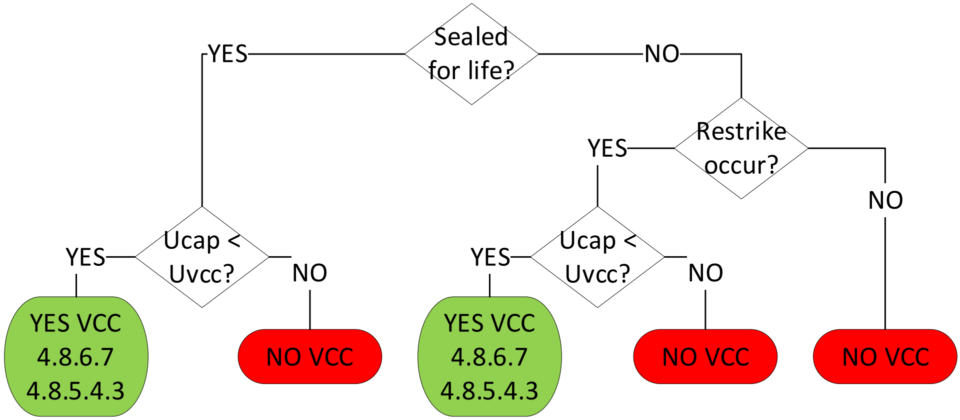
Align with IEC. Discussion?

Specifically after capacitive switching tests, the conditions for performing a post-test VCC are already aligned between 62271-100 (2017) and C37.09 (2018)

IEC 62271-100 (2017)



IEEE C37.09 (2018)



Specifically after mechanical and environmental tests:

<u>IEC 62271-100 (2017)</u>

- If insulation integrity across the open gap cannot be verified visually then,
  - If Ur ≤ 245 kV – 80% of rated dry power frequency.
  - If Ur ≥ 300 kV – 80% of rated dry power frequency.
    - 100% of rated dry power frequency withstand across the isolating distance.
- GIS and DTB are treated differently in order to stress insulation paths to the grounded enclosure.

Should IEEE permit an option for visual inspection only?
Could be subjective.
What are the pro's?
Needs discussion.

Table 38 – Test requirements for voltage tests as condition check for GIS and dead tank circuit-breakers

No. of series connected breaks	Arrangement of the current path	Circuit-breaker position		
		Open (one side)	Open (other side)	Closed
Single	Symmetrical	Y	N	Y
	Asymmetrical	Y	Y	N
Multi	Symmetrical	Y	N	Y
	Asymmetrical	Y	Y	Y

Y: necessary to apply voltage.

N: not necessary to apply voltage.

Propose to align with IEC and permit LTB to only test across the gap.

Propose to keep as-is.

<u>IEEE C37.09 (2018)</u>

- No option for visual inspection only.
- LTB, GIS, DTB all treated the same.
- Table 10: 80% of rated dry power frequency withstand according to the procedure described in 4.5.4.1.

Item List Review

#13

13	Technical	56	4.8.6.6	there are no requirements to test the integrity of Vacuum Interrupter (VI) unit in an enclosure filled with SF6	Jan Weisker	Harm Bannink, Henning Milnikel, Eldrige Byron	in progress	Reason behind proposal to be made more clear, new proposal to be prepared,	Input from Dan

Proposed text additional to clause 4.8.4.3 (original text from the STL guide IEC 62271-200):

For vacuum interrupter Circuit-Breakers places in an SF6-filled enclosure, integrity shall be verified by performing a short-circuit interrupting test.

If performed three phase, the T10 circuit shall be used with both the source and the load neutrals earthed. If performed single phase, the T10 circuit shall be used and each pole shall be tested separately. The TRV shall be as for the three-phase test condition with a first-pole-to-clear factor of 1,0.

A successful interruption in each pole is evidence that the vacuum interrupter integrity is good.

Chairman's comment:

I think T10 is too specific here. Why not go for IEC approach, at least 50 % of rated voltage and at least 10 % of rated short circuit current.

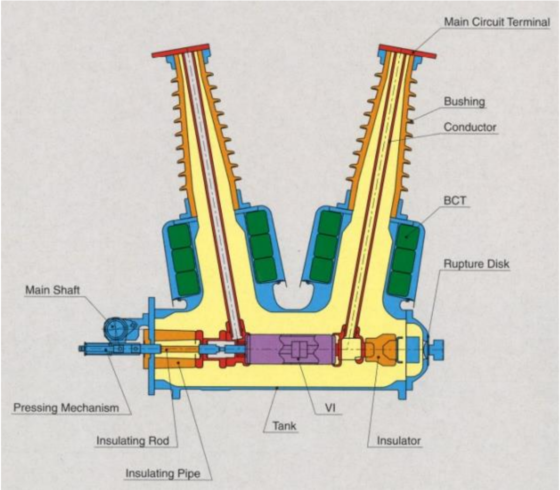
Secondly, "SF6 filled" is also too specific.

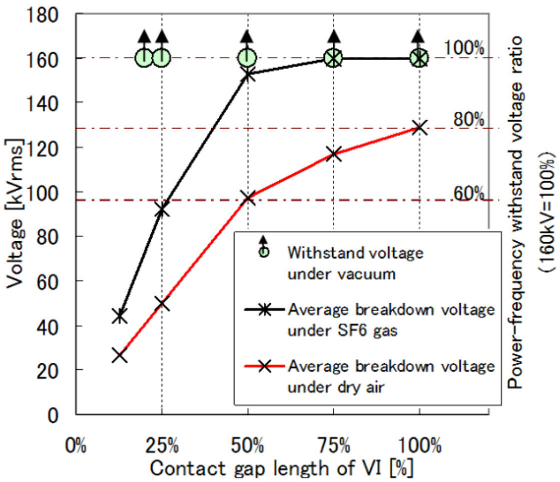
Does the voltage condition check adequately prove vacuum integrity after a type test duty?

- A compromised VI could allow external gaseous insulation into the vacuum enclosure.
- If the dielectric strength of the contaminant gas is sufficiently high, the device could pass a standard VCC in the open position (80% PF, 60% LI, etc.)

- After short-circuit duties that require a condition check, IEC 62271-100 (6.102.9.2) states that if interrupting units are placed within an insulating fluid with characteristics *other than air at atmospheric pressure* then:
  - Perform breaking test with at least 10% rated short circuit current and at least 50% rated voltage in addition to the VCC.

- But what about after mechanical or environmental tests?
  - All (usually) require a condition check after the test, but a breaking test is typically not practical.
  - CIGRE technical brochure 589 provides a proposal:
    - Perform the VCC with a vacuum contact gap reduced to 25% of the normal open gap.
    - The data at lower-right is from an 84 kV VI indicating that even when compromised with SF6 contamination, a 25% gap would fail the VCC.
    - The same test with dry air might just pass the VCC with a 100% gap.





4.8.1 Vacuum integrity

Vacuum interrupters are sealed-for-life devices. Including accessories for the direct measurement of vacuum level can significantly reduce the overall reliability of the vacuum interrupter. Therefore, vacuum integrity is not practical to determine by direct measurement. Instead, vacuum integrity can be determined indirectly with some caveats depending upon the test situation.

The validity of vacuum integrity tests comes into question when a vacuum interrupter is applied within a gaseous dielectric other than ambient air. The integrity test can be defeated, for example, if a gaseous dielectric were to leak into the vacuum interrupter and enable a compromised test object to pass a voltage withstand test. To address this possibility, short circuit interruption tests that require a post-test condition check incorporate a 10% breaking test into the duty sequence. However, this is not practical for tests performed outside the high-power laboratory such as mechanical endurance and environmental type tests. Instead, the following options are proposed:

a) After mechanical endurance and environmental tests, 80% of the rated power frequency voltage is applied as a condition check. A reduced contact gap is proposed to eliminate the possibility of a gaseous dielectric contaminant. A vacuum contact gap not more than 25% of the normal open gap has been proposed in CIGRÉ technical brochure 589 [B28].

b) In addition to the power frequency voltage condition check, the vacuum interrupter contact force is measured before and after both mechanical endurance and environmental tests and compared to the contact force limit criteria defined by the VI manufacturer. This option requires removal of the VI from the assembly after all other tests, checks and inspections are completed.

c) In addition to the power frequency voltage condition check, the vacuum interrupter arc voltage is measured and compared before (baseline) and after both mechanical endurance and environmental tests. In this option, the VI interrupts approximately tens of amperes at hundreds of volts being provided by an AC power supply. The VI manufacturer defines the arc voltage limit criteria.

For any of the proposed options, the results of vacuum integrity checks should be part of the type test report.

5.7 Vacuum integrity tests

The purpose of vacuum integrity tests is to demonstrate that the pressure on the vacuum interrupter is still below the maximum level required for the acceptable performance of the switching and insulating functions. The vacuum level will have been checked by the vacuum interrupter manufacturer before shipping the unit to the circuit breaker manufacturer. Therefore, the tests identified in this standard are to demonstrate that the assembly of the vacuum interrupter into the circuit breaker and the operation of the circuit breaker do not affect the vacuum integrity of the interrupters.

Measuring the pressure inside of a vacuum interrupter is a difficult task, and those measurements can only be performed on a vacuum interrupter by itself, not when installed in a circuit breaker. Therefore, the requirements of this standard are limited to the use of a voltage withstand test to verify that the vacuum pressure is still within the acceptable limits.

After assembly, the vacuum circuit breaker shall be subjected to a dielectric withstand test to demonstrate its integrity. The test voltage shall be stated by the manufacturer, and the final dielectric test shall be carried out after the routine mechanical production tests. This test may be combined with the requirements of 5.15.

5.15 is the routine power frequency test

The text to the left is from the version of PC37.100.7 submitted to Revcom.

- Item a) came from Cigre TB589 as stated.
- Item b) was recommended by Mr. Milnikel of Siemens.
- Item c) was recommended by Mr. Falkingham.

The text above comes from C37.09-2018 section 5 which deals only with routine tests.

These were the three vacuum integrity check options proposed in C37.100.7 to follow M&E tests.

Proposal for discussion:

Test	IEEE C37.09-2018	IEC 62271-100 (2017)	IEEE C37.09-2018a
Short Circuit Type Test (L90 or T100s)	Voltage condition check only (section 4.8.5.4.3)	10% I_{SC} with 50% (section 6.102.9.2	**Adopt the -100 procedure.**
Short Circuit Type Test (service capability)	Voltage condition check only (section 4.8.5.4.3)	N/A	**Adopt the -100 procedure.**
Capacitive Switching Type Test	Voltage condition check only (section 4.8.5.4.3)	Voltage condition check only (section 6.102.9.4)	**No change.**
Mechanical and Environmental Type Test	80% of routine power frequency test (Table 10)	Mechanical – visual inspection or VCC (6.101.1.4) Environmental – VCC only (6.101.3.1)	**Propose option c) from C37.100.7 Using a routine AC source, measure the arc voltage before and after type test. Need discussion whether to offer a) and b) as well.**
Routine Tests	Routine power frequency test (section 5.7)	Routine power frequency test (section 7.1)	**No change.**
Field Tests	Brought up by P. Dilillo. Power frequency test is listed (if applicable) (section 7)		**Manufacturer shall provide instructions for the need and methods for checking vacuum integrity in the field. Do not propose to create a standard method for field vacuum integrity testing.**

Item List Review

#New Business

IEEE C37.09-2018

Class C2: Very low probability of restrike during capacitance current breaking as demonstrated by specific type tests (4.10.9.1).

4.10.9.1.1 Class C2 test preconditioning

Capacitance current switching tests for class C2 circuit breakers shall be made after performing short-circuit test duty T60 in Table 1 as a preconditioning test.

Class C1: Low probability of restrike during capacitance current breaking as demonstrated by specific type tests (4.10.9.2).

4.10.9.2.1 Class C1 test duties

The capacitance current switching tests for class C1 circuit breakers shall consist of test duties as specified in Table 7 without preconditioning (4.10.9.1.1).

Standard does not allow preconditioning but does not say anything about other duties.

KEMA's experience that preconditioning, or any other interruptions will clean contacts and will reduce probability of restrikes.

What is other labs experience on preconditioning and how it effects probability of restrike for SF6 and VI? Does input/recommendation for next revision of IEEE C37.09 is needed?

Now IEC 62271-100:2021 matches Class C2 test preconditioning but does not say anything about C1 class. Does input/recommendation for STL Guide is needed?

Schedule PC37.09 Amd1

1) First meeting, April 12, 2022, Orlando/FL
2) Second meeting, October 18, 2022, Burlington/VT
3) Third Meeting, April 18, 2023, Clearwater/FL
4) Collect proposals through 2022/2023
5) Review proposals/open points during F22 / S23 / F23 / S24
6) Prepare D1
7) Form ballot group (validity 6 month) by fall of 2024
8) Initial Ballot end of 2024 (F24 ask HVCB for permission to ballot, form CRG)
9) Discuss Comments in CRG and S25 meeting
10) Prepare D2
11) 1st recirculation and comment resolution before S25
12) Finalization in 2025

(PAR expires December 31, 2025)

Motion to Adjourn

Thank you!

Item List - Amendment to C37.09

No	Category	Page	Sub-clause	Comment	Proposed Change	Proposer	To be prepared by	Status	Remark F22	Remark S23	Remark F23
3	Technical	84	4.3.18	Low-Temp Test – TL and TLL are neither defined in .09 or referenced in .04	Define TL and TLL	Ted Burse	Andrew Chovanec, John Webb, Jeremy Hensberger, Devki Sharma, Neil Mc Cord	in progress	Issue clarified by Ted's presentation, common item with #17	Input from Andrew Chovanec,rewrite proposal to harmonize with IEC and to allow flexible test procedure	There was discussion whether language should be added that lock out is not permitted during temperature testing. Language needs to be added to make it clear
9	Technical			Requirement to perform all interruption tests in a minimum volume enclosure?	Requiremnt to be added?	John Webb	John Webb				minimum enclosure only for the test where it is relevant
13	Technical	56	4.8.6.6	there are no requirements to test the integrity of Vacuum Interrupter (VI) unit in an enclosure filled with SF6		Jan Weisker	Harm Bannink, Henning Milnikel, Eldrige Byron, Neil McCord, Frederico di Michele, Leslie Falkingham, Dan Schiffbauer	in progress	Reason behind proposal to be made more clear, new proposal to be prepared,	Input from Dan, Necessity of integrity check generally accepted	Proposal partly accepted. Integrity with different possibilities will be introduced, final text to be provided
17	Technical	87	4.14	mention of high temp tests but not defintion/procedure	Check C37.016-2018, clause 7.11.5.3 for common clause	Andrew Chovanec	Henning Milnikel, Andrew Chovanec	in progress	cooperate with people of item #3, review wht is existing in C37.016, come up with common new text		There was discussion whether language should be added that lock out is not permitted during temperature testing. Language needs to be added to make it clear
24	Technical		4.4.5		clarify accessible spots for temperature measurements	John Webb	John Webb, Henning Milnikel, Mike Crawford, Jake Walgenbach	in progress	not discussed in F22	not discussed in S23	not discussed in F23
26	Technical		4.8.2.9	4.8.2.9 is a poorly worded section, regarding unit tests and tests of a single pole of a three.phase circuit-breaker	The word "If" in a standard leads to disagreements. > The tests required to prove the concept are not listed. > Is one opening test required? > I have been asked to perform a three phase closing test based on this. It is not clear in this language why closing is needed. I will say that with tulip contacts in SF6 this is not necessary. > Should those tests have a real TRV. > Are these test three separate and independent currents? > Or is this three interrupters in series with one current and voltage? > What is the required arcing	Neil McCord	Neil McCord, Victor Savuliak	in progress		Proposal from Neil and Victor	To be discussed

Item List - Amendment to C37.09

No	Category	Page	Sub-clause	Comment	Proposed Change	Proposer	To be prepared by	Status	Remark F22	Remark S23	Remark F23
27	Technical			A closely related item is the voltage condition check defined in IEEE Std C37.09 (2018) and IEC 62271-100 (2017). They are not the same. I wanted to ask for some discussion during the meeting about why they are not the same and if we could consider alignment with -100.		Dan Schiffbauer	Jan Weisker, Leslie Falkingham, and Dan Schiffbauer	in progress		Input from Dan, to be combined with #30	Values to be harmonized with IEC, test of insulation to ground remains required for LT breaker
29	Technical	54	4.8.5.4	As already discussed on the phone, I would like to bring in a topic regarding IEEE C37.09 subclause 4.8.5.4 Service capability and circuit breaker condition. It would be good to get a better clarification regarding procedure to demonstrate the service capability like I^2*t needs to be reached to successfully demonstrate the service capability.		Denis Baecker	Victor Savulyak, Harm Bannink, Jan Weisker	in progress		procedure to be agreed, clarifying which stresses may be combined to fulfill service capability	To be discussed
30	Technical	54	4.8.5.4.3	And please consider the “can be performed” in 4.8.5.4.3 Condition check after meeting service capability tests. “Can be” is a bit weak in this case.		Denis Baecker		in progress		to be included in #27	To be discussed
31	Technical	86	4.10.9.2.1			Victor Savulyak	Victor Savulyak, Andy Chovanek, Jan Weisker	in progress			To be discussed