**C37.100.2 Common Requirements for Testing of AC Capacitance Current Switching Devices over 1000V**

Chair: Kirk Smith
Secretary: Peter Glaesman

The meeting convened at 1:30 PM on April 3, 2024, with self-introductions of all in attendance. The attendance sheet was passed around and initialed.

Total of 45 attendees. 17 members and 18 guests.

Quorum: Initial indication was that we did not have a quorum, but further review of attendance sheet indicated that a quorum was present. 17 of 29 (?) voting members present.

Patent Slides and Copyright Slides were addressed.

Approve Fall Meeting Minutes – will post on iMeet Central - still need approval.

Approve March Virtual Meeting Minutes - will post on iMeet Central - still need approval.

Today's Topics:

- PAR schedule – Kirk submitted a 1-year extension – through December 2025. To be approved by NESCOM(?).

Kc Values – planning to divide into two tables – showed drafts (NA and NB) for simultaneous and non-simultaneous. After discussion, it was decided that the tables are too difficult to understand. A suggestion is to make additional columns to address all the variables.

Lucas said most cases below 72.5 kV may or may not be effectively grounded, where above 72.5 kV is normally effectively grounded.

- Neil suggests also separating "cables" from "banks".

Cables – Belted vs Screened for 3-phase, 3-conductor power cables.
https://blog.usesi.com/2018/09/13/types-of-underground-cables/

**Belted Cables** – **Belted cables**: The three conductors are individually wrapped with insulation and then all three conductors are wrapped with a belt of insulation. A single metallic outer layer covers all three conductors. For capacitive switching, belted cables have capacitance from phase-to-phase and phase-to-ground, similar to overhead lines. Belted cables and overhead lines can be simulated with the parallel combination of as follows:

- a three-phase bank with an ungrounded neutral and
- a three-phase with a grounded neutral.

**Screened Cables** – **Screened cables**: The three conductors are individually wrapped with insulation and then individually surrounded by a metallic outer layer. Then, a single metallic outer layer covers all three conductors. For capacitive switching, screened cables have only phase-to-ground capacitance. A screened cable can be simulated with a three-phase with a grounded neutral.

Comments on Tables NA and NB presented at the meeting.

- Jeffrey Brogdon suggests that some of the “notes” in the non-simultaneous table do not apply.
- Neil questioned breaking in a single or two phase-to-phase faults condition.
- Jan explained the situation with European systems and Neil voiced concern over the detail that is glossed over in these summary tables.
    - Non-effectively grounded includes high impedance grounded and Peterson coil grounding.
- Jeff Brogdon suggests moving cap bank switching down to 2.1 line from 1.5 line. Also, removing Notes 2 & 3 from Table NB.
- Add a NOTE saying that for double circuit towers, 0.1 should be added to Kc.

Another suggestion for the Tables.

- NA
    - Simultaneous breaking
    - Ground
    - Voltage
    - Delete Note 3
- NB
    - Banks
- NC
    - Non-Simultaneous breaking

Jeff reviewed submittal for “Open Wire Line Dropping”.

- Jeff’s presentation will be included in the iMeet Central repository.
- Three cases included - see Slide 15 – Conclusions
    - CASE 1 – kc=1.2 in C37.100.2-2018 covers all lines considered with interruption of remaining phases at the next available current zero
    - CASE 2 – kc=1.4 (below 72.5kV) and kc=1.2 (72.5kV and above) with delayed interruption of remaining phases covers:
        - 100% of 46kV lines
        - 80% of 115kV lines
        - 96% of 230kV lines
        - 100% of 500kV lines
    - CASE 3 – kc=1.4 in C37.012-2022 for breaking line charging current with delayed clearing of the second and third poles covers all lines.
- Why has kc=1.2 worked all these years
    - Lines not covered are more likely to be loaded. Trapped charge is discharged through the transformer reducing the TRV.
    - The Breaker design voltage is higher than the operating voltage.
    - The Polarity sequence of trapped charge reduces TRV half of the time for delayed interruption of remaining phases.

Jeff will Draft an Annex C for explaining derivation of recovery voltage factors.

Kirk displayed Annex K from IEC -100 document applies to circuit breakers. Plan to attempt getting approval to add as an annex to this standard.

Neil explained why controlled switching is not applicable in this standard.

- Some suggested that controlled switching devices should be tested only with the control.
- Others suggested that controlled switching devices should be tested only without the control.

So, at present, the working group is not planning to include controlled switching devices in this revision of the standard.

Pete Kowalik proposed Interrupter Aid Tests material for Section 4.9.

- Neil thinks that this does not belong in this standard, but others disagree.
- Options
  - Include Interrupter Aid Tests material for Section 4.9 of C37.100.2
  - OR
  - Include Interrupter Aid Tests material for Section 6 of C37.30 IEEE Standard Requirements for High-Voltage Switches
- Also refer to IEEE 1247 - IEEE Standard for Interrupter Switches for Alternating Current, Rated Above 1000 Volts. The latest version was published in 2005.
  - NOTE of the Chair; I think that IEEE 1247 was not revised, and that parts are to be included in other standards.
- The title for Table 5 should Include “for 38 kV and below.
- Whips and Arcing Horns are not included.

Plan for additional and interim meetings was announced and then meeting was dismissed.

- Webex Meeting in Early June 2024
  - Suggest Wednesday June 5, 2024, starting at 12 pm noon East Coast Time.
  - I plan to send out a first draft of the revision before that date.

| C37.100.2 Roster and Attendance - April 3, 2024 (session I of I) | | | |
|---|---|---|---|
| **Full Name** | **Affiliation** | **Member Status** | **Present** |
| | | | |
| Brian Roberts | Southern States | member | Y |
| Bruce Rockwell | | member | N |
| Chris Borck | Eaton | member | N |
| Chris Morton | Powertech Labs Inc. | member | N |
| Chuck Corley | Eaton | member | N |
| Damian Perrin | Entergy Services LLC | member | N |
| Dan Schiffbauer | Toshiba International Corporation | member | N |
| Don Steigerwalt | Duke Energy | member | N |
| Donald Swing | Powell Industries | member | N |
| Dragan Tabakovic | Hubbell | member | N |
| Ganesh Balasubramanian | Eaton | guest | Y |
| Harry Hirz | VESCO | member | Y |
| Jan Weisker | Siemens Energy | member | Y |
| Jeff Brogdon | Georgia Transmission | member | Y |
| Jim Van De Ligt | CANA High Voltage Ltd. | member | N |
| John Tarleton | Southern States | guest | Y |
| John Webb | ABB | member | Y |
| Lucas Collette | Duquene Light | member | Y |
| Marcus Young | Mitsubishi Electric | member | Y |
| Michael Christian | ABB | member | Y |
| Neil McCord | KEC Precision LLC | member | Y |
| Pete Kowalik | Cleaveland/Price Inc. | member | Y |
| Peter Glaesman | PCORE Electric co. | secretary | Y |
| Rob Ross | Cleveland/Price | member | Y |
| Robert Kirkland Smith | Retired | chair | Y |
| Samuel Zarharko | MEPPI | member | N |
| Sergio Flores | Schneider Electric Inc, USA | member | Y |
| Ted Burse | Powell Industries | member | N |
| Vincent Marshall | Southern Company | member | Y |
| Roy Alexander | Retired | member | N |
| Jennifer Santulli | IEEE - SA | staff | N |

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|---|---|---|---|
| **Full Name** | **Affiliation** | **Member Status** | **Present** |
| | | | |
| Carl Kurinko | Hitachi Energy | guest | N |
| Andrew Chovanec | Power Grid Components | guest | Y |
| Andy Beckel | Xcel Energy | guest | N |
| Aryan Bronsveld | Hitachi Energy Sweden | guest | Y |
| Arben Bufi | MAS Inc. | guest | N |
| Brad Leccia | Eaton | guest | Y |
| Brian Berner | Power Grid Components | guest | Y |
| Bhrugen Amin | S&C Electric | guest | Y |
| Casey Weeks | Siemens Energy | guest | N |
| Changhoon Lee | Hyosung | guest | Y |
| Chris Ekpoudom | Southern States | guest | N |
| Chunming Ma | Burns and McDonnell | guest | N |
| Conrad Pecile | Meyers Power Products | guest | N |
| Craig Polchinski | MEPPI | guest | Y |
| Daniel Gordish | Cleveland/Price | guest | Y |
| Dan Wolfe | MEPPI | guest | N |
| Gary Meekings | Southern States | guest | Y |
| Ilya Glinsky | S&C Electric | guest | Y |
| Jaden Martz | S&C Electric | guest | Y |
| Jason Cunningham | Southern States | guest | Y |
| Jeff Jordan | Southern States | guest | N |
| Jeremy Moore | Pascor Atlantic | guest | Y |
| Jerry Wen | BC Hydro | guest | Y |
| Jon Rogers | Siemens Energy | guest | Y |
| Jonathan Benge | OG&E | guest | Y |
| June Seo | HD Hyundai Electric | guest | N |
| Kaylor Garcia | Utility Solutions, Inc. | guest | N |
| Lin Tong | TK Switchgear | guest | N |
| Lissy Diaz | Florida Power & Light | guest | Y |
| Mark Peterson | Xcel Energy | guest | N |
| Michelle Antantis | Duquesne Light | guest | Y |
| Mollie Morehead | Pascor Atlantic | guest | Y |
| Pedro Castillo | ABB | guest | N |

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| **Full Name** | **Affiliation** | **Member Status** | **Present** |
| | | | |
| Randy Ward | Aluma-Form | guest | Y |
| Samuel Anris | KEMA Labs | guest | N |
| Shahryar Farhang | Megger | guest | Y |
| Tim Anderson | Aluma-Form | guest | Y |
| Timothy Terry | Meiden | guest | Y |
| V. Toups | Siemens Energy | guest | Y |
| Victor Savulyak | KEMA Labs | guest | Y |
| Yun Seong Kim | KERI | guest | Y |
| Yong Woo Lee | KERI | guest | Y |
| Zachary Beecher | Southern States | guest | Y |
| | | | |