F24_HVCB_WG_PC37.010_REV00 - Minutes of Meeting
Working Group C37.010 – Application Guide for AC High-Voltage Circuit Breakers > 1000 VAC Rated on a Symmetrical Basis

Location: Omni Oklahoma City (Oklahoma City, OK)
Date: Tuesday October 15, 2024 (4:15PM - 6:00PM CST)
Quorum: Membership Count: 41 Members Present: 31

Agenda
WG Chair Andy Keels called the meeting to order and presented the agenda.

Introduction of Members and Guests
Introductions and attendance gathered in-person
67 Total in Attendance (31 Members, 36 Guests)

Review of Attendance Logging via IEEE Attendance Tool
See meeting slides for details

Review of IEEE Patent and Copyright Policies
No Essential Patent Claims noted

Review of Schedule and Future Meetings

Quorum Check: 31 of 41 Members Present – Quorum Achieved

Review of Reference Documents loaded into IMeetCental
Motion: Approve April 2, 2024 In-Person Meeting Minutes: Albert Livshitz
2nd to the Motion: Carl Schuetz
Vote: Approved without objection/abstention

Table 6 & Table 7 Presentation/Discussion
- See slides in meeting minutes
- Review of updated cautionary note (Revision 3) related to Table 6 & 7:
- Motion: Adopt language as stated in the meeting agenda slides: Dan Benedict
- 2nd to the Motion: Dan Schiffbauer
- Discussion:
    - WG Member requested to amend the language to include an additional sentence that would have the equipment manufacturer identify the thermal limiting component and maximum total allowable temperature. Dan Benedict agreed to provide this in Rev. 4 to the task force draft document "PC37.010_Proposed".

- WG Members made a comment to 4.5.4.4 subclause (b)
    - Provide a reference to the cautionary note in subclause 4.5.4. Additional discussion noted that there may be no need to provide a reference back to the cautionary note pending inclusion of identification of the thermal limiting component and maximum total allowable temperature within the cautionary note itself.
    - Comment: 15 degrees may not be appropriate for all components within the circuit breaker.
  - WG Chair recommended Dan Benedict review with Cark Schuetz and Albert Livshitz and develop new wording for a planned February virtual meeting.

Sub-Group presentation of Update on User-Specified 105% of Rated Maximum Voltage.

- See slides in meeting minutes
- Review of proposed wording to Section 4.2 was presented:
  - Discussion:
    - The use of the word "margin" in the proposed wording was noted by WG Member as ambiguous. It was clarified that the word "margin" in this statement is intended to represent summary of the tolerances related to the values within the standard. It is also the same wording used within the current revision of C37.010.
    - WG Member recommended to remove the last sentence from the proposed Section 4.2 wording. No object was raised, so the subgroup agreed to remove "Some values used in the short circuit interrupting type tests include margins in order to accommodate aging and statistical behavior."
- Added informative note was presented:
  - Discussion:
    - Intent is to provide a caution to users that nameplate voltage is related to current interruption performance and there is a risk that the circuit breaker may not interrupt as designed when operating at above rated maximum voltage.
    - Request to revise "if these" to "the operating voltages" was reviewed and approved.
    - Question was raised about whether the working group considered the application of open breakers with out of phase overvoltages. The subgroup commented that this was not considered specifically. Subgroup took an action to review a technical brochure from the T&I Committee that may address this concern and will return to the WG with revised wording.
    - Subgroup will take action to review TI 3.2.11 with respect to: expanding upon concerns when operating at above rated voltage and consideration of operation of a disconnect switch for an open breaker.
    - Capacitive switching power frequency voltage was noted as being within the scope of the proposed language.
    - Consideration of the operation of the utility system when in overvoltage conditions is outside the scope of this document. The scope of this document is the impact to the circuit breaker.

Subgroup presentation of Update on Inverter Based Resources and the Impact on Fault Currents

- See slides in meeting minutes
- Statement made by PSRC was presented
- Next steps proposal was presented
- Wording for request for information was presented
    - Sub-group made a request for comments/data to the WG:
        - Recommendation was made for the subgroup to contact power system relay committee to collaborate on data collection
- Additional work remaining was presented
    - Luke Collette, Marcus Young, Craig Polchinski and Andy Chovanec agreed to support subgroup with the remaining technical activities.
    - Recommended to ask for input from the Cigre A.3 committee

WG Chair Call for review of other areas of the guide before drafting of document prior to ballot.

- Permissible tripping delay in Section 4.9.1 and 4.9.2 needs to be reviewed for variable discrepancy. Assigned to Dan Benedict.
- Table 2 needs reviewed/revised to be consistent with C37.04. Assigned to Mike Skidmore
- Noted that Tables in Appendix A are accurate. Text that describes how to use the tables and figures that are to be used are not being read correctly by the users.

Schedule

Next Virtual Meeting: February 7, 2025 @ 1:00PM EST (10:00AM PST)
Next in-person meeting: April 6th – 11th, 2025 in Orlando FL

Meeting adjourned by the chair at 5:15PM (CST) on 10/15/2024
Reported by: Jeremy Hensberger, Lucas Collette & Andy Keels

Working Group C37.010 – Application Guide for AC High-Voltage Circuit Breakers > 1000 VAC Rated on a Symmetrical Basis				
Location:	**Omni Oklahoma City (Oklahoma City, OK)**			
Date:	**Tuesday October 15, 2024 (4:15PM - 6:00PM CST)**			
Count	**Breakout**	**Name**	**Affiliation**	**Status**
1	C37.010 WG	Weisker, Jan	Siemens Energy	Member
2	C37.010 WG	Aristizabal, Mauricio	Hitachi Energy USA	Guest
3	C37.010 WG	Ashtekar, Koustubh	Siemens Industry inc	Guest
4	C37.010 WG	Beecher, Zachary	Southern States LLC	Guest
5	C37.010 WG	Benedict, Dan	PPL Corporation	Member
6	C37.010 WG	Bolar, Sanket	Oncor Electric	Guest
7	C37.010 WG	Bronsveld, Arjan	Hitachi Energy Sweden	Guest
8	C37.010 WG	Brooks, Adam	Duke Energy Corporation	Guest
9	C37.010 WG	Chovanec, Andrew	Power Grid Components	Member
10	C37.010 WG	Christian, Michael	ABB	Member
11	C37.010 WG	Collette, Lucas	Duquesne Light Co.	Member
12	C37.010 WG	Cunningham, Jason	Southern States LLC	Guest
13	C37.010 WG	Cuppett, Matthew	Hitachi Energy	Guest
14	C37.010 WG	de Villiers, Henry	Arizona public Service,	Guest
15	C37.010 WG	Diaz, Lissy	Florida Power and Light	Guest
16	C37.010 WG	Flores, Sergio	Schneider Electric USA Inc.	Guest
17	C37.010 WG	French, Christopher	Beta Engineering	Guest
18	C37.010 WG	Hanna, Robert	JST Power Equipment Inc	Member
19	C37.010 WG	Heinrich, Christian	Siemens AG	Guest
20	C37.010 WG	Hensberger, Jeremy	Mitsubishi Electric Power Products Inc	Member
21	C37.010 WG	Hermosillo, Victor	GE Grid Solutions	Member
22	C37.010 WG	Hunter, Jennifer	MEPPI-Warrendale Pa	Member
23	C37.010 WG	Irwin, Todd	GE Grid Solutions	Member
24	C37.010 WG	Jarnigan, Christopher	southern company/ southern nuclear	Member
25	C37.010 WG	Keating, Ryan	None	Guest
26	C37.010 WG	Keels, Thomas	kEElectric Engineering, PLLC	Member
27	C37.010 WG	Krause, Dwight	Black and Veatch	Guest
28	C37.010 WG	Kurinko, Carl	Hitachi Energy	Member
29	C37.010 WG	Livshitz, Albert	Schneider Electric	Member
30	C37.010 WG	Ma, Chunming	Burns & McDonnell	Guest
31	C37.010 WG	Markham, Jesse	Electrical Consultants, Inc.	Guest
32	C37.010 WG	Marshall, Vincent	southern company/ southern nuclear	Member
33	C37.010 WG	MARZEC, PETER	S and C Electric Co	Guest
34	C37.010 WG	May, Steven	Southern Company Services	Member
35	C37.010 WG	Mc Cord, Neil	KEC Precision LLC	Guest
36	C37.010 WG	Meekins, Gary	Southern States LLC	Guest
37	C37.010 WG	Mitchell, David	Southern States LLC	Member
38	C37.010 WG	Natale, Anthony	HICO America	Guest

39	C37.010 WG	Ordin, Fernando	Dominion Energy	Guest
40	C37.010 WG	Orosz, Miklos	Circuit Breaker Technology & Support LLC	Member
41	C37.010 WG	Palazzo, Mirko	Hitachi Energy	Member
42	C37.010 WG	Pedreros Ratmiroff, Javier	GE Grid Solutions	Guest
43	C37.010 WG	Peterson, Mark	Xcel Energy	Guest
44	C37.010 WG	Polchinski, Craig	Mitsubishi Electric Power	Member
45	C37.010 WG	Pounders, Isaac	Meiden America Switchgear	Guest
46	C37.010 WG	RAMIREZ-BETTONI, EDUARDO	Powell Industries	Guest
47	C37.010 WG	Rebovich, Justin	GE Vernova; General Electric Company (GE)	Guest
48	C37.010 WG	Ricciuti, Anthony	Eaton Corporation	Member
49	C37.010 WG	Roberts, Brian	Southern States LLC	Guest
50	C37.010 WG	Schiffbauer, Dan	Toshiba International Corporation	Member
51	C37.010 WG	Schuetz, Carl	ATC	Member
52	C37.010 WG	Scott, Jeffrey	Ameren Services	Member
53	C37.010 WG	Skidmore, Michael	American Electric Power (AEP)	Member
54	C37.010 WG	Steigerwalt, Donald	Duke Energy Corporation	Member
55	C37.010 WG	Tarleton, John	Southern States LLC	Guest
56	C37.010 WG	Toups, Vernon	Siemens Energy Inc	Member
57	C37.010 WG	Walgenbach, Jake	Siemens	Member
58	C37.010 WG	Webb, John	ABB Ltd.	Guest
59	C37.010 WG	Weeks, Casey	Siemens Energy, Inc.	Member
60	C37.010 WG	Wolfe, Daniel	MEPPI	Guest
61	C37.010 WG	Woodyard, Terry	Siemens Industry, Inc.	Guest
62	C37.010 WG	York, Richard	Mitsubishi Electric Corporation	Guest
63	C37.010 WG	Young, Marcus	Mitsubishi Electric Power Products, Inc.	Member
64	C37.010 WG	Zaharko, Samuel	Mitsubishi Electric Corporation	Member

Total in Attendance: **67**
Members Present: **31**

C37.010 Working Group

Application Guide for AC High-Voltage Circuit Breakers >1000Vac Rated on a Symmetrical Basis

Tuesday, October 15th, 2024

16:15 – 18:00 EDT

Chair: T. Andy Keels w/ kEElectric Engineering, PLLC
Secretary: Jeremy Hensberger w/ MEPPI
Vice-Chair: Lucas Collette w/ Duquesne Light Co.

Starting Document: IEEE Std C37.010-2016 (Revision of C37.010-1999)

Agenda

1. Chairman's call to order
2. Introduction of attendees:
   Please announce your *Name*, *Affiliation*, *Location*
3. Attendance Logging Instructions
4. Workgroup Required Reading
5. Anticipated Schedule (*Best laid plans*)
6. iMeet Central Workspace
7. Minutes Approval
8. Discussion of Table 6 & Table 7 (Dan Benedict w/ PPL Energy)
9. Report from Sub-group on "User-Specified 110% Voltage Duty" (Carl Schuetz w/ ATC)
10. Report from Sub-group on "Inverter-Based Resources" (Carl Schuetz w/ ATC)
11. Call for additional revisions to Section 4 or Section 5, or Annex A or B
12. Next meetings

Logging Your ATTENDANCE To This Meeting

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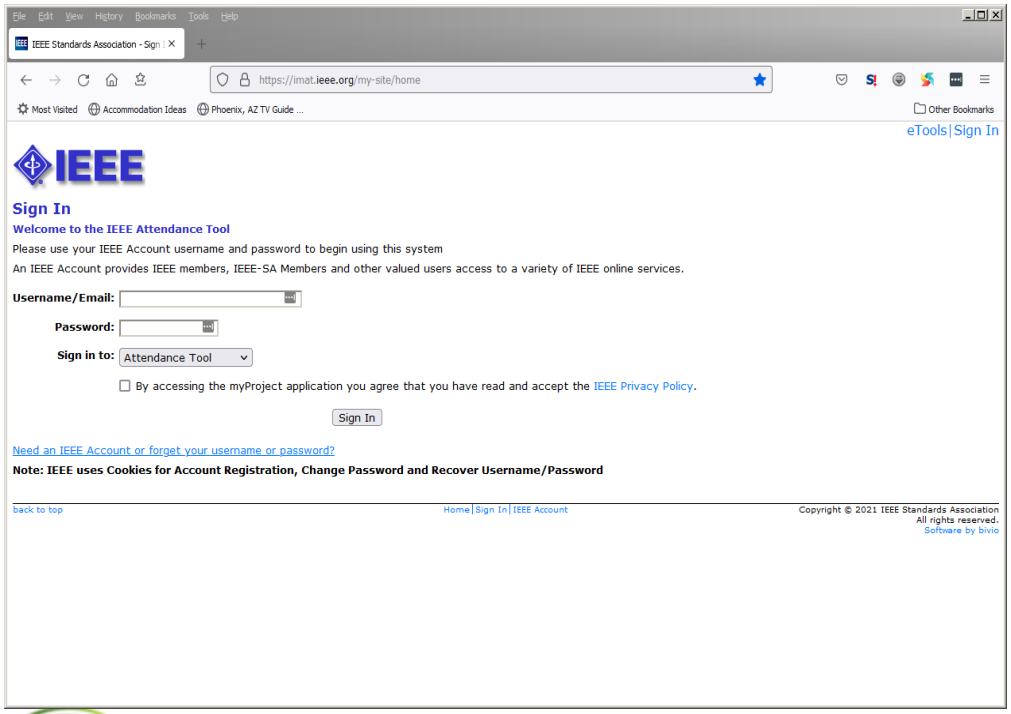
1. Go To: IEEE SA eTools, Then click on **IEEE Attendance Tool**
2. **Google:** IEEE Attendance Tool
3. Go directly to: https://imat.ieee.org/my-site/home



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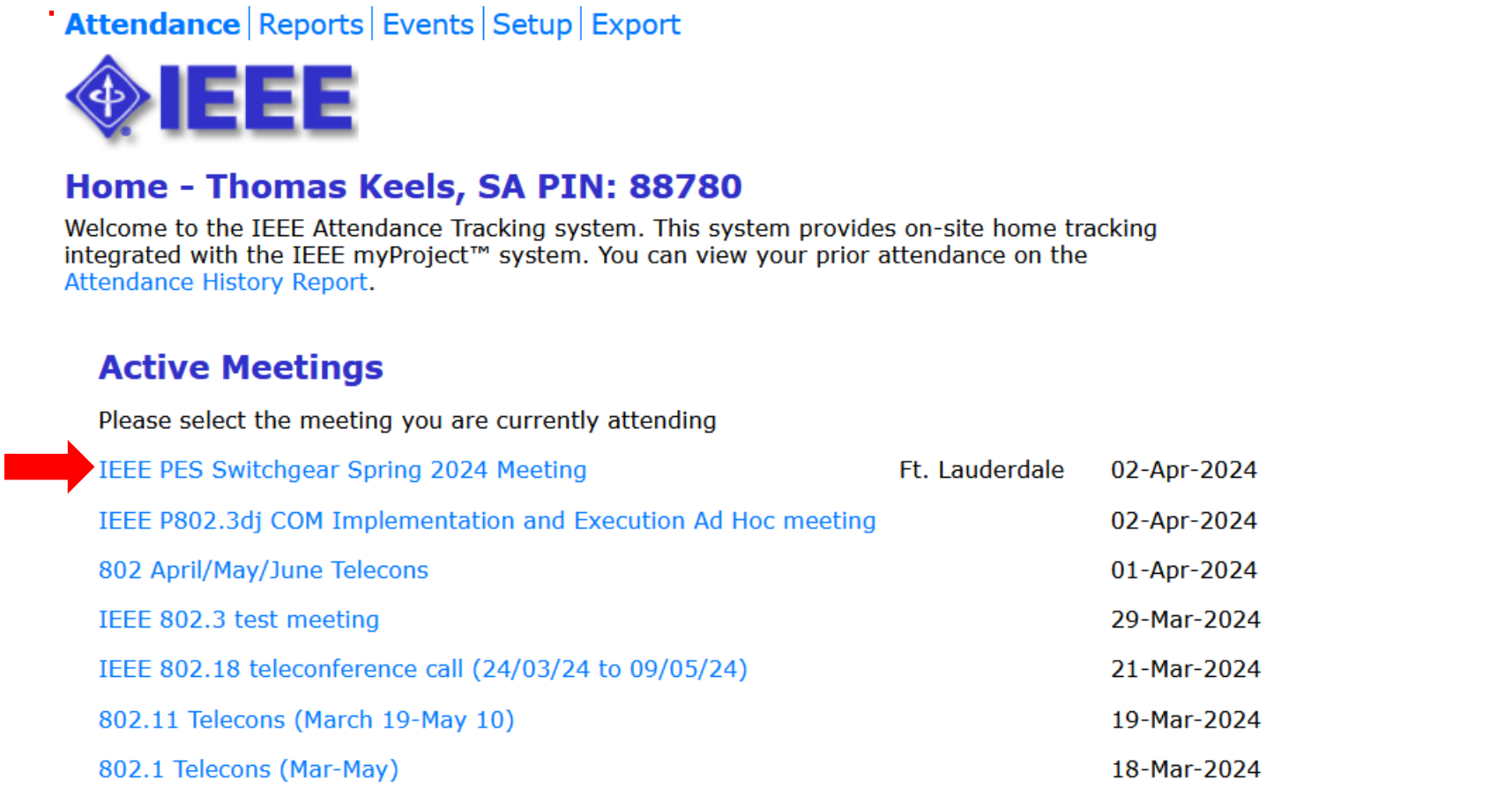


Logging Your ATTENDANCE To This Meeting

Then select the Working Group

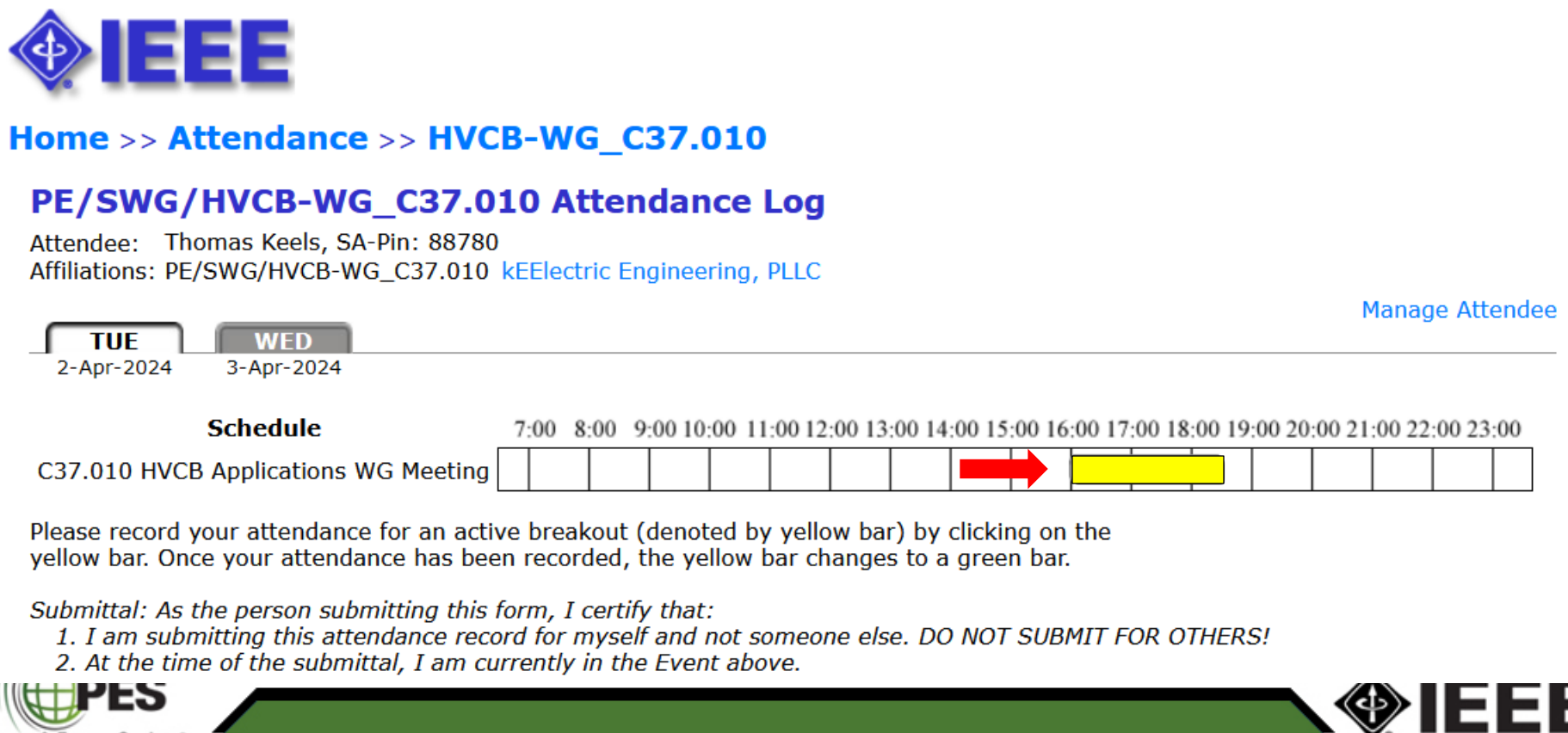
If it is a 'virtual meeting' the WG Chair should have the link listed here

Logging Your ATTENDANCE To This Meeting

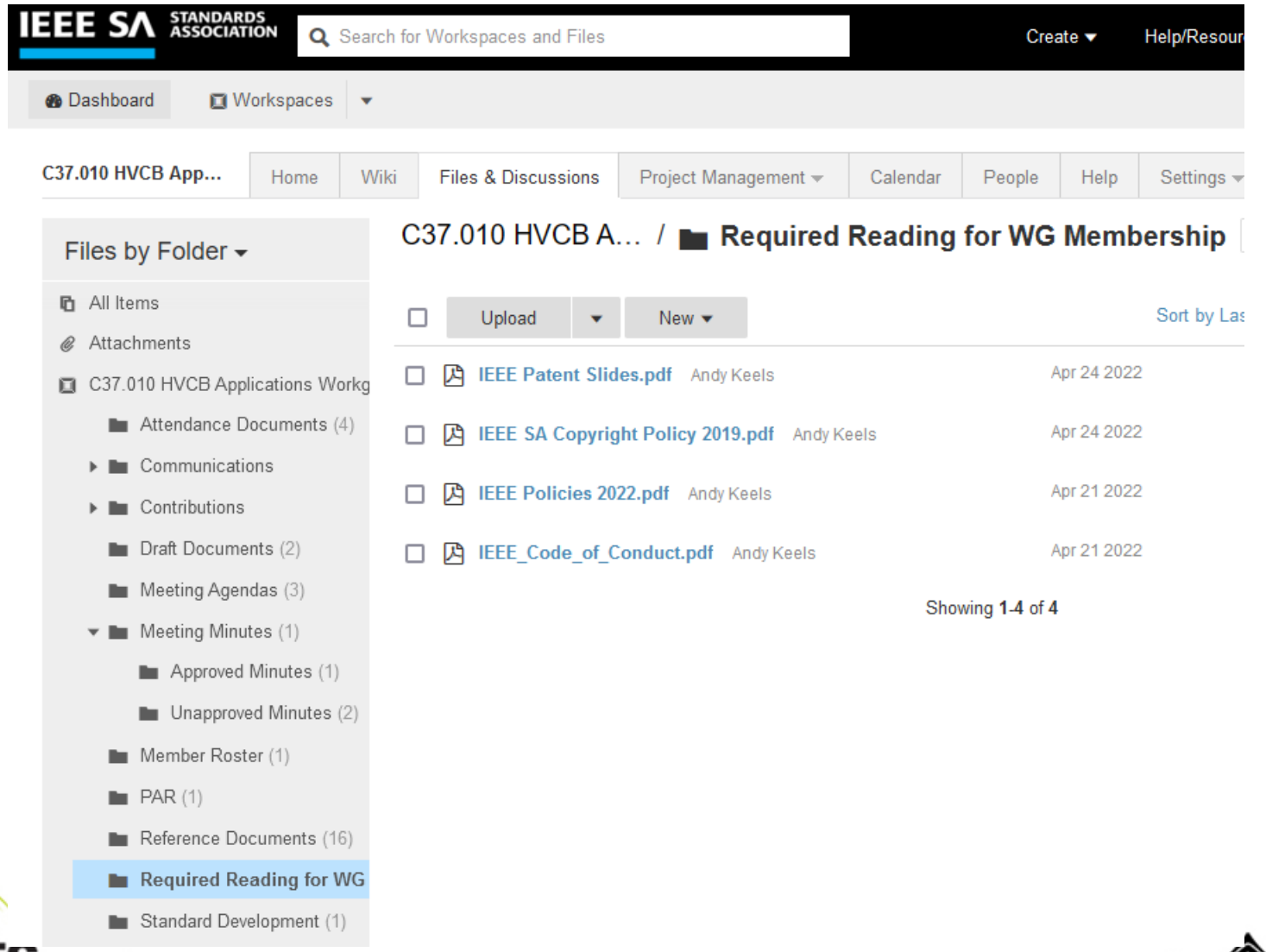
If the meeting is currently in progress then there should be a yellow box here.

Click the Yellow Box, The box will turn GREEN if your attendance is logged

You then just click Sign Out in the upper right corner



Workgroup Required Reading



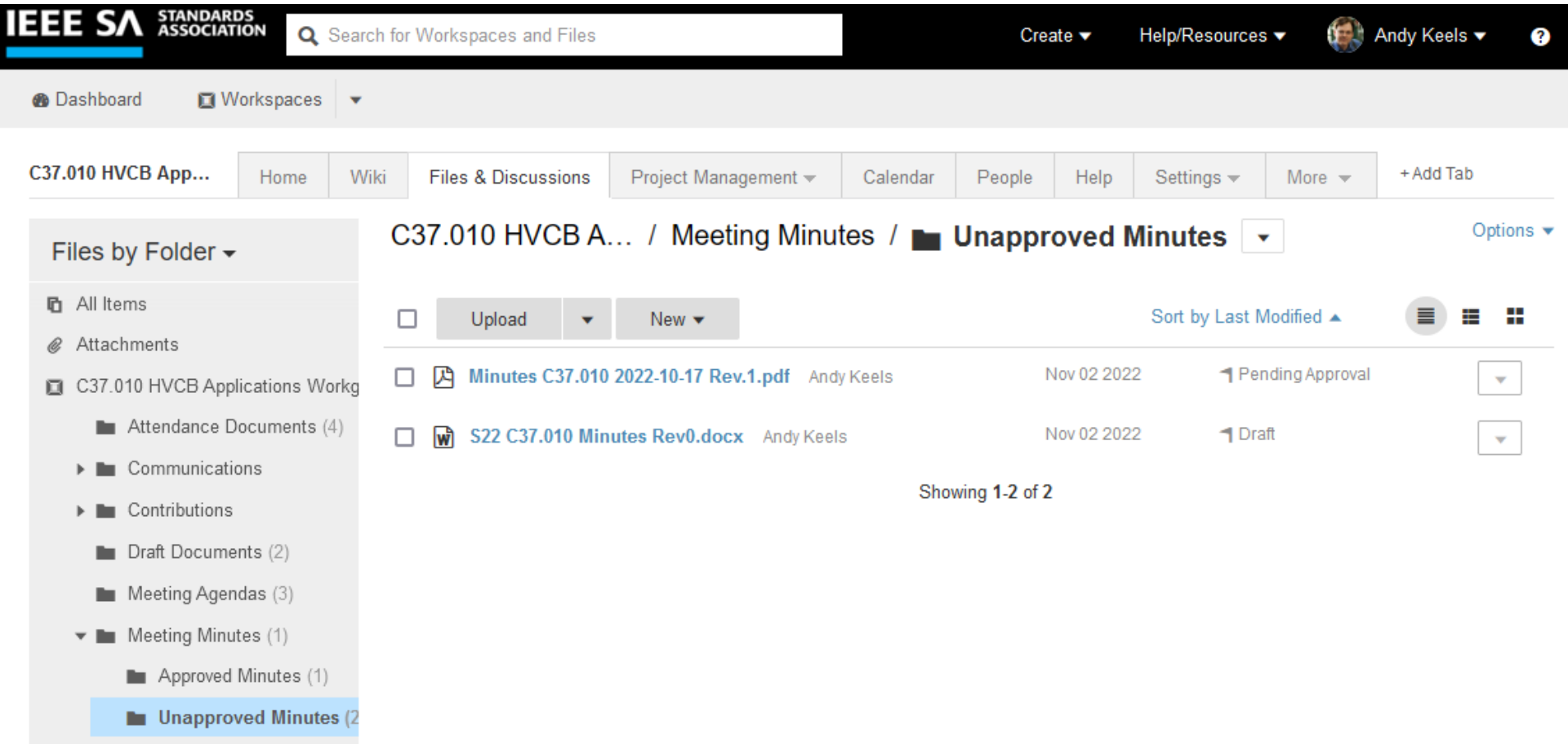
Meeting Schedule

~~04/11/2022~~	~~1st working group meeting~~
~~10/17/2022~~	~~2nd working group meeting Burlington, VT~~
~~02/03/2023~~	~~3rd working group meeting VIRTUAL Google Meeting~~
~~04/26/2023~~	~~4th working group meeting Virtual WebEx~~
~~07/19/2023~~	~~5th working group meeting VIRTUAL WebEx~~
~~10/10/2023~~	~~6th working group meeting San Diego, CA~~
~~04/02/2024~~	~~7th working group meeting Ft. Lauderdale, FL~~
10/14/2024	8th working group meeting Oklahoma City, OK
02/07/2025	9th working group meeting VIRTUAL WebEx
04/07/2025	10thworking group meeting Orlando, FL

Current Member List For Quorum Check

1 Aaron Rexroad
2 Albert Livishitz
3 Andrew Chovanec
4 Anthony Ricciuti
5 Arben Bufi*
6 Carl Kurinko
7 Carl Schuetz
8 Casey Weeks
9 Chris Jarnigan
10 Craig Bryant
11 Craig Polchinski*
12 Dan Benedict
13 Dan Shiffbauer
14 David Mitchell
15 Devki Sharma
16 Don Steigerwalt
17 Mikos Orosz
18 George Becker
19 Jake Walgenbach
20 Jan Weisker
21 Jeff Scott
22 Jeff Ward
23 Jennifer Hunter
24 Jeremy Hensberger
25 Lucas Colette
26 Marcus Young
27 Matt Westerdale
28 Michael Christian
29 Michael Crawford
30 Michael Skidmore
31 Miklos Palazzo
32 R. Kirk Smith
33 Robert Hanna
34 Samuel Zaharko
35 Steven May
36 Thomas 'Andy' Keels
37 Todd Irwin
38 Vernon Toups
39 Victor Hermosillo
40 Vincent Marshall
41 Wei Zhang

C37.010 Working Group
Approval of previous meeting minutes



Discussion of Table 6 & Table 7

Table 6—Emergency load current-carrying capability factor (I_{ea}/I_r) for various ambient temperatures for 4 h emergency period

Maximum ambient temperature (°C)		Limiting temperature (°C) of different circuit breaker components							
	θ_{max}	70	80	85	90	105	110	115	150
	θ_r	30	40	45	50	65	70	75	110
60		0.90	0.92	0.93	0.93	0.95	0.95	0.967	0.98
50		1.08	1.06	1.06	1.04	1.04	1.03	1.065	1.03
40		1.25	1.19	1.17	1.15	1.12	1.11	1.107	1.08
30		1.40	1.30	1.27	1.24	1.19	1.17	1.154	1.13
25		1.47	1.36	1.32	1.29	1.23	1.21	1.184	1.16
20		1.53	1.41	1.37	1.33	1.27	1.25	1.238	1.17
10		1.66	1.51	1.46	1.41	1.33	1.31	1.265	1.21
0		1.78	1.61	1.55	1.50	1.40	1.38	1.316	1.26
–10		1.89	1.70	1.64	1.57	1.47	1.43	1.366	1.30
–20		2.00	1.79	1.72	1.65	1.52	1.50	1.414	1.35
–30		2.00	1.88	1.80	1.72	1.59	1.54	1.460	1.38

NOTE 1—For limiting current, where the factor is 1.0 or greater, use highest θ_r and θ_{max}.

NOTE 2—For limiting current, where the factor is less than 1.0, use lowest θ_r and θ_{max}.

Discussion of Table 6 & Table 7

Table 7—Emergency load current-carrying capability factor (I_{ea}/I_r) for various ambient temperatures for 8 h emergency period

Maximum ambient temperature (°C)		Limiting temperature (°C) of different circuit breaker components							
	θ_{max}	70	80	85	90	105	110	115	150
	θ_r	30	40	45	50	65	70	75	110
60		0.79	0.85	0.86	0.87	0.90	0.90	0.931	0.94
50		0.99	1.00	0.99	0.99	1.00	0.99	1.000	1.00
40		1.17	1.13	1.11	1.10	1.08	1.07	1.065	1.05
30		1.32	1.25	1.21	1.19	1.16	1.14	1.126	1.10
25		1.40	1.30	1.27	1.24	1.19	1.17	1.154	1.13
20		1.46	1.36	1.31	1.29	1.23	1.21	1.183	1.15
10		1.60	1.46	1.41	1.37	1.30	1.28	1.240	1.19
0		1.72	1.56	1.50	1.46	1.37	1.35	1.291	1.23
–10		1.81	1.66	1.60	1.54	1.43	1.41	1.341	1.28
–20		1.95	1.75	1.68	1.61	1.51	1.46	1.390	1.32
–30		2.00	1.84	1.75	1.68	1.56	1.51	1.437	1.36

NOTE 1—For limiting current, where the factor is 1.0 or greater, use highest θ_r and θ_{max}.

NOTE 2—For limiting current, where the factor is less than 1.0, use lowest θ_r and θ_{max}.

Discussion of Table 6 & Table 7

Goal of subgroup

- Clarify Table 6 and Table 7 related to emergency load current-carrying capability
- Follow-up from Spring ‘24 meeting addressing concerns over the proposed cautionary statement

Discussion of Table 6 & Table 7

Proposed Changes

- Most previously reviewed and discussed during Spring ‘24 meeting
- Update to proposed cautionary statement:

~~Extreme care must~~ Care should be exercised by the equipment operator when exceeding the total temperature limits for the circuit breaker.

The emergency load current-carrying capability factors specified in 5.4.4 consider NEMA research utilizing historic documents that focused on oil circuit breaker and oil-impregnated paper bushing technology (C37.04-1979, C76.1-1967, and C57.13-1978); newer circuit breaker technologies and designs could render the emergency load current-carrying factors obsolete.

The most limiting temperature of the circuit breaker components should be confirmed before applying temperature rise calculations, and the ~~The~~ manufacturer should be consulted prior to the total temperature limits being exceeded to determine ~~if any components would not tolerate a higher temperature~~ safe combination of current, temperature, and time.

Report of the Max Allowable Voltage Subgroup to C37.010 Working Group

- October 15, 2024, Oklahoma City

• Summary

- **At the S24 meeting a modified proposal was recorded**

Existing wording:

> **4.2 Maximum voltage for application**
>
> The operating voltage should not exceed the rated maximum voltage of the circuit breaker. The rated maximum voltage is the voltage on which all the corresponding type tests have been based. The type tests values include some margins in order to accommodate aging as well as statistical behavior.

Proposed wording:

The operating voltage should not exceed the rated maximum voltage of the circuit breaker. "The rated maximum voltage is the voltage on which all the corresponding type tests have been based. The type tests include current interruption, capacitive, inductive, load switching and other applicable switching duties.

Some values used in the short circuit interrupting type tests include margins in order to accommodate aging and statistical behavior."

• Summary

- **Modified proposal continuation**

Add the following informative note:

"NOTE:

If system voltage operation above rated maximum voltage are experienced, the system TRV must remain within the circuit breaker capability as demonstrated in the type test report. If these are planned values the system TRV should be confirmed to be within related circuit breaker TRV capability by system study, calculation, or some other means. For further details refer to document C37.011."

Report of the IBR Fault Current Subgroup to C37.010 Working Group

- October 15, 2024, Oklahoma City

• Review of IBR fault current determination learnings to date

The stated goal is to determine how to calculate fault current contributions of an inverter based resource (IBR) to add their determination method to the existing method as described in Clause 5

- Prior literature searches concluded only transient simulation software could practically determine the peak current of an IBR
- Several calculation methods, including manual, can determine the rms fault current from an IBR

A meeting between Sub-Group members and PSRC liaisons was held to determine if the PSRC was actively seeking a method to practically determine IBR fault current peak amplitudes

The PSRC provided the following information:

- The PSRC presently has no intention of determining transient currents
- The transient period current for an IBR is best based on transient time domain simulations
- The accuracy of those simulations within the transient period is not known since the simulation performer does not typically have the manufacturers component data and algorithm
- The software companies have not expressed an interest in determining transient currents
- EPRI has a project to do so

• Impact to the stated goal

- **Learnings and next steps**

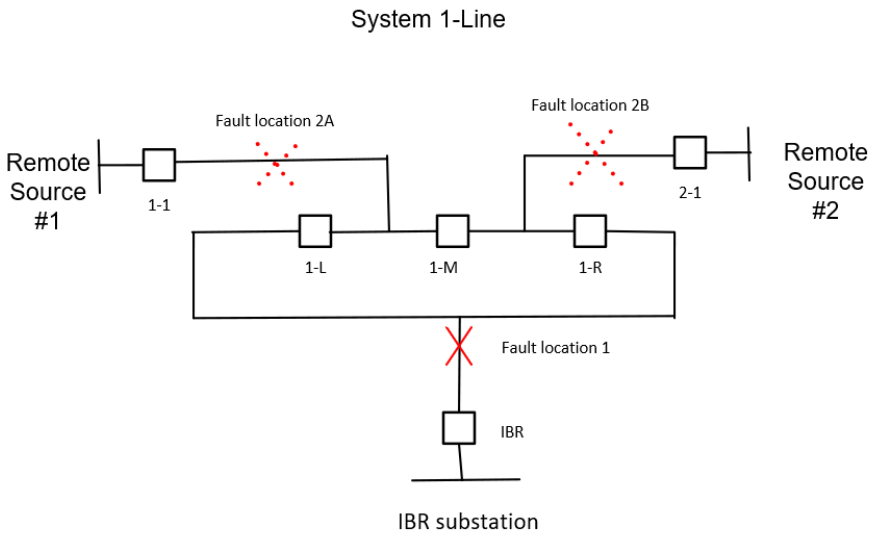
- Reviewing all information from the previous slide IBR fault current transient currents need to be determined by transient analysis software

- In order to provide a point of reference for IBR transient currents the Study Group is proposing a data collection effort of obtaining oscillography traces from power system faults that have IBR fault current sources

• Proposed request for information

• Wording for the request

The IEEE Study Group for CB application (C37.010) is requesting fault current recordings from inverter based resources during a system fault. The intent is to obtain recordings that capture the first peak of the transient current output of the IBR for such faults.



• Additional work remaining

Include revised guidance on the determination of fault currents and the limitations of the various methods

Revise the breaker selection example of clause 5 to include a system that has IBR contributions

Any suggestions from the WG that have not been identified?

Open Call for Additional Suggestions for Revisions

Contents

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Next On-Line Meeting will be via IEEE WebEx

Friday, February 7, 2025
13:00pm EDT (10am PDT)

Our Next in-person meeting is scheduled to be at:

Wyndham Bonnet Creek Resort; Orlando, FL

April 6 - 11, 2025

Would someone like to make a motion to adjourn?