

DISCUSSION MEETING SUMMARY

Study Committee C4 Power System Technical Performance

August 25, 2026

Chair: Marta VAL ESCUDERO

Secretary: Genevieve LIETZ

**Special Reporters: PS1: Julia MATEVOSYAN and Deepak RAMASUBRAMANIAN;
PS2: Zia EMIN and Aida CASTRO LOBATO; PS3: Claus LETH BAK and Jinliang HE**

1. INTRODUCTION

The 2026 Group Discussion Meeting (GDM) of Study Committee C4 was held on Tuesday, August 25th, 2026, in the Havane theatre at the Palais des Congrès as an all-day event. All preferential subjects stimulated very active discussions. There was a total of 74 prepared contributions, one NGN presentation, one invited presentation, and several spontaneous contributions.

The GDM covered the following preferential subjects:

Preferential Subject 1 (PS1) – Power system stability aspects of decarbonisation of power systems and the road to net-zero.

Preferential Subject 2 (PS2) – Power Quality (PQ) and Electromagnetic Compatibility/Interference (EMC/EMI) aspects of de-carbonisation of power systems and the road to net-zero.

Preferential Subject 3 (PS3) – Insulation co-ordination and lightning research: paving the way to net-zero in decarbonised power systems.

Next Generation Network (NGN) Presentations:

An NGN presentation from Slovenia (PS1) was given. There were questions from one Special Reporter (SR) in response to the NGN presentation.

Invited Presentation:

There was one question from the audience in response to the invited presentation.

PS1:

There were 77 papers (including 1 NGN showcase competition paper) submitted from 28 countries, and 16 questions.

There was 1 invited presentation, 1 NGN presentation, 44 prepared contributions with presentations (2 absent on the day) to 15 questions; 1 question had no submitted responses. There were a total of 3 spontaneous contributions and 2 questions with discussions.

PS2:

There were 30 papers submitted from 19 countries, and 7 questions.

There 19 contributions with presentations to 7 questions. There were a total of 3 spontaneous contributions to 2 questions and 1 questions with discussion. One spontaneous contribution will be submitted as a written contribution.

PS3:

There were 19 papers submitted from 11 countries, and 5 questions.

There were 11 contributions with presentations to 3 questions; 2 questions had no submitted responses. There were 7 questions and no spontaneous contributions.

2. RUNNING OF THE MEETING

The Group Discussion Meeting was chaired by the Study Committee Chair, *Marta VAL ESCUDERO*, with *Julia MATEVOSYAN* and *Deepak RAMASUBRAMANIAN (PS1)*; *Zia EMIN* and *Aida CASTRO LOBATO (PS2)*; *Claus LETH BAK* and *Jinliang HE (PS3)* as Special Reporters and minutes were recorded by SC C4 Secretary *Genevieve LIETZ*.

3. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 1

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

Theme 1: System Strength, Stability and Oscillatory Interactions in Converter Dominated Power Systems.

- There were 6 questions associated with this theme.
- There were 35 papers submitted in response to this theme.

Theme 2: Modelling and Advanced Simulation Methods.

- There were 5 questions associated with this theme.
- There were 28 papers submitted in response to this theme.

Theme 3: Grid Forming and Grid Enhancing Technologies for Stability and Resilience.

- There were 5 questions associated with this theme.
- There were 17 papers submitted in response to this theme.

Key points:

- Traditional SCR metric remains useful for screening, but frequency-domain methods are becoming practical stability-screening tools. Standardization and cross-tool benchmarking are still needed.
- EMT analysis is becoming essential for many emerging interactions, but it must complement rather than replace phasor-domain studies and be supported by validated, interoperable models.

- Grid-forming can provide system strength, damping, voltage and frequency support, but value depends strongly on controls, location, system conditions, and the specific capabilities required.
- Post-commissioning events measurements are increasingly critical for revealing model and control deficiencies and for validating the performance assumed in planning and compliance studies.

4. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 2

Summary: PS2 - Power Quality (PQ) and Electromagnetic Compatibility/Interference (EMC/EMI) aspects of de-carbonisation of power systems and the road to net-zero.

Theme 1: Modelling and simulation for assessment of PQ and EMC phenomena and mitigation strategies in meshed transmission systems.

- There were 3 questions associated with this theme.
- There were 12 papers submitted in response to this theme.

Theme 2: Experiences with PQ issues in IBR-dominated systems and advanced data analytics, including allocation and compliance.

- There were 3 questions associated with this theme.
- There were 12 papers submitted in response to this theme.

Theme 3: Experiences with EMI for large inverter-based generators and loads and interference between the power system (AC or DC) and pipelines and telecom systems.

- There was 1 question associated with this theme.
- There were 6 papers submitted in response to this theme.

Key points:

- Uncertainties in system development and fixed assumptions are big challenges.
- No universal approach in harmonic analysis, alternatives are proven useful.
- Limit breaches in RVC do not translate into immediate complaints.
- Harmonics still dominate PQ, but we are seeing other issues on flicker side.
- Measurements are becoming increasingly important (as part of assessments, model verification and compliance checks).
- More pragmatic approaches are being investigated (consideration of scenarios).
- EMI issues are observed with clear industry gaps in HVDC related projects.

5. CONTRIBUTIONS TO PREFERENTIAL SUBJECT 3

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

Theme 1: Modelling and simulation for assessment of PQ and EMC phenomena and mitigation strategies in meshed transmission systems.

- There were 2 questions associated with this theme.
- There were 7 papers submitted in response to this theme.

Theme 2: Experiences with PQ issues in IBR-dominated systems and advanced data analytics, including allocation and compliance.

- There was 1 question associated with this theme.
- There were 8 papers submitted in response to this theme.

Theme 3: Experiences with EMI for large inverter-based generators and loads and interference between the power system (AC or DC) and pipelines and telecom systems.

- There were 2 questions associated with this theme.
- There were 9 papers submitted in response to this theme.

Key points:

- HVDC/offshore/hybrid transients require converter blocking and strategic arrester placement.
- Modern LLS technologies achieve ~40 m location accuracy estimating charge, peak current, and steepness.
- Deep learning with sample balancing identifies faults at >96 % accuracy.
- Grounding using statistical resistivity provides better safety analysis.
- Dynamic risk frameworks incorporate wind effects and improved pollution maps.

6. CONCLUSION

A total of 126 papers, 74 prepared contributions, one invited contribution, one NGN contribution and 4 spontaneous contributions provided many interesting ideas and stimulated useful discussions. The session was of interest to all participants from a technical viewpoint.

The key takeaways from the Study Committee C4 GDM were:

- The **energy transition** is increasing system complexity and challenging established engineering practices.
- The rapid growth of both **inverter-based resources and inverter-based loads** is changing system behaviour, creating new challenges related to stability, system strength, power quality, electromagnetic compatibility and transient performance.
- **Advanced modelling, simulation and analytical tools** are becoming indispensable for planning, design and operation of future power systems.
- **Measurement-based validation** is increasingly essential to ensure confidence in models, studies and compliance assessments.
- **Emerging technologies, including grid-forming converters, advanced monitoring systems and AI-enabled applications**, offer significant opportunities to enhance system performance and resilience.
- **Collaboration and knowledge sharing** remain critical to successfully delivering the transition to net-zero power systems.