



# DISCUSSION MEETING SUMMARY

## Study Committee A3

### Transmission and Distribution Equipment

**27<sup>th</sup> of August 2028**

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<b>Chair:</b>	<b>Nenad Uzelac (US)</b>
<b>Secretary:</b>	<b>Frank Richter (DE)</b>
<b>Special Reporters:</b>	<b><u>René Smeets (NL)</u>, Nicola Gariboldi (CH), Tadao Minagawa (JP), Erik Sperling (CH)</b>
<b>Interactivity manger:</b>	<b>Martin Kriegel (CH)</b>

#### 1. INTRODUCTION

The 2024 Group Discussion Meeting (GDM) of Study Committee A3 took place on August 27, 2024, in room Bordeaux at the Palais des Congrès in Paris, France, with both morning and afternoon sessions. The meeting was chaired by Study Committee Chairman Nenad Uzelac from the US. The Special Reporters included René Smeets (NL), Nicola Gariboldi (CH), Tadao Minagawa (JP), and Erik Sperling (CH), with Frank Richter (DE) serving as the SC A3 Secretary. Martin Kriegel (CH) acted as the interactivity manager. René Smeets coordinated the work and led the team of special reporters.

The Special Report had already categorized the received papers for the three preferential subjects into four groups with a total of 19 questions. Consequently, the group discussion was also organized into these categories:

1. **SF6 alternatives and Life Cycle Assessment** (25 papers) - Moderated by René Smeets
2. **Miscellaneous T&D equipment and systems** (19 papers) - Moderated by Tadao Minagawa
3. **Asset management, monitoring, and diagnostics** (16 papers) - Moderated by Nicola Gariboldi
4. **Instrument transformers and digitalization** (18 papers) - Moderated by Erik Sperling

This thematic approach allowed for better and more specific addressing of experts due to the wide range of topics handled in SCA3, resulting in a very good average participation rate.

#### 2. RUNNING OF THE MEETING

The chair welcomed the participants and provided a brief overview of Study Committee A3 and its ongoing work. Following the introduction, a SparkUp poll was conducted to enhance interactivity with the audience. SparkUp was used consistently after breaks and between sessions to conduct polls and discuss questions from the audience.

The special reporters explained the procedure for the group discussion. Each topic was introduced by an invited speaker. The invited experts presenting the topics were:

- **Topic 1:** Toshiyuki Uchii (JP)
- **Topic 2:** Guilhem Blanchet (NO)
- **Topic 3:** Matthew Gardner (US)
- **Topic 4:** Paolo Mazza (IT)

After the invited lectures, each special reporter summarized the main news from the papers in their topic on a single slide.

Additionally, a presentation was given by a Next Generation Network (NGN) presenter. Rodolfo Saraceni (IT) contributed with a presentation on "Real-time pollution monitoring and diagnostics of Air Insulated Switchgear oriented to predictive maintenance," which was scheduled at the start of Topic 3. A brief introduction to the NGN was also provided.

### 3. CONTRIBUTIONS TO TOPICS

#### *TOPIC 1: SF6 alternatives and Life Cycle Assessment*

*By René Smeets*

Twenty-five reports were categorized under this topic, and six questions were raised in the special report. A total of 20 speakers had registered for prepared contributions.

1. **Interoperability of New Insulation/Interruption Gases:** The first question addressed the interoperability of the various new insulation/interruption gases being offered as replacements for SF6. Four speakers, all with OEM backgrounds, responded, indicating that the convergence to a single gas mixture remains distant.
2. **Stability During Switchgear Lifetime:** The second question focused on the long-term stability of the new gases in switchgear. Five OEM speakers shared their knowledge and research, stating that no significant changes have been observed over time.
3. **Adaptations for Disconnectors and Earthing Switching in Compressed Air:** The third question discussed the necessary adaptations for disconnectors and earthing switches operating in a compressed air environment. Four speakers, three of whom were manufacturers, detailed how these devices are modified to work in the new media.
4. **Supply of Key Components for New Switchgear:** The fourth question addressed the sufficiency of the supply of key components for the new switchgear. One OEM speaker elaborated that the supply of C4FN gas is being sourced from enough suppliers to ensure future operations.
5. **User Choice of Technology:** The fifth question examined how users decide on a particular technology. Two speakers from TSOs covered this topic in detail, focusing on Japan and Australia/New Zealand.
6. **Reliability of Extrapolating LCA Studies:** The sixth question looked into the reliability of extrapolating LCA studies over the long term, such as the lifetime of switchgear. Four OEM speakers responded with sensitivity analyses estimating CO2 emission equivalents of primary energy sources.

After each question, there was a short round of floor discussions, followed by a longer spontaneous discussion period after the whole topic, which saw considerable audience participation.

## TOPIC 2: MISCELLANEOUS T&D EQUIPMENT AND SYSTEMS

*By Tadao Minagawa*

Nineteen reports were categorized into this topic, and five questions were raised in the special report. A total of 11 prepared contributions were registered, with 10 eventually presented.

1. **Countermeasures for Severe Stresses:** The first question tackled responses to severe stresses like increasing fault current. Though a contribution on superconducting fault current limiters (SFCL) was prepared, it was not presented.
2. **Switchgear with Novel Sensors and Controllers:** The second question focused on switchgear equipped with new sensors and controllers to enhance functionality. Four speakers—two from OEMs and two from TSOs—discussed controlled switching (POW) technology. One TSO speaker shared experiences in monitoring circuit breakers, while another outlined their strategy for applying the technology. The OEMs provided technical details, including AI-assisted algorithms. A brief Q&A session followed a question raised through Sparc-Up.
3. **Vacuum Circuit Breakers:** The third question explored the phenomena associated with vacuum circuit breakers. One OEM speaker suggested that modified contact designs could improve the axial magnetic field (AMF) at long contact gaps, resulting in high interruption performance at high voltage.
4. **Challenges in Expanding DC Grid Applications:** The fourth question addressed the challenges in expanding the application of switching equipment in DC grids. An OEM speaker proposed technically sound test methods to apply sufficient stress to each test object for a single breaking interruption, as assumed in real systems. Testing should focus on core circuit breakers (CB) and residual current switches (RCS). The speaker also answered several questions posed through Sparc-Up.
5. **Advanced Insulators and Conductors:** The fifth question was on advanced insulators and conductors. Three speakers from OEMs and one from academia proposed advanced components for AC and DC applications, made from non-traditional materials like ceramic, silicone, and resin impregnated.

Each session was followed by a short discussion, allowing for additional questions and interactive participation.

## TOPIC 3: ASSET MANAGEMENT, MONITORING AND DIAGNOSTIC

*By Nicola Gariboldi*

Sixteen reports were received, and four questions were raised in the special report, resulting in nine prepared contributions.

1. **Investment in Centralized Asset Management and Maintenance Systems:** The first question explored why TSOs seem to be investing more than DSOs in centralized asset management and maintenance systems. Contributions from Brazil, South Africa, and Slovenia confirmed that TSOs are more committed to implementing these systems, driven by factors such as networks with fewer but higher value assets, different penalty structures for interruptions, and larger company sizes that can commit to the necessary investments.
2. **Global Database for Service Experiences and Failures:** The second question investigated the possibility of creating a global database for the anonymous collection of service experiences and types of failures. A contribution from France proposed the use of native digital equipment and cooperation among different utilities to achieve this. The USA reported an existing anonymous data collection for transformer failures, useful for benchmarking failure rates. Colombia provided an

example of a common database used by the same utility in three different countries, emphasizing the potential of a global database for various technologies and asset designs.

3. **Risks of Racking in and Out a Circuit Breaker in Medium Voltage Switchgear:** The third question focused on the risks associated with racking in and out a circuit breaker in medium voltage switchgear, and current initiatives to mitigate those risks. Australia confirmed the high risk and listed several actions in place to mitigate it.
4. **VT Bandwidth for Validating Electrical Simulations of Voltage Transients:** The fourth question sought clarification on the VT bandwidth required to validate electrical simulations of voltage transients during a single-phase earth fault. A contribution from India confirmed the limited bandwidth of the VT used but noted that the simulations mainly focused on the peak transient recovery voltage rather than its rate of rise. A second contribution from Brazil discussed single-phase versus three-phase automatic reclosing and proposed a second reclosing after 1 minute for circuit breakers already in service and after 15 seconds for new ones.

Following each question, there were discussions allowing for additional questions and interactive participation.

#### *TOPIC 4: INSTRUMENT TRANSFORMERS AND DIGITALISATION*

*By Erik Sperling*

Eighteen reports were categorized into this topic, and four questions were raised in the special report. A total of 19 speakers had registered for prepared contributions.

1. **Technology and Advantages of Low-Power Instrument Transformers:** The first question focused on the technology and advantages of low-power instrument transformers. Seven contributors shared their experiences, motivations, trends, and expectations.
2. **Future Use of AI, Asset Monitoring, and Power Quality Measurements:** The second question explored the future use of AI, asset monitoring, and power quality measurements, as well as the improvement and validation of data quality. Seven contributions provided detailed information on data recording and quality.
3. **Advantages of AI Approach and Online Condition Monitoring:** The third question examined the advantages of the AI approach and online condition monitoring, motivated by ageing processes and partial discharge (PD) measurements. Three contributions provided insights and discussed future trends.
4. **Quality and Correctness of Existing IT Models for Digital Twins:** The fourth question addressed the quality and correctness of existing IT models for modeling or usage in digital twins. Two contributions shared significant information and presented approaches and applications for using AI and asset monitoring in health index estimation.

After each question, there was a short round of questions and discussions between the floor and the contributors. Finally, a ten-minute discussion with numerous excellent contributions concluded this block.

## **6. CONCLUSION**

Fifty-eight prepared contributions were presented, complemented by five separate speakers and four report summaries. Approximately 30 spontaneous contributions were made during the group discussion meeting through the Sparkup tool. The Sparkup tool enriched the session with interactive participation from the audience, leading to a livelier discussion following most contributions. These spontaneous contributions and suggestions provided many interesting ideas. The session was of technical interest to all participants. The number of participants was around 470.