Australian Technical Committee of CIGRE
2022 Report

This Australian Technical Committee report provides an introduction to the specific reports from the individual Australian Panel Conveners on the activities of their international Study Committees, Working Groups and Australian Panels for the calendar year 2022.

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Angela Klepac
Chair of the Australian Technical Committee

December 2022

Role of the Australian Technical Committee

The Australian Technical Committee (ATC) comprises the 16 CIGRE Australia representatives on the CIGRE international Study Committees (SC). Each member of the ATC also convenes an Australian Panel (AU) matching the scope of their corresponding CIGRE international Study Committee.

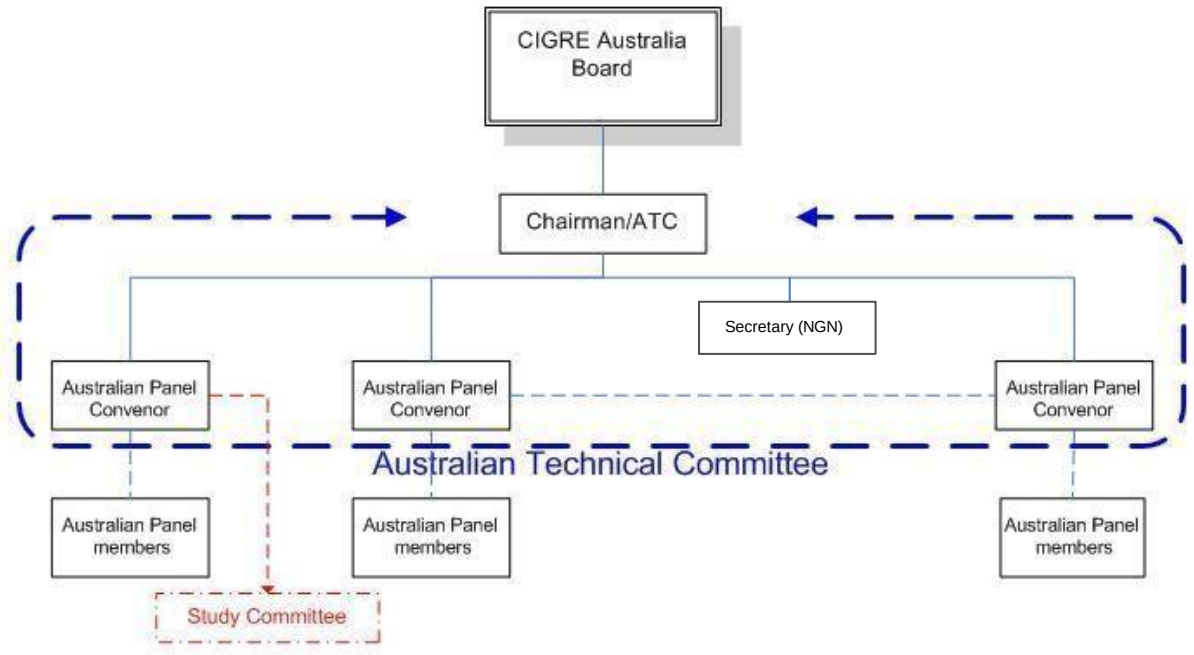
The Technical Committee provides a forum for the ATC members to:

- Represent their Australian Panels to CIGRE Australia;
- Exchange ideas with other ATC members;
- Coordinate joint activities; and
- Report on particular issues in their area(s) of expertise, both local and international.

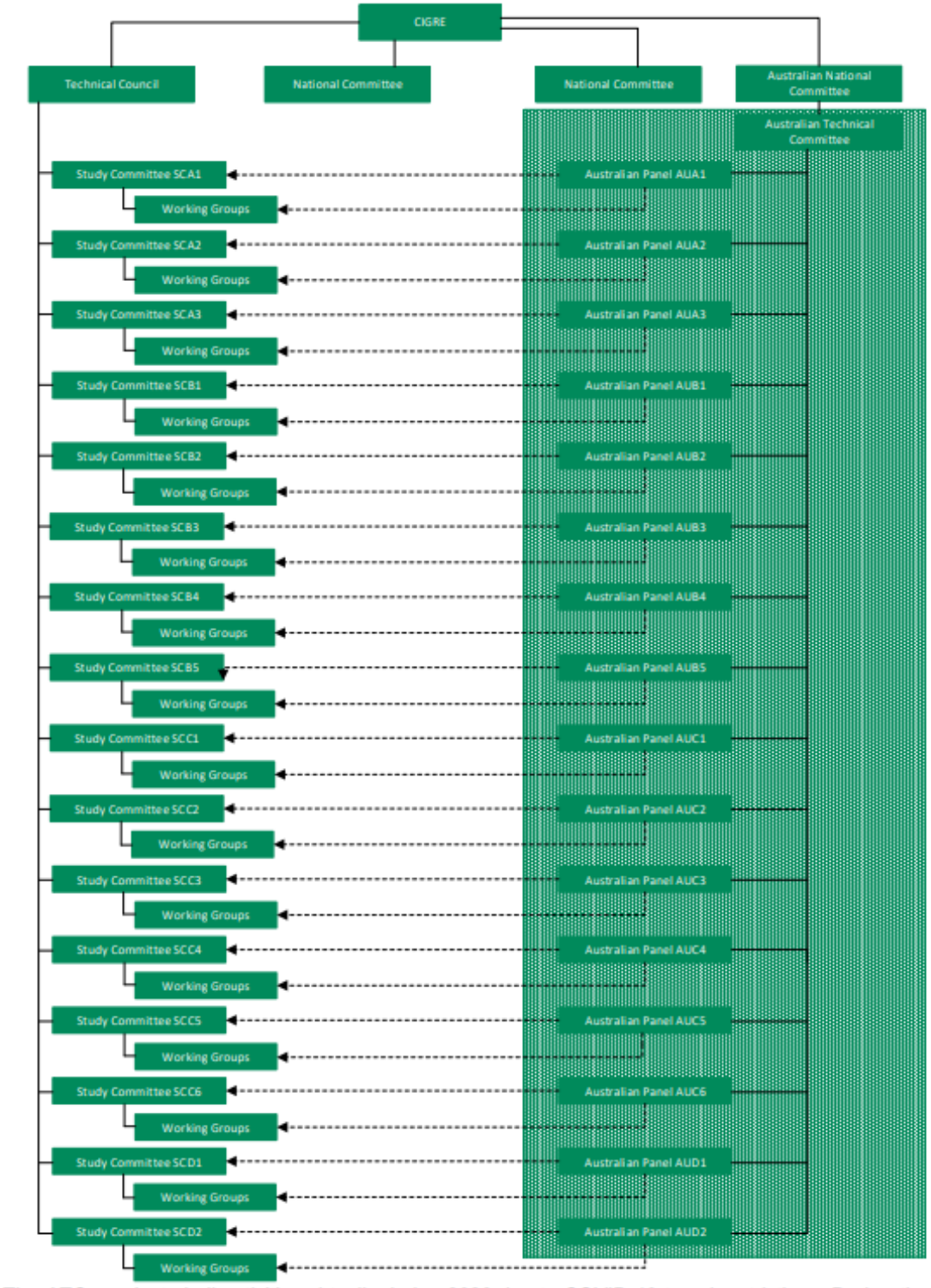
The Australian Technical Committee is convened by the ATC Chairperson. The Chairperson is also a member of the CIGRE Australia Board. The CIGRE Australia Executive Manager provides administrative support to the ATC and a linkage between the CIGRE Australia Board and the Australian Panels for all financial and administrative decisions. The ATC Secretary, is an NGN member which provides an avenue for the NGN to contribute and understand the technical activities occurring within Australia. In addition, all 16 Australian Panels have an NGN liaison fostering NGN involvement in Australian Panel activities.

The membership of the Australian Panels comes from individual and collective CIGRE members in Australia and New Zealand. Panel members are experts in the particular technical areas relevant to each Panel. Typically, a Panel has in the order of 20 members although a number of the panels have larger membership. The largest panel currently has 41 members and the smallest has 10 members. It is also pleasing to see that the number of panel members increased across 2022.

The ATC structure, including the linkage to the Australian Panels is illustrated in the organisation chart shown below.



As illustrated in the figure below the ATC structure mirrors the international structure of CIGRE. This structural alignment enhances the ability of our panels to contribute to and leverage the research activities undertaken through the various international Working Groups and Study Committees.


CIGRE
Technical Council
National Committee
National Committee
Australian National Committee
Australian Technical Committee
Study Committee SCA1
Working Groups
Study Committee SCA2
Working Groups
Study Committee SCA3
Working Groups
Study Committee SCB1
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Australian Panel AUA1
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Australian Panel AUB4
Australian Panel AUB5
Australian Panel AUC1
Australian Panel AUC2
Australian Panel AUC3
Australian Panel AUC4
Australian Panel AUC5
Australian Panel AUC6
Australian Panel AUD1
Australian Panel AUD2

Throughout the 2022 year, the ATC meetings transitioned from being run virtually online to most meetings being run as a face-to-face event. It is noted that as a result of ongoing public uncertainty due to the COVID-19 pandemic some panel meetings were still being run virtually.

To ensure regular communication across the ATC members, quarterly meetings were being held to maintain contact and share knowledge regarding the planning for the 2022 Paris session and the Annual Presentation Day.

It is noted that the ATC held a face-to-face workshop day in June 2022 to bring the convenors together after two long years working remotely and independently as a result of lock down due to COVID. This was the first time a lot of new convenors meet for the first-time face to face so it was important to set clear expectations on role and responsibilities as an ATC panel convenor.

The agenda of the workshop was for the CIGRE Australian Technical Committee (ATC) to review and revise the current role, responsibilities, and expectations for the Technical Committees to optimise their opportunity in supporting CIGRE Australia to deliver on its strategic direction.

The Workshop Objectives were set as follows:

- Shared understanding of expectations of Technical Convenor roles
- Shared understanding of the roles and responsibilities of the technical committees
- Review and confirm critical issues and emerging opportunities to enhance the performance of the Technical Committees
- Agree format for reporting to CEO, ATC Board Sponsor and Board

Acknowledgement is made of Alex Cruickshank (Convenor SC C5) attendance at these meetings as he was able to provide valuable updates from the International Technical Council.

ATC Membership

Australian Panel Conveners are normally appointed for a six-year term. It is normal practice for approximately one third of Australian Panel Conveners to retire at the Annual General Meeting in odd numbered years. In 2022, six new Panel Conveners were appointed and took over as the new 2022 incoming Convenors as follows :

Panel Number	2021 ATC Convenor	New 2022 Incoming Convenor
A2	Ross Willoughby	Mathhew Gibson
A3	Wayne Pepper	David Pita
B2	John McCormack	Asif Bhanghor
C3	James Hart	Brett Hayward
C4	Andrew Halley	Babak Badrzadeh
D2	Victor Tan	Louise Watts

It is acknowledged that ‘outgoing’ convenors have all completed an outstanding 6-year term and have provided outstanding leadership in ensuring the work of CIGRE continues to grow and bring relevance to the Australian local industry.

CIGRE Australia enjoys excellent access to the international technical activities of CIGRE through both Alex Cruickshank's role as the SC C5 Chairman and Victor Tan in the role of SCD2 as members of the CIGRE Technical Council. CIGRE Australia is currently enjoying an extended period of influence over the technical direction of CIGRE.

Australian Panels

Throughout the 2022 year, the ATC meetings transitioned from being run virtually online to most meetings being run as a face-to-face event. It is noted that as a result of ongoing public uncertainty due to the COVID-19 pandemic some panel meetings were still being run virtually.

These meetings form an important communication forum for Panel members. In addition, a number of Australian Panels have provided a number of virtual seminars, tutorials and webinars across 2022. Several webinars with a collaboration between the NGN and Australian and New Zealand Panels were held as follows:

	Title Of Tutorial Presentation	No.
A2	Part 1: Modern techniques to measure water content and keep transformers dry Part 2: Drying transformers	2
B1	Sheath Bonding Systems of AC transmission cables 1	1
B5	'Frequency protection down under – new challenges'	1
C6	A Taste of CIDER Operating a Secure System with 100% Distributed PV DER Enablement Using State Estimation and Dynamic Operating Envelopes	2
	TOTAL	6

Membership of Australian Panels across 2022 has shown steady growth. Sector representation is shown in the following figure. The distribution of panel members across different industry segments has not very significantly between 2020, 2021 and 2022.

A dedicated NGN liaison is appointed for each Panel. The NGN liaison works with the Panel convener to identify ways to involve the NGN in panel activities.

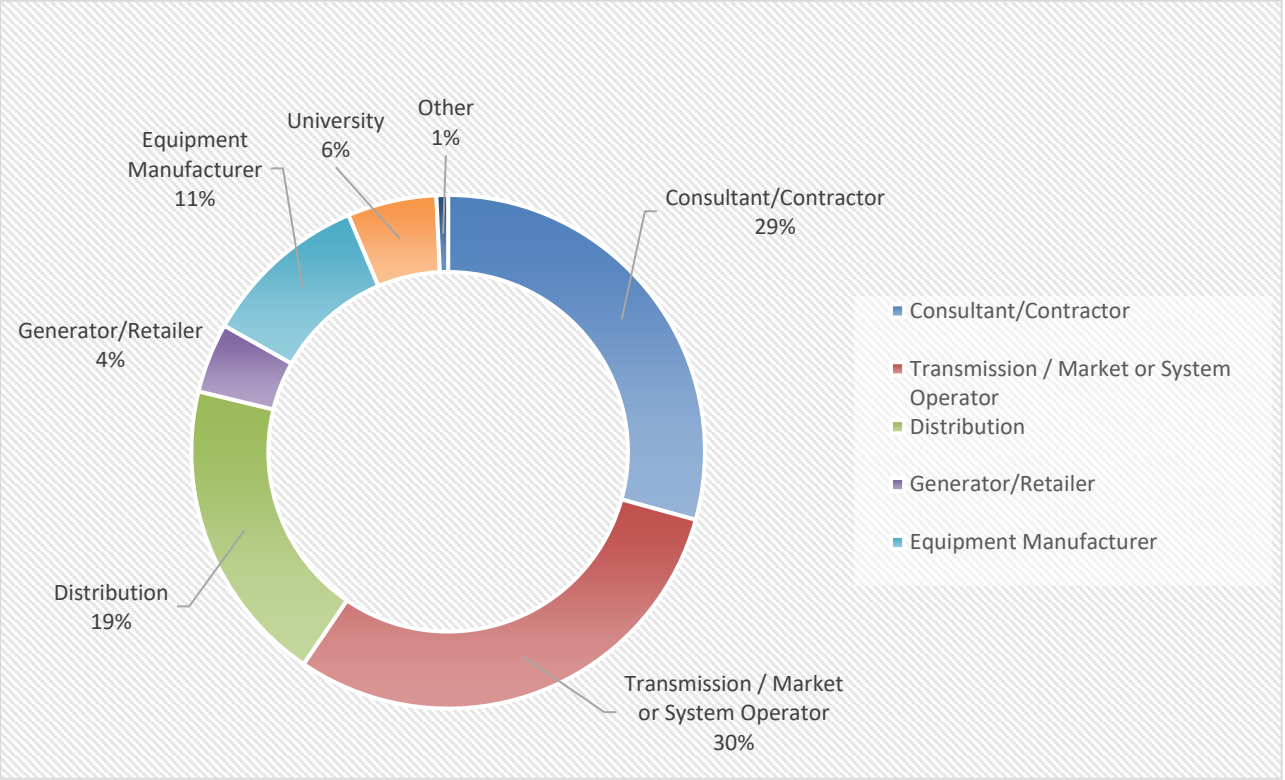
The ATC maintains a calendar that forms the basis of a rotational system that balances the location of the 16 annual panel meetings in each Australian State and in New Zealand.

Each Australian Panel Convener has detailed the activities and membership of their Panel and the key activities undertaken during the year by the international Study Committee and its Working Groups. The Panel reports and are listed in attachment 2 and copies are made available to members as part of the consolidated 2022 ATC report.

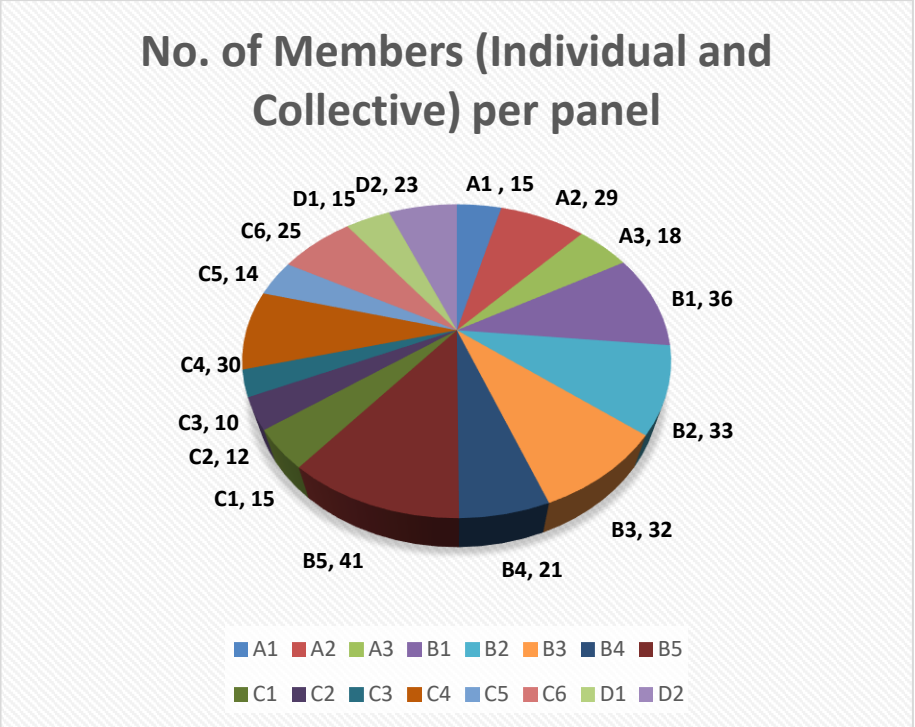
Each Panel Convener also delivered a presentation at the ATC Technical presentation days held 10th and 11th November 2022. The face-to-face meeting was hosted by CIGRE Australia at the Rydges Central in Sydney. The recorded presentations are available via the CIGRE Australia Youtube Channel.

A special thank you to Les Brand (MD Amplitude Consultants; Director CIGRE Australia) for presenting on Day 2 of the Morning session on " HVDC - Technologies and Applications ".

Also, a thank you to Transgrid for facilitating an afternoon session on Day 2 - Technical Tour at the "Haymarket Underground GIS Substation".



Above chart: Membership chart of Australian Panels across 2022 showing sector representation



Above chart : Number of members (Individual and Collectove) per panel as a percentage

Working Groups

Working Groups are established to perform specific technical activities, which they are expected to carry out within specified timeframes. The outputs of Working Groups include technical brochures that become industry reference documents detailing state of the art, industry best practice and the direction of the industry. Working groups also generate webinars reporting key findings and tutorials.

Across 2022 a total of 29 technical brochures were published. All of those brochures are available for CIGRE Australia members via the e-cigre (https://e-cigre.org/).

Australian Panel convenors and members historically are active members on working groups and on average Australian members have participated in over 50% of active working groups on an annual basis. Further details are provided in the annual reports prepared by each Australian Panel Convener regarding the involvement of panel members in international working groups.

CIGRE Australia members are also convening a number of Working Groups. CIGRE Australia supports the Australia's contribution to working groups by providing a limited amount of funding annually to support travel and accommodation costs associated with attending working group meetings. The CIGRE Australia Board has endorsed a KPI sufficient to fund travel for 10 working group meetings annually. The funding of travel for working groups is in addition to the funding for Australian Panel Conveners to attend SC meetings.

Some of the conveners listed in the preceding table have prepared a report on the key outcomes from their working group during 2022. These reports follow the Australian Panel Annual Reports and are also listed in attachment 2 of this report. Information on other working groups can be found in the annual Australian Panel reports.

A list of the 2022 Technical Brochures published and the Australian member participation on these working groups is provided in table as follows:

	No. of WG where ANC member particpated in 2022	Joint WG	Technical brochure Name and no. published in 2022
A1	6	A1/C4	890 Impact of Cycling on Large Electrical Motors 885 Guide on the assessment, specification and design of synchronous condenser for power system with predominance of low or zero inertia generators 879 Guideline on Testing of Turbo and Hydro Generators 878 Guidance on High-Speed Testing of Turbo Generator Rotors 860 Guide for cleanliness and storage of generators
A2	8	A2/D1	887 Life extension of oil filled transformers and shunt reactors 861 Improvements to PD measurements for factory and site acceptance tests of power transformers
A3	6	A3/B4	871 Current Interruption in SF6-free Switchgear 873 Design, test and application of HVDC circuit breakers
B1	20		889 Installation of underground HV cable systems 883 Installation of Submarine cables 880 Power cable rating examples for calculation tool verification 862 Recommendations for mechanical testing of submarine cables for dynamic applications
B2	13		865 Inspection and testing of tools, equipment and training for live-line work on overhead lines
B3	9		886 Guidelines for Fire Risk Management in Substations 870 Service Continuity Guide for HV GIS above 52 kV 869 Design guideline for substations connecting battery energy storage solutions (BESS)
B4	5	A3/B4 A3/C6	873 Design, test and application of HVDC circuit breakers 875 Medium Voltage DC Distribution Systems 867 Flexible AC Transmission Systems (FACTS) controllers' commissioning, compliance testing, and model validation tests 864 Guide to Develop Real-Time Simulation Models for HVDC Operational Studies 872 Static Var Compensator/STATCOM performance survey results – 2017 and 2019
B5	17	B5/D2	884 Time in Communication Networks, Protection and Control Applications – Time Sources and Distribution Methods
C1	4	C1/C6	882 Closing the gap in understanding between stakeholders and electrical energy specialists 863 Multi-energy System Interactions in Distribution Grids
C2	4		868 Mitigating the risk of fire starts and the consequences of fires near overhead lines for System Operations
C3	1		876 Interactions between Electrical Infrastructure and Wildlife
C4	13	A1/C4	885 Guide on the assessment, specification and design of synchronous condenser for power system with predominance of low or zero inertia generators 881 Electromagnetic transient simulation models for large-scale system impact studies in power systems having a high penetration of inverter-connected generation
C5	11		877 Energy Price Formation in Wholesale Electricity Markets 874 Auction Markets and Other Procurement Mechanisms for Demand Response Services
C6	17	C1/C6 A3/C6	863 Multi-energy System Interactions in Distribution Grids 875 Medium Voltage DC Distribution Systems
D1	5	A2/D1	861 Improvements to PD measurements for factory and site acceptance tests of power transformers
D2	0	B5/D2	884 Time in Communication Networks, Protection and Control

Study Committee Meetings in Australia

CIGRE Australia did not host any Study Committee meetings in 2022.

CIGRE Paris Sessions

After two years affected by the COVID pandemic, the 2022 session was held in person in Paris.

Key theme for session was around energy transition and creating a power system of the future where CIGRE work is focused on developing new technologies to reach net zero carbon emissions by 2050.

CIGRE Austral members provided significant contributions including:

- Convening and contributing to Study Committee Discussion Sessions
- Presenting at the major disturbance workshop - International interest in understanding “Wide spread impact of cyclone and restoration through long term off grid supply (WA)” and “Interim note on the suspension of the Australian National Energy Market”
- Presenting Tutorials and
- Taking on the role of special reporter.

Some key Australian statistics for the PARIS 2022 session :

- 15 of our 16 Panel convenors attended
- 7 NGN attended (2 fully subsidised, 5 partially subsidised)
- 84 Australian delegates in attendance and participated
- KMS Training Workshops held daily. A big thank you to Rodney Hughes.

Due to previous two years of the COVID 19 pandemic there was a significant reduction in the number of papers submitted from CIGRE Australia members. 9 papers were submitted for the 2022 session. This is a significant reduction from the 30 papers submitted for the 2020 Session.

Seminars, Conferences and Training

In 2022, the following Seminars and Conferences were held.

CIDER 2022 - CIGRE Australia in conjunction with our C6 Technical panel (Active Distribution Systems and Distributed Energy Resources) was pleased to be able to present the 4th CIDER (Conference on the Integration of Distributed Energy Resources) in Adelaide in May 2022. Presentations are available via the CIGRE Australia website. See Attachment 2 for a summary report form the CIDER 22 event.

SEAPAC 2023 - South East Asia Protection Automation Conference will be held on 5th September 2023 as part of the 2023 Cairns International Symposium.

Cairns International Symposium 2023 - In addition, an enormous amount of planning is in progress for the Cairns International Symposium which will be held at the Cairns Convention Centre Cairns Australia - 4-7th September 2023.

- The symposium will be hosted by the C2 and C5 Study Committees and will involve 11 of our 16 panels, WGs, etc.
- Key Theme: The end-to-end electricity system: transition, development, operation and integration
- Registrations are open
- Call for Papers open
- Synopsis Submission closes 4/11/22 with notification 2/12/22
- All papers submissions are being managed separately to Cairns Symposium and can be downloaded on the CIGRE Australia website.

Thank You

On behalf of the ATC and CIGRE Australia, I thank those member organisations in Australia and New Zealand who have support the CIGRE technical activities during 2022.

I thank the members of the ATC for their efforts and contributions. In particular I would like to make mention of the dedication and effort of each member in volunteering of their own time to make important contributions to the future of CIGRE Australia.

I also thank the CIGRE Australia office for their support of the work of the ATC and Australian Panels.

Angela Klepac

Chair of the Australian Technical Committee

December 2022

Attachment 1 – 2022 Members of the ATC

	ATC Chair Person	Angela Klepac
	ATC Secretary	Natasha D'Silva
A1	Rotating electrical machines	Tri Tran
A2	Power transformers and reactors	Matthew Gibson
A3	Transmission and distribution equipment	David Pita
B1	Insulated cables	Russell Wheatland
B2	Overhead lines	Asif Bhangor
B3	Substations and electrical installations	Crina Costan
B4	DC systems and power electronics	John Wright-Smith
B5	Protection and automation	Peter Bishop
C1	Power system development and economics	Christian Schaefer
C2	Power system operation and control	Greg Hesse
C3	Power system environmental performance	Brett Hayward
C4	Power system technical performance	Babak Badrzadeh
C5	Electricity markets and regulation	Greg Thorpe
C6	Active distribution systems and distributed energy resources	Ray Brown
D1	Materials and emerging test techniques	Yi Li
D2	Information systems and telecommunication	Louise Watts
	SC C5 Chair Person	Alex Cruickshank
	SC D5 Chair Person	Victor Tan
	Executive Manager CIGRE Australia	Terry Killen

Attachment 2 – Annual Reports by the ATC

Australian Panel Annual Reports

- CIGRE_Annual_Report_AU_A1_2022.pdf
- CIGRE_Annual_Report_AU_A2_2022.pdf
- CIGRE_Annual_Report_AU_B1_2022.pdf
- CIGRE_Annual_Report_AU_B2_2022.pdf
- CIGRE_Annual_Report_AU_B3_2022.pdf
- CIGRE_Annual_Report_AU_B4_2022.pdf
- CIGRE_Annual_Report_AU_B5_2022.pdf
- CIGRE_Annual_Report_AU_C1_2022.pdf
- CIGRE_Annual_Report_AU_C2_2022.pdf
- CIGRE_Annual_Report_AU_C3_2022.pdf
- CIGRE_Annual_Report_AU_C4_2022.pdf
- CIGRE_Annual_Report_AU_C5_2022.pdf
- CIGRE_Annual_Report_AU_C6_2022.pdf
- CIGRE_Annual_Report_AU_D1_2022.pdf
- CIGRE_Annual_Report_AU_D2_2022.pdf

Reports on Working Groups supported by ANC of CIGRE

- CIGRE_Working_Group_Report_WG_A2.58_2022.pdf
- CIGRE_Working_Group_Report_WG_B4.92_2022.pdf

AU A1 Rotating Machines

Study Committee Scope

The A1 Study Committee is responsible for the field of Rotating Electrical Machines and includes in its scope all such machines for power generation, large motors and non-conventional electrical machines. It also includes a brief to cover the application of materials technology that relevant to electrical machines.

Specific Activities of the Study Committee

A1 Study Committee has four active advisory groups, focussing on particular issues as follows:

A1-01 Turbine (Turbo) generators.

Most activity is focussed through working groups as described below. Through this activity, A1-01 continues to aim to develop a set of guidelines to give background to generator owners in dealing with identified issues in the maintenance and monitoring of high-speed turbo generators.

A1-02 Hydro generators

Activity is focussed through working groups as described below. A1-02 continues to aim to develop a set of guidelines to give background to generator owners in dealing with identified issues in the maintenance and monitoring of hydro-electric machines.

A1-05 Non-conventional rotating machines

The focus of the group is wind turbine generators and superconducting machine developments. There are two working groups currently working in this area on aspects of operation, monitoring, reliability and availability of wind generators.

A1-06 Power station motors and drives.

The scope of this group is power station motors >1kV and >500kW. Activity is focussed through working groups as described below. A number of working groups have been formed to look into benefits of High Efficiency Motor, the effects of VSD (Variable Speed Drive) on motors and impact of flexible operation on motors.

Preferential Subjects

Preferential subjects selected by the Study Committee for in 2022 Paris 49th Session on 28th August to 2nd September were:

PS 1: Generation Mix of the Future

- Effect and risk of an increasing renewable power mix on existing legacy generators, generator auxiliaries, and motors
- Improvement in designs and maintenance practices to comply with new and future grid requirements
- Evolution and trends in new machines for renewable generation

PS 2: Asset Management of Electrical Machines

- Experience with refurbishment, replacement, design improvements, power up-rating, and efficiency improvement of aged generators and motors
- Optimised condition monitoring, diagnosis, prognosis, and maintenance practices to improve reliability and extend operational life
- Operational and project experience: installations, failure analysis; robotic inspections; recovery options; cost and time reduction initiatives; and effects of torsional electromechanical oscillations

for synchronous compensators, wind turbine generators, turbo-generators, hydro-generators, and motors

PS 3: Developments of Rotating Electrical Machines and Operational Experience

- Research on Non-invasive Condition Monitoring-Based Predictive Maintenance of Electric Motors.
- Series of Powerful Water-cooled Turbine Generator.
- Features of Akkuyu NPP Turbogenerators and Factory Test Results.
- Failure of Large Turbo-Generator during first run-Case Study of Indian Power Utility
- Increasing flexibility of historical power generation thanks to micro hybrid concept, the Xflex hydro live demonstrator at Vogelgrun HPP.
- Fundamental model of full power converter variable speed Hydro Generators: Control and Simulation.
- Damaged generator rotors: the economic and logistical benefits of repair over scrappage.
- Experience with CO2 free Generator Operation.

Papers accepted for Paris Session

24 papers were accepted for presented at 2022 Paris sessions:

PS 1: Generation Mix of the Future (6 papers)

- “Performance evaluation of retrofitted coal-fired power plant simulation model”
- “A challenge faced in India by the Peak Load Stations with Nation’s commitment of massive penetration of Renewables in the Generation Mix.”
- “Case Study for Synchronous Condenser Implementation.”
- “New Proposal of the motor-generator set with renewable energy and storage battery.”
- “An innovative power system stabilization method with augmented inertia synchronous condensers.”
- “Robust Design of Nuclear Turbo-generators and AVRs for increased penetration of renewables and HVDC lines in transmission grids.”

PS 2 - Asset Management of Electrical Machines (10 papers)

- “Alleviation of Sub-synchronous Torque Oscillations in Series Compensated Power Grid Via Fuzzy Based Battery Energy Storage System.”
- “Data Science and AI for On-line Diagnosis of Rotating Machines from Pre-existing Sensors, with applications in Hydro Generators and Wind Generators.”
- “Construction of the Partial Discharge Measurement History According to IEC 60034-27-2.”
- “Review on Trend of Diagnostic factor as a Function of Thermal and Multi Aging Time of 6.6 kV Rotating Machine Insulation System.”
- “Features of Electromagnetic Processes and Force Interactions in Turbogenerators When Consuming Reactive Power.”
- “Preventive Maintenance Technology for Enhancement of Turbine Generator Reliability.”
- “On-line Partial Discharge Monitoring System for Diagnosis of Insulation Condition in Generators.”
- “Performance and Automated tool for bearing fault diagnosis in induction motors, based on MCSA technique and machine learning algorithm.”
- “Reliability of the Wind Turbines at Lam Takong Jolabha Vadhana Power Plant: A Review.”

- "Anomaly Detection in Regulation Ring from Bulb Turbines using Deep Learning."

PS 3 - Developments of Rotating Electrical Machines and Operational Experience (8)

- "Research on Non-invasive Condition Monitoring-Based Predictive Maintenance of Electric Motors."
- "Series of Powerful Water-cooled Turbine Generator."
- "Features of Akkuyu NPP Turbogenerators and Factory Test Results."
- "Failure of Large Turbo-Generator during first run-Case Study of Indian Power Utility."
- "Increasing flexibility of historical power generation thanks to micro hybrid concept, the Xflex hydro live demonstrator at Vogelgrun HPP."
- "Fundamental model of full power converter variable speed Hydro Generators: Control and Simulation."
- "Damaged generator rotors: the economic and logistical benefits of repair over scrappage."
- "Experience with CO2 free Generator Operation."

Active Working Groups

There are 24 Active Working Groups.

- 3 Technical Brochures published:-

  A1.33 (TB 860) "Guide for Cleanliness and Storage of Generators."

  A1.44 (TB 879) "Guideline on Testing of Turbo and Hydro Generators."

  A1.48 (TB 878) "Guidance on High-Speed Testing of Turbo Generator Rotors".
- 2 Working groups had work completed and technical brochures to be published

  JWG C4/B4.52 & A1.54
- 9 Working groups at final stage:

  A1.42, A1.43, A1/C4.52, A1.56, A1.59, A1.60, A1/C4.66, A1.53, A1.58
- 8 Working groups in progress:

  A1.45, A1.55, A1.61, A1.62, A1.64, A1.67, A1.68, A1.70
- 5 Working groups started:

  A1.63, A1-69, A1.71, A1.72, A1.73
- 1 New Working group forming A1.XX (TBD) - "Survey on insulation reliability of induction and synchronous motors"

SC A1 Chairperson Summary at Paris session

- Working groups status review,
- Technical Council meeting and activities,
- Presentations from working group convenors
- Study committee scope and strategic directions – "More focus on wind generation and synchronous condensers"
- 2022 paper submission and review process.
- 24 Technical papers were accepted

One Tutorial was presented at Paris session on 31/08/2022

- "Guide on the Assessment, Specification and Design of Synchronous Condenser for Power System with Predominance of Low or Zero Inertia Generators".
-

Specific Activities of the Australian Panel (AU A1)

Relevant to Australia

- TB 860 (A1-33) Guide for Cleanliness and Storage of Generators.
- TB 879 (A1-44) Guideline on Testing of Turbo and Hydro Generators.
- TB 878 (A1-48) Guidance on High-Speed Testing of Turbo Generator Rotors
- TB 690 - Vibration and stability problems met in New, Old and Refurbished Hydro-generators, Root Causes and Consequences
- WG A1-54 - Impact of Flexible Operation on Large Motors.
- WG A1-29 - Guide on New Generator - Grid Interaction Requirements. - Relevant to prevention of widespread state blackout; similar to that in 2016 in SA.
- WG A1-31 - State of the Art of Stator Winding Supports in slot area and winding overhang of hydro generators
- WG A1-37 - Generator Stator windings support systems experience. - Highly relevant to the older turbo and hydro generators where they experience in high end winding vibration.
- WG A1/C4-66 - Guide on Synchronous Condensers for System Inertia, Short Circuit withstand capability (fault levels) and MVAr support in power grids with high level of renewable energy generation. [Highly relevant to South Australia due to high concentration of wind and solar generation]
- WG A1.70 - Dielectric Dissipation Factor Measurements on Stator Windings. Relevant to diagnostics to the ageing generator fleet in Australia.

Membership Update:

- The AU A1 panel currently has 13 members and 2 guest experts,
- There are representation from Utilities, Consultants, Service Providers and Testers from all states of Australia,
- Members participate many SC A1 working groups,
- Members share experience in the form of technical presentations at panel meetings and direct contacts in a wide range of relevant topics such as generator & motor failures, abnormal operations, major overhaul experience, new industry practice and technologies, condition monitoring, management of aged generators.
- Members make contributions to technical papers,
- Excellent technical networking.

Meeting Report: Australian Panel

Annual AU A1 panel meeting on 22nd August 2022 is via teleconference.

Invitations for SC or WG's to meet in Australia

Currently there are no invitations for SC A1 meetings to be held in Australia.

ANC Members on Working Groups

The following are the current AU A1 participation in Working Groups.

WG	Title	Australian Member
A1-42	Influence of Key Requirements to Optimize the Value of Hydro-generators	Peter Wiehe Aaron Volgel
A1-55	Survey of Split Core Stators	Peter Wiehe
A1-56	Survey on Lap and Wave Windings and their consequences on Maintenance and Performance	Peter Wiehe
A1-59	Survey on Industry Practices and Effects associated with the Cutting out of Stator Coils in Hydro-generators	John Iles
(A1/C4)-66	Guide on the Assessment, Specification and Design of Synchronous Condensers for Power Systems with Predominance of Low or Zero Inertia Generators	Fabian Spescha
A1-70	Dielectric Dissipation Factor Measurements on Stator Windings.	Peter Wiehe Tri Tran

Membership of the Australian Panel in 2021-2022

There are 15 financial members in Au A1 panel in 2021-2022

Name	Organisation	Type
Tri Tran (Convenor)	AGL	Utility
Peter Wiehe (Guest)	Acutel Consulting	Consultant
Marc Ransome	Hydro Tasmania	Utility
Hossein Rahimpour	Ampcontrol ETM	Consultant
Damien VERMEER	Beca	NGN
Aaron Volgel	Snowy Hydro	Utility
Len Gunn	Origin Energy	Utility
Franco Rabines	CS Energy	Utility
Simon Nawrot	Sunset Power International	Utility
Viet Trinh	ElectraNet	Utility Transmission
Gianni Reginato	Stanwell Corporation	Utility
Fabian Spescha	Total-eren	Consultancy
Johan Strydom	Synergy	Utility
Ashok Ojha	Alinta	Utility
Andriy Kotokhov	MachineMonitor	Consultant

Convener: Tri Tran
Email: tri.tran@agl.com.au
Phone: +61 0407 185 048

AU A2 Transformers and Reactors

Study Committee Scope

The scope of SC A2 covers:

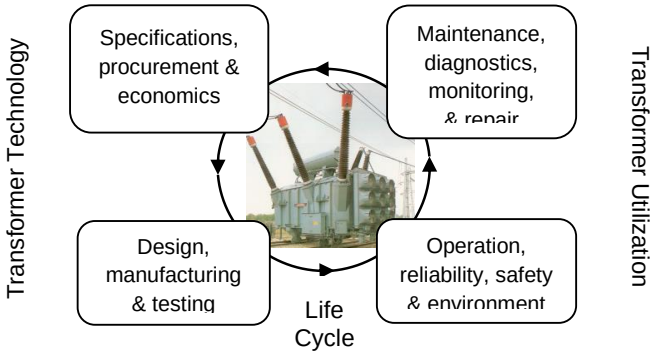
- All kinds of power transformers, including HVDC transformers converter and phase-shifting transformers;
- All kinds of reactors, including shunt reactors, series reactors, and HVDC smoothing reactors;
- All transformer components, including bushings, tapchangers, and other transformer accessories.

Specific Activities of the Study Committee

The key activities of SC A2, which cover the life cycle of a transformer, are related to the four following key domains:

1. Specification, procurement and economics
2. Design, manufacturing and testing
3. Operation, reliability, safety and environmental impact
4. Maintenance, diagnostics, monitoring and repair

Key domains (1) and (2) are associated with transformer technology, while key domains (3) and (4) are associated with transformer utilization. SC A2 will normally have activities in order to continuously cover the four key domains.



Major meetings:

Paris Session 2022: A2 held its full day Group Discussion Meeting on 30th Aug. There was a total of 330 participants with 52 prepared contributions presented addressing all 21 questions of the special report. All subjects stimulated very active spontaneous discussions from the audience.

The Preferential Subjects discussed were:

- PS1: Experience and new requirements for transformers for renewable generation
- PS2: Beyond the oil-immersed transformers and reactors
- PS3: Best practices in transformers and reactor procurement

A tutorial was also delivered by WG A2.55 on Transformer Life Extension during the Paris Session.

Preferential Subjects

The A2 Study Committee will be holding a joint Colloquium in Split, Croatia from 4th – 7th October 2023. The preferential subjects for this session are:

1. ***Digital twins***
   Definition, reliability of models (physics-based, machine learning and hybrid models)
   Development of twin modules (e.g. thermal, dielectric, mechanical, etc.), case studies
   How to make twins of existing vs. new transformers
   Benefits and use cases from using digital twin
   Input data and data management, digitalization examples
2. ***Trends in Transformer Maintenance***
   Innovative work methods (tools, robots, drones, cameras and 3D-printing)
   New development in monitoring and diagnostics (online/offline)
   Case studies of condition-based, risk-based and predictive maintenance approaches
   Total Lifecycle Cost strategies, Mid-life refurbishment, Life extension alternatives, comparative financial analysis of different strategies
3. ***Design performance in service***
   Sound levels of transformers in service
   Influence of environmental aspects and loading on thermal aspects, loss and noise
   Experience with actual in-service short circuit and overvoltage stresses,
   Resilience to earthquakes, floods, extreme heat etc.
   Experience with different breathing systems
   Transformer design verification for very fast transients
   Model verification for harmonics and GIC

Proposed New Working Group and Green Books

There were 3 new Working Groups and 1 Task Force created in 2022, as shown below.

Working Group/Task Force	Title	Convenor	Start	End
A2.68	Failure Survey of Lower Voltage Generator Step Up Transformers	Peter WERLE	2022	2025
A2.69	Guide for Transformer Maintenance - Update	Claude RAJOTTE	2022	2024
A2/D1.67	Guidelines for On-line DGA Monitoring	**Tara-lee MacARTHUR**/Khayakazi DIOKA	2022	2024
Task Force	Transformer Field Noise Measurement	Janine DICKINSON	2022	2023

A Green Book on Transformer and Reactor Procurement was published in September 2022. This book provides guidance on industry best practice in transformer procurement and Australian members Ross Willoughby and Tara-lee McArthur were both heavily involved.

Work on a new Green Book on Transformer and Reactor Life Management has commenced - planned for completion during 2025.

Specific Activities of the Australian Panel

Joint AU/NZ A2 Webtutes

The Australian and New Zealand A2 panels jointly held two webtutes during the year. The theme was measuring water in transformers and the webtutes were delivered by a great range of local and overseas experts in the area.

5th April – Part 1: Modern techniques to measure water content and keep transformers dry

The first part of the two-part series focussed on techniques for measuring water in transformers and new technologies that can help to keep them dry. Dr Ivanka Atanasova-Hohlein from Germany gave a talk on her work leading WG D1.52 and the use of capacitive moisture sensors. Dr Dan Martin from NZ talked about his work on measuring water in transformers. Dr Bhaba Das discussed modern technologies to maintain dryness.

The webtute attracted 94 attendees from all over the world (Denmark, Germany, Hungary, Indonesia, Iran, Malaysia, Morocco, Thailand and USA), as well and Australia and New Zealand.

31st May – Part 2: Drying transformers

The second part of the series continued with the theme. Ramesh Gopalan from UAE spoke about the importance of keeping transformers dry. Rob Milledge from Australia discussed innovative techniques used to dry out transformers using low frequency heating.

The webtute attracted 47 attendees.

Meeting Report: Australian Panel

The AU A2 panel held a two-day meeting on 14 & 15th November, hosted by AusNet Services in Melbourne.

Day 1 covered an update of international SC & WG activities; a report on the Paris Session and GDM summary; discussion on future webtute topics, 2023 transformer workshop and preferential subjects for the 2023 A2 Colloquium.

Day 2 was a technical discussion day covering topics of interest to the local panel members. The presentations and discussion focussed on the following areas:

- Defects/failure of Resin Impregnated Paper (RIP) transformer bushings and experience of Resin Impregnated Synthetic (RIS) transformer bushings
- Reverse power flows - effect on rating of station, overload capacity, cycling ratings, life management of assets
- Challenges and impacts on transformer assets with renewables (wind & solar); what testing/condition monitoring approach have been found effective.
- Ester fluids – gas signatures (high levels of ethane & ethylene in some esters); retro-filling

Invitations for SC or WG's to meet in Australia

There are no current invitations for future SC A2 meetings or working group meetings to be held in Australia.

ANC Members on Working Groups

The following table lists all the current AU CIGRE members on Working Groups.

Working Group/Task Force	Title	Convenor	AU/NZ Members
D1/A2.77	Tests for Insulating Fluids	Fabio SCATIGGIO	

A2/C4.52	High-Frequency Modelling	Bjorn GUSTAVSEN	**Yuriy Odarenko**
A2.54	Audible sound requirements	Christoph PLÖTNER	
A2.55	Transformer Life Extension	Pascal MÜLLER	**Paul Guy**
A2.56	Transformer Efficiency	Zarko JANIC	
A2.57	Effects of DC Bias on Power Transformers	Dejan SOUSA	
A2.58	Site Installation and Pre-commissioning of Power Transformers and Shunt Reactors	**Ross WILLOUGHBY**	**Ross Willoughby** **Matthew Gibson**
A2.59	On-Site Assembly, On-Site Rebuild, and On-Site High Voltage Testing of Power Transformers	Yukiyasu SHIRASAKA	
A2.60	Dynamic Thermal Behaviour of Power Transformers	Tim GRADNIK	**Seamus Allan**
A2.62	Analysis of Transformer Reliability	Stefan TENBOHLEN	**Dan Martin**
A2.63	Transformer Impulse Testing	Ebrahim RAHIMPOUR	**Arun Mathur**
A2.64	Condition of cellulose insulation in oil immersed transformers after factory acceptance test	Claes BENGTSSON	**Alan Vietch**
A2/D2.65	Transformer Digital Twin	Patrick PICHER	
A2/D1.66	Breathing systems of liquid filled transformers and reactors	Daniel KOCH	**Robert Li**
Task Force	Power Transformer Tank Specification for Passive Protection Against Internal Arc	Jean-Bernard DASTOUS	

Membership of the Australian Panel

Name	**Organisation**	**Type**
Arne Petersen	AP Consulting	Consultant
Caolan Griffin	Powerlink Queensland (NGN)	NGN
Carlos Gamez	Western Power	Transmission
Chandima Ekanayake	Transformer Innovation Centre	University
Dan Martin	ETEL	Manufacturer
Deepak Maini	WIlson Transformer Co P/L	Manufacturer
Gianni Reginato	Stanwell Corporation	Generator
Jude Perara	Endeavour Energy	Distribution
Kerry Williams	K-Bik Power	Consultant
Kris Bryla	Origin Energy	Generator

Lagath Ganepola	Powerlink Queensland	Transmission
Mark Cotton	AusNet Services	Transmission
Marko Prokic	ElectraNet Pty Ltd	Transmission
Matt Ridgley	Energy Queensland	Distribution
Matthew Gibson	Ausgrid	Distribution
Michael Jordanoff	Transpower New Zealand Ltd	Transmission
Peter New	Snowy Hydro Limited	Transmission
Peter Scoles	SA Power Networks	Distribution
Ross Willoughby	Reinhausen Australia	Consultant
Sam Mulquiney	Essential Energy	Distribution
Santosh Dhakal	TasNetworks	Transmission
Scott Corbett	Ampcontrol Group P/L	Contractor
Seamus Allan	Dynamic Ratings	Supplier
Shawn Nielsen	QUT (Gardens Point Campus)	University
Stjepan Perin	Hitachi Energy	Manufacturer
Tapan Saha	University of Queensland	University
Tara-Lee MacArthur	Energy Queensland	Distribution
Tri Tran	AGL	Generator
Walter Wasinger	Wasinger Transformers P/L	Consultant
Wenyu Guo	Omicron	Manufacturer/Contractor
Robert Li	TransGrid	Transmission

Membership changes:

	Previous Member	**New Member**
Transformer Innovation Centre	Ray Holzheimer	Chandima Ekanayake
Stanwell	Phil Onions	Gianni Reginato
Verico	Joe Tusek	Scott Corbett
Hitachi Energy	Rob Milledge	Stjepan Perin
SA Power Networks		Peter Scoles
NGN	Sanika Willard	Caolan Griffin

Convener: Matthew Gibson

Email: matthewg@ausgrid.com.au

AU A3 Transmission & Distribution Equipment

Study Committee Scope

The Study Committee (SC) A3 is responsible for the theory, design, construction, and application of medium, high and ultra-high voltage equipment components, equipment, and equipment systems or both AC and DC systems from distribution through highest transmission voltage levels. This includes the behaviour and interactions with, and duties imposed by the network and other system equipment under normal and abnormal conditions, testing and testing technologies, quality assurance, reliability and maintenance, environmental impact, disposal and recycling.

This equipment includes all devices for switching, interrupting, or limiting currents (circuit breakers, load switches, disconnect switches, earthing switches, fault current limiters, etc.) independent of technology. It also includes surge arresters, capacitors, busbar and equipment insulators, instrument transformers, bushings, and all other high voltage equipment not specifically covered under another equipment study committee's scopes.

Emphasis is on all kind of insulation and interrupting media in air, gas and solid insulated equipment in indoor as well as in outdoor substations.

Specific Activities of the Study Committee

The study committee has a strategic plan that is aligned to the four key strategic directions provided by CIGRE Technical Committee, namely:

- Prepare strong and smart power system of the future
- Making the best use of the existing equipment and system
- Focus on the environment and sustainability
- Network, develop knowledge and information

Specific activities (working groups - WG/ joint working groups - JWG) of study committee in alignment with the above strategic directions are listed below:

Making the best use of existing equipment and system

- WG A3.39: Metal-oxide surge arrester field experience
- WG A3.40 Technical requirements and field experiences with MV DC switching equipment
- WG A3.42 Failure analysis of recent AIS Instrument Transformer Incidents
- WG A3.43 Tools for lifecycle management of T&D switchgear based on data from condition monitoring systems.
- WG A3.44 Limitations in operation of High Voltage Equipment resulting from Frequent Temporary Overvoltages.
- WG A3.45 Methods for identification of frequency response characteristics of voltage measurement systems.
- WG A3.46 Generator circuit breakers (GCB): review of application requirements, practices, in-service experience, and future trends.
- WG A3.47 Lifetime Management of Medium Voltage Switchgear
- WG A3.48 4th CIGRE Reliability Survey on T& D Equipment
- JWG A3/A2/A1/B1.44 – Consequences of HV equipment exceeding highest system voltages
- JWG B4/A3.86 – Fault Current Limiting Technologiesfor DC Grids

Answer the environment concerns

- WG A3.41 Interrupting and switching performance with SF6 free switching equipment. The TB-871 published in October 2022.
- JWG B3/A3.59 – Guidelines for SF6 end-of life treatment of T&D equipment (above 1kV) in Susbtations
- JWG B3/A3.60 – User guide for non-SF6 gases and gas mixtures in Substations

Develop knowledge and information

- All working groups, tutorials and green book

The study committee has established permanent advisory groups to address co-ordination and strategic issues. These include:

- AG.A3.01 Strategic Planning
- AG.A3.02 Tutorials
- AG.A3.03 Green Book

These advisory groups are supported by coordination activities with various other industry standard and technical groups such as IEC, IEEE, CIRED, Current Zero Club. A brief summary of these advisory groups is provided below.

AG.A3.01: The Strategic Planning Advisory group monitors industry developments and crosschecks them with the Study Committee's strategy. It advises the Study Committee on issues that impact on the activities of the Committee and ensures the Committee responds effectively to these developments. This Advisory Group coordinates the Working Groups and supports them in technical and organizational aspects. The Strategic Planning Advisory Group consists of the Study Committee Chairman, Working Group Conveners and others nominated by the Study Committee Chairman. It meets once a year between the Study Committee meetings.

AG.A3.02: The Tutorials Advisory group has the task of arranging for the dissemination of the technical information developed within the Study Committee and its Working Groups. It plans, develop, manage and deliver workshops, colloquia and tutorials in coordination with local organizations. This advisory group has a renewed focus. It will further enhance the visibility of the work undertaken by the study committee and its working groups and their dissemination to the industry. Currently the tutorials are available on the following subjects:

- Reliability of High Voltage Equipment
- Fault Current Limiters
- Surge Arrestors
- HV Vacuum Switchgear
- Use and Application of Optical Instrument Transformers
- Circuit Breakers – Standards, Guidelines and Selection
- Recent Developments in Distribution Switchgear Standards
- Statistical Analysis of Electrical Stresses of HV Equipment in Service
- High Voltage Circuit Breakers
- Modelling and testing of Transmission and Distribution Switchgear
- Switching phenomenon for UHV and EHV Equipment
- Management of Ageing High Voltage Substation Equipment and possible mitigation techniques
- Non-intrusive condition monitoring of MV/HV equipment

AG.A3.03: The "Green Book" Advisory group have completed their task, with the publishing of the A3 Green Book titled Switching Equipment, which was released in 2018. A second edition is currently being planned with additional topics being written.

In addition to the work undertaken by the advisory groups, various active working groups progressed as below.

WG A3.39 Metal-oxide surge arrester (MOSA) field experience.

The working group is looking at the long term field experience of metal-oxide surge arresters in installations from 66kV to 1100kV. Data has shown that some higher failure frequency for old designs, even though many were installed within the last 10 years. The WG will investigate the detailed field experience observed in different countries. The draft TB is scheduled to be completed in mid-2022.

WG A3.40 Technical requirements and field experiences with MV DC switching equipment

The working group will first collect available field experience of LVDC and MVDC switching equipment used in different applications and investigate whether their technical requirements and testing considerations can meet the recent requirements under changing the MV and LV network conditions due to the massive penetrations of DER and Energy Storage systems.

.The use of MVDC switching equipment in different system configurations such as a point-to-point or multi-terminal MV grid will be examined and to understand the switching phenomena in MVDC grids. The draft TB is due in 2022.

WG A3.42 Failure analysis of recent AIS Instrument Transformer (IT) Incidents.

This working group will collect failure data regarding instrument transformer age, application type and design details, along with the failure cause, operating conditions and imposed field stresses.. It will collect field experience with the type of insulator and the utilites' policy with respsect to life management, sub-population replacement, inspection and diagnostics, reporting, risk assessment and specifications. It will analyse the failures, simulation of resultsand determine the most probable root causes, and recommend specifice requirements for IT's, additional type and routine tests and advanced diagnostic techniques. The final report is due in 2023.

WG A3.43 Tools for lifecycle management of T&D switchgear based on data from condition monitoring systems.

This working group will take the work performed by JWG A3.32 and focus on intergration of various condition monitoring systems into the maintenance and operation process of T&D switchgear. The working group will address the need to combine the data from various sources such as sensing systems, diagnostics and historic data, evaluate them automartically and provide the specific recomendations to the equipment users. These require the development of anyalytical tools which would be custom tailored to the specific switchgear equipment but expressed in simple and general ways. The final report is due in 2023.

WG A3.44 Limitations in operation of High Voltage Equipment resulting from Frequent Temporary Overvoltages.

This is a joint working group with SC's A1, A2, A3, and B1 looking at the operation of HV equipment subject to temporary power frequency overvoltages. The working group will look at user experience where equipment is frequently subject to temporary overvoltages, looking at failure statstics and mitigation measures, along with consulting with manufacturers regarding the capability and limitations of equipment to sustain temporary overvolatge condituions. The final report is due in 2023.

WG A3.45 Methods for identification of frequency response characteristics of voltage measurement systems.

This working group is looking at the frequency response of conventional and non-conventional instrument transformers used in voltage measurement. With increased power generation from sources which utilise electronic converters, voltage signal frquencies can range from DC to 10kHz; how these voltages are measured and represented by the instruments transformers will be examined. The need to for correct measurement results up to the high frequency range is required in order to attain the required power quality parameters and protect the installed high voltage quipment in service. The working group will look at carrying out tests comparing the output of voltage transformers with different frequencies, along with obtaining unser experiences. The final report is due in 2023.

WG A3.46 Generator circuit breakers (GCB): review of application requirements, practices, in-service experience, and future trends.

This working group will gather information to and produce a brouchure to serve as an educational resource on GCB topics, including history of development and applicatiomn peculiarities. Topis such as busbar dimensioning, heat dissipation, loss of service continuity, short-circuit calculations, voltage transients, condition monitoring, requirements for FAT and SAT will be included. Case studies of different GCB installations will also be included. The final report is due in 2023.

WG A3.47 Lifetime Management of Medium Voltage Indoor Switchgear

The working group will deliver a technical brochure on lifetime management of indoor medium voltage switchgear. The brochure will take into consideration the environmental, safety, equipment reliability, equipment changes of use and logistical factors and recommend options for increasing in-service life of the switchgear. Options will include various factors such as retrofitting of components, replacement, and other measures such as work practices.

The final report is due in 2024.

WG A3.48 4th CIGRE Reliability Survey on Transmission and Distribution Equipment

The previous third CIGRE reliability survey on equipment such as circuit breakers, disconnecting switches, earthing switches, instrument transformers and gas insulated switchgear (GIS) was carried out in 2004-2007, and the results on these equipment were presented in CIGRE Technical Brochures 510, 511, 512, 513 and 514, respectively.

The scope of the fourth CIGRE reliability survey is expanded to cover generator circuit breakers, vacuum circuit breakers and MO surge arresters to provide field experience to related WGs. Due to a couple of new participations in the survey, the TF1 has already collected sufficient large number of the reliability data on the equipment and analysed them classified into different design categories. They show very interesting results including ageing assets serviced more than 40 years with considerable different tendency among the countries.

JWG B4/A3.86 Fault Current Limiting Technologies for DC Grids

The purpose of the proposed Joint Working Group is to start from the literature review and global survey of the available concepts and applications for fault current limiting devices. The WG will then assess and summarize the technologies and devices, identify the possible applications and technical requirements of DC FCL. Finally, the JWG will provide guidelines for users to select DC fault current limiting technologies and devices for their specific applications. The final report is due in 2022.

JWG A3/A2/B1.44	Consequence of High Voltage Equipment operating exceeding highest system voltages In transmission and distributions systems, the operating voltage can temporarily exceed the highest voltage for the equipment (Um). This working group will investigate the influence of standard frequent TOV on the equipment, covered under B1, A1, A2 and A3 study committees (generators, power transformers, overhead lines, switching equipment, surge arrestors). This WG will not cover all TOVs that can arise in the power system such as harmonic resonances during transformer energization. This will be investigated under separate WG. The final report is due in 2023.
JWG B3/A3.59	Guidelines for SF6 end-of-life treatment of T&D equipment (>1kV) in Substations Increasing number of installed SF6-containing T & D, equipment is now reaching its end-of life in the coming years. A trend to SF6-free solutions might additionally drive a premature dismantling of SF6-containing equipment. The scope of this working group is to give practical guidelines for proper SF6 end-of-life treatment contained in T&D equipment as a blueprint for environmental responsible end-of life handling of SF6 in the electric power industry. The final report is due in 2022.
JWG B3/A3.60	User guide for non-SF6 gases and gas mixtures in Substations Recent developments show the growth in application of non-SF6 gases and gas-mixtures in medium voltage (MV) and high voltage (HV) switchgear for insulation and arc quenching. Recently presented alternative gases/ non-SF6 gases contain components of air (such as N2 or CO2) and can contain fluorinated compounds. For users and manufacturers, different aspects are still uncertain. IEC 62271-4 and TB 802 (Application of non-SF6 gases or mixtures in MV and HV GIS) provides basic information, however, the practical user aspects need to be discussed in more detail. This WG will provide guidance for non-SF6 gas handling, mixing methods, tightness, and non-SF6 gas measurement and monitoring of gas leakage. The final report is due in 2024.

SC A3 Publications

- **TB 871 - Current Interruption in SF6 free Switchgear**
  Deals with the technology, availability and application of SF6-free T&D switchgear. It focuses on the mainstream of upcoming SF6- free current interruption technologies, on the one hand based on interruption in natural-origin gases and their mixtures with fluoronitrile (C4-FN), fluoroketone (C5-FK), and on the other hand on technical air-insulated vacuum CBs.

- **TB 873 – Design, test and application of HVDC Circuit Breakers**
  This Technical Brochure presents comprehensive guides to the design, test, key functional requirements of the HVDC CBs and their interaction with HVDC system.

Preferential Subjects

The A3 preferential subjects for 2024 Paris Session are:

- PS1 Energy Transition involving T&D Equipment

- Innovative technologies to reduce total cost of ownership and to foster the energy transition
- Novel applications and increased duty of equipment in DER
- Improvement of grid resilience due to climate change: the impact of equipment requirements

- PS2 Lowering the carbon footprint of T&D Equipment
  - Performance & maturity of SF6 alternatives – report on industry experience
  - Lifecycle assessment of T&D equipment
  - Life cycle management and life extension of the existing SF6 equipment.
- PS3 Maintaining and management of T&D equipment
  - Smart sensors, low power instrument transformers, monitoring and condition assessment
  - Digital Twin and equipment reliability modelling also covering new/higher load profiles
  - Big data management and data ownership

Proposed New Working Groups

The following new working groups were approved:

- WG A3.47 has been approved in December 2021 focused on Lifetime Management of Medium Voltage Switchgear. This working group will have an Australian Convenor. The Terms of Reference document was instigated and written by members of the AU A3 panel.
- WG A3.48 has been approved in July 2022 focused on 4th CIGRE Survey on Transmission and Distribution Equipment. This working group will have Convenor from Japan. The Terms of Reference document was instigated and written by members of the JP A3 panel Ito Hiroki.
- JWG B3/A3-60 User guide for non-SF6 gases and gas mixtures in Substations. This WG will provide guidance for non-SF6 gas handling, mixing methods, tightness, and non-SF6 gas measurement and monitoring of gas leakage.

Specific Activities of the Australian Panel

Australian Panel A3 members have decided to continue focus on the following key areas in 2022-23 period:

- **SF_6 gas mitigation strategy –** Investigate a key reasons for the SF6 leak - Develop SF6 leak detection flow charts for different HV CB's, highlight HV equipment design which contributes to SF6 leaks - Develop SF6 management strategy to reduce gas leakage – Implementation action
- **Transition to SF6 free equipment technology**– Investigate the SF6 alternatives market availability and evaluate processes, procedures and impediments to adoption of new technology. Share information from leading innovators and gain from learnings from early adopters of technology for mutual benefit. Trails of equipment with SF6 alternative gases.
- **Asset management topics** – Lifecycle cost evaluations; equipment condition monitoring, condition based maintenance, risk based asset management of S/S equipment; end-of-life modelling for AER capital expenditure submissions.
- **Medium Voltage Switchgear Asset Management -** Aged equipment and internal arc – Removing oil CB's and retrofitting with vacuum CB's – Installing internal arc-fault mitigation schemes to existing switchgear – Condition assessment methods of aged switchgear – Justification and cost-effective replacement of switchboards. A new working group A3.47 – Lifetime Management of Medium Voltage Switchgear approved in December 2021. The Terms of Reference document was written by members of the AU A3 panel.

Future Events

- SC A3/B2/B4,C6 Symposium – Muscat, Oman, March 2023
- SC A3/B3 Colloquium – Birmingham UK, May 2023
- SC A3/B1/B3/B5/C1/C2?C4/C5/C6/D1/D2 Symposium – Cairns, Australia, September 2023

ANC Members on Working Groups

The following are all the current AP representatives on A3 Working Groups.

WG	Title	Australian Member
A3.42	Failure analysis of recent AIS Instrument Transformer Incidents	Wayne Pepper
A3.43	Tools for lifecycle management of T&D switchgear based on data from condition monitoring systems	Ankur Maheshwari Charbel Antoun
A3.45	Methods for identification of frequency response characteristics of voltage measurement systems.	Sean Elphick
A3.46	Generator circuit breakers: review of application requirements, practices, in-service experience and future trends	Munyaradzi Chadian
A3.47	Lifetime Management of Medium Voltage Switchgear	Ankur Maheshwari - Convenor
A3.48	4th CIGRE Reliability Survey on T& D Equipment	Wayne Pepper

Membership of the Australian Panel

Name	Organisation	Type
David Pita (Convenor)	Powerlink, QLD	Transmission
Wayne Pepper	Ausgrid, NSW	Distribution
Cameron Yates	AusNet Services, VIC	Transmission & Distribution
Julian Orozco Perez	Western Power	Transmission & Distribution
Ankur Maheshwari	AMCL	Consultant
Timothy Blair	Transgrid	Transmission & Distribution
Matthew Ridgely	Energy Queensland, QLD	Distribution
David Roby	Hitachi-ABB, NSW	Vendor
Hitesh Parekh	Hitachi-ABB, NSW	Vendor
Melissa Taylor	TasNetworks, TAS	Transmission & Distribution
John Shann	Transpower, NZ	Transmission
Xiang Heng	GE Energy, NSW	Vendor
Andrew Wilkinson	Electranet, SA	Transmission

Name	Organisation	Type
Mark Garrett	Essential Energy, NSW	Distribution
Kerry Williams	K-Bik Power Pty Ltd, QLD	Consultant
Charbel Antoun (member of WG A3.43)	Transgrid, NSW	Transmission
Harsh Gupta	AusNet Services, VIC	NGN
John Wright-Smith	AMSC	Vendor
Vinay Krishnamurthy	EPC	Vendor

Convener: **David Pita**

Email: **dpita@powerelink.com.au**

Phone: **0438 762 190**

AU B1 Insulated Cables

Study Committee Mission

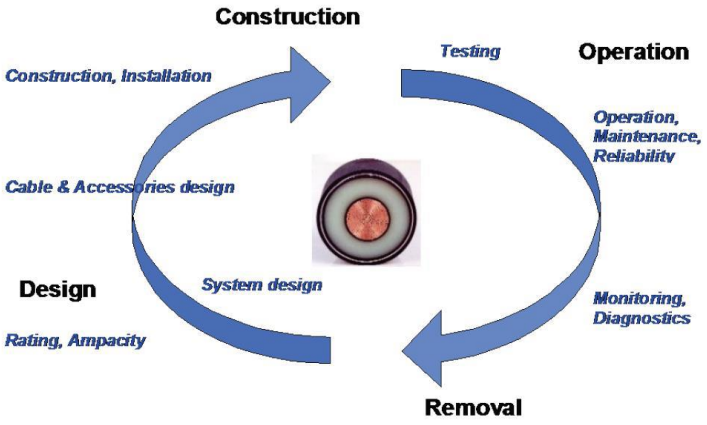
To facilitate and promote the progress of engineering and the international exchange of information and knowledge in the field of insulated cables. To add value to this information and knowledge by means of synthesizing state-of-the-art practices and developing recommendations.

The two technological fields of activity are

- AC and DC insulated power cable systems for power transmission, distribution and generation connections on land and in submarine applications.
- Power cable systems associated with micro-grids and the integration of distributed resources.

Study Committee Scope

Within its technical field of activity, the Study Committee SC B1 Insulated Cables, 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.



Specific Activities of the Study Committee

History

CIGRE was established in 1921. The first Study Committee dealing with Power Cables was founded in 1927 under the designation of SC 2. (SC 1 was for Insulating materials and oil)
It became SC 21 in 1967 and SC B1 in 2002, one of the five SC's dealing with subsystems (SC "B").
In 2017, SC B1 celebrated 90 years of existence and this year we celebrated 95 years.
For the Celebration of the 75th anniversary of the Study Committee in Paris (2002), SC B1 Chairman Aldo Bolza recalled that Insulated cables were addressed by CIGRE from the very beginning, starting with a discussion in the 1921 Session under the heading "construction of lines" and the sub heading "underground and submarine lines". The main subjects foreseen for such discussion were

- utilization limits of single and multi-core cables for AC and DC,
- determination of electric constants
- after-laying tests.

Nearly 100 years later, all these topics are still present in the main areas of activity of the Study Committee on Insulated Cables.

Study Committee Meetings

The Study Committee (**SC**) meets annually with this year's meeting returning to Paris after the pandemic.

The SC continues to focus on its two technological fields of activity while beginning to incorporate an end-to-end approach to electricity networks, bringing MV and LV cable designs into the mix. Traditionally CIGRE has had a transmission voltage focus however the ever-increasing development of micro-grids and distributed generation systems, like wind and solar farms, has necessitated the need to offer expertise in these fields.

The SC strives to be actively involved in the Asia Oceania Regional Committee (AORC) meetings. These are seen as alternatives for the Asian and Pacific area B1 members who find it difficult to attend the European based meetings. The AORC provides a means to introduce cable experts from countries in the region to CIGRE and the work of SC B1. The meetings are arranged and run in much the same way as a Working Group meeting with 2 delegates and 2 invited experts from each country,

Australia plays a significant role in the AORC, especially the AORC B1 committee which AU B1 founded. Together with NZ B1, we are trying to spearhead an incentive to start to include some of the surrounding islands. It seems a logical step but with politics, nothing is as easy as it might seem

There are 472 experts working for the SC. It is believed that the last decade of activity within the B1 committee was the most important in the Insulated Cable Committee history.

Overall SC B1 has a strong foundation for the work it undertakes:

- The SC has 43 members (24 regular, 13 observer and 6 additional}
- National Committees from the 24 represented countries have been very active during the year

SC B1 has dedicated a large part of its activities to technical work and has issued a large number of documents, including recommendations to prepare IEC standards. Recent examples are listed in section 0.

The field of activity of SC B1 is the development and operation of all types of AC and DC insulated cable systems for Land and Submarine Power Transmission. Most of the existing WGs being applicable to MV, HV and EHV applications.

Working Groups

Each year, new Working Groups are launched to address each of the four Technical Directions of CIGRE:

- Technical Direction 1: The electrical power system of the future,
- Technical Direction 2: Making best use of the existing power system,
- Technical Direction 3: Focus on environment and sustainability,
- Technical Direction 4: Communication on power system issues for decision-makers.

New work items are discussed and decided upon by the SC members present at the Annual Study Committee Meeting. The Terms of Reference (ToR) surrounding these work items are usually prepared by a Task Force (**TF**), which is formed for a 12 month term. If the TF determines that the subject is worthy of further work by the SC, a Working Group (**WG**) is created, with a convenor and international experts making up the group.

The proposals of New Work Items submitted to the Study Committee are prepared by the Customer Advisory Group (**CAG**) and formally established by the Strategic Advisory Group (**SAG**) of the Study Committee. Each Region of the World is represented in the CAG to gather the needs of the Regional Target Groups. At each CIGRE Session, questionnaires are proposed during the Group Discussion Meeting to identify the needs of the Target Groups of the Study Committee.

At the end of June 2022, SC B1 has

- 18 active Working Groups
- 5 active Joint Working groups (led by SC B1 with members from other SCs)
- 3 active Task Forces
- 9 Joint Working groups being led by other SCs

Australian National Committee
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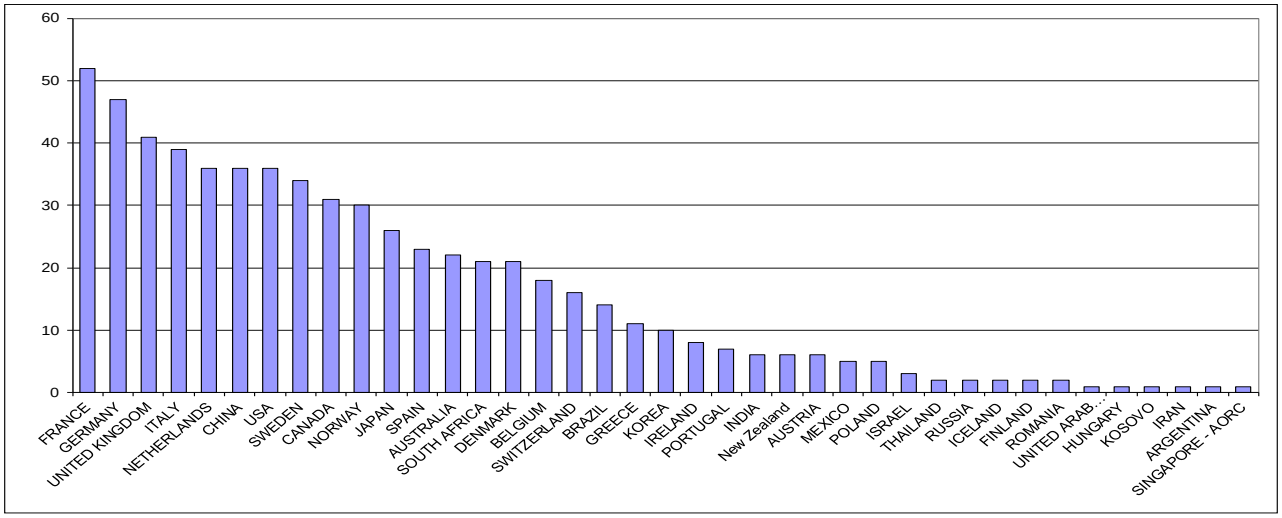
Study Committee Statistics

Some statistics from the SC show Australia's commitment to the work of CIGRE. We are well represented.

Country Participation

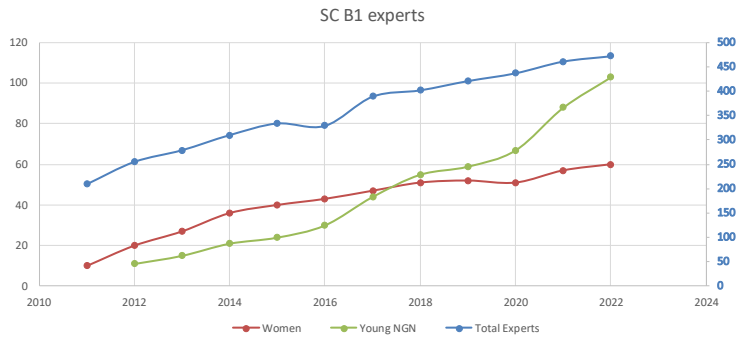
In a more detailed analysis, the 472 participations are coming from the following countries



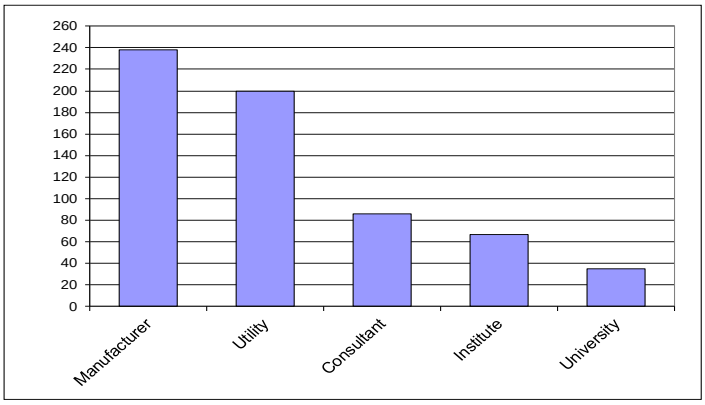
While the number of experts from Australia being involved in the SC WGs and TFs remains strong, there is always room for learned people to become involved in the committee's national and international activities.

Number of B1 experts : Total

	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012
Total Experts	472	461	437	421	402	389	329	334	310	279	255
Women	60	57	51	52	51	47	43	40	36	27	20
Men	412	404	386	369	351	342	286	294	274	252	235
Young / NGN	103	88	67	59	55	44	30	24	21	15	11



SC B1 Composition per Affiliation



Preferential Subjects for SC B1

The three preferential subjects for 2022 are

PS 1 : Learning from experiences

- Design, manufacturing, installation techniques, maintenance and operation
- Quality, monitoring, condition assessment, diagnostic testing, fault location, upgrading and uprating methodologies and relevant management
- Lessons learnt from permitting, consent and implementation

PS 2 : Future functionalities and applications

- Innovative cables and systems, exploring the limits
- Role and requirements of power cables in tomorrow's grids
- Prospective impacts from the Internet of Things, Big Data and Industry 4.0 on power cable systems

PS 3 : Towards sustainability

- Environmental challenges impacting current, planned and future cable systems
- Safety considerations, cyber and physical security, including case studies
- Projects and initiatives to promote access to affordable, reliable, sustainable distribution and transmission cable lines for all

Publications

The brief of every B1 WG is to finish within a 3 year period, to produce a Technical Brochure and a Tutorial.

Publications during 2021

Excluding the executive summary of a TB), Reference papers, Technical brochures, CSE papers, Future Connections.

WG number	Name of the Publication	Publication details
---	GREEN BOOK "Accessories for HV and EHV Extruded Cables – Vol. 1"	Ref. GB 9 – Jun 2021
---	NEWSLETTER "Safety: a crucial issue to sustainability on insulated cable systems"	Future Connection – May 2021
WG B1.60	Maintenance of HV Cable Systems	TB 825 - Jan 2021
WG B1.38	After laying tests on AC and DC cable systems with new technologies	TB 841 - Sept 2021
WG B1.62	Recommendations for testing DC extruded cable systems for power transmission at a rated voltage up to and including 800 kV	TB 852 - Nov 2021
WG B1.66	Recommendations for testing DC lapped cable systems for power transmission at a rated voltage up to and including 800 kV	TB 853 - Nov 2021

Publication Plan for 2022

WG number	Name of the Publication	Publication details (expected in …)
WG B1.56	Cable ratings verification	Q2 2022
WG B1.61	Installation of HV cable systems	Q3 2022
WG B1.65	Installation of submarine cables	Q3 2022
WG B1.54	Behaviour of cable systems under large disturbances (earthquake, storm, flood, fire, landslide climate change)	Q4 2022
WG B1.72	Cable ratings verification Part. 2	Q4 2022
WG B1.58	Condition Assessment and Diagnostic Methods to support Asset Management of MV Cable Networks	Q4 2022
WG B1.64	Evaluation of Losses in Armoured Three-core Power Cables	Q4 2022 / Q1 2023

Green Book progress

Green books are CIGRE's state of the art, flagship reference publications

Three different works are in progress at different stages:

A first draft of "Accessories for HV and EHV Extruded Cables – Vol. 2" is with Springer
Currently an update is needed due to new docs available (draft TB from B1.61).
Publication is expected in 2022.

A proposal for a book on "Cable Rating" will undergo the TC approval process within 2022
Time for preparation should not take more than 1 year

"Cable System Design" book is a proposal still to be shaped within SC B1.

Proposed New Working Groups

Currently there are four new working groups and two new task forces for SC B1 in 2021. They are:

Working Group	Title	Convener
WG B1.88	Replacement gas for SF6 in cable accessories	Pierre MIREBEAU (FR)
WG B1.89	Cable systems failure analysis	TBA
WG B1.90	Cable Systems Electrical Characteristics (Update of TB 531)	TBA
WG B1.91	Transient Thermal Modelling of Power Cables (update to IEC 60853)	Frederic LESUR (FR)
JWG B2/B1	Transition facilities between overhead and underground lines	From SC B2
Task Force	**Title**	**Convener**
TF B1.92	Recommendation for additional testing of submarine cables (update of TB 722)	James PILGRIM (UK)
TF B1.93	Robotic supervision of tunnels	To be defined (CN)

Tutorials and Webinars

The focus on webinars in 2021 which was "forced" by travel restrictions

Date of broadcast	WG/TB	Title of the webinar	Number of registrants	Number of attendees
20 Apr 2022	WG B1.50	Sheath Bonding systems of AC transmission cables	969	492
04 Mar 2021	WG B1.47	Implementation of Long AC HV and EHV cable systems	652	433
04 Jun 2021	WG B1.40 - TB 610	Offshore generation cables connections	609	349
15 Dec 2020	WG B1.52	Fault location on Land and Submarine cable links	507	331
10 Dec 2020	JWG C2/C4.41	Impact of high penetration of inverter-based generation on system inertia of networks	580	329
09 Feb 2021	WG A3	Shunt Reactor Switching: Theory and Practice	445	280
04 May 2021	WG B4.70	Guide for Electromagnetic Transient Studies involving VSC Converters	433	272
30 Nov 2021	WG B1.60	Maintenance of HV cable systems	448	252
25 Jun 2020	JWG C4/B4.38	Network Modelling for Harmonic Studies	432	245
28 May 2020	WG B1.48	Trenchless Technologies	364	226
24 Feb 2021	WG B2.63	Tutorial on CIGRE TB 792 – Compact AC lines	364	181
15 Nov 2018	B4/B5.59	Protection and Local Control of HVDC grids	275	168
29 Oct 2020	JWG C2/B4.38	Capabilities and requirements definition for Power Electronics based technology…	359	159
25 Mar 2021	WG B5.50	IEC 61850 Based Substation Automation Systems – Users Expectations…	316	135
04 Apr 2019	JWG C4-C6.35	Modelling of inverter-based generation for power system dynamic studies	263	112

SC B1 Public Website

Creation of the new B1 public website : https://b1.cigre.org

Explanation of the content of the website

- Structure
- Publications: technical brochures, overview can be created with Excel file to search for key words
- Tutorial request: automatic emails are sent to TAG Convener

Specific Activities of the Australian Panel

The AU B1 panel continues to grow, currently having 39 members, with 2 new representatives joining over the past 12 months. This continues to be exciting times for the panel.

The AU Panel has representatives from both AU and NZ. Historically with CIGRE's focus having been on transmission voltage levels, the very few companies within NZ having transmission lines had joined the AU panel to be able to converse with like-minded experts. Now with CIGRE's broadened approach to end-to-end expertise, which incorporates MV and LV assets, we have worked with CIGRE NZ to establish the NZ B1 panel. NZ B1 focuses on MV and LV cable topics.

Considerable cable activity throughout both countries

- MV cable networks continue to grow as more new housing estates are established
- MV, HV and EHV connections are being deployed as networks are expanded to capture renewable generation points of supply
- Conductor sizes continue to rise

Extended involvement of AU NGN members has been welcomed by the panel

Continued support of both the CIGRE AORC Council and the AORC B1 panel.

Topics of interest are:

- Distribution utilities keen on implementing more robust condition assessment electrical testing (Tanδ & PD) measurements to support managing MV cable assets. Guidelines on choosing equipment and services and integrating those with the asset management process
- ISO55001 is also of interest. Both AU and NZ utilities foresee that guidelines or specialist knowledge on integrating cable maintenance decisions with asset management
- The importance and benefits of maintenance programs
- Continued connections for Solar and Wind farms at MV, HV and EHV levels.
- Lots of non-cable people becoming involved in cable related decisions
- Big Battery systems to harness renewable energy are being connected by cables (MV, HV and EHV)
- Continued growth in use of fibre optic cables for measuring and monitoring cable performance
- Off-shore windfarms - Submarine cables, DC links, long AC links

- Large conductors for HV cables (66kV 2500mm2)

Summary of Past/Future Event(s)

Event Name	Date	City	Web site link	Comments
AUB1 on-line meeting	May 2022	On-line	https://cigregroups.org/display/AUB1/2022+05+On-Line	On-line panel meeting 95% attendance 2x 2.5hr sessions
AU B1 Face to face meeting	Nov 2022	Sydney	https://cigregroups.org/display/AUB1/2022+11+Sydney	Meeting after Paris session

Invitations for SC or WG's to meet in Australia

An invitation has been accepted by SC B1 to meet in Cairns - Australia in 2023 for the CIGRE Symposium.

Currently SCA3, SCB1, SCB3, SCB5, SCC1, SCC2, SCC4, SCC5, SCC6, SCD1 and SCD2 will be attending.

AU B1 will hold their 2023 meeting in Cairns at the same time. The symposium will give an ideal opportunity for networking with the international SC B1 members. Everyone is encouraged to attend.

AU B1 Members currently on Working Groups

The current SC B1 working groups and their AU corresponding members are shown below.

Australia boasts representatives on 20 out of the 27 active TF's, WG's and JWG's.

WG#	WG Title	AU B1 Rep
WG B1.89	Guidance for conducting cable systems failure analysis	Rob Bradley
WG B1.87	from TF B1.84_1 Finite Element Analysis for Cable Rating Calculations	Chandima Ekanayake
WG B1.86	Guidelines for safety issues associated to cable systems	Nic Moffa
JWG B1/C3.85	Environmental impact of decommissioning of underground and submarine cables	Nang H
WG B1.83	Grounding aspects for long HVDC land cable connections	Tony Auditore
WG B1.82	MVDC Cable system requirements/topics	Craig Harrison
WG B1.81	How to have statistics every 2 years?	Russell W
WG B1.80	Guidelines for Site Acceptance Test of DTS and DAS systems	Jeff Cairns
WG B1.76	Enhancing Quality Assurance/Quality Control Procedures for HV and EHV Cable Systems	Peter N
JWG D1/B1.75	Strategies and tools for corrosion prevention for cable systems (2019 – 2022)	Graeme B
JWG B1/B3.74	Recommendations for a performance standard of insulated busbars (2019 -2022)	David Platt
WG B1.73	Recommendations for the use and the testing of optical fibers in land cable systems (2019 - 2022)	Graeme B
WG B1.72	Cable ratings verification (2nd part) (2018 - 2020)	David S
WG B1.71	Guidelines for safety risk management in cable systems (2018 - 2019)	Greg C
JWG B1/C4.69	Recommendations for the insulation coordination on AC cable systems (2018 - 2021)	Tony A
WG B1.68	Condition evaluation and lifetime strategy (2018 - 2021)	Rob B
WG B1.67	Loading pattern on cables connected to windfarms (2018 - 2021)	Kerry P
WG B1.61	Installation of HV cable systems (2016-2019)	Peter R
WG B1.58	Asset management in MV cables networks (2016-2019)	Dave L
WG B1.54	Behavior of cable systems under large disturbances (earthquake, storm, flood, fire, landslide climate change)	Richard J

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Membership of the Australian Panel as at November 2022

Name		Position	Organisation	Type
Russell	WHEATLAND	Convener	AusNet Services	Utility
Eddie	VAN DER	Secretary	Powerlink Queensland	Utility
Peter	ROBINSON	Representative	Cable Systems Engineering	Consultant
Mohanad	AL-HASANI	Specialist	Vector	Utility
Ryan	ATKINSON	Representative	Marinus Link	Consultant
Kenneth	BARBER	Representative	Istana Park Pty. Ltd.	Consultant
Graeme	BARNEWALL	Representative	Essential Energy	Utility
Rob	BRADLEY	Representative	Ausgrid	Utility
Peter	BUTTERFIELD-ROSSI	Representative	ElectraNet Pty Ltd	Utility
Jeffree	CAIRNS	Representative	TransGrid	Utility
Greg	CALDWELL	Representative	Energy Queensland	Utility
Billy	CHEUNG	NGN	Power Water corporation	Utility
Chandima	EKANAYAKE	Representative	The University of Queensland	Academic
Joska	FERENCZ	Representative	Basslink Pty Ltd	Asset Owner
Nimal	GUNATILAKA	Representative	WesternPower	Utility
Jarad	HUGHES	Representative	TasNetworks	Utility
Mark	JANSEN	Representative	Powercor Network Services	Utility
Richard	JOYCE	Representative	Transpower New Zealand	Utility
Henry	Kent	Representative		Consultant
Dooham	james KIM	Representative	Taihan Electric Australia	Manufacturer
Dong-churl	LEE	Representative	Mondo	Service Provider
Albert	MAJADIRE	Representative	Prysmian	Manufacturer
David	MATE	Representative	Endeavour Energy	Utility
Samir	MD ARIS	Representative	SA POWER NETWORKS	Utility
Gian	MOFFA	Representative	Jacobs	Consultant
Nicola (nic)	MOFFA	Representative	PROTOP Engineering	Consultant
Sudesh	NAIR	Representative	GHD	Consultant
Peter	NEW	Representative	Snowy Hydro Ltd	Utility
Colin	PEACOCK	Representative	Pavocon	Consultant
Goran	PEVEC	Representative	LS Cable and System	Manufacturer
Timothy	POPKISS	Representative	INTERTECH Engineering Pty	Consultant
Kerry	PRICKETT	Representative	UDCS Consulting	Consultant
Robert	SEVIOR	Representative	RANS Electrical	Consultant
Pallavi	SINGH	NGN	Aurecon	Consultant
David	SPACKMAN		Tesla Consultants Limited	Consultant
Yohan	WEERASINGHE		CableGrid	Manufacturer
Frank (tony)	AUDITORE		Voltoni Limited – HV	Consultant

Australian National Committee
Panel Report 2022

Convener: Russell Wheatland

Email: russell.wheatland@ausnetservices.com.au

Phone: 0418 175 590

AU B2 Overhead Line Design

Study Committee Scope

Study Committee B2 covers the design, construction and operation of overhead lines. This includes the mechanical and electrical design and experimental validation of new line components (conductors, ground wires, insulators, accessories, structures and their foundations), the study of in-service line performance and assessment of aged line components, line maintenance, the refurbishment and life extension as well as upgrading and uprating of existing overhead lines.

Statistics of the committee

- Regular Members from 24 countries, plus 5 Regular Additional Members, Observers from 17 countries
- 25 active Working Groups
- Ca. 600 experts in Working Groups from 48 countries
- 7 % female members in WGs
- B2 has issued 93 Technical Brochures since 1994

Change of leadership

During the Paris session the following changes occurred to the leadership team:

- TAG 06: Cecile Roze will take over form Pierre VanDyke
- TAG 07: Balint Nemeth will take over from John McCormack
- Study committee chairperson: Pierre Van Dyke will take over from Herbert Lugschitz
- Study committee secretary: Vivek Chari will take over from Wolfgang Troppauer

Activities

- 5 Technical brochures have been issued in 2021 and 2022
- In the CSE magazine 7 Articles related to B2 have been published since the 2021 session
- A Green Book about the “Techniques for Protecting Overhead Lines in Winter Conditions” by M. Farzaneh has been issued in March 2022.
- The Green Book “Overhead Transmission Lines” was already downloaded 50.000 times which is a big success for SC B2

Working groups disbanded since 2021:

- B2.40: “Calculation of electric distances between live parts and obstacles for OHTL (Convener: Robert Lake)
- B2.64: “Live line working” (Convener: Balint Nemeth)

Advisory group reports

a. Customer Advisory Group

CAG – (Kjell Halsan)

Kjell reported 14 members in CAG. The 2022 CAG meeting was held in Paris on 28th August, with 14 attendees.

K. Halsan presented the output of a CAG survey and thanked S. Mushabe and H. Lugschitz for their support. In total 83 replies were arrived. More than 50% of replies were coming from the technical group of designers. Increase capacity and reliability, condition assessment has been identified as the most challenges regarding overhead lines.

The CAG group is very active. 4 TOR´s have been proposed in 2020/21, 2 have been approved since the last meeting, the remaining are under review.

- B2.86 Approach for asset management of overhead lines
  Convener: Victor Lovrencic (Slovenia)

- B2-87 Live line and vicinity working on overhead lines – safe management guidelines Convener: Balint Nemeth (Hungary)

b. Strategic Advisory Group

SAG – (Herbert Lugschitz)

HLU reported from the SAG meeting held 28th of August with the same attendance as in CAG. The main aspect was the identification of the preferential subjects for 2024.

c. TAG04

Electrical Performance (Javier Iglesias)

Javier reported 6 active WG.
1 WG finished their work in the last year. No new WG was started. 1 tutorial were presented since the last meeting.

d. TAG05

Tower/Foundation/Insulators (Joao da Silva)

TAG05 is split in 3 sub-groups, towers, foundations, and insulators.
6 WG are active working.
New demands:

- Towers: 5 new potential groups
- Foundations: 1 “old” demand on standby
- Insulators: 3 new demands
- Construction: 1 demand
- 2 green books are in preparation.

e. TAG06

Mechanical behaviour of conductors and fittings (Pierre VanDyke)

In the moment 7 working groups are active with total 129 regular members.
The majority of WG will finalize their work in 2023.

For future work in total 8 topics are in pipeline respectively under assessment in the CAG.

f. TAG07

TAG 07 – Asset Management – Reliability and availability of OHL (Balint Nemeth on behalf of John McCormack). Currently 7 WG and 2 JWG are active. 2 tutorials were held since the last session, respectively 1 in Paris 2022. For WG B2.85 the new convener is Mr. Bing Lin (Australia) WG B2.86 and B2.87 started in 2022.

New proposals to CAG and future ideas are:

- OHL construction methodology
- Safety management for OHL construction

In total 11 topics have identified in the TAG07 strategic meeting.

g. PTAG activities (Wolfgang Troppauer)

The new PTAG convener reported that since the last meeting 3 tutorials were held. All members are requested to report details (title, venue, estimated attendees) to him after a tutorial was held.

h. Cooperation between B2 and C3 (System Environmental Performance) – (Joao da Silva).

The new ambassador Joao da Silva reported a change in chairmanship of CS C3. The new chair is Mrs. Mercedes Vazquez from Spain. J. DaSilva will discuss with C3.14, C3.16, C3.18 and C3.85 the interactions with B2.

2 TB publications are scheduled for publication in 2022. (C3.14 and C3.16).

Cooperation between B2 and B1 (Underground Cables) – (John McCormack). J. McCormack informed upfront per mail that there is nothing of special interest to report.

Working groups update

- B2.50: “Safe handling of fittings and conductors” (P.VanDyke on behalf of P.Dulhunty)
  The TB is reviewed and H.Lugschitz will review this final version within September.
- B2.57: “Survey of operational composite insulator experience and application guide for composite insulators” (H.Lugschitz on behalf of F.Schmuck)
  The technical brochure is planned to be completed by end of 2022.
- B2.59: “Forecasting dynamic line ratings” (G.Biedenbach on behalf of G.Watt)
  Meeting held in Paris to organize the following activities and tasks. The first chapters have been reviewed. 10 case studies are included. The publication is scheduled for Q4/23
  Nominated reviewers are: Brent McKilop, A.Haldar, V.Lovrencic
- B2.60: “Affordable overhead transmission lines for Sub-Saharan countries” (V.Naidoo)
  The review of the TB is scheduled December 2022, a tutorial for November 2022. Nominated reviewers are: Asif Bhangor, Anish Anand, Joao da Silva and new member Rob Stephen.The group discussed if the work could be expanded to other/similar countries too.
- B2.65: “Detection, prevention and repair of sub-surface corrosion in OHL supports, anchors and foundations” (R.Meijers).
  The content of the TB is finished, the date of finalization is re-scheduled to 2024. The tutorial is scheduled for 2023. Reviewers are: J.F.Goffinet, H.Valente
- B2.66: “Safe handling and installation guide for high temperature low sag (HTLS) conductors” (V.Chari)
  The WG is split in 5 TF, the total number of members is 29 regulars and 23 corresponding. The competition is revised to 2023. Volunteers for reviewing are: JF Goffinet, Hugo Valente, Brian Townsend
- B2.67: “Assessment and testing of wood and alternative material type poles (N.Spencer)
  No report submitted. The convener informed that nothing happened in the WG.
- B2.68: “Sustainability of OHL, conductors and fittings – Conductor condition assessment and life extension” (C.Roze)
  TB1 “State of the art” consists of 190 pages will be published in 12/2022. TB2 is in preparation, the scheduled publication is 12/2023. Nominated reviewers: A.Banghor, C.Nascimento, V.Lovrencic
- B2.70: “Aircraft warning markers and bird flight diverters for overhead lines – experience and recommendations” (N.Sahlani)
  The TB and the tutorial are re-scheduled to 2022.
- B2.71: “Recommendations for Interphase spacer for Overhead Lines” (P. VanDyke on behalf of J.P.Paradis)
  The first draft of the TB is re-scheduled to 05/23.The final TB is re-scheduled to Sendai 08/2023.
- JWG B2/D2.72: “Condition Monitoring and remote sensing of overhead lines” (C.Ying via Teams)
  The first draft of the TB is completed, the final version is scheduled for 12/2023
- B2.73: “Guide for prevention of vegetation fires caused by overhead line systems” (J. McCormack)
  The final TB is scheduled for 06/24, the tutorial for 06/25.
- B2.74: “Use of unmanned aerial vehicles (UAV´s) for assistance with inspections of overhead power lines” (N.Mahatho)
  A questionnaire has been distributed. The TB is scheduled for 12/2023, the tutorial for 12/2024.
- B2.75: “Application guide for insulated and un- insulated conductors used on medium and low voltage overhead lines” (C.Nascimento on behalf of B.McLaren)
  The publication of the TB is scheduled for 07/23, the tutorial for September 09/23
- JWG B2/C4.76 “Lightning & Grounding Considerations for Overhead Line Rebuilding and Refurbishing Projects, AC and DC” (W.Chisholm)
  The draft version of the TB is scheduled for 2022.

- B2.77: “Risk Management of Overhead Line networks: A model for identification, evaluation & mitigation of operational risks” (A.Banghor)
  The rescheduled date for the TB is 02/24, for the tutorial 04/24. Ruy Menezes volunteered as a reviewer.
- B2.78: “Use of Hight Temperature conductors in new OH line design” (R.Stephen)
  The TB is drafted, the publication is re-scheduled to 12/24.
- B2.79: “Enhancing OHL Rating Prediction by Improving Weather Parameters Measurements “(W.Troppauer on behalf of G.Watt)
  The work on the TB is in progress. The TB is scheduled for 12/2023, the tutorial for 03/2024.
- B2.80: “Numerical Simulation of electrical fields on AC and DC Overhead Line Insulator Strings” (S.Bell on behalf of F.Lehretz)
  The drafting of the TB was started, the final TB as well the tutorial is schedule for 11/24.
- B2.81: “Increasing the Strength Capacity of Existing Overhead Transmission Line Structures” (J.daSilva on behalf of S.Langlois)
  The final TB is rescheduled to 02/24, the tutorial for 04/24.
- B2.82: “Overhead line foundations for difficult soil and geological conditions (L.Nazimek virtual)
  The WG is split in 4 TF, with 22 regular members and 5 corresponding members. The final draft of TB is re-scheduled to 01/24, the tutorial to Paris 24. Lukas was inviting all members to join the WG. A.Bhangor nominated himself spontaneous. P.VanDyke will check with Canadian TSO´s.
- B2.83: “Mitigation of corona on AC and DC overhead lines (O.Regis)
  The publication of the TB is re-scheduled to 11/2024
- B2.84: “Assessment of the methodologies to analyze wind induced overhead line conductors’ motion: applications and limitations” (G.Diana)
  The final TB is rescheduled to 08/2024
- B2.85: “Emergency Restoration Systems for Overhead Lines - Guide for Design, Planning and Installation” (Bing Lin (virtual) on behalf of M.Abdolhosseinpour)
  The convenorship moved over to Mr. B.Lin (Australia). Members from Africa and South America are highly welcomed. The final TB is scheduled for 03/25, the tutorial for 06/25.
- B2.86: “Approach for asset management of overhead transmission lines” (V.Lovrencic)
  The convenor was asking for members from South America too. The TB is scheduled for 08/24, the tutorial for 08/24
- B2.87: “Live line and vicinity working on overhead lines – Safe management guidelines” (B.Nemeth)
  The WG consists of 23 regular members and 13 corresponding members. The TB is scheduled for 12/24. The convenor was asking for members from south America, Africa and India too.

Regional council updates

Specific activities are listed below:

- AORC: Asia Oceania Regional Council
  T.Yamanaka presented the activities. The last meeting was held in November 2021 as e-session, 13 presentations have been performed. The next meeting is in preparation and will be held again as e-session in November 2022.

- NRCC: Nordic Regional Council
  No report provided. K. Halsan reported verbally that this group is not very active. An administrative meeting was organized since the last e-session 2021. A symposium is in preparation.

- RIAC: Regional Ibero American Council
  J. Da Silva reported. This region covers 33 countries and more than 600 million inhabitants. The biggest event in May 2022 was SNPTEE in Rio de Janeiro, Brazil, with 2500 participants.

- SEERC: South East European Regional Council
  Ms. D. Gursu form Turkey is the new representative of SEERC. SEERC covers 17 member countries with a population of 280 million. The council is split into 4 regional committees. In May 2022 a colloquium was held in Vienna with 150 participants. During this colloquium the

chairmanship was handed over from Austria to Turkey. In November 2022 a conference is planned to be held in Bucharest/Romania, another event is scheduled for 2023 to be held in Istanbul/Turkey.

Future Events

- 2023
  Sendai/Japan – 29th September – 6th October - Annual B2 SC meeting and Colloquium. Yuko Kuranari freshed-up the conference proposal.
  A joint colloquium with C3 and C4 is planned. More details please see on KMS and the CIGRE homepage, all Technical Meetings documents are uploaded.

- 2024
  Paris/France – August/September – Annual B2 SC meeting

ANC Members on Working Groups

The following are all the current AP representatives on B2 Working Groups.

WG	Title	Australian Member
TBA	Safety guidelines for OHL construction & maintenance	John McCormack
B2.59	Forecasting dynamic line ratings	John McCormack
B2.65	Detection, prevention and repair of sub-surface corrosion in OHL supports, anchors and foundations	John McCormack
B2.66	Safe Handling and Installation Guide for High Temperature Low Sag Conductors	Michael Wilson
JWG.B2/C1.86	Approach for Asset Management of Overhead Transmission Lines	Gary Brennan
B2.68	Sustainability of OHL, conductors, and fittings – Conductor condition assessment and life extension	John McCormack
B2/C4.76	Lightning & grounding considerations for OHL rebuilding and refurbishing projects (AC and DC)	Anne Williams
B2.77	Risk Management of Overhead Line networks: A model for identification, evaluation & mitigation of operational risks	Asif Bhangor
B2.69	Coatings for Power Networks	Francis Lirios
B2.81	Increasing the Strength Capacity of Existing Overhead Transmission Line Structures	Raju Upadhyaya
B2.83	Mitigation of induced noises by corona activity in overhead AC and DC lines	Hoang Tong
B2.85	Emergency Restoration Systems for Overhead Lines – Guide for Design, Planning and Installation	Bing Lin

Membership of the Australian Panel

Convener: **Asif Bhangor**

Email: Asif.Bhangor@jacobs.com

Phone: **0409 375 981**

AP B3 Substations and Electrical Installations

Study Committee Scope

Our Mission

SC B3 aims to facilitate and promote the progress of engineering and exchange of information and knowledge in the field of substations and electrical installations. SC B3 acts to add value to this information and knowledge by means of synthesizing state-of-the-art practices, developing recommendations and providing best practice.

Scope of SC B3

The activities cover the design, construction, maintenance and ongoing management of substations and the electrical installation in power stations excluding generators.
SC B3 serves a wide range of target groups in the Electric Power Industry whose needs include the technical, economic, environmental and social aspects in varying degrees.
Major objectives include increased reliability and availability, cost effective engineering solutions, managed environmental impact, effective asset management and the adoption of appropriate technological advances in equipment and systems to achieve these objectives.

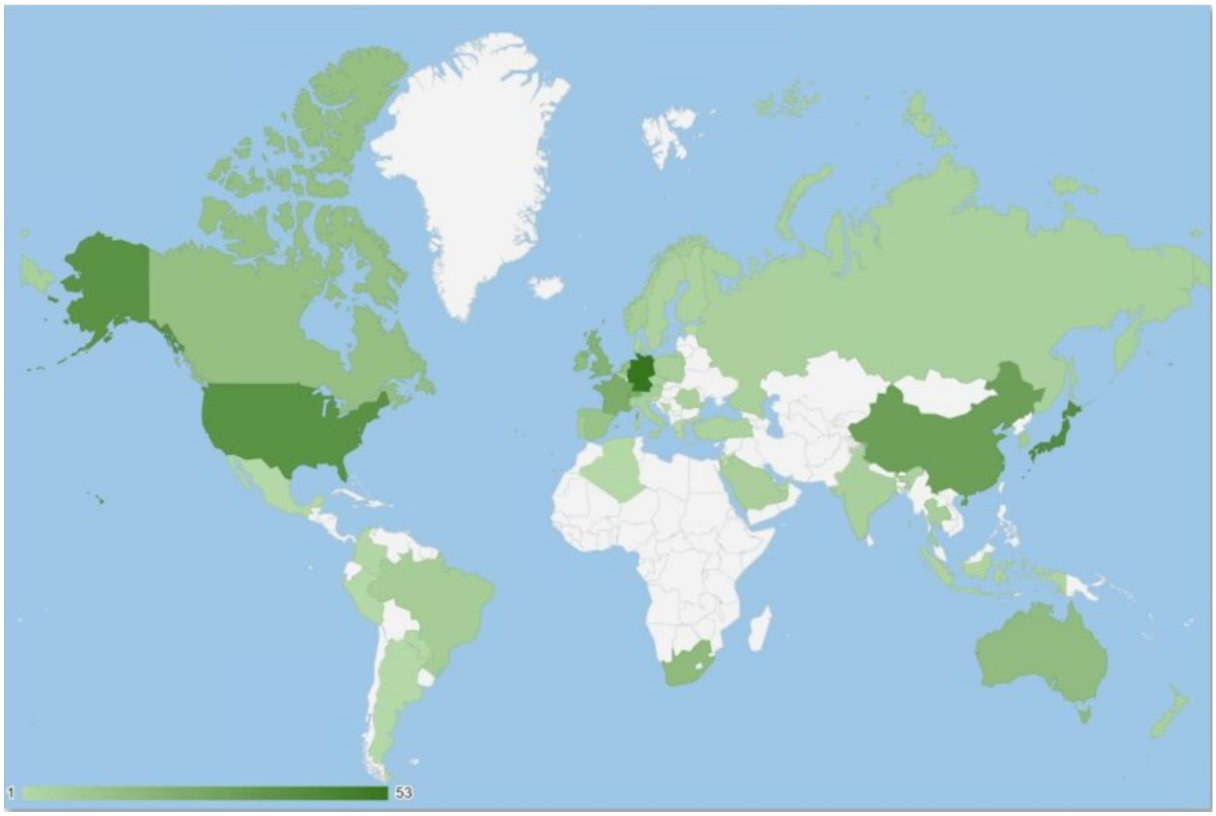


Figure 1: Distribution of SC.B3 Members

Specific Activities of the Study Committee

Paris CIGRE 2022 Event: Held in person between the 26th of August and the 02nd of September 24:

- 72 presentations from 19 countries, including 1 Young Member showcased from Japan (reducing global environmental impact through the introduction of environmentally friendly distribution substations)
- All 3 Preferential Subjects addressed, with PS3 involving 24 presentations jointly from B5
- Substation Training Course was also presented
- Addressed a wide range of the challenges facing the industry740 attendees at venue!

Australian National Committee
Panel Report 2022

Preferential subjects for 2022:

PS 1: Increased impact of clean energy transition on Substation Design

- On and Offshore wind, PV, Geothermal, etc.
- Energy Storage, Hydrogen, Synchronous compensators, etc.
- GIS/GIL application for DC network.

PS 2: Sustainability Management Challenges in Substations

- External drivers for substation intervention such as resilience, reliability, security of supply, life expectancy coordination, etc.
- SF6 alternatives and emission management, Circular economy of materials such as reuse, reduce, recycle.
- New set of skills for new technologies, Knowledge transfer and high standards of education in engineering skills

PS 3: Integration of Intelligence on Substations joint with B5

- Data analytics, remote supervising & monitoring and autonomy application
- IoT and Machine learning applications based on Protection Automation and Control data including asset management, monitoring and data analysis
- Expectations and benefits from digital substation, IEC 61850 Principles and applications to substations

Australia had 6 paper submission contributions at the SC.B3 General Discussion

Other CIGRE 2022 Activities:

Mon Aug 29: **Poster Session** -- 380 attendees

Tue Aug 30: **Group Discussion**

- 740 attendees at Auditorium!
- 72 prepared contributions; 28 spontaneous contributions or Sparkup chat

Wed Aug 31: A3/B3 **Workshop**, "SF6 alternatives for T&D substations and its switchgear" -- 290 attendees!

Wed Aug 31: **Tutorial** "Asset health indices for equipment in existing substations"

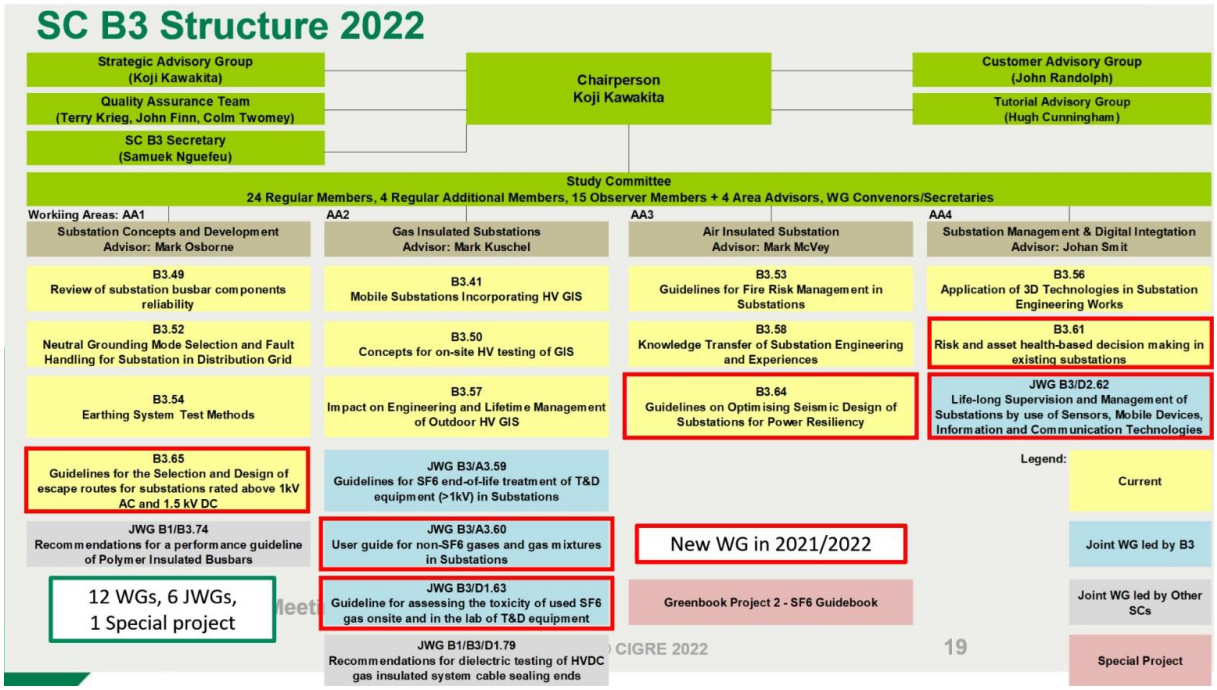
- 260 attendees!

Thu Sep 1: 59th Annual **Study Committee Meeting –** 48 attendees; 28 countries represented; plus 7 on-line participants

Fri Sep 2: B3.58 **Workshop**, "Knowledge transfer of substation engineering and experiences" 65 attendees

SC. B3 Activities in the Existing and the New Working Groups

SC. B3 has 12 active WG's, 6 joints WGs and 1 Special project with 3 recent Technical Brochures being published.



Future Topics of Interest from the Advisory Areas

AA1: Substation Concepts

- Guidelines for Managing Black Start Resilience in substations
- Offshore Substation Operational Experience
- Earthing system design guidelines for high voltage systems
- Harmonization of voltage designations and definitions across different HVDC component technologies

AA2 GIS, GIL, SF6 and Alternative Gases

- New WG B3/A3.60 “Guideline for assessing the toxicity of used SF6 gas onsite and in the lab of T&D equipment”
- Completing the Greenbook in Spring 2023

AA3: Air Insulated Substations

New WG B3.64 “Guidelines on Optimising Seismic Design of Substations for Power Resiliency”

AA4: Substation Management

- Greening substations (B3/A3/D1)

- Standardization spin off from B3.56, incl. asset register and ongoing changes

Australian Panel Working Groups Activities

The following AP.B3 members contributing to the SC.B3 WGs:

WG B3.52 Neutral Grounding Method Selection and Fault Handling for Substations in the Distribution Grid

- Bill Carman as Correspondent Member

WG.B3.53 (new): Guidelines for fire risk assessment and mitigation in substations

- Michael Verrier, Terry Lee as Members and Derek Perkins as Correspondent Member

WG.B3.54 Earthing System Testing Methods

- Stephen Palmer WG Convener

WG B3.55 Design guidelines for substations connecting battery energy storage solutions (BESS)

- Crina Costan: as Full Member

WG B3.56 Application of 3D Technologies in Substation Engineering Works

- Todd Margitich: Member

WG. B3.46: Guidelines for Safe Work Methods in Substations

- Perry Tonking as Correspondent Member and Kerry Williams as Member

WG. A3.46 Generator Circuit Breaker

- Crina Costan is a member of this working group

WG.B3.50, 51 and 57: HV GIS based WGs

- Andreas Laubi is a member of these three WGs.

WG.B3.43 Risk and Asset Health Based Decision Making in Existing Substations

- Chris Beckett is our recommended member for this new WG.

New Technical Brochures

- **858** -- "Asset Health Indices for Equipment in Existing Substations"
  WG B3.48
- **869** – "Design guideline for substations connecting battery energy storage solutions (BESS)"
  WG B3.55
- **870** – "Service Continuity Guide for HV GIS above 52 kV"
  WG B3.51

cigre SC B3

Australian National Committee
Panel Report 2022

Year 2022 Panel Activities Include:

- Support of WG convened by APB3 members
- Contributions and members to IEEE, IEC and AS panels
- Continuing engagement with distribution utilities for increased involvement
- Encourage participation & interaction with NGN and other CIGRE panels
- Two-day AP.B3 annual meeting on the 24th and the 25th of November with 3 guest speakers
- Liaison with the Australian Standards Committees

Future Activities: SCB2 & International Symposiums

X WORKSPOT in Foz do Iguaçu, Brazil 27-30 November 2022

https://www.cigreworkspot.com.br/

2023 CIGRE Symposium, Cairns Australia, 4-7 September 2023

CIGRE Symposium - 2023 - Events (cigreaustralia.org.au)

B3/A3 Joint Colloquium, Birmingham UK, 8-12 May 2023

Membership of the Australian Panel

There are 34 members from the following areas of expertise and disciplines:

- Transmission
- Distributions
- HV Equipment Suppliers
- Energy Consultancies
- Independent Consultants
- Contracting Companies
- BHP

	Name	Company
1.	Alan Crombie	UGL
2.	Alan Goodridge	Peracon
3.	Quinn Ho	Transpower
4.	Andreas Laubi	Aurecon
5.	George Bergholcs	ElectraNet
6.	Blake Christian	Endeavour
7.	Doug Ray	Vector
8.	Peter Legg	Western Power

9.	Melissa Taylor	TasNetworks
10.	Ping S Wang	GE Grid
11.	Tara-Lee Macarthur	Energy Queensland
12.	Stephen Palmer	Safearth
13.	Peregrine Tonking	PWC
14.	Terry Krieg	Powernetwork Consulting
15.	Matthew Wiese	Siemens
16.	Wu Hang	Aecom
17.	Daniel de Groot	Entura
18.	Mark Pritchard	SA Power Networks
19.	Evan Lamplough	Transgrid
20.	Dasgupta Raj	NT PWC
21.	Malcolm Busby	WSP
22.	Brett Roberts	Ausgrid
23.	Fay Nunn	BHP
24.	Marco Surace	APD
25.	John Szmalko	Jacobs
26.	Joseph Pinheiro	Powerlink
27.	Hao Tian	Individual member
28.	Chris Grinter	AusNet
29.	Crina-Miana Costan	TS Consulting
30.	James Warr	CPP
31.	Daniel Stafford	NGN - Jacobs
32.	Alex Pejkinoski	Jemena
33.	Zafir Ahmed	Jacobs
34.	Sudesh Nair	GHD

Convener: **Crina-Miana Costan**

Email: **crina.m.costan@gmail.com;**

AU B4 DC and Power Electronics

Study Committee Scope

The Study Committee B4 (SC B4) facilitates and promotes the progress of engineering, and the exchange of information and knowledge, in the field of DC and power electronics. It adds value to this body of information and knowledge by assessing the state-of-the-art practices and developing recommendations.

Specific Activities of the Study Committee

The study committee activities include following:

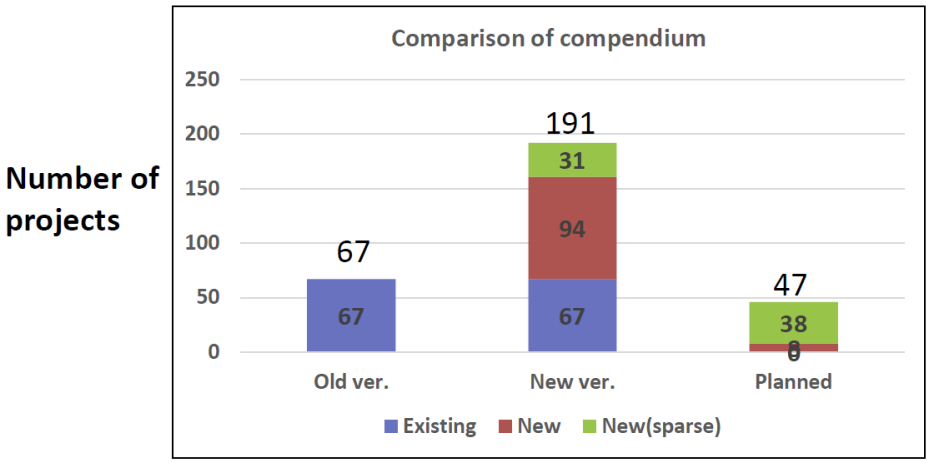
- PS1: HVDC systems and their applications:
  - Planning and implementation of new HVDC projects including need, justification, design, integration of renewables, environmental and economic assessment
  - Application of new technologies including cyber security and advanced controls to address emerging network issues, DC grid, Multi-Terminal HVDC and hybrid HVDC systems
  - Refurbishment and upgrade of existing HVDC systems, service and operating experience of converter stations including offshore converters, and implication of converter equipment resulting from the conversion of ac to dc circuits
- PS2: DC for distribution systems
  - DC applications in distribution systems
  - New concepts, technologies and designs of equipment
- PS3: FACTS and Power Electronic (PE)
  - Planning and implementation of new FACTS and other PE devices including need, justification, design, integration of renewables, environmental and economic assessment.
  - Application of new technologies in FACTS and other PE devices including interfacing generation and storage to the network
  - Refurbishment and upgrade of existing FACTS and other PE devices, service and operating experience

Specific B4 Study Committee activities over the last 12 months have included:

- HVDC Performance Survey - The study committee is continuing to survey the performance of HVDC transmission systems. The survey has been carried out by the Advisory Group B4.04 since 1970 and resulted in a reliable and independent database on the performance of existing HVDC links and technologies. The results for the years 2017-2018 are currently being collated for publication in 2022.
- Performance of SVC/STATCOM - The collation of data and analysis of performance of FACTs devices, particularly SVCs and STATCOMs is underway. The results for the years 2017-2018 are currently being collated for publication in 2022.
- Green Books
  - Green book on FACTS has been published by Springer.
  - Green Book on Electricity Supply of the Future – SC B4 completed a chapter on HVDC and FACTS. The Green Book, which comprises of submissions from all study committees is expected to be published prior to Paris 2022.
- HVDC Compendium – The Study Committee is coordinating the collation of an online compendium of all HVDC systems installed around the world, with key characteristics shown for each.

- The compendium is being updated and revised and is expected to be available on e-cigre by 2022.
- *Figure 2* shows the addition of more projects in service and planned projects I the new compendium, increasing the number of projects from 77 (in the old compendium) to 191.

Figure 2 - Comparison of Content - Old vs New Compendium



Preferential Subjects

The preferential subjects for the 2021 Paris Technical Session for the B4 Study Committee were agreed and accepted as:

- PS 1 HVDC systems and their applications
  - Planning and implementation of new HVDC projects including, need, justification, design, integration of renewables, environmental and economic assessment;
  - Application of new technologies in HVDC, HVDC Grids / Multi-Terminal HVDC, and hybrid dc systems;
  - Refurbishment and upgrade of existing HVDC systems; and
  - Service and operating experience of converter stations including off shore platforms.
- PS 2: DC and Power Electronic (PE) for distribution systems
  - DC deployed in distribution systems;
  - PE and FACTS devices applied in distribution projects including the economics and reliability;
  - New concepts and designs; and
  - Power electronics interfacing generation and storage to the network.
- PS 3: FACTS
  - Planning and implementation of new projects including, need, justification, FACTS devices for renewables, environmental and economic assessment;
  - Application of new technologies in FACTS and other PE equipment;
  - Refurbishment and upgrade of existing FACTS and other PE systems; and

- Service and operating experience.

Working Groups that have Completed Their Assignments

Recognitions of WGs that have completed their assignments

- B4.74 - Guide to Develop Real Time Simulation Models (RTSM) for HVDC
- Operational Studies (TB 864) – Qi Guo
- • B4.83 - Flexible AC Transmission Systems (FACTS) controllers' commissioning, compliance testing and model validation tests (TB 867) –
- Babak Badrzadeh
- • C6/B4.37 - Medium Voltage DC distribution systems (TB 875) – ready for
- publication – James Yu
- • B4/A3.80 – Design, test and application of HVDC circuit breakers (TB 873)
- – ready for publication – Junzheng Cao
- • C4/B4.52 – Guidelines for Sub-synchronous Oscillation Studies in Power
- Electronics Dominated Power Systems – under 60-day review – Chandana Karawita

Working Groups

The main changes in direction observed in SC B4 over the last 10 years include:

1. More application of VSC HVDC;
2. More feasibility and development on HVDC grids;
3. More PE applications in other areas with joint effort with other SCs
4. Application of DC technologies started to extend to distribution
5. Fewer LCC HVDC WGs
6. Fewer FACTS WGs.

	1.1.	B4.64	Impact of AC System Characteristics on the Performance of HVDC schemes	Jef Beerten
	1.2.	B4.69	Minimizing loss of transmitted power by VSC during	Dennis Woodford
	1.3.	B4.71	Application guide for the insulation coordination of Voltage Source Converter HVDC (VSC HVDC) stations	Mojtaba Mohaddes
	1.4.	B4/B1/C4.73	Surge and extended overvoltage testing of HVDC Cable Systems	Markus Saltzer
	1.5.	B4.79	Hybrid LCC/VSC HVDC Systems	Hong Rao
	1.6.	C4/B4.52	Guidelines for Sub-synchronous Oscillation Studies in Power Electronics Dominated Power Systems	Chandana Karawita
	1.7.	B4/A3.80	HVDC Circuit Breakers - Technical Requirements, Stresses and Testing Methods to investigate the interaction with the system	Junzheng Cao
	1.8.	B4.81	Interaction between nearby VSC-HVDC converters, FACTs devices, HV power electronic devices and conventional AC equipment	Kamran Sharifabadi

	1.9.	B4.82	Guidelines for Use of Real-Code in EMT Models for HVDC, FACTS and Inverter based generators in Power Systems Analysis	Garth Irwin
	1.10.	B4.84	Feasibility study and application of electric energy storage systems embedded in HVDC systems	Hani SAAD
	1.11.	B4.85	Interoperability in HVDC systems based on partially open-source software	Staffan Norrga
	1.12.	B4/A3.86	Fault Current Limiting Technologies for DC Grids	Zhiyuan He
	1.13.	B4.87	Voltage Source Converter (VSC) HVDC responses to disturbances and faults in AC systems which have low synchronous generation	Carl Barker
	1.14.	TF B4/B1 88	Insulation coordination procedure for DC cable systems in HVDC stations with Voltage Source Converters (VSC)	Kees Koreman
	1.15.	B4.89	Condition Health Monitoring and predictive maintenance of HVDC Converter Stations	Nadine Chapalain
NEW	**1.16.**	B4.90	Operation and maintenance of HVDC and FACTS Facilities	Les Brand
NEW	**1.17.**	B4.91	Power-electronics-based transformer technology, design, grid integration and services provision to the distribution grid	Marco Liserre
NEW	**1.18.**	B4.92	STATCOMs at Distribution Voltages	John Wright-Smith
NEW	**1.19.**		WG B4.93 – Development of Grid-Forming Converters for Secure and Reliable Operation of Future Electricity Systems	Dechao Kong

Specific Activities of the Australian Panel

Key activities of the AU B4 panel during 2022 include:

- Significant contribution by Australian and New Zealand members to the Green Book on FACTS:
  - Babak Badrzadeh
  - Peeter Muttik
  - Rizah Memisevic
  - Andrew Van Eyk
- Contributing author to Green Book on Electricity Supply of the Future, HVDC chapter - Les Brand.
- Member, SC B4 AG-01 “Advisory Group” - Les Brand.
- VSC HVDC Common Terms Document – Outgoing AU B4 convenor (Les Brand) assigned the task to develop a “Common Terms and Description” document for VSC HVDC technologies, that can be referenced as background material for all future VSC working group Technical Brochures.
- Participation on International Working Groups and Task Forces:
  - Task Force TF B4.77 – “AC Fault response options for VSC HVDC Converters” - Simon Bartlett.

- JWG C6/B4.37 – "Medium Voltage DC distribution systems" - Les Brand and Georgios Konstantinou.
- B4 .82 – "Guidelines for Use of Real-Code in EMT Models for HVDC, FACTS and Inverter based generators in Power Systems Analysis" - Nathan Crook.
- B4.78 – "Cyber Asset Management for HVDC/FACTS Systems" - Mark Shilliday.

• Les Brand assigned the Special Reporter role for the Paris 2022 technical session.

Meeting Report: Australian Panel

The Cigre AP B4 - HVDC and Power Electronics 2022 Annual Meeting eSession was held Wednesday 2nd and Thursday 3rd November 2022, with UQ Field Trip Friday 4th November.

Members attended the meeting.

AGENDA

DAY ONE – Wednesday 02 November 2022

Location: Level 6, 15 Astor Terrace, Spring Hill QLD 4000

Host: Amplitude Consultants

No	Topic	Approx. Time
1	Introduction and Welcome	9:00 – 9:15
2	Minutes of the Previous APB4 Meeting, Melbourne, 2018	9:15 – 9:30
3	Action items from APB4 Meeting, Melbourne, 2018	9:30 - 10:00
4	Review of AP B4 membership • New Members • Update Membership List	10:00 -10:15
	Coffee Break (30 mins)	**10:15 – 10:45**
5	Report and Update on SC B4 • SCB4 Working Group Activities • SCB4 Annual Meeting - Outcomes • New Working Groups • Green Books	10:45 – 12:00
	Lunch (1 hr)	**12:00 – 13:00**
6	AP B4 Activities • Australian Panel contributions to SC B4 Working Groups • NGN Update • Webinars	13:00 – 14:00

7	ANC/ATC Update	14:00 – 14:30
	Coffee Break (30 mins)	**14:30 – 15:00**
8	Member Presentations (20 mins each)	15:00 – 16:45
9	Closing Remarks	16:45 – 17:00
	Dinner – TBA	**TBA**

DAY TWO – Thursday 03 November 2022

Location: Level 6, 15 Astor Terrace, Spring Hill QLD 4000

Host: Amplitude Consultants

No	Topic	Approx. Time
1	Member Presentations (20 minutes each)	10:00 – 11:15
	Coffee Break (15 mins)	**11:15 – 11:30**
2	Member Presentations (20 minutes each)	11:30 – 12:30
	Lunch (1 hr)	**12:30 – 13:30**
3	Member Presentations (20 minutes each)	13:30 – 14:30
4	Closing / Recap Actions • Next year's APB4 meeting - Location, Format, Site Visit, Hosting • Ideas for AP B4 activities • Any other business • Conclusions	14:30 – 15:00
	Friday 4th November: visit to UQ Redlands Hydrogen H2Xport pilot plant with a 10am start	

Invitations for SC or WG's to meet in Australia

In the Paris 2022 session, AU B4 submitted a proposal to the study committee for the 2023 SC B4 Study Committee meeting and technical sessions to be held in Cairns during the Symposium being lead by AU C6.

The SC B4 membership voted 2023 SC B4 meeting and colloquium in Vienna.

ANC Members on Working Groups

The following are all the current AU representatives on Working Groups.

WG	Title	Australian Member
AG01	SC B4 Advisory Committee	Les Brand
TF B4.77	AC Fault response options for VSC HVDC Converters	Simon Bartlett
JWG C6/B4.37	Medium Voltage DC distribution systems	Georgios Konstantinou Les Brand
B4.78	Cyber Asset Management for HVDC/FACTS Systems	Mark Shilliday
B4.82	Guidelines for Use of Real-Code in EMT Models for HVDC, FACTS and Inverter based generators in Power Systems Analysis	Nathan Crook

Membership of the Australian Panel

Name	Organisation	Type
Les Brand	Amplitude Consultants	Consultant
Tuan Vu	Powerlink Queensland	Transmission
Madeline Binet	TasNetworks	Transmission / Distribution
Robert Lees	GE	Vendor
Andrew van Eyk	ElectraNet	Transmission
John Wright-Smith (Convenor)	American Superconductor	Manufacturer
Richard Xu	TransGrid	Transmission
Greg Mather	Basslink Pty Ltd	Transmission
Colin Wood	ABB	Vendor
Nalin Pahalawaththa	Hatch	Consultant
Gerard Ledwich	Queensland University of Technology	University
Angelo Iacono	Siemens	Vendor
Michael Dalzell	Transpower, New Zealand	Transmission
Stuart Dodds	APA Group	Transmission
Ranjith Perera	Entura	Consultant
Yau Chow	Western Power	Transmission / Distribution
Georgios Konstantinou	University of NSW	University
Mark Shilliday	AEMO	Market Operator
Stephen Bex	Jacobs	Consultants

Australian National Committee
Panel Report 2022

Name	Organisation	Type
Erica Twining	Ausnet Services	Transmission/ Distribution
Greg Elkins	Global Power Energy	Consultant
Gihan Chamara	Global Power Energy	Consultant
Mark Davies	TasNetworks	Transmission/ Distribution
Stephen Northwood	ABB	Vendor
Nadesan Pushparaj	AEMO	Regulator

Convener: John Wright-Smith

Email: john.t.wright-smith@bigpond.com

Phone: **+61 (0) 488 200 458**

AU B5 Protection & Automation

Study Committee Scope

Study Committee B5 Protection and Automation covers the principles, design, applications, coordination, performance and asset management of end to end:

- Power System Protection;
- Substation Control and Automation;
- Substation Monitoring and Recording;
- Remote Control Systems and Equipment;
- Metering Systems and Equipment;

Study Committee B5 also covers all associated internal and external communications including schemes relating to IEC61850 'Communication networks and systems for power utility automation'.

All technical, organisational and economical aspects are considered including staff education and training. Emphasis is placed on design and application of digital technology and modern integrated system approach including hardware and software for the acquisition of system state information, local and remote data communication, and execution of control commands.

Specific Activities of the Study Committee

Study Committee B5 has three thematic advisory groups, focussing on particular issues as follows:

- TM51 Substation Automation and Remote Control
- TM52 Protection and Monitoring
- TM53 New Network Requirements

The following preferential subjects were the basis of the 2022 Paris session B5 special reporter question response discussion sessions.

1. Addressing protection related challenges in network with low-inertia and low fault-current levels
2. Applications of emerging technology for protection, automation and control
3. Integration of intelligence on substations (Joint PS with B3)

25 B5 Working Groups are presently active.

Future Preferential Subjects

During the 2022 SC B5 meeting two Preferential Subjects were agreed for 2024:

1. Process bus: Practical experiences, new developments, and possible synergies with virtualization and hardware consolidation
2. Acceptance, Commissioning, and Field Testing for Protection and Automation Systems: Challenges and Perspectives for a New era of Digital Substations

Proposed New Working Groups

During the 2022 SC B5 meeting four new working group topics were agreed:

1. Obsolescence management for PACS
2. Education, Qualification and Continuing Professional Development of Engineers in Protection, Automation and Control
3. Protection Principles to be applied in Distribution Networks in the Future

During 2022 the following CIGRE Australia corresponding members were accepted for the following recently created working groups:

B5.77	Requirements for Information Technologies (IT) and Operational Technology (OT) managed of Protection, Automation and Control Systems (PACS)	Rob SUSANTO-LEE (C)

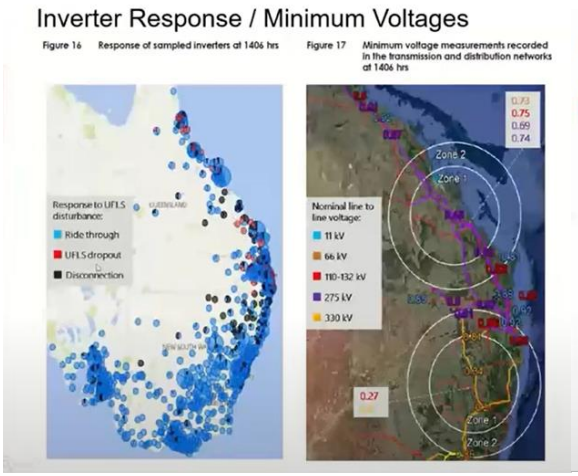
B5.78	New requirements of network protection and control for renewable energy integration	Mitchell TAP (C)

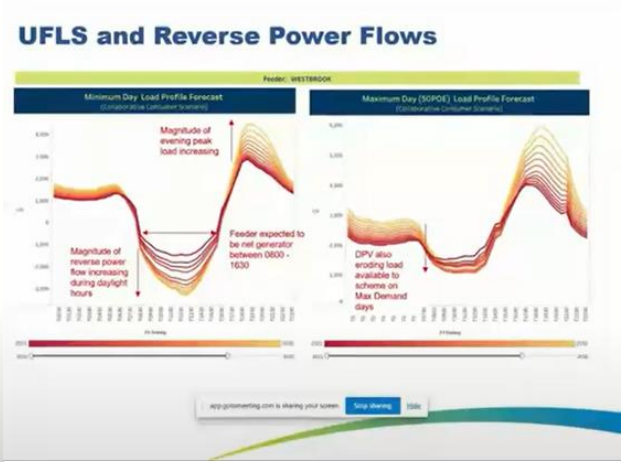
Specific Activities of the Australian Panel

During 2022 the panel has progressed with online activities and has been planning for upcoming face to face events.

Frequency Protection Webinar:

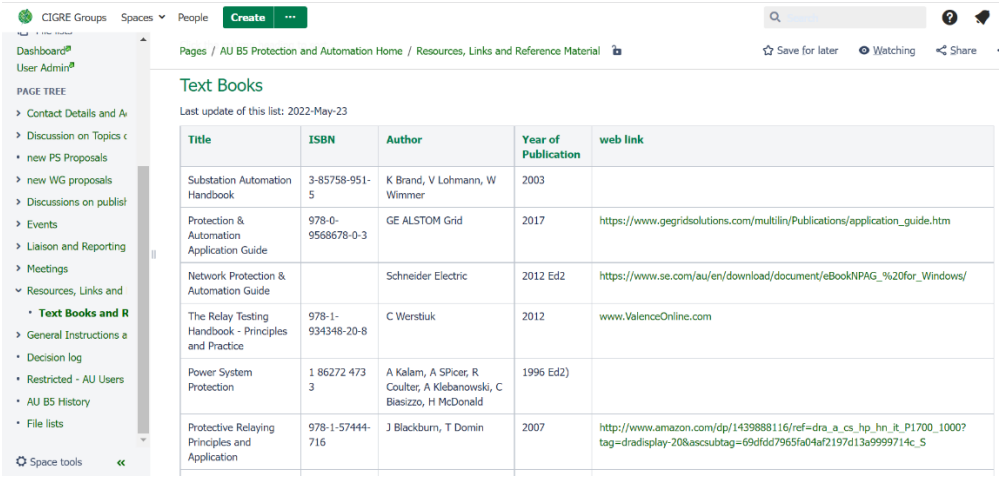
On 15 June 2022 the AU B5 panel (in association with CIGRE Australia) organised a free online industry webinar titled 'Frequency protection down under – new challenges'. It provided an online AU B5 presence and promoted discussion on a topic of relevance before the next SEAPAC conference in 2023. The webinar gave some topical insight and discussion into the important subject of frequency protection challenges in the Australian environment. It particularly related to the challenges of under frequency load shedding (UFLS) in the presence of embedded solar generation. Recent power system events had highlighted existing challenges, for which several utilities are working on protection and automation solutions. The webinar is available on CIGRE Australia's you tube channel – link to 2022 AU B5 Frequency Prot Webinar . Many thanks to the AU B5 presenters from Powerlink, Energy Queensland, SA Power Networks and Western Power. Also thank you to event chairman and AU B5 panel NGN representative - Alan Luc.





List of B5 Technical References and Text Books Now Available in Multiple KMS Spaces:

Thanks to CIGRE AU members Brett Roberts and Rod Hughes, an updated and linked cross-space KMS page was published on Text Books & References related to the B5 Domain. This list has its home KMS page in the AU General Resources space but now has linked mirrored pages in the AU NGN space, B5 SC space and AU B5 space.

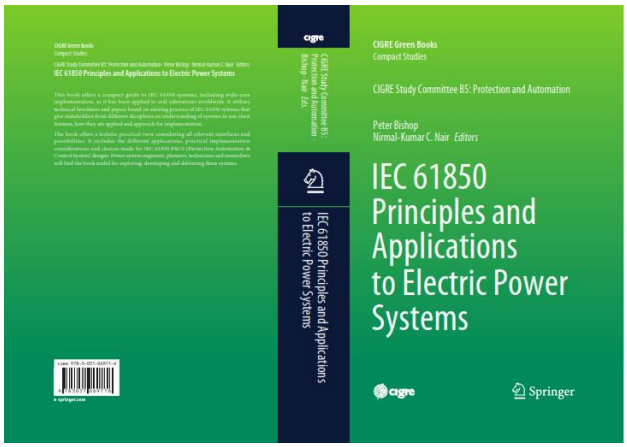


Title	ISBN	Author	Year of Publication	web link
Substation Automation Handbook	3-85758-951-5	K Brand, V Lohmann, W Wimmer	2003	
Protection & Automation Application Guide	978-0-9568678-0-3	GE ALSTOM Grid	2017	https://www.gegridsolutions.com/multilin/Publications/application_guide.htm
Network Protection & Automation Guide		Schneider Electric	2012 Ed2	https://www.se.com/au/en/download/document/eBookNPAG_%20for_Windows/
The Relay Testing Handbook - Principles and Practice	978-1-934348-20-8	C Werstiuk	2012	www.ValenceOnline.com
Power System Protection	1 86272 473 3	A Kalam, A SPicer, R Coulter, A Klebanowski, C Biasizzo, H McDonald	1996 Ed2)	
Protective Relaying Principles and Application	978-1-57444-716	J Blackburn, T Domin	2007	http://www.amazon.com/dp/1439888116/ref=dra_a_cs_hp_hn_it_P1700_1000?tag=dradisplay-20&ascsubtag=69dfdd7965fa04af2197d13a9999714c_S

Panel Working Group Contributions and Green Book Publication:

The panel continues to contribute to international working groups with AU B5 being represented on 16 of the 25 active B5 working groups. In addition AU B5 member Boris Celic is the SC B5 Bushfire Liaison Person for WG B2.73 “Guide for Prevention of Vegetation Fires Caused by Overhead Line Systems”.

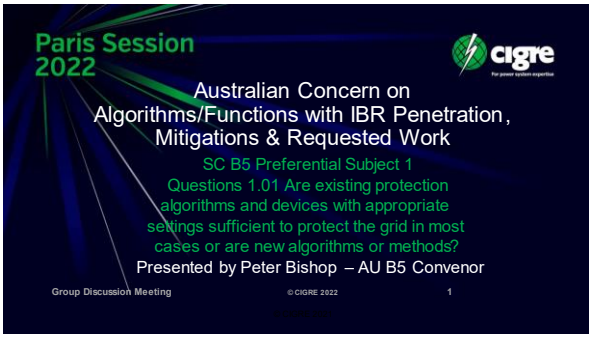
The AU B5 convenor has also been convenor (and Co-Editor) of the SC B5 Green Book on IEC 61850 Principles and Applications to Electric Power Systems. In July 2022 the book was published after three years of online meetings and collaborative work by the Task Force - comprising of 16 chapter authors and contributors. This included AU B5 representative Rod Hughes and CIGRE New Zealand representative Nirmal Nair (as Secretary and Co-Editor). The book is available to purchase via e-cigre - https://e-cigre.org/publication/gb-13-iec-61850-principles-and-applications-to-electric-power-systems

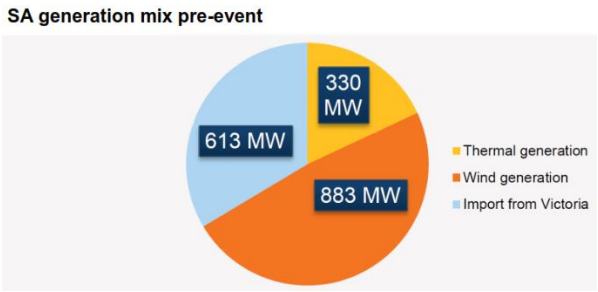


2022 Paris Session Special Report Contribution Presentations from AU B5 Members:

Peter Bishop attended the 2022 Paris Session and presented six special reporter question response contributions on behalf of AU B5 members. These related to the preferential subjects and covered Australian/New Zealand feedback on:

- Concern & mitigations for protection with increased Inverter Based Resource (IBR) generation
- Experience of IBR generation behaviour and validation
- Experience of Digital Substations -Benefits, Challenges & Evolutions
- Experience and Challenges with Travelling Wave Fault Location





SEAPAC 2023 Conference Planning:

Every second year the panel organises the South East Asia Protection, Automation and Control (SEAPAC) Conference. The next conference was due in 2021. Due to the Covid-19 virus situation and the desire to hold a complete face to face event, the AU B5 panel and CIGRE Australia decided that the next physical event will be in 2023. Over 2022 the organising committee has been planning for the 2023 SEAPAC conference which will be incorporated as a session within the September 2023 Cairns Symposium. In August 2022 the SEAPAC call for paper abstracts was issued.

Support for newly formed CIGRE NZ B5 panel:

During 2022 the AU B5 panel convenor helped support the newly formed CIGRE NZ B5 panel by attending the B5 arc flash workshop in April and several downed conductors working group meetings. NZ distribution and generator utilities have participated in sharing local issues during 2022. The NZ B5 panel convenor is a representative on the AU B5 panel.

Australian Panel Meeting Report

36 organisation representatives attended the annual AU B5 panel meeting on 26 and 27 July 2022. Again, due to Covid-19 and associated travel restrictions, it was conducted entirely by online video conference in two 4 hour sessions over two days. During the meeting several new members were welcomed, working group activity was reviewed, 2022 Paris session special reporter questions and AU experience was discussed. There was widespread conversation about the challenges with the increasing penetration of inverter based distributed generation in Australia and particularly South Australia. A local presentation was shared on Endeavour Energy's IEC 61850 Journey with their evolved digital substation design and installation. After the meeting Paris 2022 special reporter question response contributions were developed and submitted based on the discussion at the meeting.

An end of year panel update video conference presentation and question & answer session was held on 9 December 2021. This presented highlights from the 2021 Paris virtual centennial session, explained outcomes from the August online SC B5 meeting and updated the panel on several other activities. Another end of year panel update video conference is planned for December 2022. During this feedback from the Paris 2022 session will be shared.

Invitations for SC or WG's to meet in Australia

The B5 study committee has decided to participate in the 2023 Cairns Symposium. This will be a grand opportunity for local protection and automation engineers to attend, present and interact with international experts. The panel is encouraging B5 member paper submissions and attendance. A local B5 organising committee is arranging the SEAPAC session (incorporated within the Symposium) and is also liaising with the B5 Study committee on related B5 meetings (including B5 tutorial arrangements).

ANC Members on Working Groups

The following are all the current AU representatives on Working Groups.

WG	Title	Australian Member
B5.48	Protection for developing network with limited fault current capability of generation	Rajnish Sood
B5.51	Methods & Application of Remotely Accessed Information for SAS Maintenance and Operation	Taren Hobson
B5.56	Optimization of Protection Automation and Control Systems	Tuan Vu
B5.57	New challenges for frequency protection	Chris Wembridge
B5.58	Faster protection and network automation systems: implications and requirements	Stephen Pell
B5.59	Requirements for Near-Process Intelligent Electronic Devices	Kevin Hinkley

WG	Title	Australian Member
B5.63	Protection, Automation and Control System Asset Management	Mark Mundell
B5.65	Enhancing Protection System Performance by Optimising the Response of Inverter-Based Sources	Leonardo Torelli
B5.67 JWG D2	Time in Communication Networks, Protection and Control Applications – Time Sources and Distribution Methods	Benjamin Haines
B5.69	Experience feedback and Recommendation for implementation of process bus in PACS	Frankie Lu (C)
B5.70	Methods of Evaluating and Comparing Reliability of PACS Architectures/ Guide for reliability calculation and specification for PACS functions and architecture	Stewart Collins (C)
B5.71	Protection, Automation and Control Systems Communication Requirements for Inter-Substation and Wide Area Applications	Ritesh Bharat (C)
B5.72	Modelling, Assessment, and Mitigation of Protection Performance Issues caused by power plants during Dynamic Grid Events	Gurinder Saluja (C) Paul Blanchfield (C)
B5.74	Busbar Protection Considerations When Using IEC 61850 Process Bus	Gurinder Saluja (C)
B5.76	Architecture, Standards and Specification for metering system in a Digital Substation and Protection, Automation and Control (PACS) Environment	Satendra Bhola (C)
B5.77	Requirements for Information Technologies (IT) and Operational Technology (OT) managed of Protection, Automation and Control Systems (PACS)	Rob Susanto-Lee
B5.78	New requirements of network protection and control for renewable energy integration	Mitchell Tap
B2.73	Guide for Prevention of Vegetation Fires Caused by Overhead Line Systems	Boris Celic (C)

Membership of the Australian Panel

Name	Organisation	Type
D Harper	AECOM NZ	Consultant
J Brown	BECA NZ	Consultant
R Hughes	Rod Hughes Consulting	Consultant
P Blanchfield	Independent Consultant	Consultant
M Ufferhardt	Tesla Consultants NZ	Consultant
H De Wet	Future Grid Connect Consulting Pty	Consultant
G.Munting	Entura	Consultant
H Mzungu	PSC	Consultant

Name	Organisation	Type
M Doherty	GHD	Consultant
T Foxcroft	Power Test Services	Consultant
L Kruk	Jacobs	Consultant
R Susanto-Lee	APD Engineering	Consultant
M Huang	Aurecon	Consultant
P Tree	Essential Energy	Distribution
M Stanbury	Ausgrid	Distribution
R Coggan	Energy Queensland	Distribution
B Celic	SA Power Networks	Distribution
M Browne	Endeavour Energy	Distribution
Brendan May	Evoenergy	Distribution
R Simpkin	United Energy	Distribution
D Yadav	Jemena	Distribution
N Kamenyitzky	Snowy Hydro	Generation
M Pallotta	ElectraNet	Transmission
B Capstaff	Powerlink Queensland	Transmission
M Sokolowski	AusNet Services	Transmission
S Bhola	TasNetworks	Transmission
G Saluja	TransGrid	Transmission
P Bishop	Transpower NZ	Transmission
K Dhang	Western Power Corporation	Transmission
S Gharti Chhetri	Power & Water Co	Transmission
A Kalem	Victoria University	University
Madhusudan S	Hitachi	Vendor
I Young	Schneider Electric	Vendor
L Torelli	CSE-Uniserve	Vendor
B Hampson	SEL NZ	Vendor
F Lu	Siemens	Vendor
F Pambrun	Grid Solutions	Vendor
D Blake	Dynamic Ratings	Vendor
T Congo	Omicron	Vendor
S Kumar	BHP	Manufacturer
Alan Luc	Ausgrid	NGN Rep
S Chiu	PowerCo	CIGRE NZ B5

Convener: **Peter Bishop**

Email: **peter.bishop@transpower.co.nz**

Phone: **+6421408503**

AU C1 – Power System Development and Economics

Study Committee Scope

The scope of Study Committee C1 is to study economic and system analysis methods important for the development of power systems, and to assist utilities to find the best solutions in various evolving, competitive and unbundled conditions in the context of the overall energy supply system and with social and environmental considerations.

Specific Activities of the Study Committee

The main areas of attention are:

- Methods and tools for power system static and dynamic analysis.
- Planning predicaments and methods in competitive and regulatory structures. Progress and new approaches in application of power system planning criteria and reliability (security and adequacy) assessment.
- Capacity enhancement by use of risk-based security assessment and advanced information, communication and power-electronics technology for improving system stability and dynamic performance.
- Future dependence, requirements and economy of ancillary services for frequency and voltage control and other system needs.
- The impact of pricing and tariff methods for transmission services on system development.
- Asset management strategies in the definition of optimal policies.
- Planning issues related to long distance transmission and international interconnections.
- System planning issues in newly industrialised and developing countries.
- Impact on system development of new solutions and technologies in fields such as generation and demand side management (DSM).

Preferential Subjects

The C1 preferential subjects agreed at the 2022 Paris summit focus on solving technical challenges that the power system of the future will have to overcome. These are continuation of the same subjects of 2021:

- PS1: Steering the Energy Transition: cooperation, achieving top-down targets through bottom-up investment decisions (Interconnections & System Integration):
  - Governance of the different sectors of the integrated energy system, role of system operators, role of regulation & markets; achieving public targets through private investments, coordinated decision-making processes and international cooperation.
  - Power-to-Gas & Hydrogen as energy carrier and as long-term storage; energy efficiency & infrastructure efficiency in the interconnected electricity/gas/hydrogen system; large interconnection projects
  - System aspect aggregation of the electrification of transport, industry, and buildings: conditions and barriers, role of stakeholders in the End-to-End system.
- PS2*:* Flexibility as pivotal criterion for system development (Grid Planning & System Development):
  - Including in the planning process the flexibility options both within and outside the grids; non-network-assets and non-electric solutions: Storage, Demand Response, Energy Communities, behind-the-meter resources.

  - Matching flexibility needs with flexibility sources: market design evolution, value of various flexibility products, optimal flexibility portfolio; prioritization of sector coupling initiatives; role of forecasts of demand and variable generation.
  - Storage device evolution, technical & economic performances, short/medium term measures for balancing the grid, and managing the energy system in the longer term, including thermal & molecular long duration energy storage.
- PS3*:* Resilience as pivotal criterion for system development (Asset Management & Economics):
  - Metrics and criteria to plan resilience and strength of the future power system; flexibility means as enhancers also of resilience.
  - Optimal planning and efficient use of resilience measures: risk assessment, prevention, mitigation, adaptation, re-start measures.
  - Resilience improvements from grid architecture and grid components: including the role of power electronics control and grid forming features, smart load shedding, and fast restoration methods.

Preferential subjects were discussed at the 2022 Paris meeting of Committee C1, and agreed to continue a focus of Steering the energy transition (PS1), Flexibility (P2), and Resilience (P3).

Proposed New Working Groups

Committee C1 has proposed four new working groups to commence in 2023, conveners and ToR are being sought, with developments to be discussed at the next SC1 meeting in Q1 of 2023.:

- System planning guidelines and compatibility with future system expansion for offshore grids.
- System strength in transmission planning and development.
- Follow on of C1.44: global interconnection with consideration of sector coupling.
- Follow on of C1.48: Electrolysers as flexible load.

Specific Activities of the Australian Panel

The Australian Panel will have its own activities that might include:

- Local initiatives such as site visits, or dedicated workshops during face to face meetings
- General work to support the activities of the Study Committee by contributing Australian perspectives to the preferential subjects.
- Preparation of workshops and seminars during the 2023 Cairns Symposium
- Proposed local committee seminars or workshops for 2023.

All the above will be member participation and interest pending.

Meeting Report: Australian Panel

Committee AP C1 met three times during 2022, all meetings were held via video conferencing.

Our first meeting in January focused on reviewing the SC1 activities, AU ATC activities, and work planning for the year ahead. Inspired by several C1 interest related presentations by members, such as:

- Social Licence in transmission infrastructure expansion
- Role of planning in managing the energy transition
- Impact of new technologies on power system planning
- Electrification and vector coupling, and its impact on the electrical network
- Planning under uncertainty
- Integrated planning
- Planning standards

Looking ahead, AP C1 agreed to focus group discussions and debate on matters related to holistic and coordinated energy system planning, and a review of national and international planning standards.

We reflected on the limited engagement and often poor attendance at regular AP C1 meeting and discussed how to increase engagement and participation. Members were encouraged and agreed to consider how to recruit new members and individual contributions from existing ones.

With a present membership of 17, AP C1 has strong representation from across the Australian energy sector, with every Australian and New Zealand TNSP represented and one DNSP. However, members with a strong generation background are still being sought to complement the expertise on transmission, distribution and renewables already present in the group. Given the accelerated grid expansion activities in Australia, AP C1 has also reached out to some of the regional planning authorities charged with development and planning of Renewable Energy Zones, such as Vic Grid and Energy Corp of NSW. Follow up discussions are proposed for early 2023.

The last meeting of 2022 was held in December 2022 and used to discuss:

- The AU AGM of September 2022.
- The 2022 Paris event, the new WGs proposed (see section 4) at the steering committee and Australian participation in these.
- Focus areas and subjects of interest to C1 (see section 3).
- New potential members for the AP C1.

Invitations for SC or WG's to meet in Australia

While maintaining casual and frequent contact with other overseas based members of Committee C1, there have been no international or national CIGRE C1 meeting invitations issued. Exception being the upcoming 2023 Cairns Symposium, at which the international C1 committee will be meeting.

Participation of the SC1 committee members in upcoming symposiums and conferences was discussed. AP C1 intends to be present at Cairns conference in 2023, travel restrictions allowing. If possible, AP C1 intends to engage in both with larger meetings and a workshop to showcase some of Australia's leadership in transmission planning.

ANC Members on Working Groups

The following are all the current AU representatives on Working Groups:

WG	Title	Australian Member
C1.45	Harmonised metrics and consistent methodology for benefits assessment in Cost-Benefit Analysis (CBA) of electric interconnection projects.	Prateek Beri Henry T. Nguyen
C1/C4.46	Optimising power system resilience in future grid design.	Christian Schaefer
C1.47	Energy Sectors Integration and impact on power grids.	Christian Schaefer
C1.48	Role of green hydrogen in energy transition: opportunities and challenges from technical and economic perspectives.	Herath Samarakoon Cameron Potter

Membership of the Australian Panel

Name	Organisation	Type
Christian Schaefer	GHD (Convener)	Consultant
Brad Parker	ElectraNet	Transmission
Enrique Montiel	Powerlink Queensland	Transmission
YiSiang Ooi	AEMO	System Operator
Eli Pack	AEMO	System Operator
Julian Swartz	GSMT Consulting	Consulting

Name	Organisation	Type
Christine Hill	TransPower	Transmission
Mark Parker	EPEC	Consulting
Herath Samarakoon	TasNetworks	Transmission
Athmi Jayawardena	Hatch	Consulting
Donald Vaugh	Entura	Generation/Consulting
Tom Bakker	Aurecon	Consultant
Glenn Carruthers	Western Power	Transmission
Stephen Hodgkinson	ETSE Consulting	Consulting
Matthew Webb	AusGrid	Distribution
Nathan Crooks	Aurecon (NGN Representative)	Consultant
Jony Kaushik	Transgrid (NGN Representative)	Transmission

Convener: Christian Schaefer

Email: christian.schaefer@ghd.com

Phone: 0428 867 171

AU C2 Power system operation and control

Study Committee Scope

The scope of Study Committee C2 covers the technical, human resource and institutional aspects and conditions for a secure and economic operation of power systems in a way that is in compliance with requirements for network security, against system disintegration, equipment damages and human injuries and security of electricity supply.

Specific Activities of the Study Committee

Technical Direction

Study Committee C2 had defined three Technical Directions (TD) to address important factors that will influence and define new requirements on the System Operation performance.

TD1 – Real-time System Operation and Control focuses on the real-time power system operations;

TD2 – System Operational Planning and Performance Analysis focuses on the operational planning, impact analysis and follow up of system operations in terms of security, quality and economic efficiency and also the interaction between involved parties in the operational process; and

TD3 – Control Centre Infrastructure and Human Resources for System Operation focuses on the Control Centres and the integration of human and technical resources to achieve secure and efficient system operations, including operational personnel education, initial and continuous training and certification.

Large Disturbances

Study Committee C2, together with Study Committee C5, organised the Large Disturbance Workshop during the Paris Session to review selected power system and market events and gather lessons learnt. The large disturbances presented and discussed were:

- European system split July 2021 – system operation and control aspects;
- Tokyo blackout following earthquake March 2022;
- Israeli system cascade separation March 2020 – challenges and lessons learned;
- Resilience test of the Indian power system during extremely severe cyclone ‘Tauktae’;
- Generation and voltage disturbance during very high demand in New Zealand;
- Widespread impacts of cyclone and restoration through long term off-grid supply in Western Australia; and
- Interim note on suspension of the Australian National Electricity Market.

Publications and Tutorials

One new Technical Brochure (TB) was published during the year, reflecting the findings and recommendations from the Working Group:

- TB 868 Mitigating the risk of fire starts and the consequence of fires near overhead lines for System Operation (WG C2.24).

Two tutorials were presented by Study Committee C2 during the year:

- Impact of High Penetration of Inverter-Based Generation on System Inertia of Networks (JWG C2/C4.41) – April 2022 – Kyoto Symposium; and
- TSO-DSO Co-operation – Control Centre Tools Requirements (WG C2.40) – September 2022 – Paris Session.

Preferential Subjects

Preferential subjects selected by the Study Committee for the 2024 Paris Session are:

1. Create operational resilience to extreme / unpredictable events:

a. Natural phenomena forecasting applied to operations planning studies and real-time decision support;
b. Threats and hazards from other systems that affect supply / demand of electricity;
c. Lessons learned and best practices to deal with high impact / low probability events on system operation; and

2. Changes in system operation and control considering the energy transition:
   a. Disturbances and system restoration in power systems with a high share of inverter-based resources;
   b. Flexibility and ancillary services for high Renewable Energy System (RES) share environments;
   c. Power system operation strategies and operation planning studies considering a high share of RES.

Proposed New Working Groups

One new Working Group has been established:

- JWG C2/B4.43 - The impact of offshore wind power hybrid ACDC connections on system operations and system design.

The Australian Panel C2 has drafted a Terms of Reference to propose a new Working Group to examine operational strategies for managing new power system minimums (demand / inertia / system strength / etc).

Other topics for possible new Working Groups include:

- Power system operational resilience indices;
- Cyber security impacts on power system operations (joint with SC D2?); and
- Influence of changing climate policies on system operations (joint with C3?).

Specific Activities of the Australian Panel

The Australian Panel C2 has contributed to the ongoing work of CIGRE as follows

- Ongoing contribution to working groups as set out in section 8 of this report;
- Two prepared contributions to the SC C2 group Discussion Meeting at the 2022 Paris Session highlighting Australia's operational experiences with Battery Energy Storage Systems;
- Franco Crisci (Convenor WG C2.24) presented to the SC C2 Annual Meeting in Paris on the balancing of fire risk and customer impacts from power shutdowns linked to bushfires; and
- Sharing of local learnings through completion of surveys to support the work of working groups.

Meeting Report: Australian Panel

The AU C2 panel met in a hybrid format on 9 November 2022. The Convenor provided an update on the activities of SC C2 and CIGRE internationally. The key insights gained from the 2022 Paris Session were shared and discussed with the panel. It was noted that the Large Disturbance Workshop provided insights into a wide variety of challenging operational situations.

Other topics of interest that were discussed included:

- Digitalisation of the industry and its impact on control centre people and processes;
- Understanding what the power system operator of the future will look like and how we will get there; and
- How to build quality in vendor support networks for Australia given increasing cyber security concerns with off-shore support.

Panel members shared their recent experiences of power system disturbances within their own networks and the learnings resulting from these. Panel members also contributed ideas for future AU C2 activities and thoughts for future working groups.

Australian National Committee
Panel Report 2022

Invitations for SC or WG's to meet in Australia

Study Committee C2 will meet in Cairns in 2023 in conjunction with the Cairns Symposium. SC C2 is one of the lead SCs for this Symposium.

ANC Members on Working Groups

The following are all the current AU C2 representatives on Working Groups.

WG	Title	Australian Member
C2.18	Wide area monitoring protection and control systems – decision support for system operators	James Guest
C2.26	Power system restoration accounting for a rapidly changing power system and generation mix	Babak Badrzadeh (Convenor)
C2.39	Operator Training in Electricity grids at Different Control Levels and for Different Participants / Actors in the New Environment	Danial Lavis Russell Gordon
C2.42	The impact of the growing use of ML-AI in the operation and control of power networks from an operational perspective	Karin Rodrigues

Membership of the Australian Panel

Name	**Organisation**	**Type**
Stuart Donaldson	Ausgrid	Distribution
Shane Duryea	Western Power	Transmission
Duncan Griffin	Power and Water Corporation	Operator / Transmission / Distribution
Greg Hesse	Powerlink	Transmission
Jennifer Hughes	Transgrid	Transmission
Chong Ong	TasNetworks	Transmission / Distribution
Alexandra Price	Energy Queensland	NGN
Matthew Rigano	Energy Queensland	Distribution
Matthew Robinson	PSC Consulting	Consultant
Emma Rogers	Powerlink	Transmission
Richard Sherry	Transpower	Operator / Transmission
Colin Taylor	ElectraNet	Transmission
Tjaart Van Der Walt	AEMO	Operator
Bradley Vogel	Essential Energy	Distribution

Convener: **Greg Hesse**

Email: **greg.hesse@powerlink.com.au**

Phone: **0418 783 840**

AU C3 Power System Environmental Performance

Study Committee Scope

Responsible for the identification and assessment of the various impacts on the natural environment arising in electric power systems, and the recommendation of appropriate monitoring, management and control measures.

Impacts addressed will include greenhouse gases, air and water pollution, electromagnetic fields, noise, visual, land use and flora and fauna impacts.

Major considerations will include: sustainable development vs. economic development; risk assessment and the economics of impact containment; effective communication with the public and regulatory authorities.

Tools and measures for quantifying, controlling and mitigating the environmental impact such as life-cycle assessment (LCA), environmental product declarations (EPD), global benchmarking, etc. are included in the scope.

The committee works closely with relevant equipment and systems committees within its field of responsibility.

Specific Activities of the Study Committee

SC C3 currently has 1 reference group and 12 active working groups.

Working Group	**Convenor**
AG C3.01 EMF and Human Health	Michel Plante (CA)
WG C3.09A Sustainable corridor management	Aleš Kregar (SL)
WG C3.12 Methodologies for greenhouse gas inventory and reporting for T&D utilities	*Pending*
WG C3.14 Impact of environmental liability on transmission and distribution activities	Vincent Du Four (BE)
WG C3.15 Best environmental and socioeconomic practices for improving public acceptance of high voltage substations	----
WG C3.16 Interactions between electricity infrastructure (overhead lines and substations) and wildlife	Cecile Saint-Simon (FR) Anaelle Brand (FR) **Finished. Technical Brochure published**
WG C3.17 Interaction between wildlife and emerging renewable energy sources and submarine cables	Katherine Palmquist (USA)
WG C3.18 Eco-friendly approaches in transmission and distribution	----
WG C3.20 Sustainable development goals in the power sector	Lou Cecere (USA)
WG 3.21 Including stakeholders in the investment planning process	Susana Batel (PT)
WG 3.22 Vegetation management in substations	Vincent Du Four (BE)
WG C3.23 Eco-design methods for TSOs/DSOs under	Guillaume Busato (FR)

environmental transition	
JWG B1/C3 85 Environmental impact of decommissioning of underground and submarine cables	Kieron Leeburn (ZA)

During the SC C3 meeting at the Paris 2022 Session, members were reminded to be focused on finalising working groups and progressing to Technical Brochures. In some cases, the convenors or members are no longer available, and commitment and participation was encouraged to assist in finalising the various working groups.

Preferential Subjects 2024

The current preferential subjects, subject to approval by the Technical Council (in November-December 2022), include:

PS 1: **Public acceptance and stakeholder engagement in power system – generation, transmission and distribution infrastructure**

- Experiences in dealing with public acceptance of new and existing infrastructure
- Strategies, tools, indicators and methods that allow for effective stakeholder engagement
- Role of mitigation, compensation and offsetting measures (permitting processes)

PS 2: **Climate change and impact on power system, a holistic approach**

- Potential variations in the climate variables in different scenarios and impacts on power infrastructure and system operations
- Risk assessment methodologies and experiences
- Adaptation measures: lessons learned and criteria to be considered for the future and existing infrastructure

PS 3: **Sustainability starting for the supply chain**

- Inclusion of eco-design and circularity criteria: solutions to reduce impact along the whole of life for assets
- Green procurement: experiences and methodologies to incorporate sustainability aspects in tendering decisions
- Decarbonisation: accounting for scope 3 emission and reduction strategies

Proposed New Working Groups

During the SC C3 meeting at the Paris 2022 Session, a new working group was proposed by Frode Johansen from Norway, as follows:

Methods of reducing electrocution of birds from power lines: a focus on low voltage networks.

Proposal noted the electrocution of birds on power lines is a global problem. Whilst C3.16 dealt with gathering knowledge and best practice relating to the interactions between electrical infrastructure and wildlife, this was focused on transmission leaving a gap on lower voltages.

The objective of the working group, if approved, would be to gather knowledge and best practice to reduce bird fatalities on lower voltage networks. For a better understanding of the problem, the group will gather information about which species are more prone to be electrocuted and why, which technical designs are responsible for bird electrocutions and how to reduce these problems.

Specific Activities of the Australian Panel

During 2022, the Australian C3 panel held two meetings including one virtual meeting on 21 July 2022 and a face-to-face meeting hosted by TasNetworks in Hobart on 14 October 2022.

Meeting Report: Australian Panel

In Hobart, the C3 panel meeting discussed a range of important topics, including:

- Sustainability linked loans – Endeavour Energy

- Electricity Network Safety Management System (AS5577) integration with the Environmental Management System – Essential Energy
- Wedgetail Eagle tracking and monitoring, including interactions with powerlines – TasNetwork (leading sponsor of research program)
- Avian interaction with powerlines relating to the South Jerrabomberra project – Essential Energy
- Discussion on statutory frameworks relating to the interaction of electricity assets with threatened species
- Field visit, including approaches to minimising powerline issues with bushfire prone land and electricity supply challenges to Mount Wellington

Invitations for SC or WG's to meet in Australia

Japan has been successful in hosting SC C3 in 2023 at the Colloquium in Sendai.

ANC Members on Working Groups

The following are all the current AU representatives on Working Groups.

WG	Title	Australian Member
WG C3.09A	Sustainable corridor management	Brett Hayward

Due to a number of members leaving Cigre member organisations, there is only one Australian member participating in an active working group. In considering the need to focus on closing out old working groups, there is an opportunity over the coming year to encourage participation from ANC members, particularly for **JWG B1/C3 85** Environmental impact of decommissioning of underground and submarine cables. Ausgrid has particular expertise in this field and would be able to provide expert commentary.

Membership of the Australian Panel

Name	Organisation	Type
Brett Hayward	Essential Energy	Distribution
James Hart	Ausgrid	Distribution/Transmission
Gina Pavlovic	Endeavour Energy	Distribution
Ed Parker	TasNetworks	Distribution/Transmission
David Donahue	Transgrid	Transmission
Lynde Murray	Energy Queensland	Distribution
Russell McKenna	Powerlink	Transmission
Scott Haynes	Electranet	Transmission
James Widenbar	Western Power	Distribution/Transmission
Natasha D'Silva	AEMO (NGN)	Regulator

Convener: **Brett Hayward**

Email: **brett.hayward@essentialenergy.com.au**

Phone: **0409 603 005**

AU-C4 System Technical Performance

Study Committee Scope

SC C4 deals with methods and tools for the analysis of power systems, with particular reference to dynamic and transient conditions and the interactions between the power system and its apparatus/subsystems (including external causes of stress). Specific issues related to the design and manufacturing of components are not in the scope 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 network. However, as many design studies depend on the tools used and developed within the scope of SC C4, it is important to note that C4 encourages and regularly supports joint activities with other study committees.

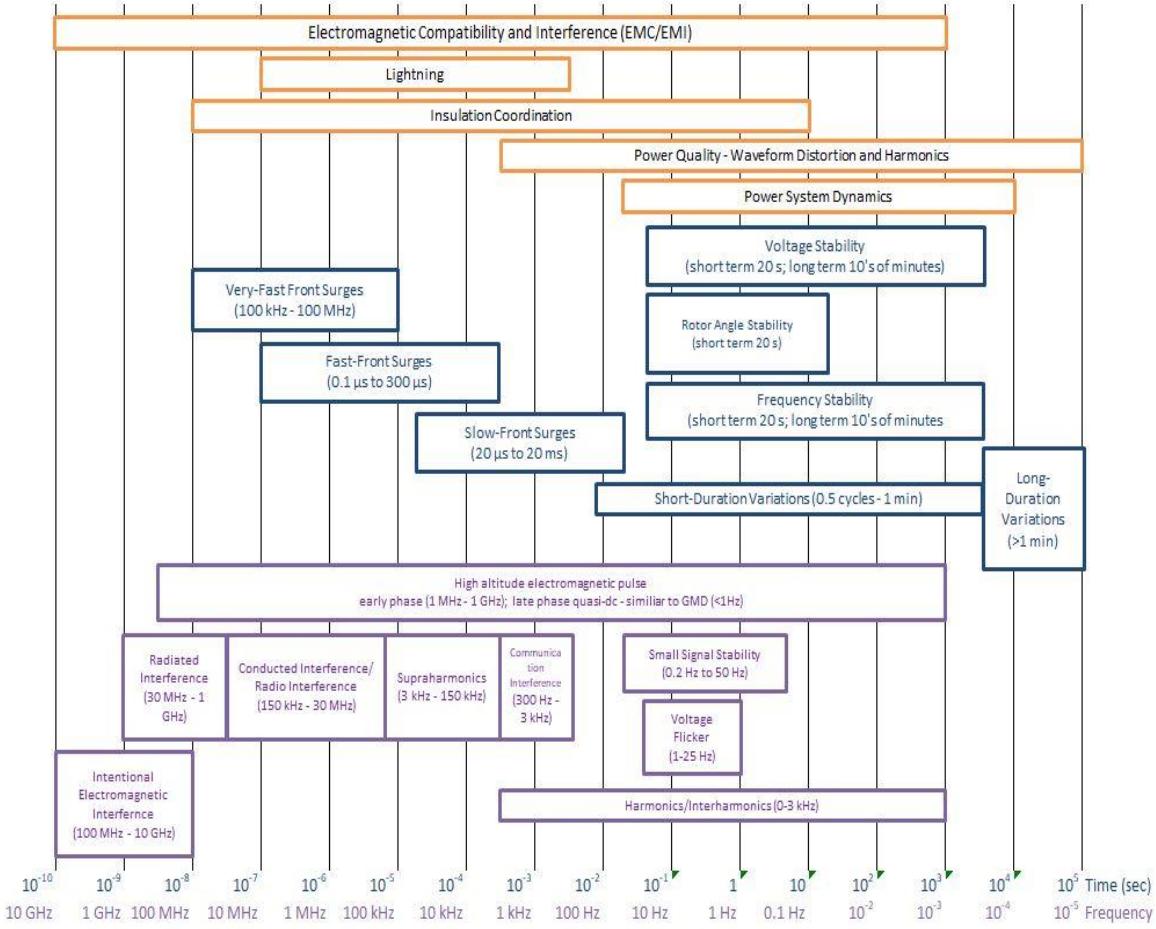


Figure 3: Time frame of various phenomena of interest in power system studies.

To better describe the continuum of phenomena, the following broad topics of interest are defined:

- Power quality
- Electromagnetic compatibility and interference (EMC/EMI)
- Insulation co-ordination
- Lightning
- Power systems dynamics and numerical analysis

The common theme among the topics is the investigation and development of new tools, models, analysis methods and techniques for the assessment of critical power system dynamics. The need for models ranges from individual pieces of equipment up to the system level, with the focus being on

simulations to analyse system and equipment interactions. Measurement systems and techniques, and their use in validating complex simulation tools, forms part of the overall modelling effort. The broad listing provided above also relates to emerging smart grids, micro grids, distributed and renewable energy resource technologies (such as wind and solar), with emphasis on power quality, advanced tools for the analysis of electromagnetic and electromechanical transients, and the dynamic performance of power electronic interfaced equipment.

Study Committee Structure

The organisational structure of SC C4 is as shown in Figure 2. At the 2022 SC meeting held during the Paris Session, the composition of the SC was confirmed as follows:

- Chair and Secretary
- 26 Regular Members
- 18 Observer Members

The membership of SC C4 presently encompasses 43 countries.

Figure 4: SC C4 structure

From AU C4, Babak Badrzadeh is a Regular Member of the SC, being one of the twenty six (26) national representatives.

Members of the three advisory groups are yet to be defined following recent appointment of Marta Val Escudero as the SC C4 Chair.

Specific Activities of the Study Committee

3.1 Active Working Groups

SC C4 currently has Forty-Two (42) active Working Groups (WG). The breakdown by sub-topic is:

- Power quality, 6
- Electromagnetic compatibility and interference (EMC/EMI), 5
- Insulation co-ordination, 5
- Lightning, 10
- Power systems dynamics and numerical analysis, 16

WG #	Title	Convener	Schedule
WG C4.36	Winter Lightning – Parameters and Engineering Consequences for Wind Turbines	M. Ishii (Japan) - bio	2014 - 2017
JWG C4.40/CIRED	Revisions to IEC Technical Reports 61000-3-6, 61000-3-7, 61000-3-13, and 61000-3-14	M. Halpin (USA)	2015 - 2018
JWG C4.42/CIRED	Continuous assessment of low-order harmonic emissions from customer installations	I. Papič (Slovenia)	2015 - 2018
WG C4.43	Lightning problems and lightning risk management for nuclear power plants	A. Tatematsu	2017 - 2020
WG C4.44	EMC for Large Photovoltaic Systems	E. Salinas (Sweden)	2017 - 2019
WG C4.46	Evaluation of Temporary Overvoltages in Power Systems due to Low Order Harmonic Resonances	F. F. da Silva (Denmark)	2017 - 2019
WG C4.47	Power System Resilience (PSR WG)	M. Panteli (Cyprus)	2017 - 2020
WG C4.49	Multi-frequency stability of converter-based modern power systems	Ł. Kocewiak (Denmark)	2018 - 2021
WG C4.50	Evaluation of Transient Performance of Grounding Systems in Substations and Its Impact on Primary and Secondary Systems	B. Zhang (China)	2018 - 2021
WG C4.51	Connection of Railway Traction Systems to Power Networks	D. Vujatovic (UK)	2018 -2021
JWG C4/B4.52	Guidelines for Sub-synchronous Oscillation Studies in Power Electronics Dominated Power Systems	C. Karawita (Canada)	2019 - 2021
JWG C4/A3.53	Application Effects of Low-Residual-Voltage Surge Arresters in Suppressing Overvoltages in UHV AC Systems	J. He (China)	2019 - 2021
WG C4.54	Protection of high voltage power network control electronics from the High-altitude Electromagnetic Pulse (HEMP)	W.A. Radasky (USA)	2019 - 2022
WG C4.55	EMC related very-fast transients in gas-insulated substations - EMC interferences, measured characteristics, modelling and simulations	A. Ametani (Japan)	2019 - 2022
WG C4.57	Guidelines for the Estimation of Overhead Distribution Line Lightning Performance and its Application to Lightning Protection Design Scope	K. Michishita (Japan)	2019 - 2022

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WG #	Title	Convener	Schedule
JWG C4/C2.58/IEEE	Evaluation of Voltage Stability Assessment Methodologies in Transmission Systems	U. Annakkage (Canada)	2019 - 2021
JWG C4/C2.62/IEEE	Review of Advancements in Synchrophasor Measurement Applications	A. Rajapakse (Canada)	2021 - 2023
WG C4.59	Real-time Lightning Protection of the Electricity Supply Systems of the Future	C. Tong (China)	2019 - 2022
WG C4.60	Generic EMT-Type Modelling of Inverter-Based Resources for Long Term Planning Studies	A. Haddadi (USA)	2020 - 2023
WG C4.61	Lightning transient sensing, monitoring and application in electric power systems	J. He (China)	2021 - 2023
WG C4.63	Harmonic power quality standards and compliance verification – a comparative assessment and practical guide	N. Shore (UK)	2021 - 2024
WG C4.64	Application of Real-Time Digital Simulation in Power Systems	C. Fang (Canada)	2021 - 2023
WG C4.65	Specification, Validation and Application of Harmonic Models of Inverter Based Resources	J. David (Australia)	2021 - 2024
WG C4.66	New concept for analysis of multiphase back-flashover phenomena of overhead transmission lines due to lightning	M. Miki (Japan)	2021 - 2024
WG C4.67	Lightning Protection of Hybrid Overhead Lines	A. Piantini (Brazil)	2022 - 2025
WG C4.68	Electromagnetic Compatibility (EMC) issues in modern and future power systems	P. Munhoz-Rojas (Brazil)	2021 - 2024
WG C4.69	Quantifying the lightning response of tower-footing electrodes of overhead transmission lines: methods of measurement	S. Visacro (Brazil)	2021 - 2023
WG C4.70	Application of space-based lightning detection in power systems	J. Montanyà (Spain)	2022 - 2025
WG C4.71	Small signal stability analysis in inverter based resource dominated power system	S. Goyal (Australia)	2022 - 2025
WG C4.73	Insulation Coordination of HVDC Overhead Lines	I. Uglesic (Hungary)	2022 - 2025
JWG C4/B4.72	Lightning and switching induced electromagnetic compatibility (EMC) issues in DC power systems and new emerging power electronics-based DC equipment	Q. Li (China)	2022 - 2025
JWG A2/C4.52	High-frequency transformer and reactor models for network studies	B. Gustavsen (Norway)	2014 - 2018
JWG A1/C4.52	Wind generators and frequency-active power control of power systems	N. Miller (USA)	2015 - 2018
JWG A1/C4.66	Guide on the Assessment, Specification and Design of Synchronous Condensers for Power	D. K. Chaturvedi (India)	2019 - 2021

WG #	Title	Convener	Schedule
	Systems with Predominance of Low or Zero Inertia Generators		
JWG B1/C4.69	Recommendations for the insulation coordination on AC cable systems	T. du Plessis (South Africa)	2018 - 2021
JWG B4/B1/C4.73	Surge and extended overvoltage testing of HVDC Cable Systems	M. Saltzer (Sweden)	2016 - 2017
JWG B4/C4.93	Development of Grid Forming Converters for Secure and Reliable Operation of Future Electricity Systems	D. Kong (UK)	2022 - 2025
JWG B5/C4.61	Impact of Low Inertia Network on Protection and Control	R. Zhang (UK)	2017 - 2020
JWG C1/C4.36	Review of Large City & Metropolitan Area power system development trends taking into account new generation, grid and information technologies.	V. Jesus (Brazil) S. Utts (Russia)	2017 - 2019
JWG B2/C4.76	Lightning & Grounding Considerations for Overhead Line Rebuilding and Refurbishing Projects, AC and DC	William A. Chisholm (Canada)	2019 - 2022
JWG C1/C4.46	Optimising power system resilience in future grid design	Christian Schaefer (Australia)	2021 - 2022
JWG B5/C4.79	Protection Roadmap for Low Inertia and Low Fault Current Networks	Mukesh Nagpal (Canada)	2022-2024

3.2 Proposed Working Groups

The SC Chairman noted during the 2022 Paris session meeting that SC C4 has one of the highest numbers of active WGs, and as such a gap analysis might be prudent on what new working groups are most warranted to avoid potential duplication and investing time on the most important topics.. Further information to follow later on.

3.3 Green Books

New green book in development; Power System Modelling and Analysis in Evolving Networks with the following Australian representatives.

- Chief Editor; Babak Badrzadeh
- Secretary: Genevieve Lietz
- Chapter lead (Model Validation): Nilesh Modi
- Members: Sachin Goyal, Sorrell Grogan, Donald Vaughan, Andrew Halley

3.4 CIGRE Science and Engineering Journal and Electra Articles

The following reference material has been published by SC C4 members over the last twelve months in the CSE Journal:

- Harmonic Emission Assessment of Solar Farms: a Comparative Study Using EMT and Frequency Domain Models, CSE 025, June 2022
- Joint Estimation of System Inertia and Load Relief, CSE 025, June 2022
- Virtual Synchronous Generator Versus Synchronous Condensers: An Electromagnetic Transient Simulation based Comparison, CSE 024, February 2022
- Fast Frequency Response from Transmission-Connected Solar Farms: Australian Experience, CSE 024, February 2022
- System strength, inertia and network loss factors - implications for power networks and renewable generation, CSE 023, December 2021

All documentation is available via the e-CIGRE website.

3.5 Published Technical Brochures

The following TB have been published by SC C4 in 2021/2022.

TB 829: Challenges with series compensation applications in power systems when overcompensating lines

TB 836: Measuring techniques and characteristics of fast and very fast transient overvoltages in substations and converter stations

TB 839: Procedures for Estimating the Lightning Performance of Transmission Lines – New Aspects

TB 851: Impact of High Penetration of Inverter-based Generation on System Inertia of networks

TB 855: Effectiveness of line surge arresters for lightning protection of overhead transmission lines

TB 881: Electromagnetic transient simulation models for large-scale system impact studies in power systems having a high penetration of inverter-connected generation

3.7 International Events

The current listing of future events which SC C4 is likely to be involved with is as follows:

- **CIGRE Symposium 2023,** "*The end to end electricity system: transition, development, operation and integration*", Cairns (Australia), 4-7 September 2023.

- **CIGRE Paris Session 2024**

3.8 SC C4 Awards

The incoming SC C4 Chair received the technical council award with the outgoing SC C4 Chair receiving the honorary member award. Paris Sessions

4.2 Contributions from AU-C4

Two papers were accepted from AU C4 and presented as part of the 2022 Paris session. These include:

- Critical Review of Harmonic Assessment Procedures for Transmission Customers and Renewable Generators, by Tim Browne, Vic Gosbel and Robert Barr
- System strength support using grid forming energy storage to enable high penetrations of inverter-based resources to operate on weak networks, by Stephen Sproul, Nilesh Modi, Stanislav Cherevatskiy, Ahvand Jalali, Sasan Zabihi, Jorgen Zimmermann, Andrew Tuckey

Contributions were made at the C4 GDM, breakdown of papers and contributions are shown in the Table below.

Preferential subject	Total papers	AU papers	Total GDM presentations	AU GDM presentations
PS 1: Challenges and advances in power quality (PQ) and electromagnetic compatibility (EMC)	19	1	11	2
PS 2: Challenges and advances in insulation coordination and lightning research AU response presentations (0)	11	0	5	0
PS3: Challenges and advances in power system dynamics	29	1	24	8

These contributions were made by:

- Babak Badrzadeh
- Behrooz Bahrani
- Jason David
- Nathan Crooks (2)
- Nilesh Modi (2)
- Sachin Goyal
- Stephen Sproul
- Tim Browne

4.3 Technical Workshop –Session 2022

On Tuesday 30th August, the SC-C4 workshop was held. The title of the workshop was:

"*Oscillatory instabilities and interactions in inverter based resource dominated power systems*".

The workshop consisted of presentations from two separate, but related working groups:

- C4.49 – Multi-frequency stability of converter-based modern power systems

- C4/B4.52 – Guidelines for Subsynchronous oscillation studies in power electronics dominated power systems

The workshop was very well attended which introduced some of the screening tools developed to identify conditions in which sub-synchronous oscillations may occur. Some discussion of potential mitigation was also provided.

Other Specific Activities of the Australian Panel

The following summary highlights the major achievements of the panel over the last 12 months.

5.1 Contributions to WG

The following CIGRE Australia members are recognised by AU-C4 as contributing to active WGs.

WG Ref	Title	AU.C4 Reps	Involvement	Status	TB Ref
JWG B4/C.93	Development of Grid Forming Converters for Secure and Reliable Operation of Future Electricity Systems	Majid Fard Zhou Yi Behrooz Bahrani	Member Member Corresponding Member	In Progress	Pending
WG C4.73	Insulation Coordination of HVDC Overhead Lines	Errol Bebington	Member	In progress	Pending
C4.71	Electromagnetic transient simulation models for large-scale system impact studies in power systems having a high penetration of inverter connected generation	Sachin Goyal Andrew Halley Qiming Zhang Alex Hugall	Convenor Member Member Member	In Progress	Pending
JWG C4/C2.62/IEEE	Review of Advancements in Synchrophasor Measurement Applications	Devinda Perera	Corresponding member	In Progress	Pending
C4.65	Specification, validation and application of harmonic models of inverter based resources	Jason David Sarath Perera	Convenor Member	In Progress	Pending

WG Ref	Title	AU.C4 Reps	Involvement	Status	TB Ref
C4.60	Generic EMT-Type Modelling of Inverter-Based Resources for Long Term Planning Studies"	Sasan Zabihi Behrooz Bahrani	Member Member	In progress	Pending
C4/C2.58/IEEE	Evaluation of Voltage Stability Assessment Methodologies in Transmission Systems	Ehsan Farahani	Corresponding member	Under review	Pending
C4.56	Electromagnetic transient simulation models for large-scale system impact studies in power systems having a high penetration of inverter connected generation	Babak Badrzadeh Sachin Goyal Mark Davies Sorrell Grogan Jingwei Lu	Convener Member Corresponding Members	Complete	TB 881
C4.51	Connection of railway traction systems to power networks	Igor Perin Phil Coughlan	Members	In progress	Pending
C4.47	Power system resilience	Julian Eggleston Terry Lampard Mancarella Pierluigi	Member Member Member	In progress	Pending
C4.42/CIRED	Continuous assessment of low-order harmonic emissions from customer installations.	Tim Browne Sarath Perera Vic Gosbell	Corresponding Members	In progress	Pending
C4.40/CIRED	Revisions to IEC Technical Reports 61000-3-6, 61000-3-7, 61000-3-13, and 61000-3-14.	Alex Baitch Sarath Perera Vic Gosbell	Members	In progress	Pending
C4.39	Effectiveness of line surge arresters for lightning protection of overhead transmission lines	Thomas Daly	Corresponding Member	2015	In progress

5.4 AU C4 Panel Meeting and Technical Seminar

The Australian Panel of C4 held its annual meeting this year in Adelaide at Electranet Offices. Twenty-two members and one online attendee participated in the administrative meeting held on Thursday July 21. The meeting agenda included a review of key outcomes from the CIGRE Australia Annual General Meeting (AGM), feedback from the most recent International Study Committee Meeting and a review of AU-C4 activities over the last 12 months. The meeting also addressed the Australian contributions to the 2022 Paris Session. The day concluded with members providing a short summary of key activities being undertaken in their organisations related to the scope of C4. On Friday July 22, a technical site tour to the Robertstown synchronous condenser was undertaken.

Membership of the Australian Panel

The AU C4 Panel consists of thirty three (33) members as of November 2022.

Name	Organisation	Type
Babak Badrzadeh	Aurecon	Consulting
Shabir Ahmadyar	KPMG	Consulting
Salim Anwari	Hatch	Consulting
Alex Baitch	BES (Aust) Pty Ltd	Consulting
Errol Bebbington	PSC Consulting	Consulting
Tim Browne	Qualis Power	Consulting
Umberto Cella	DIgSILENT	Consulting
Aditya Upadhye	GridWise Energy Solutions	Consulting
Damiano O'connor	Aurecon	Consulting
Miron Janjic	Beca	Consulting
Jason David	Australian Power Quality & Reliability Centre	Academia
Sarath Perera	University of Wollongong	Academia
Neville Watson	University of Canterbury	Academia
Mehdi Ghazavi Dozein	The University of Melbourne	Academia
Michael Negnevitsky	University of Tasmania	Academia
Behrooz Bahrani	Monash University	Academia
Stephen Sproul	Hitachi Energy	Original Equipment Manufacturer
Ping Wang	GE	Original Equipment Manufacturer
Nilesh Modi	Australian Energy Market Operator (AEMO)	System Operator
Genevieve Lietz	Australian Energy Market Operator (AEMO)	System Operator
Hieu Nguyen	AMP Power Australia	Developer
Anthony Palechek	Trina Solar	Developer
Hadi Lomei	Essential Energy	Network Service Provider
Devinda Perera	ElectraNet Pty Ltd	Network Service Provider
Albert Pors	Endeavour Energy	Network Service Provider
Don Geddy	TransGrid	Network Service Provider
Steven Senini	Energy Queensland Ltd	Network Service Provider
Huuson Nguyen	Western Power	Network Service Provider
Ben Li	AusNet Services	Network Service Provider

Name	Organisation	Type
Andrew Halley	TasNetworks	Network Service Provider
Peter Woloszyn	Ausgrid	Network Service Provider
Wei Jian Chan	Energy Queensland	Network Service Provider
Manjula Dewadasa	Powerlink	Network Service Provider

Panel contact details

For further information or questions, please contact:

Convener: Babak Badrzadeh
Email: Babak.Badrzadeh@aurecongroup.com
Phone: 0466 504 953

Secretary: Jason David
Email: jasond@uow.edu.au
Phone: 0401 495 741

AP C5 Markets and regulation Study Committee Scope

Our Mission

The Mission of Study Committee C5 (SC C5) is to facilitate and promote the progress of engineering and the international exchange of information and knowledge in the field of electricity markets and regulation.

SC C5 members provide needed insight to the wide variety of market and regulatory requirements involved with providing reliable energy with the changes in energy policy, technology development, consumer choice, and climate conditions.

Scope of SC C5

The scope of Study Committee C5 is to facilitate and promote the progress of engineering and international exchange of information and knowledge in the field of electricity markets and regulation.

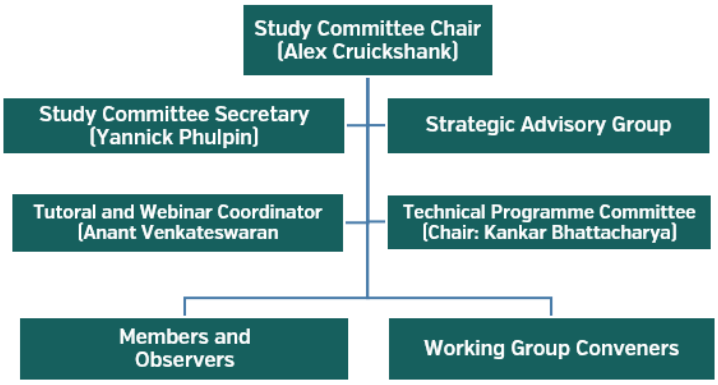
SC C5 Electricity Markets and Regulation covers the design, implementation and operation of electricity markets and supporting regulatory arrangements. SC C5 activities include:

- Market design, efficiency and regulation;
- Integration of renewable resources into market structures;
- Generation and transmission investment;
- Congestion pricing and management; and
- Market
- Governance arrangements

The study committee conducts the Large Disturbance Workshop in Paris Sessions in conjunction with study committee C2.

The structure of the Study Committee

The structure of the Study Committee and key individuals is shown in the following diagram.



Internationally, the study committee had 6 working groups (7 at the time of this report). There were 153 members in the working groups. The WG members were spread across 31 countries. Our working groups had 13% female membership and a smattering of NGN members.

The Australian C5 Panel includes members from east and west coast and also New Zealand and Singapore as these countries do not have sufficient members to support a panel of the own. This diversity of membership is most welcome as it brings broad perspectives and experiences to activities of the panel.

Specific Activities of the Study Committee in 2022

Activities in 2022 returned to live participation in the Paris Session and on WGs.

2022 PARIS SESSION

Group Discussion Meeting

The CIGRE 2022 Session included an in-person general discussion meeting, for the first time since 2018.

The Preferential Subjects of the 2022 CIGRE Session attracted papers that cover the analysis of the impacts on the planning and operation of electric power systems of different market approaches and solutions. This includes new structures, institutions, actors and stakeholders as well as the role of competition and regulation in improving end-to-end efficiency of the electric power system. SC C5 had 40 papers from 20 countries.

The Discussion Group Meeting was chaired by the Study Committee Chairman, Alex Cruickshank, with Kankar Bhattacharya, Samir C. Saxena, and A. Venkateswaran as Special Reporters and Yannick Phulpin as SC C5 Secretary. In total, there were 31 prepared contributions and a handful of spontaneous contributions that triggered timely and lively discussions.

Australian Panel contributors made six presentations

Large Disturbance Workshop

The study committee again convened a workshop, in conjunction with SC C2 to examine large disturbances in energy market and systems. Australia's Alex Cruickshank (chair of C5) and Jayme Macedo from Brazil and chair of C2 were joint convenors, Greg Thorpe of Australia was a co-organiser together with his counterpart from C2. The Large Disturbance workshop has been convened during the Paris Session for many years and recently has included market disturbances. In total more than 500 people attended the workshop.

Australian Panel contributors made two full presentations (from WA and NZ) and one interim report (on the NEM market suspension of June 2022).

Panel session

The study committee also convened one panel session in conjunction with IEEE, to examine pilot projects implementing blockchain technology to manage electricity-related trades. The panel session was preceded by a tutorial on Blockchain.

Tutorials

The study committee organized two tutorials on Blockchain (noted above) and WG C5.32 presented a tutorial based on their work examining carbon pricing in electricity markets.

SC. C5 Activities in the Existing and the New Working Groups

Australia was represented on a number of the WGs convened by C5 and Joint Working Groups with other study committees.

WG C5.26	**Auction Markets and Other Procurement Mechanisms for DR Services**
WG C5.28	**Energy Price Formation in Wholesale Electricity Markets**
JWG C5/C6.29	**New Electricity Markets, Local Energy Communities**
WG C5.30	**The Role of Block Chain Technologies in Power Markets**
WG C5.31	**Wholesale and Retail Electricity Cost Impact of Flexible Demand Response**
WG C5.32	**Carbon Pricing in Wholesale Electricity Markets**

WG C5.33	**Trading electricity with blockchain systems**
WG C5.34	**Summary of current uses of electric vehicle charge/discharge flexibility in wholesale energy markets and reliable grid operations**
WG C5.35	**Integration of hydrogen in electricity markets and sector regulation**
WG C5.36	**Certification of the electricity used to produce hydrogen**
JWG C2/C5.6	**Interventions by System Operators and Market Operators**

Technical Brochures

The Study Committee published two Technical Brochures. Australian panel members contributed to both:

TB-877 Energy Price Formation in Wholesale Electricity Markets

TB-874 Auction Markets and Other Procurement Mechanisms for Demand Response Services

Articles in CIGRE newsletters and Electra

In addition to the two Technical Brochure summaries, the Study committee contributed four articles for Future Connections and Electra:

The role of blockchain technologies in power markets by David Bowker.

Energy price formation in wholesale electricity markets.

A season of high electricity prices in Europe.

Virtual Power Plants are leveraging Australian consumer investment in rooftop solar.

PENDING TECHNICAL BROCHURES FOR 2022/23

Three working groups expect to complete their work and publish technical brochures in the coming 12 months:

- The Role of Block Chain Technologies in Power Markets
- Carbon Pricing in Wholesale Electricity Markets
- Wholesale and Retail Electricity Cost Impact of Flexible Demand Response

PENDING Panel Meetings

Tbd for mid year 2023

Australian National Committee
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Membership of the Australian Panel

There are 17 members of the Australian panel as follows. Industry experts with specialist expertise are also co-opted where appropriate. In the last two years gender and geographic diversity of membership has grown. At the end of 2022 David Bowker announced his retirement from the panel after a number of years of excellent service. I would like to record my appreciation of his contributions.

	Name	Company
1.	David Bowker	Sole trader
2.	Jacqui Bridge	Powerlink
3.	John Cooper	Hydro Tas
4.	Julian Eggleston	DigSilient
5.	Victor Francisco	PSC
6.	Stephen Hinchliffe	Mott MacDonald
7.	Chantal Hopwood	Tasnetwork
8.	Rachel Johnson	Hydro Tas
9.	Rainer Korte	ElectraNet
10.	Li Zhenhui	EMC, Singapore
11.	Ramu Naidoo	TransPower NZ
12.	Jacinda Papps	Alinta Energy
13.	David Swift	Sole trader
14.	Greg Thorpe	Oakley Greenwood
15.	Pippa Williams	NGN, Hydro Tas
16.	Ben Vanderwaal	EY
17.	Rohan Zauner	Jacobs

Convener: **Greg Thorpe**

Email: Gthorpe@oakleygreenwood.com.au

AU C6 Active Distribution Systems and Distributed Energy Resources

Study Committee Scope

The scope of the C6 Study Committee (SC) is principally concerned with the assessment of the technical impacts and requirements which a more widespread adoption of distributed generation could impose on the structure and operation of electricity distributions systems.

In parallel, the SC assesses the degree to which such solutions are likely to be adopted in the short, medium and long term. The practical importance and timing of the related technical impacts and requirements are also assessed. Rural electrification, demand side management methodologies and application of storage are within the scope of this SC.

Through its work the SC strives to objectively analyse the implications of distributed generation and to become an internationally recognised forum on this evolving subject.

Specific Activities of the Study Committee

Working groups develop technical recommendations and best practices for topics within the Study Committee's scope.

The main areas of attention are:

- Enabling technologies for renewable and distributed energy resource integration and application:
  active network management, microgrids, virtual power plants, distribution management systems, DER monitoring and control, aggregation systems and platforms.
- Innovative solutions for DER and distribution technology deployment:
  smart inverters and power electronic interfaces and interconnection device applications, MV/LV DC supply systems, distribution system modernization.
- Storage technologies:
  deployment of various storage technologies such as electrochemical battery energy storage systems, flywheels, flow batteries, hydropower, hydrogen, multi-energy solutions (with thermal storage), power2X applications (power to heat, power to gas, etc), electric vehicles.
- New approaches to configure distribution systems for enhanced reliability and resilience: islandable grid-connected microgrids, power exchange between microgrids.
- 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:
  isolated power systems and individual customer off-grid systems and solutions.

Preferential Subjects

The proposed preferential subjects for the 2024 Paris Session are:

PS1 - Flexibility Management in Distribution Networks

- Energy storage systems with the associated provision of their grid services to distribution and upstream networks
- Evolving planning and operational objectives and criteria with increased electrification, with changes in technology enabling end-to-end system operations
- Electric vehicle integration and impacts

PS2 - Power Electronic-based Solutions for Smart Distribution Systems

- Evaluating and quantifying the added value of smart invertor and convertor functions and their integration into distribution networks
- Case studies of DC and DC / AC hybrid grid solutions for the future
- Provision of ancillary services for distribution and upstream networks

PS3 - Rural, Islanded and Industrial Electrification Standards, Practices and Technology Options

- Applications highlighting the interface between technical and non-technical aspects for rural electrification
- Off-grid and island DER applications including appropriate resilience measures
- Microgrid and multi-microgrid installations

Publications

In 2022 two C6 technical brochures were published, as follows:

- TB 863 - Multi-energy System Interactions in Distribution Grids
- TB 875 - Medium Voltage DC Distribution Systems

Proposed New Working Groups

In 2022 one new C6 working group was approved:

- C6.45 The Impact of Distributed Energy Resources (DER) on the Resilience of Distribution Networks

Specific Activities of the Australian Panel

AU C6 hosted a technical webinar - *A Taste of CIDER* - on 3 March 2022 as a precursor to the 2022 CIDER conference. There were 132 attendees and two excellent presentations, as follows:

- Jenny Riesz, *Operating a Secure System with 100% Distributed PV*
- Peter Kilby & Terese Milford, *DER Enablement Using State Estimation and Dynamic Operating Envelopes*

The CIGRE Kyoto Symposium 2023 was held in hybrid format on 5-8 April 2022, with SC C6 one of the two lead study committees. Three papers were accepted for SC C6 from Australia. However, due to travel restrictions imposed by the Japanese Government due to the Covid pandemic, all three papers had to be presented remotely. The accepted papers were:

- *Voltage Support of Low-voltage Distribution Networks Using STATCOMs*, Michael Wishart & Mihai Ciobotaru
- *A Practical Method for Control of PV Generation in Microgrids*, David Stephens, Ray Brown & Sean Elphick
- *Experience with DER Integration in Australia*, Ray Brown & Pierluigi Mancarella

No papers from Australia were submitted for SC C6 for the 2022 Paris Session, although two prepared contributions and a number of spontaneous contributions were given during the SC C6 group discussion meeting.

In addition to the contribution to SC C6 working groups as listed in Section 10 below, Australia has assisted the international SC C6 with reviews of draft technical brochures and other documents, through Advisory Group AG C6.02 "Quality Review".

CIDER 2022

Australian Panel C6 hosted its Conference on Integration of Distributed Energy Resources (CIDER) in Adelaide on 10-11 May 2022. This was held at the Stamford Grand Hotel in Glenelg and attracted 125 registrations, the best attendance at any CIDER to-date. The conference included:

- two keynote presentations, Bruce Bennett of AGL and Brendon Hampton of SA Power Networks;
- 26 presenters in a single-stream format, covering a number of issues including dynamic operating envelopes, distribution state estimation, hosting capacity, flexibility and grid services, system strength, curtailment, under-frequency load shedding, storage, harmonics, and STATCOMs;
- an NGN panel, on *How Can the Industry Support Uptake of Renewables Whilst Managing Customer Expectations?*;
- a second panel on *Microgrids - Hype, Hope or Here to Stay?*;
- stand-up networking dinner.

The conference received extremely good feedback from attendees, both in a survey sent to all participants immediately after the event (94% excellent or very good) and comments directly from delegates during the conference.

This was the fourth CIDER run by Australian Panel C6, the previous conferences being in Brisbane in 2015, Sydney in 2017 and Melbourne in 2019. The conference was originally scheduled to be held in November 2021 but was postponed due to the Covid pandemic. The next CIDER will be held in Cairns on 4-5 September 2023, in conjunction with the CIGRE Cairns Symposium 2023.

Meeting Report: Australian Panel

Australian Panel C6 held its annual meeting in Adelaide on 9 May 2022, at the Stamford Grand Hotel. This was a one-day meeting held immediately before CIDER 2022. Australian Panel C6 typically holds a one-day meeting when held in conjunction with CIDER (odd years) and a two-day meeting in other (even) years. There were 11 panel members in attendance plus two guests. General administrative items and wider CIGRE news were covered in the morning, with members' presentations and discussion in the afternoon.

Invitations for SC or WGs to meet in Australia

Study Committee C6 has accepted the Australian National Committee's invitation to hold their meeting in 2023 in Cairns, in conjunction with the CIGRE Symposium. It is planned to be held on 7 September 2023.

ANC Members on Working Groups

The following are current AU representatives on Working Groups.

WG	Title	Australian Member
C6/C2.34	Flexibility Provision from Distributed Energy Resources	Pierluigi Mancarella (convenor)
C6/C2.34	Flexibility Provision from Distributed Energy Resources	Michael Negnevitsky
C6/C2.34	Flexibility Provision from Distributed Energy Resources	Gloria Zhang
C6.35	DER Aggregation Platforms for the Provision of Flexibility Services	Jenny Gannon
C6.35	DER Aggregation Platforms for the Provision of Flexibility Services	Archie Chapman
C6.36	Distributed Energy Resource Models for Impact Assessment	Filip Brnadic
C6.36	Distributed Energy Resource Models for Impact Assessment	Shariq Riaz
C1/C6.37/ CIRED	Optimal Transmission and Distribution Investment Decisions under Increasing Energy Scenario Uncertainty	Alex Baitch
C6.39	Distribution Customer Empowerment	Neha Moturi (secretary)
C6.39	Distribution Customer Empowerment	Matthew Zillmann
C6.40	Electric Vehicles as Distributed Energy Resource (DER) Systems	Laura Jones
C6.40	Electric Vehicles as Distributed Energy Resource (DER) Systems	David Stephens
C6.41	Technologies for Electrical Railway Distribution Supply Systems	Phil Coughlan
C1/C6.42	Planning Tools and Methods for Systems Facing High Levels of Distributed Energy Resources	Rama Ganguli
C6.43	Aggregation of Battery Energy Storage and Distributed Energy Resources (DER), including Solar PV	Han Wang
C6.43	Aggregation of Battery Energy Storage and Distributed Energy Resources (DER), including Solar PV	Julius Susanto
AG C6.02	Quality Review	Ray Brown (convenor)

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Membership of the Australian Panel

Name	Organisation	Type
Greg Abramowitz	AGL	Retailer
Graeme Ancell	Ancell Consulting	Consultant
Ken Ash	Energ-G Management Group	Consultant
Alex Baitch	BES	Consultant
Ray Brown	RBPE	Consultant
David Butler	TasNetworks	Distribution
Warwick Crowfoot	Essential Energy	Distribution
Sean Elphick	University of Wollongong	University
John Fletcher	University of NSW	University
Jenny Gannon	Energy Queensland	Distribution
Victor Ho	SA Power Networks	Distribution
Nathan Kirby	Western Power	Distribution
Luke Koedijk	AGL	Retailer
Adrian Lloyd	Energy Queensland	NGN Rep.
Alan Luc	Ausgrid	Distribution
Janica Lukas	Western Power	Distribution
Jackson Lung	Wellington Electricity	Distribution
Pierluigi Mancarella	University of Melbourne	University
Yateendra Mishra	Queensland University of Technology	University
Michael Negnevitsky	University of Tasmania	University
Albert Pors	Endeavour Energy	Distribution
Jenny Riesz	AEMO	Operator
Stephen Sproul	Hitachi Energy	Manufacturer
David Stephens	Horizon Power	Distribution
Mike Wishart	EcoJoule Energy	Manufacturer
Wai-Kin Wong	Hatch	Consultant
Richard Yan	University of Queensland	University
Ahmad Yousuf	Omicron	Manufacturer

Convener: **Ray Brown**

Email: ray@rbpe.com.au

AP D1 Materials and Emerging Test Techniques

Study Committee Scope

The D1 study committee deals with testing techniques and material developments that support HV plant. It is one of the two horizontal committees that also provide services to other SCs. Typically, D1 partners with a SC to provide engineering and scientific input into their understanding of plant asset management.

This includes:
1. Providing information on new materials to advance the properties of, or facilitate application of, appropriate materials or component substitutions, e.g. SF6 gas replacement options
2. Investigating and identifying degradation mechanisms
3. Identifying new asset management tools
4. Providing insight into the impact of new test techniques on plant
5. Assisting with standardisation of tests and information
6. Providing any technical assistance to any equipment committee that needs a partner with materials or testing expertise.
7. Maintaining liaisons with IEC technical committees
8. Determining preferential subjects for events

Specific Activities of the Study Committee

Topics of Working Groups

WG D1.50	Atmospheric and Altitude Correction Factors for Air Gaps and Clean Insulators
WG D1.54	Basic Principles and Practical Methods to Measure the AC and DC Resistance of Conductors of Power Cables and Overhead Lines
WG D1.58	Evaluation of Dynamic Hydrophobicity of Polymeric Insulating Materials under AC and DC Voltage Stress
WG D1.60	Traceable Measurement Techniques for very fast Transients
WG D1.61	Optical Corona Detection and Measurement
WG D1.62	Surface Degradation of Polymeric Insulating Materials for Outdoor Applications
WG D1.63	Partial Discharge Detection under DC Voltage Stress
WG D1.64	Electrical Insulation Systems at Cryogenic Temperatures
WG D1.65	Mechanical Properties of Insulating Materials and Insulated Conductors for Oil Insulated Power Transformers
WG D1.66	Requirements for partial discharge monitoring systems for gas insulated systems
WG D1.67	Dielectric performance of new non-SF6 gases and gas mixtures for gas-insulated systems
WG D1.68	Natural and synthetic esters – Evaluation of the performance under fire and the impact on environment
WG D1.69	Guidelines for test techniques of High Temperature Superconducting (HTS) systems
WG D1.70	Functional properties of modern insulating liquids for transformers and similar electrical equipment
WG D1.72	Test of material resistance against surface arcing under DC
WG D1.73	Nanostructured dielectrics: Multi-functionality at the service of the electric power industry

WG D1.74	PD measurement on insulation systems stressed from HV power electronics
JWG D1/B3.57	Dielectric testing of Gas-insulated HVDC Systems
JWG D1/B1.75	Strategies and tools for corrosion prevention for cable systems
JWG D1/A2.77	Liquid tests for electrical equipment
JWG A2/D1.51	Improvement to partial discharge measurements for factory and site acceptance tests of power transformers
JWG B1/D1.75	Interaction between cable and accessory materials in HVAC and HVDC applications
JWG B1/B3/D1.79	Recommendations for dielectric testing of HVDC gas insulated cable sealing ends

Publications in 2021 and 2022

TB 861 – Feb 2022	Improvement to PD measurements for factory and site acceptance tests of power transformers - JWG A2/D1.51
TB 856 – Dec 2021	Dielectric performance of insulating liquids for transformers – WG D1.70 TF 3
TB 850 – Oct 2021	Harmonised test for the measurement of residual methane in insulating materials – JWG D1/B1.49
TB 849 – Oct 2021	Electric performance of new non-SF6 gases and gas mixtures for gas-insulated systems – WG D1.67
TB 846 – Oct 2021	Electrical insulation systems at cryogenic temperatures – WG D1.64
TB 842 – Sept 2021	Dielectric testing of gas insulated HVDC systems – JWG D1/B3.57

Preferential Subjects

D1 Preferential subjects for Paris Session 2022

PS1 : Testing, Monitoring and Diagnostics

- Testing and experience with non-standardized, composite and combined voltages
- PD measurement under DC, rectifier and impulse stress
- Requirements of systems for testing, monitoring and diagnostics

PS2 : Materials for electrotechnical purposes

- Ageing under electrical, mechanical & thermal stress (e.g. power electronics and semiconductors, load cycling, higher temperatures, compact applications, corrosion and radiation ageing, etc.).
- Functional properties of insulation materials & testing for validation
- Materials for battery and charging devices

PS3 : Simulation tools partnered with measurement techniques

- Application and development of new multi-physics simulation methods
- Digital twin for insulation components and insulation systems
- Physical models and sensors

Proposed New Working Groups

1. 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.

Specific Activities of the Australian Panel

1. AU D1 panel hybrid meeting on 5 – 6 July 2022 at University of Queensland, St. Lucia Campus and via Zoom for those who were not able to attend face-to-face.
2. First quarterly panel member catch-ups on 19 Oct. 2022. D1 has decided to hold quarterly one-hour catch-up meetings on-line.

2. Meeting Report: Australian Panel

2022 AU Panel D1 meeting was held on 5 and 6 October at University of Queensland St. Lucia Campus and also on Zoom for those who were not able attend face-to-face. A total number of 19 members and guests attended, with 6 via Zoom. University of Queensland sponsored meeting venue, refreshments, lunches and the meeting dinner.

Below is a draft record of the meeting:

5 July 2022		
Time	**Session Number**	**Session**
08:50 – 09:00		Arrival at the meeting room
09:00 – 09:30	1	• Welcome by convenor; a. Check the guest list, Xin Zhong (UoQ), H Zhang, Andy McMahon (NZ) • Welcome by Prof Tapan Saha, University of Queensland; a. Welcome given by Prof Tapan Saha, intro to the facility and Transformer Innovation Centre. • Cigre Antitrust guidelines; a. Introduction of the antitrust guidelines and acceptance by signing the

5 July 2022		
		attendance sheet. • Self-introduction of members and guests (1-2 mins each); a. Xin Zhong – Final year PhD of UoQ b. Hong Zhang – PhD of Uni of Queensland, working in the industry. c. Andy McMahon – Principal Engineer, Transpower. d. Mariam – Omicron Australia, Pacific Regional Manager e. Atanu Mondal – Hitachi Energy, High Voltage Department f. Prasanna – Energy Queensland, Principal Engineer g. Dave Allan – Agile Professor, Uni of Queensland h. Wenyu – Omicron Australia, Specialist Engineer i. Abdallah – Primary Plant Principal Engineer, Electranet j. Anupuam – Final Year PhD in University of Queensland k. Tapan Saha – Prof of EE, University of Queensland l. Karl – Various roles, testing, trainer and Doble m. Hui Ma – Senior Lecturer at Uni of Q, n. Winston Yan – Laboratory at NMI o. Yi Li – Manager of High Voltage at NMI. p. Toan Phung – University of NSW. • Confirmation of minutes of 2021 meeting; a. Meeting Minutes Confirmed. • Matters arising from minutes; a. No matters
09:30 – 10:00	2	• CIGRE Australia update – ACT 2021 annual report , Cairns Symposium 2023, CIGRE Australia members survey; • Introduction to KMS, Dr Yi has uploaded all the papers. • Cigre membership rules are changing, limits of observer status. • Cairns Symposium in September 2023. Submit papers. • Call for papers will commence in August. • 10 committees confirmed in 2022 including D1. • Cigre Survey 127 respondents. • Informal communication group such as WhatsApp. • AU D1 2021 Report ; • NGN updates; • Sam shared an update on NGN and encouraged young engineers to join. • SC D1 – update on WGs, JWGs ad Tutorials; • Yi has shared Ralf's presentation from Feb 2022 which was delayed from 2021. This was also an e-meeting. • Joint Working Group – D1/B1.75 (J.Tusek) • Preferential Subjects: PS1, PS2 and PS3. • Duval triangle AI interpretation
11:00 – 10:30	3	Members Reports - Equipment/insulation failures or degradation; - Research activities; - New applications/ materials;

5 July 2022		
		Nonstandard or novel diagnostic techniques • Transpower NZ - Andy o 33kV Bushing failure o 33kV XLPE termination failure – Common failure in the industry. o 33kV Voltage Transformer Failure o 220kV GIS barrier leak and crack. Cracked barrier board issues. Installed 30 years ago. • Energy Queensland - Prasanna o Online PD measurements on underground cables o Opex pressures has resulted in reduced testing of cables. o GABBA outage was a nation event. o There are interpretation difficulties in understanding TEV measurements. o Are there are discharges from the cable joint or termination. Online PD is not simple requires interpretation. • Toan Phung – UNSW o Flame retardant electrical insulation materials to address bushfire risk o Diagnostics using Artificial Intelligence / Machine Learning o Use deep learning to determine the extent of pollution o Detection of series arching in PV systems o Security against Cyber Attacks o DDF measurement under distorted excitation voltage. • Karl Haubner – Doble o Altanova o Cable & Joint Degradation o Cable forensics – Moisture and workmanship issues o Karl runs a cable training course that is VESI approved. o Water treeing is occurring not a predominant failure mode in recent times. It is typically workmanship at joints or termination. • David – Member o Discussion of articles in IEEE Electrical Insulation magazine. • Dr Yi Li – NMI o NMI - service capabilities o Calibration of HV Capacitors and HV AC divider on test trucks o 100kV precision AC/DC divider o On-site calibration at devices o PD testing of high voltage devices o Impulse voltage testing of 500KV line-line EWP
10:30 – 11:00 Morning Tea		
11:00 – 12:30	4	Members Reports - Equipment/insulation failures or degradation - Research activities - New applications/ materials - Nonstandard or novel diagnostic techniques
1230 – 1330 Lunch (provided by UQ at meeting venue)		

5 July 2022		

13:30 – 15:00	5	Presentations on specific topics
		• Ageing analysis of solar farm inverter transformers, Mr. Xin Zhong, Univ. of Queensland (30 minutes)
		  • Inverter transformer are one of the components in solar farms.
		  • Inverter transformer load curve different to distribution transformer
		  • Moisture dependent thermal model (MDTM)
		  • Influence of Weather on the lifetime behaviours of the transformers.
		  • Influence of current harmonics on lifetime behaviours
		  • Ageing mainly occurs during summer and mainly very limited.
		• Transformer Insulation Thermal Aging after retro filling with Ester Fluids, Mr. Anupam Dixit, Univ. of Queensland (30 minutes)
		  • Industry shift from Mineral Oil to Ester Oil
		  • FR3 oil is used in the research project.
		  • Esters will have a higher breakdown voltage.
		  • Thermal performance need to be assessed due to change in insulation liquid.
		  • Can be assessed using numerically or experimentally.
		  • CFD simulation using a 2D model
		  • The temperature is 1.7 degrees higher than mineral oil transformer, but maybe higher for larger transformers.
		• VLF diagnosis testing on MV power cables, Dr Hao Zhang, Megger
		  • Cable diagnostic testing: resonant, system voltage, VLF and DC.
		  • Applicable test standards for VLF testing
		  • Testing using AC sine wave, damped AC and cosine rectangular.
		  • Damped AC - LC resonant circuit
		  • VLF 0.1 Hz Sinewave
		  • Practical experience that VLF testing can only identify 75% of faults, 25% are not detected.
		• Terry, Cigre CEO Introduction.
		• Digital substation cybersecurity, Wenyu Guo, Omicron
		  • OT & IT systems should be brought together.
		  • IEDs have vulnerabilities
		  • Buffer overflow vulnerability and exploits
		  • Establish an asset inventory.
		  • Identifying the attack vectors on substations
		  • Reduce attack surface and eliminate attack vectors.
		  • Intrusion Detection System

1500 – 1530 (Afternoon tea)		

1530 – 1700	6	Discussion and review of
		• Paris 2022 D1 papers
		• Ways of enhancing interactions among D1 panel members –
		  ○ Quarterly Catch-up
		  ○ WhatsApp group

5 July 2022		
		• AU D1 web space access ○ Committee has access • CIGRE memberships
19:00 – 21:00		Meeting dinner at Little Beirut: https://www.littlebeirut.com.au/

6 July 2022		
Time	**Session Number**	**Session**
08:20 – 08:30		Arrival at the meeting room
08:30 – 10:10	7	Presentations on specific topics • Vibro-acoustic measurement on transformer on-load tap changers. Wenyu Guo, Omicron a. Several methods to test transformers: Static winding can diagnose several issues. b. Dynamic OLTC can diagnose issues with the motor, diverter and etc. c. Tap Changer is design is vital in determining issues. d. Baseline or a fingerprint is required. e. Vibro acoustic method (VAM) f. Can be used offline or online. g. VAM can be combined with DRM and motor current • Mark Cotton - RIP Bushing Construction a. No discharges previous to the heat run b. Bushings start to discharge post heat run. c. Stem is typically bonded via glue d. C0 can vary significantly from 1kHz to 10kHz e. Varying results with RIP insulation measured at multiple temperatures. f. Ausnet does a thermal testing on all transformers. g. Bushings result in approx. 20-30pc after thermal testing. h. Manufacture is investigating mechanical bonding. i. Tan Delta varies significantly post thermal testing. ~300% increase j. 500kV bushings were stored outside in plastic wrap, developed micro cracks inside as the bushing dry-out was accelerated as the bushings were wet and storage boxes absorbed moisture. Resulting in 2000-3000pC. • Development of high-current and high-voltage calibration systems at frequencies up to 10 kHz. Dr Winston Yan, National Measurement Institute (20 mins) a. Harmonics are generated from power electronics that pollute the power grid. b. Traceable calibration of harmonic voltage and current for transducers up to 132kV and up to 4000A. c. Zero-flux current transformer d. Current distortion limits defined in IEEE 519:2014 e. Reference comparison using a double circuit method f. Initial Test: Large difference of ration from 3rd to 9th order g. High standard deviation and instability among repeats.

6 July 2022		
		h. Linearity test split into three groups. i. Capacitor voltage divider for Harmonic voltage calibration system. j. Frequency sweep at 1kV from 50 Hz to 10 kHz k. Most of the harmonic voltage is lost on the magnetic step up transformer. • Transformer and Substation Steelwork Risk Methodology, Sam Murali, Transgrid a. Sam Murali Intro
10:10 – 10:30 Morning Tea		
10:30 – 12:00	8	Technical tour of Australian Transformer Innovation Centre, Long Pocket Campus, Univ. of Queensland • Tour completed
12:00 – 12:30 Lunch (provided by UQ at meeting venue)		
12:30 – 15:30	9	Discussion of • Paris 2022 D1 papers special report and AU D1 responses a. PS1: Testing, Monitoring and Diagnostics b. PS2: Materials for Electro Technical Purposes c. PS3: Simulation Tools partnered with Measurement methods. d. IEC specification on non-conventional partial discharge. e. Review of several papers. • Next meeting a. Omicron – Maryam – Melbourne. • AOB
15:30		Meeting Close

Invitations for SC or WG's to meet in Australia

There are no current invitations for WG or DC's to meet in Australia.

ANC Members on Working Groups

The following are all the current AU representatives on Working Groups.

WG	Title	Australian Member
D1.59	Methods for dielectric characterisation of polymeric insulating materials for outdoor applications	Chandima Ekanayake and Dr Toan Phung (corresponding members)
D1.60	Traceable measurement techniques for very fast transients	Dr Yi Li (Convenor)
D1.50	Atmospheric and altitude correction factors for air gaps and clean insulators	Dr Yi Li
D1.69	Guidelines for test techniques of High Temperature Superconducting (HTS) systems	Richard Taylor (Convenor)
D1/B1.75	Strategies and tools for corrosion prevention for cable systems	Joe Tusek (Convenor)

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Membership of the Australian Panel

Name	Organisation	Type
Dr Yi Li	National Measurement Institute	Other
Sam Murali	TransGrid	Transmission
Andrew McMahon	Transpower	Transmission
Wenyu Guo	Omicron	Manufacturer
Mark Cotton	AusNet Services	Transmission
James Baker	Essential Energy	Distribution
Karl Haubner	Doble	Manufacturer
Atanu d-mondal	Hitachi Power Grids Australia	Manufacturer
Andrew Wilkinson	ElectraNet	Transmission
Sam Murali	TransGrid	Transmission
Dharmendra Shah	Powerlink	Transmission
Hui Ma	University of Queensland	University
Prasanna Wickramasuriya	Energy Queensland	Distribution
Toan Phung	University of NSW	University
Trevor Blackburn	University of NSW	University
Hao zhang	Megger	Manufacturer
Joe Tusek	Verico	Consultant

Convener: **Yi Li**

Email: **yi.li@measurement.gov.au**

Phone: **0423 557 620**

AU D2 Information Systems and Telecommunication

Study Committee Scope

SC D2's mission is to facilitate and promote the progress of engineering and the international exchange of information and knowledge in the field of information systems and telecommunication for power systems.

Specific Activities of the Study Committee

In the area of information systems and cybersecurity, the trends observed within the SC D2 panel members are as follows:

a) Opportunities from emerging technologies, including Big Data, AI, Virtualisation and Internet of Things (IoT)
b) Cybersecurity challenges to the power utility
c) Meeting the demands of the modern utility in terms of resiliency, including migration to packet-based networks, cloud-based systems and new technologies (5G)

The SC D2 Strategic Plan is as follows:

a) Develop joint work with other Study Committees
b) Fulfil the needs of its Target Groups (SC members, Grid market participants, Cigre Internal)
c) Balanced coverage between the topics of Information Systems and Telecommunication
d) Draw the interest of its Target Groups for the work done in the SC D2
e) Develop reciprocal exchange with other international bodies with similar scope (e.g. IEC) to strengthen links and avoid duplication of work.

The CIGRE Session 2022 was held between 28 August and 2 September 2022 and saw 49 papers from 27 countries with 2 papers from D2 Australia. D2 presented both a Tutorial and Workshop at the session as follows:

- Tutorial: Artificial intelligence application and technology in power systems
- Workshop: Standardisation of cybersecurity in power utilities digital infrastructures – a joint vision from IEC, IEEE and CIGRE

D2 was represented at the Kyoto Join Symposium in April 2022 and the Vienna SEERC Conference in May 2022 where the following tutorials were presented:

- Enabling Software Defined Networks for EPU telecom applications Victor TAN, Hiroki DOI (WG D2.43)
- Advanced consumer-side energy resource management systems Alexey Nebera (JWG D2/C6.47)
- Cyber Security Management – a key player in the EPU resilience strategy Giovanna Dondossola and Roberta Terruggia

Preferential Subjects

Preferential subjects (PS) were as follows:

a. THE OPPORTUNITIES AND CHALLENGES BROUGHT BY EMERGING INFORMATION AND COMMUNICATION TECHNOLOGIES TO ELECTRIC POWER UTILITIES IN THEIR PATH TO DIGITAL TRANSFORMATION
   i. IoT technologies and architectures in physical asset management.
   ii. Artificial intelligence, big data and analytics tools to improve asset management in electric power utilities.
   iii. Augmented and virtual reality technologies in electric power utilities and power plants.
b. CYBERSECURITY TECHNIQUES, TECHNOLOGIES, AND APPLICATIONS FOR SECURING CRITICAL UTILITY ASSETS
   i. Cybersecurity directives, supporting standards and certification schemes – experiences from electric power utilities worldwide.
   ii. Cyber incident management and experiences in the implementation of security operation centres for electric power utilities.
   iii. Impact assessment and mitigation strategies for cyber-attacks to power system operations. Studies and experiences in the integration of information and

communication technology (ICT) network and cybersecurity simulators with existing power system analysis tools.

c. MEETING THE DEMANDS OF THE MODERN UTILITY AND DER WITH AN AGILE AND RESILIENT TELECOMMUNICATION NETWORK
   i. Supporting operation technology (OT) services and applications using current and next generation cellular (4G/5G) and IoT-based wireless technologies.
   ii. Increasing efficiency and cyber security with the use of cloud-based techniques and intelligent networks including modern network management systems, network automation and service orchestration, network function virtualization (NFV) and software-defined wide area network (SD-WAN).
   iii. Improving and maintaining reliability and resiliency of critical services including protection services using modern telecommunication techniques and technologies.

New Working Groups

Three new working groups were launched in 2022:

- WG D2.56 "Interdependence and Security of Cyber-Physical Power System (CPPS)"
- JWG A2/D2.65 "Transformer Digital Twin – concept and future perspectives"
- JWG B3/D.62 "Life-long Supervision and Management of Substations by use of Sensors, Mobile Devices, Information and Communication Technologies"

Specific Activities of the Australian Panel

In 2021, the Roundtable Update format was introduced. The purpose of such a meeting outside of our annual regular panel meeting is to provide an opportunity for all panel members to have a focused coverage on a particular topic, through a short 1-2 hour online meeting format.

The following were the Roundtable Update sessions held in 2022:

1. 1st February: Roundtable Update on Virtual Power Plants
   a. 32 participants
   b. Presentations:
      i. Origin Energy's Virtual Power Plant Journey – Daniel Sue, Origin Energy
      ii. Tesla Virtual Power Plant Integration Project – James Brown, SA Power Networks
      iii. Project EDGE – Communications within a trial DER marketplace - contact Nigel Zeinert AusNet Services
      iv. Panel discussions

On the 4th of March 8 panel members met to discuss and respond to the AEMO Issues Paper for the Power Systems Data communications Standard to provide a AU D2 Panel response.

Meeting Report: Australian Panel

The D2 Panel meeting was held online via web conferencing this year on 27th and 28th July 2022 with 32 attendees including panel members and guests. The themes for the panel meeting aligned with the Paris preferential subjects for 2022.

There were 19 panel member update presentations where the following trends were noted:

a. Wireless networks
   i. Telstra 3G Decommissioning
   ii. IOT applications and proof of concepts
b. Data networks resiliency and growth
   i. IP/MPLS & MPLS-TP migrations from TDM
   ii. GOOSE architectures
   iii. Renewables and growth of DER
   iv. Synchronisation and timing
   v. Asset management and monitoring systems
c. Supply chain issues are a big challenge
d. Cyber Security
   i. AESCSF benchmarking
   ii. SOCI Act impacts
   iii. Substation architectures and standards
   iv. Threat profiling

e. Ongoing major asset replacement
   i. Extending the life of DC systems
   ii. Microwave radio
   iii. Data networks
   iv. AER submissions

Guest speakers were invited to present on the following topics;

- Next Generation Timing Concepts, Jim Olsen, Microchip
- Networking for the Hyper-Connected, Hyper Distributed Utility of the Future, Dr Krishna Balachandran, Bell Labs
- Substation Network Management Systems, Sever Sudakov, Moxa
- Cyber Security Threat Management - Current and Emerging Security Threats to Critical Infrastructure, Jonathan Thompson, SA Power Networks
- AusNet Security Operations Our Challenges, Development and Roadmap, Nathan Clarke, Ausnet Services

Panel members participated in 2 x 10-minute virtual workshops, using online whiteboarding tool Miro. The topics aligned to the preferential topics for Emerging technologies and Cyber Security where the members explore Opportunities, Challenges and Applications.

A short presentation outlining the panel meeting was provided to participants through KMS along with the session recordings.

Invitations for SC or WG's to meet in Australia

Not Applicable.

ANC Members on Working Groups

The following are all the current AU representatives on Working Groups.

WG	Title	Australian Member
NA.		

Membership of the Australian Panel

Name	Organisation	Type
Aaron Gates	Western Power	Transmission
Andy Hemming	Transpower	Transmission
Adam Hoare	Transgrid	Transmission
Ahmad Taufiq	Origin Energy	Generator
Aruna Yahampath	Endeavour Energy	Distribution
Chris Yuen	Horizon Power	Distribution
David Conway	Powercor	Distribution
David Paramandan	CommTel	Distribution
David Taddeo	GHD Pty Ltd	Vendor
James Cole	Evoenergy	Transmission, Distribution
Josh Cunningham	TasNetworks	Transmission
John Grace	Genesis Energy	Distribution
Louise Watts	SA Power Networks	Distribution
Mark Mullins	Tesla Consultants	Contractor

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Name	Organisation	Type
Mark Remmer	Powerlink	Transmission
Nigel Zeinert	AusNet	Transmission, Distribution
Paul McKeen	Energex	Distribution
Rohan Fernandez	ElectraNet	Transmission
Ross Gaspard	PSC Consulting	Contractor
Sumith Withanage	Power and Water Corporation	Transmission, Distribution
Tony Myatt	SA Power Networks	Distribution
Victor Tan	VTan Consulting	Contractor
Warren McLean	Essential Energy	Distribution
Warwick Glendenning	Wellington Electricity	Distribution

Convener: **Louise Watts**

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Australian National Committee
Panel Report 2022

CIGRE Conference Presented by AU C6

Conference on Integration of Distributed Energy Resources 2022

Details of the Conference

Australian Panel C6 hosted its Conference on Integration of Distributed Energy Resources (CIDER) in Adelaide on 10-11 May 2022. It was held at the Stamford Grand Hotel in Glenelg and attracted 125 registrations, the best attendance at any CIDER to-date. The conference included:

- two keynote presentations, Bruce Bennett of AGL and Brendon Hampton of SA Power Networks;
- 26 presenters in a single-stream format, covering a number of issues including dynamic operating envelopes, distribution state estimation, hosting capacity, flexibility and grid services, system strength, curtailment, under-frequency load shedding, storage, harmonics, and STATCOMs;
- an NGN panel, on *How Can the Industry Support Uptake of Renewables Whilst Managing Customer Expectations?*;
- a second panel on *Microgrids - Hype, Hope or Here to Stay?*;
- stand-up networking dinner.

This was the fourth CIDER run by Australian Panel C6, the previous conferences being in Brisbane in 2015, Sydney in 2017 and Melbourne in 2019. The conference was originally scheduled to be held in November 2021 but was postponed due to the Covid pandemic. The next CIDER will be held in Cairns on 4-5 September 2023, in conjunction with the CIGRE Cairns Symposium 2023.

Conference Program

Tuesday 10 May 2022

Bruce Bennett AGL Keynote Speaker	ESCRI/Dalrymple Grid-forming Battery
Stace Tzamtzidis Planet Ark Power	Enabling Commercial-Scale, Grid-Connected DER Solutions that Stabilise and Support Distribution Networks
Peter Wong Eagles Engineering Consultants Pty Ltd	Dynamic Hosting Capacity for a DER Friendly Electricity Distribution Network
Yogendra Vashishtha EA Technology	Enhanced flexibility on the LV networks: Enabling a successful DER integration into the LV networks
David Butler TasNetworks	TasNetworks Future Distribution System Vision and Roadmap
Alexander Makarowsky University of NSW	DER behaviour during major power system disturbances: Data driven analysis of real-world operation
Hugh Chan GridSight	Leveraging Data to Improve Network Safety & Customer Satisfaction
Vlora Dzeladini SA Power Networks	Successful Distribution State Estimator Deployment in Active Distribution Grids - SA Power Networks Challenges and Learnings
Seamus Allan Dynamic Ratings	LV Network Data is Supporting the Transition
Brendan Banfield, GridSight	Using Data to Become DOE-Ready & Implement DOE in the Field

Laura Jones The Australian National University	Making V2G Work in the Real World?
Pierluigi Mancarella The University of Melbourne	Techno-economic Modelling for Community Batteries
Hao Zhang Megger Australia	Implications on Relay Commissioning and Maintenance Testing Methodologies Driven by the IEC 60255-181:2019 Standard
Adrian Lloyd (Moderator)	NGN Panel Session How Can the Industry Support Uptake of Renewables Whilst Managing Consumer Expectations? Kenneth Hee (Tesla) Natasha D'Silva (Energy Locals) Alan Luc (Ausgrid) Laura Jones (ANU) Brendan Banfield (GridSight)
	Social Event / Drinks / Stand-up Networking Dinner

Wednesday 11 May 2022

Brendon Hampton SA Power Networks Keynote Speaker	South Australia - Creating the Clean Energy Energy Future
Cathryn McDonald SA Power Networks	Operational Experiences from a 100% Solar Network
Mike Wishart Ecojoule Energy	Low Voltage Distribution Network Support Using STATCOMs
Sean Elphick University of Wollongong	The Impact of Distributed Generation on Power Quality in Low Voltage Networks
Shariq Riaz The University of Melbourne	Flexibility and Grid Services from Distributed Energy Resources
Jason David University of Wollongong	State of the Art in Hosting Capacity Assessment and Enhancement
Pablo Campillos Energy Web	The Leading EDGE: Building Australia's Energy Demand and Generation Exchange
Baran Yildiz University of NSW	Curtailment and Network Voltage Analysis Study (CANVAS)
Ahmad Tavakoli Vysus Group	A Review of Power System Strength Remediation and Augmentation for Integrating Distributed Energy Resources (DER)
Anthony Morton Vysus Group	Decoupling System Strength Impact from Fault Current for Grid Forming Inverters

Amin Mahdizadeh Goldwind Australia	On the V-Q Response Requirement from Asynchronous Generators
Daena Ho AEMO	Impacts of Distributed PV on Under Frequency Load Shedding
Mehdi Ghazavi Dozein University of Melbourne	System Strength in Distribution Grids: Concepts and Challenges
Daniel Rocco Schweitzer Engineering Laboratories, Inc.	Microgrid Systems: Design, Control Functions, Modeling, and Field Experience
Ken Ash Ener-G Mgt Group	Yarrabah Microgrid Feasibility Study
Jenny Gannon (Moderator)	Microgrids Panel Session - Hype, Hope or Here to Stay Ken Ash(Ener-G Mgt Grp) Nicholas Logan (ITP Renewables) Nic Jacobsen (Enernet)

Conclusion

The conference received extremely good feedback from attendees, both in a survey sent to all participants immediately after the event (94% excellent or very good) and comments directly from delegates during the conference.

Name: Ken Ash, Jenny Gannon, Adrian Lloyd, Terry Killen, Albert Pors, Sean Elphick, Wai-Kin Wong and Ray Brown

Email: ray@rbpe.com.au

Working Group A2.58 - Installation, Pre-commissioning and Trial Operation
Working Group Scope

The Working Group will prepare a guide that covers the full scope of activities in the installation, testing, functional checking and pre-commissioning of transformers and reactors (ready for handing over to others for final switchyard commissioning – an important distinction). The guide provides a methodology for all stakeholders - asset managers, specification writers, installation practitioners, project managers and technical experts. That methodology must define adequately, yet comprehensively, the important stages, tasks, deliverables, risks and competencies for these site activities. Ultimately, the goal is to assist all stakeholders realize consensus on required expectations.

The guide will also cover activities and practices for the period of trial operation – which effectively coincides with the warranty period.

Link to Terms of Reference
https://www.cigre.org/userfiles/files/News/2018/TOR_WG_A2_58_Installation_and_Pre_Commissioning_of_Transformers_and_Shunt_Reactors.pdf)

Working Group Activities

2017

1st Meeting 6-7 April Sydney hosted by GE

2nd Meeting 30-31 August Nuremberg, Germany hosted by Siemens

2018

3rd Meeting 26-27 February Klaus, Austria hosted by Omicron

4th Meeting 25-26 August before the Paris Session

2019

5th Meeting 12-13 April Boston, USA hosted by Doble

6th Meeting 17-18 September Hamilton, Scotland hosted by Polaris Diagnostics

7th Meeting 20 November Delhi during the A2/B2/D1 Colloquium

2020

8th Meeting 4-5 February Prague, Czech Republic hosted by CEPS (transmission utility)

A series of 2h teleconferences then commenced due to COVID and having to cancel the 9th face to face meeting.

5 May, 27 May, 9 June, 24 June, 8 July, 22 July, 9 September, 7 October, 4 November, 9 December

2021

A series of 1.5h teleconferences continued through 2021 due to COVID.

13 January, 14 January, 10 February, 11 February, 7 July, 28 July, 21 October, 3 November, 17 November, 1 December, 14 December, 16 December

2021

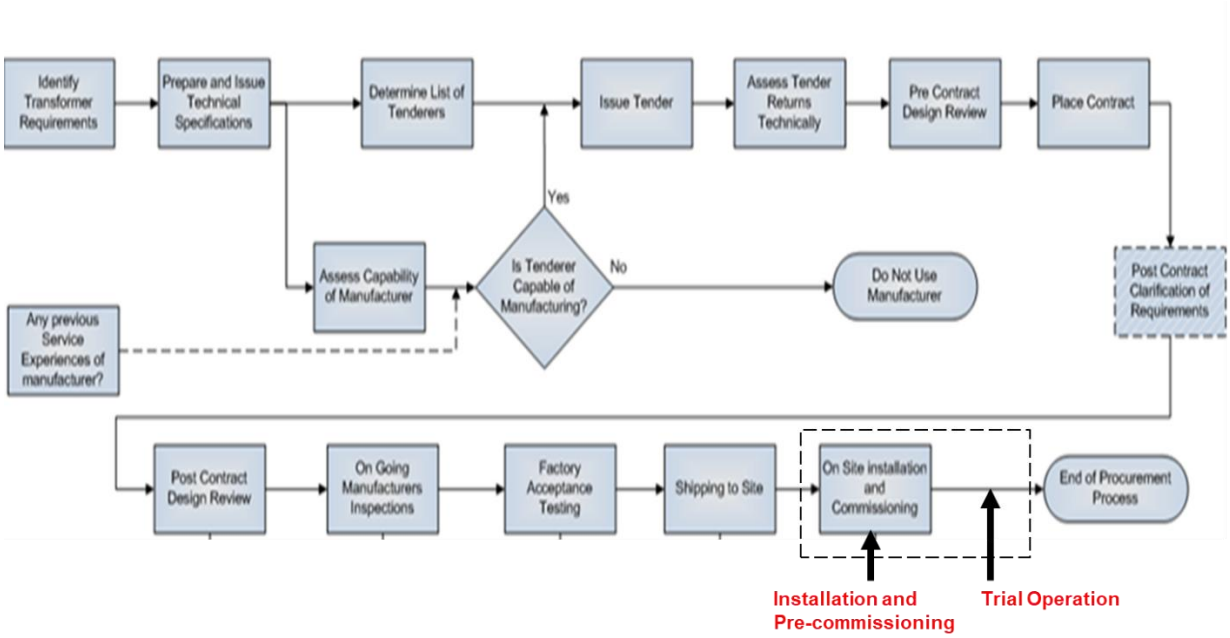
A series of 1.5h teleconferences continued through 2022 due to progress the review and augmentation of our draft TB.

7 April, 10 May, 9 June, 18 August, 5 October, 19 October, 26 October

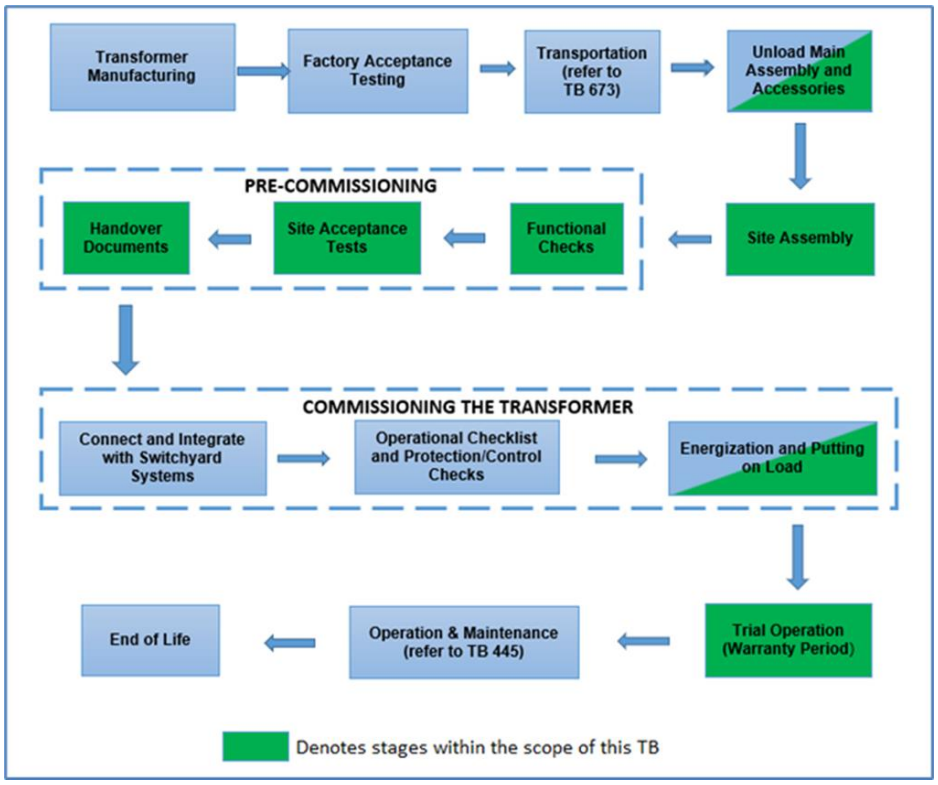
The final, face to face WG meeting was held during the 2022 CIGRE Paris Session on Friday 2 September.

The TB is developing very well as a much-needed guideline to inform all stakeholders when installing new transformers or reactors. Our work in 2022 has provided more guidance on site acceptance testing, DGA during trial operation period and adding new appendices on offshore installation, and example site documentation (generic ITP). Latest draft of our TB is Revision 16.

Context of WG TB in the Procurement Process



Context of WG TB with Life Cycle and some related A2 TBs



Some of the WG contributed chapters include in the recently published SC A2 Green Book on Transformer Procurement (Springer Verlag 20 Sept 2022).

Working Group Program

It is planned at this stage that a draft Technical Brochure document, ready for comment, will be completed in Q4 2022 or Q1 2023 for the SC Chair to review. The TB document can then be finalized, along with a tutorial and Electra article prepared in Q1 2023.

No.	Milestone	Planned	Status	Completed Date	Deliverables
1	Scope finalized and submitted	08 2016	√	08 2016	TOR
2	TOR Accepted and call for members	02 2017	√	02 2017	List of members
3	TB structure defined, TF leaders identified	08 2017	√	08 2017	Table of content
4	Literature review	12 2022	95%		Bibliography
5	Preparation of the TB chapters	07 2021	100%	07 2021	1st draft
6	Review of the draft by WG	12 2022	80%		Final draft
7	Preparation of the tutorial	03 2023	0%		Tutorial ppt
8	Preparation of the Electra article	03 2023	0%		Article
9	Review of the final draft by SC A2	03 2023	0%		Publication of TB

Progress summary of the draft TB

Chapter	Title	Progress Complete (%)
1	Site Preparations	100
2	Site Assembly	95
3	Pre-commissioning	95
4	Trial Operation	90
Appendix A	Definitions and Abbreviations	0
Appendix B	References and Links	0
Appendix C	WG A2.58 Survey Results	95
Appendix D	IEEMA Flow Chart for Erection of Power Transformer	100
Appendix E	Example Documentation of Transformer Installations	50

Chapter	Title	Progress Complete (%)
Appendix F	Ester Liquids	95
Appendix G	Offshore installation	100

Date and place of the next meeting(s)

Meetings	Date	Location / Virtual meeting	Access provided for online (y/n)	Attendance (% WG)
Meeting 1	17 Nov 2022	Virtual (teleconferencing only)	y	100
Ongoing	Q4 2022	Virtual	y	100
If needed	Q1 2023	Virtual	y	100

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Working Group B4.92 – STATCOMS at distribution voltages

Working Group Scope

Scope, deliverables and proposed time schedule of the WG:

Background: An increasing integration of green energy resources, such as renewable energy sources and electric vehicles, challenges the management of the distribution grids. It requires an extensive infrastructure upgrade, to avoid voltage limit violations or over loading of lines. This comes with a large investment cost.

Power electronics-based STATCOMs, also referred as Volt Var Optimisers (VVO), allows better grid controllability and facilitate the integration of green energy resources, limiting or deferring the infrastructure upgrade. Power electronics-based STATCOMs provides dynamic injections and absorption of reactive power into the distribution system, which enhance distribution grid with more flexible and reliable voltage control and power quality improvement including damping of flickers and harmonics control as compared to other device such as capacitors.

A number of distribution VVO STATCOMs are currently being developed and installed in the world such as USA, Canada and UK. It would be necessary and beneficial to collect and evaluate the design and operational experience gained from these newly developed distribution STATCOMs, and prepare general guidance for the future application of STATCOMs in distribution systems.

Scope:

This WG will focus on providing guidelines for the VVO STATCOM grid integration and grid services capabilities based on and with reference to existing service experience. The TB will provide recommendations to the following:

- **Topologies and architectures of VVO in distribution grids.**
- **Definition and control of VVO stages.**
- **Type and factory tests for acceptance of VVO in distribution grids.**
- **Guidance of application of STATCOM for connecting and operating the VVO in AC at medium voltage level, and in radial and meshed configurations.**
- **Service provision for distribution grids.**
- **Economical assessment and business cases.**

A liaison expert from SC C4 and C6 will be invited to participate this WG.

Working Group Activities

2021

1st Meeting Friday 29th October, Teams Meeting hosted by John Wright-Smith

2022

2nd Meeting March, 2022, Teams Meeting hosted by John Wright-Smith

3rd Meeting Thursday 1st September, CIGRE Paris Meeting for day

2023

4th Meeting planned for February, 2023

5th Meeting planned for Cairns, 2023

Working Group Program

The draft Technical Brochure is now 70 pages and going through final edit.

It is planned at this stage that a draft Technical Brochure document, ready for comment, will be completed in Q1 2023 for the SC Chair to review.

The TB document can then be finalized, along with a tutorial and Electra article prepared in Q3 2023.

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