

# **DISCUSSION MEETING SUMMARY**

## Study Committee C4

### Power System Technical Performance

***August 30, 2024***

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**Chair: Marta VAL ESCUDERO**

**Secretary: Genevieve LIETZ**

**Special Reporters: PS1: Torsten LUND and Antti HARJULA; PS2: Patricio MUNHOZ-ROJAS and Tim BROWNE; PS3: Angelica ROCHA and Lukas SCHWALT**

#### **1. INTRODUCTION**

The 2024 Group Discussion Meeting (GDM) of Study Committee C4 was held on Friday, August 30th, 2024, in the Bordeaux Ampitheatre at the Palais des Congrès as an all-day event. Approximately 290 participants were in attendance during parts of the session, with the highest concentration attending the PS1 session in the morning. All preferential subjects stimulated very active discussions. There was a total of 76 prepared contributions and numerous spontaneous contributions.

The GDM covered the following preferential subjects:

**Preferential Subject 1 (PS1)** – Power system dynamic analysis in the energy transition: challenges, opportunities and advances.

**Preferential Subject 2 (PS2)** – Power quality (PQ) and electromagnetic compatibility (EMC) analysis in the energy transition: challenges, opportunities and advances.

**Preferential Subject 3 (PS3)** – Insulation co-ordination and lightning interference analysis: challenges, opportunities and advances.

#### **Next Generation Network (NGN) Presentations:**

NGN presentations from Denmark (PS1) and Australia (PS2) were given. There were questions in response to both NGN presentations.

**PS1:**

There were 41 papers (including 1 NGN paper) submitted from 19 countries, and 12 questions.

There was 1 NGN presentation, 39 contributions with presentations to 11 questions; 1 question had no submitted responses. There was a total of 6 spontaneous contributions and 5 questions with discussions.

**PS2:**

There were 19 papers submitted (including 1 NGN paper) from 13 countries, and 6 questions.

There were 1 NGN presentation, 14 contributions with presentations to 5 questions; 1 question had no submitted responses. There was a total of 6 spontaneous contributions and 2 questions with discussions.

PS3:

There were 23 papers submitted from 15 countries, and 5 questions.

There were 21 contributions with presentations to 5 questions. There were no spontaneous contributions or questions.

## 2. RUNNING OF THE MEETING

The Group Discussion Meeting was chaired by the Study Committee Chair, *Marta VAL ESCUDERO*, with *Torsten LUND*, *Antti HARJULA (PS1)*; *Patricio MUNHOZ-ROJAS*, *Tim BROWNE (PS2)*; and *Angelica ROCHA*, *Lukas SCHWALT (PS3)* as Special Reporters and minutes were recorded by SC C4 Secretary *Genevieve LIETZ* (online).

## 3. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 1

### **Summary: PS1 - Power system dynamic analysis in the energy transition: challenges, opportunities and advances**

**Theme 1:** Methodologies including modelling tools and techniques, model validation, metrics and data analytics.

- There were 25 papers submitted from 15 countries in response to this theme.

**Theme 2:** Technologies including storage, large scale electrification and advanced control methods.

- There were 15 papers submitted from 7 countries in response to this theme.

**Theme 3:** Phenomena including control interactions, system needs and required equipment capabilities for planning and operation of secure power systems.

- There were 10 papers submitted from 10 countries in response to this theme.

### **Key points:**

- The need and use of wide-scale EMT use for system-wide studies is increasing.
- Tools and models are developing all the time – careful consideration should be given to the validity of the tools and models for type of study.
- Many metrics on identifying stability risks have been proposed – each has its unique problems and benefits.
- The impact of large-scale and distributed power electronic interfaced loads is an emerging topic and needs further research.
- Great potential in dynamic capabilities and services from new technologies
- More work on addressing electrolyzers is needed – no submissions were received in response to the associated question.

## 4. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 2

### **Summary: PS2 - Power quality (PQ) and electromagnetic compatibility (EMC) analysis in the energy transition: challenges, opportunities and advances**

**Theme 1:** New tools and methods for the assessment and the mitigation of PQ issues for low-carbon grids.

- There were 13 papers submitted from 11 countries in response to this theme.

**Theme 2:** EMC related challenges arising from large penetration of renewable energy plants and electric vehicles (EV) charging networks.

- There were 3 papers submitted from 3 countries in response to this theme.

**Theme 3:** Evaluation and mitigation of high-altitude electromagnetic pulse (HEMP), intentional electromagnetic interference (IEMI) and geomagnetically induced current (GIC) in modern power systems.

- There were 2 papers submitted from 2 countries in response to this theme.

#### **Key points:**

- For Theme 1, a key conclusion from the contributions is that complexity in modelling, measurement and mitigation of power quality issues is increasing in the energy transition.
- A conclusion from the contributions to Theme 3 is that, in the understanding of the problem of GICs, the solution of the geophysical problem is much more advanced than the solution of the engineering problem.

## **5. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 3**

### **Summary: PS3- Insulation co-ordination and lightning interference analysis: challenges, opportunities and advances**

**Theme 1:** Overvoltage stress of future HVDC and HVAC transmission and distribution systems, including new characteristic waveforms.

- There were 13 papers submitted from 9 countries in response to this theme.

**Theme 2:** Advancements in lightning detection systems and lightning performance assessment methods including advanced data analytics of AC and DC high voltage, medium voltage, hybrid overhead lines and other exposed structures.

- There were 8 papers submitted from 7 countries in response to this theme.

**Theme 3:** Impact of extreme weather events, such as wind, fires, flooding, lightning, icing, snow, etc, on insulation co-ordination including practical solutions.

- There were 2 papers submitted from 2 countries in response to this theme.

#### **Key points:**

- Equipment performance and cause of failures in relation to high frequency transients as well as the influence of pollution.
- Temporary or transient overvoltages and voltage scaling phenomena.
- Need for and knowledge from transient studies, requirements for simulations as well as automatic generation of simulation data.
- Lightning performance, outages and protection of transmission lines, use of additional data in relation to extreme weather events.

## **6. CONCLUSION**

A total of 83 papers (including 2 NGN papers), 76 prepared contributions and 12 spontaneous contributions provided many interesting ideas and stimulated useful discussions. The session was of interest to all participants from a technical viewpoint. The peak number of participants was around 130 and averaged more than 80 throughout the day.

The key takeaways from the Study Committee C4 GDM were:

- There is an increasing need and use of wide-area EMT analysis.
- Screening metrics for system strength and stability risks are evolving.
- There are promising future AI applications for power systems.
- The increasing complexity in PQ analysis, allocation of emission limits and compliance assessment mean that new approaches may be needed.
- The development of an open database of GIC measurements was proposed.
- Knowledge gained from equipment failures means possible improvement in transient models and analysis.
- Advanced lightning locations systems are becoming increasingly important.
- A new CIGRE JWG has been created to assist in insulation co-ordination taking contamination into account.