



TECHNICAL COMMITTEE REPORT

2025

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1 Introduction

This report summarises CIGRE UK Technical Committee (UK TC) related work conducted over 2025 and its intended recipients are the CIGRE UK members.

The report provides information on the structure of CIGRE UK TC, updated information from the lead areas within the remit of CIGRE UK TC, i.e. Technical Panels, Technical Events, Liaison activities and Session Papers. Since the concept for CIGRE UK for Technical Panels was introduced a few years ago, progress has been made in establishing a number of panels. Information with respect to the composition of these are given in the individual SC RM reports sections.

The main content of this report is the updates from each of Regular Members (RMs) representing UK in the international Study Committees.

CIGRE UK TC has a dedicated website and KMS webpage and relevant information relating to TC work is uploaded onto the KMS site. CIGRE UK membership can request access to the public parts of the KMS in order to keep informed on aspects of various TC works.

2 CIGRE UK Technical Committee

CIGRE UK Technical Committee mirrors the international CIGRE Technical Council with the specific aim of serving the technical requirements of CIGRE UK. In doing so CIGRE UK TC aims:

- 1 to be the technical thought leader for the UK electricity supply industry
- 2 to support the active participation in and access into the critical technical working groups of CIGRE,
- 3 to provide a staircase of new talent into technical study committees and working groups as the core of future expertise for the UK electricity supply industry,
- 4 to leverage overall CIGRE organization by providing greater depth of technical knowledge from the UK electrical supply industry.

CIGRE UK TC works towards the achievement of the above objectives by:

- 1 providing leadership in the practical development of the UK transmission and distribution networks,
- 2 ensuring CIGRE technical activities reflect the issues of interest/concern to UK,
- 3 establishing closer links between UK Regular Members and all UK members using adopted communication techniques in the form of Technical Panels,
- 4 establishing responsibilities expected from UK Regular Members in terms of representing the UK,
- 5 introducing review and selection process/methods for UK papers to maximize the number and quality of papers accepted by CIGRE Technical Council,
- 6 ensuring UK Regular Members gain clear view of technical topics of interest/concern to UK members,
- 7 promoting exchange of technical information to all UK members without commercial constraints.
- 8 promoting joint activities across TPs/SCs, providing further support to the TPs/SCs with smaller UK members/communities.

2.1 CIGRE UK TC Structure

CIGRE UK TC is structured as shown in Figure 1. Roles and responsibilities attached to each position can be found on CIGRE UK TC KMS webpage (<https://cigregrroups.org/x/EAX6>). In addition to the assigned roles the UK TC invites CIGRE UK Chair and Vice Chair as well as the NGN and Women’s Network representatives to the UK TC meetings. CIGRE UK TC normally meets 4 times annually and teleconference in the meantime as necessary.

In the past year, Cheng Chen joined as the Technical Council Rep and led on the Whole Energy System development. In this role, Cheng champions a whole system approach, exploring how CIGRE’s technical work, structure, and methods can be better aligned to this vital concept—and how we can connect our activities more strongly to the dynamic, evolving UK energy landscape. Cheng brings deep expertise and high regard within the industry. As Head of Offline Modelling at the National Energy Systems Operator (NESO), his leadership has already delivered powerful contributions to strategic network design and net-zero innovation.

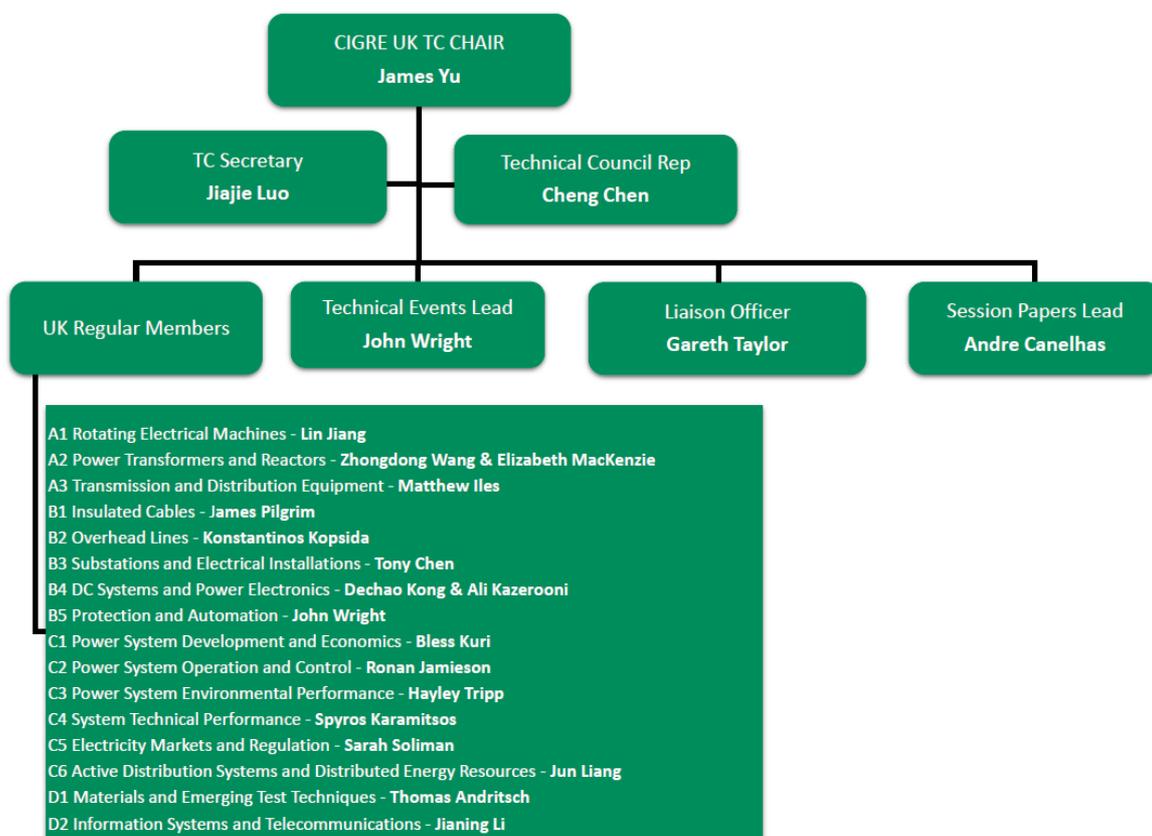


Figure 1: CIGRE UK TC structure

2.2 CIGRE UK Regular Members

The following table shows the current UK RMs serving in Study Committees along with their contact details. An introduction of RMs can be found on the CIGRE UK website: [CIGRE UK Technical Committee - CIGRE-UK](#)

Study Committee	Regular Member/Additional Regular Member	Email
A1	Lin Jiang	ljiang@liverpool.ac.uk
A2	Zhongdong Wang	zhongdong.wang@manchester.ac.uk
A2	Elizabeth Mackenzie	elizabeth.a.mackenzie@btinternet.com
A3	Matthew Iles	matthew.iles@nationalgrid.com
B1	James Pilgrim	japil@orsted.co.uk
B2	Konstantinos Kopsida	K.Kopsidas@manchester.ac.uk
B3	Tony Chen	lujia.chen@manchester.ac.uk
B4	Dechao Kong	Dechao.Kong.DIPS120@said.oxford.edu
B4	Ali Kazerooni	ali.kazerooni@gmail.com
B5	John Wright	john.w.wright@ge.com
C1	Bless Kuri	bless.kuri@sse.com
C2	Ronan Jamieson	ronan_jam@hotmail.com
C3	Hayley Tripp	Hayley.Tripp@nationalgrid.com
C4	Spyros Karamitsos	spyros.karamitsos@ieee.org
C5	Sarah Soliman	sarah.soliman54@gmail.com
C6	Jun Liang	liangj1@cardiff.ac.uk
D1	Thomas Andritsch	t.andritsch@soton.ac.uk
D2	Jianing Li	jianing.li@wsp.com

3 CIGRE-UK Technical Events

3.1 Introduction

CIGRE-UK has organised Technical Liaison Meetings, webinars, and many other events in this year. The active support of RM's, NGN and the wider CIGRE community has been greatly appreciated. For more details, please visit the CIGRE UK website, and follow the CIGRE UK LinkedIn account.

CIGRE UK Website:

<https://cigre.org.uk/category/events/>

LinkedIn:

<https://www.linkedin.com/company/cigre-uk/posts/?feedView=all>

3.2 Event Highlight and Summary

A large number of excellent events have been organised this year, and the below table gives a summary.

Date	Event/Meeting/Webinar	Type	Organiser/Presenter
15th & 16th January	A3/B3 Technical Liaison Meeting	In-Person	Tony Chen/Matthew Iles
21st January	C4 Technical Liaison Meeting	Hybrid	Spyros Karamitsos/Sofia Koukoura
22nd January	Monthly Technical Webinar	Online	Keith Bell & Simon Gill/University of Strathclyde
19th February	Monthly Technical Webinar	Online	WiE: Dr Avinash Aithal & Nicolas Manea
19th March	Monthly Technical Webinar	Online	Sabrina Mercer/Siemens Energy
3rd April	C1 Technical Liaison Meeting	In-Person	Bless Kuri/Mark Kent
23rd April	Monthly Technical Webinar	Online	NGN: Mehdi Ghazavi Dozien/Monash University
16th May	B4 Technical Liaison Meeting	In-person	Dechao Kong
28th May	Monthly Technical Webinar	Online	Vjay Shinde/Siemens Energy
13th June	CIGRE UK One Day Conference	In-person	Charlotte Higgins - ARUP
18th June	Joint Event with IEEE PEL	Hybrid	Jun Liang/Cardiff University
19th June	Knowledge Exchange/ HVDC UK & China/UoB Summer School	Meeting	Prof. Zhang/UoB Summer School
25th June	Monthly Technical Webinar	Online	Eli Kling/Avande
25th July	Monthly Technical Webinar	Online	NGN Belgium/NGN UK
24th September	Monthly Technical Webinar	Online	Muhammad Shaban - National Grid
25th September	Joint Event with UoW SuperAIRE	Workshop	Cheng Chen
7th October	Visits to Blackhillock & Keith Substations	Visit	Bless Kuri
15th October	B1/D1 Technical Liaison Meeting	Hybrid	James Pilgrim/Thomas Andritsch

29th October	Monthly Technical Webinar	Online	Asmus Graumann Moser - Orsted
31st October	University of Manchester Hub: Inaugural event.	In-Person	Maria-Irina Oancea/Tee Shengji
19th November	A2 Technical Liaison Meeting	In-Person	Zhongdong Wang/Elizabeth Mackenzie
19th November	AGMs & Awards Dinner	In-Person	John Finn/Martin Ansell
20th November	Technical Conference	In-Person	James Yu
26th November	Monthly Technical Webinar	Online	Giovanni De Carne - Karlsruher Institut für Technologie (KIT)
5th December	Joint B5/D2 Technical Liaison Meeting	In-Person	Jianing Li/John Wright
17th December	Monthly Technical Webinar	Online	Xiaoming Li/Duncan Hughes - Zenobe

4 CIGRE-UK Technical Panels

More information on the UK Technical Panels is available on individual Regular Member reports of this document.

5 CIGRE Working Groups

There are approximately 320 CIGRE Working Groups (WG) managed by the Study Committees. Every year between 40 and 50 WGs terminate their work by publishing a Report or a Technical Brochure, after the review and approval of their Study Committees. The Technical Council approves every year almost the same number of new WGs with new Terms of Reference (TOR) proposed by the Study Committees.

CIGRE Working Groups approved in 2025

- [TOR WG D2.68](#) Enhancing access management cybersecurity in power utilities
- [TOR JWG B4 B1.106](#) Guideline of VSC HVDC Converter and DC Cable Interface Management
- [TOR WG B1.100](#) Recommendations for qualification procedures of Metallic Return cable (HVDC systems)
- [TOR WG B1.99](#) Evaluation of sustainable power cables system and their installation
- [TOR WG B1.101](#) Recommendations for testing of DC superconducting cable systems
- [TOR WG D1.83](#) Optical spectral sensing technologies for partial discharge (PD) and arc detection in gas-insulated equipment
- [TOR JWG D1 A2.84](#) Silver corrosion in power transformers
- [TOR WG B3.71](#) Substations Improvements to Support Network Black Start Capability
- [TOR WG A2.81](#) Guide for power transformer design review
- [TOR WG D2.67](#) Power embodied intelligence technology and application
- [TOR JWG A3 A2 B3 B4 C4.53](#) Inductive load switching in transmission and distribution systems
- [TOR WG B5.89](#) Protection Redundancy and Backup for Modern Power Systems
- [TOR JWG C4 A3.79](#) Temporary overvoltage protection technologies for high-voltage transmission systems with large-scale renewable energy bases
- [TOR JWG C4 B1 B2 B4.78](#) Interference effects between HVDC circuits and nearby metallic infrastructure
- [TOR WG B3.72](#) Integration of asset information in modern substations for (asset) management of substation equipment
- [TOR WG C6.48](#) DER's integration in Distribution Systems Operation and Control
- [TOR WG C6.49](#) Virtual power plant (VPP) aggregation of distributed energy resources (DER)
- [TOR-JWG C1 D2.56](#) Electrical cyber integration to meet net zero goal by support of cloud infrastructure
- [TOR-WG B3.70](#) Guidelines for the use of advanced technologies for information and knowledge management in substations
- [TOR-JWG C6 C1 CIRED.50](#) Planning distribution networks under significant uncertainties
- [TOR-WG B3.73](#) Asset management and digital integration of mobile substations for a resilient and flexible transmission grid
- [TOR-JWG C1.55](#) A benchmarking survey on the use of asset investment planning practices and systems by utilities
- [TOR-WG A1.78](#) Guide for the application of electrical and current signature analysis of electric motors generators and powertrain
- [TOR-WG A2.80](#) Guide to Transformer Supplier Qualification and Development

- [TOR-JWG C2 C4.47](#) Wide Area Operational Security Systems to enable the Energy Transition
- [TOR-JWG C5 C1.43](#) Approaches to account for the contribution of short-duration electric storage systems in capacity adequacy assessment
- [TOR-JWG A2 C3.79](#) Power Transformers and Reactors Sound Levels On Site
- [TOR-WG D2.66](#) Low Voltage Power Line Carrier Communications Application
- [TOR-WG D2.65](#) Optical Transport Communication Networks for Electric Power Utilities
- [TOR-WG A2.78](#) Bushing Diagnostics Off-Line Testing and On-Line Monitoring Systems
- [TOR-WG B2.96](#) Composite Insulated Cross-arms for New-build and Retrofitted Transmission Line Supports
- [TOR-WG D2.64](#) Application of AI in Cybersecurity Defence of Power Systems
- [TOR-WG C5.42](#) Market pricing issues and solutions for low short-run marginal-cost systems
- [TOR-WG B3.69](#) Process Requirements for Commissioning and Inspection of Air Insulated Substations (AIS) and Gas Insulated Substations (GIS)
- [TOR-JWG A3 D2.52](#) Application of Digital Twin in Switchgear
- [TOR-WG B5.87](#) Digital Transformation of Protection, Automation and Control Systems expanding the Application of IEC 61850
- [TOR-WG C5.41](#) Regulation and market design to foster decarbonation through industry electrification
- [TOR-WG B5.88](#) Implementation Guide for fully digital IEC 61850-based Protection, Automation and Control Systems
- [TOR-WG D2.63](#) Inter-Control Center Communications Protocol (ICCP) Security and Resilience for Grid Reliability
- [TOR-WG D2.62](#) Efficient spectrum allocation and utilisation for electric power industry private communication networks
- [TOR-JWG A2 C4 D1.77](#) Design of transformers for very fast transient overvoltages

6 RM Report on SC A1 Rotating Electrical Machines

Comment from Secretary: A1 RM has not provided a SC report for 2025. A copy of the A1 report for 2024 is provided here to give readers some information about the SC.

6.1 Study Committee Scope

SC Chair: Howard SEDDING
 SC Secretary: P. WIEHE

In 2024, the SC changed its name from “Rotating Electrical Machines” to “Power generation and electromechanical energy conversion” to better serve the evolving landscape driven by the energy transition.

The SC covers the full equipment lifecycle, from research, development, design, manufacture, and testing of power generation and electromechanical energy conversion equipment and their associated auxiliaries to commissioning, operation, condition assessment, maintenance, life extension, refurbishment, upgrades, efficiency improvement, conversion (e.g., from power generation duty to synchronous condenser/compensator duty), storage, and de-commissioning.

Within these fields, SCA1 promotes the international exchange of information, knowledge, practice, and experience and adds value by synthesizing state-of-the-art practices to develop guidelines and recommendations.

6.2 SC-A1 Advisory Groups

- AG A1.01: Turbogenerators
- AG A1.02: Hydro-Generators
- AG A1.05: Wind Generators and New Technologies
- AG A1.06: Large and High-Efficiency Motors
- Details of the Advisory Group Coordinators:

Advisory Group		Convener	
No	Name	Name	email address
AG01	Turbogenerators	Monique Krieg (Netherlands)	m.g.krieg@eic-highenergy.com
AG02	Hydro-Generators	Johnny Rocha (Brazil)	johnny.rocha1959@gmail.com
AG05	Wind Generators and New Technologies	Luis Rouco (Spain)	rouco@comillas.edu
AG06	Large and High Efficiency Motors	Erlí Figueriedo (Brazil)	erliff@uol.com.br

6.3 2024 Preferential Subjects

For the 2024 Group Discussion Session, three preferential subjects were proposed to stimulate discussion considering the strategic directions.

- PS1 - Rotating Electrical Machines and the Energy Transition

- PS2 - Evolution and Development
- PS3 - Keeping the Lights On

A total of 29 papers have been accepted and published.

a) Preferential Subject 1: Rotating Electrical Machines and the Energy Transition

The preferential subject covers:

- Impact of the energy transition on the role, duty, and flexible operation of rotating electrical machines,
- Changing requirements on rotating machines to support the evolution of smart grids,
- Update of international standards for electrical machine requirements to reflect future applications.

Nine papers were accepted under PS1.

b) Preferential Subject 2: Evolution and Development

The preferential subject covers:

- Developments in the design of generators for new applications such as wind turbines, synchronous compensators, and variable speed pump storage,
- Improvements in design, manufacture, efficiency, insulation, cooling, bearings, and materials,
- Enhancements in the performance, reliability, and control of rotating electrical machines,
- Design evolution of rotating electrical machines based on operational experience

c) Preferential Subject 3: Keeping the Lights On

The preferential subject covers:

- Condition monitoring, diagnosis, and prognosis of rotating electrical machines, including the use of artificial intelligence, deep learning techniques and digital twin concepts,
- Ensuring power supply reliability by asset management of installed base and maintenance practices,
- Improving performance and extending the operational service life of installed base through refurbishment, replacement, and power up-rating, and methodologies to establish the sequence of machines to be refurbished/replaced.

6.4 Technical Panel Meetings, Seminars &Tutorials

Two SC A1 Tutorials were given in the Paris Session on Tuesday morning, 27th of August 2024.

1. “Survey of Partial Discharge Monitoring in Large Rotating Machines”.

This tutorial presents the highlights from the survey carried out by WG A1.63 on discharge monitoring of large motors and was presented by Andre T. Carvalho (Brazil).

2. “Challenges in designing salient pole synchronous condensers equipped with negative excitation systems”.

Due to the challenges resulting from the energy transition, synchronous compensators/condensers are widely used in many countries to support grid power quality and operational performance. This tutorial explains their design principles, how their operation differs from traditional machines used for power generation and design challenges. It will also give an example of how negative excitation can be used to extend the MVAR capability. Johnny Rocha (Brazil) presented the tutorial.

6.5 Current Working Group Status (March 2024) and UK member (Bold)

WG Nr.	ADVISOR Y GROUP	WG TITLE	CONVENOR	STATUS
A1.42	AG-02	Influence of key requirements to optimize the value of hydro generators	Eduardo Guerra	TB prepared. Final check before review under 6-week rule.
A1.43	AG-02	State of the art of rotor temperature measurement	Stjepan Tvoric	The work is complete and reviewed; a report will be published in 2024.
A1.45	AG-06	Guide for Determining the Health Index of Large Electric Motors	Dr Zhang Pinjia	The responses to the distributed questionnaire have been insufficient so far to complete the work. The SC will assess how to continue with this working group.
A1-C4.52	AG-05	Wind generators and frequency-active power control of power systems	Nick Miller	TB in preparation.
A1.53	AG-06	Guide on Design Requirements of Motors for Variable Speed Drive Application	AK Gupta	Needs revision following 6-week rule feedback. Work to be reallocated as Mr. Gupta has retired.

A1.55	AG-02	Survey on Split Core Stators	Sun Yutian	Draft report available. Will be rechecked before submitting for review under the 6-week rule.
A1.56	AG-02	Survey on Lap and Wave Winding and their Consequences on Maintenance and Performance	Richard Perers	TB prepared. Final check before review under 6-week rule.
A1.58	AG-06	Selection of Copper Versus Aluminium Rotors for Induction Motors	Fredemar Rüncos	TB prepared. To be circulated for review under the 6-week rule.
A1.60	AG-02	Guide on economic evaluation for refurbishment or replacement decisions on hydro generators	Mark Bruintjies	Questionnaire responses are being analysed.
A1.61	AG-06	Survey of Partial Discharge Monitoring in Large Motors	André Tomaz de Carvalho	TB in preparation.
A1.62	AG-02	Thrust Bearings for Hydropower - A Survey of Known Problems and Root Causes	Daniel Langmayr	Limited responses were received from the questionnaire making it difficult to compile a globally representative report. The SC will review how to conclude this working group.
A1.63	AG-01	Turbo Generator Stator Winding Bushings and Lead Connections – Field Experience, Failures and Design Improvements	Jabulani Bembe	Questionnaire responses are being analysed.
A1.64	AG-06	Guide for Evaluating the Repair / Replacement of Standard Efficiency Motors	Erli Ferreira Figueiredo	Report in preparation.
A1.67	AG-02	State of the Art in methods, experience and limits in end winding corona testing for Hydro Generators	(Hélio de Paiva Amorim Junior)	New convenor required.
A1.69	AG-02	Hydro-Generator Excitation Current Anomalies	J. Johnny Rocha E.	Team assembled.
A1.70	AG-01	Dielectric Dissipation Factor Measurements on Stator Windings	Monique Krieg-Wezelenburg	To be issued in several parts due to volume of content. > TB 918 “DDF Measurements on Stator Windings – Part 1

				<p>Survey Answers” issued.</p> <ul style="list-style-type: none"> > Part 2 in progress. > > UK Member > Richard Ludlow (member) > Ian Simmonds (member)
A1.71	AG-02	Survey on damper-winding Concepts and its operational experience on hydro generators and motor-generators	Thomas Hildinger	Questionnaire is being prepared.
A1.72	AG-02	Survey on multi-turn coils with dedicated turn insulation versus coils without dedicated turn insulation	Yoon Duk Seol	Questionnaire is being prepared.
A1.73	AG-02	Customer Requirements for Qualification of Form Wound Stator Insulation Systems for Hydro Generators	Dr. Marcelo Jacob da Silva	Questionnaire completed and circulated on 13 March 2024.
A1.74	AG-06	Evaluating quality of electric motors (previously WG A1.68)	Kondra Nagesh	Questionnaire being prepared. Need to review WG status & schedule.
A1.75	AG-01	Large air-cooled turbo-generator – state of the art, limits and perspectives for Small Modular Reactors	Vincent Fernagut	Questionnaire is being prepared
A1.76	AG-01	Study on Eco-Design, Circular economy and impacts on generator production process	Raül Morales Garcia	Questionnaire is being prepared
A1.77	AG-06	Survey on Insulation Reliability of Induction and Synchronous Motors	Fernando Spezia	Planning of work. Need more WG members. Request for WG members to be recirculated.

7 RM Report on SC A2 Transformers

7.1 Study Committee Scope

SC Chair: Pascal Müller

SC Secretary: Mark Foata

From August 2026:

SC Chair: Prof. Stefan Tenbohlen

SC Secretary: Tara-Lee McArthur

7.2 Mission

Within its technical field of activity, Study Committee A2 addresses topics throughout the asset management life-cycle phases of power transformers and reactors; from conception, through research, development, design, production, deployment, operation, and end-of life.

Technical, safety, economic, environmental and social aspects are addressed at all life stages, as well as interactions with, and integration into, the evolving power system and the environment. All aspects of performance, specification, testing are within scope, with a specific focus on the impact of changing interactions and demands due to evolution of the power system.

Life cycle assessment techniques, risk management techniques, education and training are also important aspects.

UK representation on the committee is Prof. Zhongdong Wang (RM) and Elizabeth MacKenzie (ARM). They will be succeeded by Jonathan Walmsley (GE Vernova) as RM and Tee Shengji (SPEN) as ARM in August 2026.

7.3 Strategic Advisory Groups

AG 2.1 Strategic – Pascal Mueller;

AG 2.2 Knowledge Transfer – Tara-Lee McArthur;

AG 2.3 Transformer Technology – Khayakazi Dioka;

New joint advisory group

AG 2.4 Utilisation/operation – Ralf Schneider;

AG 2.7 Transformer Digitalisation – Patrick Picher;

AG 2.6 Green Book – Dormant;

AG 2.8 Lower Voltage Applications – Peter Werle.

7.4 Preferential Subjects

The Preferential Subjects for 2026 Paris Session are:

PS 1: Major challenges to the Power transformer industry

PS 2: Power Transformer Digitalization Journey

PS 3: Failure prevention, detection and investigation

7.5 New Working Groups

A2.75	Tap Changer Specification, Condition Assessment, Testing and Maintenance Guidelines	Sidwell MTETWA (ZA)
A2.76	Power transformer passive protection against internal arcing faults	Jean-Bernard DASTOUS (CA)
A2.78	Bushing Diagnostics Off-Line Testing and On-Line Monitoring Systems	Poorvi PATEL (US)
A2.80	Guide to Transformer Supplier Qualification and Development	Simon RYDER (UK)
A2.81	Guide for power transformer design review	Werner BOONEN (NL)
A2/C3.79	Power Transformers and Reactors Sound Levels On Site	Janine DICKINSON (UK)
A2/C4/D1.77	Design of transformers for very fast transient overvoltages	Bruno JURISIC (HR)
Task Force	Explore how Differences Internationally in Regulation, Society Expectations and Government Policies Impact the Replacement Age of Power Transformers	Dan MARTIN (AU)

7.6 Technical Panel Meetings, Seminars & Tutorials

The last technical panel and liaison meetings was held on 27th-28th November 2024 at the University of Manchester, with one day for the liaison meeting and technical panel meeting, and one day for a transformer research dissemination meeting. 52 people registered for the liaison meeting.

The University of Manchester hosted a presentation competition co-organised by CIGRE UK Study Committee A2 and the NGN. 33 people from both academia and industry attended and listened to 12 engaging presentations on power transformer-related topics. The presentations were delivered by research students from the University of Manchester and industry professionals from companies such as SPEN, SSE, GE Vernova, IST Power and Doble. The presentation winners were: Hang Xu, IST Power – GOLD; Zhengbo Xu, the University of Manchester – SILVER; Alex Campbell, SPEN – BRONZE. The organising committee would like to extend thank you to the judges: Elizabeth Mackenzie, Shanika Matharage and Jonathan Walmsley. The competition was followed by a networking lunch and a visit to the University of Manchester High Voltage Laboratory, the biggest of its kind in the UK.

7.7 Technical Brochures published in 2024-5

Four technical brochures have been published recently, and five papers in CIGRE Science and Engineering and Future Connection and Electra

Technical Brochures published since the last SC Meeting in Paris

WG	Brochure	Convenor	Publication
A2.54	TB940 Power Transformer Audible Sound Requirements	Christoph PLOETNER	September 2024
A2.57	TB944 Effect of DC Bias on Power Transformers	Dejan SOUSA	November 2024
A2.69	TB962 Guide for Transformer Maintenance	Claude RAJOTTE	May 2025
A2.56	TB971 Transformer Efficiency	Zarko JANIC	September 2025

7.8 CIGRE Science and Engineering (CSE)

38th Edition, October 2025: Silver Corrosion in Liquid-Filled Transformers (A2 Task Force)

38th Edition, October 2025: Engineering the Future: Optimizing Power Transformer Performance in Renewable-Powered Grids (Dan MARTIN)

36th Edition, February 2025: On-site GIC withstand experiment on a 1000 MVA 3-limb autotransformer and a 300 MVA 5-limb transformer (Statnett, Hitachi)

35th Edition, December 2024: Analysis of non-accelerated thermal aging of model windings immersed in mineral oil and natural ester (Diego ROBALINO, Matias MEIRA, Raul ALVAREZ, Fabio SCATIGGIO)

7.9 Future Connection and Electra

May release: Future proofing transformer tanks: Why passive protection against internal arc should be studied, by A2 task Force (convenor Jean-Bernard Dastous)

7.10 Current Working Groups and UK Members

WG	Title	UK Member	Organisation
A2.58	Installation and Pre-Commissioning of Transformers and Shunt Reactors	John Lapworth Ian Hunter	Doble Polaris
A2.59	On-Site Assembly, On-Site Rebuild, and On-Site High Voltage Testing of Power Transformers	Simon Ryder	Doble
A2.60	Dynamic Thermal Behaviour of Transformers	Muhammad Daghrah Jose Quintana Xiang Zhang	M&I Materials SPEN MMU
A2.63	Transformer Impulse Testing	Qiang Liu	Manchester Univ.
A2/D2.6 5	Transformer Digital Twin – concept and future perspectives	Zhongdong Wang Tim Zhao	Manchester Univ.
A2/D1.6 6	Breathing systems of liquid filled transformers and reactors	Russel Martin	M&I Materials
A2/D1.6 7	Guideline for Online Dissolved Gas Analysis Monitoring	Michelle Fiddis Shuhang Shen	GE Exeter Univ.
A2.68	Failure Survey of Lower Voltage Generator Step Up Transformers installed in Wind farms and Photovoltaic Parks	Elizabeth MacKenzie Denis Nesbitt Florian Marpoux Muhammed Dagrah	Consultant Doble EdF M&I
D1/A2.7 7	Liquid tests for Electrical Equipment	Atitila Gyore Qiang Liu Russel Martin David Walker Gordon Wilson	M&I Materials Man Univ. M&I Materials SPEN NGET
A2/C3.7 0	Life Cycle Assessment (LCA) of Transformers	Hang Xu	Man Univ.
A2/D1.7 1	Modern insulating liquids qualification for OLTC, bushings and other accessories	None	
A2/D1.7 2	Retrofill of mineral oil in transformers – Motivations, considerations and guidance	Paul Dyer Caleb Walker Attila Gyore	UKPN SPEN Shell
A2.73	Enhancing the exchange of transformer information through digitalization	Zhongdong Wang	Univ of Manchester

A2.75	Tap Changer Specification, Condition Assessment, Testing and Maintenance Guidelines	Matthew Kayes	ENWL
A2.76	Power transformer passive protection against internal arcing faults	Haonan Yang	Univ of Manchester
A2/C4/D1.77	Design of transformers for very fast transient overvoltages	Zhongdong Wang	Univ of Manchester
A2.78	Bushing Diagnostics Off-Line Testing and On-Line Monitoring Systems	New	
D1/A2.79	Improved understanding of dynamic behaviour of winding insulating materials in liquid insulated power transformers	UK rep are recommended through D1	
A2/C3.80	Guide to transformer supplier qualification and development	Simon Ryder (Convenor) Jose Quintana (Secretary) Aasim Chaudhry	Doble SPEN SPEN
D1/A2.80	Functional properties of non-metallic solid materials for liquid filled transformers and reactors and their compatibility with insulating liquids	UK rep are recommended through D1	
D1_A2.84	Silver corrosion in power transformers	UK rep are recommended through D1	
A2.81	Guide for Power Transformer Design Review	Fabiano Nicolaus Caleb Walker Rafal Zaleski	GE Vernova SPEN Doble

Due to considerable interest from UK members, A2 has also set up UK mirror groups for JWG A2/C3.70, Life Cycle Assessment (LCA) of Transformers and A2/C3.80, Guide to transformer supplier qualification and development. These groups will shadow the working groups, with the UK WG member liaising between the WG and the mirror group.

7.11 Working Group Updates

WG A2.54 Power Transformers Audible Sound Requirements

The aim of the WG was to provide a clear, simple way for users to understand typical sound levels for transformers of different rated power and to provide best practice guidance on how to specify sound levels for new transformer purchases. Data was collected from the FATs of >1000 transformers from 12 manufacturers around the world and a set of graphs were produced for no load, load and cooling system sound, which can be used for specification purposes. The WG had 24 members from 14 countries comprising mainly transformer manufacturers and utilities. A tutorial was given at the CIGRE colloquium in Split in 2023 and the brochure, TB940 was subsequently published in September 2024.

WG A2.57 Effects of DC Bias on Power Transformers

The working group explores how DC bias, especially from geomagnetic disturbances or HVDC systems, can influence transformer performance, ageing, and failure modes. Work completed and brochure TB944 was published in November 2024. The brochure is structured into eight chapters: Sources of DC bias; Effects on transformers; Thermal modelling; DC testing setups; Transformer modelling in system studies; Design considerations; Monitoring and mitigation; Accessories and ancillary equipment.

WG A2.60 Dynamic Thermal Behaviour of Power Transformers

The WG focuses on reviewing and improving Dynamic Transformer Thermal Modelling (DTTM), particularly enhancing the IEC standard model with considerations for cooling systems, new insulating liquids, and sub-zero temperatures. The group has made significant progress, notably developing and publishing the DTTM Benchmarking Platform (DTTM-BP). The working group consists of 4 task forces: TF1 on underlying physics and dynamic thermal phenomena; TF2 on DTTM modelling and literature review; TF3 on benchmarking of DTTMs; TF4 on applications of DTTMs. The Technical Brochure is approximately 80-90% complete. Currently, the group is focusing on finalising task force 1, 2 and 4, expanding the Transformer Thermal Scenario database and integrating proprietary DTTMs into the benchmarking platform. The WG is expected to deliver the Technical Brochure in September 2026.

WG A2.63 Transformer Impulse Testing

The working group aims to review existing practice and potential issues related to transformer impulse testing. Three task forces were formed, including: TF1 - High Frequency Power System Transients; TF2 - Power Transformer Testing, Test Equipment and Techniques; TF3 - Transformer Transient Simulations. The working group is towards the end, where three draft brochures, one each TF, have been prepared and undergoing review within the working group. A follow-up working group was suggested, which has just been launched (TOR-JWG A2_C4_D1.77_Design of transformers for very fast transient overvoltages).

JWG A2|D2.65 Transformer Digital Twin – Concept and Future Perspectives

The purpose of the WG is to study the digital twin concept when applied to transformers and discuss the perspectives for future developments. After 3 years, the WG has completed the literature review on digital twins and supporting digitalisation technologies applied to transformers, identified the physics-based and data-based modelling techniques, conducted a survey on industrial use cases, priorities and benefits. A few papers were published in CIGRE colloquium 2023 and CIGRE symposium 2025. The draft technical brochure is nearly completed and the WG is due to end in Q1/2026.

JWG A2|D1.66 Breathing systems of liquid filled transformers and reactors

The aim is to investigate the ability of breather and sealed expansion systems to control the oxygen and water content over the transformer lifetime, report on likely influence of the systems on transformer operation, recommend when and how to use, as well as how to monitor and maintain these systems. Separation of group into task-forces dealing with specific aspects is still efficient. Assessment of survey data started. Due to low response rate, conclusions can be assumed but not statistically proven. It turns out that various aspects related to oil-properties are assessed in other WGs in more detail. The group agreed not to duplicate the content but use references instead. Thus, completion of content creation is slightly related to the progress in these WGs. Draft of TB (50%) is not yet ready to be published. Active phase of the JWG needs to be extended.

JWG A2|D1.67 Guideline for Online Dissolved Gas Analysis Monitoring

The purpose of this WG is to develop guidelines for the interpretation of dissolved gas analysis (DGA) results from online monitoring equipment, including acceptable limits and trends, alarm response strategies, system specification requirements, and maintenance procedures. The group will also provide practical examples of various use cases for online DGA systems. Although the outline of the Technical Brochure was previously drafted, progress in 2025 has been delayed. Nevertheless, several Task Forces have continued to meet, and corresponding chapters have been updated. Major progress has been achieved in the chapters of alarm response and maintenance. Within Task Force 3 (Alarm Response), discussions have led to the development of a gas priority table, preliminary recommended alarm thresholds for key gases, and a draft flowchart illustrating a guideline alarm response strategy. Within Task Force 5 (Maintenance), a comprehensive survey of 15 OEMs has been completed. The analysis summarises the different gas extraction and measurement technologies used in both fault detection and diagnostic monitors and provides a consolidated list of maintenance actions for various DGA technologies. In addition, more case studies have been gathered from utilities and published literature. The next steps include collecting and analysing user survey data, followed by the preparation of the final Technical Brochure.

WG A2.68 Failure Survey of Lower Voltage GSUs installed in Wind Farms & Photovoltaic Parks

The purpose of the WG is to validate by use of a survey whether or not there is a higher failure rate of windfarm and solar park transformer than the general population, and if there are common failure causes. There are regular, short online meetings with 1-2 in-person meetings each year. A simple survey has been produced. Data has been received, with more than 6,000 transformers in the database and data for 20,000 more that must be converted to the correct format to be added to the database. A basic statistical analysis has been carried out on the initial data, but the full analysis has still to be done. The technical brochure is about 60% complete. An interim Technical Brochure may be published with the technical background and initial results; this has still to be decided upon. The WG is due to end in Q1/2027.

WG A2.69 Guide for Transformer Maintenance

The purpose of the WG is to help transformer users to define and apply best practice for transformer maintenance. Work completed and Technical Brochure 962 published May 2025. Chapter 2 describes the different maintenance strategies (time-based, condition-based, monitoring, etc.) and presents a survey on maintenance practices. Chapter 3 describes the maintenance process. Chapter 4 describes how transformer specifications may affect maintenance requirements. Chapter 5 contains a repertoire of all possible maintenance actions, including condition assessment and condition improvement. Chapter 6 describes the particularities and challenges of major work on transformers.

JWG A2|C3.70 Life Cycle Assessment of Transformers

The purpose of the JWG is to evaluate the life cycle assessment (LCA) of transformers throughout their lifetime including material, design, manufacturing, operation and end-of-life stages. There have been five online meetings of the JWG and one in-person meeting in 2025. Additionally, three online meetings have been held with the UK mirror group. The structure of the technical brochure has been defined, agreed, and staffed. Data and case study collection are in progress. One paper has been submitted for the CIGRE SC A2 & D1 Joint Colloquium Seoul 2025. The JWG is due to end in 2026.

JWG A2|D1.72 Retrofill of Mineral Oil in Transformers

The purpose of the JWG is to investigate the feasibility of retrofilling mineral oil filled transformers with alternative liquids. There have been eight online meetings of this working group, and 4-5 online meetings in the task forces in 2024 and 2025. Four task forces formed about Motivation, Technical suitability of retrofilling, Liquid processing and Testing. The outline of the technical brochure has been drafted, with names allocated to chapters. The WG is due to end in Q3/2026.

JWG D1|A2.77 Liquid Tests for Electrical Equipment

The WG aims to review a wide range of testing parameters of transformer liquids. The group is organized as: Task Force 1 - Measurement Aspects; Task Force 2 - Data Handling and Categorisation, with Sub-Task Force 2-1 – Electrical Tests; Task Force 3 - Modelling and Case Studies. The working group is towards the end, where a draft brochure is nearly ready (about 90%). Round-robin tests of DGA Ostwald coefficients for various liquids were conducted. A transformer liquid data collection template was suggested. It also inspired the establishment of a new working group (A2.73 - Enhancing the exchange of transformer information through digitalization).

WG A2.80 Guide to Transformer Supplier Qualification & Development

The WG focuses on update to TB 530 to consider changes in user expectations and requirements arising from the Energy Transition, including the development of new design concepts, new manufacturing methods, new test methods, and increased expectations concerning environmental, health and safety management. The WG commenced in Q3 2025, with a scheduled end of Q3 2028. Early progress: Recruited 22 members so far. Strong participation from Europe and Asia-Pacific. Mirror group formed in the United Kingdom. Members have been reviewing and discussing existing brochure on this subject (530) and ISO 9001. Updates to existing CIGRE brochure (530) in progress. Plan to hold three meetings during 2026 – in March (Bruxelles), in August (Paris), and somewhere in the Asia-Pacific region (November).

7.12 UK Members of the Technical Panel

Name	Organisation	Role	WG
Zhongdong Wang	Manchester University	Chairman	65
Elizabeth MacKenzie	TCL	Vice-Chairman	68
Jose Quintana	SP Energy Networks	Secretary	60, 80
ShengJi Tee	SP Energy Networks	Events	
Paul Dyer	UK Power Networks	Member	
Steve Blanche	Hyosung	Member	
Wenhui Deng	SSE	Member	
Tom Breckenridge	TB TCS	Member	
Ian Hunter	Polaris	Member	
Qiang Liu	Manchester University	Member	63
Simon Ryder	Doble	Member	80
Ruth Hooton	National Grid	Member	
Andrew Reynolds	National Grid	Member	
David Walker	SP Energy Networks	Member	77
Dave Fishman	Btrac	Member	
Jonathan Walmsley	GE	Member	
Hari Maletapi	Wilson Power Solutions	Member	
Prakash Dahi	Brush Transformers	Member	
Partha Subramanian	Winder Power	Member	
Jim Butler	Rosh Engineering	Member	
Mike Munro	Polaris Diagnostics	WG Member	64
Kevin Wilson	Wilson Power Solutions	WG Member	
Dongsheng Guo	National Grid	WG Member	57
John Lapworth	Doble	WG Member	
Muhammad Daghrah	Midel & Mivolt Fluids	WG Member	60, 68
Stefan Dragostinov	Doble	WG Member	63
Sicheng Zhao	Manchester Power Solutions Ltd	WG Member	65
Janine Dickinson	National Grid	WG Member	54

Xiang Zhang	Manchester Met University	WG Member	60
Allan Holton	SP Energy Networks	WG Member	69
Michelle Fiddis	GE	WG Member	67
Shuhang Shen	Exeter University	WG Member	67
Florian Marpoux	EDF Renewables	WG Member	68
Dennis Nesbitt	Doble	WG Member	68
Hang Xu	Exeter University	WG Member	70
Steven Vallance	SP Energy Networks	WG Member	70
Caleb Walker	SP Energy Networks	WG Member	74
Jamie Beardsall	Drax Power	WG Member	65
Fraser Cook	Qualitrol DMS	WG Member	66
Russell Martin	Shell	WG Member	66
Attila Gyore	Shell	WG Member	72

8 RM Report on SC A3 Transmission and Distribution Equipment

8.1 Study Committee Scope

SC Chair: Nicola Gariboldi

SC Secretary: Frank Richter & Paolo Mazza

The scope of SC A3 covers all kinds of transmission and distribution equipment above 1kV, including:

- All kinds switching devices, including AC and DC at the MV, HV and UHV ranges;
- All kinds of instrument transformers, including non-conventional instrument transformers for AC and DC applications;
- Surge Arresters for AC and DC applications.
- Digitization and the implications of new and emerging technologies such as digital twins, machine learning, virtual and augmented reality and new substation functions.

The key activities of SC A3 address topics throughout all life-cycle phases; from conception, through research, development, design, production, deployment, operation, and end-of life.

At all stages the technical, safety, economic, environmental and social aspects are addressed as well as interactions with, and integration into, the evolving power system and the environment. Technical aspects such as performance, specification, testing and the application of testing techniques are covered as well as asset management topics such as life cycle assessment techniques, safety and risk management techniques, education and training. Some of the key topics include:

- Theory, principles and concepts, functionality, technological development, design, performance and application of materials, efficiency.
- Manufacturing, quality assurance, application guidance, planning, routing and location, construction, erection, installation.
- Reliability, availability, dependability, maintainability and maintenance, service, impacts of harmonics, condition monitoring, diagnostics, restoration, repair, loading, upgrading, uprating.
- Environmental considerations, both of the equipment impact on the environment and the natural environment (and its changes) impact on the equipment.
- Increasing asset intelligence or capability enhancement through intelligent or advanced control and protection, use of integrated sensors, interaction with future networks and the impact of increased distributed and renewable generation.
- Refurbishment, re-use/re-deployment, deterioration, dismantling, disposal.

UK representation on the committee is Matthew Iles (RM).

8.2 Strategic Advisory Groups

AG 3.01 strategic planning – Nicola Gariboldi;

AG 3.02 Utility Advisory board – Sophie Chablin;

AG 3.03 Green Book – Hiroki Ito;

Tutorial Special Reporters Webinars Advisory Group – René Smeets;

8.3 Preferential Subjects

The Preferential Subjects during the 2025 Montreal symposium were:

PS 1: System Enhancement, Markets and Regulation

PS 2: Application or Technologies, Information Technology (IT) and Artificial Intelligence (AI)

PS 3: Climate Change and Extreme Weather Events

In all 46 papers were accepted and presented, 6 of which were authored or co-authored by the UK.

The Preferential Subjects for the 2026 Paris session are:

PS1: Transformation of T&D assets for evolving grid conditions

- Innovative current limiting solutions for distribution & transmission networks
- Innovation in and field experience of T&D equipment to enhance system flexibility, resilience, stability and connectivity
- Application of T&D equipment in meshed DC-grids

PS2: Sustainability and circular economy of T&D equipment

- Use of recycled material and refurbished components in T&D equipment
- Alternatives to SF6 and field experience in applications; impact of PFAS regulations on T&D equipment design
- Impact of low power instrument transformers and smart sensors

PS 3: Asset Management strategies for T&D equipment

- Integration of sensors in T&D Equipment for enhanced monitoring
- Efficient data management and information sharing for T&D condition assessment
- Utilizing Digital Twins, IoT, and AI for T&D equipment management

In all 146 Synopses have been submitted.

8.4 New Working Groups

New WGs:

- JWG B3/A3.67 Operational safety of Medium Voltage GIS in case of abnormal leakage
- JWG A3/D3.52 Application of Digital Twin in Switchgear

WGs Disbanded:

Three working groups finished their work.

- JWG C4/A3.53 (TB 921).
- JWG B3/A3.59 (TB 914).
- WG A3.40 (TB 931)

JWG B3/A3.67 may be disbanded due to a lack of suitable participants.

8.5 Technical Meetings, Seminars & Tutorials

The last meeting of the A3 Study Committee met on the 28th September at the Montreal Symposium. The meeting took place in person.

There was a meeting of the strategic advisory group in Klingenberg in March and at Trondheim in May.

A3 and B3 held a joint forum in Klingenberg in March. During this 2 tutorials were held on “switching performance of SF6 alternatives” and “International and European actions aimed at fostering energy transition”.

A3 also participated in the Trondheim Symposium in May and the Montreal Symposium in September/October. During the Trondheim Symposium an A3/B5 tutorial on was held on “Modern Instrument Transformers for Protection Applications” and a workshop on “Digitalization of Information for T&D Equipment”.

During the Montreal Symposium A3.45 presented a tutorial on “Methods for determining the frequency response characteristics of voltage measurement systems - basics, requirements, performance, mathematical and measurement identification On-site calibration and verification of the accuracy of instrument transformers”. A second workshop on “Digitalization of Switchgear: Implementation experience and integration with the protection world” was also held on the fourth day.

Next year the main event being attended by A3 will be the 2026 Paris session. The preliminary program is currently as follows:

Poster session	Monday,	26.08.2026 08:30 - 12:30
SC Meeting	Tuesday	27.08.2026 08:30 - 18:00
SC A3 group discussion	Wednesday,	28.08.2026 08:45 - 18:00
Tutorial	Thursday	29.08.2026 10:40 - 12:30

There are currently plans for 2 events in 2027 that A3 will officially participate in. A Symposium in Heidelberg, Germany in April which is to be a joint event with VDE and IEEE with a focus on Distribution Grids. Another Joint A3/B3 Colloquium is being planned for October in Tokyo, Japan. A second Symposium is being planned in Bangkok, Thailand for November 2027 which A3 will not officially participate in, but participation is of course welcome.

8.6 Technical Brochures and Publications

Working group activity continuing to gain momentum and several which have been slow to progress are now progressing, however there are still some technical brochures and Electra articles which are outstanding. The following table details the most recent publications, and pending publications related to SC A3.

Ref.	WG	Title
TB 953	A3.43	Tools for lifecycle management of T&D switchgear based on data from condition monitoring
TB 947	A3.48	1. Fourth CIGRE international reliability survey on equipment
Webinar	JWG C4/A3.53	Deeply Suppressing Overvoltages in UHV AC Systems by Advanced Surge Arresters
TB 931	WG A3.40	Technical Requirement and Field Experiences with MV DC Switching
TB 921	JWG C4/A3.53	Applying Low-Residual-Voltage Surge Arresters to Suppress Overvoltages in UHV AC Systems
WBN053	CZC	Fundamentals of Current Interruption in (High-Voltage) Vacuum
TB 914	JWG	Guidelines for SF6 end-of-life treatment of T&D equipment (>1kV) in
WBN041	CZC	The fundamentals of current interruption in SF6 and its alternatives
TB 873	JWG B4/A3.80	Design, test and application of HVDC circuit breakers

TB 871	A3.41	Current interrupting in SF ₆ -free switchgear
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8.7 Last Study Committee Meeting (Highlights)

Study Committee A3 met during the Montreat Symposium in 2025 on the 28th September 2025. It was chaired by Nicola Gariboldi who welcomed all attendees.

The meeting agenda was reviewed and approved along with the minutes of the last meeting in 2024. There was a round of introductions to welcome new regular members.

Nicola presented an overview of A3 activities, summarizing the study committee structure and listing active working groups. The new working groups management tool was presented. There was discussion about problems with using it and uncertainty about how to approve multiple people from a single country if they were suitable. Nicola confirmed NCs can appoint up to two Experts (one of them NGN). Other Experts can be accepted under the responsibility of the Convener and of the Chair that no bias is present in WG composition.

Central Committee have decided KMS is not the right tool for generating Technical Brochures however it will remain the reference database for Cigre. Proposals for writing technical brochure include a better intelligent template and a secretariat service for formatting similar to the IEC, however no decision has been made yet.

Nicola ran through the existing working groups, closed working group or those which could be closed and listed the new publications since the last SC meeting. He also highlighted webinars, tutorials and workshops at previous A3 meetings at Trondheim, Klingenberg and Paris 2024.

Nicola then presented slides summarising statistics for the previous Paris session showing increasing participation over the last 3 sessions and a breakdown of exhibitors, delegates, visitors, working groups, organisations, CEOs, etc. Statistics on attendance at the tutorial (on Generator CB), poster session and GDM were presented along with other SC. Overall the Paris 2024 session was a success, to the point where the high income from last Session (nett margin ~€5M) triggered the question what to do with the cash. An Innovation and Education fund.€1.5M has been approved to create organic growth inside CIGRE. The aim of the fund is Universities will be founded to serve underserved areas. Main target to help people to get access to education and get more contribution of resources, but also contribute to electrification of the area which are still w/o electricity.

In future central office has stated that every SC must submit 2 article/year with topic different from TB or SC report.

National Committees were asked to present their national structure, where there are any SC A3 mirror Committee, what events will take place or took place, what are the main challenges regarding SC A3 scope in your country, how would you like improve the communication, what are our expectations and if there are any good practices which could be shared?

Sophie Chabin has been confirmed as the next chair of the Utilities Advisory Board. Nicola welcomed her to the group and she gave a brief summary of her career and plans for the future for the UAB.

The working groups then presented updates on meetings and technical brochure production.

Proposals for new working groups were run through (below).

Nicola shared a couple of slides showing the key dates and current proposed timings for the Paris session 2026. The poster session will be held on Monday, the SC meeting on Tuesday, the GDM on Wednesday and tutorials on Thursday. An appeal was made for reviewers, with 146 synopses submitted it will take considerable effort to review all the papers. There was discussion about how to ensure papers adhered to the rules, such a total numbers of pages. Clearer guidance could help ensure consistent submissions, such as does the bibliography contribute to the page total.

The proposed 2027 symposium and colloquium were presented by the representatives from Germany, Japan and Thailand.

Updates from IEC TC38, TC17A, TC17C, BV3, D1, IEEE, CZC and the Green Powered Future Mission (GPFM) were then presented.

8.8 Current Working Groups and UK Members

WG/JWG	Title	Convener	Secretary	UK Participation
WG A3.39	Application and field experience with Metal Oxide Surge Arresters	R. le Roux (IE)	F. Richter (DE)	
WG A3.42	Failure analysis of recent AIS instrument transformer incidents	Z. Roman (US)	Fernando Lagos (BR)	
JWG A3.43 /CIRED	Tools for lifecycle management of T&D switchgear based on data from condition monitoring systems	N. Gariboldi (CH)	J. Mantilla (CH)	
JWG A3/A2/A1/B1.44	Limitations in Operation of High Voltage Equipment Resulting of Frequent Temporary Overvoltages	B. Rusek (DE)	-	Richard Parke
WG A3.45	Methods for identification of frequency response characteristic of voltage measurement systems	E. Sperling (CH)	M. Freiburg (DE)	
WG A3.46	Generator Circuit-Breakers: review of application requirements, practices. In-service experience and future trends	P. Novak (DE)	-	
JWG B4/A3.86	Fault Current Limiting Technologies for DC Grids	Z. He (CN)	-	Masoud Bazargan, Ashish Bangar, Xiaoze Pei
JWG B3/A3.60	User guide for non-SF6 gases and gas mixtures in Substations	K.P. (Piet) Knol (NL)	-	
WG A3.47	Lifetime Management of Medium Voltage Indoor Switchgear	A. Maheshwari (AU)	Matthew Ridgley	Ian Naylor
WG A3.48	4th CIGRE reliability survey on transmission and distribution equipment	H.Ito (JP)		Matthew Iles
WG A3.49	Aging effects on accuracy class of Instrument Transformers	Roberto Tinarelli (IT)		Philip Orr
WG A3.50	On-site calibration and verification of the accuracy of instrument transformers	Paolo Mazza (Italy)	Christoph Datz	Rui Zhang
WG A3.51	Requirements for HV T&D Equipment operating under Abnormal Weather Conditions	Dr. Santosh Kumar Annadurai (IN)	Sasi Vettayappan (IN)	Tarachand Wankhede, Rohith Sangineni
JWG A3/D2.52	Application of Digital Twin in Switchgear	Javier Mantilla		Jiu Dun (Joseph) Yan, Phillip Enock Siwila
JWG B3/A2/A3/C3/D1.66	Guidelines for Life Cycle Assessment in Substations considering the carbon footprint evaluation	Akshaya Prabaker (NL)	Dennis van der Born (NL)	Mark Waldron, Muhammad Shaban, Chloe

				McFarlane, Alison Fulford
JWG B3/A3.67	Operational safety of Medium Voltage GIS in case of abnormal leakage	Maik Hyrenbach (DE)		Tony Chen
JWG C4/A3/B2/B4.75	Guide to procedures for the creation of contamination maps required for outdoor insulation coordination	Massimi Marzinotto (IT)		
WG C4.76	Overvoltage protection in switching inductive devices with vacuum circuit breaker	Q. Yang (CN)	Q. Sun (CN)	G. Dakin

Updates on working groups:

A3.39 Update

The draft TB needs to be updated to meet publication rules. No provisional date given yet.

A3.42 Update

Both the convenor and secretary resigned in 2020 so a new convener and secretary took up position. The last meeting of the WG was held in November 2023. Almost all contributions have been received except from 2 countries that promised contributions. Slow progress since 2024 due to health reasons and lack of time. The next scheduled meeting was on 29th October 2025. The 4th draft is being edited with help from Mr Pramod Rao.

A3.43 Update

The Technical Brochure 953 has been published, working group to be disbanded.

A3.45 Update

TB has been sent to Central Office for publishing.

A3.46 Update

No update.

A3.47 Update

Ankur requested help and support from SC :

1. more experts and / or users of medium voltage switchgear
2. Case studies for lifetime management of medium voltage switchgear

There are 7 active members, 4 members with limited activity and 5 which are inactive. Progress to date has been slow but they are getting back on track. There is limited representation from experienced MV switchgear users which has hampered progress. Outline chapters and content have been decided with a first draft of the TB being targeted for February 2026. The aim is to publish the TB in July 2026, followed by a *Electra* article in July and tutorial in August.

A3.48 Update

The WG has not met since Paris 2024. A planned meeting in Klingenberg was unable to take place due to room availability. The first TB has been published and 2 other draft TBs on circuit breakers and GIS are being circulated around the SC for review. TBs on DS and ES, and IT and SA have been postponed until the end of 2025. The second draft TB on VCB and GCB are being prepared, aiming for the end of 2025. A request for official approval for the next survey was submitted in September.

A3.49 Update

The last meeting of the WG was on 16th December 2024. (meeting #11). Activity in 2025 has been significantly slowed due to health of the convener. The next meeting is planned to take place in November 2025. Results to the survey were discussed in meeting #10. It was decided to keep the

questionnaire open and to add/modify some questions. Up to now, 39 answers received and processed. Technical brochure drafting is in progress with some sections drafted and others requiring further discussion. 90% of the information deal with legacy ITs so it is difficult to have reliable information about modern ITs. The draft of the final chapter (1) is proposed for Q2 2026 for presentation at the Paris session. Targeting publication in Q4 2026. A tutorial is being proposed in cooperation with A3.50.

A3.50 Update

The activity of the WG will be linked with the one performed by WG A3.49 "Aging effects on accuracy class of Instrument Transformers". The working group will be supported by a liaison with IEC TC38, with particular reference to WG 47 "Evolution of Instrument transformer requirements for the modern market" and to JWG 55 "Uncertainty evaluation in the calibration of Instrument Transformers linked to IEEE/IMS/TC39 "Measurements in Power Systems". The WG has been holding regular monthly meetings with 2 meetings in person (April 2024 and August 2024 with A3.49). To TB is planned to have 15 sections, work has started in 6 of them estimating 40% on 2 of them. The TB is targeting publication in Q3 2026.

A3.51 Update

There have been 5 virtual meetings to date with a 6th planned for 3rd December 2025, and 2 physical meetings. The flow of work has been finalised in the team with initial work allocation for the state of the art study. The WG is proceeding in collaboration with IEEE and WGE8. Teams for each extreme climate have been created and data collection is ongoing. The next meeting is planned to be a physical meeting in Australia in March 2026. The questionnaire is planned to be finalised and sent out in March 2026.

WG A3/A2/A1/B1.44 Update

TB has been sent to Central Office for publishing.

B3/A3.60 Update

No update

JWG B3/A2/A3/C3/D1.66 Update

No update

JWG B3/A3.67 Update

Need for more contributions from Distribution System Operators, with particular reference to the European ones. At present only the Australian one is strongly contributing. If no other DSO is contributing it is likely the WG will be disbanded.

JWG B4/A3.86 Update

No update

JWG C4/A3/B2/B4.60 Update

No update

8.9 New Working Group Proposals

New WGs were proposed during the SC meeting at the Montreal Symposium.

- A3.XX - Global database for circuit breaker testing data was proposed. The main challenge perceived with this proposal was suppliers agreeing for their type test data to be held by a third party and become more widely available.
- A3/D1.XX - Testing requirements for gas insulated switchgear equipment with rated voltages less or equal 245 kV. There was discussion about the purpose for this and requirements for PD testing and potential for standardized test voltages considering integrated components like surge arresters, plug in cables, voltage transformers, etc.

- A3.XX - Guide for conducting factory capability assessment for switchgear. The discussion was around whether there was a willing convener for this. There is broad agreement that it would be beneficial work. At present there is no proposed convener to progress.
- A3.XX - Inductive switching in HV and MV. This working group has been approved and a call for working group members went out in October.
- A3/B3.XX - Verification of temperature rise limits for T&D equipment above 1 kV. The proposer cannot take the Convener ship, there can be no progress until a convener is found.
- B2/B3/A2/A3.XX - Dangerous distances between 13,8 kV cables / transformers to building facades and laypeople windows in urban circuits. There was discussion about the need for such a working group and its purpose. Nenad described a scenario which could be dangerous to the general public and there was consensus that there was a benefit in progressing this. A Convener needs to be found for this.
- A3/C6/B5/D2 - Enabling the Self-Healing Grid: From Protection to Prevention
- A3/B3.XX - Purchase evaluation guidelines for Transmission and Distribution (T&D) equipment to promote sustainable development. A new proposal brought to the group by Mark Kucshel.

9 RM Report on SC B1 Insulated Cables

9.1 Study Committee Scope

SC Chair: Geir Clasen, NO
SC Secretary: Matthieu Cabau, FR

9.2 Strategic Advisory Groups

There are now four advisory groups in the B1 SC

- Strategic Advisory Group (Chair: Geir Clasen, NO).
- Tutorial Advisory Group (Chair: Luigi Colla, IT)
- Customer Advisory Group (Chair: Carla Damasceno)
- Reliability Advisory Group (Chair: Russell Wheatland, AU)

The Reliability Advisory Group was launched with effect from September 2022 on the topic of Cable System Statistics (Every Two Years). The Advisory Group was created based on the recommendations of TF B1.81 (How to have statistics every two years) and is focused on capturing the service experience of insulated cable systems on a more frequent basis. An update was published at the 2024 Paris Session, and the next update is due to be presented at the 2026 Paris Session. The introduction of a permanent Advisory Group (rather than ad-hoc Working Groups) will provide more stability to the process of collecting the service experience data, which is very widely used across the industry. The new Advisory Group will implement a revised data collection process which, it is hoped, will improve the range of information collected. Unfortunately, very few network owners in the UK have responded to the survey, resulting in UK being highlighted in the Study Committee for the poor contribution. This is partly a function of the large number of organisations owning cable assets in the UK which has made it difficult to ensure a full contribution, combined with relatively high staff turnover in some of the networks business and a (perceived) lack of management buy-in for these kinds of Cigre activities.

9.3 Draft Preferential Subjects

The Draft Preferential Subjects for 2026 Paris Session are shown below. These should not be treated as final, although the broad categories for the subjects (Future systems, experience and sustainability) are very similar to previous years.

PS 1: Future cable systems and innovative cable applications

- Cable systems challenges and solutions such as floating applications/deep water, meshed DC grids, overhead-line/substation interfaces
- New developments on materials, design and construction challenges such as super-conducting solutions, hydrogen inclusion, high temperature / electric stress, very large conductors and cost-effectiveness

- Intelligence into cables. Integration of sensor technologies, real-time use of data, predictive maintenance, use of robotics, dynamic management of load demands, digital twins, data use for Building Information Methodology implementation

PS 2: Recent experience with AC and DC cables, both land and submarine

- Quality, monitoring, condition assessment, diagnostic testing, After Installation Testing, fault location, upgrading and uprating methodologies and relevant management
- Lessons learned from permitting, consent, interface management cables to other equipment/device/substations and safety issues
- Experiences with new test requirements and new tools for cable ratings calculation

PS 3: Environmental Impact and Cable Lifecycle

- Development in more sustainable materials and production methods, recover, recycle, reuse of cable materials and SF6 alternatives
- Best practices in Life Cycle Assessment and Environmental Certification
- Environmental impact of cable systems with regards to climate change

9.4 New Working Groups

Working Groups (WG) normally take 3 years to complete and the deliverable is a Technical Brochure with recommendations based on Terms of Reference (ToRs) developed by a Task Force. At the time of writing, the formal ToR for these groups has not been approved by the Technical Council but the activities were approved by the B1 Study Committee during their meeting in Netherlands in September 2025.

It is worth noting that this is a major increase compared to the amount of new work that has been sanctioned in recent years, in recognition of the fact that a large number of WG that were delayed during the covid-19 era are finally closing and publishing their TBs. Some of the new items are proceeding directly from a working group, as the Customer Advisory Group and Strategic Advisory Group has received specific requests for certain items, meaning that the scope of work was already well defined.

Number	Provisional Title	UK Member
B1.94	Grid operations (switching etc.) and transient voltages in XLPE insulated cable systems possibly causing accelerated failure modes	TBC
B1.96	Cable Accessory Failure Hazard Mitigation	TBC
B1.99	Evaluation of sustainable power cables	TBC
B1.100	Guidelines for qualification of dedicated metallic return cables	TBC
B1.101	DC superconductive cable systems	TBC
B1.102	Specific tests and characteristics of large cross section cables	TBC
B1.105	Update of TB756 (grid operators use of dynamic rating)	TBC
JWG C4/B1/B2/B4.78	Interference effects between HVDC circuits and nearby metallic infrastructure	TBC

TF B1.98 “Test Recommendations for Earth Screen Power Cable Connections in Wind Farm Array Cabling” was unable to complete its work prior to the Study Committee meeting. On that basis, it is now due to report in 2026. It can be re-submitted for the vote at the 2026 SC meeting to determine if it should proceed to a WG.

New Task Forces are shown below.

Number	Title	UK Member
B1.103	Recommendations for spare parts management	TBC
B1.104	Cable Lifetime Extension	TBC

9.5 Technical Panel Meetings, Seminars & Tutorials

A hybrid Technical Liaison meeting will be held on 15th October 2025, with attendance of approximately 30 persons in person and around 25 online. The meeting will again be held jointly with the D1 UK group, and the D1 RM Thomas Andritsch presented a summary of B1-relevant material to the group.

In addition, the process of holding Shadow WG meetings has been restarted, with the intention being to set up shadow UK groups for those topics where the UK has a strong interest. The decision to start a shadow group will be made between the UK B1 RM and the UK full member of the respective working group, with meetings scheduled at times where UK contributions can best shape the direction of the work.

9.6 Technical Brochures

The following TBs have been published since November 2024:

- TB 945 Recommendations for a performance guideline of solid insulated busbar systems
- TB 957 Recommendations for dielectric testing of HVDC gas-insulated cable connection assemblies
- TB 959 Behaviour of cable systems under large disturbances
- TB 963 Finite Element Analysis for cable rating applications
- TB 968 Interaction between cable and accessory materials in HVAC and HVDC applications

There is a significant backlog of late running TBs (due to delays in the respective WGs circulating a draft). A further 7 draft TBs have been commented on by the UK and are in the finalization stage, several others are expected to be released for commenting imminently.

When a TB is circulated for comment (to B1 UK community members who had expressed an interest in reviewing the documents), typically only half of the promised reviews are delivered. That said, the RM remains grateful to those reviewers who do take the time to provide high quality comments.

9.7 Last Study Committee Meeting (Highlights)

The B1 Study Committee meeting was held in Netherlands in September 2025, and was primarily an in person meeting with the exception of a small number of participants who were unable to travel.

A new process was trialled for the assessment of the new work items, with two parallel tracks. The first was the scoping of new work items by CAG/SAG, and the second was a more formal template to be filled in by countries who wanted to propose new work items. This was successful in reducing the number of “speculative” new work items where the proposer had not done sufficient work to formulate the idea.

The UK submitted two items for consideration as new work. The first was on the topic of Cable Lifetime Extension, with the target of producing some guidance which would be suitable to non-expert stakeholders. This item was accepted and a TF will run as TF B1.104. This item was seen as

relevant for the UK considering that many of the early XLPE insulated submarine cables will approach end of design life within the coming 10 years. A second idea was presented concerning Digital Twins for HV Cables, and this one came just below the cut line in terms of number of votes received. Although it received a lot of support from some participants in the room, there were concerns about whether B1 could run this work alone. The idea will be refined in the UK during 2026 and resubmitted for consideration at the 2026 SC meeting.

Many WG have been delayed due to the impact of the COVID pandemic and restrictions on physical meetings. It is notable that many of the delayed groups are now struggling to make progress even though there have been no COVID related restrictions for some years; this is often linked to key personnel retiring or changing jobs in the intervening period.

9.8 Current Working Groups and UK Members

Note: although the final publications of B1.54 and B1.58 are not yet available, the work is understood to be completed and the WG are effectively closing – hence they are not mentioned here.

Number	Title	UK Member (only B1)
WG B1.67	Loading pattern on cables connected to windfarms	Ross Wilson (UK)
JWG B1/C4.69	Recommendations for the insulation coordination on AC cable systems	Francis Waite (UK)
WG B1.70	Recommendations for the use and the testing of optical fibres in submarine cable systems	Roman Svoma (UK, Convener), Phil Miller (UK), Jingyi Wan (NGN)
WG B1.72	Current rating verification (Part 2)	James Pilgrim (UK), Kenneth Benton (NGN)
JWG B4/B1/C4.73	Surge and extended overvoltage testing in HVDC cable systems	None
JWG D1/B1.75	Mechanism for corrosion and how to monitor it	None
WG B1.76	Increasing the role of quality assurance and quality control to reduce the cable failure possibility	Roman Svoma (UK)
WG B1.80	Guidelines for Site Acceptance Tests of DTS and DAS Systems used for Cable Systems Monitoring	None
WG B1.82	MVDC Cable system requirements	Leigh Williams
WG B1.83	Grounding aspects for long HVDC land cable connections	Dongsheng Guo
JWG B1/C3.85	Environmental issues of decommissioning	None
WG B1.86	Assessment, Prevention and Mitigation of Safety Risk in Cable Systems	Christopher Donaghy-Spargo
WG B1.88	Recommendations regarding the use of non SF6 gases in cable systems	Manu Haddad (UK)
JTF B4/B1.88	Insulation coordination procedure for DC cable systems in HVDC stations with Voltage Source Converters (VSC)	Rosemary Urban (UK)
WG B1.89	Guidance for conducting cable systems failure analysis	Ross Wilson (Conv), Raed Ayoob (UK)
WG B1.90	Cable systems electrical characteristics (Update to TB 531)	Sara Anild (Conv), Tanmay Joshi (UK)
WG B1.91	Transient thermal modelling of power cables	Ahmed Badawi (UK)
WG B1.92	Qualification of Lead Free Submarine Cables at 72.5kV < Um < 170 kV	Chris Donaghy-Spargo (UK), Jack Stride (NGN)

TF B1.94	Grid operations (switching etc ...) and Transient voltages in XLPE insulated cable systems possibly causing accelerated failure modes	Laurence Trim (UK)
WG B1.95	Mechanical performance and limits of submarine cables - modelling and testing	David Young (UK), Andrew Matthiesen (NGN)
TF B1.96	Cable Accessory Failure Hazard Mitigation	Francis Waite (UK)
TF B1.98	Test Recommendations for Earth Screen Power Cable Connections in Wind Farm Array Cabling	Alex Neumann (UK)

NOTE: UK denotes the UK member, IE denotes Invited Expert, NGN denotes Next Generation Network member.

9.9 UK Members of the Technical Panel

As the B1 liaison meetings are quite popular (40+ attendees) it would be difficult to have this number of people in a technical panel.

After considering different models, the intention in B1 is to retain the large liaison meetings to give the wider community the latest information on B1 activities, while also setting up more shadow UK WGs to support the main UK members. This should allow a larger number of people to be involved in B1 activities, and also provide a ready stream of reviewers for the draft TBs (this having been a source of difficulty in the past).

10RM Report on SC B3 Substations and Electrical Installations

10.1 Study Committee Scope

SC Chair: Mark McVey (US)

SC Secretary: Samuel Nguefeu (FR)

The scope of Study Committee (SC) B3 addresses topics throughout the asset management life-cycle phases; from conception, through research, development, design, production, deployment, operation, and end-of life. At all stages, technical, safety, economic, environmental and social aspects are addressed as well as interactions with, and integration into, the evolving power system and the environment. All aspects of performance, specification, testing and the application of testing techniques are within scope, with a specific focus on the impact of changing interactions and demands due to evolution of the power system. Life cycle assessment techniques, risk management techniques, education and training are also important aspects.

Within this framework additional specific areas of attention include:

- Theory, principles and concepts, functionality, technological development, design, performance and application of materials, efficiency.
- Manufacturing, quality assurance, application guidance, planning, routing and location, construction, erection, installation.
- Reliability, availability, dependability, maintainability and maintenance, service, condition monitoring, diagnostics, restoration, repair, loading, upgrading, uprating.
- Refurbishment, re-use/re-deployment, deterioration, dismantling, disposal.

Key strategic directions

- New substation concepts
- Substation ownership issues
- Life-cycle management
- Integration of intelligence for digitalization on substations

10.2 Strategic Advisory Groups

- Strategic Advisory Group (SAG) – Mark McVey (JP)
- Customer Advisory Group (CAG) – John Randolph (US)
- Tutorial Advisory Group – Hugh Cunningham (IE)
- AA1 - Substation concepts & developments – Mark Osborne (UK)
- AA2- Gas Insulated Switchgear (GIS) Substations – Mark Kuschel (GE)
- AA3 - Air Insulated Switchgear (AIS) – Mark McVey (US)
- AA4 - Substation Management – Johan Smit (NE)

10.3 Draft Preferential Subjects

2026 Paris Session B3:

PS1 innovative substation concepts, designs and operation experience

- Experience with digital design, training tools using 3D software, AI and machine learning.
- Modular substations and prefabricated material design methods for all voltage classes.

- UHV or HVDC operational experience with renewables for onshore and offshore substations.

PS2: Life cycle & asset management

- Monitoring, diagnostics and testing equipment to improve energy efficiency and functionality to reduce CO₂ as well as improve resiliency.
- Substation up-rating, upgrading experience and operation concepts.
- Asset management strategies including optimised maintenance, SF₆ transitions and improve resiliency.

PS3: Grid transformation and new reliability threats

- Physical security designs and experience.
- Substation designs, upgrades and concepts to mitigate severe weather.
- Experience building substations to connect large customers such as data centers, reliably and safely.

2025 Symposiums

Klindenberg, Germany, in March 2025

keynote presentations, engaging discussions, and insights into current topics such as the 2GW offshore wind farms and their integration. There were numerous tutorials on A3 transmission and distribution and B3 substations.

Trondheim, Norway, in May 2025

NRCC Symposium - led by B5. Focus on changes required in the power system for the energy transition – Preferential subjects still under agreement, likely to focus on system dynamics, AC onshore and Offshore, Power to X.

Montreal, Canada, in September 2025

This is a CIGRE international symposium that brings together 10 study committees. Key topics of focus include Grid Enhancement, Strategic Planning, Technological Innovation and Climatic Adaptation for Resilient Future Energy Systems.

10.4 New Working Groups

Number	Title	UK Member
B3.69	Process Requirements for Commissioning and Inspection of Air Insulated Substations (AIS) and Gas Insulated Substations (GIS)	Matthew Kayes Constantinos Onoufriou (NGN)
B3.73	Asset management and digital integration of mobile substations for a resilient and flexible transmission grid	Tarachand Wankhede Omama Zaheen (NGN)
B3.72	Integration of asset information in modern substations for (asset) management of substation equipment	Alok Alok Mahesh Atapattu Oladipo Phillips (NGN)
B3.70	Guidelines for the use of advanced technologies for information and knowledge management in substations	Isaac Lenton

10.5 Technical Brochures Published 2024-25

TB number	Title	WG
957	Recommendations for dielectric testing of HVDC gas-insulated cable connection assemblies	B1/B3/D1.79
945	Recommendations for a Performance Guideline of Solid Insulated Busbar Systems	B1/B3.74
930	Review of substation busbar component reliability	B3.49

10.6 Current Working Groups and UK Members

Number	Title	UK Member
B3.49	Review of substation busbar component reliability	Sadiq Siddiqui
D1/B3.57	Di-electric testing of gas insulated HVDC system	TBC
B3.50	On-site testing of HV GIS after installation, extension, repair or maintenance	TBC
B3.51	Service continuity guide for maintenance repair and extension of HV GIS	TBC
B3.52	Neutral grounding method selection and fault handling for substations in the distributed grid	Tony Yip (Secretary)
B3.54	Earthing System Test methods	Stephen Tucker, Dongsheng Guo, Mark Osborne AA1 advisor
B3.56	Application of 3D technologies in substation engineering works	Marcin Mroz
JWG B1/B3/D1.79	Recommendations for dielectric testing of HVDC GIS cable sealing ends	TBC
B3/A3.60	User guide for non SF6 gases and gas mixtures in substations	Mark Waldron
B3.61	Risk & Asset Health based decision making in existing substations	Dawn O'Brien
B3/D2.62	Life-long Supervision and Management of Substations by use of Sensors, Mobile Devices, Information and Communication Technologies	TBC
B3/D1.63	Guideline for assessing the toxicity of used SF6 gas onsite and in the lab of T&D equipment above 1 kV in substations	Tony Chen
B3.64	Guidelines on Optimising Seismic Design of Substations for Power Resiliency	TBC
B3.65	Escape routes from Substation rated above 1kV AC and 1.5 kV DC (Draft TOR)	TBC

10.7 UK Members of the Technical Panel

Delivered Technical Webinar

December 2025 Webinar – Maik Hyrenbach, presented a summary of the current progress on the PFAS discussion in the EU.

The UK liaison meeting

The B3 meeting will be jointly held with A3/D1 on the 2nd March 2026, in Birmingham.

Presentations will cover various topics and provide an open platform for UK suppliers and users to present their respective plans and exchange their perspectives on the following topics:

1. The move away from SF₆ and managing existing assets face supply chain issues, product challenges, the ongoing PFAS discussion, and skills shortage.
2. The development of mobile substation bays to provide a cost-effective, rapid-deployment option to maintain system reliability.
3. Additive manufacturing addresses supply chain issues by enabling rapid, flexible production of critical parts.
4. Innovation on plug-and-play connector systems requiring minimal specialist input. These solutions address offshore logistical challenges, cut reliance on cable jointing, and facilitate faster restoration after faults or upgrades.
5. Refurbishment strategies for existing legacy air-insulated equipment to extend its operational life.

We will use this event to explore the sector-wide challenges and identify common themes for our CIGRE members. All of this leads to a key question: how can CIGRE, as an organisation recognised for its technical excellence, better support the development of solutions to tackle these issues and help accelerate the UK's national effort to achieve Net Zero?

11RM Report on SC B4 HVDC and Power Electronics

11.1 B4 Study Committee

Mission

To facilitate and promote the progress of engineering and the international exchange of information and knowledge in the field of Direct Current (DC) equipment/systems and power electronics applications. To add value to this information and knowledge by means of synthesizing state-of-the-art practices and developing recommendations.

Technological Field of Activities

- Direct Current equipment and systems including converter technologies and semi-conductor devices.
- Power electronics for AC systems and power quality improvement, advanced power electronics and applications.

Scope

Within its technical field of activity, [Study Committee B4](#) addresses DC systems and Power Electronics (PE) equipment in both transmission and distribution systems. The study committee also addresses DC Converters for the integration of distributed renewable (PVs) and energy storage as well as power quality control. SC B4 covers the full spectrum of DC systems and PE devices including technology, specification, design, implementation, operation, maintenance, refurbishment of DC systems and Flexible AC Transmission System (FACTS) devices.

Within this framework additional specific areas of attention include:

- Theory, technologies, design, performance, operation & maintenance, and application of DC converters and systems.
- Theory, technologies, design, performance, operation & maintenance, and application of FACTS devices.
- DC interconnectors and establishment of DC grid(s)/multi-terminal HVDC systems to increase power transmission capacities and to reduce existing network congestions (AC network overlay), to enable power trading, to share spinning reserve, and to reduce energy costs.
- Technologies of inverters with grid-forming control capabilities to improve and enhance the reliability and stability of the PE dominated power system with integration of growing renewable generations and battery storage resources.
- Standardization and digitalization of Offshore DC platforms.
- Implementation of Interoperability of HVDC systems constructed by various HVDC OEMs for flexible and reliable operation and control of largely interconnected power system through HVDC system;
- Application of DC technologies and PE in distribution system for better power quality control;
- MVDC applications such as connection of large solar parks.
- Refurbish and upgrade of HVDC systems and FACTS devices.
- Inverter based energy storage.

11.2 CIGRE B4 SC - Strategic Advisory Groups

SC B4 Chair: Joanne Hu (Canada); SC B4 Secretary: Rebecca Ostash (Canada)

Number	Title	Convenor	Secretary
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AG01	Strategic Advisory Group	Joanna Hu	Rebecca Ostash
AG02	B4 Newsletter	Hani Saad	
AG03	Communication and Website	Silvia Sanz Verdugo	
AG04	HVDC/FACTS System Performance	Josh Burroughs	Phaedra Taiarol
NGN	B4 NGN Group	Yuebin Zhou	
WiE	B4 Women in Energy	Rebecca Ostash	

11.3 CIGRE B4 UK Members

Dechao KONG	Chair and Regular Member	TSO
Ali KAZEROONI	Additional Regular Member	Consultant
Nan Chen	NGN Representative	TSO

11.4 CIGRE 2025 International Symposium in Montreal, Canada (29th Sept to 3rd Nov, 2025)

The theme of the CIGRE 2025 International Symposium is: “Grid Enhancement, Strategic, Planning, Technological Innovation and Climatic Adaptation for Resilient Future Energy Systems.

This Event is primarily supported by eleven CIGRE Study Committees:

- A1 Power generation and electromechanical energy conversion
- A2 Power transformers and reactors
- A3 Transmission and distribution equipment
- B2 Overhead lines
- B3 Substations and electrical installations
- B4 DC systems and power electronics
- C1 Power system development and economics
- C3 Power system sustainability and environmental performance
- C4 Power system technical performance

- C5 Electricity markets and regulation
- C6 Active distribution systems and distributed energy resources

With the support of the other Study Committee Chairs, this Symposium has accepted papers from all CIGRE Study Committees. Additionally, the EHV and UHV, AC & DC Conference is also part of the Symposium. As a result, 600 papers have been presented by authors from 46 countries.

Three tutorials have been successfully delivered by B4 SC.

- The first tutorial was held on 29th Sept by WG B4.89 with title “Condition Health Monitoring and Predictive Maintenance of HVDC Converter Stations”.
- The second tutorial was held on 30th Sept with title “Protocol for reporting operational performance of HVDC systems and FACTS”.
- The third tutorial was held on 2nd Oct 29th Sept with title “Operation and Maintenance of HVDC and FACTS facilities”.

Total 55 papers from B4 SC have been presented across this event.

- B4.1 – HVDC/FACTS – Interaction and Coupling (7 Papers)
- B4.2 – HVDC Project Planning, Design and Testing (6 Papers)
- B4-3 – HVDC Control, Protection and Performance (8 Papers)
- B4-4 – Multiterminal HVDC (10 Papers)
- B4-5 – Meshed AC/DC Systems (6 Papers)
- B4-6 – FACTS Application, Design, Control and Performance (8 Papers)
- B4-7 – HVDC/FACTS – Reliability, Performance Monitoring and Cyber Security (6 Papers)
- B4-8 – Application of Real-time Simulation and Hardware-in-loop in HVDC/FACTS/IBRs (4 Papers)

On 29th Sept, A workshop was delivered in B4 area with title “**Future of Power Transmission, emphasizing the transformative role of High-Voltage Direct Current (HVDC) technology in enabling resilient, flexible, and sustainable energy systems.**”

For more details, please see the URL:

[https://cigre.ca/upload/files/CATALOGUE%20MONTREAL%20updated%20on%2019%2009%2025%20\(1\)\(1\).pdf](https://cigre.ca/upload/files/CATALOGUE%20MONTREAL%20updated%20on%2019%2009%2025%20(1)(1).pdf)

11.5 2026 Paris Session – Call for Papers

URL: https://session.cigre.org/fileadmin/cru-1725973228/Session_2026/CFP/CIGRE-CFP-2026-220125-BD.pdf

- The Preferential Subjects for 2026 Paris Session:
 1. PS 1 DC Equipment and Systems
 - PS1.1: Planning, design, performance, testing and commissioning of DC equipment and systems including point to point, multiterminal and DC grids, especially offshore DC systems.
 - PS1.2: Refurbishment and upgrade of existing DC systems.
 - PS1.3: Service and operating experience of DC converter stations and systems, especially VSC based DC systems and offshore DC systems.
 2. PS 2 FACTS and Power Electronics
 - PS2.1: Planning, design, performance, testing and commissioning of FACTS and other PE devices including inverter-based generation.
 - PS2.2: Refurbishment and upgrade of existing FACTS and other PE devices.
 - PS2.3: Service and operating experience.
 3. PS 3 New Technologies and Concepts of DC and FACTS Enabling Energy Transition
 - PS3.1: New technologies/concepts to address network issues such as application of synchronous grid forming converters, multi-vendor interoperability, standardisation.
 - PS3.2: New Concepts, Technologies and design of DC converters and PE devices for both transmission and distribution systems including interfacing generation and storage to the network, energy hubs/islands, etc.

As informed by CIGRE UK in early November 2025, [total 17 synopses from CIGRE UK B4](#) have been accepted by the SC B4 and will be further developed into full papers in line with CIGRE's timescale.

11.6 Working Groups with UK Members' Engagement and Contribution

- **List of Active SC B4 Working Groups**

URL: <https://b4.cigre.org/GB/technical-activities/working-groups>

		Convenor
B4.64	Impact of AC System Characteristics on the Performance of HVDC schemes	Jef Beerten
B4.69	Minimizing loss of transmitted power by VSC during	Dennis Woodford
B4/A3.86	Fault Current Limiting Technologies for DC Grids	Zhiyuan He
B4.87	Voltage Source Converter (VSC) HVDC responses to disturbances and faults in AC systems which have low synchronous generation	Carl Barker (UK)
TF B4/B1 88	Insulation coordination procedure for DC cable systems in HVDC stations with Voltage Source Converters (VSC)	Kees Koreman / Tanumay Karmokar
B4.89	Condition Health Monitoring and predictive maintenance of HVDC Converter Stations	Nadine Chapalain
B4.90	Operation and maintenance of HVDC and FACTS Facilities	Les Brand
B4.91	Power-electronics-based transformer technology, design, grid integration and services provision to the distribution grid	Marco Liserre
B4.92	STATCOMs at Distribution Voltages	John Wright-Smith
B4.93	Development of Grid Forming Converters for Secure and Reliable Operation of Future Electricity Systems	Dechao Kong (UK)
B4.94	Application of grid-forming VSC-HVDC system in black start restoration	Arash Fazel Darbandi
TF B1B3B4 C4D1.95	Harmonization of voltage designations and definitions across different HVDC component technologies	Bruno Bisewski
C4/B4.72	Lightning and Switching Induced Electromagnetic Compatibility (EMC) issues in DC power systems and new emerging power electronics-based DC equipment	Qingmin Li
B4.95	Developments in Power Semiconductor Technologies and Applications in HVDC/FACTS	Joerg Dorn
B4.96	HVDC connection of power system with high proportion of photovoltaic (PV) generation	Qi Guo

C4/A3/B2/ B4.75	Guide to procedures for the creation of contamination maps required for outdoor insulation coordination	Massimo Marzinotto
B4/C4.97	Benchmarking of simulations models for control interaction in meshed AC networks with multiple converters	Arash Fazel Darbandi
C1/B4.49	Offshore transmission planning	Cornelis Plet
B4.98	Design considerations in integration of DC systems to meshed DC/AC Transmission networks	Afshin Pashaei (UK)
B4.99	Design and Construction of offshore Voltage Sourced Converter (VSC) Stations	Sofie Nilsson
B4.100	Dynamic Active and Reactive Power Supporting Devices for VSC HVDC Systems	Chandana Karawita
B4.101	Industrial Implementation and Application of Grid Forming Energy Storage Systems (GFM ESS)	Changjiang Zhan
B4.102	Technical Requirements and Scenario Considerations on Grid-Forming Capabilities of VSC-HVDC Systems	Zhiyong Yuan
B4/C4.103	AC Network Equivalents for HVDC and FACTS Project Studies	Hiranya Suriyaarachchi
B4.104	HVDC Digital Twin – concepts and roadmap	Arkadiusz Burek
C4/B1/B2/ B4.78	Interference Effects between HVDC Circuits and Nearby Metallic Infrastructure	Mohammad Naemi

- Completed Working Groups and UK Members for Contribution

Completed working groups with TB as published or under review in 2025 and UK members for contribution

Number	Title	UK Member for Contribution
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<p>WG B4.82/IEEE (TB 958)</p>	<p>Guidelines for Use of Real-code in EMT Models for HVDC, FACTS and Inverter based Generators in Power System Analysis</p>	<p>1. E. AMANKWAH 1. R. GUPTA</p>
<p>WG B4.85 (TB 961)</p>	<p>Interoperability in HVDC Systems based on Partially Open Software</p>	<p>1. P. BRIFF 2. I. COWAN 3. P. HOFBAUER 2. L. VACIRCAY</p>
<p>WG C2/B4.53 (TB 972)</p>	<p>The Impact of Offshore Wind Power Hybrid AC/DC Connections on System Operations and System Design</p>	<p>4. M. JONES</p>

11.7 Working Groups with UK Members' Engagement and Contribution

- The 2025 CIGRE UK B4 Technical Liaison Meeting was held on 16th May 2025 (Hybrid). For more details, see URL: <https://cigre.org.uk/uk-news/cigre-uk-b4-technical-liaison-meeting-friday-16th-may-2025-hybrid/>



- CIGRE UK Monthly Technical Webinar – Advancements & Solutions for Low Voltage DC Residential Grids to be held on 26th November 2025 and presented by Giovanni De Carne. For more details, see URL: <https://cigre.org.uk/blog/cigre-uk-monthly-technical-webinar-wednesday-26th-november-1230-1330/>
- CIGRE UK Monthly Technical Webinar on Grid Forming Battery Storage Energy Storage to be held on 17th December 2025 and presented by Duncan Hughes and Xiaoming Li (TBA).
- For more information for CIGRE UK B4 zone, please see URL: <https://cigre.org.uk/category/b4-zone/>

12RM Report on SC B5 Protection and Automation

12.1 Study Committee Scope

SC B5 Chair: Volker Leitloff (France)
SC B5 Secretary: Peter Bishop (NZ)

The scope of SC B5 is to facilitate and promote engineering development and knowledge exchange in the field of protection and automation by means of “synthesizing” the best practices and recommendations. It covers principles, design, applications, coordination, performance, and asset management of “Light Current” systems and equipment. All technical, organisational, and economical aspects are considered including staff education and training.

12.2 Strategic Advisory Groups

SAG Convenor, Volker Leitloff (France)
Substation Automation (TG.51), Casale Emiliano (Italy)
Protection & Monitoring (TG.52), Cedric Moors (BE)
New Network Requirements (TG.53), Nirmal Nair (NZ)
Tutorial/IEC Liaison, Anita Oommen (ZA)
IEEE Liaison, Jonathan Sykes (US)
Communication Officer, A. Apostolov (US)

12.3 2024 B5 SC 2025 Osaka Colloquium 30th June – 6th July

Three Preferential Subjects:

1.1 PS1 - IEC 61850 based Interoperability of IEDs of different manufacturers and technologies integrated in one PACS

1.2 PS2 – PACS Life Cycle Performance and Longevity

1.3 PS3 - Sharing of best practices on revised principles enabled by modern protection IEDs

12.4 Proposed New Working Groups for 2025 and PS for Colloquium 2027 (Canada)

New Working Groups for 2025

- Guidelines for commissioning and testing of fully digital PACS
- Monitoring and Diagnostic of PACS in Digital Substation
- Best practices and challenges related on islanding protection

New Preferential Subjects for 2027

- Experience and challenges regarding SIPS and WAMPACS
- New requirements of network protection and control for renewable energy integration

- Artificial Intelligence in PACS

12.5 Future Events

- 20th IET DPSP – IET London Savoy Place – 2-5March 2026
- Cigre Paris 2026

12.6 New Working Groups Started in 2024

Number	Title	UK Member
B5.87	Digital Transformation of Protection, Automation and Control Systems: expanding the Application of IEC 61850	RM: Haiyu Li
B5.88	Implementation Guide for Fully Digital IEC 61850-Based Protection, Automation and Control Systems	RM: Deepa Shaji Kumar NGN: Karan Oommen
B5.89	Protection Redundancy and Backup for Modern Power Systems	RM: TBA

12.7 Technical Panel Meetings, Seminars & Tutorials

Cigre B5 UK Technical Panel Meeting – September 24
 B5 Liaison Meeting Nov 24– combined with D2
 Cigre UK AGM Technical Event – November 24
 Cigre B5 / NGN / University Manchester Event – Protection Life Cycle – Feb 25
 Cigre B5 / NGN / University Birmingham Event – Protection Life Cycle – Mar 25
 PACWORLD Glasgow June 25
 B5 Liaison Meeting Dec 25– combined with D2
 Cigre UK AGM Technical Event – November 25

12.8 Technical Brochures

Reference	Working Group	Title
949	WG B5.69	Experience Gained and Recommendations for Implementation of Process Bus in Protection, Automation and Control Systems

The deployment of Protection, Automation and Control Systems (PACS) using IEC 61850 process bus constitutes a major development. The scope, goals and design of these projects vary widely. In order to enable a realistic technical and economic evaluation of these technologies, WG B5.69 was created to perform a review on this subject. This Technical Brochure is intended to serve as a comprehensive resource for utilities, manufacturers, and system integrators involved in the evaluation and deployment of digital substations using IEC 61850 process bus, helping them navigate the challenges and opportunities associated with this transformative technology.

12.9 Awards

No UK Awards for B5 this year.

12.10 Current Working Groups and UK Members

Country Member	Type	WG Member (WG-___(R)/(C) (R) - regular (C) – corresponding
Xiao-ping Zhang	University	JWG B5/C4.61
Bojana Djukic	Utility	WG B5.57
Sadegh Azizi		WG B5.57
Dechao Kong		WG B5.57
V. Terzija	Other	JWG B5/C4.61 WG B5.57 WG B5.72 (R)
Zoran Gajic	University	WG B5.57
Peter Crossley,	University	WG B5.55 Convener WB B5.82 (R)
Peter Watson	Consultant	WG B5.72 (R)
John Wright	Vendor	WG B5.59 (R) WG B5.63 (R) WG B5.81 (Convener)
Abraham Varghese	Vendor	WG B5.58 (R)
Thomas Charton	Tx Utility	WG B5.64 (R) WG B5.69(R) WG B5.59 (R)
Steven Blair	Other	WG B5.64 (C)
Colin Scoble	Dx Utility	WG B5.65 (R)
Dave York	Vendor	WG B5.70 (C)
Chee-Pinp Teoh	Vendor	WG B5.77 (C)
Rasoul Azizipanah	Tx Utility	JWG B5/C4.61 (C)
Raju Paidi	University	JWG B5/C4.61 (C)

Country Member	Type	WG Member (WG-___(R)/(C) (R) - regular (C) – corresponding
Chen, Linwei	Tx Utility	WG B5.68 (C)
Stockton, Mark	Tx Utility	WG B5.68 (C) WG B5.71 (R)
Hengxu Ha	Vendor	WG B5.70 (C)
Shimeh Jahangiri	Vendor	WG B5.71 (C)
Dr Jianing Li	University	WG B5.72 (C)
Usman Ajmal	Consultant	WG B5.72 (C)
Richard Adams	Consultant	WG B5.72 (C) WG B5.65 (R) WG B5.70 (C) WG B5.71 (C)
Dr. Daniel Gheorghe	Consultant	WG B5.72 (C)
Joao Pestana	Vendor	WG B5.73 (R)
Saurabh Makwana	Vendor	WG B5.73 (C)
Mohseen Moheemmed	Tx Utility	WG B5.74 (R)
Robert Leone	Vendor	WG B5.74 (C)
Ian Nicoll	Other	WG B5.76 (R)
Jesus Joao	Vendor	WG B5.76 (C)
Daniel Dantas	Utility	WG B5.77 (C)
Conor Shore	Vendor	WG B5.77 (C)
Simanand Gandhi-Jeyaraj	Other	WG B5.77 (C)
Jesus Valdivieso	NGN	WG B5.78 (C)
Venkatesh Chakrapa	Vendor	WG B5.79 (R)
Ryan Young	Gx	WG B5.79 (C)
Adam Dysko	University	WG B5.79 (C)
Ryan Murphy	Vendor	WG B5.81 (R)
PP Angela	TSO	WG B5.81 (C)
Philip Carss	Other	WG B5.81 (C)
Jesudoss Savarimuthu	Gx	WG B5.81(C)
Beatrice Chong	TSO	WG B5.82 (C)

Country Member	Type <ul style="list-style-type: none"> ○ Tx Utility ○ Dx Utility ○ Gx Utility ○ Vendor ○ Consultant ○ University ○ Other 	WG Member (WG-__(R)/(C) (R) - regular (C) – corresponding
David Meadows	Vendor	WG B5.82 (C)
Tony Yip	Vendor	WG B5.83 (C)
Ali Adbulla	Vendor	WG B5.84 (C)
Thomas Charton	TSO	WG B5.84 (R)
Daniel Otto	Vendor	WG B5.84 (C)
Ryan Sims	University	WG B5.85 (C)
Liang Wuxing	Consultants	WG B5.85 (C)
Li Ding	Vendor	WG B5.85 (C)
Roshini Shaik	NGN	WG B5.85 (C)
Venkatesh Chakrapani –	Vendor	WG B5/C4.79 (R)
Ryan Young	Gx	WG B5/C4.79 (C)
Adam Dysko	University	WG B5/C4.79 (C)
Oleg Bagleybter	Vendor	WG B5/C4.79 (C)
Sean Norris	Vendor	WG C2/B5.46 (C) WG B5.85 (C)
Sihui Chen	Vendor	WG B5.86 (C)
Benjamin Haines	Other	WG B5.86 (R)
Haiyu Li	University	WG B5.87 (R)
Karan Oommen	Consultant	WG B5.88 (C)
Deepa Shaji Kumar	TSO	WG B5.88 (R)

12.11 Notable Industry Activities, Highlighting Positive Issues And Difficulties

Recognition that technology is a key enabler to meet the net zero targets. Use of AI/ML, and the digital twin.

Lack of Engineering skills to meet increasing demand.

Impact of Renewable Energy on Protection and Control Systems

Impact of Cyber Security on PAC`s particularly as standards are still evolving.

Digital Substation (process bus) – momentum gaining to push to business as usual. Challenge is business case and delivery risk.

Increased move to standard designs and focus on asset / obsolescence management. Supply chain challenges.

Increased move to standard designs and focus on asset / obsolescence management. Supply chain challenges.

12.12 UK Members of the B5 Technical Panel

Chairman: John Wright

Secretary: Ryan Murphy

- Academia by Haiyu Li / Xiao-Ping Zhang
- Transmissions by Mark Stockton / Thomas Charton / Craig McTaggart
- Distributions by Sean Stack / Colin Scoble
- Manufacturers (OEMs) by Robbie Smith / Dave York
- Consultancies/Contractors by Peter Watson
- Others/Rail by Dave Hewings
- NGN : Zhenkun Yang
- Women's Network : Bojana Djukic / Anis Yaakob
- Testing – Ali Abdulla - Omicron

13RM Report on SC C1 System Development and Economics

14.1 Study Committee Scope

SC Chair: Antonio Iliceto
SC Secretary: Peter Roddy

The scope of Study Committee C1 is to study economics and system analysis methods for the development of power systems: methods and tools for steady state and dynamic analysis, planning issues and methods in various contexts, asset management strategies, in order to support electricity system planners worldwide to anticipate and successfully manage system changes to address the arising needs, opportunities and uncertainties while respecting multiple constraints.

14.2 UK C1 Technical Panel

The Technical Panel for UK C1 activities was established in 2024 and has successfully continued through 2025. The purpose of the panel is to achieve the core values of CIGRE through actively building a community of UK C1 members, facilitating knowledge sharing, fostering and mentoring the next generation engineers, and promoting CIGRE in the wider technical community.

The Technical Panel is made up of 9 members from industry and academia. The Chair of the Technical Panel is Bless Kuri, (Regular Member) and Mark Kent (NGN) is the Secretary.

In 2025, the Panel met four times, and has a further meeting planned in December 2025 to develop details of activities in 2026. The Panel successfully planned multiple events including webinars, site visits and liaison meeting.

14.3 CIGRE Paris Session 2026

14.3.1 Preferential Subjects

Preferential Subjects (PS) for Paris Session 2026 are as follows:

PS1: Holistic planning of an integrated energy system for the energy transition

- Sustainable scenarios encompassing gases, heat, mobility, IT (data centres) as loads and as flexibility sources.
- Planning methodologies and modelling targeting net zero while ensuring adequacy of resources and increased resilience.
- Prioritisation of asset management plan and allocation of capital, including role of private investments in transmission networks.

PS2: Strategic investment decisions in the context of the energy transition

- Optimal portfolio mix of transmission, generation, storage and non-wire solutions for ensuring adequacy, resilience and flexibility, and relevant governance framework.

- Investment economics and risk analysis in the new energy landscape.
- Sustainable asset management practices, especially for aging infrastructures.

PS3: Planning the cyber-physical system

- Impact of digitalisation on power system planning: role of AI, digital twins, big data.
- Integration of physical, cyber and electrical security with asset management techniques.
- Case studies of successful applications of modelling and digital tools in power system planning.

14.3.2 Papers

All eleven synopsis from the CIGRE UK Study Committee C1 submitted for the Paris 2026 session were accepted. Seven of these were on PS1, three on PS2 and one on PS3. Authors of these synopses have been advised of acceptance, and the general deadline for sending in papers to the National Committee was also advised as 12 January 2026. This is an encouraging success rate.

14.4 New Working Groups

Several new working groups have been established this year with candidates provided from the UK.

These include:

- **C1.55.** A Benchmarking survey on the use of Asset Investment Planning practices and systems by Utilities,
- **C1.54.** Assessment of system reserves and flexibility needs in the power systems of the future, and a Joint working group,
- **C1/D2.56.** Electrical-Cyber Integration to meet Net Zero Goal by support of Cloud Infrastructure.

There are a number of new working groups also in the early planning stages including:

- **C1.57.** EV charging infrastructure impact on grids,
- **C1.58.** VSC-HVDC transmission system planning, and
- **C1.59.** Power-Heat Sector Integration

14.5 Technical Panel Meetings, Seminars & Tutorials

- UK C1/NGN Webinar – January 2025 – “How far does the power need to go?”
- C1 Liaison Meeting – April 2025 - Birmingham
- Site Visit – October 2025 – Blackhillock Substation & Zenobe BESS
- Montreal Symposium – C1 Attendance

- C1 Webinar – Planned Q1 2026 – “Potential Roles of Energy Storage”
- C1 Liaison Meeting – tbc 2026
- C1 Site Visit – Keele Smart Demonstrator – tbc 2026

14.6 Last Study Committee Meeting (Highlights)

Study Committee (2 October 2025) – Face to face during Montreal Symposium

It was announced that Antonio Iliceto will cease to be the Chair of SC C1 in August 2026 and Chiara Vergin will take over as Chair. Peter Roddy will also step down at the same time, after serving as secretary for 25 years.

The meeting covered the following:

- Updates from active working groups and recently closed working groups
- Update on C1 session and tutorials
- Discussed and agreed new Working Groups
- Discussed plans for Paris 2026
- Excellent attendance online and virtually

14.7 Current Working Groups and UK Members

Number	Title	Status	UK Member
C1.23	Transmission investment decision points and trees	TB published	Daniel Clarke (National Grid) Peter Roddy (NESO)
C1/6.42	Planning tools and methods for systems facing high levels of distributed energy resources	TB progressing well, resource required to continue development.	Charlotte Higgins (Arup)
C1.48	Role of green hydrogen in energy transition: opportunities and challenges from technical and economic perspective	TBC	TBC
C1.33	Interface & allocation issues in multi-party and/or cross-jurisdiction power infrastructure projects	Progress stalled, resource required to continue.	Peter Roddy (NESO)
C1.51	Potential Roles of Energy Storage in Electric Power Systems	TB published	Mark Kent (SPEN) Kelly Loukatou (NESO) Keith Bell (University of Strathclyde) Colin Ray
JWG C6/C1/CIREN.50	Planning distribution networks under significant uncertainties	WG starting Nov. 2025.	Mark Kent (SPEN) Daniel Donaldson

			(University of Birmingham)
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14.8 UK Members of the Technical Panel

This year we bid farewell to Sami Abdelrahman who is leaving the UK. Sami has immensely contributed to the C1 UK Technical Panel meetings and activities. We wish him well in his endeavours. We were pleased to welcome Margi Shah who joined the Technical Panel. The current Technical Panel stands as follows:

Bless Kuri (SSEN Transmission) – Regular Member

Mark Kent (SPEN) – Secretary

Charlotte Higgins (Arup)

Calum Mackenzie (NGET)

Sivapriya Mothilal Bhagavathry (PNDC)

Keith Bell (University of Strathclyde)

Kelly Loukatou (NESO)

Raul Montano (Hitachi Energy)

Margi Shah (SPEN) - NGN

14RM Report on SC C2 System Operation and Control

14.1 Study Committee Scope

SC Chair: **Renuka Chatterjee**
SC Secretary: **Vinay Sewdien**
UK Regular Member – **Ronan Jamieson**

The scope of C2 covers the technical, human resource and institutional aspects and conditions for the secure and economic operation of power systems under security requirements against system disintegration, equipment damages and human injuries and security of electricity supply.

14.2 Strategic Advisory Groups

TD 1: Real-time System Operation and Control
TD 2: System Operational Planning and Performance Analysis
TD 3: Control Centre Infrastructure and Human Resources for System Operation

14.3 Preferential Subjects

The Paris 26 Session had the following preferential subjects on

PS 1 : Advanced decision support, training and skills for control room personnel

- New requirements for personnel skills, procedures and tools
- Digitalization and use of artificial intelligence for enhancing decision support
- Operational procedures, tools and processes for operating grids during extreme events

PS 2 : Maintaining operational reliability through flexibility

- Methods to identify and quantify system services in response to the energy transition
- Operational experience with flexibility services, including demand side response, topology changes, sector coupling and results from pilots

PS 3 : Power system dynamics and control in operations

- Operational experience with managing power system stability, including oscillations
- Monitoring and control of power system dynamics in the control room, including wide area systems
- Impact of adverse interactions between power electronics interfaced devices on system operations

14.4 Working Groups

New Working Groups

- C2/C4.47 Wide Area Operational Security Systems to enable the Energy Transition

Current WGs:

- WG C2.44 - Operational strategies to manage power system minimum operating conditions
- WG C2.45 - Estimation, evaluation, and provision of power system inertia in networks with high share of renewable generation
- JWG C2/B4.43 - The impact of offshore wind power hybrid AC/DC connections on system operations and system design
- JWG C2/B5.46 - System Integrity Protection Schemes and the N-1 criteria

14.5 Technical Panel Meetings, Seminars & Tutorials

- WG C2.39 - Operator Training in Electricity Grids at Different Control Levels and for Different Participants/Actors in the New Environment
- WG C2.42 - The impact of the growing use of AI/ML for power system operations from an operational perspective
- JWG C2/B4.43 - The impact of offshore wind power hybrid AC/DC connections on system operations and system design

14.6 Technical Brochures

Published Technical Brochures

- TB 925 - Operator training in electricity grids at different control levels and for different participants, actors in the new environment
- TB 943 - Evaluation of Voltage Stability Assessment Methodologies in Modern Power Systems with High Penetration of Inverter-Based Resources
- TB 941 - The Impact of Electricity Market Interventions by System Operators during Emergency Situations
- TB 936 - Enhanced Information and Data Exchange to Enable Future TSO-DSO Coordination and Interoperability
- TB 946 - The impact of the growing use of machine learning/artificial intelligence in the operation and control of power networks from an operational perspective
- TB 917 - Wide Area Monitoring Protection and Control Systems – Decision Support for System Operators

14.7 Last Study Committee Meeting (Highlights)

This RM participated in the Trondheim Symposium from 12-15 May 2025. The SC had a face to face meeting during the symposium and chaired four engaging paper sessions:

System Operational Challenges and Experiences with Integration of Renewables, Tools and Methods for Congestion Management and Operational Planning, Inertia Monitoring DSA and other Tools for Enabling System Operations with Increasing IBR & Ancillary Services and Control in Power Electronics Dominated Power Systems.

Also C2 is in the process of developing a Task Force with SC C4 and C1 that will focus on the interconnection of large loads on the power system, their impacts to the system and considerations for power system operation and control. SC C2 will also begin exploring power system disturbances that have occurred over the last 10 years as the energy transition has unfolded. By analyzing past disturbances, SC C2 will be able to identify how the causes of disturbances has changed over the years and also determine if disturbances are occurring more frequently on the power system as a result of the energy transition.

15RM Report on SC C3 System Environmental Performance

15.1 Study Committee Scope

SC Chair: Mercedes Vazquez

SC Secretary: Angel Salinas

The mission of SC C3 is to facilitate and promote the principles of sustainable development in the field of power system performance through the global exchange of information and knowledge, generating added value by identifying best practices and developing recommendations in line with global best practices.

The scope of SC C3 covers interactions between the natural and social environments and the end-to-end electricity system. It involves addressing environmental and social impacts such as land use, biodiversity; greenhouse gases; air, soil, and water pollution; natural resource consumption; waste generation; electromagnetic fields; noise or landscape. It also considers the prominent role and relevance of different stakeholder groups, with a special focus on local communities.

The main areas of attention for the C3 SC are: All kinds switching devices, including AC and HVDC;

- Environmental & social impacts of power system development and operation with a life cycle approach
- Sustainability: role of the power system
- Stakeholders' engagement and public acceptance

15.2 Strategic Advisory Groups

AG 3.01 Electric and magnetic fields and human health – Convenor: Michel Plante

15.3 Current Working Groups and Joint Working Groups

SC C3 presently consists of the following WGs detailed below by topic and their current status.

Working Group number	Title	Activity	UK member
AG 3.01	EMF and human health	Active	Hayley Tripp
WG 3.09A	Corridor management	Finished	
WG C.12	Methodologies for Greenhouse gas inventory and reporting for T&D utilities (Renewed TOR, not approved yet): Managing GHG emissions of T&D activities. Accounting, reducing & reporting progress.	To be relaunched (TOR to be reviewed and need of convenor)	
WG C3.15	Best environmental and socioeconomic practices for improving public acceptance of high voltage substations	TB and tutorial completed by Joris den Breejen (NL)	
WG C3.16	Interactions between electrical infrastructure and Wildlife	Taken over by new JWG C3.B2/24	
WG C3.17	Interaction between wildlife and emerging renewable energy sources and submarine cables	To be relaunched (TOR to be	

		reviewed and need of convenor)	
WG C3.20	Sustainable Development Goals in the Power Sector	Active. Convenors: Lou Cecere (USA) /Katia Garcia (BR) /Manon Schenkels (NL)	
WG C3.22	Vegetation management in substations	Active: Vincent Du Four (BE)	
WG C3.25	Eco-design methods for TSOs/DSOs under environmental transition	Relaunched and new WG	
JWG C3.B2/24	Methods of reducing electrocution of birds from power lines	WG was created to complete WG C3-16 work, and the TOR was approved in 2023 Brian McGovern (IE)	
JWG B1/C3 85	Environmental impact of decommissioning of underground and submarine cables	Active: Kieron Leeburn (ZA)	
JWG A2/C3.70	Life Cycle Assessment (LCA) of Transformers	Myles Margot (DE) New WG	

15.4 New and Disbanded Working Groups

New WGs:

- WG C3.25: Eco design methods for the power system -
- JWG C3/B2.24: Methods of reducing electrocution of birds from power lines

WGs Disbanded:

- WG C3.13 Impact of environmental liability on transmission and distribution activities - disbanded with no publication
- WG C3.18 Eco-friendly approaches in transmission and distribution disbanded with no publication
- WG C3.21 Including stakeholders in the investment planning process (Renewed TOR of former JWGC1/C3.31)- disbanded with no publication

15.5 Technical Brochures and Publications

The following table details the most recent publications, and pending publications related to SC C3.

Ref	WG	Title
TB 966	WG C3-09A	Sustainable corridor management
TB 965	WG C3.15	Best environmental and socio-economic practices for improving public acceptance of high voltage substations
Submitted to CSE	AG 3.01	HVDC Transmission lines and health
Submitted to Scandinavian Journal of work environment and health	AG 3.01	Risk of interference of high 50/60 Hz electric and magnetic fields with the normal functioning of active cardiac implants: from the recent 20 years of research to return to work facilitation for utility workers
In preparation for	AG 3.01	The real cause behind "Electromagnetic hypersensitivity, or hypersensitivity to electromagnetic fields". What should employers do?

submission to CSE		
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15.6 Preferential Subjects

The Preferential Subjects during the Trondheim 2025 session were:

- PS1: Integrating sustainability criteria into network planning, project design and construction;
- PS2: Technology to reduce environmental impact Power infrastructure and biodiversity / Technology to reduce environmental impact

In all 15 papers were accepted and presented during the Symposium and a tutorial session from WG C3-15 covering the “Best environmental and socio-economic practices for improving public acceptance of high voltage substations” took place.

15.7 Technical Meetings, Seminars & Tutorials

The 2025 Annual SC C3 Meeting was held in person at the Trondheim symposium on Tuesday, May 15

The meeting agenda covered, among others, the following:

- The SAG meetings
- An update of AG 3.01 activities.
- Updates of WG from Convenors
- SC discussions on:
 1. Existing WG: cancelation or relaunching of “non- active” WG.
 2. New working groups
 3. Other proposals
- Participation in Cigre activities
 1. Paris session 2026:
 - a. Preferential subjects and Special reporters
 - b. Paper reviewers
 - c. Cigre collaborations
 - d. Webpage
 2. Other Symposiums in 2025:
 - a. Montreal (Canada) 2025
 - b. Cabon storage (Kosovo) October 2025
 - c. EMF specific meeting (Italy) 2026.

The next meeting of the C3 SC will be at the Paris Session in August 2026.

15.8 Last Study Committee Meeting (Highlights)

Study Committee C3 met during the Trondheim 2025 Symposium on the 13th May. It was chaired by Mercedes Vazquez who welcomed all attendees.

The meeting agenda was reviewed and approved along with the minutes of the last meeting in 2024.

Mercedes discussed changes to the C3 Regular Members and introductions for all new members were made. A discussion proceeded about the number of disbanded WG, and that the scope of these WGs is large and a narrower approach for proposals may be more successful. A reminder was given about the need for WGs to use the correct online tools to draft Technical Brochures. Working Groups were also reminded that it must produce Technical Brochures as part of its work.

An update of current WGs were made by convenors of each group, including focus of work to date, members, and progress.

TD1 Asset management and environment

The WGs are focused on identifying the interaction between nature and infrastructure and defining tools and measures to minimise their negative impact and enhance their positive contribution. There are some active WG regarding this topic:

C3-09 A: “*Corridor management*”. This WG was disbanded for a few years, but the TOR of the group was reviewed, and a new version of the group (C3-09A) continued. The WG collected information and compared regulation, procedures, methods, and best practices from different countries that apply to relations with landowners and environmental aspects of corridor management. The tutorial was finally presented during the 2024 Paris Session, and the TB has been published this year.

WG C3.22 “*Vegetation management in substations*”. The main intention of the work is to identify experiences and knowledge regarding the alternatives to the use of herbicides, but the scope also includes the collection of best practices regarding types of surfaces and vegetation control in substations. The work is in progress.

JWG B1/C3 85 “*Environmental impact of decommissioning of underground and submarine cables*”. It focuses on old and new cables and is investigating the decommissioning strategy (leave it in or dig it up) and impact on environment. The work is in progress.

JWG C3.B2/24 “*Methods of reducing electrocution of birds from power lines*”. This WG was created to complete WG C3-16, and the TOR was approved in 2023. new convenor is leading the group and work is in progress.

Non active WG:

WG C3-17 “*Interactions between wildlife and emerging renewable energy sources and submarine cables*”. This WG was created to complete WG C3-16 work by addressing renewable projects and associated transmission systems, focusing on operational aspects, though construction impacts are also considered. As the scope of the work is very broad, the TOR is being reviewed. The aim is to create one group focused on submarine cables and other groups referred to renewable generation infrastructure. By now, there is no agreement regarding offshore substations & marine substation platforms, as the potential environmental impacts could be similar to the effects of submarine cables. The SC3 is looking for convenors to propose the updated TORs to the Technical Committee and lead the works.

TD2 Sustainability: the role of the power sector

This TD is to address the new trends in the power sector under a sustainability approach. The aim is to anticipate future challenges and their implications.

WG C3-20 “*Sustainable Development Goals in the electric power sector*”. The general aim of the WG is to develop recommendations on how the electric power sector should implement SDGs within their business strategies to reach a maximum contribution to the achievement of these goals. SC3 aim is to publish any result as soon as possible.

WG C3.25 “*Eco-design methods for the power system*”. The purpose of the group is to activate and harmonize the eco-design potential for TSOs/DSOs to reduce environmental impact, given that the implementation of a systemic eco-design approach will be a key success factor to achieve our sustainable goals. The TOR was approved in June 2024, and the first meeting took place during Paris 2024 session. The work is in progress.

Participation in relevant WG led by other SCs:

JWG B3/A2/A3/C3/D1.66 “*Guidelines for Life Cycle Assessment in Substations considering the carbon footprint evaluation*”.

JWG A2/C3.70 “*Life Cycle Assessment (LCA) of Transformers*”

Non active working groups:

C3-12 “Greenhouse Gas Emissions inventory and report for transmission system operators”. The purpose of the WG was to review and recommend harmonized procedures and methods for accounting and reporting GHG emissions that can be used by TSO’s worldwide, but the work of this group was temporary suspended due to a lack of members. The TOR was updated, and a new title was proposed: “Managing GHG emissions of T&D activities. Accounting, reducing & reporting progress”. The SC3 is looking for a new Convenor and participants to relaunch the works.

TD3 Stakeholder engagement and public acceptance

This TD deals with other traditional issue of SC3 scope of work: people. It includes topics related to EMF (as one of the main discussion issues for stakeholders) and engagement strategies to improve infrastructure development and maintenance.

C3-AG: “EMF and Human Health”. The group provides CIGRE with information and advice on topics regarding EMF and all health aspects related to electrical installations and the use of wireless communication. The scope of the advisory group includes:

- AC Transmission line environment - 50/60 Hz Electric and magnetic fields; spark discharges
- DC Transmission line environment - Static Electric and magnetic fields; air ions
- Intermediate frequencies and radiofrequencies up to 300 GHz
- Interference with medical implants (pacemakers; cardiac defibrillators, insulin pumps etc.)

WG C3-15. “Best environmental and socio-economic practices for improving public acceptance of high voltage substations”. The working group aims to make an inventory of the best practices, options, and boundary conditions for the integration of substations in their environment. The resulting Brochure intends to be an international reference document to be used in the discussion with other stakeholders. It should help to identify workable solutions from environmental and socio-economic perspectives and increase acceptance by local authorities. This WG has now completed its work and the Technical Brochure was published this year.

The Paris sessions meeting will be the location of the next SC Technical committee meeting and members were encouraged to attend in person. Proposals for new working groups were presented. There was a call for new work proposals and an encouragement of SC members to use their networks to promote the process.

15.9 Technical liaison committee meetings

The next UK C3 Technical liaison committee meeting will take place online on the 20th January 2026.

16RM Report on SC C4 System Technical Performance

16.1 Study Committee Scope

SC C4 Chair: Marta Val Escudero (IE)

SC C4 Secretary: Dr Genevieve Lietz (DE)

The main mission of Study Committee (SC) C4 is to facilitate and promote the progress of engineering and the international exchange of information and knowledge in the field of end-to-end power system technical performance. To add value to this information and knowledge by means of synthesizing state-of-the-art practices and developing recommendations supporting the energy transition.

The scope of SC C4 is the development and review of methods and tools for analysis related to power systems, with reference to dynamic and transient conditions and the interaction between the power system and its apparatus/subsystems, as well as between the power system and external causes of stress and other installations. Specific issues related to the design and manufacturing of components and apparatus are not in the scopes of SC C4, nor are those specifically related to planning, operation, and control, apart from those cases in which a component, apparatus, or subsystem behaviour depends on, or significantly interacts with the performance of the nearby power system. Thus, the scope of SC C4 is quite broad and covers all aspects of the technical performance of large power systems across the entire range of phenomena and time frames, the continuum of which is shown in Figure 16.1

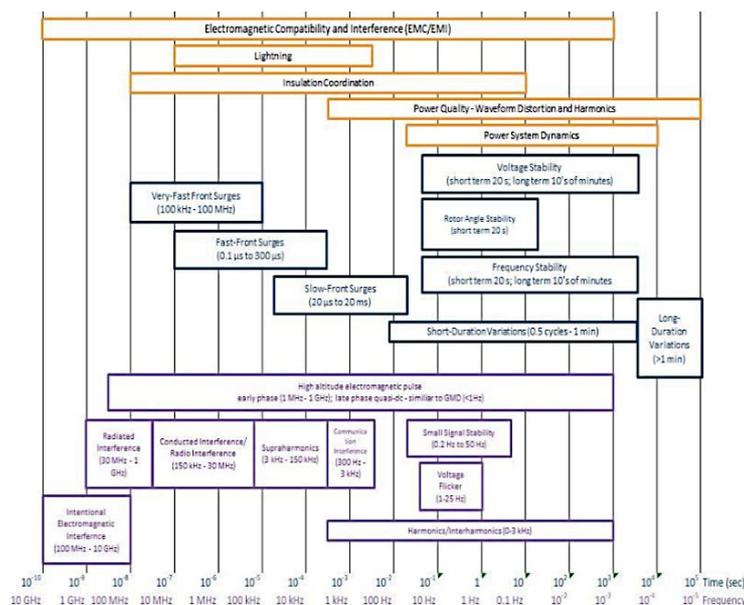


Figure 16.1 Time Frame with the Range of Phenomena Investigated by SC C4.

To better define the scope of SC C4, the following broad topics of interest are covered:

- Power Systems Stability & Dynamics – Performance, Models and Numerical Analysis (PMNA)
- Power Quality (PQ)
- Electromagnetic Compatibility and Interference (EMC/EMI)
- Insulation Coordination (IC)
- Lightning (L), Switching

The common theme among these broad topics is the investigation and development of new tools, models, analysis methods and techniques for the assessment of such phenomena. The list provided above also relates to the emerging smart grid, microgrid and distributed and renewable energy resource technologies (such as wind and solar), with emphasis concerning power quality and advanced tools for the analysis of electromagnetic and electromechanical transients and dynamic performance.

Due to its wide remit, SC C4 alone cannot investigate all technical performance issues without being in close cooperation with other CIGRE SCs that deal with equipment, system planning and operations, distribution networks, materials and testing, and environmental aspects of the power system.

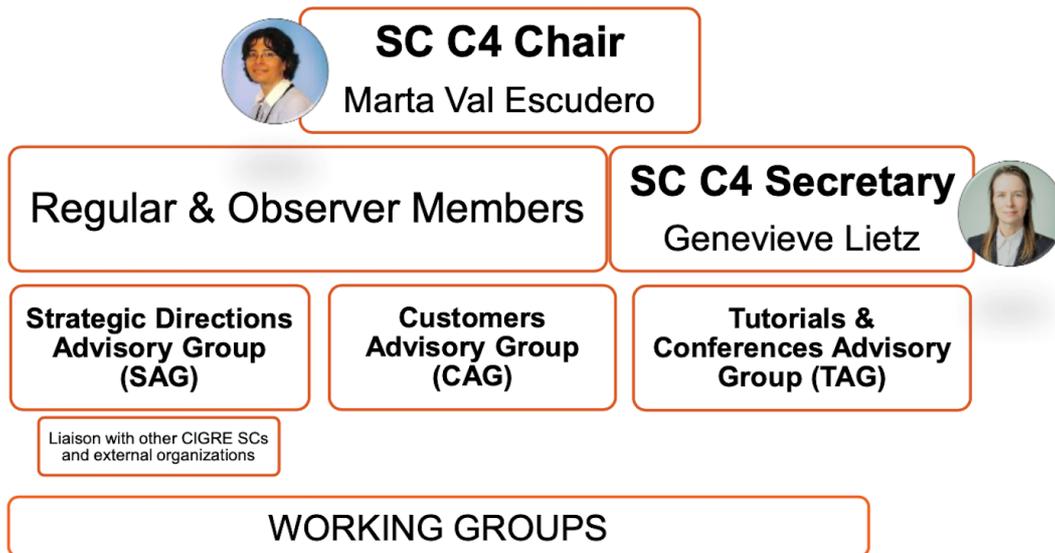
16.2 Structure and Strategic Advisory Groups

The membership of SC C4 presently encompasses 35 countries. At the 2024 SC C4 meeting on Tuesday, August 27th, Palais des Congrès, Paris, France, [the composition of the SC C4](#) was confirmed as follows:

- Chair: Marta Val Escudero (MVE)
- Secretary: Dr Genevieve Lietz
- 27 Regular Members, 3 Additional Regular Members
- 1 NGN Regular Member, 1 WiE Regular Member and 9 Observer Members

Figure 16.2 shows the organisational structure of the CIGRE SC C4. It comprises 3 Advisory Groups (AGs), as follows:

- Strategic Directions AG C4.1 (SAG) – AG1 includes liaisons with IEC and IEEE;
- Customers AG C4.2 (CAG) – Convenor: Position Open
- Tutorials & Conferences AG C4.3 (TAG) – Convenor: Papiya Dattaray (PD)



Country	Name	Nomination	Membership Type
Italy	PISANI Cosimo	2022	regular
Japan	HOJO Masahide	2022	regular
Japan	OKADA Naotaka	2024	Regular Additional
Jordan	WALA Bani Saeed	2024	regular
Jordan	AL-MATAR Suad S.	2024	regular WiE
Netherlands	SCHUTTE Peet	2022	regular
Peru	BEDRINANA Manfred	2024	Observer
Poland	PRZYGRÓDZKI Maksymilian	2025	Observer
Portugal	LEIRIA Andreia	2022	regular
Romania	TOMA Lucian	2022	Observer
Romania	ALBA Miron	2024	Regular
Russia	SHCHEPOTIN Alexander	2024	Observer
Slovenia	RIBIC Janez	2020	regular
South Africa	BEUTEL Andreas	2024	Regular
Spain	SANTOS CARRO Sergio	2020	regular
Spain	GALLARRETA Alexander	2024	Regular NGN
Sweden	NORLANDER Christer	2022	regular
Switzerland	LARSSON Mats	2024	regular
Thailand	PIMJAIPONG Witthaya	2024	Observer
Turkey	GUNERI Melih	2020	regular
United Kingdom	KARAMITSOS Spyros	2020	regular
United States	SINGH Gaurav	2020	regular
United States	MATEVOSYAN Julia	2024	Regular Additional

Figure 16.2: Organisational Structure of SC C4.

16.3 CIGRE SESSION 2026 – Preferential Subjects

The Preferential Subjects (PS) for the CIGRE 2026 Paris Session have been finalised:

PS1: Power system stability aspects of decarbonisation of power systems and the road to net-zero

- Emerging tools and methods for plant and system-wide stability analysis, model validation, advanced data analytics, screening and performance monitoring.
- Power system stability impact of new technologies including storage, large scale inverter-based generators, inverter-based loads, network elements and control methods (e.g. grid forming). Development of appropriate specifications.

- Dynamic phenomena impacting power systems stability - e.g. wide-area, local interactions and forced oscillations.
- Demystifying system strength: definition, metrics, impact on power systems, experiences, challenges and solutions.

PS2: Power quality (PQ) and electromagnetic compatibility/interference (EMC/EMI) aspects of decarbonisation of power systems and the road to net-zero

- Modeling and simulation for assessment of PQ and EMC phenomena and mitigation strategies in meshed transmission systems.
- Experiences with PQ issues in IBR dominated systems and use of advanced data analytics to investigate trends. Approaches for allocation of PQ limits and compliance processes.
- Experiences with EMI for large inverter-based generators and loads and interference between the power system (AC or DC) and pipelines and telecom systems.

PS3: Insulation co-ordination and lightning research: paving the way to net-zero in decarbonised power systems

- Future of insulation co-ordination for AC, DC and hybrid systems.
- Improvement of lightning detection systems with a focus to enhance power system reliability.
- Lightning protection designs and advanced protection of damage to IBRs, including impact on insulation co-ordination.

16.4 Current Working Groups and UK Members

SC C4 presently consists of some **44 active (J)WGs** performing highly technical work aligned with its strategic fields. These WGs are composed of over 600+ individual technical experts from 60+ countries around the world, some serving in more than one WG. The number of active WGs by topic is as follows:

Number	Title (RAG Status)	UK Member
<u>WG C4.36</u>	Winter Lightning – Parameters & Engineering Consequences for Wind Turbines	
<u>JWG C4.40/CIRE</u>	Revisions to IEC Technical Reports 61000-3-6, 61000-3-7, 61000-3-13, and 61000-3-14	Emin, Zia Foster, Sarah Koo, Leong Thomas, Dave Djokic, Sasa Vujatovic, Davor
<u>JWG C4.42/CIRE</u>	Continuous assessment of low-order harmonic emissions from customer installations	Djokic, Sasa Moore, Fabian
<u>WG C4.43</u>	Lightning problems and lightning risk management for nuclear power plants	Siew, Wah-Hoon Knott, Robert
<u>WG C4.44</u>	EMC for Large Photovoltaic Systems	Siew, Wah-Hoon
<u>JWG C1/C4.46</u>	Optimizing power system resilience in future grid design	Panteli, Mathaios
<u>WG C4.47</u>	Power System Resilience (PSR WG)	Rapier, Aisling Panteli, Mathaios Skarvelis-Kazakos, Spyros Strbac, Goran Zhou, Yutian
<u>WG C4.50</u>	Evaluation of Transient Performance of Grounding Systems in Substations and Impact on Primary & Secondary System	Negi, Himanshu

<u>WG C4.51</u>	Connection of Railway Traction System to Power Network	Vujatovic, Davor-Convenor Emin, Zia Ghassemi, Forooz
<u>JWG A1/C4.52</u>	Wind generators and frequency-active power control of power systems	Vujatovic Davor, Jamil Shakin
<u>WG C4.54</u>	Protection of high voltage power network control electronics from the High-altitude Electromagnetic Pulse (HEMP)	Hoad, Richard
<u>WG C4.55</u>	EMC related very-fast transients in gas-insulated substations - EMI, measured characteristics, modelling and simulations	James, Jonathan Haddad, Manu
<u>WG C4.57</u>	Guidelines for the Estimation of Distribution OHL Lightning Performance and Application to Lightning Protection Design Scope	Haddad, Manu
<u>WG C4.59</u>	RT Lightning Protection of the Electricity Supply Systems of the Future	
<u>WG C4.60</u>	Generic EMT-Type Modelling of Inverter-Based Resources for Long Term Planning Studies	Li, Rui Vozikis, Dimitrios Nieto Calvo, Alejandro Larkins , Andrew Vaheeshan, Jeganathan Abiri Jahromi, Amir
<u>JWG B5/C4.61</u>	Impact of Low Inertia Network on Protection and Control	Zhang, Ray - Convenor
<u>JWG: C4/C2.62/IEEE</u>	Review of Advancements in Synchrophasor Measurement Applications	Blair, Steven Clark, Stuart Simmons, Clarke Li, Yun Cowan, Ian L Shams, Negar
<u>WG C4.63</u>	Harmonic power quality standards and compliance verification – a comparative assessment and practical guide	Emin, Zia Shore, Nigel – Convenor Koo, Kah-Leong Pampana, Ramesh Blair, Steven Ghassemi, Forooz
<u>WG C4.64</u>	Application of Real-Time Digital Simulation in Power Systems	Ponnalagan. Bharath Wijesinghe, Sarath
<u>WG C4.65</u>	Specification, Validation and Application of Harmonic Models of Inverter Based Resources	Pampana, Ramesh Monteiro, Jose
<u>WG C4.66</u>	New concept for analysis of multiphase back-flashover phenomena of overhead transmission lines due to lightning	Nurashikin, Jamil
<u>WG C4.67</u>	Lightning Protection of Hybrid Overhead Lines	
<u>WG C4.68</u>	Electromagnetic Compatibility (EMC) issues in modern and future power systems	Ragusa, Antonella Frosinou, Asimina
<u>WG C4.69</u>	Quantifying the lightning response of tower-footing electrodes of overhead transmission lines: methods of measurement	Fabian Koehler
<u>JWG B1/C4.69</u>	Recommendations for the insulation coordination on AC cable systems	
<u>WG C4.70</u>	Application of space-based lightning detection in power systems	Fabian Koehler
<u>WG C4.71</u>	Small signal stability analysis in IBR dominated power system	Tatiana Assis Can Li

<u>JWG C4/B4.72</u>	Lightning and Switching Induced Electromagnetic Compatibility (EMC) issues in DC power systems and new emerging power electronics-based DC equipment	Oheidhin, Gearoid
<u>JWG B4/B1/C4.73</u>	Surge and extended overvoltage testing of HVDC Cable Systems	
<u>JWG B2/C4.76</u>	Lightning & Grounding Considerations for Overhead Line Rebuilding and Refurbishing Projects, AC and DC	
<u>WG C4.73</u>	Insulation Coordination of HVDC Overhead Lines	
<u>WG C4.74</u>	Accurate Line and Cable Models for Steady-State and Transient Studies	Alexander Yanushkevich, Ross Falconer
<u>JWGC4/A3/B2/B4.75</u>	Guide to Procedures for the Creation of Pollution Maps Required for Outdoor Insulation Coordination	
<u>WG C4.76</u>	Protection in Switching Inductive Devices with Vacuum Circuit Breaker	Garret Dakin
<u>WG C4.77</u>	Best practices for individual and collective conformity assessment	Jayaraman Ramachandran Colin Foote
<u>JWG B5/C4.79</u>	Protection Roadmap for Low Inertia and Low Fault Current Networks	
<u>JWG B4/C4.93</u>	Development of Grid Forming Converters for Secure and Reliable Operation of Future Electricity System	Dechao Kong – Convenor Peng, Jinsheng
<u>JWG B4/C4.97</u>	Benchmarking of simulation Models for control interaction in meshed AC networks with multiple converters	
<u>JWG B4/C4.103</u>	AC Network Equivalents for HVDC and FACTS Project Studies	
<u>JWG C2/C4.47</u>	Wide Area Operational Security Systems to Enable the Energy Transition	
<u>JWG C4/A3.79</u>	Temporary overvoltage protection technologies for high-voltage transmission systems with large scale renewable energy bases	Felipe Rocha Velloso Almeida Pedroso Rui Alves
<u>JWG A2/C4/D1.77</u>	Design of transformers for very fast overvoltages	
<u>JWG: C4/B1/B2/B4.78</u>	Interference effects between HVDC circuits and nearby metallic infrastructure	Gearoid O' Heidhin Omer Habiballa
<u>JWG A3/A2/B3/B4/C4.53</u>	Inductive load switching in transmission and distribution systems	

The number of the above-mentioned 44 active (J)WGs by topic is as follows:

- Power Systems Performance Models and Numerical Analysis (PMNA): 15 (J)WGs
- Power quality (PQ): 5 (J)WGs
- EMC/EMI: 6(J)WGs
- Insulation Coordination (IC): 8 (J)WGs
- Lightning (L): 10 (J)WGs

16.5 New Working Groups

Following the 2024 Annual SC C4 **5 new WGs** were formed in SC C4 as listed below, while there is further work in progress to propose new WGs:

- **JWG C2/C4.47:** “Wide Area Operational Security Systems to Enable the Energy Transition”. Convenor Giannuzzi Giorgio (Italy)

- **JWG C4/A3.79:** "Temporary overvoltage protection technologies for high-voltage transmission systems with large scale renewable energy bases". Convenor Professor Jinliang He (China)
- **JWG A2/C4/D1.77:** "Design of transformers for very fast overvoltages". Convenor Jurisic Bruno (Croatia)
- **JWG: C4/B1/B2/B4.78:** "Interference effects between HVDC circuits and nearby metallic infrastructure". Convenor Mohammad Nazemi (Germany)
- **JWG A3/A2/B3/B4/C4.53:** "Inductive load switching in transmission and distribution systems". Convenor Christian Heinrich (Germany)

New working group TOR proposals:

- IBL conformity assessment (continuation from C4.77). Convenor: Babak Badrzadeh (Australia)
- Development of network equivalents for assessment of large IBR projects and use of EMT for large scale stability analysis in planning and operations timeframes. ToR under development by Nilesh Modi (Australia)
- Insulation Co-ordination of AC/DC hybrid transmission lines: gap analysis in international standards. Task Force led by Hideki Motoyama (Japan)
- System Strength: concept, metrics and approaches for management from planning to real-time operations. ToR under development by Andrew Halley (Australia).
- WG B4. "Guide for Electromagnetic Transient Studies of VSC-HVDC connected offshore wind farms". Convenor Pierre ULT (rance). C4 liaison member.
- Quantum Information Science and Technology (QIST) for Reliable and Secure Power Systems. ToR under development by Convenor Yifan Zhou (USA)

Other areas of interest in industry were discussed, including whether new ToRs are warranted. It was agreed that TFs will be established to assess needs and develop ToR for new WGs in:

1. Large-scale demand facilities (joint with C2)
2. Review of definition and classification of power system stability phenomena
3. System strength (potential joint TF with IEEE)
4. AI use cases within the scope of C4
5. Impedance-based analysis methods and tools.

Invitations for nominating new WG members will be circulated in due course once the Terms of References for any new WGs are finalised and accepted.

16.6 Technical Brochures

The following **Technical Brochures (TBs) have been published** since 2024 as a result of work done by SC C4 WGs and JWGs:

- **TB 922:** "Review of Large City & Metropolitan Area power system development trends taking into account new generation, grid and information technologies", JWG C1/C4.36, 2024. Convenor: S. Utts. Co-Convenor: V. S. de Jesus.
- **TB 928:** "Multi-frequency stability of converter-based modern power systems.", WG C4.49, 2024. Convenor: Ł. Kocewiak – UK C4 Members: Mills David, Ding Xiaoling, Shore Nigel, Emin Zia.
- **TB 943:** "Evaluation of Voltage Stability Assessment Methodologies in Modern Power Systems with High Penetration of Inverter-Based Resources", JWG C4/C2.58/IEEE, 2025. Convenor U. Annakkage – UK C4 Members: Awadallah Selma.

- **TB 955:** “Lightning Transient Sensing, Monitoring and Application in Electric Power Systems”, WG C4.61, 2025. Convenor: J. He (China) – UK C4 Members: Siew Wah-Hoon.

The following **TBs are expected to be finalised** and submitted for publication in 2025/2026:

Ready for Publication:

- JWG B4/B1/C4.73: Surge and extended overvoltage testing of HVDC Cable Systems

Already reviewed by SC C4. Waiting for final TB Revision:

- JWG C4.42/CIRED: Continuous assessment of low-order harmonic emissions from customer installations
- WG C4.59: Real-time Lightning Protection of the Future Electricity Supply Systems
- JWG B1/C4.69: Recommendations for insulation coordination on AC cable systems
- JWG B2/C4.76: Lightning & Grounding Considerations for Overhead Line Rebuilding and Refurbishing Projects, AC and DC

Draft TBs currently under review by SC C4:

- JWG C4/C2.62/IEEE: Review of Phasor Measurement Unit Applications

Draft TBs expected in 2025-2026, to be reviewed by SC C4:

- WG C4.36: Winter Lightning - Parameters and Engineering Consequences for Wind Turbines
- WG C4.43: Lightning problems and lightning risk management for nuclear power plants
- WG C4.44: EMC for Large Photovoltaic Systems
- WG C4.47: Power System Resilience
- WG C4.50: Evaluation of Transient Performance of Grounding System in Substation and Its Influence on Secondary System
- WG C4.54: Protection of high voltage power network control electronics from the High-altitude Electromagnetic pulse (HEMP)
- WG C4.57: Guidelines for the Estimation of Overhead Distribution Line Lightning Performance and its Application to Lightning Protection Design
- WG C4.60: Generic EMT-Type Modelling of Inverter-Based Resources for Long Term Planning Studies
- WG C4.64: Application of Real-Time Digital Simulation in Power Systems
- WG C4.66: New concept for analysis of multiphase back-flashover phenomena of transmission lines due to lightning
- WG C4.67: Lightning Protection of Hybrid Overhead Lines
- WG C4.68: EMC issues in modern and future power systems
- WG C4.69: Qualifying the lightning response of tower-footing electrodes of transmission lines: methods of measurement
- WG C4.70: Application of space-based lightning detection in power systems
- JWG A1/C4.52: Wind generators and frequency-active power control of power systems
- JWG B5/C4.61: Impact of Low Inertia Network on Protection and Control
- JWG C1/C4.46: Optimising power system resilience in future grid design
- JWG B5/C4.79: Protection Roadmap for Low Inertia and Low Fault Current Networks

SC C4 in CIGRE Science & Engineering Journal (CSE) since October 2024:

CSE Best of C4 Papers Paris 2024 Session

- **PS1: #10459** – “Grid Forming Functional Specifications and Verification Tests for North American Bulk Power System Connected Battery Energy Storage Systems”. Published in CSE No 24 – October 2024. Authors: Aung THANT, Hongtao MA, Andrew ISAACS, Lukas UNRUH, Ryan QUINT, Deepak RAMASUBRAMANIAN, Julia MATEVOSYAN and Andy HOKE.

- **PS3: #10294** – “Transformer Withstand Capability to Temporary Overvoltages: A General Determination Method from Standard Input Data”. Published in CSE No 25 – December 2024. Author: Manuel MARTINEZ-DURO.

SC C4 Newsletter issued in December 2024. Chief Editor: Udaya Annakkage (CA)

JOINT B4/C4 TASK FORCE ON GRID FORMING CONTROLS – Objective:

- To publish a **Reference Paper** providing clarity on the topic of **Grid Forming Controls**, covering aspects like definition, compliance testing, service experience, modelling and tools.
- Timelines and Deliverables: Kick-off in January 2025, CSE paper publication in Q3 2025 –
- Task Force Members:
 - Dechao Kong (Task Force Leader. B4, Developer, Europe)
 - Carl Barker (B4, OEM, Europe)
 - Xiongfei Wang (C4/B4, Academia, Europe)
 - Julia Matevosyan (C4/B4, R&D, North America)
 - Xiao-Ping Zhang (C4/B4, Academia, Europe)
 - Deepak Ramasubramanian (C4/B4, R&D, North America)
 - Xiaoyao Zhou (C4/B4, TSO, Europe)
 - Jean Mahseredjian (C4/B4, Academia/Consultancy, North America) Changjiang Zhan (B4, OEM, Asia & Pacific)
 - Chengyi Wu (NGN)

SC C4 members are asked to support the following WGs:

- **JWG C4.40/CIREN** Revisions to IEC Technical Reports 61000-3-6, 61000-3-7, 61000-3-13, and 61000-3-14, Convener: Mark Halpin (US)
- **WG C4.51** Connection of Railway Traction Systems to Power Networks. Convener: Davor Vujatovic (GB)

16.7 Last Study Committee Meeting (Highlights)

The **2025 Annual SC C4 Meeting** was held on Thursday, May 15th, 2025, during the **CIGRE 2025 NRCC Symposium in Trondheim, Norway**. Participants included SC C4 Regular Members, AG Members and WG Conveners. The meeting agenda covered, the following:

MEETING AGENDA

1	Welcome and introductions	09:00 – 09:15
2	CIGRE Antitrust guidelines	09:15 – 09:20
3	Approval of Agenda (additions/changes)	09:20 – 09:25
4	SC C4 membership & structure	09:25 – 09:35
5	Study Committee Chair's report	09:35 – 10:00
6	Trondheim 2025 Symposium: “the highlights”	10:00 – 10:15
	Expected C4 workload for 2025	10:15 – 10:30
	Morning Coffee break	10:30 – 11:00
	New WG management tool platform	11:00 – 11:10
	Advisory Group 1 – Strategic Directions: <ul style="list-style-type: none"> • SAG Membership • Status of Current Active WGs/JWGs • New ToRs under development <ul style="list-style-type: none"> ○ Interference effects between DC transmission lines and nearby pipelines (Mohammad Nazemi -DE) ○ Insulation coordination for AC systems interconnected with DC systems (Hideki Matoyama -JP) ○ IBL conformity assessment (Babak Badrzadeh -AU) ○ Temporary overvoltage protection technologies for large-scale renewable energy systems (Jinliang He - CN) 	11:10 – 12:30
	Lunch break	12:30 – 13:30
8	Advisory Group 1 – Strategic Directions: (<i>continuation</i>) <ul style="list-style-type: none"> • Institutional liaison reports 	13:30 – 14:00
8	Advisory Group 2 – Customers	14:00 – 14:10
9	Advisory Group 3 – Tutorials & Conferences <ul style="list-style-type: none"> • 2025 Symposia • Other supported events • Recent Tutorials and Workshops 	14:10 – 14:30
	• CIGRE Academy Webinars	
12	Publications: Technical Brochures , CSE papers, Green Book	14:30 – 15:00
	Afternoon Coffee break	15:00 – 15:30
	Paris 2026 Session	15:30 – 16:00
14	Next SC C4 Meetings	16:00 – 16:10
15	Any Other Business	16:10 – 16:30
16	Final remarks and closing of the meeting	16:30

16.8 Technical Panel Meetings, Seminars & Tutorials

Past Events: Since August 2024, SC C4 has supported the following events:

CIGRE 2024 Paris Session: As part of the CIGRE 2024 Paris Session that was held from Sunday 25 to Friday 30 August 2024, SC C4 had a Group Discussion Meeting on Friday August 30, 2024, a Paper Session, as well as Workshop and Tutorial events described below:

- **The SC C4 Group Discussion and Paper Session:** SC C4 selected **81 papers** aligning with the **3 Preferential Subjects (PS)** for the 2024 CIGRE Session. 2 out of the 81 selected papers were submitted as part of NGN Member showcase competition.
- **Joint C4/C1 Workshop** entitled: “Resilience by design”, August 27, 2024
- **The SC C4 Workshop** entitled: Workshop: C4 Green Book – “Power system dynamic modelling and analysis in evolving networks”, August 28, 2024.
- **The SC C4 Tutorial** entitled: WG C4.68– “EMC issues in modern and future power systems “, August 29, 2024.
- **SC C4 Group Discussion Meeting**, August 30, 2024.

CIGRE 2025 Symposium Trondheim (Norway) – “Changes needed in the power system for the energy transition”, 12-15 May 2025.

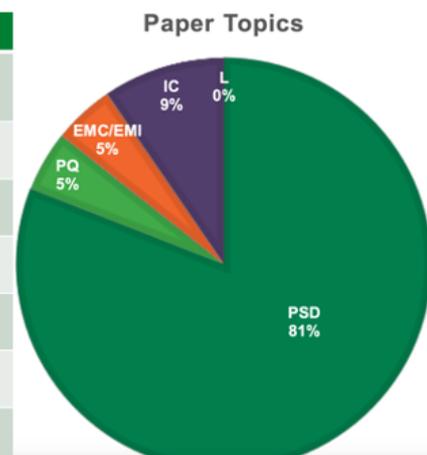
CIGRE SC C4 co-led with B1, 11 participating SCs and the Preferential Subjects were:

- **PS1:** Integration of renewable energy resources to the grid
- **PS2:** Technologies supporting the power grid for energy transition to carbon neutral energy production

It comprised of:

- **7 paper sessions**

#	Session Chair	Session Title
1	Spyros Karamitsos (SPR)	Instability and Oscillations in Inverter Dominated Power Systems (7 papers)
2	Yannick Vernay (RTE)	Dynamic Performance of Power Systems in the Energy Transition (5 papers)
3	Peet Schutte (DNV)	Power Quality, Transients and EMC Challenges in the Energy Transition (8 papers)
4	Babak Badrzadeh (Etik Energy)	Enhanced Models and Simulation Capabilities for Inverter Dominated Power Systems (6 papers)
5	Claus Leth Bak (Aalborg University)	Enhanced Solution Methods for Analysis of Modern Power System (8 papers)
6	Julia Matevosyan (ESIG)	Grid Forming, analysis methodologies (3 x B4 papers + 4 x C4 papers)
7	Vinay Sewdien (Microsoft)	Power System Stability in Inverter Dominated Grids (3 x C2 papers + 4 x C4 papers)



- **42 selected Papers and 40 Presentations from 21 Countries.**
 - **Synopsis:** 63 accepted
 - **Papers:** 42 accepted
 - **Review panel:** 56 experts from 31 countries

<p>1. Emerging Stability Challenges</p> <ul style="list-style-type: none"> • Oscillations more frequent, driven by weak grids & control interactions. • Forced & natural oscillations require attention; traditional definitions limited. • Converter-Driven Stability (CDS) and Resonance Stability call for refined frameworks. 	<p>2. Advanced Control & Mitigation</p> <ul style="list-style-type: none"> • GFM inverters & STATCOMs demonstrated for damping & blackstart. • HVDC studies highlight need for coordinated tuning and modelling standards. • FACTS devices used for sub-synchronous interaction mitigation. 	<p>3. Simulation & Methodologies</p> <ul style="list-style-type: none"> • EMT simulations essential for fast transients; use is increasing. • Nyquist-based SISO analysis and impedance methods validated for interactions. • Screening metrics must be complemented by detailed simulations. 	<p>4. Modelling & Interoperability</p> <ul style="list-style-type: none"> • Black-box models and vendor confidentiality limit collaborative analysis. • Adoption of FMI standards and EMT translation facilitates integration. • Emphasis on HIL and load model fidelity for distribution-level dynamics.
<p>5. Power Quality, EMC & Transients</p> <ul style="list-style-type: none"> • Harmonic management critical in weak grids; IEC-based allocation advocated. • EMT studies crucial for overvoltage, switching surge, and GIC resilience. • GFM control improves PQ and harmonic damping at interfaces. 	<p>6. GFM Control & Specifications</p> <ul style="list-style-type: none"> • Comparative studies on GFM control configurations reveal performance trade-offs. • Performance envelopes proposed as an effective specification approach. • Small Signal Models (SSMs) validated as valuable design tools with EMT 	<p>7. Dynamic Performance & Security</p> <ul style="list-style-type: none"> • Case-specific reliability screening and Dynamic Security Assessment tools discussed. • Locational inertia and variability between IBR technologies recognized. • Cross-committee (C1, C2) collaboration vital to align planning and operations. 	<p>Closing Remarks - IBR Integration demands:</p> <ul style="list-style-type: none"> • New analytical frameworks - Standardised modelling practices • Enhanced EMT and hybrid simulations • Stronger TSO-vendor collaboration • Performance-based control specifications

- **2 Tutorials + 1 Workshop**
 - **B4/C4 Workshop:** “Modelling and Tools for Resilient Power Systems Design:-a HVDC-WISE Workshop”
 - **C4 Tutorial:** “Modelling of Inverter Based Resources and Distributed Energy Resources for System Analysis”
 - **C4/C2 Tutorial:** JWG C4/C2.62 - “Recent Advancements in Technology and Applications of Synchrophasor Measurements” ()
- **AG and SC Meeting - 2 WG meetings**

CIGRE 2025 Symposium Montreal (Canada), – “Grid Enhancement, Strategic Planning, Technological Innovation and Climatic Adaptation for Resilient Future Energy Systems”, 29 September - 2 October 2025:

Preferential Subjects:

- **PS1:** System Enhancement, Markets and Regulation
- **PS2:** Application of Technologies, Information Technology (IT) and Artificial Intelligence (AI)
- **PS3:** Climate Change and Extreme Weather Events
- **EHV & UHV AC and DC**

B2/C4 Tutorial: Lightning & Grounding Considerations for Overhead Line Rebuilding and Refurbishing Pro-jects, AC and DC (JWG B2/C4.76)

- Presenter: Dr. Lukas Schwalt (Austrian Power Grid AG). Event: CIGRE Austria Conference. Vienna 28 January 2025

B2/C4 Tutorial: Lightning & Grounding Considerations for Overhead Line Rebuilding and Refurbishing Pro-jects, AC and DC (JWG B2/C4.76)

- Presenter: William A. (Bill) Chisholm (JWG B2/C4.76 Convener). Event: CIGRE Canada Conference. Winnipeg 28 October 2024

CIGRE ACADEMY Webinars:

- **JWG C4/A3.53** – “Deeply Suppressing Overvoltages in UHV AC Systems by Advanced Surge Arresters”, Prof. Jinliang He
- **JWG C4/C2.58/IEEE** – “Evaluation of Voltage Stability Assessment Methodologies in Transmission Systems”, Udaya Annakkage, Costas Vournas, Mohamed Ramadan Younis, Katelynn Vance, Anurag Srivastava, Venkataramana Ajjarapu, Thierry van Cutsem, Jose Rueda Torres
- **WG C4.61** – “Lightning Transient Sensing, Monitoring and Application in Electric Power Systems”, Prof. Jinliang He

Future Events: Below are the upcoming events supported by the CIGRE SC C4, in terms of planned Meetings, Seminars, and Tutorials:

CIGRE 2026 Paris Session, France, 23-28 August 2026

Preferential Subjects:

- **PS1:** Power System Stability Aspects of Decarbonization of Power Systems and the Road to Net-Zero
- **PS2:** Power Quality and Electromagnetic Compatibility Aspects of Decarbonization of Power Systems and the Road to Net-Zero
- **PS3:** Insulation Co-Ordination and Lightning Research: Paving the Way to Net-Zero in Decarbonized Power Systems

SC C4 Works and planning towards the 2026 Paris Session.

- Review panel required to be set up to meet various review deadlines
- Tutorial / workshop topics
- Special Reporters and Poster Coordinators sought
- C4 GDM will take place on Tuesday 25th August
- C4 poster session, tutorial and workshop will take place on Wednesday 26th August
- C4 will support C2 in a joint GDM session for C2-PS3 (Power system dynamics and control in operations) on Thursday 27th August
- C4 Annual Meeting will take place on Friday 28th August
- Online: January 2026 o In-person: Paris2026

SC C4 will hold a meeting in Thailand - Bangkok, November 2027

16.9 UK SC C4 Technical Panel Members and Meeting

[The 2025 CIGRE UK Study Committee C4 Technical Panel Liaison Meeting](#) held in conjunction with the CIGRE UK SC C4 Technical Event entitled “[Developments and Challenges in Grid Integration and Power Systems Stability](#)”. This hybrid event took place at the Scottish Power Headquarters in Glasgow, on January 21st and was chaired by the CIGRE UK SC C4 Regular Member, Spyros Karamitsos. Over 200 colleagues across the industry joined both in person and online, attending 12 excellent presentations and contributing to the discussion during the Q&A and networking sessions



It brought together experts from industry and academia to present issues in ‘Grid Integration and Power Systems Stability’ and discussed advancements in modelling methods and study tools essential for analysing these complex systems. In-Depth Discussions related to:

- Power System challenges towards Net Zero transition – impact on electricity network stability aspects of the modern inverter dominated grids and main considerations due to interactions, transients, power quality issues, grid-forming technology (restoration) and AI.
- Grid Integration of Renewable Energy Systems BESS, FACTS and HVDC Interconnectors – state-of-the-art technologies, grid code compliance, advanced practices, methods and tools for power system analysis.

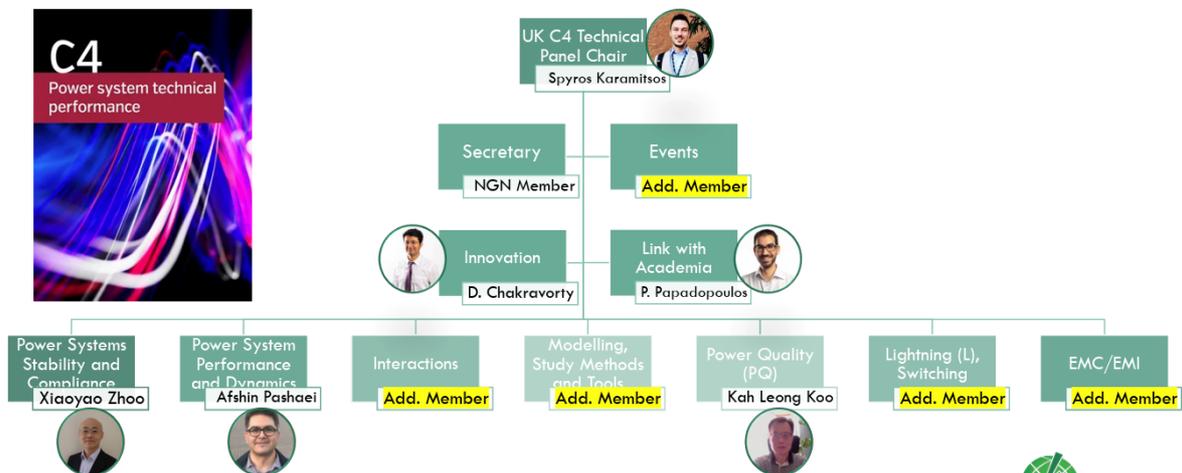
The meeting also provided a high-level overview of the ongoing activities in CIGRE related to SC C4 – Power System Technical Performance. Technical Brochures published in the last year were highlighted, along with a status update on certain active SC C4 Working Groups with UK participation. Special mention was made to the work items approved by the C4 Study Committee during the CIGRE 2024 Paris Session and possible work items that could be proposed in the future. The 2025 CIGRE UK Event’s Agenda is shown below:

CIGRE UK Study Committee-C4 Liaison Meeting & Technical Event 2025		
Developments and Challenges in Grid Integration and Power Systems Stability		
Time	Topic	Presenter
10:00- 10:25 Arrival and Welcome Refreshments - Tea/Coffee		
10:25	Welcome	Dr Sofia Koukoura, Innovation Manager at Scottish Power
10:30	Welcome from the Regular Member the CIGRE UK Study Committee C4 - Event Introduction & Overview of CIGRE SC C4 Activities and Updates, incl. Paris Session 2024	Dr Spyros Karamitsos, Chair-Elected Regular Member of CIGRE UK Study Committee C4, UK Lead Grid and System Studies Manager at Scottish Power / Iberdrola (SPR/IBR)
10:50	CIGRE and Energy Innovation: Technical Committee Introduction	Dr James Yu, Chair of CIGRE UK Technical Committee
11:00	Clean Power 2030, Power System Stability Challenges	Dr Xiaoyao Zhou, Operability Policy Manager at National Energy System Operator (NESO), Honorary Professor at the University of Birmingham
11:30	Overview of CIGRE TB 908: "Guidelines for Sub-synchronous Oscillation Studies in Power Electronics Dominated Power Systems", JWG C4/B4.52	Dr Afshin Pashaei, Power Quality & Dynamic Performance Manager at National Grid, UK Member of the CIGRE JWG C4/B4.52
12:00- 12:30 Q&A - Break - Networking Lunch		
12:30	Advancing Grid Stability, System Modelling and Risk Mitigation Techniques in Power Systems - Insights from the National HVDC Centre	Ben Marshall, HVDC Technology Manager at The National HVDC Centre Dr Colin Foote, Senior Simulation Engineer at The National HVDC Centre Dr Dong Chen, Senior Simulation Engineer at The National HVDC Centre
13:00	Stability Challenges in Converter Dominated Networks	Prof Agustí Egea Alvarez, Network Operational Performance Manager at Scottish Power Energy Networks (SPEN), Professor at the University of Strathclyde
13:30	Addressing the Complexity and Uncertainty in Future Power System Dynamic Behaviour	Dr Panagiotis Papadopoulos, Reader (Associate Prof) at the University of Manchester
14:00 - 14:30 Q&A - Comfort/Coffee Break		
14:30	Identification of IBR-driven Subsynchronous Oscillations - Overview of CIGRE 2024 Paris Session Papers SC C4-11096, SC C4-11099	Dr Diptaraha Chakravorty, Principal Consultant at SIEMENS Energy
15:00	Harmonic Power Quality Standards and Compliance Verification - Works of the CIGRE WG C4.63, Oscillation Modes Identification via SVD and PCA - CIGRE 2024 Paris Session Paper SC C4-11448	Dr Kah-Leong Koo, Technical Director - Power System Studies at Power Systems Consultants (PSC) Dr Carlos Ferrandón, Senior Strategic Advisory Consultant at Power Systems Consultants (PSC)
15:30	Grid Integration Challenges for Co-locating BESS with existing Onshore Windfarms in Scotland, Overview of CIGRE TB 913: "Evaluation of Temporary Overvoltages in Power Systems due to Low Order Harmonic Resonances", WG C4.46	Dr Isaac Gutiérrez, Principal Electrical Engineer - Control and Grid Integration team - UK Technical Services SPR Kiran Munji, Grid Services Manager at Scottish Power (SPR)
16:15 - 16:30 Q&A - Session Closing Remarks - AOB		
16:30 - 17:00 Networking - Refreshments		

Furthermore, the session unveiled plans for the UK SC C4 for 2024–2026, including the introduction of new members and updates to the Technical Panel structure.

CIGRE UK SC C4 – Organisational Structure

CIGRE UK SC C4 Technical Panel 2024



For nominating new UK C4 TP members - a brief current CV to the CIGRE UK SC C4 RM e-mail: spyros.karamitsos@ieee.org

The 2026 CIGRE UK Study Committee C4 Technical Panel Liaison Meeting will be held in conjunction with the CIGRE UK SC C4 Technical Event and will be co-chaired by the outgoing CIGRE UK SC C4 Chair Spyros Karamitsos (2020-2026) and the incoming SC C4 UK Regular Member for 2026-2028. The goal will be to disseminate CIGRE Paris 2026 SC C4 activities, further organise the CIGRE UK SC C4 Technical Panel and hold a successful CIGRE UK SC C4 Liaison Meeting and Technical Event including a (JWG Update Session and invite Keynote and Guest Speakers from industry, utilities, and academia to maintain member engagement.

17RM Report on SC C5 Electricity Markets and Regulation

17.1 Study Committee Scope

The scope of the Study Committee is to analyse the impacts on the planning and operation of electric power systems of:

- different market approaches and solutions
- new structures, institutions, actors and stakeholders
- Industry practices and standards in terms of certification of origin, for electricity and other energy sources
- the role of competition and regulation in improving end-to-end efficiency of the electric power system.

The study committee focuses on three key areas

- Market structures and products. Market design, physical & financial markets and their interaction, isolated and interconnected systems, interactions with Hydrogen systems.
- Market approaches and tools. Demand & price forecasting, financial risk management, demand management and active customer integration, integration of blockchain technologies.
- Regulations. Regulatory objectives, regulatory approaches, transmission pricing, ancillary service pricing, reliability and economics.

In addition, the study committee is interested in:

- Changes in regulatory roles and jurisdiction related to the interaction between the transmission system and the distribution system.
- The role of retail and wholesale markets, including: the integration and coordination of distributed energy resources; the impact on wholesale market price formation caused by non-wholesale market participants; the need for and development of distribution service providers.
- The impact of emerging technologies on system operations.
- Market clearing procedures, techniques and principles used to take advantage of the flexibility of aggregating large numbers of end-users.
- Potential market rule changes to address changes in traditional ancillary service products.

The current areas of attention, which are reflected in the current working groups:

Demand side developments and their integration into existing market structures

Innovative DR mechanisms and EV charge/discharge solutions have become a priority in the transition to low carbon energies. The WGs focus on the role of transmission system operators (TSOs) and distribution system operators (DSOs) in managing DR and EV services (e.g. operational time frames, service procurement mechanisms, payment methods, and activation of such services) and on the development of market-based approaches for the management of these services (time frame, bid structure, and pricing mechanisms).

- WG C5.31 Wholesale and retail electricity cost impact of flexible demand response
- WG C5.34 Summary of current uses of electric vehicle charge/discharge flexibility in wholesale energy markets and reliable grid operations

Market drivers and development in markets

The purposes for market changes, the initiators of those changes, the processes for selecting a proposed change and the success of changes in meeting their objectives.

- JWG C5/C6.29 New Electricity Markets, Local Energy Communities
- WG C5.40 Framework for retail competition in electricity markets

- WG C5.42 Market pricing issues and solutions for low short-run marginal-cost systems
- JWG C5/C1.43 Approaches to account for the contribution of short-duration electric storage systems in capacity adequacy assessment

Environmental regulation in the electricity sector

A variety of regulatory or market-based approaches are implemented to manage environmental constraints, such as reductions in greenhouse gas emissions

- WG C5.38 Certificates of origin for electricity in power markets
- WG C5.41 Regulation and market design to foster decarbonation through industry electrification

Sector regulation to support investment

Regulatory approaches to foster efficient investment in network assets.

- WG C5.37 Regulatory framework on modernization and extension of useful life of transmission & distribution assets
- WG C5.39 Regulatory frameworks and market integration for assets under non-firm grid connection

17.2 Current Preferential Subject for C5

PS1: Market designs and non-market approaches to support the energy transition

- Ensuring resource adequacy and supporting investment decisions
- Cost allocation for the energy transition: who owns and who pays
- Tradeoffs between markets and regulatory approaches

PS2: Developing reliable price signals and regulations across the value chain

- Tools and approaches for markets to withstand adverse events and shocks
- Consistent end-to-end price signals to integrate emerging technologies, distributed energy resources and energy communities

PS3: Applying practical experiences to emerging issues

- Integrating various electricity markets with emission reduction approaches and long-term contracts
- Market designs and products to deal with increasing short-term uncertainty
- Data analytics in electricity markets, market surveillance and transparency

17.3 Current working groups and UK members

The study committee has 7 working groups (10 at the time of this report). There are 117 members in the working groups. The WG members are spread across 31 countries. Our working groups had 19% female membership and numerous NGN members, several of whom are serving as WG secretaries.

Over the last year, there are increasing UK representation in Cigre Working Groups. If you're interested in joining any of the working groups below, please reach out the UK Regular Member (Sarah Soliman).

Number	Title	UK Member
JWG C5.C6-29	New Electricity Markets, local energy communities	None
WG C5-31	Wholesale and Retail electricity cost impacts of flexible demand response	None
WG C5-34	Summary of Current Uses of Electric Vehicle Charge/Discharge Flexibility in wholesale energy markets and reliable grid operations	None
WG C5-35	Integration of hydrogen in electricity markets and sector regulation	None
WG C5-36	Certification of electricity used to produce hydrogen	None
WG C5-37	Regulatory framework on modernization and extension of useful life of transmission and distribution assets	None
WG C5-39	Regulatory frameworks and market integration for assets under non-firm grid connection	Kate Thompson (EA technology)
WG C5-40	Framework for retail competition in electricity markets	Roya Ahmadi (NESO) and Wei Gan (Cardiff University)
WG C5-41	Regulation and market design to foster decarbonation through industry electrification	Nsrine Kebir (SSE) and Vilhjalmur Jonsson (Blake Clough)
WG C5-42	Market pricing issues and solutions for low short-run marginal-cost systems	Doga Can Tanrikulu (Mott McDonald) & Chao Long
WG C5.C1-43	Approaches to account for the contribution of short-duration electric storage systems in capacity adequacy assessment	Chris Dent (University of Edinburgh) & Luke Yeo (Blake Clough)

17.4 Technical Brochures for 2024-025

The Study Committee published two Technical Brochures:

- TB-948 Integration of hydrogen in electricity markets and sector regulation
- TB-960 Certification of the electricity used to produce hydrogen

Articles in CIGRE newsletters and ELECTRA

In addition to the two Technical Brochure summaries, the Study Committee contributed two articles for Future Connections and ELECTRA:

- “Regulatory frameworks and market integration for assets under non-firm grid connection,” by Rabindra Nath Shaw
- “Regulation and market design to foster decarbonation through industry electrification,” by Xavier Poupart

There are several pending technical brochures:

Four working groups expect to complete their work and publish Technical Brochures in the coming 12 months:

- JWG C5/C6.29 – New Electricity Markets, Local Energy Communities
- WG C5.31 – Wholesale and retail electricity cost impact of flexible demand response
- WG C5.34 – Summary of current uses of electric vehicle charge/discharge flexibility in wholesale energy markets and reliable grid operations
- WG C5.37 – Regulatory framework on modernization and extension of useful life of transmission & distribution assets

18RM Report on SC C6 Active Distribution Systems and Distributed Energy Resources

18.1 Study Committee Scope

SC Chair: Kurt Dedekind (SA)

SC Secretary: Evert de Haan

Communications Officer: Harry Evans

NGN Representative: Stefanie Cray (unconfirmed)

WiE Representative : Belgin Turkey

Mission: Assessment of the technical impacts resulting from a more widespread adoption of DER applications on planning and operation and on approaches, and of enabling technologies and innovative solutions for DER integration in active distribution systems.

Areas of attention include:

- Enabling technologies: active network management, micro-grids, virtual power plants, distribution management systems (ADMS, DERMS), DER monitoring and control, aggregation systems, platforms, block-chain applications.
- Innovative solutions: smart inverters and power electronic interfaces and interconnection device applications, MV/LV DC supply systems, distribution system modernization
- Storage technologies: electrochemical electric battery energy storage systems, flywheels, flow batteries, and new storage technologies, hydropower, hydrogen, multi-energy solutions (with thermal storage), power2X applications (power to heat, power to gas ...), electric vehicles.
- Consumer integration and empowerment: Demand side integration and participation, demand response, load management, smart load, new customer sectors such as electric vehicles, smart home and smart meter applications with impact on distribution systems.
- Smart cities: integrated distribution system technologies, power, control and information and communication technology deployment for flexibility, integration of multi-energy systems.
- Rural Electrification, islanded power systems and individual customer off-grid systems and solutions.

The critical role that SC C6 plays

- Role of DER integration in the Energy Transition, and how to deal with Energy Security in this regard
- The impact of technology on the end-to-end operation of systems
- Impact of new technologies
- Dealing with multi-energy systems
- What measures should we be taking to broaden the scope of the SC activities to include these trends
- The increasing role that the customer plays

18.2 Evolution of changes expected within SC C6

Originally C6 was focused on technology adoption, this has now **evolved** to include:

- Impact of **Smart Inverter** settings and functions, with a view of understanding a model-based analysis of DER functions and their settings
- Optimal Siting of **Microgrids and Energy Storage** for improved resilience measures
- Impact of **Electrification** on the operations of Distribution Networks
- **Flexibility management** and the role that the DSO plays in ensuring a sustainable and reliable provision of electricity
- Operational and system integration requirements for sound TSO-DSO, DSO / Aggregator / Customer functioning. This will include the utility needs, timelines and architectures for full DERMS adoption.
- **Customer empowerment** requirements
- The continued growth of **EV adoption**, including the integration of V2G requirements
- The role and impact of **MV and LV DC** integration with Distribution Networks
- **Rural Electrification...**The challenge of ensuring affordable access to electricity for all

18.3 Strategic Advisory Groups (AG C6.01)

AG C6.02 Quality Check of Brochures' (Conv. Ray Brown, AU)
 AG C6.03 Tutorials (Conv. Samuel Jupe, GB)
 AG C6.04 Women in Energy (Conv. Belgin Turkey)
 AG C6.05 Next Generation Network
 AG C6.06 Communication (Harry Evans)
 AG C6.07 'Rural Electrification' (Conv. Britta Buchholz, DE, Kurt Dedekind)

18.4 Preferential Subjects (CIGRE 2026)

There were 10 submissions to SC C6. After careful review, these papers are accepted and full papers are under preparation.

Preferential Subject 1 Enabling flexibility with increased Multi-Energy integration in Distribution Networks

- Impact of and grid services provision by energy storage systems and energy conversion units (e.g. hydrogen) in distribution systems
- The role of energy communities, aggregators and virtual power plants to enhance the flexibility of distribution networks
- Risk appetite in times of network congestion and the balance between flexibility procurement and stretching operational limits

Preferential Subject 2 The interface between the DSO and customers in distribution networks

- The impact of evolving planning objectives and criteria, with increased electrification and new electric loads, coupled with the changes in end-use technology behaviours.
- Electric Vehicle integration and impact in Distribution Systems
- The role of the DSO to improve power quality and network resilience of distribution networks.

Preferential Subject 3 The adoption of appropriate rural electrification standards, practices and technology options

- Microgrid and multi-microgrid installations (including industry networks)
- Off-grid and island DER applications including appropriate resilience measures
- Applications highlighting the connection of the last mile of rural electrification projects

18.5 New Working Groups 2025

- **Virtual Power Plant aggregation of DER**
Convenor: Prof Nikos Hatziargyriou (Greece)
- **DER integration into Distribution System Operations and Controls**
Convenor: Clara Gouveia (Portugal)
- **Planning Distribution Networks under increasing uncertainty**
Convenors: Federico Silvestro (Italy), Fabrizio Pilo (Italy, CIRED)
- **Modelling technologies and benchmark systems for Distribution Systems with DER**
Convenor: Chengxi Liu (China)

UK is proposing a new one on Distribution System and Its Role in Supporting a low carbon electricity Network Resilience and Restoration

18.6 Technical Panel Meetings, Seminars & Tutorials

The following tutorials were presented by SC C6 recently:

- **CIGRE Symposium Trondheim, May 2025: C6 Workshop** “DSO tools and practices for operating active Distribution networks”
- **CIGRE Symposium Montreal, October 2025:** There is no C6 Tutorials planned for the Montreal Symposium, and no SC Meeting will be taking place there either

A one-day workshop was held in Cardiff on 19th June. There were more 50 attendants. Two international experts from Brazil and USA were invited to Cardiff and gave presentations in-person.

18.7 Technical Brochures

Recently completed Technical Brochures:

- WG C6.31: TB 793 –*Medium Voltage Direct Current (MVDC) grid feasibility study, 2020*
- WG C6.28: TB 826 –*Hybrid systems for Offgrid-Supply, 2021*
- WG C6.38: TB 835 –*Rural electrification, 2021*
- WG C6/C1.33: TB 863 –*Multi-Energy interactions in Distribution Grids, 2022*
- JWG C6/B4.37: TB 875 –*Medium Voltage DC Systems, 2022*
- WG C6.36: TB 906 –*Distributed Energy Resource Models for quasi-static time-series power flow simulations, 2023*
- JWG C1/C6.37/CIRED: TB 923 –*Optimal investment decisions for transmission and distribution networks under increasing energy scenario uncertainty, 2024*
- JWG D2/C6.47: TB 929 –*Advanced Consumer side energy resource management systems, 2024*
- WG C6.43: TB 932 –*Aggregation of Battery Energy Storage and Distributed Energy Resources, 2024*
- WG C6.40: TB 954 –*Electric Vehicles as Distributed Energy Resource (DER) Systems, 2025*

UK is leading and contributing a green book on Application of MVDC, Zhao Ma, Rui Li, James Yu and Jun Liang C6.37

18.8 Last Study Committee Meeting (Highlights)

The last SC C6 meeting took place hybrid (in-person and online) May 2025 in **Trondheim Norway**. Minutes from the meeting has been published.

The meeting covered the following topics:

1. Welcome and introduction
2. Report of the Chair
3. Summary of recent SC C6 events
4. Final reports of terminated WGs
5. Report of Advisory Groups
6. Status of ongoing SC C6 WGs
7. Status of WGs led by other SCs
8. New and Planned WGs
9. SC C6 Green Book
10. 2026 Paris General Session
11. Next SC meetings, future events and activities
12. Organisational matters and other business

18.9 Current Working Groups and UK Members

Number	Title	UK Member
JWG C6/C2.34	Flexibility provision from distributed energy resources	
C6.35	Distributed energy resources aggregation platforms for the provision of flexibility services	
C6.39	Distribution Customer Empowerment	
C6.42	Electric Transportation Energy Supply Systems	
C6.44	Nodal Value of Distributed Renewable Energy Generation	
C6.45	The Impact of DER on the Resilience of Distribution Networks	
C6.46	Energy Efficiency in Distribution systems	
C6.47	DSO-customer interfaces for efficient system operation	
C6.48	DER's Integration in Distribution Systems Operation and Control	Behzad Kazemtabrizi and Jianfeng Wen (NGN)
C6.49	Virtual power plant (VPP) aggregation of distributed energy resources (DER)	Waqquas Bukhsh and Aditya Joshi (NGN)
JWG C6/C2.34	Flexibility provision from distributed energy resources	
JWG C5/C6.29	New Electricity Markets, Local Energy Communities	
JWG C5.31	Wholesale and Retail Cost Impact of Flexible Demand Response	
C6-C1- CIRED.50	Planning distribution networks under significant uncertainties	Laiz Souto and Mark Kent (NGN)

18.10 UK Members of the Technical Panel

Name	Company	Role
Jun Liang	Cardiff University	RM C6 UK
Samuel Jupe	Nortech Management Ltd	TP Secretary / Manufacturer Representative
Julio Perez Olvera	SSEN	NGN / DSO Representative
Harry Evans	GHD	NGN / Industry Representative
Tania Wallis	University of Strathclyde	Women's Network / Academia Representative
James Yu	SP Energy Networks	DNO / DSO Representative
Greg Shirley	NGED	DNO Representative
Matthew Williams	Ionate	Consultancy Representative
Gordon Watson	TNEI	Consultancy Representative

19 RM Report on SC D1 Materials and Emerging Test Techniques

19.1 Study Committee Scope

SC Chair: Simon Sutton (UK)

SC Secretary: Gordon Wilson (UK)

UK RM: Thomas Andritsch

The scope of SC D1 is concerned with the monitoring and evaluation of:

- new and existing materials for electrotechnology,
- diagnostic techniques and related knowledge rules,
- emerging test techniques which may be expected to have a significant impact on power systems in the medium to long term.
- support of other study committees in their analysis of recently introduced and developing materials, emerging test techniques and diagnosis techniques

19.2 Strategic Advisory Groups

AG D1.01 Liquids and Liquid Impregnated Insulation Systems (Qiang Liu (UK))

AG D1.02 High Voltage and Current Testing and Diagnostic (Uwe Riechert (CH))

AG D1.03 Solid Materials (Jerome Castellon (FR))

AG D1.04 Gases (Karsten Juhre (DE))

Tutorial AG (Ivanka Atanasova-Hoehlein (DE))

Strategic and Customer AG (Simon Sutton (UK))

19.3 Preferential Subjects

The Preferential Subjects for 2026 Paris Session are:

PS1 Testing, monitoring and diagnostics

- › Testing and condition monitoring for reliability in conventional high voltage systems and power electronics applications.
- › Understanding of space charge and PD behaviour under AC, DC, rectifier, and impulse stress.
- › Advances in knowledge rules and tools for improved diagnostics including ML, AI, explainable AI (XAI) etc. considering multiple data sources or contextual information.

PS2: materials for electrotechnical purposes and modelling

- › Ageing of materials under electrical, mechanical or thermal stresses and associated ageing markers.
- › Modelling materials and field simulations under AC, DC and composite voltages.
- › Application of novel materials and processes; eco-friendly and recycled materials, materials to enable energy storage or cryogenic systems, additive manufacturing etc.

PS3: measurements and modelling of interfaces

- › Understanding interfacial behaviour through experiments at any scale between the nano- and macro-scale.
- › Modelling electric field, magnetic field, or charge dynamics at interfaces.
- › Assessing material compatibility of used and unaged materials.

19.4 New Working Groups Approved

Number	Title	UK Member
A2/C4/D1.77	Design of transformers for very fast transient overvoltages	TBC

19.5 Technical Panel Meetings, Seminars & Tutorials

Two UK liaison meetings were held in the past 12 months:

- 27/11/24-28/11/24 – Joint A2/D1 meeting. (approx. 50 attendees)
- 15/10/25 – Joint B1/D1 meeting (30 attendees in-person, 10 attendees online)

For 2026, two joint Liaison meetings are planned:

- A3/B3/D1 UK Liaison Meeting, 2026-03-02 (tbc) at IET Austin Court, Birmingham
- B1/D1 Liaison Meeting, October 2026 (tbc)

19.6 Technical Brochures

In the past 12 months the following technical brochures have been published:

- TB952 Evaluation of Dynamic Hydrophobicity of Polymeric Insulation Materials Under AC Voltage Stress [e-cigre link](#)
- TB957 Recommendations for dielectric testing of HVDC gas-insulated cable connection assemblies [e-cigre link](#)
- TB967 Mechanical properties of insulation materials for power transformers [e-cigre link](#)
- TB968 Interaction between cable and accessory materials in HVAC and HVDC applications [e-cigre link](#)

19.7 Last Study Committee Meeting

- Held at the 2025 A2/D1 Symposium in Seoul, South Korea.
- New D1 website live:
<https://www.cigre.org/article/d1---materials-and-emerging-test-techniques>
- Next meeting will be held at the 2026 Paris Session, France.

19.8 Current Working Groups and UK Members

Number	Title	UK Member
D1.63	Partial discharge detection under DC stress	Malcolm Seltzer-Grant
D1.68	Natural and synthetic esters - Evaluation of the performance under fire and the impact on environment	Russell Martin
D1.69	Guidelines for test techniques of High Temperature Superconducting (HTS) systems	Bartek A. Glowacki
D1.70	Functional properties of modern insulating liquids for transformers*	Qiang Liu Attila Gyore Zhongdong Wang
D1.73	Nanostructured dielectrics: Multi-functionality at the service of the electric power industry	Raed Ayoob Thomas Andritsch
D1.74	Partial discharge measurement on insulation systems stressed from HV power electronics	
D1.76	Tests for verification of quality and ageing performance of cellulose insulation for power transformers	Attila Gyore Richard Heywood Qiang Liu Mike Munro

Number	Title	UK Member
		Shanika Matharage Gordon Wilson
D1.78	Partial discharge properties of non-SF6 insulating gases and gas mixtures	Fraser Cook Graeme Coapes (NGN)
D1.81	Methods and common data file format for Time-Domain Reflectometry	Andrew Barclay
D1.82	Additive Manufacturing/3D Printing in Service of the Electrical Power Industry	Thomas Andritsch Dave Clark Calum Macdonald
D1/B1.75	Strategies and tools for corrosion prevention for cable systems	
D1/A2.77	Liquid Tests for Electrical Equipment	Gordon Wilson Russel Martin Attila Gyore Dave Walker Qiang Liu
D1/A2.80	Functional properties of non-metallic solid materials for liquid filled transformers and reactors and their compatibility with insulating liquids	George Chen Qiang Liu
A2/D1.67	Guideline for online dissolved gas analysis monitoring	Michelle Fiddis Shuhang Shen
A2/D1.72	Retrofill of Mineral Oil in Transformers – Motivations, Considerations and Guidance	Gordon Wilson Paul Dyer Attila Gyore Caleb Walker
A2/D1.66	Breathing systems of liquid filled transformers and reactors	
B3/D1.63	Guideline for assessing the toxicity of used SF6 gas onsite and in the lab of T&D equipment above 1 kV in substations	
D1/A2.79	Improved understanding of dynamic behaviour of winding insulating materials in liquid insulated power transformers	
B1/B3/D1.79	Recommendations for dielectric testing of HVDC gas insulated system cable sealing ends	
A2/C4/D1.77	Design of transformers for very fast transient overvoltages	

19.9 UK Members of the Technical Panel

There is currently no UK Technical Panel for D1. The plan for 2025 is to identify a suitable secretary for the RM and build a UK technical panel, which has been postponed to early 2026.

20 RM Report on D2 Information Systems, Telecommunications, and Cybersecurity

20.1 Study Committee Scope

SC Chair: Mr Victor Tan (AU)

SC Secretary: Mr Marcelo DE ARAUJO (BR)

SC D2 aims to facilitate and promote the progress of engineering on information and telecommunications systems for electric power systems, as well as the international exchange of information and knowledge in those fields. To add value to this information and knowledge by means of summarizing state-of-the-art practices and developing recommendations and to make managers, decision-makers and regulators (between other stakeholders) in the EPI sector aware of its work.

The activities cover the specification, design, engineering, performance, operation, maintenance, economic and management aspects of the Information and the Telecommunication systems :

- ICT applied to digital networks from UHV to distribution (smart meter, IoT, big data, EMS, etc...).
- Communication solutions for information exchange in the smart delivery of electrical energy
- Interoperability and data exchange (file format, frequency, etc.) between network operators, market players, off-grid premises
- Cyber security issues from field equipment to corporate IT (Gouvernance constraints, system design, implementation, testing, operation and maintenance...)
- Technologies and architecture to ensure business continuity and disaster recovery
- IT systems to support the decision-making process in Asset Management

20.2 Strategic Advisory Groups

- AG D2.01: Core business information systems and services – Marcelo Aroujo (Brazil)
This advisory group is ITS user oriented. It monitors the needs and the stakes of the users in their core business which is linked with ITS like Telecontrol, asset management, customer relationship etc.
- AG D2.02: Cybersecurity techniques and technologies – Giovanna Dondossola (Italy)
This Advisory Group fosters the adoption of specialized cybersecurity measures to protect Operational Systems
- AG D2.03: Telecommunication networks, services and technology – Zwelandile Mbebe (South Africa)
This Advisory group focuses on pure telecommunication issues like transmission media, protocols, network architecture, service provision, etc.

20.3 Preferential Subjects for 2026 Paris Session

PS 1: IT/OT solutions to improve the efficiency and resilience of electric power systems:

- IoT architectures and applications in physical asset management
- Applications and Platforms of Artificial Intelligence, Big data and Analytics in operation and maintenance
- Technical challenges in the development of digital twins in operation and maintenance of power systems and DERs
- Business Continuity Architectures in the Cloud

PS 2: Cybersecurity in emerging application domains and technologies for securing energy organisations:

- Cybersecurity for DER and microgrid control infrastructures
- Cybersecurity for Energy Communities' digitalization
- Cybersecurity for Electric Vehicle charging and discharging control

- Cybersecurity in cloud-based applications of EPU's

PS 3: Meeting the challenges of energy transition with reliable, scalable, and efficient telecommunications networks:

- Building scalable and resilient networks with management, automation and orchestration solutions and methods.
- Integration of current and new wireless technologies in meeting the requirements of power utility applications.
- Techniques and methods in building resilient networks to support critical utility applications

20.4 New Working Groups

Approved in 2025:

Number	Title	UK Member/Status
D2.62	Low Voltage Power Carrier Communications Current State and Future Application	Approved
D2.63	Electric-power resource allocation and optimization for electric power systems	Approved
D2.79	Inter-Controller Communication Protocol (ICCP) Security and Reliability	Approved
A3/D2.52	Application of Digital Twin in Switchgear	Approved
D2.64	Application of AI in Cybersecurity Defence of Power Systems	Approved
D2.65	Optical Transport Communication Networks for Electric Power	Approved
D2.66	Low Voltage Power Carrier Communications Application	Approved

20.5 Technical Panel Meetings, Seminars & Tutorials

- One day conference: “CIGRE UK B5/D2 Joint Technical Liaison Meeting 2025”, 05/12/2025, Birmingham.
- Panel: Panel Discussion – Cyber Security, AI, Advanced Telecommunications during UK Technical Conference 2025, 20/11/2025

Future events planned for 2026:

- Webinar: To be confirmed
- D2 one day conference – spring 2026, details tbc
- Paris Session 2026.

20.6 Technical Brochures and Publications

During the last year the following key documents from Study Committee D2 were published:

Previous publications:

- TB 936: Enhanced Information and Data Exchange to Enable Future TSO-DSO Coordination and Interoperability; Convenor: Gareth Taylor (GB)
- TB 929 : Advanced Consumer Side Energy Resource Management Systems; Convenor: Aleksey Nebera (RU)
- TB 892: Data Management
- TB 884: Time in Communications networks, Protection and Control applications
- TB 866: Enabling Software Defined Networking for electric power utilities

- TB 840: Cyber Security for Contingency Operations
- TB 796: Cyber security – future threats
- TB 746 Design, Deployment and Maintenance of Optical Cables associated to Overhead HV Transmission Lines.

20.7 Last Study Committee Meeting Highlights

During the last meeting as part of the Roundtable discussion in Barcelona an overview of key topics was discussed:

- ◆ Innovative Technologies Shaping the Future of Grid Communication
 - Can you share some experiences from recent innovation projects or emerging technologies that have been implemented in communication networks or information systems to meet the future needs of power grids?
 - What impact have these technologies had on the efficiency, reliability, and security of the grid?
- ◆ Building a Resilient Cybersecurity Framework for Power Grid Networks
 - What are the best practices or lessons learned for developing and maintaining a robust cybersecurity framework for power grid communication networks?
 - What are the common challenges faced when ensuring compliance with communication network design standards in power grid projects?
 - How do these practices ensure the security and resilience of the grid?
- ◆ Future Challenges in Power Grid Communication Infrastructure
- ◆ What are the key future challenges that the industry will face in the construction and maintenance of communication networks for power grids?
- ◆ How can these challenges be addressed to ensure the continued reliability, security, and efficiency of the grid?

20.8 Current Working Groups and UK Members

UK membership is currently reviewed – current records indicate the following:

WG	WG Title	WG Convenor
		GB representative
WG D2.58	Monitoring, Maintenance and Control of Packet Networks & Services – From Situational Awareness to Network Control	Bongani Shezi (South Africa)
		Carlos Diago (GE Vernova) James Milsom (NGET)
WG D2.57	CIM (Common Information Model) Methodology	Roman Bogomolov (RU)
		Siva Kaviya, Trichy Siva Raman (NG ESO) / Gareth Taylor (Brunel)
WG D2.56	Interdependence and Security of Cyber-Physical Power System	QINGLAI GUO (CN)
		Wentao Zhu (GB)
WG D2.55	Application of 5G Technology to Smart Grids	KUNLUN GAO (CN)
		Lin Jiang (GB)
WG D2.54	Regulatory approaches to enhance EPU's cybersecurity frameworks	Tbc.
		Mohammed Zumla (GB)
WG D2.53		ZHENGYUN SUN

WG	WG Title	WG Convenor
		GB representative
	Technology and Applications of Internet of Things in Power Systems	Ester Hwang (GB)
WG D2.52	Artificial Intelligence Application and Technology in Power Industry	KUNLUN GAO (CN)
		Fraser Cook / Giulio Riccardi (GB)
WG D2.51	Implementation of Security Operations Centers (SOC) in Electric Power Industry as Part of Situational Awareness System	V. KARANTAEV (RU)
		Shimeh Jahangiri / Gareth Taylor (GB)
WG D2.49	Augmented reality / Virtual reality to support Operation and Maintenance In Electric Power Utilities	S. H. KHALAJ (IR)
		Douglas Gray / Richard Moore (GB)
JWG B2/D2.72	Condition monitoring and remote sensing of overhead lines	Y. Chen (CN) / A.KULKARNI (GB)
JWG D2/C2.48	Enhanced information and data exchange to enable future transmission and distribution interoperability	G. TAYLOR (GB)
		Rui Zhang (GB)
JWG D2/C6.47	Advanced consumer side energy resource management systems	A.A NEBERA (RU)
		James King / Spyros Skarvelis-Kazakos (GB)
JWG B5/D2.67	Time in Communication Networks, Protection and Control Applications – Time Sources and Distribution Methods	Qiaoyin YANG (CN)
WG D2.45	Impact of governance regulations and constraints EPU sensitive data distribution and location of data storage	H. KLIMA (AT)
WG D2.44	Usage of public or private wireless communication infrastructures for monitoring and maintenance of grid assets and facilities	P. MULVEY (IE)
JWG A2/D2.65	Transformer Digital Twin – concept and future perspectives	P. Picher (CA)
JWG B3/D2.62	Life-long Supervision and Management of Substations by use of Sensors, Mobile Devices, Information and Communication Technologies	N. Fantana (DE)

20.9 UK Members of the Technical Panel

UK D2 Technical Panel Chair: Jianing Li
 UK D2 Technical Panel: Thomas Charton, Gareth Taylor
 Secretary: Kaviya Sivaraman