

CIGRE Key Takeaways 2026

D1 – Materials and Emerging Test Techniques



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Content

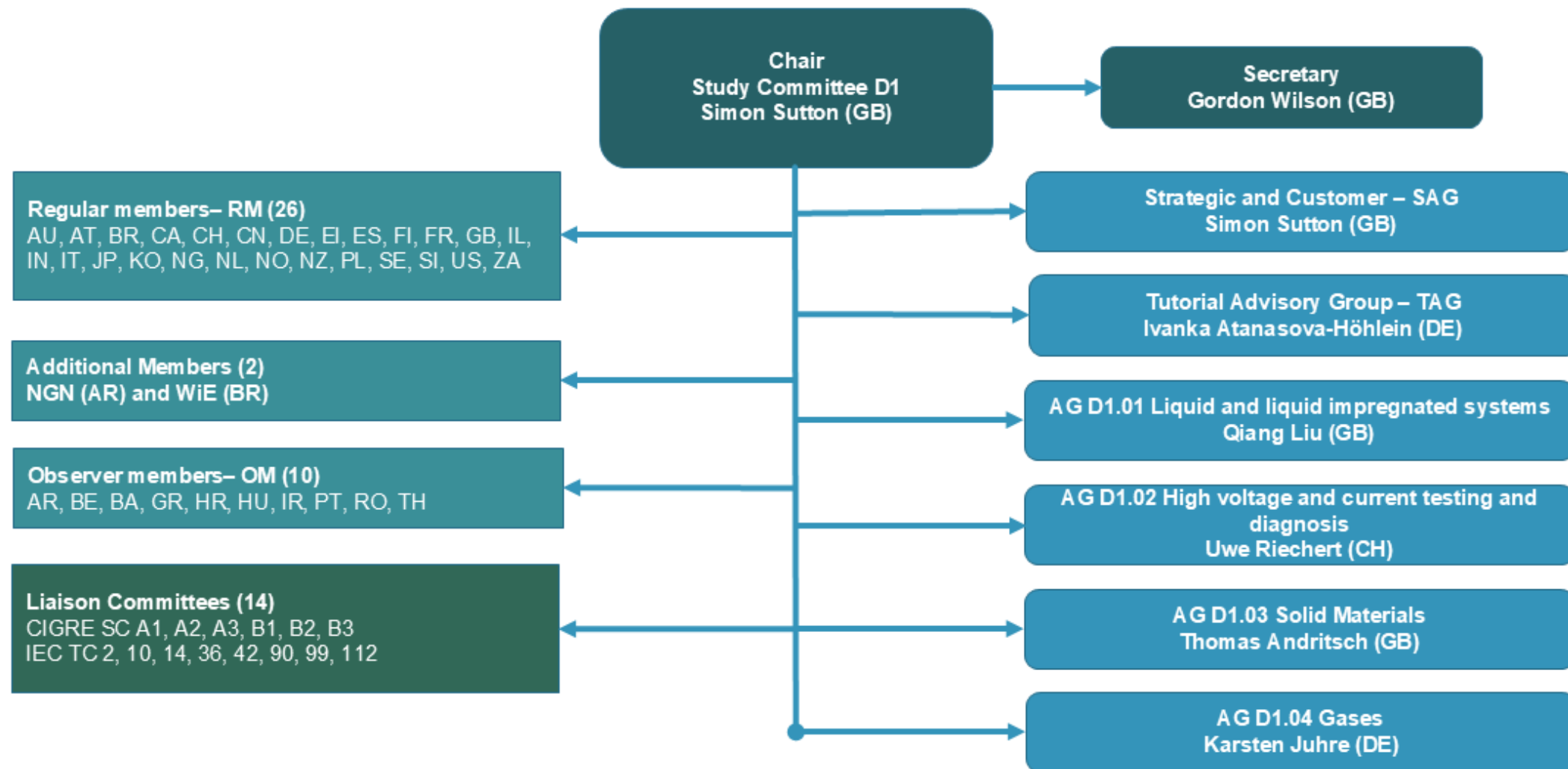
- Study Committee D1
- Technical brochures
- Paris session - Preferred Subjects
- Poster Session, Workshops and Tutorials
- Preferred Subjects for 2028

Study Committee D1 Meeting in Paris



SC D1 Organisation

September 2026



SC D1 Working Groups

Study Committee D1

August 2026

Liquid and liquid impregnated systems (AG D1.01)

WG D1.68 Natural and synthetic esters - Evaluation of the performance under fire and the impact on environment - M.Pompili (IT)

WG D1.76 Tests for verification of quality and ageing performance of cellulose insulation for power transformers - J.Lukic (RS)

JWG D1/A2.77 Liquid Tests for Electrical Equipment - F.Scatiggio (IT)

JWG D1/A2.79 Improved understanding of dynamic behaviour of winding insulating materials in liquid insulated power transformers - O.Girlanda (SE)

JWG D1/A2.84 Silver corrosion in power transformers - J.Lukic (RS)

JWG A2/D1.66 Breathing systems of liquid filled transformers and reactors - D.Koch (DE)

JWG A2/D1.71 Modern Insulating Liquids Qualification for OLTC, Bushings and other Accessories - H.Campelo (PT)

JWG A2/D1.72 Retrofill of Mineral Oil in Transformers - Motivations, Considerations and Guidance - R.Asano Jr (BR)

JWG A2.D1.74 Online moisture monitoring of transformers for ageing assessment - S.Leivo (FI)

A2/D1.82 Possibilities limits and risk for increasing transformer overload capability E.teNyenhuus (CA)

High voltage and current testing and diagnosis (AG D1.02)

WG D1.61 Optical corona detection and measurement - N.Mahatho (ZA)

WG D1.63 Partial Discharge Detection under DC voltage stress R.Plath (DE)

WG D1.69 Guidelines for test techniques of High Temperature Superconducting (HTS) systems - R.Taylor (AU)

WG D1.74 PD measurement on insulation systems stressed from HV power electronics - A.Cavallini (IT)

WG D1.81 Methods and common data file format for Time-Domain Reflectometry - A.Barclay (GB)

WG D1.84 Revised test method for the tracking and erosion resistance under DV voltage stress - C.Baer (DE)

JWG A2/D1.67 Guidelines for online dissolved gas analysis monitoring - T-L.Macarthur (AU)

JWG A2/C4/D1.77 Design of transformers for very fast transient overvoltages - B.Juriscic (HR)

JWG B3/A2/A3/C3/D1.66 Guidelines for Life Cycle Assessment in Substations considering the carbon footprint evaluation - A.Prabakar (IN)

Solid Materials (AG D1.03)

WG D1.62 Surface degradation of polymeric insulating materials - B.Komanschek (DE)

JWG D1/A2.80 Functional properties of non-metallic solid materials for liquid filled transformers and reactors and their compatibility with insulating liquids - D.Vukovic (DE)

WG D1.82 Additive Manufacturing/3D Printing in Service of the Electrical Power Industry

Gases (AG D1.04)

WG D1.78 Partial discharge properties of non-SF6 insulating gases and gas mixtures M.Walter (CH)

WG D1.83 Optical spectral sensing technologies for partial discharge (PD) and arc detection in gas-insulated equipment - D.Ju (CN)

WG D1.85 Impact of new insulating gases on tightness of gas insulated systems leakage testing and conversion factors - M.Hyrenbach (DE)

WG 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 R.Kurte (DE)

New Working Groups since Paris 2024

WG	TITLE
D1.85	Impact of new insulating gases on tightness of gas insulated systems leakage testing and conversion factors (maik.hyrenbach@de.abb.com , 2026)
D1.84	Revised test method for the tracking and erosion resistance under DC voltage stress (christiane.baer@wacker.com , 2026)
D1.83	Optical spectral sensing technologies for partial discharge (PD) and arc detection in gas-insulated equipment (judf321@163.com , 2025)
JWG	
A2/D1.82	Possibilities limits and risk for increasing transformer overload capability (ed.g.tenyenhuis@hitachienergy.com , 2026)
D1/A2.84	Silver corrosion in power transformers (jelena.lukic@ieent.org , 2025)
A2/C4/D1.77	Design of transformers for very fast transient overvoltages (2025)



Technical Brochures published since Paris 2024

Number/Title		Working Group	Published
1002	Traceable Measurement Techniques for Very Fast Transients	WG D1.60	2026-09
998	Further Investigations on a DC Tracking & Erosion Test	WG D1.72	2026-08
974	Strategies and Tools for Corrosion Prevention for Cable Systems	JWG D1/B1.75	2025-11
968	Interaction between cable and accessory materials in HVAC and HVDC applications	JWG B1/D1.75	2025-07
967	Mechanical properties of insulation materials for power transformers	WG D1.65	2025-06
957	Recommendations for dielectric testing of HVDC gas-insulated cable connection assemblies	JWG B1/B3/D1.79	2025-02
952	Evaluation of Dynamic Hydrophobicity of Polymeric Insulation Materials Under AC Voltage Stress	WG D1.58	2025-01



Papers, 74 in 3 preferred subjects (PS)

PS1: Testing, monitoring and diagnostics (34)

PS2: Materials for electrotechnical purposes and modelling (34)

PS3: Measurements and modelling of interfaces (6)



D1 GDM – 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.



D1 GDM – PS1 Testing, monitoring and diagnostics



34 Papers with the following content:

- Measurement of PD: diagnostics and continuous monitoring
 - *Optical, UHF, Acoustic (using fiberoptics)*
 - *Alternative gases, ToF in GIS, gas composition under fault currents...*
 - **Note:** *There are 5 working groups on PD and corona measurement!*
- Liquid dielectric systems: diagnostics, assessment and monitoring
 - *DGA, moisture, breakdown voltage*
 - *Cable terminations, transformers*
- AI supported assessment of diagnostic and monitoring data
 - *Very limited contribution, mainly PD diagnostics*

D1 GDM – 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.

D1 GDM – PS2 Materials for electrotechnical purposes and modelling



34 Papers with the following content:

- Ageing and degradation of liquid insulation systems
 - *Traditional DGA and 2-FAL unsuitable for new materials and liquids.*
 - *Byproducts do not necessarily come from degradation anymore (antioxidants)*
 - *Assumptions for mineral oils do not transfer to other liquids*
- Ageing and degradation of GIS
 - *Long-term performance of alternative gases*
 - *Design optimization of GIS with alternative gases*
 - *Gas tightness of GIS*
- Bio-based materials (such as epoxy resins from e.g. soybean oil)
- Additive Manufacturing of insulation materials (e.g. silicone rubbers)
- Better understanding of ageing and treeing processes on HV outdoor insulators

D1 GDM – 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.

D1 GDM – PS3 Measurements and modelling of interfaces



6 Papers with the following content:

- Surface charge measurements on a dielectric barrier in pressurized air
- Electrical and thermal phenomena in anisotropic CFRP composite panels
- Modelling of respect width for magnetic field for electrical substations of Terna
- Comprehensive analysis of lightning performance of the oil-wedge type electrode model immersed in selected dielectric liquids
- The importance of material compatibility for transformers
- Charge transport multiscale modelling for bridging material properties to insulation performance: case study of moisture deterioration at cellulose–oil interface

Workshops, tutorial, poster session

- Joint workshop: “SF6 replacement and alternatives ”
 - Speakers from A3, B3 and D1, 469 attendees
- Workshop: “Frontiers in PD diagnosis”
 - 387 attendees
- Tutorial: “Latest developments of test methods for polymeric insulating materials under high voltage outdoor conditions” – 292 attendees
 - Connected to WG D1.58: “Evaluation of Dynamic Hydrophobicity of Polymeric Insulation Materials Under AC Voltage Stress” – TB952
 - Also presented work from WG D1.72: “Test of material resistance against surface arcing under DC” – TB to be published soon
 - By Christiane Bär and Stefan Kühnel
- Poster session, included posters from the AG’s and WG’s, 1909 attendees
 - 2 time slots, PS1 in the first half, PS2 and 3 in the second



What's up in 2027



CIGRE Symposium Heidelberg 2027

Heidelberg, Germany, April 27 – April 30, 2027

Only for the annual SC D1 meeting

CIGRE International symposium 2027

Bangkok, Thailand, November 8 – November 12, 2027



Preferred subjects voor Paris 2028 – Option 1

PS1: Testing, monitoring and diagnostics

- Testing and condition monitoring for reliability of MV to EHV assets in modern power grids.
- Advances in data analytics, statistics, ML, AI etc for improved diagnosis and reliability.
- Measuring material behaviour under AC, DC, rectifier, impulses, composite and transient voltages.

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.
- Novel and eco-friendly materials to support the energy transition.

PS3: Electrical insulation systems under DC voltage

- Partial discharge behaviour, measurement and monitoring under DC and composite voltages.
- Understanding of space and surface charges, and potential distribution under DC and composite voltages.
- Experience and requirements for new test procedures and standards

Preferred subjects voor Paris 2028 – Option 2 (Preferred by SC D1)

PS1: Testing, monitoring and diagnostics

- Testing and condition monitoring for reliability of MV to EHV assets in modern power grids.
- Advances in data analytics, statistics, ML, AI etc for improved diagnosis and reliability.
- Measuring material behaviour under AC, DC, rectifier, impulses, composite and transient voltages.

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.
- Novel and eco-friendly materials to support the energy transition.

PS3: Tools and Techniques for Asset Management

- Asset condition assessment, health index, risk assessment criteria and statistical analysis for fleet management.
- Maintenance optimisation, life extension methodologies and experiences.
- Techniques and approaches to gather data from teardowns (before failure) and post-failure investigations.