

Report to the CIGRE Australian Technical Council

Study Committee SC D1 and Australian Panel AU D1 Activities



Yi Li

Convenor CIGRE AU D1

AU D1 Report 2025

Aust_yli@outlook.com



cigre

For power system expertise

D1

Materials and emerging
test techniques



Study Committee D1 – Scope of Work and Activities

The scope of Study Committee D1 covers new and existing materials for electrotechnology, diagnostic techniques and related knowledge rules, as well as emerging test techniques with expected impact on power systems in the medium to long term. (<https://cigregrroups.org/display/SCD1/Study+Committee+D1+Home>)

Principal areas of interest

- Insulating gases and gaseous insulation systems.
- Liquid and liquid impregnated insulation systems.
- Solid materials.
- High voltage and high current testing and diagnosis.

Current activities

- Development of materials and testing methodologies to support energy transition
- Characterization of materials and electrical insulation systems (EIS).
- Study of emerging test and diagnosis techniques for UHVDC and UHVAC.
- Development of materials and diagnostic tools and related knowledge rules.

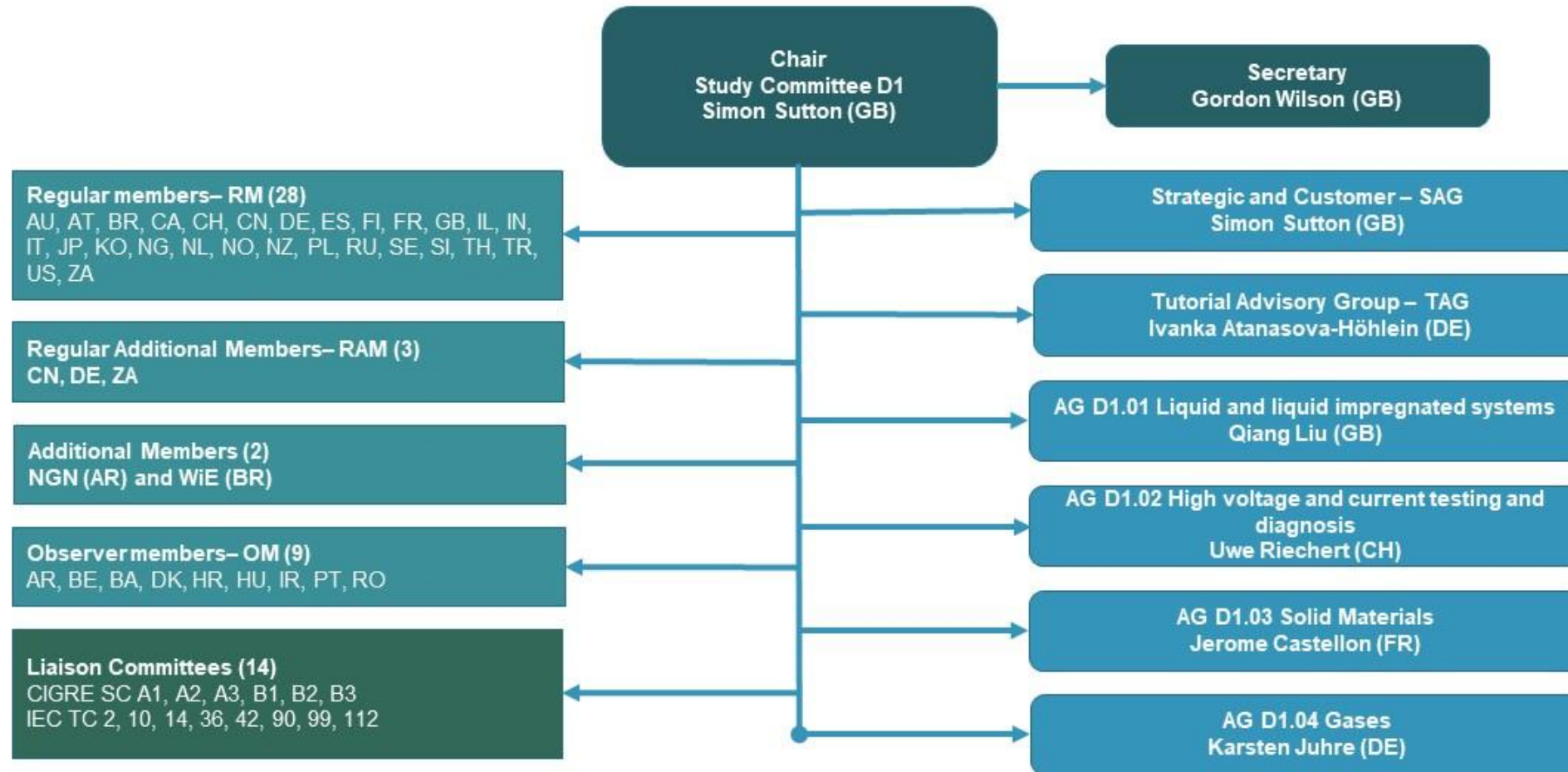
Examples of specific activities and areas of interests:

- Providing information on new materials, e.g. SF6 gas replacement options.
- Investigating material degradation mechanisms, e.g. thermal, electrical stress or multi-factor stress.
- Identifying new asset management tools, e.g., on-line monitors, expert systems, AI diagnostic tools...
- Providing insight into the impact of new test techniques on plant, such as life extension and cost reduction.
- Assisting with standardisation of tests and information, in response to requests from IEC, IEEE...

SC D1 Organisation



September 2024



SC D1 Working Groups

Study Committee D1

September 2024

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 A2/D1.66 Breathing systems of liquid filled transformers and reactors - R. Kurte (DE)

JWG A2/D1.71 Modern Insulating Liquids Qualification for OLTC, Bushings and other Accessories - L.Liden (SE)

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)

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

WG D1.60 Traceable measurement techniques for very fast transients - Y.Li (AU)

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 D1.72 Test of material resistance against surface arcing under DC - C.Bär (DE)

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)

JWG B1/B3/D1.75 Recommendations for dielectric testing of HVDC gas insulated system cable sealing ends C.Plet (NL)

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

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)

WG D1.73 Nanostructured dielectrics: Multifunctionality at the service of the electric power industry - J.Castellon (FR)

JWG D1/B1.75 Strategies and tools for corrosion prevention for cable systems - J.Tusek (AU)

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

JWG B1/D1.75 Interaction between cable and accessory materials in HVAC and HVDC applications - A.Gustafsson (SE)

Gases (AG D1.04)

WG D1.66 Requirements for partial discharge monitoring systems for gas insulated systems W.Koltunowicz (DE)

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

JWG 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)

SC D1 working groups approved in 2025

WG/JWG	Title	Convener
A2/C4/D1.77	Design of transformers for very fast transient over-voltages	<u>Bruno JURISIC</u> <u>bjurismic@koncar-institut.hr</u> <u>TOR-JWG A2 C4 D1.77</u>

SC D1 new working group proposals

With the TC for approval

- D1.83 – Optical Spectral Sensing Technologies for Partial Discharge (PD) and Arc Faults Detection in Equipment
- D1/A2.84 – Silver Corrosion in Power Transformers

Proposals still being finalized

- Gas decomposition and material compatibility of non-SF6 insulating gases and gas mixtures applied in gas-insulated systems
- Impact of new insulating gases on tightness of gas-insulated systems, leakage testing and conversion factors

2025 Published D1 Technical Brochures

No. / Title		Working Body	Published
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

2025 Published D1 Technical Brochures

952



Evaluation of Dynamic Hydrophobicity of Polymeric Insulation Materials Under AC Voltage Stress

This brochure describes an improved Dynamic Drop Test (DDT) setup and procedure applied to clean silicone rubber surfaces under AC conditions. The work addresses hydrophobicity retention, recovery, and transfer for silicone rubber-based materials. Round Robin Tests (RRT) were used to validate the reproducibility and repeatability of the test results.

967



Mechanical properties of insulation materials for power transformers

Solid insulation materials, such as paper, pressboard, laminated wood, and aramid-based components, are essential for power transformers' performance. They must sustain high mechanical loads in addition to their dielectric role, especially during special events such as short circuits. Advances in materials science and modelling have improved our understanding of their mechanical behavior. The D1.65 brochure reviews the state of the art for liquid-filled transformers, focusing on mechanical properties, innovative testing methods, and modelling.

SC D1 Activities

2025 SC D1 Annual General Meeting – 28 Nov 2025 (Seoul)

- 2025 SC D1 meeting was held along with A2/D1 Colloquium in Seoul, 28 Nov. 2025
- Next SC D1 meeting is to be held in Paris along with Paris Session 2026 on 28 August 2026
- SC D1 meeting in 2027 is to be held (tentatively) in Germany along with 2027 CIGRE Symposium Heidelberg Germany 26 – 30 April.

Activities at CIGRE Paris Session 2026

Monday 26:

- D1 Poster Session
- A3/B3/D1 Workshop "Driving T&D substations and equipment towards net zero emissions"
- B1 Tutorial on HVDC cables will include work from JWG B1/B3/D1 "Recommendations for dielectric testing of HVDC gas insulated system cable sealing ends"

Tuesday 27:

- D1 Group Discussion Meeting/Session

Wednesday 28:

- Study Committee D1 meeting

Thursday 29

- D1 Tutorial "Functional properties of insulating liquids for transformers: laboratory methodologies and dielectric performance"

SC D1 Preferential Subjects for 2026 Paris Session (draft)

- PS1: Testing, monitoring and diagnostics
 - Testing and condition monitoring for reliability in conventional high voltage systems and power electronics applications.
 - Assessment of diagnostics for equipment in remote or inaccessible locations.
 - PD measurement under DC, rectifier, and impulse stress.
- PS2: Materials for electrotechnical purposes and modelling
 - Ageing of materials under electrical, mechanical or thermal stresses and ageing markers.
 - Modelling materials and field simulations for AC and DC applications.
 - Assessment of compatibility of aged and new materials resulting from refurbishment or life extending activities.
- PS3: Materials to enable the energy transition
 - Alternative electrotechnical materials or manufacturing processes which reduce environmental footprint.
 - Materials and systems for energy storage; batteries, charging devices, capacitors etc.
 - Materials to enable a hydrogen economy

AU D1 Activities

AU D1 2025 Annual Meeting held on 2 September along with CIGRE Australia Conferences

- 15 members and guests attended the meeting
- **Presentations at the AU D1 Panel meeting:**
 - Insulation of high-voltage current transformers under fast transients: measurement of disconnector-induced impulses and transmitted over-voltages, Winston Yan, NMI
 - Substation cybersecurity, Wenyu Guo and Amro Mohamed, Omicron Energy
 - Digital Twin Testing, Hao Zhang, Megger
 - Copperstring project and HV current transformer issues, PowerLink
 - Testing facilities for power transformers and cables, Ausnet
 - Composite powerline poles and SF6-free equipment program – Essential Energy
 - Minimum Energy Performance Standards project – UNSW



AU D1 Panel membership

Name	Organisation	Name	Organisation
Yi Li (Convenor)	National Measurement Institute	Wenyu Guo	Omicron Australia
Sam Murali (Secretary, NGN Rep)	Transgrid	James Baker	Essential Energy
David Alan	University of Queensland	Karl Haubner	High Energy Service
Andrew McMahon	Transpower	Hui Ma	University of Queensland
Dharmendra Shah	Powerlink	Toan Phung	University of New South Wales
Prasanna Wickramasuriya	Energy Queensland	Trevor Blackburn	University of New South Wales
Dejan Susa	Ausnet Services	Andrew Wilkinson	ElectraNet
Atanu Mondal	Hitachi Energy	Hao Zhang	Megger
Winston Yan	National Measurement Institute	Kelvin Yew	Mondo
Yilin Xu	AusGrid		

AU D1 Panel Activities

– AU Participation in CIGRE D1 WGs

WG No.	Topic
D1.60	Traceable measurement techniques for very fast transients
D1.69	Guidelines for test techniques of High Temperature Superconducting (HTS) systems
D1/B1.75	Strategies and tools for corrosion prevention for cable systems

Thank you !