Technology and Innovation Subcommittee

IEEE Switchgear Fall 2019 standards meeting

Location: Hilton Hotel, Burlington, VT
Date: April 29th, 2019
Room: Green Mountain A
Time 1:30PM to 3:15PM
Chair: Nenad Uzelac
Minutes: Paul Leufkens

Meeting Minutes

1. **Call to order**

   The meeting was called to order at 1.30PM.

2. **Introductions and Circulation of the subcommittee sign-in sheet.**

   Sign-in sheets were circulated, and introductions were made.
   Paul Leufkens volunteered to write minutes.

3. **Attendance**

   There were 68 guests in attendance.

4. **Approval of the agenda**

   The agenda was elucidated by the chair and accepted without changes.

5. **Meeting minutes approval.**

   The meeting minutes from the October 15th, 2018 meeting were showed. No objections or changes.

6. **Chairman report:**

   - Subcommittee scope: The chair stated that this is the third Technology & Innovation (T&I) subcommittee meeting but the first official one as the T&I subcommittee is approved by IEEE PES Technical committee.
     - Important point is that T&I will not be developing standards. The subcommittee deliverables will include technical reports and technical papers, which could later be used for the advancements of the switchgear standards.
   - Subcommittee membership and structure: The chair also stated that as now the new O&P are approved, the subcommittee will need members. People interested should be eager to participate and have to be nominated by a Subcommittee chair, we look to 3 per SC.
     The job of T&I subcommittee members is:
     - to discuss and chose new proposals for forming task forces
     - to help to identify experts to lead/participate in those task forces
     - to review / comment / approve Task force reports

People who want to become member should send an email to Nenad
We hope the population to have taken place at the fall session.

7. Task Force reports

a. TF1: Review IEEE 1547 standard's impact on switchgear standards
   - Task Force chair Paul Leufkens summarized the findings in the presentation "the influence of IEEE 1547 on Switchgear standards". Paul Leufkens presented.
   - Presentation File:

TF IEEE 1547
Burlington v429.pdf

   - An animated discussion followed with next elements:
     - Requirements like 110% voltage and unlimited duration are major factors that our standards don't comply with, but would drastically change insulation coordination of the Distribution (and even Transmission) grid.
       - The whole inverter access introduces also problem with the sine wave.
     - It is considered to write a position paper to oppose that part of the 1547.
     - It is too late to do anything on the standard itself, only the IEEE 1547.1 is still under ballot but is not really the place to amend.
       - It is considered to propose that a corrigendum is written on the 1547, but it seems not unlikely that that will be opposed.
       - We may look for cooperation with EPRI and CEATI
       - Everybody who wants to participate in the ballot has 10 days to subscribe.
     - The conflict is big and our Subcommittee strongly recommend that the Switchgear Committee brings it to PES level, as this supersedes our component level and is an issue as much for transformer, cables, etc.
     - The T&I TF 1547 started writing a white paper to present the problem.

b. TF2: Draft Project Proposal Procedure for T&I committee
   Nenad presented this:

Research Group
proposal.pdf

8. New Proposals

a. Create Alternative Gases "Maintenance team"

b. Influence of inverter-based technologies to switchgear

John Webb and Mohit will prepare a 2 pages Terms of Reference / scope document

carry over of last T&I meeting agreed to be prepared before Fall 2019 meeting:

1) Issue of aging equipment (diagnostics, end of life)

a. (Albert to write the proposal)

2) Need for longer product life (increased number of operations, etc)
   a. (Sushil to write the proposal)
3) Implications of inverter-based technologies on the switchgear
   a. (Paul Leufkens and Dave Johnson to write the proposal)

9. Updates from relevant organizations: ***Nenad Uzelac***

a. Nenad presented an CIGRE A3 update:

- Published TB
- Open Working Groups
- New WG discussions


Cigre A3 WGs.pdf

b. IEC TC17 update:

- New development

c. CIRED 2019

10. Future events / conferences of interest

a. Europe has begun a project "Promotion" about meshed offshore HVDC T Networks. As a part of this project, 3 different DC breakers will be tested. The project will be completed in 2020 and results presented at CIGRE 2020 conference.

11. Future meetings

- Fall 2019: Catamaran Resort, San Diego, CA – October 6th to 10th , 2019
- Spring 2020: Peppermill Resort, Reno, NV – May 4th to 8th, 2020
- Fall 2020: Sheraton Sundance Square, Fort Worth, TX – October 4th to 8th, 2020

12. Adjourn

The chair promised that in future meetings we would restrict more the actual TF discussion to status and progress.
The meeting was adjourned at 3: 15PM

	Role	First Name	Last Name	Company	Country
1	Guest	Ken	Edwards	FirstEnergy Corp.	USA
2	Guest	John	Harley	FirstPower Group LLC	USA
3	Guest	Xi	Zhu	GE Energy Management	USA
4	Guest	James	Houston	Southern Company Transmission	USA
5	Guest	Roy	Alexander	RWA Engineering	USA
6	Guest	Joe	Rostron	Southern States LLC	USA
7	Guest	Albert	Livshitz	CE Power Engineered Services	USA
8	Guest	Dean	Sigmon	Eaton Corporation	USA
9	Guest	Jeff	Mizener	Siemens Industry, Inc.	USA
10	Guest	George	Becker	POWER Engineers	USA
11	Guest	Jeffrey	Gieger	Thomas & Betts	USA
12	Guest	Anthony	Ricciuti	Eaton Corporation	USA
13	Guest	John	Webb	ABB	USA
14	Guest	Victor	Hermosillo	GE Grid Solutions	USA
15	Guest	Patrick	Di Lillo	Consolidated Edison Co. of NY, Inc.	USA
16	Guest	Bill	Hurst	GE	USA
17	Guest	Edgar	Dullni	retired	Germany
18	Guest	David	Dunne	Schneider Electric	USA
19	Guest	Herman	Bannink	KEMA Netherlands	Netherlands
20	Guest	James	van de Ligt	CANA High Voltage Ltd.	Canada
21	Guest	Henk	te Paske	KEMA Netherlands	Netherlands
22	Guest	Jon	Spencer	Utility Solutions	USA
23	Guest	Paul	Leufkens	Power Projects Leufkens	USA
24	Guest	Stephanie	Montoya	Southern California Edison	USA
25	Guest	Clint	Carne	Schneider Electric	USA
26	Guest	Wangpei	Li	Eaton	USA
27	Guest	Robert	Sazanowicz	Avangrid - United Illuminating	USA
28	Guest	Raymond	Frazier	Ameren	USA
29	Guest	Paul	Found	BC Hydro	Canada
30	Guest	Sterlin	Cochran	Hubbell Power Systems	USA
31	Guest	Richard	Rohr	Powell Electrical Systems	USA
32	Guest	Michael	Christian	ABB	USA
33	Chair	Nenad	Uzelac	G&W Electric	USA
34	Guest	Dustin	Sullivan	Hubbell Power Systems	USA
35	Guest	James	Lagree	Eaton	USA
36	Guest	Karla	Trost	G&W Electric	USA
37	Guest	Wei	Zhang	Hitachi T&D Solutions, Inc.	USA
38	Guest	Anil	Dhawan	ComEd	USA
39	Guest	James	Ruebensam	S&C Electric Co.	USA
40	Guest	Joseph	Jasinski	ITC Holdings Corp.	USA
41	Guest	David	Caverly	Trench Ltd.	Canada
42	Guest	Rahul	Jain	S&C Electric Company	USA
43	Guest	Francois	Trichon	Schneider Electric	France
44	Guest	Scott	Lanning	S&C Electric	USA
45	Guest	Jeffrey	Door	The H-J Family of Companies	USA
46	Guest	Philippe	Corriveau	MindCore Technologies	Canada
47	Guest	Brian	ONeil	RMS Energy	USA
48	Guest	Torsten	Wirz	ABB AG	Germany
49	Guest	Edwin	Almeida	Southern California Edison	USA
50	Guest	Benson	Lo	Toronto Hydro	Canada
51	Guest	Caryn	Riley	Georgia Tech/NEETRAC	USA
52	Guest	Danish	Zia	UL LLC	USA
53	Guest	Larry	Putman	Powell	USA
54	Guest	Leonel	Santos	Schneider Electric	USA
55	Guest	Mohit	Chhabra	S&C Electric Company	USA
56	Guest	Justin	Palmer	ELECTRONSYSTEM MD (EMD)	USA
57	Guest	Karthik Reddy	Venna	Siemens AG	Germany
58	Guest	William	Weishuhn	ABB	USA
59	Guest	Robert	Hanna	ABB INC	USA
60	Guest	Ralf	Methling	Leibniz Institute for Plasma Science and Technolo	Germany
61	Guest	Ryan	Sherry	ITC Holdings Corp.	USA
62	Guest	Christopher	Hastreiter	Eaton	USA
63	Guest	Edward	Hester	Entergy	USA
64	Guest	Michael	Shook	Hubbell Power Systems	USA
65	Guest	Douglas	Mason	ComEd	USA
66	Guest	Ashley	Moran	IEEE Standards Association (IEEE-SA)	USA
67	Guest	Justin	Johnson	RMS Energy	USA
68	Guest	nadia	El khattabi	Hydro-Quebec	Canada

IEEE 1547 influence on C37 standards Task Force (Innovation Subcommittee)

Clinton Carne, Mohit Chhabra, Sterlin Cochran, David Dunne, Paul Leufkens

Burlington, April 29th 2019

Agenda

1. The new IEEE 1547 2018 and its follow-up
2. TF Process and conclusions
3. Potential issues with C37 standards
   a. Ref 4.11.2 Surge Withstand
   b. Ref 4.11.3 Paralleling device, 220 % rated Voltage
   c. Ref 6.3 EPS reclosing
   d. Ref Tables 11, 12 and 13: Shall Trip requirements
   e. Ref Tables 14 and 15: operation at 110% of Vn
4. Responses C37 subcommittees
5. Next steps

1. The new IEEE 1547-2018 and 1547.1

- The IEEE 1547, Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces
  - Published in 2018
  - Former version 2003
  - It is a system standard, not component
  - It contains elements that may conflict with C37 elements
  - The thinking has mostly Low Voltage background
- The IEEE 1547.1 with Test Procedures is under ballot now
  - "Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems"
  - Former version 2005
- As far as we would like to change elements it should have been done in the 1547 – too late for that now.

2. TF Process and conclusions

- Identifying and analysis of 5 potential issues
- Interaction with people from the IEEE 1547.1 Working Group
  - Andy Hoke, NREL, chair IEEE 1547.1
  - Babak Enayati, Nat. Grid, VC
  - John Carr and Tim Zgonena, UL
- Conclusions:
  - We cannot change the standards
  - Possible heads-up in C37 standards
  - Possible use UL's "Certification Requirement Decision" (CRD)
    - after a consensus proposal in a UL document is the way to explain the situation and when and how the extra requirements
  - We don't need a guide, but will write a paper
  - The TF can finalize in 2019

3.A Ref Cl 4.11.2 Surge Withstand

“4.11.2 Surge withstand performance

The interconnection system shall have the capability to withstand voltage and current surges in accordance with the interconnection system ratings and environments defined in IEEE Std C62.41.2, IEEE Std C37.90.1, IEEE Std C62.45, or IEC 61000-4-5, as applicable.”

Issue: C62 exceeds C37 LV surge requirements

Remarks: in the 1547.1 draft both C62.41.1 & C62.45 are Recommended Practices and compliance is not mandatory

- In the C62.41.2 there are a number of tables proposing different values depending on the exposure and application

Follow-up: Share insights at the IEEE Sw.G.C. meeting

- Check whether we reference C62 documents

- Make sure that ultimate 1547.1 text is acceptable

3.b Ref Cl 4.11.3: Paralleling device, 220 % rated Voltage

4.11.3 Paralleling device

Where used for isolation of a DER unit that continues to produce voltage after isolation from the Area EPS, the DER paralleling-device shall be capable of withstanding 220% of the DER rated voltage across the paralleling device for an indefinite duration.

Issue: 220% is result of out of phase voltage. This may not be a concern for air gap switches, but solid dielectric likely will have the leakage concern.

Remarks: We should differentiate between switching devices that perform short term synchronization functions and those that perform long term separation between the utility and an islanded microgrid where the switching device will be exposed to up to 220% of rated grid voltage for long periods of time for up to months. Probably a one-day overvoltage requirement is more or less covered with the typical 1 min Hipot test.

Follow-up:

- The idea to draft a new set of requirements, to distinguish between different applications and the times of overvoltages but drop indefinite time
  - Not feasible
- UL CKD?
- TF to review the requirements, propose the validation tests for the switchgear.

3.c Ref Cl. 6.3: EPS reclosing

6.3 Area EPS reclosing coordination

Appropriate means shall be implemented to help ensure that Area EPS automatic reclosing onto a circuit remaining energized by the DER does not expose the Area EPS to unacceptable stresses or disturbances due to differences in instantaneous voltage, phase angle, or frequency between the separated systems at the instant of the reclosure (e.g., out-of-phase).

Issue: How is this tested? What field application is this trying to prevent?

Conclusion: This is related to the upstream reclosing device and has no influence on the paralleling device so not a big issue

Follow-up: Share in Switchgear Committee

3.d Ref Cl 6.4 Shall Trip requirements in Tables 11, 12 and 13

6.4.1 Mandatory voltage tripping requirements

In tables there are mandatory voltage tripping requirements

Issue: How does this affect programmable devices? Is this meant for the users and not the manufacturers? .

Remarks: During these events the generation is typically controlled electronically and ceases its export by means other than opening or closing its output switchgear or contactors. The requirements have very tightly controlled timing windows of operation which is in part why the electronics are used for these control functions vs electromechanical switching.

Conclusion: This is part of system evaluation and not a component evaluation or performance requirements

Follow-up: Discuss in Switchgear Committee

3.e Ref Cl 6.4 continuous operations at 110% Un in Tables 14 and 15

6.4.2 Voltage disturbance ride-through requirements

Issue: Tables 14 and 15 allow continuous operation at 110% of the nominal system voltage. There is risk at the short circuit rating of the product the performance may be different at +10% (660V on 600V system), because today we test LV at not more than +5.8% (635V for 600V system).

Remarks: it doesn't say that if it goes to this level DERs should be on there, for instance National Grid requests plus or minus 5% and there may be infrequent violation during short period of time, this doesn't mean that the system voltage must be higher.

Note that the 1547 is almost only about LV, not much thought to MV

Follow-up: Discuss in Switchgear Committee

- Tables 14 and 15 are critical for LV and MV.

- The IEEE 1547 group will discuss so they can potentially create an optional evaluation for 110% components for switchgear, breakers and fuses.

4.1 Responses C37 Sub-committees on surge and 110%

- Response HV Subcommittee, James Houston
  - C37.30.1 does not reference the C62.41 or C62.45.
  - Based on the preferred power frequency ratings, all high voltage switches are tested to withstand greater than 110% voltage continuously.
- Response Fuses subcommittee, John Leach
  - HV Fuses Subcommittee does not reference C62.41 or C62.45 in any of its standards.
  - Dielectric withstand is complex story
- LV: this week consult

4.2 Response RODE

- The requirement in C37.68 has not been set, but the reference to C62.41 has been made in the technical report that we will be referring to. The WG may decide to go with the most stringent requirement for surge withstand voltage.
- Per CSA, voltages recorded outside the LV network normal range limits, but within the extreme range limits, are tolerable over the short-term and shall be scheduled for remedial action within the next regular planning cycle.
- Voltages recorded outside the LV extreme range limits or the MV range limits shall be scheduled for immediate remediation.

Nominal Voltage	Extreme Range			
	Min	Normal Range		Max
		Min	Max	
1 Phase, 3 Wire 120/240 V	106/212 V (-11.7%)	110/220 V (-8.3%)	125/250 V (+4.2%)	127/254 V (+5.8%)
3 Phase, 4 Wire 120/208 V	110/190 V (-8.3%)	112/194 V (-6.7%)	125/216 V (+4.2%)	127/220 V (+5.8%)
3 Phase, 4 Wire 277/480 V	245/424 V (-11.6%)	254/440 V (-8.3%)	288/500 V (+4.0%)	293/508 V (+5.8%)
3 Phase, 4 Wire 347/600 V	306/530 V (-11.8%)	318/550 V (-8.3%)	360/625 V (+3.7%)	367/635 V (+5.8%)

5. Next steps

- Identify the issues for which we need caution
- Identify the standards in which a reference
- Identify where to use CRD (coordination UL)
- White paper

CIGRE STUDY COMMITTEE A3 **List of SC A3 Working Groups, Task Forces and Advisory Groups, February 2017**

Type [1]	Number [2]	Title [3]	Name of Convener [4]	Created[5]	Disbanded [6]
WG	A3.30	Overstressing of HV substation equipment	A. Carvalho (BR)	2010	2019
WG	A3.31	Instrument transformers with digital output	F. Rahmatian (CA)	2011	(2019)
WG	A3.36	Application and Benchmark of Multi Physic Simulations and Engineering Tools for Temperature Rise Calculation	M. Kriegel (CH)	2014	(2019)
WG	A3.38	Shunt capacitor switching in distribution and transmission systems	E. Dullini (DE)	2016	(2019)
WG	A3.39	Application and field experience with Metal Oxide Surge Arresters	R. le Roux	2017	(2020)
WG	A3.40	Technical Requirements and Testing Recommendations for MV DC switching equipment at distribution levels	Christian Heinrich (DE)	2018	(2022)
WG	A3.41	Interrupting and switching performance with SF6 free switching equipment	René Smeets (NL)	2018	(2021)
WG	A3.42	Failure analysis and risk mitigation for recent incidents of AIS instrument transformers	Helvio Jailson Azevedo Martins (BR)	2018	(2021)
JWG	A3.43/ CIRED	Tools for lifecycle management of T&D switchgear based on data from condition monitoring systems	Nicola Gariboldi (CH)	2018	(2022)
JWG	B4/A3.80	HVDC Circuit Breakers - Technical Requirements, Stresses and Testing Methods to investigate the interaction with the system	Dr. Junzheng Cao (CN)	2018	(2022)
JWG	C4/A3.54	Application Effects of Low-Residual-Voltage Surge Arresters in Suppressing Overvoltages in UHV AC Systems	Jinliang He (CN)	2018	2021
JWG	A3/B1/B2/B4/C 4.44	Consequence of High Voltage Equipment operating exceeding highest system voltages	Bartosz Rusek	(2019)	(2023)
WG	A3.45	Methods for identification of frequency response characteristic of voltage measurement systems	Erik Sperling	(2019)	(2023)
WG	A3.46	Generator CB	???	(2019)	(2023)

[1] Type : Working Group (WG), Task Force (TF), Advisory Group (AG), Co-operation Group (CG), Joint Working Group (JWG), Joint Task Force (JTF), …
[2] Number : identification number
[3] Title : full title in English
[4] Name : Initials NAME (2 letters for nationality)
[5] Created : year of creation
[6] Disbanded : scheduled year of disbanding

Last update : 04/05/19

IEEE Switchgear Technology
& Innovation subcommittee

DRAFT

New Research Group Proposal

Date	
Rev #	

	Submitters' Name:	Affiliation	Email
1			
2			
3			

Title						
Deliverable	**Quick feasibility (0-6 mon)**		**White paper (6 – 12 mon)**		**Technical Report (1-3 years)**	
Affected subcommittees	**HVCB**	**RODE**	**HVF**	**HVS**	**SA**	**LVSD**
Affected IEEE committees	(substation committee, relay committee, transformers committee, etc…)					
Other	(NEMA, CIGRE, IEEE standards, IEC standards, EPRI, etc…)					

Background information:		
Scope of Work and deliverables:		
Comments from T&I Chair		
Approval by T&I subcommittee		
Date		
Research group timing	**Start**	**Finish**