Australian Technical Committee of CIGRE
2020 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 2020.

Contents

David Bones
Chair of the Australian Technical Committee

December 2020

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.

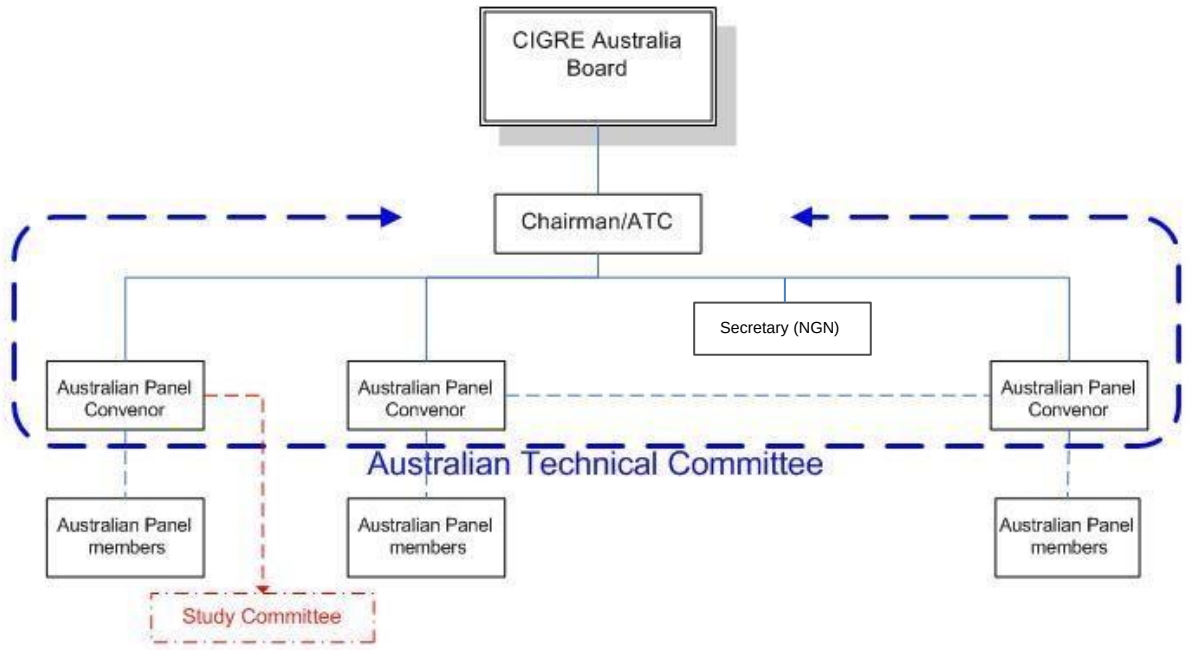
The Technical Committee provides a forum for the ATC members to:

- 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.

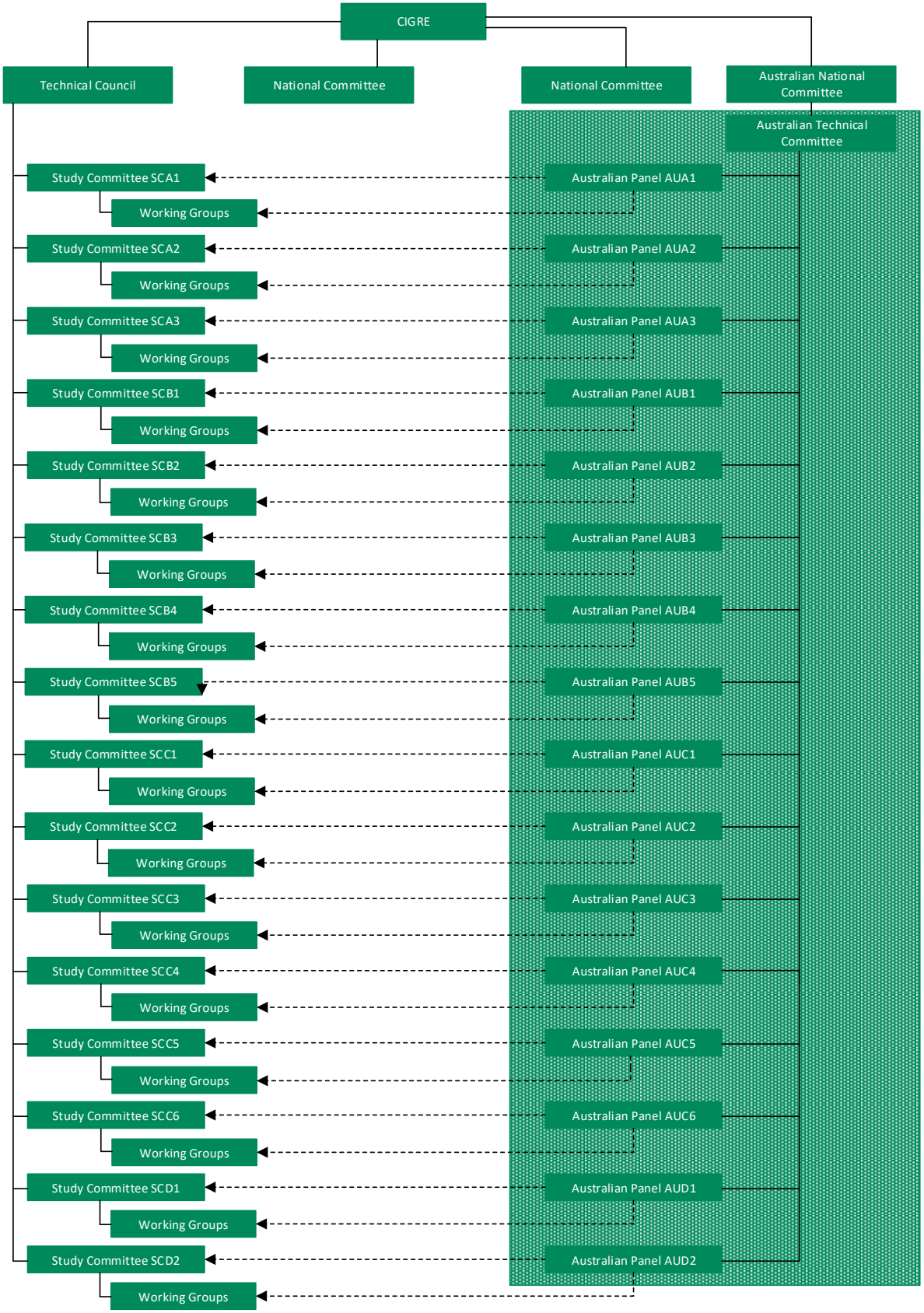
The Australian Technical Committee is convened by the ATC Chairman. The Chairman is also a member of the CIGRE Australia Board. The CIGRE Australia Executive Manager provides administrative support to the ATC and a linkage between the CIGRE Australia Board and the Australian Panels for all financial 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 43 members and the smallest has 9 members. The number of panel members increased across 2020 with convenors reporting and increase of 41 panel members.

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.



The ATC conducted all activities virtually during 2020 due to COVID-19 travel restrictions. During the year we held regular teleconferences to maintain contact and share knowledge regarding the planning for the 2020 e- session. During those meeting Alex Cruickshank (Convenor SC C5) 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. While no Panel Conveners retired during 2020, Phil Coughlan stepped down from the role of ATC secretary with that role transitioning to Alex Price.

Phil has made a significant contribution to the smooth functioning of the ATC over the past four years and his efforts are very much appreciated. Phil continues to be involved in CIGRE as a co-chair of the NGN, member of AUB1 and active contributor to CIGRE working groups.

Alex is also an active NGN member contributing to AUB2 panel activities and working groups. Alex will ensure that we continue to have effective NGN involvement in the operation of the ATC.

CIGRE Australia enjoys excellent access to the international technical activities of CIGRE through Alex Cruickshank's role as the SC C5 Chairman and member of the CIGRE Technical Council. With Alex in this role CIGRE Australia is enjoying an extended period of influence over the technical direction of CIGRE having had three Study Committee Chairmen from Australia with overlapping terms on the international Technical Council (Phil Southwell, Terry Krieg and Alex Cruickshank).

Peter Wiehe is the Secretary for Study Committee A1 Rotating Machines and a number of Australian Panel Conveners and Panel Members are active members of advisory groups within their respective Study Committee. The full membership of the ATC during 2020 is shown in attachment 1.

Australian Panels

Locally, ATC members have convened virtual meetings of their Australian Panels. These meetings form an important communication forum for Panel members. In addition a number of Australian Panels have provide virtual seminars, tutorials and webinars across 2020. Several webinars with a collaboration between the NGN and Australian Panels.

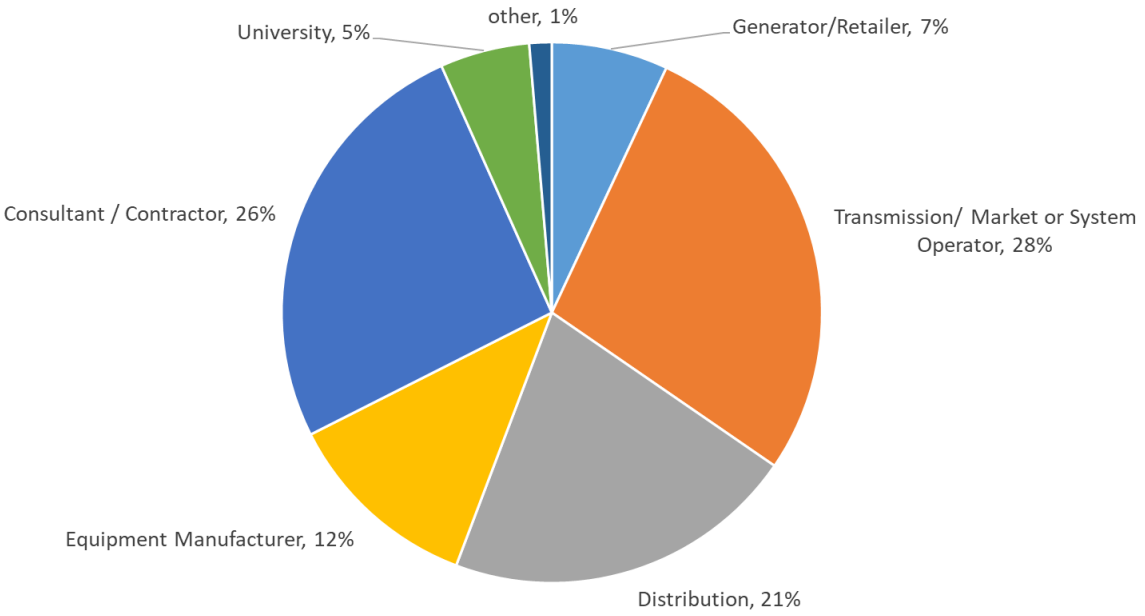
Membership of Australian Panels increased across 2020, with total panel member numbers increasing by 12% compared to the numbers reported in 2019. Sector representation is shown in the following figure. Compared to 2019, the strongest growth in panel membership has come from the consulting and contracting sector of the industry with a noticeable reduction in the representation from academia.

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, although such face to face meetings were not possible during 2020.

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 2020 ATC report.

Each Panel Convener also delivered a presentation at the ATC Seminar held of the day before the 2019 AGM. Those presentations highlighted SC activities of particular relevance to Australia. The presentations are available from the CIGRE Australia internet site https://www.cigreaustralia.org.au/cigre-events/cigre-australia-annual-technical-summary/



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. Attachment 3 lists the Technical Brochures published by CIGRE in 2020. All of these brochures are available for CIGRE Australia members via the e-cigre (https://e-cigre.org/). During 2020, 7 webinars were also made available via e-cigre.

As at 30 November 2020 there were 250 active Working Groups. Historically CIGRE Australia members have participated in about 55% of active working groups. Statistics compiled by the ATC in late 2020 reveal that across 2020, CIGRE Australia members contributed to 64% of the active working groups. 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. Due to COVID-19, travel for working group meetings was suspended for much of 2020.

The following table lists the working groups convened by Australian members during 2020.

WG/TF No	WG or TF Name	Convener
A2-58	Site Installation and Pre-commissioning of Power Transformers and Shunt Reactors	Ross Willoughby
B2-40	Calculations of the electrical distances between live parts and obstacles for OHL : Preparatory studies for revision of IEC standard (IEC61865 –IEC60826 – EN50341)	Robert Lake
B2-50	Safe handling of fittings and conductors	Peter Dulhunty
B2-67	Assessment and Testing of Wood and Alternative Material Type Poles	Nathan Spencer
B2-73	Prevention of vegetation fires caused by OHL systems	Peter Dulhunty
B2/C1 - 77	Risk Modelling of OHL for Severe Weather Events	Asif Bhangor
B3-54	Earthing System Testing Methods	Stephen Palmer
B4-90	Operation and Maintenance of HVDC and FACTS Facilities	Les Brand
B4-92	STATCOMs at Distribution Voltages	John Wright-Smith
C1-38	Valuation as a comprehensive approach to asset management in view of emerging developments	Graeme Ancell
C1-41	Closing the Gap in understanding between stakeholders and electrical energy specialists	Phil Southwell
C2-24	Mitigating the risk of fire starts and the consequences of fires near overhead lines for System Operations'	Frank Crisci
C2-26	Power system restoration accounting for a rapidly changing power system and generation mix	Babak Badrzadeh
C3-19	Responsible management of the Electric and Magnetic Field Issue	James Hart
C4-56	Electromagnetic transient simulation models for large-scale system impact studies in power systems having a high penetration of inverter-based resources	Babak Badrzadeh
C5-30	The Role of Block Chain Technologies in Power Markets	David Bowker
C5-33	Block chain applications in power markets	David Bowker
C6/C2-34	Flexibility Provision from Distributed Energy Resources	Pierluigi Mancarella
D1/B1 - 75	Strategies and tools for corrosion prevention for cable systems	Joe Tusek
D1-50	Traceable measurement techniques for very fast transients	Dr Yi Li
D1-60	Atmospheric and altitude correction factors for air gaps and clean insulators	Dr Yi Li

WG/TF No	WG or TF Name	Convener
D1-69	Guidelines for test techniques of High Temperature Superconducting (HTS) systems	Richard Taylor
D2.43	Enabling software defined networking for EPU telecom applications	Victor Tan

Some of the conveners listed in the preceding table have prepared a report on the key outcomes from their working group during 2020. 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.

During the 2020 the following working group convened by a CIGRE Australia members were finalized and a technical brochure is now available:

- C1-38 – Valuation as a comprehensive approach to asset management in view of emerging developments convened by Graeme Ancell
- C3-19 – Responsible management of electric and magnetic fields (EMF) convened by James Hart
- C5-30 – The role of blockchain technologies in power markets convened by David Bowker

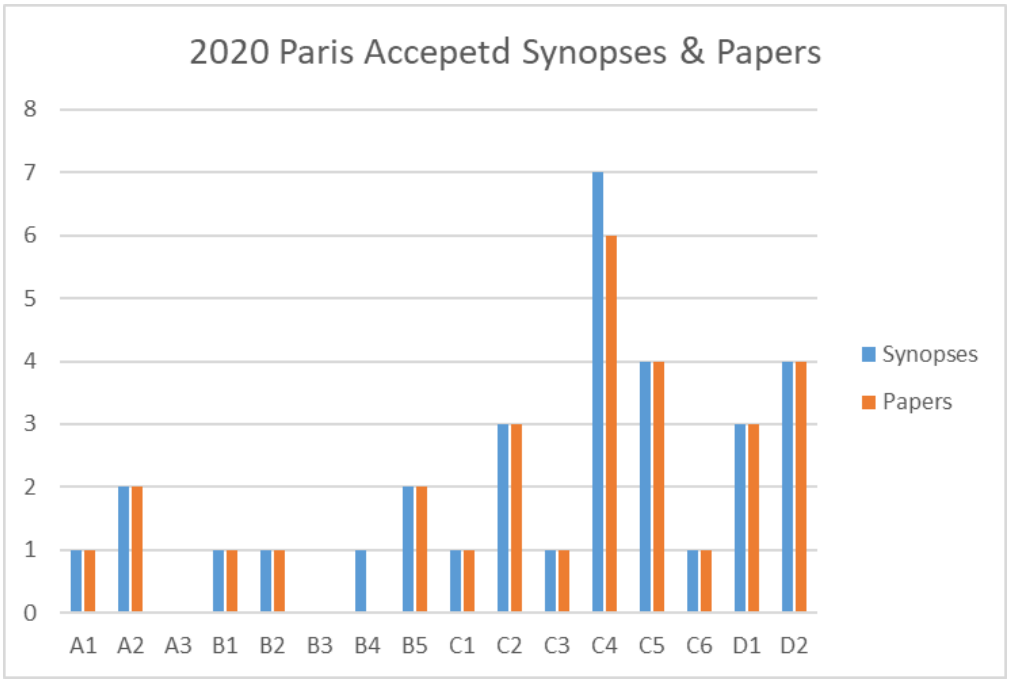
Technical Brochures for completed Working Groups will be published via e-cigre and can be downloaded by CIGRE Australia members from https://e-cigre.org/

Study Committee Meetings in Australia

CIGRE Australia did not host any Study Committee meetings in 2020.

CIGRE 2020 Session

A record number of papers (30) were submitted by CIGRE Australia for the 2020 Paris e-Session. The following figure shows the distribution of CIGRE Australia synopses and papers across the 16 Study Committees.



Seminars, Conferences and Training

Due to COVID-19 travel restrictions, no face-face seminars/workshops were organized by Australian Panels in 2020. Planning is underway to enable the following seminars in 2021, subject to COVID-19 restrictions:

- **Transformer Workshop**
- **SEAPC -** The South East Asia Protection, Automation & Control Conference (SEAPAC)
- **CIDER -** Conference on Integration of Distributed Energy Resources (CIDER)

During 2020 in addition to supporting the Paris e-session a number of virtual seminars and workshops were organized by Australian Panels. Summaries are provided in the annual reports for the Australian Panels.

Health of Technical Activities – ATC KPI

The ATC uses a set of measures to monitor the sustainability and health of the 16 Australian Panels. The set of measures is referred to as the ATC KPI and is illustrated in the following table. The KPI measures:

- The strength of the technical contribution delivered by the 16 Australian Panels and
- The sustainability of the structure of the panels

Measure	Targets	August 2020
Technical contribution	10 working groups pa, (projected outcome based on YTD commitment)**	GREEN
	10 In The Loop (ITL) WG articles pa, (projected outcome based on YTD commitment)*	GREEN
	3 technical seminars pa, achieving positive feedback (preparation on track and positive feedback post event)***	GREEN
	Annual reports provided to members for each Panel and funded WG (templates in Aug, reports before AGM)	GREEN
	55% WG have Australian member	GREEN
	20 papers for Paris session	GREEN
	9 substantive roles during Paris session	GREEN
Sustainable structure	All panels have active NGN liaison	GREEN
	All panels have convenor and identified successor	YELLOW
	Panel membership reflects all industry sectors	YELLOW

*In 2020 focus shifted to supporting Corona Times

**In 2020 restrictions on international travel have limited WG sponsorship opportunities

***In 2020 focus shifted to delivery of Webinars recognizing travel restrictions due to COVID-19

The table above shows the performance against each measure in 2020. Colours are used to identify whether targets have been achieved:

Green	indicates target was met or exceeded
Yellow	indicates target was achieved for a majority of panels
Red	indicates target was no achieved in a majority of cases

The measures relating to the technical contribution were achieved during 2020, allowing for the impact of COVID-19.

The measures relating to the sustainability of Australian Panels indicate opportunities for improvement. This is a continuing area of focus for the ATC. Key issues identified include:

- 50% of panels have identified gaps in their membership when compared with the composition of the relevant parts of the power industry;
- Only 40% of panels have identified a successor for the current convener

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 2020.

I thank the members of the ATC for their efforts and contributions.

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

David Bones

Chair of the Australian Technical Committee

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Attachment 1 – 2020 Members of the ATC

	Chairman ATC	David Bones
	Secretary ATC	Phil Coughlan / Alex Price
A1	Rotating electrical machines	Tri Tran
A2	Power transformers and reactors	Ross Willoughby
A3	Transmission and distribution equipment	Wayne Pepper
B1	Insulated cables	Russell Wheatland
B2	Overhead lines	John McCormack
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	James Hart
C4	Power system technical performance	Andrew Halley
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	Victor Tan
	SC C5 Chairman	Alex Cruickshank
	Executive Manager CIGRE Australia	Terry Killen

Attachment 2 – Annual Reports by the ATC

Australian Panel Annual Reports

- CIGRE_Annual_Report_AU_A1_2020.pdf
- CIGRE_Annual_Report_AU_A2_2020.pdf
- CIGRE_Annual_Report_AU_B1_2020.pdf
- CIGRE_Annual_Report_AU_B2_2020.pdf
- CIGRE_Annual_Report_AU_B3_2020.pdf
- CIGRE_Annual_Report_AU_B4_2020.pdf
- CIGRE_Annual_Report_AU_B5_2020.pdf
- CIGRE_Annual_Report_AU_C1_2020.pdf
- CIGRE_Annual_Report_AU_C2_2020.pdf
- CIGRE_Annual_Report_AU_C3_2020.pdf
- CIGRE_Annual_Report_AU_C4_2020.pdf
- CIGRE_Annual_Report_AU_C5_2020.pdf
- CIGRE_Annual_Report_AU_C6_2020.pdf
- CIGRE_Annual_Report_AU_D1_2020.pdf
- CIGRE_Annual_Report_AU_D2_2020.pdf

Reports on Working Groups supported by ANC of CIGRE

- CIGRE_Working_Group_Report_WG_A2.58_2020.pdf
- CIGRE_Working_Group_Report_WG_C1.38_2020.pdf
- CIGRE_Working_Group_Report_WG_C1.41_2020.pdf
- CIGRE_Working_Group_Report_WG_D1.60_2020.pdf

Attachment 3 – Brochures published by CIGRE in 2019

Study Committee	TB Number	Title
A1	813	Magnetic core dimensioning limits in hydro generators
A2	812	Advances in the interpretation of transformer Frequency Response Analysis (FRA)
A3	816	Substation equipment overstress management
	817	Shunt capacitor switching in distribution and transmission systems
B1	797	Sheath bonding systems of AC transmission cables - design, testing, and maintenance
	801	Guidelines for safe work on cable systems under induced voltages or currents
	815	Update of service experience of HV underground and submarine cable systems
B2	788	Dynamic loading effects on overhead lines- Impact on foundations
	792	Compact AC overhead lines
	809	Dynamic loading effects on overhead lines: Impact on structures
	818	Transmission line structures with Fiber Reinforced Polymer (FRP) composite
B3	802	Application of non-SF6 gases or gas-mixtures in medium and high voltage gas-insulated switchgear
	805	Guidelines for safe work methods in substations
	807	Application of robotics in substations
	814	LPIT applications in HV Gas Insulated Switchgear
	823	Substation servicing and supervision using mobile devices and smart sensing
B4	798	Implications for harmonics and filtering of the installation of HVDC converter stations in close proximity
	804	DC grid benchmark models for system studies
	811	DC side harmonics and filtering in HVDC transmission systems
B5	789	Improved metering systems for billing purposes in substations
	790	Cybersecurity requirements for PACS and the resilience of PAC architectures
	800	Network protection performance audits
	810	Protection and automation issues of islanded systems during system restoration/black start
	819	IEC 61850 based substation automation systems – Users expectations and stakeholders interactions
C1	791	Valuation as a comprehensive approach to asset management in view of emerging developments
	820	Optimal power system planning under growing uncertainty
C2/B4	821	Capabilities and requirements definition for power electronics based technology for secure and efficient system operation and control
C3	806	Responsible management of electric and magnetic fields (EMF)
C4	795	Extrapolation of measured values of power-frequency magnetic fields in the vicinity of power links
	799	Assessment of conducted disturbances above 2 kHz in MV and LV power systems
C5	803	Exploring the market value of Smart Grids and interactions with wholesale (TSO) and distribution (DSO) markets
	808	Short-term flexibility in power systems: drivers and solutions
	824	The role of blockchain technologies in power markets
C6	793	Medium voltage direct current (MVDC) grid feasibility study

Study Committee	TB Number	Title
D1	794	Field grading in electrical insulation systems
	822	Methods for dielectric characterisation of polymeric insulating materials for outdoor applications
D2	796	Cybersecurity: Future threats and impact on electric power utility organizations and operations

Study Committee	Webinar Number	Title
B1	16	Recommendations for additional testing for submarine cables from 6 kV (Um = 7.2 kV) up to 60 kV (Um = 72.5 kV)
	18	Trenchless technologies
C2/B4	21	Capabilities and requirements definition for Power Electronics based technology for secure and efficient system operation and control
C2/C4	22	Impact of high penetration of inverter-based generation on system inertia of networks
C4	17	Understanding of the geomagnetic storm environment for high voltage power grid
C4/B4	19	Network modelling for harmonic studies
D2	20	Future threats and impact on organizations and operations – An overview (TB 762 & 796)

AU A1 Rotating Machines

1. 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.

2. 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 >800kW. 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.

3. Preferential Subjects

Due to the Covid-19 pandemic, the 2020 Preferential Subjects and submitted papers will be used for 2021 Discussion Group Meeting. Special Reporters will compile a Special Report for the 2021 Group Discussion Meeting.

Preferential subjects selected by the Study Committee for in 2022 Paris session were:

PS 1: Generation Mix of the Future

- Impact and effect of increasing renewable power mix on new and existing generators, generator auxiliaries and motors
- Evolution and trends in designs of machines for renewable generation
- Role of synchronous compensators in supporting power generation networks

PS 2: Asset Management of Electrical Machines

- Experience with refurbishment, replacement, conversions, power up-rating and efficiency improvement of generators.
- Novel techniques to overcome known operational and design problems
- Optimised condition monitoring, diagnosis, prognosis and maintenance practices to improve reliability and extend operational life at conventional plant and in new volatile grid conditions.

PS 3: Developments of Rotating Electrical Machines and Operational Experience

- Latest design, specification, materials, manufacture, maintenance and performance and efficiency improvements

- Evolution of international standards for electrical machine design & performance
- Operational experience: Failures, root cause analysis, recovery options, cost and time reduction initiatives.

4. Proposed New Working Groups

A new Working Groups A1-70 - "Dielectric Distribution Factor Measurements on Stator Windings" was formed in June 2020. Convenor is Mrs. Monique Krieg-Wezelenburg (NL). The main scope of this new working group is to investigate whether this test method adds value in the process of assessing the condition of the stator windings. This investigation would complement the work that has already performed as published in TB-769 "Dielectric Dissipation Factor Measurements on New Stator Bars and Coils.

5. Specific Activities of the Australian Panel

Due to Covid-19 restriction, AU A1 regular annual face to face panel meeting was not possible. Instead a teleconference meeting is planned for December 2020.

Shorter teleconference panel meetings were held on 11/10/2019 and 17/01/2020 with good attendance.

At the Colloquium, tutorial and WG meeting in India in September 2019, the following activities were also taken place:

- WG Session presentations on progress - 23/09/19
  - 4 WG (A1-29, A1-31, A1-37, A1-39) finished
  - 3 WG (A1-33, A1-48, A1-50) at final stage
  - 4 new WG (A1-63, A1-65, A1/C4-66, A1-70) TOR approved, in progress
- SC A1 Chairman Summary - 24/09/19
  - Technical Council meeting and activities,
  - Review of Cigre membership status,
  - Women with Cirge, e-Cigre, KMS,
  - Proposal for 2021 Colloquium in Japan and 2023 in Russia.
- Four Tutorials were presented 25/09/19
  - Magnetic Core Dimensioning Limits in Hydro-Generators
  - Application of dielectric dissipation factor measurements on new stator coils and bars.
  - Guidance on the Requirements for High speed Balancing/over speed testing of turbine Generator Rotors following Maintenance or Repair
  - Guidance for Cleanliness and Proper storage of Generators and Components

SC A1 Colloquium 26/09/19 and 27/09/19 two main Preferential Subjects:

- PS 1 - High Renewable Penetrated Networks
- PS 2 - Operational Experience and New Developments

With 24 presentations on:

- large turbo-generators and hydro-generators
- machine insulation system, and large motors.

6. Meeting Report: Australian Panel

- Annual AU A1 panel meeting in 2020 is via teleconference (refer to meeting minutes).
- Quarterly AU A1 panel meetings in 2019 and 2020 are via teleconference (refer to the meeting minutes)

7. Invitations for SC or WG's to meet in Australia

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

8. ANC Members on Working Groups

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

WG A1.XX	Title	Australian Member
33	Guide to the Proper Storage and Cleanliness of Turbogenerators and Components	Tri Tran
42	Influence of Key Requirements to Optimize the Value of Hydro-generators	Kapila Nanayakkara Peter Wiehe
44	Guidelines on Testing of Turbo and Hydro-Generators	Peter Wiehe Kris Bryla
48	Guidance on the Requirements for High Speed Balancing / Overspeed Testing of Turbine Generator Rotors Following Maintenance or Repair	Len Gunn
49	Magnetic core dimensioning limits in Hydro-Generators	Peter Wiehe
51	Monitoring, Reliability and Availability of Wind Generators	Tri Tran
55	Survey of Split Core Stators	Peter Wiehe
56	Survey on Lap and Wave Windings and their consequences on Maintenance and Performance	Peter Wiehe
57	Visual Inspection of Stator Windings and Cores of Large Turbo-generators	Tri Tran
59	Survey on Industry Practices and Effects associated with the Cutting out of Stator Coils in Hydro-generators	John Iles
66 (A1/C4)	Guide on the Assessment, Specification and Design of Synchronous Condensers for Power Systems with Predominance of Low or Zero Inertia Generators	Fabian Spescha
70	Dielectric Dissipation Factor Measurements on Stator Windings.	Peter Wiehe Tri Tran

9. Membership of the Australian Panel in 2019-2020

Name	Organisation	Type
Tri Tran (Convenor)	AGL	Utility
Peter Wiehe	Acutel Consulting	Consultant
Marc Ransome	Hydro Tasmania	Utility
Kapila Nanayakkara	Snowy Hydro	Utility
Len Gunn	Origin Energy	Utility
Franco Rabines	CS Energy	Utility
Simon Nawrot	Delta Electricity	Utility
Viet Trinh	ElectraNet Pty. Ltd	Transmission Utility
Phil Onions	Stanwell Corporation	Utility
Fabian Spescha	AEMO	AEMO
Johan Strydom	Synergy	Utility
Ashok Ojha	Alinta	Utility
Johan Strydom	Synergy	Utility

Hossein Rahimpour	AmpControl	Consultant
Andriy Kotokhov	MachineMonitor	Consultant
David Graham	Energy Australia	Utility

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

AU A2 Transformers and Reactors

1. Study Committee Scope

The scope of SC A2 covers:

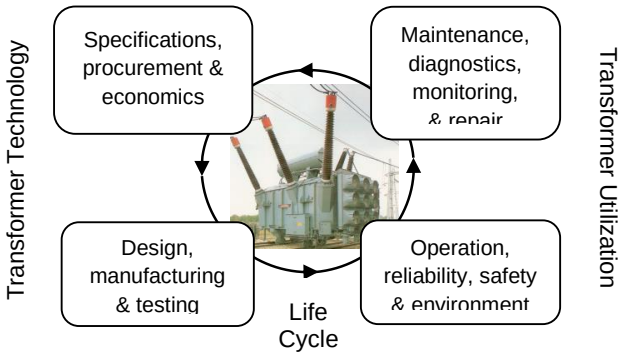
- All kinds of power transformers, including HVDC transformers converter and phase-shifting transformers;
- All kinds of reactors, including shunt reactors, series reactors, and HVDC smoothing reactors;
- All transformer components, including bushings, tapchangers, and other transformer accessories.

2. 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.



The SC also has very close relationships with IEC and IEEE technical committees,

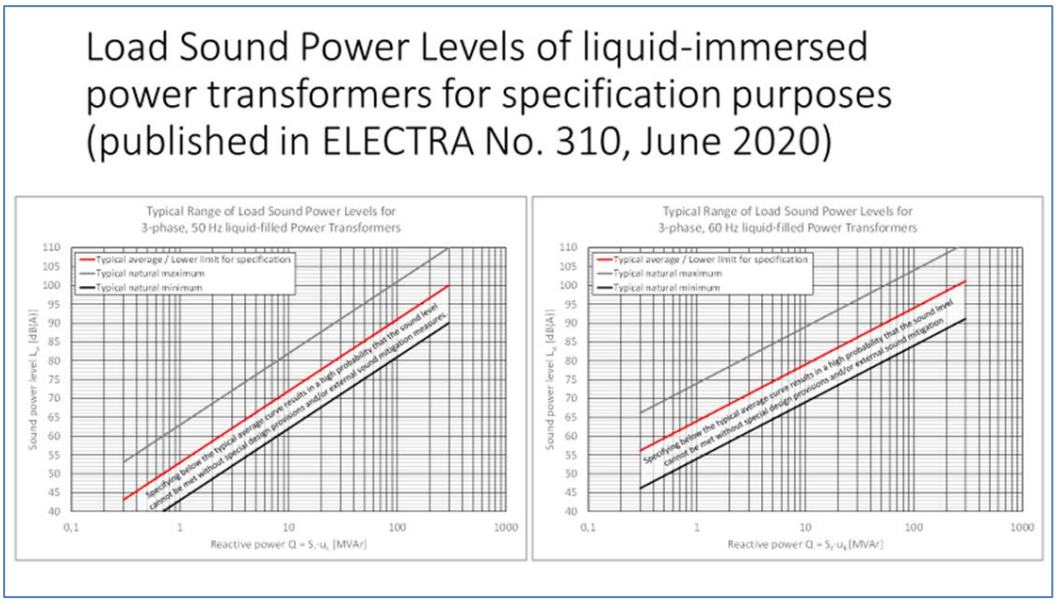
TC 10 “Fluids for Electrotechnical Applications”,
TC 14 “Power Transformers”
TC 122 “UHV AC Transmission”

SC A2 activity overview,

- 1 new JWG has been approved
- 1 Technical Brochure and 1 Electra Paper have been published

Brochures and papers published in 2020

- Load Sound Power Levels for Specification Purposes of Three-Phase 50Hz and 60Hz Liquid-Filled Power Transformers – Electra 310, June 2020



- TB 812 – Advances in the Interpretation of Transformer Frequency Response Analysis (FRA) – September 2020

Major meetings:

Paris e-Session, 24 Aug (for SC) and 31 Aug – 2 Sept. 2020 (for PS papers and tutorial).

3. Preferential Subjects

There are currently 4 proposals for preferential subjects for the 2022 Paris Session (3 are to be finally selected by SC vote):

***1: Operational experience and new requirements of power transformers for on- and off-shore windfarms*.**

- Operational experience: problems, maintenance, condition assessment, monitoring, failure rate, failure rate, lifetime, lessons learnt
- Requirements in design, test, insulation, monitoring, maintenance
- Difference in requirements and experience for on-shore and off-shore applications, wind turbine, step-up, in-tower and secondary substation transformers
- Future outlook: size and design of wind transformers for future applications

2: Beyond the Mineral Oil-Immersed Transformer

- Alternative technologies for improved safety and environmental performance: gas-insulated transformers, ester-immersed transformers, dry-type transformers and solid-state transformers
- Operational experience with transformers using these new technologies
- Advantages and limitations, impact on specifications
- Possible applications, business cases

3: Best Practices in Transformer Procurement

- Return of Experience: Factory qualification process, design reviews, implementation of new specifications
- Quality control: manufacturing check points, sub-supplier qualification, validity period for type tests
- Testing: Enhancements to standards, special tests, short-circuit test, paper DP measurement
- Dealing with non-conformities, performance guarantees, warranty

4: Trends in Transformer Maintenance

- New approaches of maintenance: Online versus offline, use of robots and drones, innovative work methods and diagnostics
- Case studies of condition-based, risk-based and predictive maintenance approaches
- Total life cycle cost strategies, mid-life refurbishment, life extension alternatives, comparative financial analysis of different strategies

4. Proposed New Working Groups

JWG A2/D1.77 “Liquid Tests for Electrical Equipment” was approved by central TC chair in March. Representation by an AU D1 member may be appropriate.

5. Specific Activities of the Australian Panel

AU A2 had proposed to hold an interactive workshop in Melbourne in March 2020, in conjunction with Techcon Asia Pacific. Due to COVID-19, the event has had to be postponed to Wednesday 17 March, 2021. The proposed workshop title is “Transformers – Improving Reliability – An Interactive Workshop”

The proposed topics align mainly with SC A2 Preferential Subject 3 on transformer reliability from the 2020 e-Session as well as the work of WG A2.62:

- CIGRE Tutorial on TB 771 – Advances in DGA Interpretation
- ANZ failure statistical evaluation results
- Experiences in Transformer Onsite Refurbishment (based on Robert Li’s PS3 paper)
- Application of Conditional Probability (based on Chris Beckett’s PS3 paper)
- Transformer failure modes listed and respective assessment criteria (based on work of WG A2.49 Tx Condition assessment and TB 761)
- Transformer site testing (Winding Resistance and Dielectric Response)

The next panel face to face meeting will be convened in Melbourne on March 16, immediately before the 17-19 March 2021 Cigre/TechCon Conference, also in Melbourne. This will minimise travel expenses for 2021, and increase the likely attendance and involvement of the AU A2 panel membership in the Cigre Transformer Workshop held on March 17. The panel meeting will be hosted by one of the Victorian AU A2 membership employers.

6. Meeting Report: Australian Panel

Meetings for AU A2 in 2020 have been conducted as a series of teleconferences due to COVID and having to cancel the AU A2 face to face meeting.

24 March (2h) – Membership changes. Round the “room” feedback on member issues. Paris session update – the e-Session. Review PS paper subjects. Update from member of WG A2.60 on dynamic thermal behaviour. Request to members from WG A2.63 to complete transformer reliability survey. Update from the convener on WGA2.58 on site installation, pre-commissioning and trial operation.

12 October (1h) – Membership changes. Convener provided feedback to panel om Paris e-Session proceedings. Discussed PS Papers that had been presented by Robert Li and Chris Beckett. Outlined the tutorial on new TB812 on FRA .

23 November (1h) – Reminder about WG A2.62 survey on transformer failures. Reviewed new ToR for JWG D1 A2.77 Liquid Tests for Electrical Equipment. Proposal to create survey on effects of COVID on our industry. Panel discussed their experiences, both positive and negative impacts. A survey questionnaire to be drafted based upon those discussions.

7. 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.

8. ANC Members on Working Groups

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

WG	Title	Australian or NZ Member
A2/D1.51	Improvement to Partial Discharge Measurements for Factory and Site Acceptance Tests of Power Transformers	Nil
A2/C4.52	High Frequency Transformer Models for Non-Standard Waveforms	Nil
A2.54	Power Transformer Audible Noise Requirements	Nil
A2.55	Transformer Life Extension	Ross Willoughby (observer)
A2.56	Power Transformer Efficiency	Rob Milledge (corresponding)
A2.57	Effects of DC Bias on Power Transformers	Nil
A2.58	Installation and Pre-Commissioning of Transformers and Shunt Reactors	Ross Willoughby (Convener) Matt Gibson (corresponding)
A2.59	On-Site Assembly, On-Site Rebuild, and On-Site High Voltage Testing of Power Transformers	Ross Willoughby (observer)
A2.60	Dynamic Thermal Behaviour of Transformers	Seamus Allan
A2.61	On-load Tapchanger Best Practice	Kevin Newman
A2.62	Analysis of Transformer Reliability	Dan Martin
A2.63	Transformer Impulse Testing	Arun Mathur
A2.64	Condition of cellulose insulation in oil immersed transformers after factory acceptance test	Alan Vietch (according to WG progress report)
A2/D1.77	Liquid Tests for Electrical Equipment	Nil
TF	The Condition of Transformer Solid Insulation at End-of-Life	Nil

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

WG	Title	Australian or NZ Member
AG-2	Tutorial	Tara-Lee Macarthur (convener)
AG-4	Power Transformer Utilization	Ross Willoughby (member)
AG-6	Green Book – Transformer Procurement	Tara-Lee Macarthur (secretary)
AG-6	Green Book – Transformer Procurement	Ross Willoughby (member)

9. Membership of the Australian Panel

Name	Organisation	Type
Seamus Allan	Dynamic Ratings	Supplier
Kenneth Budin	Budin Philipp	Consultant
Kris Bryla	Origin Energy	Generator
Mark Cotton	AusNet Services	Transmission
Santosh Dhakal	TasNetworks	Transmission
Carlos Gamez	Western Power	Transmission
Lagath Ganepola	Powerlink Queensland	Transmission
Matthew Gibson	Ausgrid	Distribution
Wenyu Guo	Omicron Electronics Australia Pty Ltd	Manufacturer / Contractor
Ray Holzheimer	Transformer Innovation Centre	University
Michael Jordanoff	Transpower NZ	Transmission
Robert (Yi) Li	TransGrid	Transmission
Tara-Lee Macarthur	Energy Queensland	Distribution
Deepak Maini	Wilson Transformer Co. Pty Ltd	Manufacturer
Robert Milledge	ABB Australia Pty Limited	Manufacturer
Sam Mulquiney	Essential Energy	Distribution
Peter New	Snowy Hydro	Generator
Shawn Nielsen	Queensland University of Technology	University
Phil Onions	Stanwell Corporation Ltd	Generator
Jude Perera	Endeavour Energy	Distribution
Arne Petersen	AP Consulting	Consultant
Peter Scoles	SA Power Networks	Distribution
Marko Prokic	ElectraNet	Transmission
Tapan Saha	University of Queensland	University
Thomas Smolka	Reinhausen Australia	Manufacturer
Tri Van Tran	AGL	Generator
Joe Tusek	Ampcontrol ETM	Contractor
Walter Wasinger	Wasinger Transformers	Consultant
Kerry Williams	K-BIK Power Pty Ltd	Consultant
Ross Willoughby	Individual member	Consultant
Vacant*	GE Grid Australia Pty Ltd	Manufacturer / Contractor

*Ross Willoughby, representing GE Grid Solutions, took a redundancy on 31 July 2020. There has been no replacement nominated by GE to date. Ross, the AU A2 convener, continues his involvement as an individual member of CIGRE.

The NGN Liaison allocated to AU A2 is Mrs Sanika Willard of Cutler Merz.

Convener: Ross Willoughby
Email: willoughby.ross@icloud.com
Phone: 0417 712 879

AU A3 Transmission & Distribution Equipment

1. 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.

2. Specific Activities of the Study Committee

The study committee has a strategic plan which 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
- Answer the environment concerns
- 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:

Prepare strong and smart power systems of the future

- WG A3.31: NCIT with digital output

Making the best use of existing equipment and system

- WG A3.30: Overstressing aspects of substation equipment
- WG A3.36: Multi-physic simulation for temperature rise test
- WG A3.28: Capacitor switching and transmission and distribution systems
- 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.

Answer the environment concerns

- WG A3.41 Interrupting and switching performance with SF6 free switching equipment

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 and 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 A3.30 Substation equipment overstresses.

In addition to classical, condition based, end of life considerations, a specific aspect of lifetime management is the possibility that, during its operational lifetime, equipment becomes subject to system conditions which exceed its (proven) capabilities; often termed (potential) overstressing. The proposed Working Group will review this aspect concerning end of life decision making as it applies to high voltage substation equipment. This working group completed its activities in 2020 and the brochure was published in September as TB 816.

WG A3.31 Accuracy, Calibration & Interfacing of Instrument Transformers with Digital Outputs.

The use of digital output for ITs (magnetic or electronic) requires development & adaptation of the accuracy testing procedures and the development of appropriate methods for in factory and on-site calibration which may become more frequent with the deregulation of electric power companies. The redundancy of various equipment and links will also need to be considered to achieve the high reliability and availability levels required for a modern electrical network. This accuracy testing & calibration activity is the main focus of this Working Group. An Electra article is to be the outcome of this working group hopefully due to be published in late 2020.

WG A3.36 Application and Benchmark of Multi Physic Simulations and Engineering Tools for Temperature Rise Calculation

This working group will study a benchmark of multi-physics simulation and simplified engineering tools to predict temperature rise tests, describing the state of the art techniques regarding MV and HV switchgears and defining the critical parameters that affect the accuracy of thermal modelling. It will also show the benefits of simulation, whilst benchmarking more simplified tools, which can be used by non-experts and are adjusted by tests or advanced simulation techniques. The brochure is expected in late 2020.

WG A3.38 Capacitor switching in distribution and transmission systems.

This working group is investigating the long term field experience of shunt capacitor bank switching focusing on MV switchgear comparing with the expeience of HV switchgear. The WG is collecting information on alternative capacitive switching devices, filter bank applications and experience with vacuum devices (MV) and SF_6 devices (HV) separately. The TB was published in September 2020 as TB 816. This working group completed its activities in 2020 and the brochure was published in September as TB817.

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 December 2020.

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 A3.41 Interrupting and switching performance with SF_6 free switching equipment.

This working group will collect available interrupting and switching performance data with different SF_6 free gas alternatives, and evaluate the expected lifetime and consider long term stability and impact on the maintenance works related to switching. It will review the advantages and disadvantages of all SF_6 free solutions in comparison with the state of the art solution based on SF_6. The final brouchure will provide a guideline to utilities to keep in mind which factors when they use SF_6 free gas as an alternate solution. The final report is due in 2021.

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 2022.

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 2022.

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 2022.

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.

3. Preferential Subjects

The A3 preferential subjects for 2020 Paris Session were:

- Development of Transmission and Distribution equipment
  - DC equipment
  - Measure to improve reliability
  - Developments of equipment with less environmental impacts
  - SF6 alternatives for switching and isolation
- Lifetime management of Transmission and Distribution equipment

- Diagnostics and prognostics / monitoring of equipment
- Influence of environmental and operating conditions
- Experience and countermeasures for overstresses and overloads

- Impact on Transmission and Distribution equipment under the introduction of renewables, distributed generation and storage
  - New switching devices and emerging equipment
  - Incorporation of intelligence into the equipment
  - Impacts or RES / DER and energy storage on equipment requirements

4. Proposed New Working Groups

During the A3 Study Committee meeting held as part of the Paris eSession, a call for new working groups was made by the study committee chairman.

5. Specific Activities of the Australian Panel

Australian Panel A3 members have decided to continue focus on the following key areas in 2020-21 period:

- **SF_6 gas management –** Provide practical information on design factors which contribute to SF_6 leakage for high voltage equipment from a practical experience perspective. Provide information on techniques to detect SF_6 gas leakage and mitigation techniques. Review current practices for the different utilities with regards to leak repairs.
- **Adoption of new equipment technology in Australia and New Zealand** – Evaluate processes, procedures and impediments to adoption of new technology and collaborate on evaluation of key new technologies for adoption and leverage outcomes for all members. The idea is share information from leading innovators and gain from learnings from early adopters of technology for mutual benefit.
- **Asset based condition scoring and assessment of probability of failure for risk assessments** – Evaluate methods used for health and condition scoring and associated likelihood of failure assessments, Evaluate ageing models and their application for assessment of likelihood of asset failure. Provide guidance to AP A3 members on options for asset-based condition scoring and assessment of probability of failure for risk assessments.
- **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

6. Invitations for SC or WG's to meet in Australia

Currently there is no intention for the A3 Study Committee to meet in Australia. The next non-Paris year study committee meetings will be held in Russia (2023). As there is limited AP-A3 involvement in existing working groups, it is not likely that working groups will be holding meetings in Australia due to the travelling distances involved, and increased use of online meeting platforms.

7. ANC Members on Working Groups

The following are all the current AP representatives on 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
A3.46	Generator circuit breakers: review of application requirements, practices, in-service experience and future trends	Munyaradzi Chadilwa

8. Membership of the Australian Panel

Name	Organisation	Type
Wayne Pepper (convenor)	Ausgrid, NSW	Distribution
Nandana Boteju	AusNet Services, VIC	Transmission & Distribution
Ankur Maheshwari	Western Power, WA	Transmission & Distribution
David Pita	Powerlink, QLD	Transmission
Matthew Ridgely	Energy Queensland, QLD	Distribution
David Roby	Hitachi-ABB, NSW	Vendor
Hitesh Parekh	Hitachi-ABB, NSW	Vendor
Robert Scott	TasNetworks, TAS	Transmission & Distribution
John Shann	Transpower, NZ	Transmission
Alan Tancin	GE Energy, NSW	Vendor
Andrew Wilkinson	Electranet, SA	Transmission
Mark Garrett	Essential Energy, NSW	Distribution
Kerry Williams	K-Bik Power Pty Ltd, QLD	Consultant
Charbel Antoun	Aurecon, NSW	Consultant
Harsh Gupta	AusNet Services, VIC	NGN
John Wright-Smith	AMSC	Vendor

Convener: **Wayne Pepper**

Email: **wpepper@ausgrid.com.au**

Phone: **0408 667 076**

AU B1 Insulated Cables

1. 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.

2. 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.

Within this framework additional specific areas of attention include:

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

3. Specific Activities of the Study Committee

The Study Committee (SC) meets annually with the most recent being on-line, in place of the Paris session in October 2020.

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 windfarms, 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 are not able 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,

Currently, SC B1 has 18 Working Groups, 2 Task Forces and 4 Joint Working Groups.

There are 535 experts working for the SC. It is believed that the last 10 years of activity within the B1 committee was the most important in the Insulated Cable Committee history.

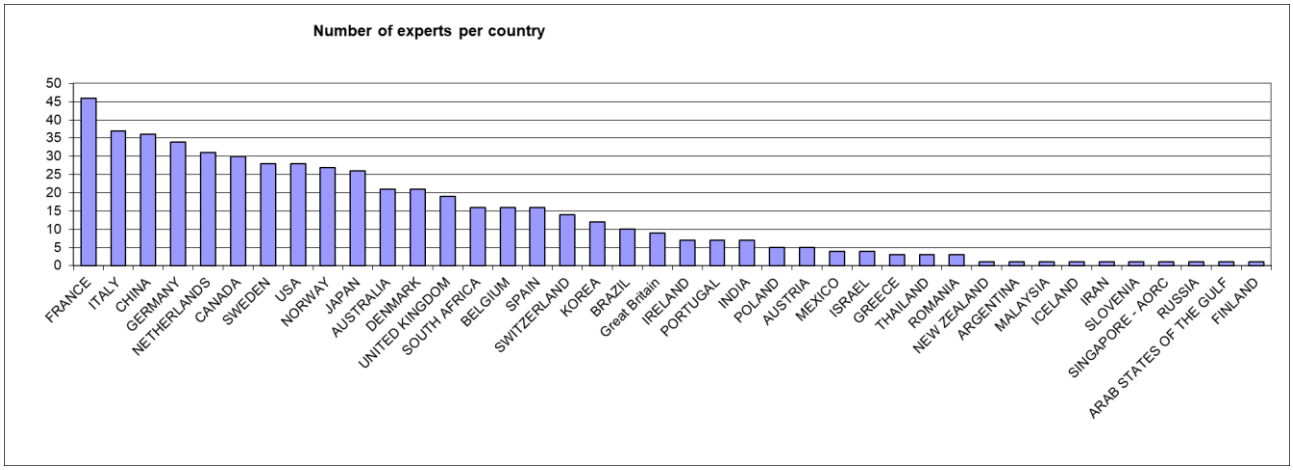
Overall SC B1 activities are very well attended with:

- All 43 SC members (29 regular and 15 observer) attended this year's SCB1 meeting.
- National Committees from the 24 represented countries have been very active during the year

4. Study Committee Statistics

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

In a more detailed analysis, the 535 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.

5. Preferential Subjects

The preferential subjects agreed 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

6. Working Group Reports

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

During 2020, the SC published the following tutorials

- B1.45 Thermal monitoring of cable circuits and grid operators' use of dynamic rating systems
- B1.48 Trenchless Technologies
- B1.52 Fault Location on Land and Submarine Links (AC & DC)

The following tutorials are in progress

- B1.44 Guidelines for safe work on cable systems under induced voltages or currents
- B1.46 Conductor Connectors: Mechanical and Electrical Tests
- B1.50 Sheath Voltage Limiters and Bonding Systems (Design, Testing, Operation and Monitoring)
- B1.54 Behaviour of cable systems under large disturbances (earthquake, storm, flood, fire, landslide, climate change)
- B1.57 Update of Service Experience of HV underground and submarine Cable Systems
- B1.60 Maintenance of HV Cable Systems

7. Proposed New Working Groups

Currently there are three new working groups and four new task forces proposed for SC B1. They are:

Working Group	Title	Convener
JWG C3/B1.24	Environmental impact of decommissioning of underground and submarine cables	To be defined, from SC C3
WG B1.76	Enhancing Quality Assurance/Quality Control Procedures for (E)HV Cable Systems	Christian Freitag (DE)
WG B1.80	Guidelines for Site Acceptance Test of DTS and DAS systems	Sudhakar Cherukupalli (CA)
Task Force	**Title**	**Convener**
TF B1.81	How to have statistics every 2 years	Soren Mikkelsen (DK)
TF B1.82	MV DC cables topics	Shoji Mashio (JP)
TF B1.83	Grounding aspects for long HVDC land cable connections	Benjamin Pailler (FR)
TF B1.84	Update of IEC 60853 (cyclic and emergency current rating of cable) and IEC 62095 (Finite element method - current rating)	James Pilgrim (GB)

8. Specific Activities of the Australian Panel

The Australian Panel held its annual meeting in Sydney in October 2019, hosted by Transgrid. Twenty-eight (out of a total of 33) AU B1 members (or their representatives) were able to attend, along with five guests including two NGN members. The meeting was held over two days and gave the opportunity for each member of the panel to make a short presentation on "what's happening in my patch". As can be seen from the included members' list, the panel has a wide variety of experience which leads to a very healthy discussion around many topics. There is a significant need to educate Australians in all aspects of insulated cables and to this end, a planned cable seminar was discussed. It was envisaged that, as a trial run, a 'lite' seminar would be held in NZ directly following our AGM in Wellington NZ. However, as the year unfolded and the Covid19 pandemic took hold of the world, our plans quickly changed to hold some on-line tutorials on a limited range of subjects in an attempt to disseminate the information to the industry. At the time of writing, we have held 2 webTutes to cover cable design, accessory design, safety in design, thermal rating calculations and backfill materials. These have been well received by the industry.

In May 2020 we held our first on-line panel meeting, which lasted for 2 hours. This provided an opportunity to hear from our Working Group and Task Force members as to their activities.

AU B1 is a strong group of experienced, well educated, some expert, people in the field of insulated cables.

At the time of writing, a 2nd on-line meeting is planned.

9. 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 SCB1, SCC4, SCC5, SCC6 and SCD2 will be attending and possibly SCB5.

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.

10. AU B1 Members currently on Working Groups

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

Working Group	Title	AU / NZ Representative
WG B1.54	Behaviour of cable systems under large disturbances (earthquake, storm, flood, fire, landslide, climate change) Final report expected Q4 of 2020.	Richard J.
WG B1.57	Update of service experience of HV underground and submarine cable systems	Carmelo N.
WG B1:58	Asset Management in MV Cables Networks	Dave L.
WG B1:60	Maintenance of HV Cable Systems	Joska F.
WG B1:61	Installation of HV Cable Systems	Peter R.
WG B1.67	Loading pattern on cables connected to windfarms	Kerry P.
WG B1.68	Condition evaluation and lifetime strategy	Rob B.
JWG B1/C4.69	Recommendations for the insulation coordination on AC cable systems	Tony A.
WG B1.71	Guidelines for safety risk management in cable system	Carmelo N.
WG B1.72	Cable ratings verification (2nd part)	David S.
WG B1.73	Recommendations for the use and the testing of optical fibres in land cable systems	Graeme B
JWG B1/B3.74	Recommendations for a performance standard of insulated busbars	David Platt
JWG D1/B1.77	Strategies and tools for corrosion prevention for cable systems	Tony A
JWG C3/B1.24	Environmental impact of decommissioning of underground and submarine cables	Michelle English
WG B1.76	Enhancing Quality Assurance/Quality Control Procedures for (E)HV Cable Systems	Peter New
WG B1.80	Guidelines for Site Acceptance Test of DTS and DAS systems	Jeffery Cairns
TF B1.81	How to have statistics every 2 years	Andre Cuppen
TF B1.82	MV DC cables topics	Craig Harrison

11. Membership of the Australian Panel as at November 2020

Name		Position	Organisation	Type
Russell	Wheatland	Convener	AusNet Services	Utility
Peter	Robinson	Secretary	Cable Systems Engineering	Consultant
Tony	Auditore	Representative	Voltoni Limited	Consultant
Ken	Barber	Representative	Istanapark P/L	Consultant
Graeme	Barnewall	Representative	Essential Energy	Utility
Evan	Bayliss	Guest	Snowy Hydro	Utility
Neil	Bennett	Representative	TransGrid	Utility
Rob	Bradley	Representative	Ausgrid	Utility
Peter	Butterfield Rossi	Representative	ElectraNet	Utility
Jeffree	Cairns	Representative	Transgrid	Utility
Phillip	Coughlan	NGN	Level Crossing Removal Project	Service
Andre	Cuppen	Representative	Unison Networks	Utility
Michelle	English	Representative	Western Power	Utility
Dean	Farrar	Representative	LS Cables & Systems	Manufacturer
Joska	Ferencz	Representative	Basslink	Asset Owner
Steve	Frazer	Representative	SA Power Networks	Utility
Jarad	Hughes	Representative	TasNetworks	Utility
Mark	Jansen	Representative	Powercor Network Services	Utility
Richard	Joyce	Representative	Transpower	Utility
Seong Woo	Ju	Representative	Taihan	Manufacturer
Henry	Kent	Representative	Energy Action	Consultant
Dong-Churl	Lee	Representative	Select Solutions	Service Provider
Albert	Majadire	Representative	Prysmian Group	Manufacturer
David	Mate	Representative	Endeavour Energy	Utility
Nic	Moffa	Representative	Protop Engineering Service	Consultant
Peter	New	Representative	Snowy Hydro Ltd	Utility
Carmelo	Noel	Representative	Energy Queensland	Utility
David	Paul	Representative	Vector Ltd.	Utility
Colin	Peacock	Representative	Pavocon	Consultant
Tim	Popkiss	Representative	Intertech Engineering	Consultant
Kerry	Prickett	Representative	UDCS Consulting	Consultant
Naveed	Rahman	Representative	Nexans / Olex	Manufacturer
David	Spackman	Representative	Spackman Consulting	Consultant
Eddie	van der Draai	Representative	Powerlink	Utility
Yohan	Weerasinghe	Representative	Cablegrid	Utility

Convener: **Russell Wheatland**

Email: russell.wheatland@ausnetservices.com.au **Phone:** **0418 175 590**

AP B2 Overhead Lines

1. Study Committee Scope

The CIGRE Study Committee (SC) B2 Overhead Lines Terms of Reference (ToR) is to study:
The design, construction and operation of overhead lines including the mechanical and electrical (in cooperation with SC C3 and SC C4) design of line components (conductors, ground wires, insulators, accessories, structures and their foundations), validation tests, the study of in-service performance, the assessment of the state of line components and elements, the maintenance, the refurbishment as well as upgrading and uprating of overhead lines.

2. Specific Activities of the Study Committee

The SC consists of a number of advisory and working groups.

- Strategic Advisory Group (SAG) reviews SC performance and develops strategy for future direction of the SC; reviews/endorses proposed ToR for publications; and General Session preferential subjects are critiqued and new WG's approved.

- Customer Advisory Group (CAG) reviews customer survey to assess the introduction of customer suggested study activities and to ensure alignment with these activities. The ToR for new WG's are reviewed by the CAG and relevant TAG, and recommended to the SC.

- Four Technical Advisory Groups (TAG) to assist in the coordination of new Working Groups (WG), oversees progress on publications and review content of proposed tutorials.

Australia has maintained its membership on the SAG and CAG, and in 2018 gained the position of TAG07 convenor.

SC/TAG Convenors & Australian membership as at October 2019 are:

Committee	Position		AU Members
SAG	**SC Chairman** **SC Secretary**	Herbert Lugschitz (Austria) Wolfgang Troppauer (Austria)	John McCormack
CAG	**Convenor**	Zibby Keiloch (Canada)	John McCormack
TAG04 Electrical Performance	**Convenor**	Javier Iglesias (Spain)	John McCormack
TAG05 Tower, Foundations and Insulators	**Convenor**	Joao Da Silva (Brazil)	John McCormack
TAG06 Mechanical Behaviour of Conductors & Fittings	**Convenor**	Pierre Van Dyke (Canada)	Peter Dulhunty John McCormack
TAG07 Asset Management, Reliability, Availability	**Convenor**	John McCormack	Peter Dulhunty Robert Lake Ahsan Siddique Asif Bhanghor Nathan Spencer Michael Lee

SC Activities in 2020 include

- Paris convention on-line, Aug 2020
- 3 new WG's established
- 9 new ToR under consideration (including one proposed by the AP).
- TB publications (see appendix A)

3. Preferential Subjects

PS 1 Challenges & New Solutions in Design and Construction of new OHL

- Design for reliability, availability, future climate parameters, more frequent extreme loads, design against theft, vandalism, terrorism
- AC/DC Hybrid Lines, multi-purpose utilization (e.g. renewables, telecommunication)
- OHL challenging construction projects: multiple circuits lines, high towers, long spans, heavy wind and ice, high altitudes, geology, access to site, no proper machinery, long lines and variation in reliability criteria etc.

PS 2 Latest Techniques in Asset Management, Capacity Enhancement, Refurbishment

- Preparedness and countermeasures for natural disasters and other emergencies
- Decisions of replacement based on monitoring, maintenance, operation, historical data
- Strengthening of existing lines to improve reliability, ampacity, lifespan

PS 3 Environmental and safety aspects from OHL (joint PS with C3?)

- Safety of workers in construction and maintenance of lines (equipment, methods, etc.)
- Reducing environmental impacts from new and existing OHL – for B2 and C3
- Reserved for C3 topic

4. New/Proposed Working Groups

New WG	Title	ANC Support	Target Complete	AUB2 Rep
JWG 76	Lightning Performance of OHL		2024	Anne Williams (WG member), Glen Stapelton (specialist)
WG 77	Risk Management of OHL	Convenor sponsorship	2024	Asif Bhangor (convenor), John McCormack
WG 78	Use of HT Conductor on new lines		2024	
WG 79	Enhancing OHL Rating Prediction by Improving Weather Parameters Measurements		2024	Josh Smith (WG member), Hoang Tong (specialist)
WG 80	Numerical Simulations of electric fields on AC & DC insulator strings		2024	
WG 81	Increasing Strength Capcity of Ex OHL Structures		2024	Raju Upadhyaya (WG member), Frank Salandra (specialist), Bing Lin, Farid Faiz, Frank Yao

Proposed WG	Title	ANC Support	Target Start	Proposed AUB2 Rep
	Emergency Restoration of OHL		2021	Bing Lin

	Live Work Safe Management Guidelines	WG member attendance	2021	John McCormack (WG member), Adrian Parker (external specialist)
	Ice on OHL		tbc	Brett McKillop
	Audible Noise of OHL		tbc	Jitesh Raniga
	Foundations for Difficult Soils		tbc	Frank Yao, Graeme Paterson
	Safety management for OHL	Convenor Sponsorship	2021	John McCormack (convenor)

5. Australian Panel Activities Report 2020

i) General

- Annual Panel Meeting & "Asset Management" case studies
- Distribution/review ToR, WG surveys,
- Nomination of WG & CM members to 4 of 6 new B2 WG's
- Support of WG convened by AUB2 members
- Interaction with AORC
- Continuing engagement with distribution utilities for increased involvement
- Continuing engagement with research facilities for involvement opportunities
- Participation & interaction with NGN
- Nomination of reviewers for 3x draft TB's

ii) Future Activities:

- 2021 Panel meeting - Western Power, Perth
- 2022 panel meeting, Power & Water, Alice Springs (tbc)
- 2023 panel meeting, Energy Qld, Cairns (combine with I/N SC meeting)
- AORC on-line, 2020 Nov
- SCB2 2021 June, Slovenia
- SCB2 2022 August, Paris
- SCB2 2023 Japan
- Proposal to engage with Asset Management Council & OHL Asset Managers postponed due to COVID 19 constraints

6. AUB2 2020 Meeting Report

- 4x 3 hour on-line panel meetings
- 1x closed meeting for panel members only
- 3x open meetings; Total attendance including guests – over 60 persons
- Guests from NZ, South Africa, Japan and Bangladesh.
- Open meetings comprised WG reports and a total of 15 presentations & case studies from panel members/guests.

7. Invitations for SC or WG's to meet in Australia

Nil

8. AUB2 Members on Working Groups

WG	Title	Australian Convenor	WG Members	Reviewer	CM
WG40	WG B2.40 Calculations of the electrical distances between live parts and obstacles for OHL : Preparatory studies for revision of IEC standard (IEC61865 –IEC60826 – EN50341)	Robert Lake (NZ)			John McCormack
WG50	WG B2.50 Safe handling of fittings and conductors	Peter Dulhunty (Australia)			
WG57	WG B2.57 Survey of operational Composite Insulator Experience and Application Guide for Composite Insulators				Steve Redhead
WG58	WG B2.58 Vibration Modelling of High Temperature Low Sag conductors - Self damping characterization			Sarah Sun	Jack Roughan
WG59	WG B2.59 Forecasting Dynamic Line Ratings			Brent McKillop	Michael Lee
WG60	WG B2.60 Affordable Overhead Transmission Lines for Sub-Saharan Countries		Michael Lee		Elias Elkoury
WG61	WG B2.61 Transmission Line Structures with Fibre Reinforced Polymer (FRP) Composites		Francis Lirios	Peter Dulhunty	Asif Bhangor Tony Gillespie
WG62	WG B2.62 Design of Compact HVDC Overhead Lines				Asif Bhangor
WG63	WG B2.63 Compact AC Transmission Lines				
WG64	WG B2.64 Inspection and Testing of Equipment and Training for Live-Line Work on OHL		Alexandra Price	John McCormack	Simon Leitch John Mc
WG65	WG B2.65 Detection, Prevention and Repair of Sub-surface Corrosion in OHL Supports, Anchors and Foundations				Elias Elkhoury

WG66	WG B2.66 Safe handling and installation guide for high temperature low sag conductors				Michael Wilson, Transpower
WG67	WG B2.67 Assessment and testing of wood and alternative material type poles	Nathan Spencer	Peter Dulhunty		Glen Ford
WG68	WG B2.68 Sustainability of Conductor & Fittings		Andrew Taylor (P&W), john Mak		
WG69	Coatings for Power Networks		Francis Lirios		
WG 70	Aerial Warning Markers		Jack roughan; Peter Dulhunty		sarah sun Glen Ford
WG 71	Inter-phase spacers		Sarah Sun, jack roughan, Indhran Pillay (specialist)		
WG 72 JWG D2	Condition Monitoring Of Overhead Lines In Uninhabited Areas		Rob Lake Stephen Brooks		
WG 73	Prevention of vegetation fires caused by OHL systems	Peter Dulhunty	Francis Lirios, John Mak David Mate, Grant Bailey (specialist), Trevor Blackburn Linden Bronleigh, Simon Ling (Western Power), Henry Hawes (specialist), Frank Crisci (SAPN - specialist), Glen Ford, Andrew Johnson (Energy QLD), Michael Lee Ian Flatley (Groundline), Abrar Aziz (Middleton Group), Martin van der Linder (Noja)		Greg Chapman
WG 74	UAV for maintenance of OH distribution lines		John Mordacz (Energy Qld)		
WG 75 JWG C4	Guide for the application of insulated conductors on overhead MV & LV distribution lines				Linden Bronleigh

WG 76	Lightning performance and grounding of OHL		Anne Williams (aurecon)		J McCormack
			Glen Stapleton (PLQ)		
WG 77 JWG C1	Risk Modelling of OHL for Severe Weather Events	Asif Bhangor (Australia)	John McCormack, others tbc		
WG 78	Use of HT Conductor on new lines				
WG 79	Enhancing OHL Rating Prediction by Improving Weather Parameters Measurements		Josh Smith (Enet) Hoang Tong (transgrid)		
WG 80	Numerical Simulations of electric fields on AC & DC insulator strings				
WG 81	Increasing Strength Capacity of Ex OHL Structures		Raju Upadhyaya (WG member) Frank Salandra CPP (Spec)		Bing Lin, Farid Faiz, Frank Yao

9. AUB2 Members

Company	Name	Surname	Panel Role	type
AECOM	Iqbal	Kalsi	member	consultant
APD	Frank	Yao	secretary, NGN rep	consultant
Aurecon	Steve	Redhead	member	consultant
Aurecon	Anne	Williams	specialist	consultant
Ausnet	Francis	Lirios	member	utility
Ausnet	Asif	Bhanghor	member	utility
Beca	Farid	Faiz	member	consultant
	Gary	Brennan	past panel convenor	consultant
Downer	Graeme	Paterson	member	contractor
Dulhunty Poles	Peter	Dulhunty	member	supplier
Dulhunty Poles	Phillip	Dulhunty	member	supplier
ElectraNet	John	Mcormack	convenor	utility
ElectraNet	Raju	Upadhyaya	specialist	utility
ElectraNet	Josh	Smith	specialist	utility
Endeavour Energy	David	Mate	member	utility
Eneregy Qld	Steve	Brooks	member	utility
Eneregy Qld	John	Mordacz	member	utility
Energy Qld	Alex	Price	NGN rep	utility
Essential Energy	Damien	Lloyd	member	utility

Gillespie Power Consultancy	Tony	Gillespie	member	consultant
Hydro Tasmania	vacant			utility
Jack ROUGHAN	Jack	ROUGHAN	member	supplier
Jacobs	Ahsan	Siddique	member	consultant
Jacobs	Bing	Ling	NGN rep	consultant
Ken Barber	Ken	Barber	B1 rep	consultant
Michael Lee	Michael	Lee	member	consultant
(URI Engineering)	Nathan	Spencer	member	consultant
Prysmium	vacant			supplier
PSC	Robert	Lake	member	consultant
PLQ	Alan	Delac	member	utility
PLQ	Glen	Stapleton	member	utility
PWC	Michael	Murtagh	member	utility
PWC	Andrew	Taylor	proxy member	utility
Sarah SUN	Sarah	Sun	member	supplier
TasNetworks	Brent	McKillop	member	utility
Transgrid	Robert	Alcoro	member	utility
Transgrid	Hoang	Tong	specialist	utility
Transgrid	Sanu	Maharaj	guest	utility
Transpower	Simon	Leitch	member	utility
Transpower	Michael	Wilson	member	utility
UGL	Elias	Elkoury	member	consultant
Western Power	Linden	Bronleigh	member	utility
WSP Australia	Conor	Reynolds	member	consultant

Convener: **John McCormack**
Email: **mccormack.john@electranet.com.au**
Phone: **0418 400 866**

AP B3 Substations and Electrical Installations

1. 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.
Specific Activities of the Study Committee

During Paris 2020 the SC. B3 activities included:

- Tuesday the 25th of August 2020: Annual Committee Meeting;
- Wednesday the 26th of August 2020 Tutorial: Guidelines for Safe Works Methods in Substations;
- Thursday the 02nd of September: Paper Sessions

2. SC Activities in 2020 Include

- 7 Working Group (WG) Meetings:
- B3 Annual **Study Committee Meeting**, in Chengdu China
- B3 **Poster Session,** 35 posters displayed: 484 visitors
- AP. B3 Substation Conference – Hobart Nov 2019
- Chairing IEEE Power and Energy Society in Victoria
- Contribution to IEEE standards: Earthing and Lightning

3. Activities in the Existing and the New Working Groups

SC. B3 has 19 active WG's, with 4 recent Technical Brochures

- 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
- Crina Costan is currently providing a review of the draft document
- 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 Correspondent 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 Generator Circuit Breaker
- Crina Costan is a member of this working group
- WG. B42: Reliability Analysis and Design Guidelines for LV AC Aux Systems
- AP. B3 is currently preparing some documentation proposed to be included in this new TB.

4. Australian Panel Activities Report

Year 2020 Panel Activities Include:

- Technical Seminar held on the 28th of May 2020, over 50 people attended via MS Teams
- Active participation in the SC B3 initiatives
- Distribution of ToR, WG surveys, and draft TB for review
- Nomination of WG & CM members
- Support of WG convened by APB3 members
- Contributions and members to IEEE panels
- Continuing engagement with distribution utilities for increased involvement
- Encourage participation & interaction with NGN
- Two-day AP.B3 annual meeting on the 25th and the 26th of November conference in Hobart
- Two task force teams created at the beginning of June 2020. Included members from AP.A3
- The papers and recommendations are planned to be available at the end of November 2020

Future Activities: Australian Panel – 2020

The goal for next year is to interact more with the other Australian CIGRE panels;

Exploring the potential for anew substation conference in Nov 2021.

Future Activities: SCB2 & International Symposiums

- Centennial Session 2021 in Paris, France: 22 August

Other Future B3 relevant events:

- Symposium 2021 in Ljubljana, Slovenia: 1-4 June;
- Joint Colloquium 2021 in Bucharest, Romania with A2: 11-15 October;
- WORKSPOT 2021 in Parana, Brazil: 21-24 November;
- 2022 Symposium in Kyoto, Japan: 3-8 April 2020.

5. Membership of the Australian Panel

There are 31 members

We have one NGN member

Our members come from the following fields:

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

	Name	Company
1.	Alan Crombie	UGL
2.	Alan Goodridge	Peracon
3.	Andy McMahon	Transpower
4.	Andreas Laubi	Jacobs
5.	George Bergholcs	ElectraNet
6.	Evan Stevenson	Endeavour
7.	Doug Ray	Vector
8.	Mark Hibbert	Aurecon
9.	Michael Verrier	TasNetworks
10.	Ping S Wang	GE Grid
11.	Simon Hickey	Energy Queensland
12.	Stephen Palmer	Safearth
13.	Peregrine Tonking	Horizon Power
14.	Terry Krieg	Powernetwork Consulting
15.	Chris Gonzalez	Siemens
16.	Wu Hang	Aecom
17.	Jeremy Kearney	Entura
18.	Mark Pritchard	SA Power Networks
19.	Evan Lamplough	Transgrid
20.	Dasgupta Raj	NT Water & Power
21.	Malcolm Busby	WSP
22.	Anurag Gupta	GHD
23.	Mark Burns	Office of Technical Regulator
24.	Marco Surace	Western Power
25.	John Szmalko	Jacobs
26.	Joseph Pinheiro	Powerlink
27.	Hao Tian	ABB
28.	Chris Grinter	AusNet
29.	Crina-Miana Costan	TS Consulting
30.	James Warr	CPP
31.	Daniel Stafford	NGN - Jacobs

Convener: **Crina-Miana Costan Principal Engineer at Tudor Solutions Pty Ltd**

Email: costan.crina@electranet.com.au;

crina.m.costan@gmail.com;

AU B4 DC and Power Electronics

1. 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.

2. Specific Activities of the Study Committee

The study committee activities include following:

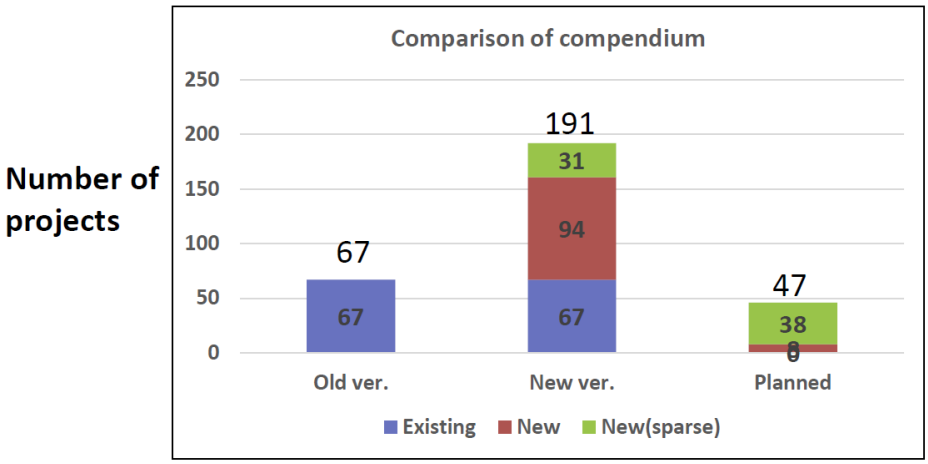
- PS1: HVDC systems and their applications:
  - Planning and implementation of new HVDC projects including need, justification, design, integration of renewables, environmental and economic assessment
  - Application of new technologies including cyber security and advanced controls to address emerging 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 December 2020.
- 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 December 2020.
- 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 2020.
- 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 December 2020.

- Figure 1 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 1 - Comparison of Content - Old vs New Compendium



3. Preferential Subjects

The preferential subjects for the 2020 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.

4. Proposed New 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.

A number of new working groups were created during 2020:

- Power Electronics-Based Transformer Technology, Design, Grid Integration and Services Provision to the Grid
- STATCOMs at Distribution Voltages – John Wright-Smith, Convenor!
- Operation and Maintenance of HVDC Facilities – Les Brand, Convenor!

5. Specific Activities of the Australian Panel

Key activities of the AU B4 panel during 2020 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 2020 technical session.

6. Meeting Report: Australian Panel

The Cigre AP B4 - HVDC and Power Electronics 2020 Annual Meeting eSession was held Thursday 29th October, 2020.

18 out of 19 members attended the meeting.

Location: Microsoft Teams eSession Meeting

No	Topic	Approx. Time
1	Introduction and Welcome – John W-S Teams host	08:30
2	Minutes of the Previous APB4 Meeting, Queenstown, 2019	08:30 – 09:00
3	Action items from APB4 Meeting, Queenstown, 2019	09:00 – 09:30
4	Review of AP B4 membership • New Members • Update Membership List	09:30 – 09:45
5	Report and Update on SC B4 • SCB4 Working Group Activities • SCB4 Annual Meeting - Outcomes • New Working Groups • Green Books	09:45 – 10:30
	Coffee Break (15 mins)	**10:30 – 10:45**
6	AP B4 Activities • Australian Panel contributions to SC B4 Working Groups • NGN Update • Webinars	10:45 – 12:00
	Lunch and break (30 minutes)	**12:00 – 12:30**
7	ANC/ATC Update	12:30 – 12:45
8	Member Presentations (20 mins each) – expect 9	12:45 – 14:30
	Coffee Break (15 mins)	**14:30 – 14:45**
8	Member Presentations (20 mins each) - continued	14:45 – 16:00
9	Closing / Recap Actions • Next year's APB4 meeting - Location, Format, Site Visit, Hosting • Ideas for AP B4 activities • Any other business • Conclusions	16:00 – 16:30
10	Closing Remarks	16:30 – 16:45

7. Invitations for SC or WG's to meet in Australia

In the Paris 2020 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 will take a vote during the Paris 2020 Study Committee meeting.

8. 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

9. 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
Erica Twining	Ausnet Services	Transmission/ Distribution

Name	Organisation	Type
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: 0488 200 458

AU B5 Protection & Automation

1. 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.

2. 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 2020 Paris e-session paper presentations.

1. Human aspects in Protection, Automation and Control (PACS)
2. Communication network in Protection, Automation and Control (PACS): Experience and challenges

25 B5 Working Groups and 1 Green Book are active.

3. Preferential Subjects

Preferential Subjects for 2022 Paris France

1. Mitigation Strategies and Methodologies to Manage the Impact of Low-inertia and Low Fault Level Networks
2. Applications of Emerging Technology for PACS

4. Proposed New Working Groups

During the 2020 SC B5 meeting three new working groups were proposed:

1. PACS Lifecycle Documentation
2. Process Bus Based Busbar Protection
3. Architecture, Standards and Specification for Metering System in a Digital Substation/PACs Environment

During 2020 the following CIGRE Australia corresponding members were accepted for the following recently created working groups:

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)

5. Specific Activities of the Australian Panel

Despite the 2020 Covid global and national situation, the panel has progressed with activities in 2020 - albeit in a different way or in a different format. Over the year panel membership has grown from 29 to 36.

Panel Working Group and Green Book Contributions:

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

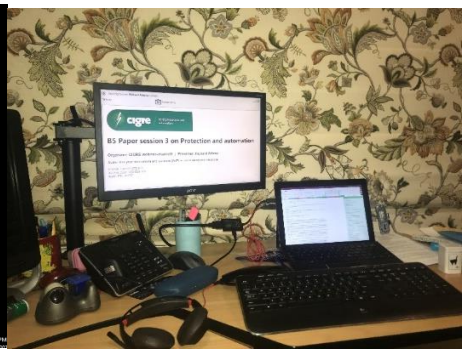
The AU B5 convenor is also convening the SC B5 Green Book on IEC 61850 Principles and Applications to Electric Power Systems. Four online web meetings were held in 2020 where lead chapter writers for all chapters have been confirmed and chapter content is being developed with the aim of completion by August 2021.

Condensed On-Line Panel Meeting in June and Update in December:

A condensed annual panel meeting was held in June and concentrated on introducing new members, discussing the changed situation under Covid-19, planning for the SEAPAC conference and other panel activities during 2020/21. An end of year panel update presentation with questions and answers was also held on 2 December.

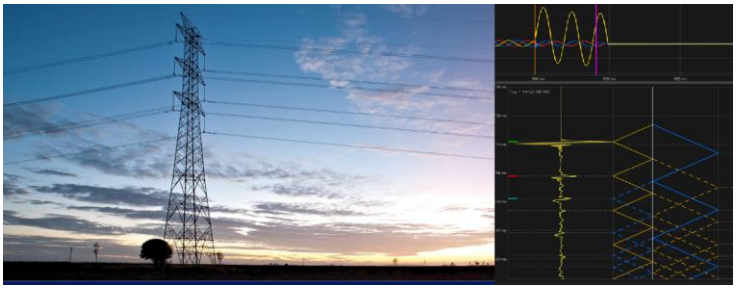
2020 Paris E-Session Presentation from AU B5 Members:

AU B5 members Satendra Bhola and Ritesh Bharat drafted a paper and presented it at the 2020 Paris e-session. It was titled ‘Common Errors and Traps in Design, Testing and Commissioning of Protection and Control Schemes’ and was associated with the very relevant preferential subject of Human aspects in Protection, Automation and Control. The AU B5 convenor attended the online 2020 Paris e-session and presented a summary of highlights at a November AU B5 panel end of year update video conference meeting.



Joint November AU B5/NGN Webinar Presentation:

Normally at the annual panel meeting there are a number of local presentations relating to aspects such as learnings from recent protection operations or application of new protection systems. This year it was decided that panel members could volunteer to give a local presentation by Webinar to a wider audience. On 17 November a joint AU B5/NGN local presentation Webinar by AU B5 member Bruce Capstaff highlighted Powerlink's travelling wave fault location implementation experience.



In the Loop Article Contribution relating to Cyber Security Technical Brochures:

Four technical brochures associated with SC B5 were published over the last year. This included a brochure on Cyber Security requirements for PACS and the resilience of PAC architectures. This topic is very relevant for Protection & Automation Engineers in Australia and New Zealand. AU B5 and D2 Convenors assisted in drafting an associated article for the September edition of the CIGRE Australia 'In the Loop' newsletter.

SEAPAC 2021 Conference Planning:

Every second year the panel organises the South East Asia Protection, Automation and Control (SEAPAC) Conference. The next conference is due in 2021. A panel survey was conducted on options for the 2021 conference and an organising committee was established. With the changing situation and a preference for a face to face conference, a decision will be made in February on holding the conference later in 2021.

Support to CIGRE NZ in forming a NZ B5 panel:

During 2020 the AU B5 panel convenor helped support the CIGRE NZ national committee in their request to form a complementary NZ B5 panel. After two formation meetings there is active interest on sharing local issues from many NZ distribution and generator utilities and panel systems are being set up.

Online AU B5 KMS Space Sharing:

The panel also continued to use the CIGRE Knowledge Management System (KMS) on the AU B5 panel space to share knowledge and experience on different protection topics.

6. Meeting Report: Australian Panel

A condensed 2020 Australian B5 panel meeting was held via web meeting on 10 June 2020. 18 members attended. 5 new members were welcomed to the panel. Changes to CIGRE international activities such as the Paris 2020 session were explained. There was discussion on future panel activity, including plans and options for the SEAPAC 2021 conference.

An end of year panel update video conference presentation and question & answer session was held on 2 December. This presented highlights from the 2020 Paris e-session, explained outcomes from the August online SC B5 meeting and updated the panel on several other activities.

7. Invitations for SC or WG's to meet in Australia

A face to face SC B5 Green book milestone meeting was planned for March 2020 in Sydney. However, this was cancelled just before the event due to the Covid-19 situation. A Goto web meeting was held instead.

8. 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
B5.50	IEC 61850-based Substation Automation Systems – Expectation of Stakeholders and User Interaction	Ian Young
B5.51	Methods & Application of Remotely Accessed Information for SAS Maintenance and Operation	Taren Hobson
B5.52	Analysis and comparison of fault location systems in Substation Automation Systems	Darren Spoor (Full M)
B5.56	Optimization of Protection Automation and Control Systems	Tuan Vu
B5.57	New challenges for frequency protection	Mitchell Eadie Chris Wembridge
B5.58	Faster protection and network automation systems: implications and requirements	Gavin de Hosson
B5.59	Requirements for Near-Process Intelligent Electronic Devices	Kevin Hinkley
B5.62	Life Cycle Testing of Synchrophasor Based Systems used for Protection, Monitoring and Control	Ritesh Bharat
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) Kevin Hinkley
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)
Green Book	IEC 61850 Principles and Applications to Electric Power Systems	Peter Bishop (Convenor)

9. 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
D Collins	Tesla Consultants NZ	Consultant
J De Wet	Jacobs	Consultant
G.Munting	Entura	Consultant
S Kerr	PSC	Consultant
M Doherty	GHD	Consultant
T Foxcroft	Power Test Services	Consultant
R Susanto-Lee	APD Engineering	Consultant
R Johnston	Essential Energy	Distribution
M Stanbury	Ausgrid	Distribution
R Coggan	Energy Queensland	Distribution
B Celic	SA Power Networks	Distribution
M Browne	Endeavour Energy	Distribution
R Anegondy	Evoenergy	Distribution
R Simpkin	United Energy	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	ABB	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
S Kumar	BHP	Manufacturer

Darren Scott from Ausnet is also on the panel as an NGN representative.

Convener: **Peter Bishop**
Email: **peter.bishop@transpower.co.nz**
Phone: **+6421408503**

AU C1 – Power System Development and Economics

1. 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.

2. 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; and
- Impact on system development of new solutions and technologies in fields such as generation and demand side management (DSM).

3. Preferential Subjects

The C1 preferential subjects agreed at the 2020 Paris summit focus on solving technical challenges that the power system of the future will have to overcome:

- PS1 - Power System Resilience Planning
- PS2 - Energy Sector Synergies for efficient decarbonization
- PS3 - Distributed Energy Resources in Transmission Planning

4. Proposed New Working Groups

Committee C1 has established four new working groups to commence in 2021:

- C1.45: Harmonised metrics and consistent methodology for benefits assessment in Cost-Benefit Analysis (CBA) of electric interconnection projects.
- C1/C4.46: Optimising power system resilience in future grid design.
- C1.47: Energy Sectors Integration and impact on power grids.
- C1.48: Role of green hydrogen in energy transition: opportunities and challenges from technical and economic perspectives.

5. Specific Activities of the Australian Panel

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

- Local initiatives
- Work to support the activities of the Study Committee
- Seminars or workshops held in 2020
- Proposed Seminars or workshops for 2021

6. Meeting Report: Australian Panel

Committee AP C1 met three times during 2020, face to face in early March, and twice via video conferencing.

As it was the first meeting of the year, as well as the first chaired by a new convener and with a number of new members, the March meeting focused on member introductions and work planning for the year ahead. Inspired by a number of C1 interest related presentations by members, such as:

- AEMO's Renewable integration study
- 2020 Draft Integrated System Plan
- Project Energy Connect progress update and planning
- Western Murray Zone renewable integration

AP C1agreed 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.

The AP C1 group welcomed a number of new members from GHD, EPEC, Jacobs, AEMO, and Western Power. With a present membership of 18, AP C1 has strong representation from across the Australian energy sector. Members with a strong generation background are still being sought to complement the expertise on transmission, distribution and renewables already present in the group.

A follow-up meeting held in August focused on preparation of the Paris summit and proposals for new working groups. One particular topic of interest to the members was that of power system resilience planning. A proposal for a new WG on this subject was prepared for submission to the Technical Committee in Paris late August. After discussion this was accepted and established as C1/C4.46. The same meeting was also used to discuss the final 2020 ISP in more detail amongst the members.

The last meeting of 2020 was held in October and used to discuss:

- The 48th Paris event, the new WGs proposed (see section 4) at the steering committee and participation in these.
- Focus areas and subjects of interest to C1 (see section 3).
- New members for the AP C1.

7. 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.

During September several members of the group supported or engaged with the CIGRE AU promoted ESIG Down Under[1]. Many of the presentations provided as part of the nine plenary and breakout sessions provided relevant and useful insights into the changing environment and interfaces of the transmission and distribution systems. The engagement showed the benefits of the CIGRE brand in promoting such events and the opportunities of engagement with the wider engineering and technology fraternity.

8. ANC Members on Working Groups

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

[1] https://www.aemo.com.au/initiatives/events/esig-down-under

WG	Title	Australian Member
C1.45	Harmonised metrics and consistent methodology for benefits assessment in Cost-Benefit Analysis (CBA) of electric interconnection projects.	none
C1/C4.46	Optimising power system resilience in future grid design.	Christian Schaefer Samantha Christie Bianca Christensen
C1.47	Energy Sectors Integration and impact on power grids.	Eli Pack
C1.48	Role of green hydrogen in energy transition: opportunities and challenges from technical and economic perspectives.	Herath Samarakoon Cameron Potter

9. Membership of the Australian Panel

Name	Organisation	Type
Christian Schaefer	AEMO (Convener)	System Operator
Brad Parker	ElectraNet	Transmission
Enrique Montiel	Powerlink Queensland	Transmission
Graeme Ancell	Ancell Consulting	Consulting
Jacqui Bridge	Powerlink Queensland	Transmission
YiSiang Ooi	AEMO (NGN Representative)	System Operator
Eli Pack	AEMO	System Operator
Julian Swartz	GSMT Consulting	Consulting
Christine Hill	TransPower	Transmission
Mark Parker	EPEC	Consulting
Herath Samarakoon	TasNetworks	Transmission
Athmi Jayawardena	GHD	Consulting
Donald Vaugh	Entura	Generation/Consulting
Mark Hibbert	Aurecon	Consultant
Glenn Carruthers	Western Power	Transmission
Stephen Hodgkinson	ETSE Consulting	Consulting
Matthew Webb	AusGrid	Distribution

Convener: Christian Schaefer

Email: christian.schaefer@aemo.com.au

Phone: 0428 867 171

AU C2 System Operations and Control

1. 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.

2. Specific Activities of the Study Committee

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

TD2 – System Operational Planning and Performance Analysis

TD3 – Control Centre Infrastructure and Human Resources for System Operation

Two papers were published in the CIGRE Science and Engineering Journal:

- System operational challenges from the energy transition (CSE17); and
- Power system operational resilience – what it means and where we stand (CSE18)

3. Preferential Subjects

Preferential subjects selected by the Study Committee for the 2020 Paris Session are:

1. Capabilities required for future system operation
2. System operation interfaces: improving observability and controllability
3. System operation challenges with increasing use of Distributed energy resources (joint with C6)

4. Proposed New Working Groups

A new Working Group (WG C2.18) has been established – Wide area monitoring protection and control systems – decision support for system operators.

Study Committee C2 is seeking input of ideas for the development of Terms of Reference for a new JWG on cyber security in power system operation.

5. 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;
- Presentation at the Major Disturbance Workshop at the 2020 Paris Session on the NEM multiple system separation event in August 2018;
- Three paper were presented at the 2020 Paris Session;
- Franco Crisci (Convenor WG C2.24) presented to the SC C2 meeting on the impacts on Australian utilities of the 2019/20 fire danger season in Australi; and
- Sharing of local learnings through completion of surveys to support the work of working groups – particularly sharing Australian perspectives on power system operational resilience.

6. Meeting Report: Australian Panel

The AU C2 panel meeting has been held over to Q1 in 2021 due to competing priorities. This will also allow panel members to share their latest operational experiences from the Australian summer prior to the 2021 Paris Session.

7. Invitations for SC or WG's to meet in Australia

An invitation has been extended to Study Committee C2 to meet in Cairns in 2023 in conjunction with the planned Symposium. SC C2 will be one of the lead SCs for this Symposium.

8. ANC Members on Working Groups

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

WG	Title	Australian Member
C2.18	Wide area monitoring protection and control systems – decision support for system operators	James Guest (TBC)
C2.24	Mitigating the risk of fire starts and the consequences of fires near overhead lines for System Operations'	Frank Crisci (Convenor)
C2.25	Operating Strategies and Preparedness for system Operational Resilience	Mark Miller Dean Sharifi Greg Hesse
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
C2.40	TSO-DSO Co-operation – Control Centre Tools Requirements	Matthew Rigano
C2/C5.05	Development and Changes in the Business of System Operators	Greg Hesse
C2/B4.38	Capabilities and requirements definition for Power Electronics based technologies for secure and efficient system operation and control	Richard Sherry and Sorrel Grogan

9. Membership of the Australian Panel

Name	Organisation	Type
Alastair Andrews	Powerlink	Transmission
Bradley Vogel	Essential Energy	Distribution
Graeme Carter	Endeavour Energy	Distribution
Stuart Donaldson	Ausgrid	Distribution
Shane Duryea	Western Power	Transmission
Duncan Griffin	Power and Water Corporation	Operator / Transmission / Distribution
Greg Hesse	Powerlink	Transmission
Keqian Hua	TasNetworks	NGN
Chong Ong	TasNetworks	Transmission / Distribution
Andrew Power	TransGrid	Transmission
Matthew Rigano	Energy Queensland	Distribution
Matthew Robinson	PSC Consulting	Consultant
Richard Sherry	Transpower	Operator / Transmission
Colin Taylor	ElectraNet	Transmission
Tjaart Van Der Walt	AEMO	Operator

Convener: **Greg Hesse**

Email: **ghesse@powerlink.com.au**

Phone: **0418 783 840**

AP C3 System Environmental Performance

1. Study Committee Scope

The scope of SC 3 includes responsibilities 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 Study Committee works closely together with relevant equipment and systems committees within its field of responsibility.

2. Specific Activities of the Study Committee

SC C3 currently has 1 reference group and 11 active working groups.

RG C3.01 EMF and Human Health (New Advisory group)	Michel Plante (CA)
WG C3.09A Corridor management	Aleš Kregar (SL)
WG C3.12 Methodologies for Greenhouse gas inventory and reporting for T&D utilities (Renewed TOR)	Mercedes Vázquez (ES)
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	Marijke Wassens (NL)
WG C3.16 Interactions between electrical infrastructure and wildlife	Cécile Saint-Simon (FR)
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	Anne-Sophie Desaleux (FR)
WG C3-20 Sustainable Development Goals in the Power Sector	Christian Capello (AT)
WG C3.21 Including stakeholders in the investment planning process (Renewed TOR of former JWGC1/C3.31)	Susana Batel (PT)
WG C3.22 Vegetation management in substations	Mortier Johan (BE)
WG C3.23 Eco-design methods for TSO/DSO under environmental transition	Busato Guillaume

Recently completed working groups include:

JWG C3/B1/B2.13 Environmental issues of high voltage transmission lines for rural and urban areas (JWG with SC B1 and B2). –Closed this year-	Hector Pearson (UK)

WG C3.19 Responsible management of the Electric and magnetic Fields Issue	James Hart (AU)

3. Preferential Subjects

The current preferrential subjects include:

PS 1 : Sustainable development goals (SDG's) of the UN

- How do companies integrate the SDG's in their business strategy to contribute to their achievement
- What are the main challenges to do so
- In what way do companies benefit of integrating SDG's in their business strategies

PS 2: Environmental impact of energy transition

- Effects of raw materials becoming scarce
- Which methods are used for measuring these impacts, regarding whole chain
- How to deal with the negative impacts of energy transition, e.g. effects of solar fields on biodiversity

PS 3: Relation of wildlife and electric infrastructure

- Equipment of generation, transmission and distribution often suffer from wildlife like birds, rodents, exotic species. How to prevent damages or outages.
- Which methods are used and which data are needed to determine mortality
- Which methods for mitigation are used.

4. Paris session 2020

The Paris session in 2020 was conducted online. While there were some technical difficulties resulting in sessions being cancelled, a number of interesting papers were discussed. Some examples are shown below:

Brazil – proposed strategic approach to including sustainable development goals in the criteria for evaluating R&D projects. In Brazil, electricity companies are required to invest 1% of net operating revenues in R&D.

Germany – proposed approach to quantifying benefits of additional measures used to facilitate public acceptance and avoid project delays.

Japan – results from a survey of electric power companies about sustainable development goals and their business strategies. The results showed that few companies adopted strategies in line with the sustainable development goals (apart from those dealing with reneable energy and batteries).

Italy – the experiences of implementing the Envision protocol which evaluates the overall impact of electrical infrastructure over its life cycle with the aim of improving sustainability.

Norway – methods for limiting land degradation around new transmission lines. The preferred methos is to loosely replace original, stored top soils around the disturbed areas. While seeding had the highest initial vegetation cover it was suggested that seeded plant may compete with local vegetation.

Netherlands – discussed a sustainable substation using 50% less concrete, less steel, insulation, solar panels and passive climate control. A eco-cost calculation demonstrated a saving of 66% over the standard substation design.

Germany – discussed a risk assessment of equipment containing non-SF6 gases. Recommendations are given for protective measures associated with lead components in different gas mixtures.

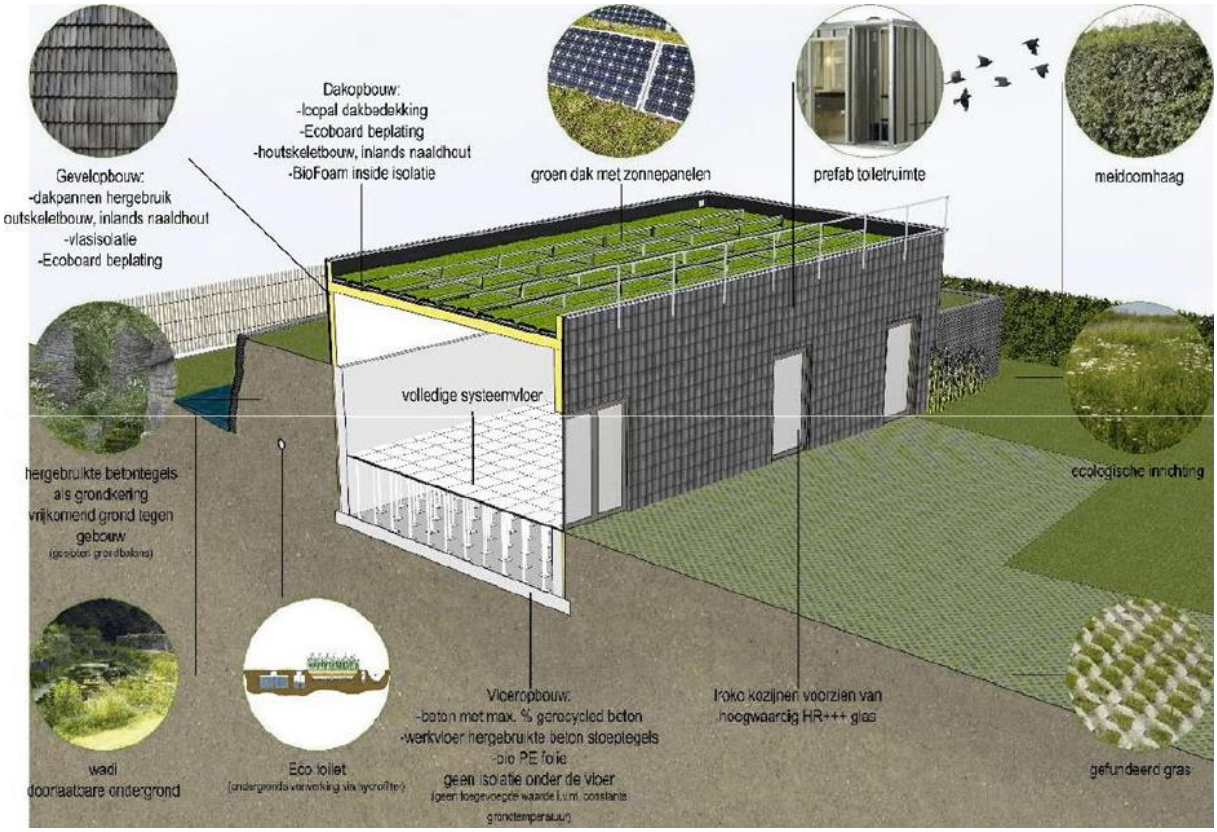
India – discussed mitigation measures for a number of scenarios involving electric field induced shocks under a 765kV transmission line. Measures included earthing fences and installing shielding wires over distribution lines.

Italy – discussed the development of an avian action plan to reduce risk associated with the interaction of birds and powerlines. The plan includes monitoring, modelling, design measures, training, guidelines for the selection and installation of nest boxes and webcams.

Germany – use of video monitoring to study the behaviour of birds. Over 100,000 birds were videoed crossing powerlines. The results showed a collison rate of 0.1%. Approximately half flew over the lines with 25% flying between the conductors and the earth wires. The larger the swarm size the more likely it was that they would fly over the line. All wiring components were collided with while larger birds were more susceptible to collision. This is likely due to their poor manoeuvrability and limited filed of vision for some species.

Portugal – discussed methods for monitoring bird mortality rates near powerlines. A number of recommendations were provided to improve monitoring programs and remove bias.

Australia – discussed a threatened bird strategy including aspects of knowledge, awareness, mitigation and offsetting. Threatened species mortality rates have fallen since the strategy was implemented. New design standards will include fibreglass cross-arms network wide, use of delta three-wire configurations in rural areas, retrofitting the network in high risk areas and use of bird diverters.



Netherlands – sustainable substation

Norway – the effect of revegetating with existing topsoil.

5. Proposed New Working Groups

Working groups which commenced in 2019 include:

WG C3.21 Including stakeholders in the investment planning process (Renewed TOR of former JWGC1/C3.31)	Susana Batel (PT)
WG C3.22 Vegetation management in substations	Mortier Johan (BE)
WG C3.23 Eco-design methods for TSO/DSO under environmental transition	Busato Guillaume

Potential working groups where the Terms of Reference are being considered include:

- Environmental aspects of SF6.
- Life cycle assessment.
- Environmental effects of decommissioning.

Other ideas suggested, which may become future working groups, include sustainable supply chain, environmental aspects of storage, and adaptation to climate change.

6. Specific Activities of the Australian Panel

During 2019 AP C3 delivered two webinars based on the work of C3.19 Responsible management of the EMF issue.

A joint EESA/CIGRE Australia webinar was delivered in May 2019.

A CIGRE International webinar was delivered in November 2019. The webinar is available on eCigre.

https://e-cigre.org/publication/WBN012-responsible-management-of-the-emf-issue

A summary of the technical brochure is provided in Attachment 1.

At the time of writing this report AP C3 has not met. It is proposed to hold a virtual meeting in November.

7. Invitations for SC or WG's to meet in Australia

CIGRE Australia is proposing to host a CIGRE Symposium, led by SCC6 in Cairns Australia 4th–7th September 2023.

The symposium theme is yet to be fully developed, but will focus on renewables and the challenges of integration and the impact of renewable generation on the Grid. It will include a number of committees including SC C3.

A decision has yet to be made by SC C3 on 2023.

SC C3 will be supporting the Slovenia Symposium in November 2021.

8. ANC Members on Working Groups

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

WG	Title	Australian Member
WG C3.18	Eco-friendly approaches in Transmission and Distribution	Andrew Johnson
WG C3.19	Responsible management of the Electric and Magnetic Field Issue (NOW COMPLETE)	James Hart (convenor)
WG C3.17	Interaction between wildlife and emerging RES and submarine cables	Michael Roberts
WG C3.20	Sustainable development goals in the electric power sector	Michael Roberts

9. Membership of the Australian Panel

Name	Organisation	Type
James Hart	Ausgrid	Distribution/Transmission
Michael Roberts	Endeavour Energy	Distribution
Brett Haywood	Essential Energy	Distribution
Andrew Johnson	ElectraNet	Transmission
Ed Parker	TasNetworks	Distribution/Transmission
David Donehue	TransGrid	Transmission
Debora Kennedt	Powerlink	Transmission
Sonya Bryce	Energy Queensland	Distribution/Transmission
Andy Shaw	Western Power	Distribution/Transmission

Convener: **James Hart**
Email: **jhart@ausgrid.com.au**
Phone: **02 93946659**

Attachment 1 – Summary of Technical Brochure C3.19 Responsible management of the EMF issue

The purpose of this brochure is to provide common, industry-wide information related to electricity distribution and transmission utility infrastructure to assist in managing the electric and magnetic field (EMF) issue.

This technical brochure is aimed at engineers and professionals within the industry who understand electricity transmission and distribution engineering principles. The content is industry specific, and at times, technically complex. It is not intended as a brochure for the general public.

Both electric and magnetic fields occur naturally. Electric fields are produced by the local build-up of electric charges in the atmosphere associated with thunderstorms. Magnetic fields are caused by the movement of molten iron in the Earth's core.

EMF are also produced wherever electricity or electrical equipment is in use. Powerlines, electrical wiring, household appliances and electrical equipment all produce EMF.

This brochure deals with EMF from power-frequency (50/60 Hz) EMF from AC sources and static EMF (0 Hz) from DC sources owned or operated by the electricity distribution and transmission utilities.

Guidelines have been developed to protect workers and the general public from known adverse acute health effects. The requirements to comply with specific guidelines will vary between countries, regions and companies.

In most cases, EMF associated with the operation of electricity assets will be well below the guideline limits and specific compliance assessments will not be required. Exceptions could include specific occupational activities near assets such as very highly loaded conductors, air cored reactors or air cored transformers.

There are also important safety precautions to consider in relation to workers with active implanted medical devices (AIMDs). This area requires appropriate policies, procedures and control measures within power utilities to appropriately manage the potential risk posed from high exposure to EMF in specific areas of distribution and transmission utility work environments.

Regarding possible health effects of exposure to EMF at levels below these guidelines, extensive research has been conducted since the 1960s. This includes 450 epidemiology studies and over 1,600 laboratory studies [B1]. Based on the findings of independent authoritative public health authorities, the body of scientific research on EMF does not establish that exposure to EMF at levels below the recognised guidelines cause or contribute to any adverse long-term health effects. However, the possibility cannot be completely ruled out.

Several countries and regions have adopted precautionary policies and, in some cases, arbitrary limits below the recognised guideline limits. The WHO's advice in relation to such practices is that policies based on the adoption of arbitrary low exposure limits are not warranted. However, there are times when EMF mitigation measures may be required. Examples include complying with local laws, responding to concerns from the public and facilitating public acceptance of new installations.

Adopting EMF mitigation measures in the name of prudence or precaution should be carefully considered and supported by effective risk communication. Such measures should not unduly compromise other issues and it cannot be said that they will result in any demonstrable health benefit. If not managed effectively, the application of prudence or precaution may be seen by the public as confirmation that the utility believes that EMF are harmful.

Regardless of the assessments published by national and international health and scientific agencies and despite the extensive research, some members of the public have genuine concerns about potential effects of EMF on their families' health and potential environmental effects. Dealing with these concerns requires a factual, open and honest approach and a genuine acknowledgement of people's concerns.

The issue of EMF remains an important issue for industry in terms of actual risks, possible risks and misinformation. Responsible management of the EMF issue is critical for ensuring the safe, reliable and cost-effective supply of electricity and maintaining the reputation and trustworthiness of the utility and the electricity distribution and transmission utility industry as a whole.

AU-C4 System Technical Performance

1. 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.

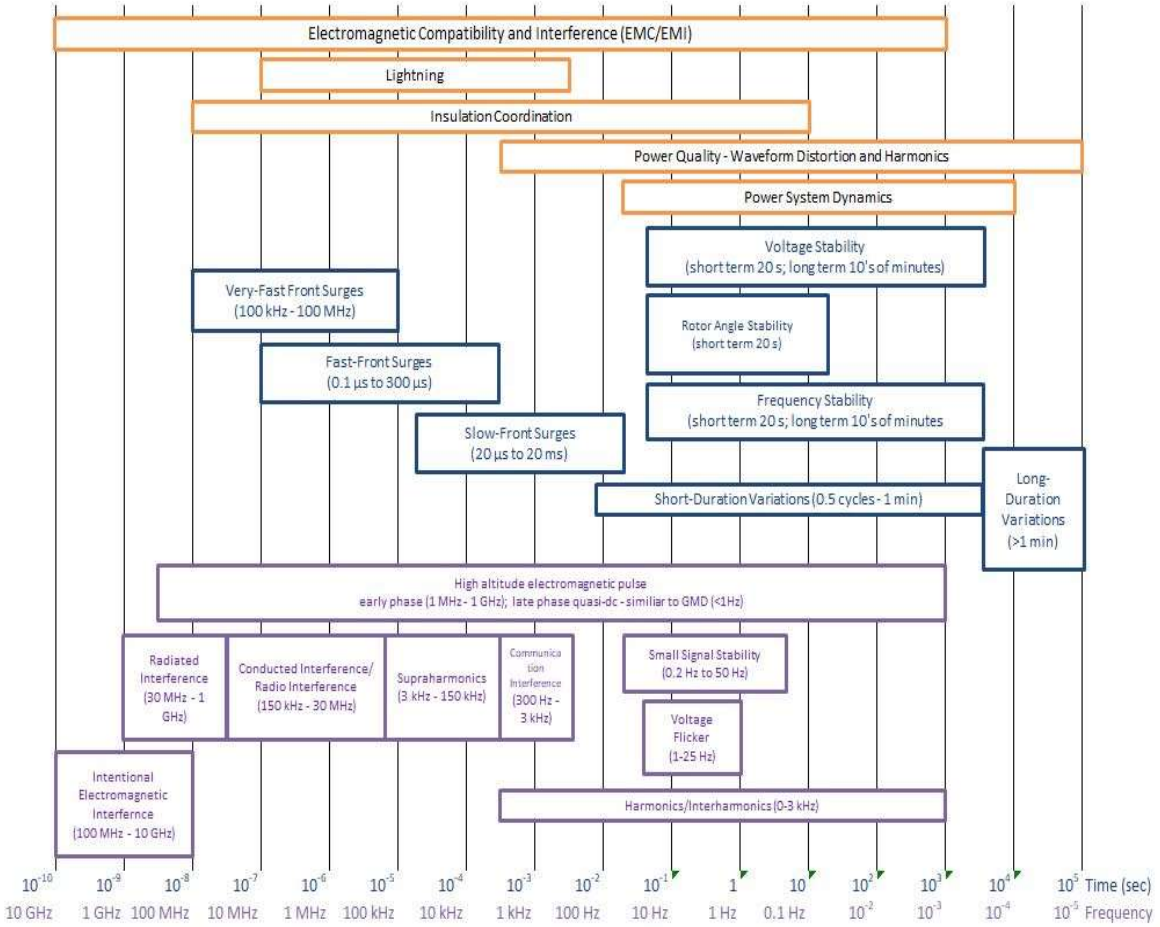


Figure 1: Time frame of various phenomena of interest in power system studies.

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.

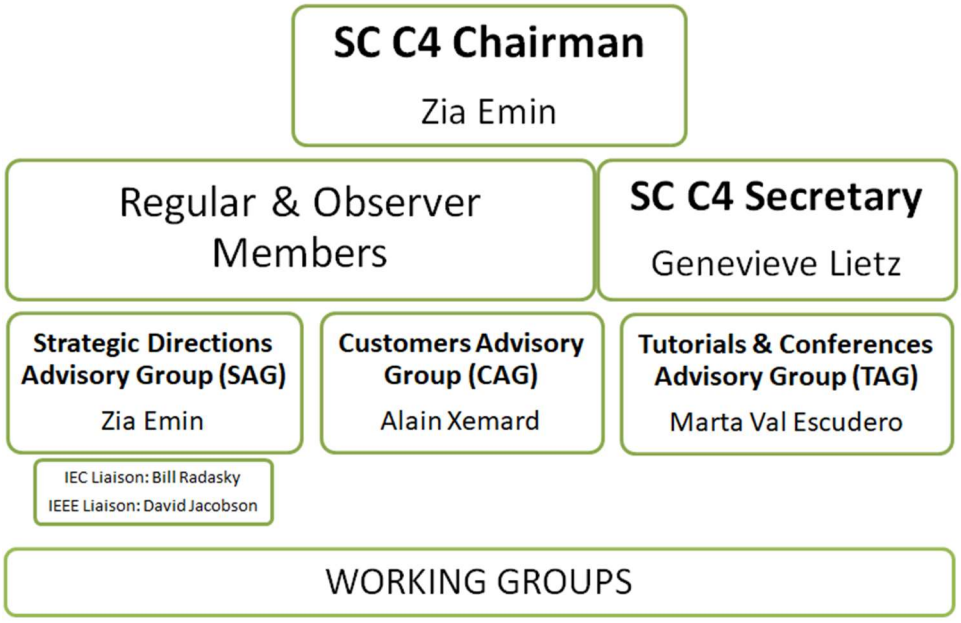
2. Study Committee Structure

The organisational structure of SC C4 is as shown in Figure 2. At the 2020 SC meeting held during the Paris E-Session, the composition of the SC was confirmed as follows:

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

The membership of SC C4 presently encompasses 42 countries.

Figure 2: SC C4 structure



From AU C4, Andrew Halley and Sarath Perera are both members of SAG. Andrew is also a Regular Member of the SC, being one of twenty seven (27) national representatives.

3. Specific Activities of the Study Committee

3.1 Active Working Groups

SC C4 currently has thirty two (32) active Working Groups (WG). The breakdown by sub-topic is:

- Power quality, 4
- Electromagnetic compatibility and interference (EMC/EMI), 3
- Insulation co-ordination, 7
- Lightning, 7
- Power systems dynamics and numerical analysis, 11

WG #	Title	Convener	Schedule
WG C4.23	Guide to procedures for estimating the lightning performance of transmission lines.	C. Engelbrecht (Netherlands)	2012 - 2015
WG C4.36	Winter lightning – Parameters and engineering consequences for wind turbines.	M. Ishii (Japan)	2014 - 2017
WG C4.39	Effectiveness of line surge arresters for lightning protection of overhead transmission lines.	K. Tsuge (Japan)	2015 - 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/B5.41	Challenges with series compensation application in power systems when overcompensating lines.	L. Haarla (Finland)	2015 - 2017
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.	T. Shindo (Japan)	2017 - 2020
WG C4.44	EMC for large photovoltaic systems.	E. Salinas (Sweden)	2017 - 2019
WG C4.45	Measuring techniques and characteristics of fast and very fast transient overvoltages in substations and converter stations.	S. Xie (China)	2017 - 2021
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.	M. van Harte (South Africa)	2017 - 2020
WG C4.48	Overvoltage withstand characteristics of power system equipment 35-1200 kV.	I. Dudurych (Ireland)	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
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 C4.56	Electromagnetic transient simulation models for large-scale system impact studies in power systems having a high penetration of inverter connected generation.	B. Badrzadeh (Australia)	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

WG #	Title	Convener	Schedule
WG C4.59	Real-time lightning protection of the electricity supply systems of the future.	C. Tong (China)	2019 - 2022
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 over voltages in UHV AC systems.	J.He (China)	2019-2021
JWG A2/C4.52	High-frequency transformer and reactor models for non-standard waveforms.	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 systems with predominance of low or zero inertia generators.	D. K. Chaturvedi (India)	2019 - 2021
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 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 C2/C4.41	Impact of high penetration of inverter-based generation on system inertia of networks	M. Rampokanyo (South Africa)	2018 - 2020
JWG C4/C2.58/IEEE	Evaluation of Voltage Stability Assessment Methodologies in Transmission Systems	U. Annakkage (Canada)	2019 - 2021
JWG B2/C4.76	Lightning & grounding considerations for overhead line rebuilding and refurbishing projects, AC and DC.	William A. Chisholm (Canada)	2019 - 2022

Six working groups are expected to complete and publish their Technical Brochures (TB) in the near future. As of November 2020, the working groups which are approaching the end of their activities are as follows:

- JWG C4/B5.41 has submitted its TB for review by the SC.
- Submissions to the SC are pending for WGs C4.23, C4.36, C4.39, JWG C4.42/CIRED and C4.43. These WG are likely to be completed in the near future.

3.2 Proposed Working Groups

There is currently only one proposal for a new WG which is under review by the SC.

- WG C4.xxx "Benchmark for stability study in AC/DC Hybrid Grid" – Yong Tang (China)

The SC Chairman noted during the E-Session meeting that a number of WG are expected to be completed soon and indicated that all SC members should consider what new WG topics could be developed to ensure ongoing C4 activity.

To progress this action, the Chairman has since instigated a SC C4 Gap Analysis Task Force having the objective to identify new areas of investigation and/or topics which require review given the significant changes occurring within the industry. The composition of the Task Force is shown below, with Australian contributors highlighted in yellow.

TF Streams	Power Quality	EMC	Insulation Coordination	Lightning	Dynamics
Contributors	Marta Val Escudero Sarath Perera Theo Laughner Brandon Peterson Igor Papic	WH Siew Bill Radasky John van Coller Ener Salinas Dave Thomas Qingmin Li Patricio Munoz Rojas Kazuo Yamamoto	Claus Leth Bak Alain Xemard Angelica Rocha Manuel Martinez Duro Filipe Faria da Silva	Alberto Borghetti Hideki Motoyama Stephan Pack Jinliang He Bill Chisholm Fridolin Heidler Marina Bernardi Vlad Rakov Maria Teresa Correia de Barros Joan Montanya Pantelis Mikropoulos Mikropoulos Yoshihiro Baba Alexandre Piantini Silvério Visacro Udaya Kumar	David Jacobson Liisa Haarla Andrew Halley Emil Hillberg Babak Badrzadeh

The Task Force will commence tabling its recommendations in late 2020 and first quarter of 2021. This will be in the form of draft Terms of Reference (ToR) for future Working Groups.

3.3 Green Books

In the last twelve months, SC C4 provided input to the following CIGRE reference material:

- *Electricity Supply Systems of the Future*. C4 provided a complete chapter on system technical performance issues which can be reasonably foreseen in the future. Members from AU C4 prepared the chapter section on power quality and also contributed to the power system dynamics section. Publication of the Green Book occurred in August 2020.

- *FACTS Devices*, The publication was led by SC B4. AU C4 members prepared the chapter which outlines commissioning test requirements and associated network considerations. Publication of the Green Book occurred in early 2020.

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 Electra and the CSE Journal:

- Electra Reference Paper: ***"The need for enhanced power system modelling techniques and simulation tools"***, RP-308-1, CSE Vol 17.
- Electra Reference Paper: ***"Power quality trends in the transition to carbon-free electrical energy systems",*** RP-308-2, CSE Vol 17.
- Numerous other SC C4 related papers were published in the CSE Journal during 2020. A number of excellent articles appear in Volumes 15, 17 and 18 including several from Australia.

All documentation is available via the e-CIGRE website.

3.5 Published Technical Brochures

The following TB have been published by SC C4 since November 2019.

TB 785: Electromagnetic computation methods for lightning surge studies with emphasis on the FDTD method, WG C4.37.

TB 795: Extrapolation of measured values of power frequency magnetic fields in the vicinity of power links, WG C4.28, AU-C4 Members: Ben Li (AusNet Services) and Garry Melik (Magshield Products International)

TB 799: Assessment of conducted disturbances above 2kHz in MV and LV power systems, WG C4.31

As outlined above, one other TB is currently under review by the SC and a number of WG are due to be completed in the near future. The expected publication list for 2020 is shown in Figure 3.

Figure 3: Expected number of TB publications in the 2020 calendar year.

3.6 Webinars

During 2020, SC C4 offered two webinars to CIGRE members:

- "**Understanding of the geomagnetic storm environment for high voltage power grids**", by Dr William A Radasky, Convener of WG C4.32, February 12, 2020.
- "**Network modelling for harmonic studies**", by Marta Val Escudero and Genevieve Lietz, Convener and Secretary of C4/B4.38. June 25, 2020.

The webinar format is proving very successful for SC C4, with 245 attendees participating in the C4/B4.38 event (with 432 registrations in total). More webinars are planned for 2021. Details will be made available via the SC C4 website: https://c4.cigre.org/GB/events/events-calendar

3.7 International Events

The impacts of COVID-19 have been widely felt and have significantly impacted international travel. As a result, a number of planned events involving SC C4 have been cancelled, most notably the International Colloquium planned to be held in Suzhou (China) during March 2021.

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

- **CIGRE Session #49**, Paris (France), August 2021.
- **CIGRE Symposium 2022,** "*Power system transformation including active distribution*", Kyoto (Japan), April 2022.
- **CIGRE Session #50**, Paris (France), August 2022.
- **CIGRE Symposium 2023,** "*The end to end electricity system: transition, development, operation and integration*", Cairns (Australia), 4-7 September 2023.

The participation of SC C4 members will continue to be influenced by travel limitations relevant at the time of the event.

3.8 SC C4 Awards

In 2020, the SC presented the following recognitions to long serving contributors to the work of C4. AU-C4 panel member Alex Baitch received a Distinguished Member Award, while Pouyan Pourbeik was awarded a CIGRE Fellowship. While now residing in the United States, Pouyan studied at the University of Adelaide and has made numerous contributions of significance to the electricity industry, both internationally as well as here in Australia.

Congratulations to both Alex and Pouyan as two very deserving recipients of these significant awards.

- Pouyan Pourbeik.....CIGRE Fellow
- Maks Babuder.....CIGRE Fellow
- Claus Leth Bak.....TC Award
- Alex Baitch..... Distinguished Member
- Jinliang He .....Distinguished Member
- Claus Leth Bak .....Distinguished Member
- Marta Val Escudero .....Distinguished Member
- Hideki Motoyama.....Distinguished Member
- Eiichi Zaima .....Distinguished Member
- Igor Papic .....Distinguished Member
- Robert Koch .....Distinguished Member
- Nicholas Miller .....Distinguished Member

4. Paris Sessions

4.1 Preferential subjects 2022

Preferential subjects for the **2022 Paris Session** were discussed at the last SC meeting and are likely to be as follows:

PS1: Challenges and advances in power quality (PQ) and electromagnetic compatibility (EMC)

- Modelling, measurement and assessment of PQ phenomena including emerging areas such as supra-harmonics, harmonic instability, geomagnetically induced currents and other similar phenomena,
- Integration and application of advanced signal processing, artificial intelligence techniques and big data analytics for event diagnostics and system planning purposes such as hosting capacity or emission limit calculation,
- Impacts on equipment compatibility and immunity, and emerging mitigation approaches.

PS2: Challenges and advances in insulation coordination and lightning research

- Insulation coordination practices for end-to-end power networks, including the effects of long lines, long cables and frequency dependent models,
- Development on insulation coordination in power electronics and DC systems, and the need for standardisation,
- Lightning evaluation of transmission and distribution systems covering new asset designs and extreme meteorological events.

PS3: Challenges and advances in Power System Dynamics

- Modelling, analysis and validation of individual components and wide-area system interactions including system level protection schemes considering changing system dynamics,
- Impact of emerging technologies such as hydrogen and other storage devices, grid forming inverters and demand side management,
- Analysis of security and resilience of power systems having high share of grid-connected or distributed inverter-based resources including feasibility of providing system support such as black start, islanding, system strength and inertia.

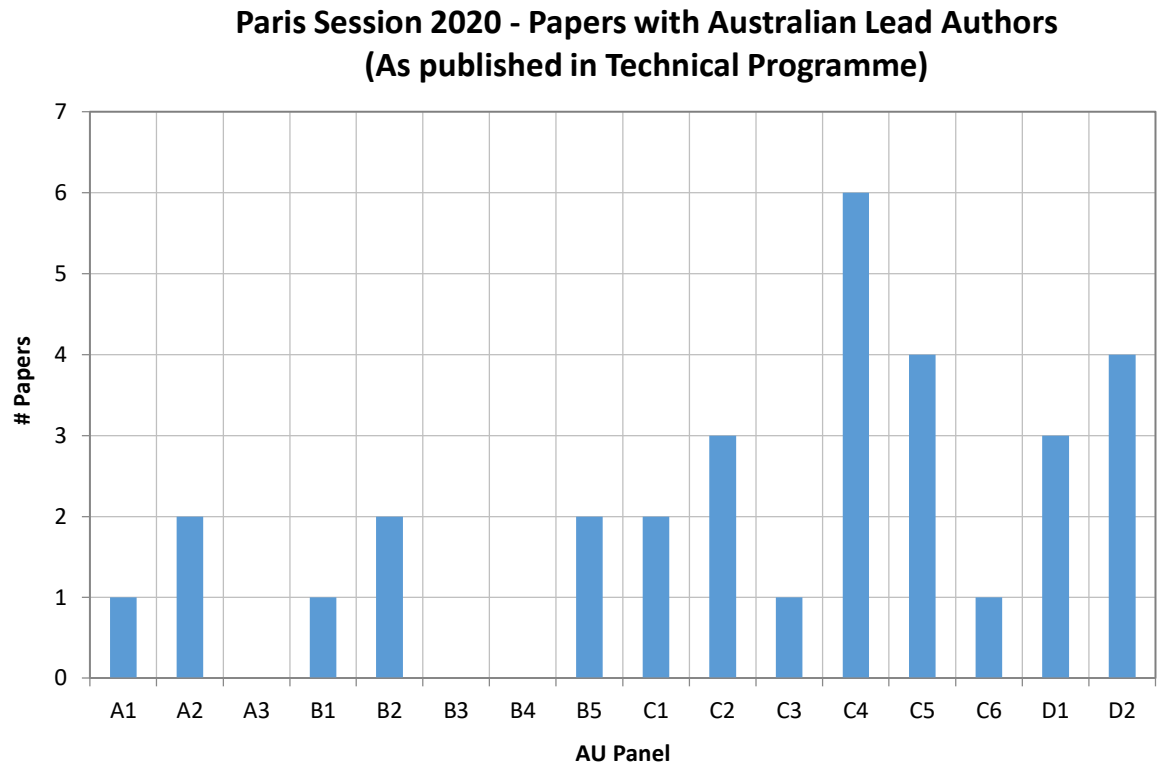
The call for papers is scheduled for December 2020 (or early 2021). The Preferential Subjects provide plenty of scope for Australian submissions, so it is hoped that a number of quality contributions from AU C4 are forthcoming as has been the case in recent years.

4.2 Accepted Papers from AU C4 for E-Session 2020

Six papers were accepted from AU C4 and presented as part of the 2020 E-session. A seventh paper was redirected to SC C2. This represents an increase of one from 2018 when five papers were presented from AU C4.

A summary of Australian authored papers presented as part of the Paris E-Session is presented in Figure 4 below.

Figure 4: Australian papers accepted for Paris E-Session 2020



The six papers that were presented from AU C4 were as follows:

Lead author	Paper #	Title
Neil Browne	C4-310	Trends in power quality disturbance compatibility in Australia.
Nalin Pahalawatta	C4-127	Power system analysis tools for supporting renewable generation connections.
Greg Hesse	C4-114	Monitoring and modelling of geomagnetically induced currents across the Australian National Electricity Market (NEM).
Babak Badrzadeh	C4-108	Synchronous condenser solutions to replace synchronous generators for providing system strength in a large-scale power system – the South Australian experience.
Babak Badrzadeh	C4-206	A large-scale electromagnetic transient model validation based on measured system disturbances.
Tony Morton	C4-119	Generator fault current injection: Are system operators asking for the right thing?

4.3 Technical Workshop – E-session 2020

On Monday 24th August, the SC-C4 workshop was held via webinar. The title of the workshop was:

"*System strength – A story about not enough shepherds and too many sheep*".

The workshop about system strength and the increasing impact of inverter based resources (IBR) in power systems, was coordinated by Andrew Halley and Babak Badrzadeh from AU C4.

The general topics that were presented by a panel of international experts were as follows:

- Explanation of what is meant by 'system strength' and its relationship with system inertia.
- Descriptions about how a 'lack of system strength' can manifest as an issue for the power system.
- Tools and techniques for analysing low system strength conditions (including screening methods and detailed simulation studies).
- Practical examples of assessing and managing local system strength issues including mitigation measures.
- Management of system strength in a real time operational environment.
- Current and prospective system strength solutions.

The workshop was held over a four hour period consisting of two 2-hour sessions, with all material being pre-recorded and available for download. Approximately 110 people attended the workshop. To encourage audience participation, question and answer times were held at the completion of each session. This provided an opportunity for presenters to interact with those in attendance and clarify issues, as well as provide additional information on the topics discussed.

Feedback on the workshop to date has been positive.

5. Other Specific Activities of the Australian Panel

The Australian Panel has continued to be active in 2020 despite the issues associated with COVID-19. There has been ongoing involvement in a number of WG, contributions to the Paris E-Session and to various other local initiatives.

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
C4/C2.58/ IEEE	Evaluation of voltage stability assessment methodologies in transmission systems.	Ehsan Farahani	Corresponding member	In progress.	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 Neville Watson	Convenor Member Corresponding members	In progress.	Pending.

WG Ref	Title	AU.C4 Reps	Involvement	Status	TB Ref
C4/B4.52	Guidelines for sub-synchronous oscillation studies in power electronics dominated power systems	Babak Badrzadeh David Vowles Sachin Goyal	Member Corresponding members	In progress.	Pending.
C4.51	Connection of railway traction systems to power networks	Igor Perin Phil Coughlan	Members	In progress.	Pending
C2/C4.41	Impact of high penetration of inverter based generation on system inertia of networks.	Nilesh Modi Michael Negnevitsky Gregor Verbic	Members	In progress.	Pending
		Cheryl Noronha Craig Blizard	Corresponding members		
C4.47	Power system resilience	Julian Eggleston Terry Lampard Mancarella Pierluigi	Members	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 (now residing in the UK)	Corresponding Member	In progress.	Pending.

5.2 Contributions to other significant industry activities

CIGRE Australia members aligned with AU C4 are also contributing to a variety of other industry activities well as technical committees associated with Standards Australia and the International Electrotechnical Commission (IEC).

Reference	AU representatives	Contribution
Paris E-Session 2020 28 August 2020	Andrew Halley Babak Badrzadeh	SC-C4 Technical Workshop "System strength – A story about not enough shepherds and too many sheep".
AEMO System Strength Seminar 6 November 2020	AEMO representatives Andrew Halley	Online seminar provided to the Australian Electricity Industry. See below for specific information on this event.
CIGRE Science and Engineering Journal "Determining Multiple Fault Ride-Through Requirements for Generating Systems in the Australian National Electricity Market"	B.Badrzadeh J.Lu S.Grogan N.Crooks	Article produced by the Australian Energy Market Operator (AEMO). Published Feb 2020, CSE-017
CIGRE Science and Engineering Journal "Power System Operation with Reduced System Strength for Inverter-connected Generation during Prior Outage Conditions"	B.Badrzadeh N.Modi N.Crooks A.Jalali	Article produced by the Australian Energy Market Operator (AEMO). Published Feb 2020, CSE-017
Reference Paper "The need for enhanced power system modelling techniques and simulation tools."	B. Badrzadeh, C4.56 Convenor (AU)	Electra Reference Paper RP-308-1
Standards Australia / IEC EL-043 High voltage installations	Alex Baitch	Chairman Mirror committee to IEC TC-99.
Standards Australia / IEC EL-064 Decentralised electrical energy and grid integration of renewable energy systems	Alex Baitch	Chairman Established in 2019 to mirror the activities of IEC TC8 and its subcommittees IEC SC8A and IEC SC8B. This year an additional subcommittee has been established (IEC SC8C).
Standards Australia / IEC EL-062 Smart Grids	Alex Baitch	Member Has recently been re-constituted with a view to acting a mirror committee to the IEC Systems Committee IEC SyC Smart Energy.

5.3 Australian System Strength Seminar

Following on from the E-Session technical workshop, AEMO and AU-C4 members combined to develop a technical seminar focused on 'system strength' and related topics. The seminar was delivered as an online event on 6 November 2020.

Twenty eight speakers participated in the event representing AEMO, network operators, consultants, academics, and equipment suppliers. The expanded speaker list drew on Australian expertise and more local examples than was possible to include in the Paris E-Session.

Key note speakers who opened the event were:

- Alex Wonhas, AEMO Chief System Design and Engineering Officer
- David Bones, CIGRE Australia Technical Committee Chairman

The major themes covered during the seminar were:

- Background – What do we mean by system strength and what are the issues?
- Generator connection issues and considerations.
- Power system operation.
- Power system planning and emerging technologies.
- International and academic experiences.

In total, the event attracted 1352 registered attendees, with 991 people attending over the course of the session (not necessarily all simultaneously). There were approximately 700 people online at any given time for the vast majority of the six and half hours over which the session was held.

A very considerable thanks goes to AEMO for taking the lead on organising this event, as well as to Terry Killen (CIGRE Australia) for providing administrative support throughout.

5.4 AU C4 Panel Meeting and Technical Seminar

The Australian Panel of C4 held its annual meeting this year as an online event. Twenty two members and three invited guests participated in the administrative meeting held on Thursday 3 December. 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 acknowledged the contributions made by retiring members Peeter Muttik (GE) and David Roby (ABB). Peeter's contributions over the years to not only the AU C4 panel, but also to various industry committees and working groups, was noted with Peeter advising that he is still keen to maintain contact with the panel and its activities.

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 4 December, a technical seminar was conducted online. The six principal authors who submitted papers to the Paris E-Session were invited to present to the AU C4 panel. This was largely for the benefit of those who could not attend in August. In total, thirty three people participated across the day which included Q&A at the completion of each presentation. The panel thanks each of the authors who made themselves available to participate on the day.

In addition to the six Paris papers, Alan Louis from Energy Queensland (EQ) provided an excellent presentation on the new Microgrid and Isolated Systems Test (MIST) facility located in Cairns. The facility includes hardware in the loop testing capabilities using a Real Time Simulator (RTS) and linear amplifier arrangement. The presentation stepped through not only the new hardware that is now available for use, but also EQs planned future activities to investigate various issues associated with large scale integration of DER. Thanks to Alan for his time and the quality of his presentation.

6. Invitations for SC or WG's to meet in Australia

Other than ongoing discussions within the SC related to the 2023 Australian Symposium in Cairns, no formal invitations have been offered or received for WG or SC meetings in the near term.

7. Membership of the Australian Panel

The AU C4 Panel consists of twenty eight (28) members as of November 2020.

Name	Organisation	Type
Shabir Ahmadyar	Jacobs	Consulting
Salim Anwari	Hatch	Consulting
Alex Baitch	BES (Aust) Pty Ltd	Consulting
Babak Badrzadeh	Australian Energy Market Operator (AEMO)	System Operator
Errol Bebbington	PSC Australia	Consulting
Jason David	Australian Power Quality and Reliability Centre	Academia
Julian Eggleston	Australian Energy Market Commission (AEMC)	Regulator
Don Geddey	TransGrid	Network Service Provider
Vic Gosbell	University of Wollongong	Academia
Andrew Halley	Tasmanian Networks Pty Ltd	Network Service Provider
Miron Janjic	BECA	Consulting
Viji Krishnaratnam	Energex Ltd	Network Service Provider
Ben Li	Ausnet Services	Network Service Provider
Hadi Lomei	Essential Energy	Network Service Provider
Garry Melik	Magshield Products International	Consulting
Rizah Memisevic	Powerlink Queensland	Network Service Provider
Michael Negnevitsky	University of Tasmania School of Engineering	Academia
Huuson Nguyen	Western Power	Network Service Provider
Hitesh Parekh	Hitachi ABB Power Grids	Equipment Supplier
Devinda Perera	ElectraNet	Network Service Provider
Sarath Perera	University of Wollongong	Academia
Albert Pors	Endeavour Energy	Network Service Provider
Brett Roberts	AUSGRID	Network Service Provider
Aditya Upadhye	Grid Wise Energy	Consulting
David Vowles	University of Adelaide	Academia
Ping Wang	GE Energy Connections (was Alstom Grid Aust)	Equipment Supplier
Neville Watson	University Of Canterbury	Academia
Pippa Williams	Hydro Tasmania	Generator / NGN Representative

8. Panel contact details

For further information or questions, please contact:

Convener: Andrew Halley
Email: andrew.halley@tasnetworks.com.au
Phone: 0419 120 115

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

AU-C4 KMS Home Page:

https://cigregroups.org/display/AUC4/AU+C4+System+Technical+Performance+Home

AP C5 Markets and Regulation

1. Study Committee Scope

The scope of Study Committee C5 is: Analysis of the impacts on the planning and operation of electric power systems of different market approaches and solutions; and of new structures, institutions, actors and stakeholders. The role of competition and regulation in improving end-to-end efficiency of the electric power system. Areas of attention include:

- **Market structures** and products such as physical and financial markets and the interaction between them, contracts, internationally integrated markets.
- **Techniques and tools** to support market actors such as demand and price forecasting profit estimation, financial risk management etc.
- **Regulation and legislation** such as regulation objectives, extension and limits, price regulation of transmission, and ancillary services, transmission/distribution coordination and interactions, international harmonization, environmental and regulatory objectives etc.
- **Evolution** of markets and regulation from wholesale transmission focus to include retail and distribution. The increasing interaction between regulation and markets throughout the electric power system value chain and the ability of markets and regulation to cater for rapid evolution in dynamic / variable generation, demand and storage technologies and behaviours.
- **Coordination** of regulation, funding and trading arrangements for new assets and technologies expansion in new market structures, including the trend of decentralization of operations with distributed applications; the remaining assets coexisting with the retirement of other in utilities; the consideration of legacy trading arrangements in the new market arena

The study committee conducts the Market Disturbance portion of the Large Disturbance Workshop held as part of the Paris Session. The C5 contribution:

- shared experiences from Australia;
- provided an opportunity to learn from real life experiences of unusual or extreme market circumstances and how markets responded during system disturbances; and
- examines the performance of various market designs and regulations.

The 2020 large disturbance workshop was held as part of the virtual 2020 Paris Session. Initial work has commenced to prepare the 2021 workshop in conjunction with C2.

2. Specific Activities of the Study Committee and AU panel participation

The Study Committee is continuing its focus on market developments, both at the macro and the micro level. A focus on distribution networks and the edge of the grid has again been included in the preferential subjects for 2022.

The SC published Technical Brochures on Systemic Risk in Electricity Markets, Wholesale Price Caps and Barriers to achieving full value for storage, flexibility within power systems in the transition to intermittent resources The AU panel was represented on both working groups. The Study Committee also contributed to the Technical Council Green book on the Grid of the Future.

Study Committee C5 continues to support Study Committee C1 in a joint working group with the IEC (ACTAD TT-4, examining the tasks to progress Global Electricity Interconnection. This work is related to WG C1-35, which is examining this issue for CIGRE. SC C5 is providing a markets perspective to this work.

The AU panel represented SC C5 in the preparation and running of the Large Disturbance workshop in cooperation with SC C2. Between 150 and 200 members were on-line for at least part of the workshop. Feedback from participants was favourable.

3. Preferential Subjects

The preferential subjects for 2020 were:

PS1: The changing nature of markets and ancillary requirements

- Market adaptations to handle the value shift between energy and services

- Markets and services to address inertia and resilience
- Role of markets with respect to aggregation and the provision of network services
- Pricing approaches for emerging technologies and impacts of those approaches

PS2: Changing role of regulators and standards

- Role of regulators in the changing markets
- Evolving policy, standards, and guidelines to address issues affecting markets
- Regulatory policies on transmission and distribution; too little or too much?

PS3: Market designs for coordination of generation and network investments

- Markets and regulations to promote coordinated investments
- Customer-driven market changes – the transition from centralized to distributed planning
- Impacts of the changing nature of customers on investments and markets
- The impact of peer-to-peer trading on the provision of market services.

4. Activities of the Australian Panel

The Australian Panel held its annual meeting via Go To Meeting on Thursday 30th July 2020. Fifteen panel members participated. The main topics for the meeting were 'dry runs' of presentations for the Large Disturbance Workshop and the papers for the Technical Session from Australian members

The chair and secretary of C5 and convenor of AU C5 held a number of web meetings with the chair and secretary of C2 to finalise the logistics for the Large Disturbance Workshop.

Four papers from AU C5 were accepted and presented to the virtual Paris Session. The papers covered:

- Value of battery behaviour to customers
- Impact of price signals on Demand Management and Distributed Energy Resources
- System strength, inertia and network loss factors
- Emerging Ancillary Service changes in the NEM

5. Invitations for SC or WG's to meet in Australia

Arrangements are progressing for SC C5 to meet in conjunction with the Cairns Symposium in 2023.

6. Australian Members on Working Groups

The current and recently reported SC C5 working groups and their AP members are shown below.

Working Group	Title	AU/NZ Leader*/ Representative
JWG C2.05/C5	Development and Changes in Business of System Operations	Greg Hesse(C2)
WG C5.24	Exploring the Market-based value of Smart Grid developments	Alex Cruickshank
WG C5-26	Auction markets and other procurement methods for demand	Gregor Verbic Victor Francisco
WG C5-27	Market Design for short term flexibility (TB published 2020)	Gregor Verbic Greg Thorpe John Cooper Tim Baker
WG C5-28	Energy Market Price Formation	Greg Thorpe

Working Group	Title	AU/NZ Leader*/ Representative
WG C5- 30	Blockchain applications (TB published 2020)	David Bowker *
WG C5-31	Cost impacts of flexible Demand Response	Alex Cruickshank
WG C5-32	Carbon Pricing in Electricity Market	Greg Thorpe Brian Joseph
WG C5-33	Block chain applications in power markets (new WG still recruiting)	David Bowker*

7. Proposed New Working Groups

WG-C5-33 has been approved, led by David Bowker. This Working Group will examine applications of black chain in the power sector and continue the work of WG C5-31 which reported during 2020

8. Membership of the Australian Panel during 2020

Name	Organisation	Type
Greg Thorpe	Convener/Oakley Greenwood	Consultant
Victor Francisco	SecretaryPSC Consulting	Consultant
Tim Baker	Tim Baker Consulting	Consultant
Ramu Naidoo	Transpower	TNSP
Bess Clark	TasNetworks	TNSP
Julian Eggleston	AEMC	Other
Stephen Hinchliffe	GHD Consulting	Consultant
John Cooper	Hydro Tasmania	Generator/Retailer
Kevin Kehl	Powerlink	TNSP
Rainer Korte	ElectraNet	TNSP
Brian Joseph	NGN/EY	Consultant
Rohan Zauner	Jacobs	Consultant
Ian Rose/Ben Vanderwaal	EY	Consultant
David Swift	David Swift Consulting/ESB	Consultant

During the year Gregor Verbic from Sydney University was obliged to withdraw from the panel due to budget restrictions imposed by the University. The panel welcomed Rohan Zauner as a new member mid-way through the year. In October Bess Clarke advised she was stepping down and Chantal Hopwood would take her place as TasNetwork's representative. I would like to thank Bess for her assistance and participation in the work of panel, Bess contributed to a number of working groups over a number of years. In November Jacinda Papps accepted an invitation to join the panel as a representative from Alinta and also Western Australia. In November Tim Baker also announced he was stepping back from involvement in CIGRE. Tim has been a long standing member of C5, a previous convenor of AU C5 and was an originator of the now very successful market disturbance workshop. His contribution will be missed – thank you Tim.

Convener: **Greg Thorpe**
Email: **gthorpe@oakleygreenwood.com.au**
Phone: **0419 347 955**

AU C6 Active Distribution Systems and Distributed Energy Resources

1. 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.

2. 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:
  islanded power systems and individual customer off-grid systems and solutions.

3. Preferential Subjects

The preferential subjects for the 2020 e-Session and the 2021 Paris Session are:

PS1: Advanced distribution system design incorporating DER

- Configuring demand response and intelligent loads for customer empowerment
- Exploiting local energy storage possibilities and managing uncertainties
- Enabling multi-energy systems using intelligent inverters and controls

PS2: Enabling technologies and solutions for distribution systems

- DER management and aggregation platforms
- Individual and multiple microgrid and virtual power plant design and control
- Rural electrification and off-grid distribution systems

PS3: System operation challenges with increasing distributed energy resources

- Enhancing flexibility, reliability and resilience
- Providing grid services through aggregators
- Aggregator interaction

Preferential Subject PS3 is to be co-chaired by both C2 and C6.

4. Proposed New Working Groups

In 2020 two new C6 working groups were approved. These were:

- C6.41 Technologies for Electrical Railway Distribution Supply Systems
- C6.42 Electric Transportation Energy Supply Systems

The following topic has been proposed as a new working group and a draft terms of reference has been circulated for comment:

- C6.43 Battery Energy Systems for Distribution Grid Services

5. Specific Activities of the Australian Panel

Two Australian papers were accepted for C6 for the 2020 Paris Session.

Australia has assisted the international SC C6 with reviews of draft technical brochures and other documents, through Advisory Group AG C6.02 "Quality Review".

6. CIDER 2021

Australian Panel C6 will host the Conference on Integration of Distributed Energy Resources (CIDER) in Adelaide on 2-3 November 2021, at the Stamford Grand in Glenelg.

This will be the fourth CIDER run by AU C6, the previous three conferences being in Brisbane in 2015, Sydney in 2017 and Melbourne 2019.

Further details and the call for presentations will be published on the CIGRE Australia website as the organisation of the conference progresses.

7. Meeting Report: Australian Panel

Due to the corona virus pandemic, the face-to-face meeting of Australian Panel C6 was cancelled in 2020. A number of teleconferences were held instead.

8. Invitations for SC or WG's 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.

9. 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/B4.37	Medium Voltage DC Distribution Systems	Georgios Konstantinou
C6.38	Rural Electrification	Jacqui Mills (secretary)
C6.38	Rural Electrification	Glen Summers
C6.38	Rural Electrification	Shervin Fani
C6.39	Distribution Customer Empowerment	Sanika Willard (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
C1/C6.42	Planning Tools and Methods for Systems Facing High Levels of Distributed Energy Resources	Rama Ganguli

10. Membership of the Australian Panel

Name	Organisation	Type
Ken Ash	Energ-G Management Group	Consultant
Alex Baitch	BES	Consultant
Ray Brown	RBPE	Consultant
David Butler	TasNetworks	Distribution
Hedy Dalvand	United Energy	Distribution
Sean Elphick	University of Wollongong	University
Shervin Fani	Western Power	Distribution
John Fletcher	University of NSW	University
Jenny Gannon	Energy Queensland	Distribution
Victor Ho	SA Power Networks	Distribution
Laura Jones	TasNetworks	Distribution
Gerard Ledwych	Queensland University of Technology	University
Adrian Lloyd	Energy Queensland	NGN Rep.
Pierluigi Mancarella	University of Melbourne	University
Michael Negnevitsky	University of Tasmania	University
Chirayu Oza	AGL	Retailer
Albert Pors	Endeavour Energy	Distribution
Jenny Riesz	AEMO	Operator
Thomas Smolka	Reinhausen	Manufacturer
David Stephens	Horizon Power	Distribution
Pradip Verma	Pacific Power Association	Distribution
Sanika Willard	CutlerMerz	Consultant
Mike Wishart	EcoJoule Energy	Manufacturer
Wai-Kin Wong	AGL	Retailer

Convener: **Ray Brown**

Email: **ray@rbpe.com.au**

AP D1 Materials and Emerging Test Techniques

1. Study Committee Scope

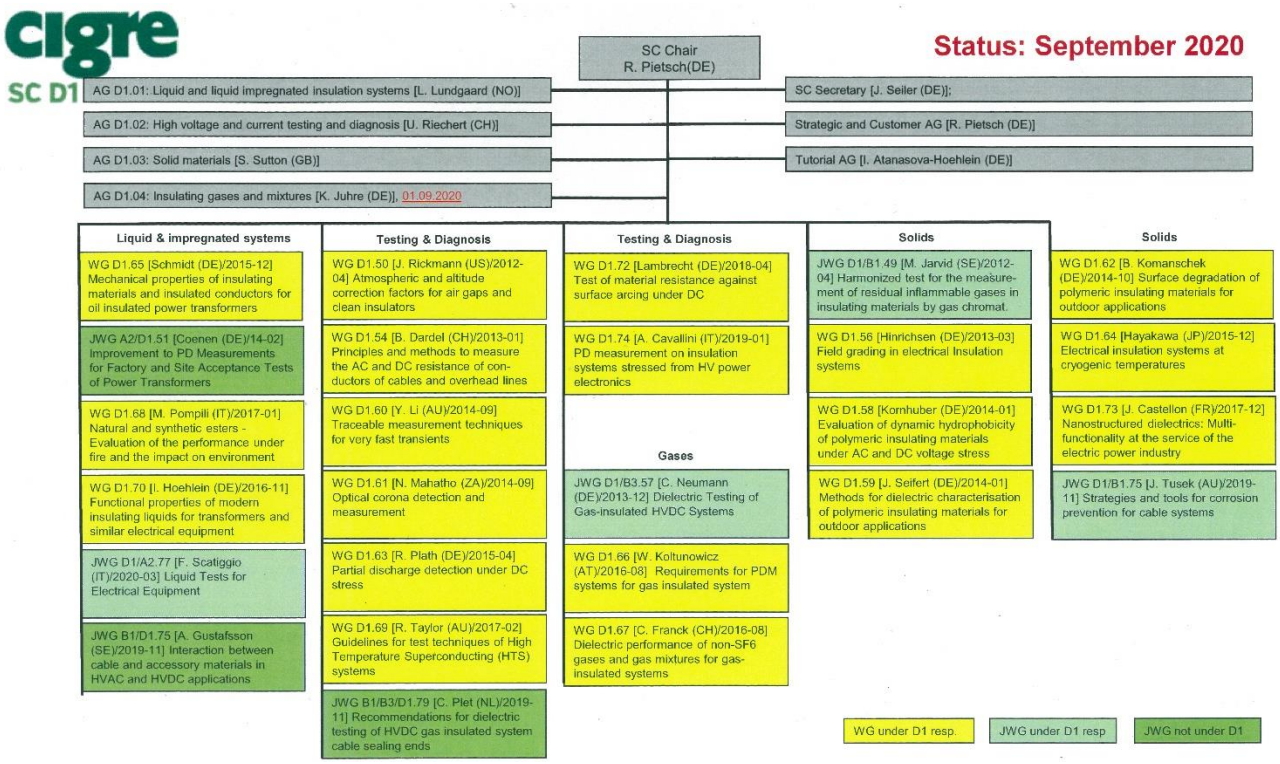
The D1 study committee deals with testing techniques and material developments that support HV plant. It is one of the two horizontal committees that also provide services to other SCs. Typically, D1 partners with a SC to provide engineering and scientific input into their understanding of plant asset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

2. Specific Activities of the Study Committee

At the time of writing this report, SC D1 had not yet met and thus the report does not contain the usual updates that follow this meeting. The SC has 27 working groups active: 22 D1 WGs, 3 JWG D1/X and 2 JWG X/D1. These are detailed in the figure below.



The SC also has very close relationships with IEC technical committees,

TC 2 “Rotating Machines”,
TC 10 “Fluids for Electrotechnical Applications”,
TC 14 “Power Transformers”
TC 28 “Insulation co-ordination” has merged with TC 9 “Insulation co-ordination and system engineering”
TC 36 “Insulators”,
TC 42 “High-Voltage and High-Current Test Techniques”, there is a need for a liaison
TC 90 “Superconductivity”,
TC 112 “Evaluation and Qualification of Electrical Insulating Materials and Systems“

Activity overview,

- New WGs that have been approved since report:
  - WG D1.74, “Partial discharge measurement on insulation systems stressed from HV power electronics”
  - WG B1/D1.75, “Interaction between cable and accessory materials in HVAC and HVDC applications”.
  - WG D1/B1.75, “Strategies and tools for corrosion prevention for cable systems”
  - WG D1/A2.77, “Liquid tests for electrical equipment”
  - WG B1/B3/D1.79, “Recommendations for dielectric testing of HVDC gas insulated system cable sealing ends”

- One Technical Brochures have been published in 2020
  - TB 794 – Field grading in electrical insulation systems – WG D1.56

3. Preferential Subjects

Preferential subjects for 48th Paris e-Session 2020

D1 - MATERIALS AND EMERGING TEST TECHNIQUES

PS 1 : Testing, Monitoring And Diagnostics
- Experience and insight from monitoring systems.
- Reliability of test equipment and systems for testing, monitoring, and diagnostics.
- Data handling, analytics, and advanced condition assessment.

PS 2 : **Functional Properties And Degradation Of Insulation Materials**
- New stresses, e.g. power electronics, load cycling, higher temperatures, and compact applications.
- Materials with lower environmental footprint, during production, operation, and disposal.
- Characterisation methods for validating functional properties.

PS 3 : Insulation Systems Of Advanced Components
- Materials under high stresses, e.g. field stress, flux, electric current, and frequency.
- Experience and requirements for new test procedures and standards.
- Development of new materials, e.g. 3D printing; lamination; casting; and additive or subtractive manufacturing.

4. Proposed New Working Groups

These are the new WG proposed for D1 although new proposals are expected during the meeting in New Delhi.

1. Draft TOR G N° D1/B4/...YY, PD measurements for insulation systems stressed by HV power electronics
2. TOR set to be approved by SC D1 for follow up to WG D1.71, to target Corrosion Management. JWG with B1 is proposed and likely to be formed in early 2020, proposed Convenor J.Tusek.

3. Draft TOR General Oil Test (GOT) of insulating liquid for electrical equipment – aims to review elements that lead to variability in DGA from sample collection through to processing with the aim of reducing differences in outcomes from different providers.

5. Specific Activities of the Australian Panel

In 2019 there were no activities of the D1 Panel associated with promotion outside of awareness initiatives within member's organisations.

6. Meeting Report: Australian Panel

The Australian Panel of D1 held a virtual meeting on 9 July 2020. This was the first meeting of AP D1 convened by the new AU D1 convenor Yi Li from the National Measurement Institute. This was a full day meeting with attendance of 17 members and guests.

Below is a record of the meeting:

Session 1:

Self-introduction of members:

- All members and guests have introduced themselves and outlined their roles in their respective organisations.

Confirmation of minutes of 2019 meeting:

- The meeting minutes have been accepted all and if there any comments or changes they are to be sent to Yi Li by COB 10th of July 2020.

Matters arising from minutes:

- No issues or matters from the previous minutes were discussed

Session 2:

SCD1 – General Presentation – Review of 2019/20:

- Yi Li has shared the study committee organisational chart and the SC D1 Tutorials 2019. These can be downloaded from the Cigre website. Cigre can present these tutorials to an organisation if they are interested. There are some costs associated with this.

CIGRE Australia update – ATC annual report, Corona Times:

- Corona Times July has been published which has a section of the AU D1 panel.

NGN Update:

- There is a new NGN committee for 2020, Sam Murali is the D1 NGN Liaison.
- There have been a couple of catch up meetings so far to introduce the new members and format for NGN this year.
- Encourage all young engineers to join the NGN
- The NGN also has a women in engineering committee.

Session 3A:

Australasian Transformer Innovation Centre – Professor Tapan Saha, UQ:

- Introduction to the Transformer Innovation Centre
- TIC has several industrial and research partners
- There are several industry benefits in joining TIC
- TIC is driven by an industry advisory steering committee (ASC)
- All the funding from the industry is spent on research within the centre.
- TIC have state of the art facilities donated by several industry partners.
- Innovation in decreasing the transformer risk, reducing maintenance risk, investigating in improving performance and increasing transformer utilisations.
- TIC hold several profession development courses. Eight CPD courses have been developed and delivered.
- There are two advanced courses scheduled for 2020

Joe Tusek has suggested sharing one of the projects from the TIC in the future, Tapan has advised Muhammad will share one of the projects later today.

Non-conventional end of life test for transformer cellulose insulation, Professor David Allan, UQ:

- David worked on testing aspects on the end of the life of transformers in 2013-14.
- Towards the end of last year TIC ran a course on Transformer Insulation master class.
- How do you measure the end of cellulose insulation? David shared that the abrasion test in the best method in determining end of life of transformers.
- There is a range of standards for various materials. However none were applicable to Karft Paper.
- David and Chris Krause from Weidmann are working on a test method for non-conventional testing of transformer insulation.
- Joe just edited a chapter for WG D1.65 and thinks it worth David discussing and sharing with Lars SCHMIDT (Convenor) as there are some similar topics discussed in this WG.
- DP is regarded as a benchmark for the ageing of the transformer.
- David had pigeon holed the project until Chris Krause started the discussion with David during the TIC master class.

Substation steelwork refurbishment, Sam Murali, TransGrid:

- TransGrid has 110 substations with 30% of them commissioned before 1970
- Gantry steelwork and hold down bolt corrosion is an emerging issue for TransGrid
- TransGrid have looked at various options such as refurbishment, steelwork replacement and substation rebuild.
- Several key challenges with in-situ steelwork refurbishments
- Footing remediation has been successful
- TransGrid will further investigate steelwork replacement and rebuild options

Condition monitoring based on PD diagnostics: recent development using machine learning methods, Shibo Lu, UNSW

- General procedures for machine learning based PD Diagnostics.
- Sharp increase in deep learning partial discharge recognition in recent years.
- Larger model size seems to provide highest accuracy
- Deep learning models are typically black box models

Solid insulating materials with better tracking, erosion and flame retardant properties, Muhammad Tariq Nazir, UNSW

- Insulator tracking/ erosion resistance
- Experiments are performed with Silicon ATH, AIN and BN insulators.
- Bushfire cases – Developing coating materials for timber poles

A distributed overhead power line monitoring system, Toan Phung, UNSW

- A small motoring unit attached to the power pole
- In built monitoring
- Self-powered unit using LoRa WAN
- Fully optical approach to measuring voltage/current in real time.
- The communication has been tested at various locations
- The practical applications to reduce stop high impedance faults resulting in bushfires.
- Challenges – High Impedance Faults (HIF)
- Outdoor testing occurred at NMI last year.

Grounding system testing including ground impedance measurement, step & touch voltage measurement, Wenyu Guo, Omicron:

- A quick overview: ground impedance, step & touch voltage, reduction factor/current splits, soil resistivity and ground grid integrity.
- There is several examples of earth grid testing and practical applications of testing for substation applications.
- Joe has advised of the safety risk and partial implications of earth grid testing in Substations and Power Stations.

Session 3B:

Condition Monitoring of Transformer using Fibre Optics Sensors – Muhammad Abdul Hafeez Ansari, UQ

- Introduction of the transformer
- Three main parameters that effect the transformer: heat, moisture and oxygen.
- Three main techniques to measure moisture: chemical, electrical and optical.
- The most popular method to measure moisture is the Karl Fisher Titration.
- Optical fibre Bragg grating sensors are used to analyse and determine moisture
- The response has been measured in air, oil and FR3
- The performance of fibre Bragg grating sensors were tested on transformers in the lab with both mineral oil and FR3.
- There have been several comparisons to various methods to bench mark the fibre optic measurement.

Updates on high-voltage activities at National Measurement Institute, Yi Li, NMI:

- Australian Government
- New test and measurement capabilities:
    - 200 kV digital voltage transformer calibration system.
    - 100 kV precision AC/DC resistive divider

- Impulse testing
- Global innovation linkage project – Power Quality of future electricity networks
- NMI have undertaken several international comparisons.
- Participation of TC42 work.

NMI mobile testing and calibration facility – Winston Yan, NMI:

- NMI have demonstrated benefits of on-site test and calibration.
- NMI have a mobile laboratory with a tail gate loader
- Sufficient height for a 500 kV reference capacitor in the new truck
- The new sensor can extend the on-site calibration capability to 500 kV.
- Portable lightning impulse and switching impulse reference measurement systems.
- NMI also have other on-site calibration

Insulation information from sweep frequency (10 to 500HZ) Power Factor measurement - field experience on circuit breaker SRBP bushings – Prasanna Wickramasuriya, Energy Queensland:

- High frequency FDS has been used on Circuit Breaker SRBP bushings to detect failures.
- Using winding resistance measurements to detect OLTC silver contact problems due to corrosive sulphur. The measurements show that it is not a perfect V shape and has lots of variances.
- EQ has success of using simple diagnostic methods to detect issues in Circuit Breakers, tap changers, transformers.
- Online PD-TEV, has prevented several failure for EQ

Practical diagnostic tools, Prasanna Wickramasuriya, Energy Queensland:

- The above presentation was joined together

Various Topics by Joe Tusek:

- During the test methodology development, it was identified that the previously supplied calibration certificate gave incorrect rise time for non-classical waveforms.
    - The oscilloscope gave ~17 ns where the calibration certificate shows 7 ns.
- Verico has recently commissioned a VT reference 330 kV standard. The OEM calibration was significantly out of specification on one range ~280ppm.
- Verico has a coupling capacitor failure
- Contact resistances when are they bad? There are some literature suggests that 100 µohm is a transitions into unstable resistance.
- Joe has experienced tin whiskers in his own electronics.
- Joe has also experiences in electronic component failure in ICs.
- Joe has an upcoming paper in the Cigre e-session discussing cable testing below 20 Hz.

Session 4:

Doble - Operator Experience DIAEL Bluebox technology - Karl Haubner:

- On line partial discharge monitor has several advantages.
- The most common sensor is a high frequency current transformers
- The location of the sensors are crucial.
- The software has the capability to do noise suppression and multiple channel data localisation.
- The Bluebox system is based on a PicoScope
- The system has automatic and manual filtering
- The have a similar method to 3PARD
- PD measurements can be made via voltage indictors but it is not perfect.

Ausnet Experiences – Mark Cotton:

- Frequency response on the bushings – Cigre bushing reliability guide
- Ausnet have had RIP bushings that have failed PD tests in the factory.
- Ausnet believe this occurs after the thermal testing.
- The failures are shown above hat
- They have recommissioned a SVC, 100MVAR and there is already growth.
- Ausnet are buying equipment to remove corrosive online over a number of years. The cycle takes 20-30 days to remove
- Bushing DDF measurements understand where you are with bushings,
- Ausnet is trialling RIS bushings

Review of Cigre publications, Paris 2020, AU D1 web space and AOB – Yi Li

- Yi Li has presented all of these items to the committee and Dr Yi will share with the committee how to access the Cigre Knowledge Management System (KMS). Yi Li would send out login invitation the day after the meeting.

Discussion of next meeting:

- It was decided to wait for a few months before looking at options of next meeting

7. Invitations for SC or WG's to meet in Australia

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

8. 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 (Convenor)

WG	Title	Australian Member
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)

9. Membership of the Australian Panel

Name	Organisation	Type
Joe Tusek	Verico	Consultant
Prasanna Wickramasuriya	Energy Queensland	Distribution
Wenyu Guo	Omicron	Manufacturer
Mark Cotton	AusNet Services	Transmission
James Baker	Essential Energy	Distribution
Karl Haubner	Doble	Manufacturer
Mukesh Sharma	Hitachi ABB Power Grids Australia	Manufacturer
Andrew Wilkinson	ElectraNet	Transmission
Sam Murali	TransGrid	Transmission
Dharmendra Shah	Powerlink	Transmission
Prof Tapan Saha	University of Queensland	University
Dr Yi Li	National Measurement Institute	Other
A. Prof Toan Phung	University of NSW	University
Prof Trevor Blackburn	University of NSW	University

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AP D2 Information Systems and Telecommunication

1. 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.

2. 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) Legacy network migration continues – mostly to IP/MPLS and MPLS-TP. For some utilities, there is a need to retain TDM (SDH/PDH) in the medium term (at least next 5 years)
b) Cybersecurity uplift continues. Wider adoption of OT frameworks and standards and BPs (AESCSF, ASD recommendations, ISO27k1). Australian utilities have been increasing in cybersecurity maturity in the last 5 years.
c) Exploring new technologies and methods to improve operations – including IoT, virtualisation / NFV, service orchestration and automation, lithium ion battery systems (for telecommunications sites), teleprotection over packet networks.

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 Paris e-Session 2020 saw 58 papers from 27 countries with 4 papers from D2 Australia.

The D2 Panel meeting was held online via web conferencing this year on 29 and 30 July 2020 with 25 attendees.

3. Paris 2020 e-Session, Online (25 – 26 September 2020)

Preferential subjects (PS) were as follows:

a) THE IMPACT OF EMERGING INFORMATION AND COMMUNICATION TECHNOLOGIES ON ELECTRIC POWER UTILITIES
   i. The potential of Machine Learning and Artificial Intelligence in improving operations.
   ii. Enhancing asset and lifecycle management using the Internet of Things, Big Data, and Analytics.
   iii. The role of Blockchain in facilitating efficiency of market operations.
b) NEW CYBERSECURITY CHALLENGES IN THE CHANGING ELECTRICITY INDUSTRY
   i. Cybersecurity challenges in the use of the Internet of Things, Big Data, and Cloud-based platforms.
   ii. Cybersecurity challenges related to Distributed Energy Resources and interconnection of new flexibility providers.
   iii. Identification of cybersecurity threats using Big Data analysis and Machine Learning.
c) INCREASING OPERATIONAL EFFICIENCY USING PACKET SWITCHED COMMUNICATION TECHNOLOGIES
   i. Challenges in the migration to packet switched networks.
   ii. Supporting the changing electricity industry with the use of existing and new communication technologies.
   iii. Supporting time critical operational services with time distribution and synchronisation.

A total of 58 papers were presented.

TB 796 (Cybersecurity: Future threats and impact on electric power utility organizations and operations) was presented in a Tutorial on Friday 28th Aug 2020.

4. Working Group Status

The summary of working group status is shown in Figure 1.

WG	Title	Convenor	Supervising AG	2020		2021		2022		2023	
				S1	S2	S1	S2	S1	S2	S1	S2
WG D2.43	Enabling Software Defined Networking for EPU telecom applications	V. TAN (AU)	AGD2.03								
WG D2.44	Usage of public or private wireless communication infrastructures for monitoring and maintenance of grid assets and facilities	P. MULVEY (IE)	AGD2.03								
WG D2.45	Impact of governance regulations and constraints on EPU sensitive data distribution and location of data storage	H. KLIMA (AT)	AGD2.02								
JWG B5/D2.67	Time in Communication Networks, Protection and Control Applications – Time Sources and Distribution Methods	QIAOYIN YANG (CN)	AGD2.03								
JWG D2/C6.47	Advanced consumer side energy resource management systems	A.A. NEBERA (RU)	AGD2.01								
JWG D2/C2.48	Enhanced information and data exchange to enable future transmission and distribution interoperability	G. TAYLOR (GB)	AGD2.01								
JWG B2/D2.72	Condition Monitoring and Remote Sensing of Overhead Lines	Y. CHEN (CN) A. KULKARNI (GB)	AGD2.01								
WG D2.49	Augmented reality to support EPUs operation and maintenance	S.H. KHALAJ (IR)	AGD2.01								
WG D2.50	Electric power utilities' cybersecurity for contingency operations	D.K. HOLSTEIN (US)	AGD2.02								
WG D2.51	Implementation of Security Operations Centers (SOC) in Electric Power Industry as Part of Situational Awareness System	V. KARANTAEV (RU)	AGD2.02								
WG D2.52	AI Application and Technology on Power Industry	KUN LUN GAO (CN)	AGD2.01								
WG D2.53	Technology and Applications of Internet of Things in Power Systems	ZHENGYUN SUN (CN)	AGD2.01								

Figure 1 - SC D2 working group status

The following Technical Brochures have been published:

- TB 782 "Utilization of Data from Smart Meter System"
- TB 796 "Cybersecurity: Future threats and impact on electric power utility organizations and operations"

5. Specific Activities of the Australian Panel

The D2 Panel meeting was held online via web conferencing this year on 29 and 30 July 2020 with 25 attendees.

6. Membership of the Australian Panel

Name	Organisation	**Type** **V**endor **T**x Utility **D**x Utility **G**x Utility **C**onsultant **A**cademic
Aaron Gates	Western Power	T
Adam Hoare	Transgrid	T
Ahmad Taufiq	Origin Energy	G
Andy Hemming	Transpower	T
Aruna Yahampath	Endeavour Energy	D
Chris Yuen	Horizon Power	D
David Conway	Powercor	D
David Paramandan	CommTel	V
David Taddeo	GHD Pty Ltd	V
James Cole	ActewAGL	T, D
John Grace	Genesis Energy	D
Josh Cunningham	TasNetworks	T
Mark Mullins	Tesla Consultants	C
Mark Remmer	Powerlink	T
Paul McKeen	Energex	D
Rohan Fernandez	ElectraNet	T
Ross Gaspard	PSC New Zealand	C
Sumith Withanage	Power and Water Corporation	T, D
Thoai Ton	Ausnet	T
Tony Myatt	SA Power Networks	D
Victor Tan	VTan Consulting	C
Warwick Glendenning	Wellington Electricity	D

Convener: **Victor Tan**

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Phone: **08 7079 0301**

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

1. 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

2. 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

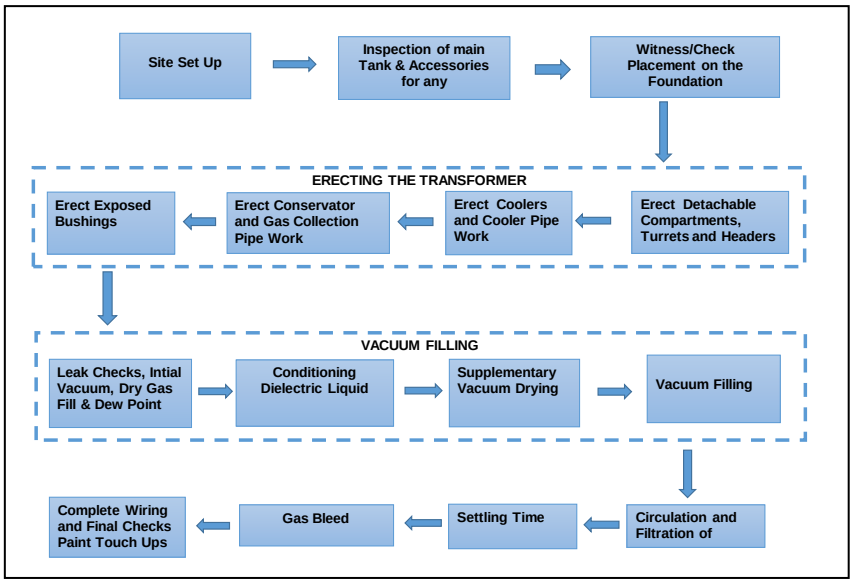
The Delhi meeting focussed on the work of TF1 site installation. A standard TB draft had been prepared by WG secretary Mike Lamb based on the extremely detailed and lengthy TF1 site installation chapter. This draft was reviewed and condensed. The IEEMA installation flow chart was reviewed. This flowchart was regarded to be too detailed to use as an introductory discussion in the site installation chapter but may be used to help draft a generic and fundamental version. Agreement was reached on how the structure and flow of the site installation chapter will be based on an introductory flow chart that details these fundamental tasks and the task sequence.

The opening detailed discussion on EHS, regulatory constraints and risk assessments was viewed to be too dry and cumbersome for the reader to wade through and will moved into the appendix so that the chapter commences with the flowchart and the sequence of titles for chapter sub clauses will be named and taken in the order shown on TB installation flowchart.

2020

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

Draft of the site installation flowchart presented and then discussed by the WG.



Draft TB Rev 1 was then reviewed. Chapter 1 Site Installation. WG decided to introduce new chapter on ‘’Site Preparation” to precede ‘’Site Installation”. A detailed review of Site Installation. Chapter 2 Site Acceptance Tests. Review Q19 from WG survey. Functional tests to be added. Review overall flow chart and made changes to SAT to now read Pre-commissioning. Proposed Chapter 3 Trial Operation draft was reviewed

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

5 May – Draft TB Rev 2 was reviewed. Discussed draft Figure 1 (context of TB in life cycle flowchart). Latest draft of Chapter 3 reviewed. Gaps identified in TB draft such as tests required for reactors, Green Book chapters 14 and 15 on Pre-Commissioning and Trial Operation were presented by Simon Ryder and reviewed

27 May – Draft TB Rev 3 was reviewed. Discussed latest revision to Figure 1 flowchart. Latest draft of Chapter 3 presented. Discussion on site electrical testing and WG survey results. Discussion on dew point moisture measurement and determination of dryness.

9 June – Draft TB Rev 4 was reviewed. Review new chapter 1 on Site Preparation. Further review of site installation chapter.

24 June – Draft TB Rev 5 was reviewed. Discussed need for more discussion on FRA and case examples. Discussion on fall arrest methods and need for example photo(s). Discussion on EPRI EL-5384 report and use of vapour pressure equations to produce a TB dew point graph. Further detailed review of site installation tasks, especially assembly of bushings, conservator and coolers.

8 July – Draft TB Rev 6 was reviewed. Discussed latest revision to Chapter 4 Trial Operation presented. Discussion on comments by Gilson on Chapter 1 Site Preparation and Chapter 2 Site Installation. Review of Chapter 3 Pre-commissioning. Discussion on draft TB dew point measurement graphs and derived determination of dryness.

22 July – Draft TB Rev 6 was further reviewed. Focus was on contributions to Chapter 3 Pre-commissioning and these were discussed in detail. Discussion on site electrical testing and WG survey results. Discussion on dew point moisture measurement and determination of dryness.

9 September – Chapter 2 Installation discussion on liquid fill diagrams. Discussed Partial fill requirement for stored transformers, spare transformer installation, strategic spares. Dew point measurement reviewed. Research by Ross and Matt Gibson on Dew point discussed. Potential for a CIGRE Science and Engineering paper on this topic – draft to be prepared by Matt and Ross. Alternative liquid requirements to be added. Chapter 4 Trial Operation now includes DGA on tapchangers. Need similar discussion on main tank DGA and case examples in trial operation.

7 October – Chapter 2 Installation discussion on fall arrest and fall restraint. Chapter 3 Pre-commissioning was reviewed with focus on regulatory requirements, functional checklists.

4 November – Chapter 2 Installation discussion on contribution from Alan Sbravati of Cargill on ester liquid handling, precautions and testing. Chapter 4 Trial Operation discussion on using DGA key gas method to identify nature of any developing gassing during trial operation. Operators need to understand not only the nature of gassing but also its relative severity and guidelines on actions to be taken to manage a developing DGA issue. TB 738 for on-line DGA was also reviewed to qualify how its application applies during trial operation.

The TB is developing very well as a much-needed guideline to inform all stakeholders when procuring new transformers or reactors. This work is also being incorporated into a SC A2 Green Book on Transformer Procurement.

3. Working Group Program

It is planned at this stage that a draft Technical Brochure document, ready for comment, will be completed in Q1 or Q2 2021 for the SC Chair to review. The TB document can then be finalized, along with a tutorial and Electra article for the 2021 Study Committee meeting in August 2021.

The NGN liaison on AU A2, Mrs Sanika Willard, has now joined the WG in the capacity of editor of our TB. Her involvement assists in both the representation of NGN and women active in CIGRE.

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Working Group C1.38 Valuation as a comprehensive approach to asset management in view of emerging development

1. Working Group Scope

The WG will carry out a survey of international practice in the justification of asset sustainment investments and the management of risk in asset investment decision-making.

The survey would include topics such as:

- How asset health and asset criticality are used in expenditure decision making;
- How asset risk management is applied by organizations and in their governance;
- The influence of regulatory regimes on asset investment decision making practices;
- Degree of integration between defining investments for CAPEX (Capital Expenditure) and O&M (Operations & Maintenance) expenditures decision making;
- Degree of integration in CAPEX decision making for different types of assets;
- Degree of integration of replacement/refurbishment capital expenditure (system sustainment) with new assets capital expenditure (system development);
- Use of prioritisation frameworks and criteria (e.g. reliability, safety, etc.);
- Extent of the use of monetization of risk, specifically in valuing consequence of failure, in investment decision making, including descriptions of how valuations are calculated for impacts on corporate key performance indicators such as reliability, safety, environment, asset value, regulatory compliance, customer service, “brand name” protection etc.;
- Risk assessment for high impact low probability events and economic justification for mitigations.

Terms of reference.

2. Working Group Activities

The working group was approved in April 2017. The Technical Brochure (TB 791) and Electra Article were published in April 2020.

3. Working Group Program

Phase	Milestone	Date	Progress
Initiation	Commence working group	May 17	Complete
Survey	Design survey	May 18	Complete
	Carry out survey	July 18	Complete
	Analysis	March 19	Complete
Prepare Report	Draft report for comment by SC	October 19	Complete
	Technical Brochure, Electra article ready	March 20	Complete

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Working Group C1.41, Closing the gap in understanding between stakeholders and electrical energy specialists.

1. Working Group Scope

This working group is examining the gap in understanding amongst the various stakeholders of the range of technical issues from a planning perspective related to the changing nature of the power system. It will review how stakeholders perceive this gap and what is being done across the world to improve the level of understanding, particularly of the non-technical stakeholders. The working group members are technical and non-technical personnel, with the latter having particular expertise in communication and/or stakeholder engagement.

(Note: we are not trying to define a "good stakeholder engagement process". Instead, we are trying to make concrete steps towards improving understanding, both in sector specialists' understanding of what stakeholders want from them and stakeholder understanding of some key issues).

The TOR is available at the following link:

https://www.cigre.org/userfiles/files/News/2018/TOR-WG%20C1_41_Closing%20the%20gap%20in%20understanding%20between%20stakeholders%20and%20electrical%20energy%20specialists.pdf

2. Working Group Activities

Work commenced at the end of 2018 and the first face-to-face meeting was held in the UK in October 2019. All other meetings have been by teleconference and more recently by video conferences. The last meeting was held on July 29, 2020. There are 25 members from 16 countries with subgroups in the UK and the US to enable additional input from those countries.

To date, twenty-four case studies have been prepared from around the world, which illustrate the gaps in understanding amongst the various stakeholders. Some of the issues raised include the following:

i. There is a lack of a trusted, impartial voice within the industry and a significant level of misunderstanding due to the lack of easy to understand resources with verifiable information. Some stakeholders now expect more options to interact with flexibility and an engaging experience where their view is heard and taken into account. They want these interactions to occur when they want them to, often via a mobile device.

ii. Complex negotiations may need educated stakeholders to represent the various stakeholder groups. The goal of these interactions is to achieve consensus and understanding on the particular problem and the preferred solution.

iii. As the nature of the power system changes, particularly with the introduction of intermittent renewable generation and smart load control options, a number of technical issues are arising that affect power system operation and reliability. These may require complex solutions that are challenging to explain to the broader non-technical stakeholder groups. If explanations are not accepted or considered reasonable, much more expensive solutions may be implemented, leading to pressure on electricity prices. This is a particular issue in Australia and two of the case studies have examined the communications challenges and the solutions that have been applied in this country.

iv. In some cases the use of models to explain the complex technical issues has proved

effective. At the same time, changes are being made to market mechanisms to try to guide commercial solutions to the lowest cost options. Some of these may be administratively costly and complex and be associated with another gap in understanding. The WG has identified a number of models and definitions, which will form part of a layman's and technical glossary in the TB.

Solutions to these challenges have included:

i. Development of a trusted online platform for the exchange of energy information.

ii. The establishment of a community fund to address the issues

iii. The use of plain simple language in all communications materials and the use of multi-channels for communications.

iv. Acceptance and consideration of all stakeholders' different points of view and interest areas.

Following a request from the SC C1 Chair, an article was also produced for the second edition of the new Future Connections publication in January 2020.

3. Working Group Program

All the planned research has now been completed including the production and analysis of 24 case studies to produce four groupings of particular kinds of engagement, a list of stakeholders, a number of models and the early development of a glossary. The remaining activities include the following:

- Produce chapters for TB by delegated WG members – Jan 2021
- Prepare presentations for SC and WG to seek final feedback – Feb 2021
- Finalise TB – April 2021
- Produce Electra article –May 2021
- Produce tutorial if considered appropriate – June 2021.

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Study Committee D1

WG SUMMARY REPORT

WG Nr: D1.60	**Year:** 2020	**Convener:**	Yi Li (AU)
Approved: 26/9/2014		**Secretary:**	Jari Hallstrom (FI)
Title of the Group:			
Number of Members: 20 **Number of countries represented:** 10		**Number of meetings:** 5 **Date of last meeting:** 30 August 2019	

One Page Summary (Scope/Task, Approach, Activities, Achievements, Deliverables, Schedule, …):

Scope :

1. Identify parameters for performance evaluations (calibrations) that are relevant to requirements of present IEC standards and other industrial applications and identify common uncertainty components and their magnitudes.
2. Literature survey of fast transient measurement techniques, not limited to, but relevant to high-voltage field, including hardware (dividers, probes) and digital algorithms.
3. Coordinate development of suitable hardware and software for traceable measurement.
4. Round-robin test of reference measurement systems (e.g., 100 kV, rise time 10 ns)

Deliverables: Report of a round robin test. Report to be published in Electra or technical brochure with summary in Electra

1. The last meeting of the working group was held on 30 August 2019, where tasks for drafting the technical brochure “Traceable measurement techniques for very fast transients” were allocated.
2. Further progress has been made in drafting the technical brochure, with a new version, v6, issued in November 2019. More member contributions had been received since v6 and the convenor is working towards a new version with the contributions.
3. The next working group meeting is planned in August/Sept 2020 during the CIGRE Paris e-Session.