

Australian Technical Committee of CIGRE 2017 Report



This report on the Australian Technical Committee is an introduction to the specific reports from the individual Australian Technical Committee members on the activities of their international Study Committees, Working Groups and Australian Panels for the calendar year 2017.

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David Bones
Chair of the Australian Technical Committee
December 2017

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 (AP) matching the scope of their corresponding CIGRE international Study Committee.

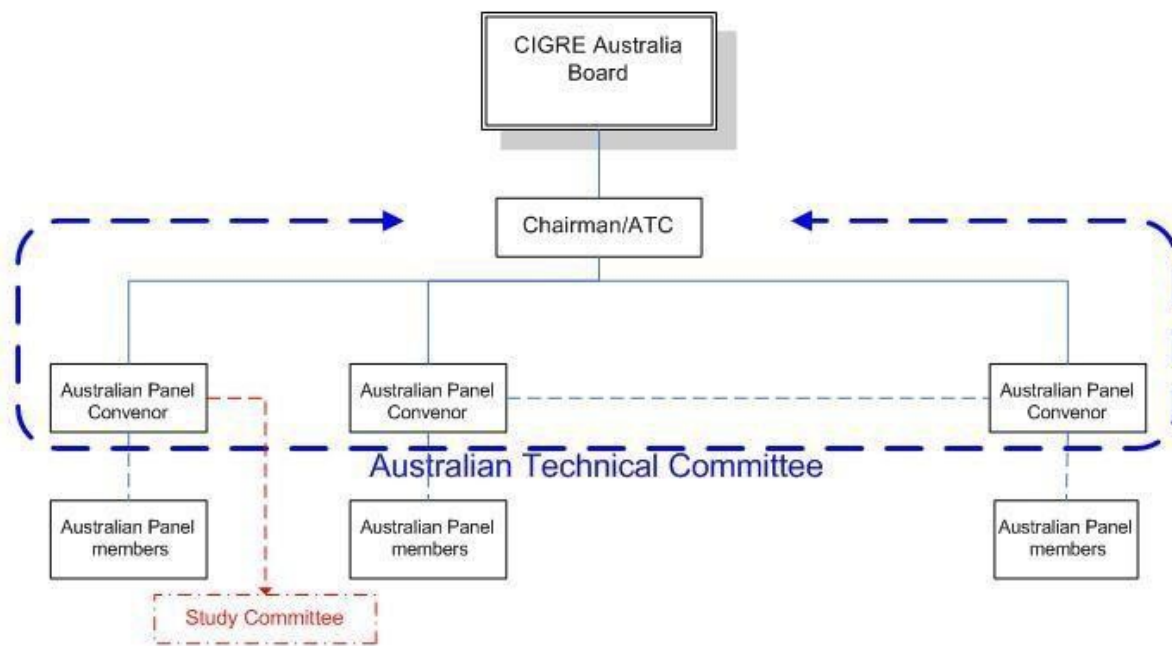
The Technical Committee provides a forum for the ATC members to:

- 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 ANC of CIGRE Board. The CIGRE Australia Executive Manager and Secretary provide administrative support to the committee and a linkage between the CIGRE Australia Board and the Australian Panels for all financial and administrative decisions.

The membership of the Australian Panels comes from individual and collective CIGRE members in Australia and New Zealand, who are expert in the particular technical areas relevant to their Panel. Typically, a Panel has membership of the order of 20 members although a number of the panels have larger membership due mainly to the structure of the electricity supply industry and the value of ANC CIGRE membership. The largest panel currently has 32 members and the smallest has 11 members.

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









The ATC conducts most of its activities during the year by quarterly teleconferences. The main face-to-face meeting was held on the day before the CIGRE Australia Annual General Meeting.

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 every second year. In 2017 six Panel Conveners retired. The following table identifies the retiring conveners and their successor who takes on the role Australian Panel Convener at the 2017 AGM.

CIGRE Australia thanks each of the retiring conveners for the contribution they have made during their term. Each has contributed to the work of CIGRE, supporting the international activities and making international experience and knowledge available to the Australian power industry through effective local panels.

A commemorative plaque was presented to each retiring convener at the 2017 AGM.

Retiring Convener		New Convener
Peter Wiehe APA1 Rotating Electrical Machines (2009 – 2017)		Tri Tran
Richard Joyce APB1 Insulated Cables (2012 – 2017)		Russell Wheatland
Angela Klepac APB3 Substations (2012 – 2017)		Crina Costan
Ian Young APB5 Protection and Control (2011 – 2017)		Peter Bishop
Mark Miller APC2 System Operation and Control (2011 – 2017)		Greg Hesse
Ken Ash APC6 Distribution Systems and Dispersed Generation (2010 – 2017)		Ray Brown

CIGRE Australia currently enjoys excellent access to the international technical activities of CIGRE through Terry Krieg role as the Chairman of Study Committee B3 Substations. In this role Terry is also a member of the CIGRE Technical Council. Terry's term as Study Committee Chairman will end at the 2018 Paris session.

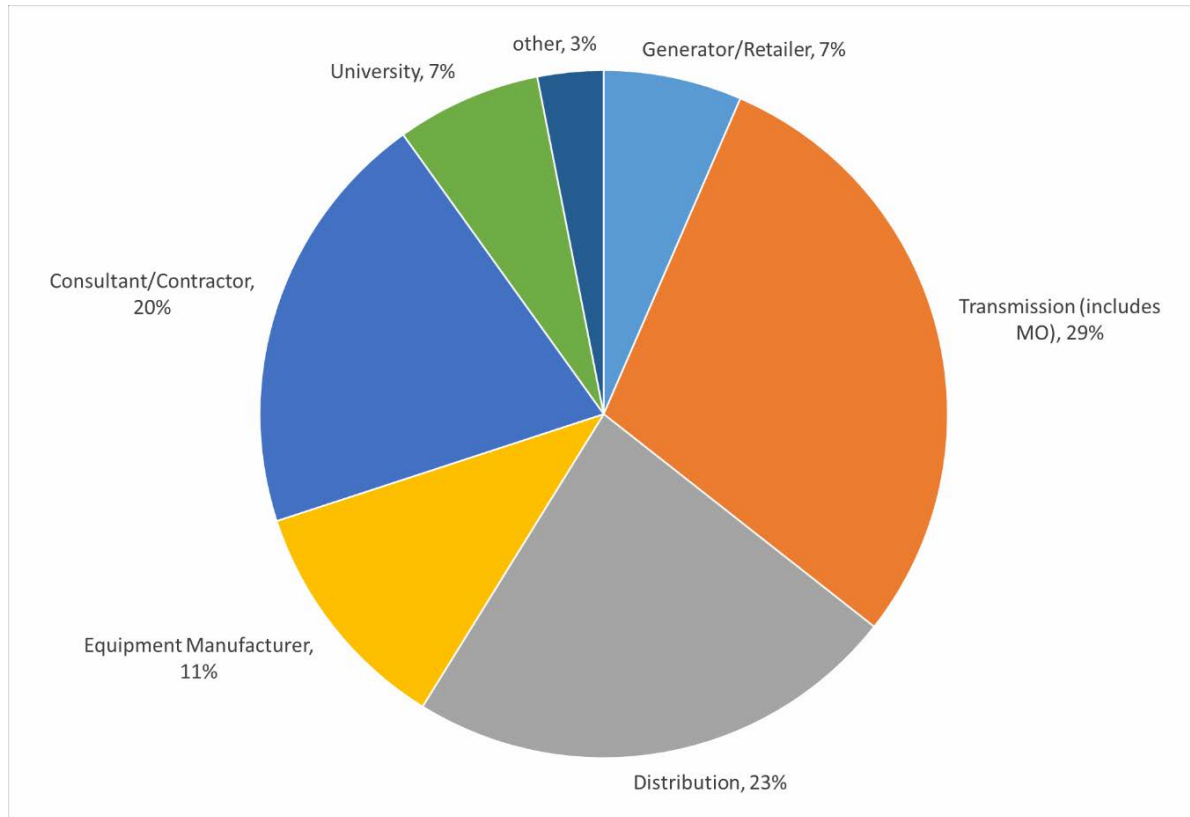
Alex Cruikshank was recently appointed as the next Chairman of Study Committee C5 Electricity Markets and Regulation. Alex will officially commence that role from the 2018 Paris session. Alex's appointment means that CIGRE Australia has enjoyed an extended period of influence over the technical direction of CIGRE having had three Study Committee Chairmen from Australia service overlapping terms on the international Technical Council (Phil Southwell, Terry Krieg and Alex Cruikshank).

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

Australian Panels

Locally, ATC members have convened meetings of their Australian Panels across various Australian States or in New Zealand. These meetings form an important communication structure for CIGRE and its members. Local initiatives also form the basis for future international CIGRE work.

Membership of Australian Panels increased slightly across 2017. Sector representation is shown below.



Each Panel has a dedicated NGN liaison who works with the Panel convener to identify ways to involve the NGN in panel activities.

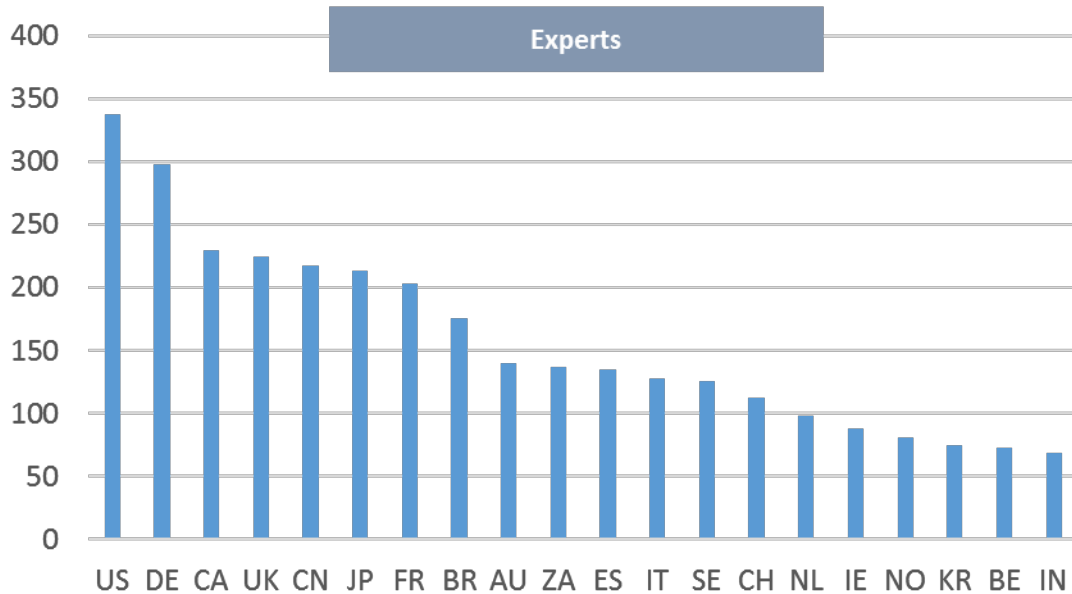
The ATC maintains a calendar that forms the basis of a rotational system that balances the location of the 16 annual panel meetings in each Australian State and in New Zealand.

Each Australian Panel Convener has detailed the activities and membership of their Panel and the key activities undertaken during the year by the international Study Committee and its component Working Groups. The Panel reports and are listed in attachment 3 and copies are made available to members as part of the consolidated 2017 ATC report. The presentations provided at the ATC Technical Seminar held on the day before the AGM provide further insight into international activities highlighting their relevance for the Australian power industry. Copies of the presentation were distributed to attendees.

Working Groups

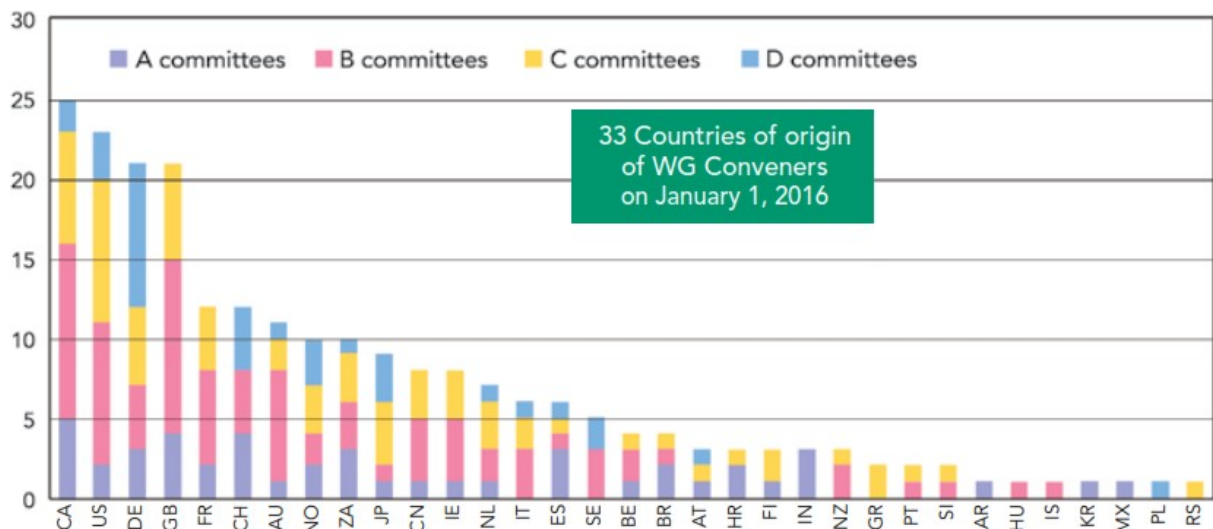
Working Groups are established to perform specific technical activities, which they are expected to carry out within pre-determined periods of time. The primary outputs of Working Groups are technical reports that become industry reference documents detailing state of the art, industry best practice and the direction of the industry. The list of Working Group Brochures published by CIGRE in 2017 is included as attachment 3 to this report. All of these brochures are available for CIGRE Australia members via the e-cigre (<https://e-cigre.org/>).

As at 27 November CIGRE had 239 active Working Groups. CIGRE Australia is currently ranked 9th among all national committees for participation in international 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.



Australia's leadership position is greatly enhanced by CIGRE Australia representatives who convene international Working Groups on topics of significant regional and international interest. These members are considered leaders in their field with the task of addressing industry issues and defining international best practice.

In statistics published in 2016 CIGRE Australia was ranked 7th among all national committees for leadership of international Working Groups¹.



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 funding travel for 10 working group meeting annually.

¹ <http://www.cigre.org/Technical-activities/Study-Committees-Working-Groups> 2016 CIGRE Scope of Work and Activities.pdf

This limited funding is allocated through a rigorous process which considers the relevance of the working group to the Australian Power Industry and the significance of the contribution that will be made by person seeking the travel support. The following table lists the working groups for which funding was provided during 2017.

WG No	WG Name	Convener/Member
A2-49	Condition Assessment of Power Transformers	Peter Cole (C)
A2-58	Site Installation and Pre-commissioning of Power Transformers and Shunt Reactors	Ross Willoughby (C)
B2-64	Inspection and Testing of Equipment and Training for Live-Line Work on Overhead Lines	Alex Price (M)
B2-67	Assessment and Testing of Wood and Alternative Material Type Poles	Ahsan Siddique (C)
B3-43	Contemporary Solutions for Substations in Developing Countries	Peregrine Tonking (C)
B4-63	Testing and commissioning of VSC HVDC Schemes	Les Brand (C)
C1-38	Valuation as a comprehensive approach to asset management in view of emerging developments	Graeme Ancell (C)
C4-40	Revisions to IEC Technical Reports 61000-3-6, 61000-3-7, 61000-3-13, and 61000-3-14	Sarath Perera (M)
C5-22	The Management of Systemic Market Risk in Electricity Markets	David Bowker (C)
D1-69	Guidelines for test techniques of High Temperature Superconducting (HTS) systems	Richard Taylor (C)
D1.60	Traceable Measurement Techniques for Very Fast Transients	Yi Li (C)
D1.71	Understanding and mitigating corrosion	Joe Tusek (C)

Each of the conveners or working group members listed in the preceding table have prepared a report on the key outcomes from their 2017 working group meetings. These reports follow the Australian Panel Annual Reports and are also listed in attachment 2 of this report.

During the 2017 the following working groups previously supported by CIGRE Australia completed their work with technical brochures submitted and awaiting publication:

- A3-29 convened by Ankur Maheshwari;
- C1-32 convened by Graeme Ancell

Congratulations to Ankur and Graeme.

CIGRE KMS

In 2016 CIGRE Central Office adopted the use of the confluence system as the preferred knowledge management system. Confluence has been used by the Australian Panel for many years to provide a collaborative online environment to assist with the management of Panel activities. Across 2016 all relevant material from the CIGRE Australia confluence site was transferred to pages created on the international confluence system.

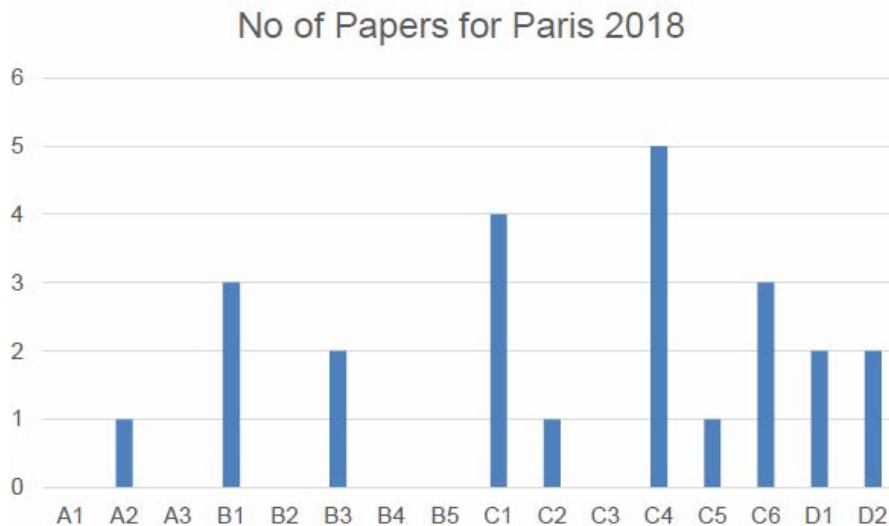
The use of the Confluence knowledge management system is now common across all study committees and working groups. Australian Panels and the ATC rely on the KMS system as the primary communication and collaboration tool. Any panel members who have not set up a KMS login should do so as it will enhance the value they gain from participation in CIGRE.

Study Committee Meetings in Australia

CIGRE Australia did not host any Study Committee meetings in 2017.

CIGRE 2018 Session

A record number of paper synopses were submitted by CIGRE Australia for the 2018 Paris Session. Of the 29 submitted 24 have been accepted for the Paris Session which is also a new record. The following figure shows the distribution of accepted CIGRE Australia papers across the 16 Study Committees.



In addition to preparing papers and contributing to the technical discussion through delivery of interventions, a number of CIGRE Australia member are taking on key roles to support the 2018 Paris Session. They include:

- Terry Krieg retiring SCB3 Chairman
- Alex Cruikshank becomes SCC5 Chairman and Chairs the market disturbance workshop
- Peter Wiehe secretary SCA1
- Wayne Pepper, James Hart, Andrew Halley, Greg Thorpe, Victor Tan are taking on roles of special reporter
- Graeme Ancell is organizing the SCC1 poster session
- Joe Tusek is a member of the SAG and CAG for SCD1
- John McCormack, Peter Dulhunty and Michael Lee are all members of TAG for SCB2
- Andrew Halley and Sarath Perera are members of AG1 of SCC4

Seminars, Conferences and Training

Transformer Workshop - A workshop was held in Sydney on 3 April 2017, and was attended by 74 delegates. The seminar was held in conjunction with Techcon Asia Pacific, which was held at the same venue on 4 and 5 April. The workshop allowed delegates to consider three problem scenarios associated with Transformer specification procurement and installation. A report on the workshop follows the Annual Panel A2 report in attachment 2

SEAPAC South East Asian Protection Automation and Controls conference was held in Melbourne on the 12th and 13th March. The conference had over 140 delegates from 13 different countries with 36



papers presented. The conference also saw 16 exhibitors on relevant technical subjects and provided a great forum for the exchange of information and ideas.

CIDER The 2017 CIDER conference was held in Sydney on 15 and 16 August. The conference was attended by over 100 delegates, included a technical exhibit area with 10 exhibitors, and included 32 presenters across 8 main sessions over the 2 days. The NGN also organised a panel session titled "The Future of Distributed Energy in Australia", which was enjoyed by all attendees.

Australian Panels have also organised a number of technical sessions associated with their annual panel meetings. The format of the session varied from a formal seminar with papers presented to technical workshops open to CIGRE members who are not members of that panel and guests of the organization hosting the panel meeting.

Further information on events is available on the CIGRE Australia website.

Thank You

On behalf of the ATC and CIGRE Australia, I thank those member organisations in Australia and New Zealand who have most generously hosted and/or sponsored Australian Panel events during 2017.

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

David.bones@ghd.com

Attachment 1 – Members of the ATC

Chairman ATC	David Bones
Secretary ATC	Phil Coughlan
A1 Rotating Machines	Tri Tran
A2 Transformers	Ross Willoughby
A3 High Voltage Equipment	Wayne Pepper
B1 Insulated Cables	Russell Wheatland
B2 Overhead Lines	John McCormack
B3 Substations	Crina Costan
B4 HVDC Electronics	Les Brand
B5 Protection & Automation	Peter Bishop
C1 System Development and Economics	Graeme Ancell
C2 Operation and Control	Greg Hesse
C3 System Environmental Performance	James Hart
C4 Technical Performance	Andrew Halley
C5 Markets and Regulation	Alex Cruikshank
C6 Distribution Systems and Dispersed Generation	Ray Brown
D1 Materials & Emerging Test Techniques	Joe Tusek
D2 Information and Telecommunications	Victor Tan
International Technical Committee	Terry Krieg
Executive Manager	Terry Killen
Secretary	Kerry Williams



Attachment 2 – Annual Reports by the ATC

Australian Panel Annual Reports

CIGRE_Annual_Report_AP_A1_2017.pdf
CIGRE_Annual_Report_AP_A2_2017.pdf
CIGRE_Annual_Report_AP_B1_2017.pdf
CIGRE_Annual_Report_AP_B2_2017.pdf
CIGRE_Annual_Report_AP_B3_2017.pdf
CIGRE_Annual_Report_AP_B4_2017.pdf
CIGRE_Annual_Report_AP_B5_2017.pdf
CIGRE_Annual_Report_AP_C1_2017.pdf
CIGRE_Annual_Report_AP_C2_2017.pdf
CIGRE_Annual_Report_AP_C3_2017.pdf
CIGRE_Annual_Report_AP_C4_2017.pdf
CIGRE_Annual_Report_AP_C5_2017.pdf
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CIGRE_Annual_Report_AP_D1_2017.pdf
CIGRE_Annual_Report_AP_D2_2017.pdf

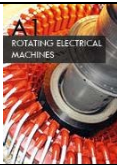
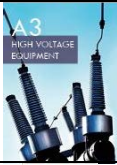
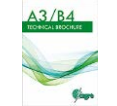
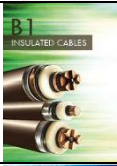
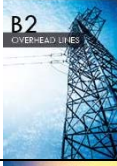

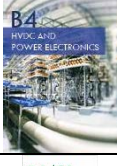

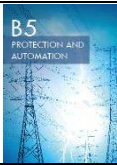
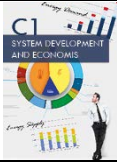
Reports on Working Groups supported by ANC of CIGRE

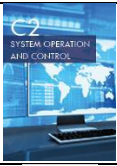



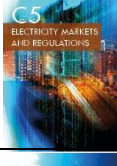
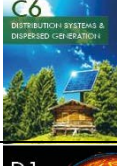


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CIGRE_Working_Group_Report_WG_B2_64_2017.pdf
CIGRE_Working_Group_Report_WG_B2_67_2017.pdf
CIGRE_Working_Group_Report_WG_B3_43_2017.pdf
CIGRE_Working_Group_Report_WG_B4_63_2017.pdf
CIGRE_Working_Group_Report_WG_C1_38_2017.pdf
CIGRE_CIREN_Working_Group_Report_WG_C4_40_2017.pdf
CIGRE_Working_Group_Report_WG_C5_22_2017.pdf
CIGRE_Working_Group_Report_WG_D1_60_2017.pdf
CIGRE_Working_Group_Report_WG_D1_69_2017.pdf
CIGRE_Working_Group_Report_WG_D1_71_2017.pdf

2017 Event Reports

CIGRE_Event_Report_A2_2017.pdf
CIGRE_Event_Report_D1_2017.pdf

Attachment 3 – Brochures published by CIGRE in 2017

Study Committee	TB Number	Title
	690	Vibration and Stability Problems Met In New, Old and Refurbished Hydro generators root causes and consequences
	682	Survey on hydro generator instrumentation and monitoring
	696	MO surge arresters - Metal oxide resistors and surge arresters for emerging system conditions
	693	Experience with equipment for series and shunt compensation
	683	Technical requirements and specifications of state-of-the-art HVDC switching equipment
	689	Life cycle assessment of underground cables
	680	Implementation of long AC HV and EHV cable systems
	695	Experience with the mechanical performance of non-conventional conductors
	694	Ground potential rise at overhead AC transmission line structures during power frequency faults
	686	Mitigating the effects of arcs in M.V. switchgear
	674	Benefits of PD diagnosis on GIS condition assessment
	699	Control methodologies for direct voltage and power flow in a meshed HVDC grid
	697	Testing and commissioning of VSC HVDC systems
	675	General guidelines for HVDC electrode design
	684	Recommended voltages for HVDC grids
	687	Experience concerning availability and reliability of digital substation automation systems dsas
	701	Review of drivers for transmission investment decisions
	681	Planning criteria for future transmission networks in the presence of a greater variability of power exchange with distribution systems
	700	Challenges in the control center (EMS) due to distributed generation and renewables

Study Committee	TB Number	Title
	677	Power system operator performance: corporate, operations and training goals and KPI's used
	688	Development of reliability standards and market rules
	679	Environmental impact of dispersed generation
	707	EMC in wind energy systems
	704	Evaluation of lightning shielding analysis methods for EHV and UHV DC and AC transmission lines
	702	Application of phasor measurement units for monitoring power system dynamic performance
	710	Impacts of environmental policy on power markets
	709	Drivers for major change to market design
	692	Market price signals and regulatory frameworks for coordination of transmission investments
	678	Smart metering, regulatory aspects, standards and development status
	706	Guidelines for the use of statistics and statistical tools on life data
	705	Guidelines for altitude correction of pollution performance of insulators
	703	Insulation degradation under fast, repetitive voltage pulses
	691	Pollution test of naturally and artificially contaminated insulators
	676	Partial discharges in transformers
	698	Framework for EPU operators to manage the response to a cyber-initiated threat to their critical infrastructure
	685	Communication solutions for information exchange in the smart delivery of electrical energy



AP A1 Rotating Electrical Machines

1. Study Committee Scope

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

2. Specific Activities of the Study Committee

Study Committee A1 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 such plant. The convener is Juergen Weidner (Germany).

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 such plant. The convener is Remi Tremblay (Canada).

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. The convener is Luis Rouco (Spain).

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. Erli Figueiredo (Brazil) is the convener of this advisory group. 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

Preferential subjects as selected by the A1 Study Committee for Paris 2018:

PS 1: Generation Mix of the Future

- Design improvements and technological developments required for machines to withstand cycled operation due to fluctuating feed-in of renewable energy and variable load demand.
- Impact and effect of increasing renewable power mix on existing legacy generators, generator auxiliaries and motors
- Evolution and trends in designs of machines for renewable generation.

PS 2: Asset Management of Electrical Machines

- Experience with refurbishment, replacement, power up-rating and efficiency improvement of aged 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 in generators and motors
- Operational experience: Failures, root cause analysis, recovery options, cost and time reduction initiatives.



4. Proposed New Working Groups

At the A1 Study Committee meeting in Vienna and subsequent to the meeting, some new working groups have been put forward for approval by the Study Committee Chairman. Terms of Reference are to be developed for submission to the Technical Committee. The topics of the proposed new SC A1 working groups are:

- Thrust Bearings for Hydropower - A Survey of Known Problems and Root Causes.
- Customer Requirements for Qualification of HV Stator Winding Insulation Systems;
- State of the Art in methods, experience and limits in end winding corona testing for Hydro Generators.
- Torsional Interaction of Turbo-generators resulting from the grid

5. Specific Activities of the Australian Panel

At the annual AP A1 meeting held in Newcastle in July 2017 the following presentations were made:

- Generator Stator End Winding Failure;
- Vales Point Power Station AVR Replacement;
- Mica Creek Generator Remedial Work (generator return from storage back to service);
- Overexcitation of Generator on Reverse Power; and
- Hydro Tasmania Generator Asset Management

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

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

7. ANC Members on Working Groups

The following are all the current AP A1 representatives on Working Groups.

WG A1.xx	Title	Australian Member
33	Guide to the Proper Storage and Cleanliness of Turbogenerators and Components	Tri Tran
37	Turbogenerator Stator Winding Support System Experience	Tri Tran
39	Application of dielectric dissipation factor measurements on new stator coils and bars	Tri Tran/ Peter Wiehe
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
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
50	Factory Quality Assurance Testing Requirements for Turbo-generator Components	Tri Tran
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



WG A1.xx	Title	Australian Member
60	Guide to Economic Evaluation for Refurbishment or Replacement Decisions on Hydro-generators	Peter Wiehe/ Kapila Nanayakkara

8. Membership of the Australian Panel

Name	Organisation	Type
Peter Wiehe	Hydro Tasmania (Acutel Consulting)	Consultant/Utility
Johan Strydom	Synergy	Utility
Tri Van Tran	AGL	Utility
Kapila Nanayakkara	Snowy Hydro	Utility
Ashok Ojha	Engie – Loy Yang B	Utility
Charles Tema	CS Energy	Utility
Hossein Rahimpour	AmpControl	Consultant
Len Gunn	Origin Energy	Utility
Nic Buckley	Stanwell Corporation	Utility
Kevin Ryan	Delta Electricity	Utility
Nik Walker*	Alinta Energy.	Utility
Viet Trinh	ElectraNet Pty. Ltd	Transmission

*- to be confirmed.

Convener: Peter Wiehe
Email: peter.wiehe@hydro.com.au
Phone: 0437 976 496

AP A2 Transformers

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.

The two Strategic Directions for A2 future activities are:

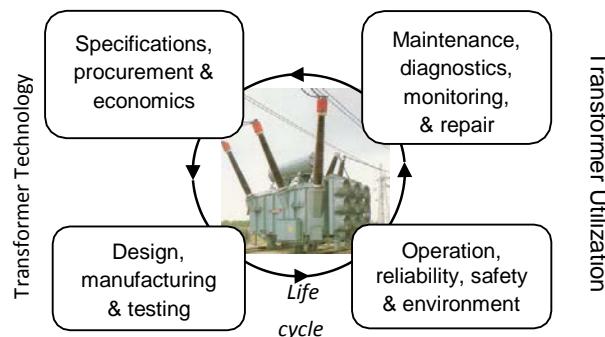
- Services to Customers (Reliability, Life management, Economics, Tutorials, etc)
- Technology Issues (Safety, New technologies and New concepts, Electrical environment, Pre-standardisation work, etc)

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

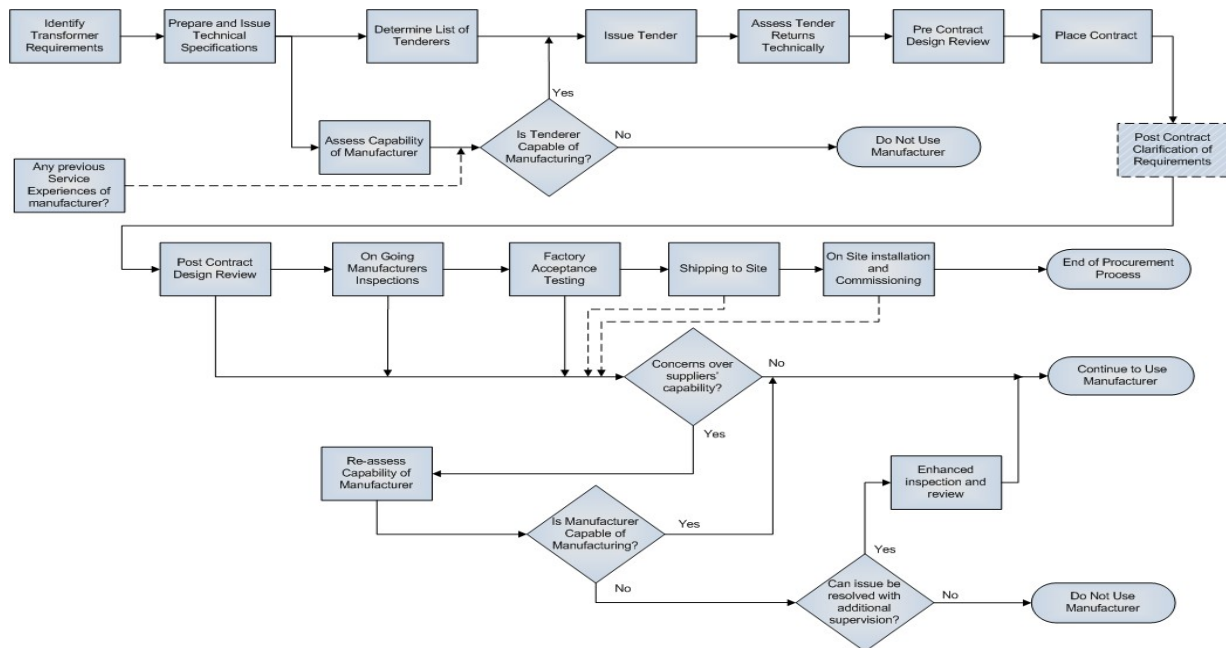
Key domains (1) and (2) are associated with transformer technology, while key domains (3) and (4) are associated with transformer utilization. SC A2 will normally have activities in order to continuously cover the four key domains.



Specific A2 Study Committee activities over the last 12 months have included:

- Krakow Colloquium – A Colloquium for SC A2 was held in Krakow, Poland on 1 to 6 October 2017. The six-day Colloquium included one day for WG meetings, two days for presenting papers in three Preferential Subjects, one day of Tutorials for recent A2 Technical Brochures, one day for the SC A2 meeting and concluded on the fifth day with a technical tour of Porabka-Zar 4x135MW pump/generation underground power station.
- Krakow Tutorials – SC A2 participated in the day-long tutorial session held on 4 October 2017 by presenting three interesting tutorials on transformer overall reliability, thermal modelling and shunt reactors. WG D1-29 also presented their tutorial on PD in Transformers
- Krakow Preferential Subject Papers – SC A2 facilitated a 2 day session held on 2 and 3 October 2017 where 39 papers were presented for PS1 Noise and Vibration, PS2 Diagnostics and Reliability of Components, and PS3 Innovative Solutions for Transport and Installation

- Transformer Procurement Green Book – The Study Committee is considering preparation of a small green book on Transformer Procurement. The work would amalgamate and develop the existing material used in the trilogy TBs 528-529-530, and add the new work of WG A2.42 Transportation and WG A2.58 Installation & Pre-commissioning. Life management issues from TB 227 could also be included. It is proposed that the work would largely follow procurement activities shown in the diagram below.



3. Preferential Subjects

The 2018 SC A2 Technical Session will be held in Paris during August 2018.

The preferential subjects for this session are:

PS1: Thermal Characteristics of Power Transformers.

- Determination of winding hot-spot temperature rise by modelling and direct measurements with different cooling modes
- Determination of temperature rise for core, tank, and other parts by modelling and direct measurements
- Effect of overload requirements on design and component selection

(Intended to follow-on from working group A2-38, and support next revision of IEC 60076-2.)

PS 2: Advances in Diagnostics and Modelling

- High frequency modelling of power transformers and shunt reactors, including comparison with measurements
- Interpretation and modelling of winding frequency response results
- Experience with different methods of measuring partial discharge, at works and at site

(Intended to support JWG A2/D1-51, JWG A2/C4-52 and WG A2-53)



PS 3: Site Commissioning Tests (There is one AP paper accepted by SC for this PS)

- Required site commissioning tests for transformers and reactors
- Additional site commissioning tests for transformers and reactors, depending on circumstances
- Trial operation of transformers and reactors, including requirements for additional monitoring

4. Proposed New Working Groups

There were no new SC A2 working groups proposed this year.

Of high interest to SC A2 was a new TF being started by SC D1. The high importance of the topic meant that a Task Force was created by D1 to deliver a paper within 6 months.

Procedure revision of measurement of the average viscometric degree of polymerization (DP_v) of new and aged cellulosic electrically insulating materials –

End users use DP value for life assessment and often request DP value of cellulose for transformer when delivered. It is now reported that there are problems with fully dissolving papers that have been through several drying sequences in the factory. This problem is well known for paper used for HV cables, but was not reported earlier for kraft paper and pressboard used in winding insulation.

Scope :

- Perform a survey among transformer factories/customers to find who has experienced this, in which situations, with what materials and description of how the DP measurements were performed.
- Collect paper samples from transformers where this has been experienced and also new paper of same quality. If supporting, have problematic paper samples tested by multiple laboratories.
- Report in back on whether this is a real problem relating processing of windings in the factory to protocols in the standard.
- In case there are deficiencies IEC 60450 protocols for this specific case, suggest further work.

5. Specific Activities of the Australian Panel

Activities of the Australian A2 panel over the last 12 months have included:

- 2017 Annual A2 Meeting – the 2017 annual meeting was held in Brisbane on 21st and 22nd August. The second day was devoted to an open session where speakers delivered powerpoint presentations on topics of high interest to the Queensland electrical industry.
- AP supported SC A3 and IEC Technical Committee 17 who needed assistance in some work they are doing on shunt reactor switching. A survey seeking representative technical data on the natural frequency of shunt reactors was disseminated to all the AP utility members that have these devices. Their responses were returned to the SC A2 chairman.
- A2 Workshop – A2 hosted a 1 day workshop on 3 April. The workshop topic was “Transformers – Dealing with the Unforeseen – an Interactive Workshop”. There were 11 speakers including 3 who were also members of the AP. The other speakers were a mix of specialists from the electrical industry, plus 2 from the insurance company FM Global and 2 from the legal firm Clayton Utz. There were 3 other members from AP who acted as reporters recording ideas from the delegates when the delegates divided into 3 sub-groups to consider scenario problems to work on.



- WG A2.58, which is convened by Ross Willoughby of Australia, commenced its activities during 2017 with its inaugural meeting hosted by GE in North Sydney. Unfortunately, this meeting had a poor attendance by international members, mainly due to the very late February 2017) approval of the ToR by CIGRE Paris Technical Committee. The Technical Committee still wanted the ToR to indicate a January 2017 start for the WG. To bolster numbers, the convener asked local AP A2 members to nominate guests (with a capacity to contribute to the topic) to attend the meeting. The 2nd meeting for this WG was held in Nuremberg Germany on 30 and 31 August and hosted by Siemens. Although the membership attendance improved, there were still 10 apologies.
- A large number of requests for observer access to the AU A2 Transformers space on the KMS were received in 2017. Nearly all have been rejected after first sending them a personalised email response. In many instances, requests have come from the staff of a CIGRE Australia collective member which already has an A2 panel representative. In those instances, the applicant was informed who their company representative is and asked not to bypass their role. The only observers approved on the AU A2 space are the ATC and ANC stakeholders that need the access for monitoring, together with the KMS coordinator Rod Hughes.

6. Meeting Report: Australian Panel

The most recent AP A2 meeting was co-hosted by Powerlink, Ergon and Energex and was held in the offices of Powerlink in Virginia, Brisbane on 21st and 22nd August 2017. Members provided an update to the group of what was happening in their part of the industry as well as brief reports about any issues that they had experienced with transformers. The majority of the first day was expended on this interactive discussion. Several new members to the panel benefitted from this approach in making introductions and learning the background and current industry issues concerning the regular members.

On the second day, presentations were given by invited visitors, as well as panel members during an open session. Topics discussed at the 2017 open session included:

- “Power transformer failure survey and modelling reliability – Update and looking ahead” – Dan Martin of University of Queensland
- “Advantages and Challenges of Natural and Synthetic Ester Liquids in Use in New Transformers” – Attila Gyore of Midel
- “Retrofilling with Natural and Synthetic Ester Liquids” – Attila Gyore of Midel
- “The Use of Natural and Synthetic Esters in Tap-Changers for Power Transformers” – Thomas Smolka, Reinhausen Australia
- “Transformer Core Demagnetisation and the effect of core Remanence on Diagnostic Measurements such as SFRA” – Wenyu Guo, Omicron

The next meeting of AP A2 will be co-hosted by ElectraNet and SA Power Networks and will be held in Adelaide. The timing has not been decided yet, however holding the meeting before the August Paris session is preferred in order to prepare any interventions on the PS. The meeting will be jointly sponsored by ElectraNet and SA Power Networks.

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

The inaugural meeting for WG A2.58 Installation and Pre-Commissioning of Transformers and Shunt Reactors was held in North Sydney (and hosted by GE) in the same week and immediately following the 2017 CIGRE/TechCon Conference in April.

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



8. Report on AP Seminars/ Conferences

AP A2 hosted an interactive workshop in Sydney, in conjunction with Techcon Asia Pacific. The workshop was held at the Hilton Hotel on Monday 3 April, 2017, and was attended by 74 delegates and 11 speakers. The workshop was held in conjunction with Techcon Asia Pacific, which was held at the same venue on the 4 and 5 April. The workshop operated using twin projectors. The delegates divided into three sub-groups (to each consider three problem scenarios) by partitioning the main room during the lunch break in readiness for the afternoon session.

Refer also to a separate comprehensive report, with photographs, for this 2017 CIGRE Event.

9. Proposed Activities

Another seminar, to be held in April 2018 in conjunction with Techcon Asia Pacific, may be considered. Details of the seminar are still to be decided but it is expected that it could include a number of new or existing CIGRE tutorials, as well as technical presentations from A2. The CIGRE Tutorials are a verbal presentation of key points from the Technical Brochure prepared by a Working Group. It is hoped that delegates attending the conference who are not CIGRE members will join CIGRE to access the Technical Brochures that were introduced in the seminar.

The next panel meeting will be convened in Adelaide ahead of the August 2018 Paris Session. Another open session is being considered for that meeting on its second day.

10. ANC Members on Working Groups

The following are all the current AP representatives on Working Groups. I have also listed CIGRE Australia members if they are not actually AP A2 representatives.

WG	Title	Australian or NZ Member
A2.43	Bushing Reliability	Jonathon Brown (NZ)
A2.45	Transformer Failure Investigation and Post-Mortem Analysis	Arne Petersen (corresponding)
A2/D1.46	Field Experience with Transformer Solid Insulation Ageing Markers	Joe Tusek
A2.49	Transformer Condition Assessment	Peter Cole (Convener) Ross Willoughby Chris Beckett NGN (editorial) Tara-Lee Macarthur NGN (editorial)
A2/D1.51	Improvement to Partial Discharge Measurements for Factory and Site Acceptance Tests of Power Transformers	Jose Lopez-Roldan, Dan Martin, John Tonkin, Joe Tusek
A2/C4.52	High Frequency Transformer Models for Non-Standard Waveforms	Nil
A2.53	Objective interpretation methodology for the mechanical condition assessment of transformer windings using FRA	Joe Tusek
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) Rafik Shenouda Matt Gibson (corresponding) Barry Myburgh (corresponding)
A2.59	On-Site Assembly, On-Site Rebuild, and On-Site High Voltage Testing of Power Transformers	Ross Willoughby (observer)



11. Membership of the Australian Panel

Name	Organisation	Type
Seamus Allan	Dynamic Ratings	Contractor
Nick Blakeney	Individual	Individual
Gary Buckley	Energex	Distribution
Kenneth Budin	Budin Philipp	Consultant
Mark Cotton	AusNet Services	Transmission
Santosh Dhakal	TasNetworks	Transmission
Derek Freeman	Origin Energy	Generator
Carlos Gamez	Western Power	Transmission
Lagath Ganepola	Powerlink Queensland	Transmission
Matthew Gibson	Ausgrid	Distribution
Wenyu Guo	Omicron Electronics Australia Pty Ltd	Manufacturer / Contractor
Michael Jordanoff	Transpower NZ	Transmission
Tara-Lee Macarthur	Ergon Energy	Distribution
Rob Milledge	ABB Australia Pty Limited	Manufacturer
Peter New	Snowy Hydro	Generator
Shawn Nielsen	Queensland University of Technology	University
Phil Onions	Stanwell Corporation Ltd	Generator
Mohinder Pannu	Wilson Transformer Co. Pty Ltd	Manufacturer
Jude Perera	Endeavour Energy	Distribution
Marko Prokic	ElectraNet	Transmission
Neil Ridings	SA Power Networks	Distribution
Tapan Saha	University of Queensland	University
Thomas Smolka	Reinhausen Australia	Manufacturer
Tri Van Tran	AGL	Generator
Joe Tusek	Ampcontrol ETM	Contractor
Walter Wasinger	Wasinger Transformer P/L	Consultant
Kerry Williams	K-BIK Power Pty Ltd	Consultant
Ross Willoughby	Alstom Grid Australia Ltd	Manufacturer / Contractor
Dharmendra Yoga	TransGrid	Transmission

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



AP A3 High Voltage Equipment

1. Study Committee Scope

The Study Committee (SC) A3 is responsible for the theory, design, construction, and application of 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 A3.25: MOSA/resistors for emerging system
- WG A3.31: NCIT with digital output
- WG A3.33: Equipment for series / shunt compensation
- JWG A3/B4.34: DC switching equipment
- JWG A3/B5/C4.37: Out-of-phase experience
- WG A3.35: Commissioning and Operation of Controlled Switching Projects

Making the best use of existing equipment and system

- WG A3.29: Deterioration and ageing process of HV equipment
- WG A3.30: Overstressing aspects of substation equipment
- WG A3.32: Non-intrusive methods for condition assessment
- WG A3.35: Commissioning practices of controlled switching
- 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

Answer the environment concerns

- Investigate SF6 Alternatives

Develop knowledge and information

- All working groups, tutorials and upcoming 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, CIGRE, 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

AG.A3.03: The “Green Book” Advisory group will have the task of development of a reference group for all work that has been undertaken and is being undertaken by CIGRE A3. The intention is to publish the Green Book by 2018. The Green Book is intended to be corpus of the work undertaken by CIGRE A3 for use as a “textbook” for young engineers – initially targeted at switching equipment and will strongly contribute to the international standing of CIGRE. It is anticipated that the Green Book will be revised periodically.

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

- | | |
|----------|--|
| WG A3.25 | MO Resistors & Surge Arrestors for emerging system conditions.
The working group is undertaking research on energy handling withstand capability and long term performance of MO material for emerging system conditions including UHV. Technical brochure 696 was completed and published in 2017. |
| WG A3.29 | Deterioration and Ageing of HV Substation Equipment.
Managing an ageing high voltage asset population is a key task for utilities and other asset owners. Definitive guidance and recommendation in this field is not readily available. In order to enhance the available guidance in this area SC A3 is undertaking a comprehensive review of experiences in the fields of degradation processes, lifetime assessment & life extension techniques, and the role of condition monitoring, refurbishment and re-verification. The draft technical brochure is currently being reviewed by the study committee members for publishing in 2018. |



- 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. The brochure is expected to be published in 2018.
- 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. The brochure is expected to be published in 2018.
- WG A3.32 Non-Intrusive Condition Monitoring of MV/HV switchgear
- The working group will review the current and future trends of non-intrusive, especially in service, diagnostic methods to apply in the condition monitoring of both high and medium voltage equipment. It will provide user feedback and return of experience from utilities, manufacturers and services providers. The brochure is expected to be published in 2018.
- WG A3.33 Experience with equipment for Series/ Shunt Compensation
- This working group will investigate the switching transient phenomenon in relation to the developments with series/ shunt compensation, including the requirements for the compensation means themselves. The investigation also includes the impact of series/ shunt compensation on transmission system overvoltages, short circuit currents and secondary arc current extinction during system fault. The working group will also investigate field experience with these topics. Technical brochure 693 was completed and published in 2017.
- WG A3.34 Requirements and specification of DC switching equipment
- This working group is a joint effort with CIGRE SC B4. The working group will review the technical requirements of DC switching equipment for different applications such as multi-terminal DC systems and off-shore wind farm connections. It will collect all available specifications of the state-of-the-art DC switching equipment used at transmission and distribution voltages. It will also investigate the technical capabilities and limitations of existing and projected switching equipment. Technical brochure 683 was completed and published in 2017.
- WG A3.35 Commissioning and Operation of Controlled Switching Projects
- This working group will first update the previous 2001 CIGRE survey on installation records of Controlled Switching Switchgear in service, gather worldwide experience with and then provide a guide for the best commissioning practices. This guide will reflect the recent field experience with CSS including pitfalls to avoid. The brochure is expected by 2018.



- 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 2018.
- WG A3.37 System conditions for and probability of Out-of-Phase
- This working group is a joint effort with CIGRE SC B5 and C4. It will investigate service experience with out-of-phase and out-of-step conditions, and will describe the circumstances under which out-of-phase occurs, develop models and methods to estimate the out-of-phase angles, out-of-phase currents, out-of-phase voltages, and its development over time. The draft technical brochure is currently being reviewed by the study committee members for publishing in 2018.
- 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 experience of HV switchgear. The WG is collecting information on alternative capacitive switching devices, filter bank applications and experience with vacuum devices (MV) and SF6 devices (HV) separately. The draft TB is scheduled to complete in January 2020.
- 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.

3. Preferential Subjects

The A3 preferential subjects for 2018 Paris Session are:

- Requirements for AC & DC Transmission and Distribution equipment
- Lifetime management of Transmission and Distribution equipment
- Novel developments of T&D equipment

The proposed preferential subjects for the 2019 SC A3 & B3 Colloquium in Bucharest, Romania are:

- PS1 – Lifetime Management of increasing Ageing transmission and distribution assets.
- PS2 – New challenges including monitoring and diagnostics of substation and equipment for future T&D networks.
- PS3 – Impact of rapid penetration of renewable energy of substations and equipment.
- PS4 – Application of information technology tools for development & management of substation equipment.

4. Proposed New Working Groups

During the A3 Study Committee meeting in Winnipeg in October 2017, the following proposal were put forward as possibilities for new working group topics to be developed further:-

- Reliability Surveys on equipment
- Switching with SF₆ alternatives



- Medium Voltage DC Circuit Breakers
- Accurate high frequency voltage measurement
- Equipment operating at higher voltage than system voltage
- Air-insulated VT/CT reliability analysis

5. Specific Activities of the Australian Panel

Australian Panel A3 members have decided to continue focus on the following key areas in 2017-19 period:

- **Whole of life cycle management of disconnectors** – Review the disconnector type technology and provide information on why different types are suited to different substation types, i.e. the two common disconnector types used in Australia and New Zealand are rotating double break and centre break. Evaluate practices currently adopted for management of disconnectors and where practical provide guidance to AP A3 members on options for selection, installation, operation and maintenance activities associated with disconnectors.
- **SF6 gas leakage** – Provide practical information on design factors which contribute to SF6 leakage for high voltage equipment from a practical experience perspective. Provide information on techniques to detect SF6 gas leakage and mitigation techniques.
- **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.

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 two non-Paris year study committee meetings will be held in Romania (2019) and India (2021). 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.

7. ANC Members on Working Groups

The following is the current AP A3 representatives on Working Groups.

WG	Title	Australian Member
A3.29	Deterioration and Ageing of HV Substation Equipment	Ankur Maheshwari Previous AP-A3 convenor and regular member



8. Membership of the Australian Panel

Name	Organisation	Type
Nandana Boteju	SPAusnet, VIC	Transmission & Distribution
Shamir Chibbah	Electranet, SA	Transmission
Kasun Fernando	Transgrid, NSW	Transmission
Vinay Krishnamurthy	EPC International, VIC	Vendor
David Kruijver	TAS Networks, TAS	Transmission & Distribution
Ankur Maheshwari	Western Power, WA	Transmission & Distribution
Wayne Pepper (convenor)	Ausgrid, NSW	Distribution
David Pita	Powerlink, QLD	Transmission
Matthew Ridgely	Ergon Energy, QLD	Distribution
David Roby	ABB, NSW	Vendor
John Shann	Transpower, NZ	Transmission
Alan Tancin	GE Energy, NSW	Vendor

Convener: Wayne Pepper
Email: wpepper@ausgrid.com.au
Phone: 0408 667 076



AP B1 Insulated Cables

1. Study Committee Scope

Study Committee (SC) B1 is responsible for all aspects pertaining to land and submarine insulated cable systems. The scope of work of SCB1 covers the whole life cycle of Insulated Cables including theory, design, applications, manufacture, installation, testing, operation, and maintenance as well as diagnostics techniques.

2. Specific Activities of the Study Committee

The main goals of Study Committee are to:

- Promote and contribute effectively to the progress in insulated cable systems technology.
- Facilitate the integration of insulated cable systems in electric power networks and in the environment, covering the complete life cycle of cables.
- Maintain its leading position in the field of power cables by providing unbiased and neutral information on all essential cable aspects.
- Be recognised by the Electric Power Industry as a leading and reliable partner with competence in all engineering issues related to insulated cable systems, i.e. technical, economical, ecological and social.
- Monitor and assess current trends in cable technology.

Specific B1 Study Committee activities over the last 12 months have included:

- 2016 CIGRE Canadian conference, October 201, the opportunity was also taken to present several tutorials.
- ICC Fall meeting, November 2016 in San Diego USA, similarly several tutorials were presented.
- 2017 ICEMPE 2017 conference in Xian, China

3. Preferential Subjects

The Preferential Subjects for the future Paris 2018 were re-confirmed at the recent Study Committee meeting and are as follows: -

PS 1: Recent experiences with underground and submarine AC and DC cable systems

- Design, manufacturing, quality control, installation techniques and operation
- Advances in testing and relevant experience
- Environmental issues and mitigation
- Lessons learnt from permitting, consent and implementation

PS 2: Best use of existing underground and submarine AC and DC cable systems

- Condition assessment and diagnostic testing of T&D cable systems
- Innovative tools for monitoring cables and accessories
- Upgrading methodologies and related experiences
- Trends in maintenance strategies, asset management and remaining life methodologies

PS 3: AC and DC underground and submarine cable systems in the Network of the Future

- New functionalities expected from cable systems
- Advances in modelling
- Innovative Cables and Systems
- Environmental challenges for future cable systems
- Higher voltage levels for AC and DC Cables

4. Proposed New Working Groups

The following New Working Groups and Task Forces were established at this year's SC Meeting: -

TF B1.65 Installation of offshore Cable Systems*

TF B1.67 Loading pattern on cables connected to windfarms

TF B1.68 Update of TB 358



TF B1.69 Revision of TB 189**

TF B1.70 Fiber optic elements embedded in power cables**

*Continuing from previous year

**Australia undertook to provide members for these working Groups and the process to identify suitable candidates has commenced.

5. Specific Activities of the Australian Panel

The only activity undertaken by the Australian B1 panel over the last year has been the annual meeting.

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

There are no current invitations for SC B1 study committee or working group meetings to be held in Australia.

7. ANC Members on Working Groups

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

WG	Title	Australian Member
WG B1.44	Work under Induced Voltages and Induced Currents + Link Boxes	George Bucea
WG B1.48	Trenchless technologies	Henry Kent
JWG B1.B3.49	Standard design of a common, dry type plug-in interface for GIS and power cables up to 145kV	Peter Robinson
WG B1.50	Sheath Voltage Limiters and Bonding Systems (Design, Testing, Operation and Monitoring)	George Bucea
WG B1.51	Fire issues for insulated cables installed in air	Richard Joyce/Nick Lee (Young member)
WG B1.54	Behaviour of cable systems under large disturbances (earthquake, storm, flood, fire, landslide, climate change)	Richard Joyce
WG B1.57	Update of service experience of HV underground and submarine cable systems	John Lansley
WG B1.58	Asset management in MV cables networks	Dong-Churl Lee
WG B1.60	Maintenance of HV cable systems	Joska Ferencz
WG B1.61	Installation of HV cable systems	Peter Robinson



8. Membership of the Australian Panel

Name	Organisation	Type
Richard Joyce (Convener)	Transpower NZ Ltd (NZ)	Operator/Transmission
Peter Robinson (Secretary)	Cable System Engineering (NSW)	Consultant
David Mate	Endeavour Energy (NSW)	Distribution
Naveed Raman	Nexans Olex (VIC)	Manufacturer
Eddie Van der Draai	Powerlink (QLD)	Transmission
Seong Woo Ju	Taihan Electric Corporation	Manufacturer
Hans Mayer	(VIC)	Consultant
Henry Kent	Energy Action (NSW)	Consultant
John Lansley	Energex (QLD)	Distribution
Joska Ferencz	Basslink (VIC/TAS)	Submarine Cable Owner
Jarad Hughes	TasNetworks	Transmission/Distribution
TBA – <i>previous member retired during the year.</i>	Vector (NZ)	Distribution
Kerry Prickett	UDCS Consulting (QLD)	Consultant
David Pearce	SA Power Networks (SA)	Distribution
Peter New	Snowy Hydro	Generator
Russell Wheatland	SP Ausnet (VIC)	Transmission/Distribution
Peter Butterfield Rossi	Electranet (SA)	Transmission
Tadeusz Czaszejko	Monash University (VIC)	University
Kek Tang	TransGrid (NSW)	Transmission
Tim Popkiss	Intertech Engineering (VIC)	Contractor
Graeme Barnewell	Essential Energy (NSW)	Distribution
Jim Lyall	(QLD)	Consultant
Albert Majadire	Prysmian (NSW)	Manufacturer
Ken Barber	Nan Cable (VIC)	Manufacturer
Rob Bradley	Ausgrid	Distribution
Dong-Churl Lee	Select Solutions (VIC)	Service Provider
Nang Huynh	Western Power	Transmission/Distribution

Convener: Richard Joyce
Email: richard.joyce@transpower.co.nz
Phone: +64 4 5906609 (Direct)
+64 21 575921 (Mobile)



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.

The Strategic Advisory Group (SAG) reviews SC performance and considers the future direction and new activities of the SC. In addition, proposed publications and General Session preferential subjects are critiqued and new WG's approved.

The 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) established in 2008 to assist in the coordination of new Working Groups (WG), oversees progress on publications and reviews the content of proposed tutorials.

Australia has maintained its membership on the SAG and CAG. Australian membership on TAG's are:

Convenor	TAG	Aust. Memb.
Javier Iglesias	TAG04 Electrical Performance	John McCormack Michael Lee
Joao Da Silva	TAG05 Tower, Foundations, and Insulator	John McCormack
Pierre Van Dyke	TAG06 Mechanical Behaviour of Conductors and Fittings	Peter Dulhunty
Jarlath Doyle	TAG07 Asset Management, Reliability, Availability	John McCormack

Activities in 2017 include

- SC meeting & symposium in Dublin
- Two new WG's formed with approved ToR
- 5 proposals under consideration (including two proposed by the Australian Panel).

3. Preferential Subjects

PS 1: Overhead Lines and Information Technology

- Recent developments in Geographic Information Systems for line routing, environment mapping, data collection and analysis
- Transmission Lines as a communication network: monitoring and operation, Internet of things, Fiber optics and antennas
- Dynamic line rating and forecasting

PS 2: Experiences leading to Improvements of OHL

- Failures – excessive climatic conditions, line and hardware defects, component ageing
- Reliability – condition assessment and monitoring, residual life criterion, life extension methods
- Availability – corridor encroachments; maintenance access limitations; solutions for inspection, repair and construction

PS 3: Technical and environmental aspects of OHL

- Advantages and challenges of reducing environmental impacts
- Public acceptance (incl psychological elements)
- Innovative design
- Multi-material structures



- Compact lines
- Mitigation and design for external impacts

4. New Working Groups

New Working Groups proposed or approved as follows:-

WG Ref	Title	Convenor	ToR
B2.65 Re-initiated	Detection, Prevention and Repair of Sub-surface Corrosion in OHL Supports, Anchors and Foundations	Rob Meijers (Netherlands)	Corrosion mechanisms and guidelines for repair/ treatment
B2.66	Safe Handling of High Temperature Conductor	Vivec Chari	tbc
B2.67	Assessment and testing of wood and alternative material type poles	Ahsan Siddique	Review industry practice and provide condition assessment guidelines.
B2.68	Sustainability of Conductor & Fittings	Cecile Roze	Review performance criteria and failure mechanisms; provide asset condition assessment guidelines.
Proposal	The role of OHL electrical assets with respect to the initiation and prevention of bushfires	APB2 Proposal (Michael Lee -- Nexans)	Identify range and frequency of different fire starts emphasis on those associated with electrical assets. Review means of preventing fire starts.
Proposal	Risk Modelling of OHL for Severe Weather Events	APB2 Proposal (John Mc/Asif Bhangor)	Develop risk model for evaluation of OHL network
Proposal	Aerial Warning Markers		Develop industry guidelines for design of materials and installation on OHL
Proposal	Coatings for Power Networks		Corrosion mitigation, noise/pollution reduction
Proposal	Foundations for Difficult Soils		Survey industry practice and provide guidelines for selection of appropriate footing systems.

5. Specific Activities of the Australian Panel

The Australian Panel activities include:

- 2018 Panel Meeting to be held in Hobart
- Planning for proposed 1 day seminar/workshop linked with 2018 panel meeting
- Review of draft TB & other publications and other work to support SC activities
- Proposal to engage with distribution utilities for increased involvement with B2 panel
- Proposal to engage with research facilities for increased involvement with panel
- Encourage participation & interaction with NGN
- APB2 database maintenance.

6. Recent and Pending Publications

TB Ref.	WG	Title	Status
tbc	B2.23	Geotechnical and structural design of the foundations of HV & UHV Lines,	Publish 2017/18
tbc	B2.24	Qualification of HV and UHV Overhead Line Supports under static and dynamic Loads	Publish 2018



tbc	B2.40	Calculations of the electrical distances between live parts and obstacles for OHL	Publish 2018
tbc	B2.45	Bushfire characteristics and potential impacts on Overhead Line Performance	Publish 2018
tbc	B2.47	Remedial actions for aged fittings and repair of conductors	Publish 2017/18
tbc	B2.50	Safe handling of fittings and conductors	Publish 2017
tbc	B2.53	Management guidelines for outsourcing OHTL technical expertise	Publish 2018
tbc	B2.51	Methods for optimized design of overhead transmission lines	Publish 2018
tbc	B2.52	The use of robotic in assessment and maintenance of OH	Publish 2018
tbc	B2.55	Conductors for the Uprating of Existing Overhead Line	Publish 2018
tbc	B2.56	Ground Potential Rise at Overhead AC Transmission Line Structures during Faults	Publish 2018

7. Meeting Report: Study Committee

Study Committee meeting convened at Paris 2016.

Key Items

1. Strategic plan reviewed.
2. Reports from WG's.
3. Preferential subjects proposed.

8. Australian Panel Meeting Report: Melbourne September 2016

i) Panel meeting

- Attendance of and presentations by NGN representatives.
- Attendance of international guests from Brazil universities and industry, and presentations on the Brazilian network , 6201 AAAC conductor failure, & proposed use of 1120 AAAC conductor.
- Bureau of Meteorology guest speaker: Severe Weather forecasting
- WG progress reports.
- Case studies from panel members.
- Technical tour of Ausnet network, Dulhunty pole manufacturing plant, and University of Victorian conductor testing facilities.
- Sponsored by Ausnet & Nexans.

ii) 1-day Technical Seminar

- International speakers (Brazil, NZ)
- Range of technical presentations on conductor performance, electrical design issues and wood pole condition assessment.
- Total registrations achieved expectations; in part, this was achieved by large group of junior engineers from Jacobs.
- Sponsored by Jacobs.

9. Report on AP Seminars/ Conferences

Seminars, workshops or conferences involving the Australian Panel include:

- AORC
- TAG 04
- TAG 06
- Webinar – various
- ENA – live work sub-committee.



10. Proposed Activities

i) Australian Panel

- 2018 Sept Panel meeting - Hobart
- 2019 Sept Panel meeting – Sydney
- 2019 Sept Proposed B2 technical seminar linked with panel meeting – Sydney

ii) SCB2 & International Symposiums

- SCB2 - 2018 August, Paris
- SCB2 - 2019 November – India
- Symposium – 2019 April - Japan

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

Nil.

12. ANC Members on Working Groups

Active WG and current AP representatives.

WG	Title	Australian Member
WG23	Geotechnical and structural design of the foundations of HV & UHV Lines, application to the updating to the refurbishment and upgrading guide	CM: Graeme Paterson
WG24	QUALIFICATION OF HV AND UHV OVERHEAD LINE SUPPORTS UNDER STATIC AND DYNAMIC LOADS	CM: Elias Elkhoury
WG40	Calculations of the electrical distances between live parts and obstacles for OHL	Convenor: Rob Lake
WG42	Guide to Operation of Conventional Conductor Systems above 100°C	CM: Michael Lee
WG45	Bushfire characteristics and potential impacts on Overhead Line Performance	WGM: Francis Lirios
WG47	Remedial actions for aged fittings and repair of conductors	-
WG50	WG B2.50 Safe handling of fittings and conductors	Peter Dulhunty
WG52	WG B2.52 The use of robotic in assessment and maintenance of OHL	Francis Lirios
WG55	WG B2.55 Conductors for the Uprating of Existing Overhead Lines	Glenn Ford
WG56	WG B2.56 Ground Potential Rise at Overhead AC Transmission Line Structures during Faults	Charles Crew
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	Jack Roughan
WG59	WG B2.59 Forecasting Dynamic Line Ratings	Michael Lee
WG60	WG B2.60 Affordable Overhead Transmission Lines for Sub-Saharan Countries	CM: Elias Elkoury
WG61	WG B2.61 Transmission Line Structures with Fibre Reinforced Polymer (FRP) Composites	WGM: Francis Lirios
WG62	WG B2.62 Design of Compact HVDC Overhead Lines	Asif Bhangor
WG63	WG B2 63 Compact AC Transmission Lines	David Morato
WG64	WG B2.64 Inspection and Testing of Equipment and Training for Live-Line Work on OHL	CM: Simon Leitch; WGM: Alex Price (Energex)
WG65	Detection, Prevention and Repair of Sub-surface Corrosion in OHL Supports, Anchors and Foundations	CM: Elias Elkhoury
WG66	Safe handling and installation guide for high temperature low sag conductors	CM: Michael Wilson



WG	Title	Australian Member
WG67	Assessment and testing of wood and alternative material type poles	Convenor: Ahsan Siddique
WG68	Sustainability of Conductor & Fittings	WGM: Gary Brennan CM: Andrew Taylor

13. Membership of the Australian Panel

Name	Group Role	Company	Type
John MCCORMACK	owner	ElectraNet	Transmission
Bingxiang LIN	Secretary (NGN)	ElectraNet	Transmission
Arun ARORA	representative	AECOM Limited	Consultant
Asif BHANGOR	representative	Jacobs	Consultant
Gary Brennan	specialist	Endeavour Energy	Transmission/ Distribution
Linden Bronleigh	representative	Western Power	Transmission/ Distribution
Steve BROOKS	representative	Ergon Energy	Transmission/ Distribution
Alan DELAC	representative	Powerlink	Transmission
P DULHUNTY	representative	Dulhunty Works	Manufacturer
Glenn FORD	representative	Ausgrid	Transmission/ Distribution
Tony GILLESPIE	representative	Gillespie Power Consultancy	Consultant
Robert LAKE	representative	PSC	Consultant
Michael LEE	representative	Nexans	Manufacturer
Simon LEITCH	representative	Transpower	Transmission
Francis LIRIOS	representative	AusNet Services	Transmission
Sanu MAHARJAN	representative	TransGrid	Transmission
David MATE	representative	Endeavour Energy	Transmission/ Distribution
Brent MCKILLOP	representative	TasNetworks	Transmission/ Distribution
Michael Murtagh	representative	NT Power & Water	Transmission/ Distribution
Alex Price	NGN rep	Energex	Transmission/ Distribution
Steve REDHEAD	representative	Aurecon	Consultant
Jack ROUGHAN	representative	Fluidlimit	Consultant
Ahsan SIDDIQUE	specialist	Jacobs	Consultant
Michael Wilson	specialist	Transpower NZ	Transmission
Philip DULHUNTY	specialist	Dulhunty Poles Pty Ltd	
Henry HAWES	specialist		



14. Other Business

1. Robert Lake was presented the prestigious Technical Committee award at the 2016 Paris convention. The award was in recognition of Robert's management of the 2013 Auckland symposium, and active service in various WG's as convener of WG 40 "Calculations of electrical distances between live parts and obstacles for OHL".

It is noted that Robert is the second B2 convener, after Gary Brennan, to receive such an award.

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



AP B3 Substations

1. Study Committee Scope

CIGRE Study Committee B3 scope includes the study of the design, construction, maintenance and ongoing management of transmission and distribution substations, and electrical installations in power stations excluding generators.

The Study Committee (SC) and the Australian Panel (AP) B3 aim to serve the needs of a broad range of target groups in the electrical power industry in Australia and New Zealand including consideration of the technical, economic, environmental and social considerations of substations.

The Australian Panel aims to facilitate and promote the progress of substation engineering and related management activities and the international exchange of information and knowledge in the substations field and to add value to this information and knowledge and develop recommendations by synthesising state-of-the-art practices and techniques.

Major study objectives include increasing plant reliability and availability, optimised management of assets, minimising carbon footprint and environmental impact of substations and the recognition of social needs and priorities in facilitating sustainable development and the adoption of appropriate technological advances in equipment and systems to achieve these objectives.

Study Committee B3 has a strong association with the “systems” study committees (the C Committees) and the more specialised “equipment” committees (the A Committees) and has working relationships with most of the other study committees.

2. Specific Activities of the Study Committee

The Study Committee maintains Strategic Advisory, Technical Advisory and Customer groups which meet at least twice during each calendar year as well as the annual study committee meeting. The B3 ‘Substations’ Study Committee meeting was held on 20th September 2017 in Recife, Brazil. This study committee annual meeting coincided with the B3 ‘Substations’ Colloquium which was held from 18th September to 19th September 2017. Meetings were also held for all working groups and Advisory Areas. This event was a success, attracting over 80 attendees from 20 different countries.

This year’s Colloquium theme was focused on “Challenges and Trends to the Next Years”. The Colloquium was supported by workshops and tutorials covering current issues in substation technology, design, materials and diagnostics.

The Colloquium and meetings covered topics on three preferential subjects:

PS 1. Life cycle asset management

- Experiences in equipment condition monitoring and its contribution to the reduction of life cycle cost and reliability;
- Operating performance of substation equipment contributing to improving technical requirements, specifications and certification;
- Lifetime management, deterioration and ageing of substation equipment;
- Risk quantification and optimised asset decision making;
- Sustainable maintenance optimisation.

PS 2. Advances in substations technology and reliability

- New connection configuration for higher reliability and reduced cost;
- Reliability Evaluation of Substation Based on System Performance;
- Reliability Modeling in GIS and MTS Substations;
- Reliability, arrangements and layout comparison between AIS, MTS & GIS technologies for substations;
- Quantifying the impact of substations arrangement in operational flexibility

PS 3. Substations design: New solutions and experiences

- Modular, pre-fabricated, fast assembly and plug-and-play concept for substation solutions;
- Combination of outdoor and GIS/MTS technologies for substation area reduction;
- Combination of GIS, GIL and Insulated Cables in substation design;
- Grounding substations: solutions for urban areas;



- Mitigation solutions of substations to meet emerging grid requirements includes new renewable energy resource growth;
- Substations security against physical and cyber invasion.

Study Committee B3 is also currently working towards writing a 'Green Book' which is a CIGRE reference book series that will cover a range of topics on substations.

3. Preferential Subjects

The following preferential subjects are approved for the Paris 2018 session.

PS 1. Advances in Substation Technology and Design

- GIS and GIL developments including HVDC
- Adapting substations to meet emerging power system requirements and optimised availability including modular, fast deployment substations and live working.
- Changing roles and opportunities for substations including challenges for medium voltage and integration of storage systems.

PS 2. Evolution in Substation Management

- Advanced technologies for substation management, new information technologies, robotics and the application of 3D techniques.
- Risk quantification and optimised asset decision making, substation economics, maintenance management and life cycle management.
- Substation asset performance, residual life, health and condition metrics.
- Operations and maintenance of offshore substations

PS 3. Health, Safety, Environmental and Quality Assurance Considerations in Substations

- Customer and stakeholder interaction to reduce substation impact including aesthetics, noise and fire management.
- Design for safety, eco-design / recycling and product development
- Physical and cyber-security considerations for substations.
- Managing the implementation of health, safety and environmental requirements for substations, including training.

Two papers from the Australian Panel B3 and/or their member organisations have been accepted to the Paris 2018 Session.

4. Proposed New Working Groups

SC B3 has a number of active working groups. New proposed working groups in 2017 included the following:

- WGB3.48 Asset Health Indices for existing substation equipment
- WGB3.49 Review of Substation Component Reliability
- WGB3.50 Concepts for on-site HV testing of GIS after installation, extension, retrofit or repair
- WGB3.TBC Optimal Replacement Decision Making for Substations Assets

5. Specific Activities of the Australian Panel

AP B3 has contributed to a number of international working groups, conducted a number of member surveys and held a successful annual Australian panel meeting in Adelaide on 16th – 17th August, 2017.

The annual panel meeting included contributions from member organisations in particular areas of discussion included safety and significant incidences within organisations, technical presentations and discussions that the APB3 panel group are currently involved with or have experience to share with



the greater APB3 CIGRE community. Panel members and/or their organisation members have been successful in having two PARIS papers accepted for 2018 as follows:

- Effective Substation Earthing System Assessment – The Quest for Clean Measurements
Authors: D.J.Woodhouse, S.J.Palmer, W.J.V.Tocher from Safearth Consulting, Australia
- Modelling Substation Control and Protection Assets Condition for Optimal Reinvestment Decision Based on Risk, Cost and Performance
Authors: Tuan VU, Michael PELEVIN, David GIBBS, Chuanli ZHANG by Powerlink Queensland, Australia

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

There are no SC or WG meetings scheduled in Australia for 2018.

7. ANC M embers on Working Groups

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

WG	Title	Australian Member
B3.35	Substation earthing system design optimisation through the application of quantified risk analysis	Bill Carmen (Convenor) Stephen Palmer (Secretary)
B3 06/34	Expected impact of future grid concept on substation management	Robert Deller (Previous APB3 member)
B3.43	Contemporary Solutions for Low Cost Substations	Peregrine Tonking (Convenor)
B3.47	Application of robotics in substations	Robert Li
B3.48	Asset Health Indices for existing substation equipment	Michael Verrier

8. Membership of the Australian Panel

Name	Organisation	Type
Bergholcs George	ElectraNet	Utility
Goodridge, Alan	Peracon	Consultant
Crombie, Alan	United Group Infrastructure	Consultant
Crina Costan	CPP	Consultant
David Pritchard	SA Power Networks	Utility
McMahon Andy	Transpower	Utility
Dick, Stuart	SP AusNet	Utility
Surace, Marco	Western Power Corporation	Utility
Martin, Ralph	Powerlink Qld	Utility
Wang, Ping S	ALSTOM	Manufacturer



Name	Organisation	Type
Khor, Jonathan	ENERGEX	Utility
Klepac, Angela	TransGrid	Utility
Laubi, Andreas	Jacobs	Consultant
Weis, Matthew	Siemens Ltd	Manufacturer
Whitehouse, Luke	Entura	Utility
Ray, Doug	VECTOR Limited	Utility
Wu, Hang	AECOM	Consultant
Hickey, Simon	Ergon Energy	Utility
Hibbert Mark	Aurecon Group	Consultant
Verrier, Michael	Tasmanian Networks	Utility
Crisafulli, Colin	Endeavour Energy	Utility
Busby Malcolm	WSP Parsons Brinckerhoff	Consultant
Palmer, Stephen	Safearth	Consultant
Szmalko, John	Mott Macdonald	Consultant

Convener: Angela Klepac
Email: Angela.Klepac@TransGrid.com.au
Phone: 0459 813 407



AP B4 HVDC 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 HVDC 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:

- HVDC: economics of HVDC, applications, planning aspects, design, performance, control, protection, and testing of converter stations.
- Power electronics for AC transmission and distribution systems and power quality improvements: economics, applications, planning, design, performance, control, protection, construction and testing. This includes Flexible AC Transmission (FACTS) devices such as SVCs and STATCOMs.
- Advancements in power electronics: development of new converter technologies including controllers and use of new devices, application of these technologies in HVDC, power electronics for AC systems and power quality improvement.

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

- Winnipeg Colloquium – A combined Colloquium (A3, B4 and D1) was held in Winnipeg, Canada on 2 and 3 October 2017. The two-day Colloquium included presentations on activities associated with these study committees, and concluded with a technical tour of the Riel Converter Station, a part of the 2,000MW Bipole III HVDC project currently under construction by Manitoba Hydro.
- Winnipeg Tutorials – SC B4 participating in the day-long tutorial session held on 4 October 2017 by presenting tutorials on three interesting topics – harmonics associated with VSC HVDC, the testing and commissioning of VSC HVDC and the procurement of STATCOM systems.
- 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 2015-2016 are currently being collated for publication in Paris next year (2018).
- Performance of SVC/STATCOM - The collation of data and analysis of performance of FACTS devices, particularly SVCs and STATCOMs is underway.
- FACTS Green Book – The Study Committee is preparing a text-book on Flexible AC Transmission Devices (FACTS). The work is in progress.
- 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. Country representatives are asked to drive provision of the information for HVDC systems within their country.

3. Preferential Subjects

The 2018 SC B4 Technical Session will be held in Paris during August 2017.

The preferential subjects for this session are:

- PS 1 - HVDC systems and their applications
 - Planning and implementation of new HVDC projects including, need, justification, design, integration of wind generation, environmental and economic assessment.
 - Application of new technologies in HVDC, HVDC grids / multi-terminal HVDC.
 - Refurbishment and upgrade of existing HVDC systems.
 - Service and operating experience of converter stations including off shore platforms.



- PS 2 - MVDC / LVDC and power electronics for distribution systems
 - Medium voltage DC technology deployed in distribution systems.
 - PE technologies applied in distribution projects including the economics and reliability.
 - New concepts and designs.
 - 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.
 - Service and operating experience.

4. Proposed New Working Groups

The following new working groups have been proposed:

- *Investigation of Virtual Synchronous Machine (VSM) capability for VSC converters* – To investigate the possibility for VSC converters to be designed to act and behave on the AC network like a synchronous generator. This is in preparation for a new regulation in the UK due out in May 2018. It was agreed during the meeting that this work is too urgent to wait for a working group timeline (i.e. 3 years+), so a Task Force has been created instead to deliver a paper within 6 months.
- *Cyber security of HVDC projects* – a working group to look at the requirements and issues related to the cyber security of HVDC assets. This will possibly be a joint working group.
- *Study on Unified Power Flow Controller and its Application* – A TOR is under draft.
- *Update of TB97 – Commissioning of LCC HVDC Systems* – After the issue of the recent technical brochure on commissioning VSC systems, it was suggested that the document for LCC systems (created in 1997) be revised and updated to bring it in line with the VSC one. Les Brand from Australia has taken an action to investigate the need and develop a TOR.
- *Operation and Maintenance of HVDC Systems* – A proposal to create a working group on developing strategies for the operation and maintenance of HVDC systems was presented by Les Brand (Australia). It was argued that the IEC standard is enough, however Les has been asked to investigate this and prepare a TOR if a working group is justified.

5. Specific Activities of the Australian Panel

Activities of the Australian B4 panel over the last 12 months have included:

- 2016 Annual B4 Meeting – the 2016 annual meeting was held in Canberra on 4th and 5th October 2016. The two-day event concluded with a site visit to the Royalla Solar Farm outside of Canberra.
- NGN Webinar – B4 will be preparing a series of webinars on HVDC systems for NGN members. The first, “Introduction to VSC HVDC” was presented by Les Brand on 5th May 2017. Other panel members will be presenting more webinars on aspects of HVDC and FACTS over 2018.
- WG B4.63, which was convened by Les Brand of Australia, completed its activities during 2017 and Technical Brochure 697 was published in late August 2017. Les delivered a tutorial in Winnipeg on this topic on 4th October 2017.
- B4/C4 Seminar – B4 and C4 have joined forces to deliver a seminar on 9th and 10th November 2017 on the topic “The impact of power electronics on network performance and capability”. There has been a lot of interest in the event.
- 2017 Annual B4 Meeting – the 2017 annual meeting will be held in Brisbane immediately prior to the B4/C4 Seminar, on 8th November 2017.

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

There are no current invitations for SC B4 study committee meetings or working group meetings to be held in Australia.



7. ANC Members on Working Groups

The two working groups that were convened by Australian panel members over the past 2 years have now been closed – B4.62 (Convenor: Nalin Pahalawaththa) and B4.63 (Convenor: Les Brand).

There are no current AP representatives on Working Groups.

A few notes relating to AP B4 participation in working groups going forward:

- AP B4 panel members have participated significantly in the current survey on the Performance of SVC and STATCOMs being run by AG B4.04.
- Simon Bartlett of UQ has been nominated to be an Australian representative of the new Task Force on Virtual Synchronous Machine operation of VSC HVDC systems.
- Les Brand has proposed a working group for the O&M of HVDC Systems and has volunteered to convene this working group should it be accepted.

8. Membership of the Australian Panel

Name	Organisation	Type
Les Brand (Convenor)	Amplitude Consultants	Consultant
David Gibbs	Powerlink Queensland	Transmission
Luke Roberts	TasNetworks	Transmission / Distribution
Peeter Muttik	GE	Vendor
Andrew van Eyk	ElectraNet	Transmission
John Wright-Smith	American Superconductor	Manufacturer
Richard Xu	TransGrid	Transmission
Mark Shilliday	Basslink Pty Ltd	Transmission
Colin Wood	ABB	Vendor
Gerard Ledwich	Queensland University of Technology	University
Angelo Iacono	Siemens	Vendor
Michael Dalzell	Transpower, New Zealand	Transmission
Stuart Dodds	APA Group	Transmission
Marian Piekutowski	Hydro Tasmania	Generation
Yau Chow	Western Power	Transmission / Distribution
Georgios Konstantinou	University of NSW	University
Nadesan Pushparaj	AEMO	Market Operator

Convenor: Les Brand

Email: les.brand@amplitudepower.com

Phone: 0488 020 948



AP B5 Protection and Automation

1. Study Committee Scope

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

- 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 IEC61850.

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 Auckland Colloquium

Preferential Subjects 2017 Auckland New Zealand

PS1 Challenges of design and maintenance of IEC 61850 based systems

PS2 Protection issues in modern power systems with renewable generation and storage

PS3 The Impact on Protection and Control from Working Existing Assets Harder

3. Preferential Subjects

Preferential Subjects 2018 Paris France

1. Protection under System Emergency Conditions.
 - Emergency loading, load shedding and islanding practices and experiences
 - System oscillation detection and out of step / pole slipping
 - Thermal Protection
2. User experience and current practice with IEC 61850 process bus
 - Interoperability between merging units, stand alone and associated to NCIT, and Protection functions
 - Experience from FAT, SAT, commissioning and maintenance of process bus based equipment and functions
 - Use of process bus for metering and monitoring of HV equipment

2. Preferential Subjects 2019 Tromsø Norway

1. Time in Protection Applications –Time Sources and Distribution Methods
2. Leveraging PMU Data for Better System Protection
3. Future technologies for inter-substation communication
 - Migrating Digital Teleprotection Channels to Packet-Based Networks

4. Proposed New Working Groups

Three new working groups were proposed:



1. Cyber Security requirements for PACSCyber Security Resilience of PAC Architectures,(B5 focus)
2. Time in Protection Applications –Time Sources and Distribution Methods
3. Protection System Support by response of Inverter-Based Sources

5. Specific Activities of the Australian Panel

The Australian Panel B5 meeting was hosted by Powerlink in Brisbane with 24 members (5 were substituted) and 2 NGN guests in attendance.

The following presentations were given.

Bruce Capstaff	Powerlink	Process Bus Trial
Grant Munting	Entura	Tasmanian Supplementary Generation Project due to Bass Link Cable Failure
Peter Bishop	Transpower	South Island Islanding & Restoration Event at Clyde PS
Terry Foxcroft	Snowy Hydro	Snowy Scheme Overview and Snowy 2.0 Expansion Proposa

All Special Reporters' Questions for Paris 2017 were reviewed. Three contributions were prepared with assistance from Electranet and Western Power

The next Australian panel meeting is planned to be held in New Zealand in July 2017. The next SEAPAC is planned for Sydney in March, 2019

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

No invitations given or planned.

7. ANC Members on Working Groups

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

WG	Title	Australian Member
B5.41	Investig & Improvem't Possibilities for Metering Systems for Billing	Darron Tabone (N)
B5.47	Network Protection Performance Audits	Peter Bishop NZ (M)
B5.50	IEC 61850-based Substation Automation Systems – Expectation of Stakeholders and User Interaction	Ian Young (L)
B5.51	Methods & Application of Remotely Accessed Information for SAS Maintenance and Operation	Taren Hobson (M)
B5.52	Analysis and comparison of fault location systems in Substation Automation Systems	Darren Spoor (Full M)
B5.54	Protection and Automation Issues of Islanded Systems during System Restoration/Black Start	Terry Foxcroft (L)
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 (M)



WG	Title	Australian Member
B5.59	Requirements for Near-Process Intelligent Electronic Devices	Kevin Hinkley (H)
B5.63	Protection, Automation and Control System Asset Management	Mark Mundell

8. Membership of the Australian Panel

Name	Organisation	Type
D Harper	AECOM NZ	Consultant
K Ward	BECA NZ	Consultant
R Hughes	Rod Hughes Consulting	Consultant
P Blanchfield	Jacobs Australia	Consultant
D Collins	Tesla Consultants NZ	Consultant
C Simmons	Entura	Consultant
R Johnston	Essential Energy	Distribution
D Dwyer	Energex	Distribution
A Turner	Ausgrid	Distribution
R Coggan	Ergon Energy	Distribution
M Doherty	SA Power Networks	Distribution
M Browne	Endeavour Energy	Distribution
R Anegondy	Actew AGL	Distribution
R Simpkin	United Energy	Distribution
T Foxcroft	Snowy Hydro	Generation
M Pallotta	ElectraNet	Transmission
S Tohui	PNG Power	Transmission
B Capstaff	Powerlink Queensland	Transmission
M Sokolowski	AusNet Services	Transmission
S Bhola	TasNetworks	Transmission
K Hinkley	TransGrid	Transmission
P Bishop	Transpower NZ	Transmission
K Dhang	Western Power Corporation	Transmission
A Kalem	Victoria University	University
Madhusudan S	ABB	Vendor
I Young	Schneider Electric	Vendor
L Torelli	CSE-Uniserve	Vendor
G Tolo	Relay Monitoring Systems	Vendor
B Hampson	SEL NZ	Vendor
W Priest	Siemens	Vendor
F Pambrun	Grid Solutions	Vendor



Name	Organisation	Type
S Allan	Dynamic Ratings	Vendor

Emma Rogers from Energex is also on the panel as a NGN representative.

The highlighted organisations have not attended the last 3 AP meetings

Convener:

Email:

Phone:



AP C1 System Development and Economics

1. Study Committee Scope

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

2. Specific Activities of the Study Committee

Planning for rapid development, uncertain generation and desired reliability (newly and rapidly developing countries, system performance, contingency planning, mass penetration of renewables, a greenfield approach)

Investment drivers, decision processes and tools (investment drivers, planning criteria, grid codes and the role of new technology, new investment decision processes, new tools and methods for increasing uncertainty)

Asset management practices including risk assessment now and in the future (risk management, broad trends and practices, new solutions for changing power system designs).

3. Preferential Subjects

1. (Business Investment). Expanding role of social factors, transparency and uncertainty in transmission investment decision approaches
 - new elements in the multi criteria evaluation
 - new stakeholders in the decision making process
 - scope management of investments with high/volatile uncertainties
2. (Asset Management). Impact of changing external factors on asset management
 - Political, economic, regulation, weather, cyber and physical security factors etc.
 - Company-internal strategy on grid modernization, e.g. monitoring, Big Data, asset analytics, security
 - Asset usage and longevity effects from variable/non-programmable generation
3. (Interconnectivity). Coordinated planning between grid operators across all voltage levels
 - Methodologies
 - How to share costs or adjust company organization and strategy

4. Proposed New Working Groups

1. (Business Investment). C1/C3.31: Including stakeholders in the investment planning process.
2. (System Planning). C1/C4.36: Review of metropolitan area power system development trends taking into account new generation, grid and information technologies

5. Specific Activities of the Australian Panel

The key activities of the Australian Panel during 2017 included actively participating in ongoing C1 working groups including convening working groups (C1.32 and C1.38).

Four papers from AP C1 were accepted at the Paris Session 2018.

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

There were no seminars or conferences organised during 2017 by APC1.

7. ANC Members on Working Groups

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

WG	Title	Australian Member
C1.34	ISO Series 55000 Standards: General Process Assessment Steps and Information Requirements for Utilities	Herath Samarakoon



WG	Title	Australian Member
C1.38	Valuation as a comprehensive approach to asset management in view of emerging developments	Graeme Ansell (Convener)
C1.39	Optimal power system planning under growing uncertainty	Christain Schafer

8. Membership of the Australian Panel

Name	Organisation	Type
Graeme Ansell	Ansell Consulting	Consultant
Herman De Beer	Ausnet services	Distribution
Keith Frearson	Jacobs	Consultant
Mark Hibbert	Aurecon	Consultant
Stephen Hodgkinson	ESTE	Consultant
Cristiano Marantes	Vector	Distribution
Yateendra Mishra	QUT	University
Lekshmi Jaya Mohan	Western Power	Transmission and Distribution
Enrique Montiel	Powerlink	Transmission
Brad Parker	Electranet	Transmission
Herath Samarakoon	Tasnetworks	Transmission
Christian Schafer	AEMO	MSO and Transmission
Julian Swartz	GHD	Consultant
Donald Vaughan	Entura	Generation
David Volwes	University of Adelaide	University
Matthew Zillmann	Ergon Energy	Distribution

Convener: Graeme Ansell
Email: graeme.ansell@ansellconsulting.nz
Phone: +64 21 283 036



AP C2 System Operations and Control

1. Study Committee Scope

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

2. Specific Activities of the Study Committee

The main areas of attention are:

- Control and switching of objects, voltage control, frequency control by balancing generation vs. demand, monitoring of loading limits and actions to avoid capacity violations (congestion management). Reserves and emergency strategies, management of fault and restoration situations, interaction between the system and power plants. Short term planning and coordination of system capacity needs with maintenance of the physical assets.
- Evaluation and bench-marking of the system performance in terms of fault frequency, interruptions, operational and maintenance efficiency, both from the technical and economical points of view.
- Impact on system operation targets, methods and performance from new institutional structures of System Operators (TSO or ISO), regulators, market actors, trading mechanisms, and contracted ancillary services.
- Requirements, methods, tools (simulators) and performance indices for training of operators.
- Development and use of power system analysis and security assessment functionalities within operational planning and the computer and telecommunication systems supporting the control centres and the operators.
- Lessons learnt from Major Power System Disturbances

3. Preferential Subjects

The preferential subjects for the 2018 Paris Session will be:

- PS 1 Ensuring operating reliability
 - New concepts of system observability, controllability and flexibility.
 - New solutions for provision of ancillary services: frequency and voltage control.
 - Wide area control
 - System restoration.
- PS 2 Big Data and their use for system operations
 - Transformation of data into information for system operators.
 - Data exchange platforms with other entities: e.g. DSO, DG, among others.
 - Monitoring, visualization, awareness systems, decision support tools.

4. Proposed New Working Groups

The following possible new Working Group was discussed at the SC Meeting in May 2017:

- Operational Measures to reduce risk of bushfires starting from electricity assets

The following new Working Groups have commenced their activities in the past year:

- JWG C2/C4.37 Recommendations for Systematic Framework Design of Power System Stability Control
- JWG C2/B4.38 Capabilities and requirements definition for Power Electronics based technology for secure and efficient operation and control.

5. Specific Activities of the Australian Panel

A meeting the Australian C2 Panel was held in Sydney on 12 October 2016. The meeting was hosted by TransGrid.

Mark Miller updated the panel on the current activities of the C2 Study Committee and the associated working groups. A report was presented on the CIGRE Congress of August 2016.



The Panel then discussed operating incidents over the previous year in Australia and their implications including:

- the black system event in South Australia
- a wide-ranging improvement programme instituted by Power and Water to improve reliability of supply in the Northern Territory
- challenges that had been faced by the Tasmanian energy system during the recent extended failure of the Basslink Cable including:
 - managing restrictions during an energy shortage as opposed to a capacity shortage
 - installation of 250MW of emergency generation over a three-month period

The meeting also discussed the implications of increased levels of RES on system restoration strategies

Panel Members inspected TransGrid’s Condition Monitoring Centre and its iDemand experimental system

Another meeting the Australian C2 Panel was held in Brisbane on 18 October 2017. The meeting was hosted by AEMO.

Mark Miller updated the panel on the current activities of the C2 Study Committee and the associated working groups. A report was presented on the CIGRE Symposium in Dublin in May 2017.

The Panel then discussed recent operating incidents in Australia and New Zealand and their implications including:

- the results of AEMO’s investigation into the black system event in South Australia
- challenging operational events in NSW, Western Australia and New Zealand
- impact of mini hydro generating units on the Tasmanian distribution system
- implication of new auditing requirements for cyber security
- recent flood events in Queensland.

A presentation was made on AEMO’s summer readiness program for the NEM.

Panel Members inspected AEMO’s Brisbane NEM Control Centre and were given a demonstration of the dispatch training simulator.

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

Currently there are no invitations.

7. ANC Members on Working Groups

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

WG	Title	Australian Member
C2.22	Application of resilience engineering to safety management principles in Control Centers ensuring and enhancing power system reliability.	Mark Miller
C2.23	System Restoration Procedure and Practices	Mark Miller
JWG C2/C5.05	Development and Changes in the Business of System Operators	Mark Miller
JWG C2/B4.38	Capabilities and requirements definition for Power Electronics based technology for secure and efficient operation and control	Richard Sherry and Sorrel Grogan (corresponding members)

8. Membership of the Australian Panel



Name	Organisation	Type
Shane Duryea	Western Power WA	Operator/Transmission/Distribution
Colin Taylor	ElectraNet SA	Transmission
Chong Ong	Networks Tasmania	Transmission /Distribution
Richard Sherry	Transpower NZ	Operator/Transmission
Graeme Carter	Endeavour Energy NSW	Distribution
Mark Miller		Outgoing Convenor
Tjaart Van der Walt	AEMO	Operator
Greg Hesse (1)	Powerlink QLD	Transmission
Andrew Power	TransGrid NSW	Transmission
Eric Sonogo	Energex QLD	Distribution
Andrew Dunn	Power Systems Consultants Pty Ltd	Consultant
Stuart Donaldson	Ausgrid NSW	Distribution
Geoff Burgess	Essential Energy NSW	Distribution
Chris Wembridge	Tas Networks	NGN Representative

(1) Incoming Convenor

Convenor: Mark Miller

Email: mrmiller@optusnet.com.au

Phone: 0417 435 226



AP C3 System Environmental Performance

1. Study Committee Scope

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. Issues include climate change, pollution, EMF, noise, public acceptance and ecology.

2. Specific Activities of the Study Committee

The current areas of work of the Study Committee are reflected in the active working groups.

- EMF and health (C3.01)
- Methodologies for Greenhouse gas inventory and reporting (C3.12)
- Corridor management (C3.09)
- Environmental issues of transmission lines (B1/B2/C3.13)
- Environmental liability (C3.14)
- Improving public acceptance of substations (C3.15)
- Interactions between wildlife and powerlines and substations (C3.16) and emerging renewable energy sources (C3.17)
- Eco- friendly approaches to T&D (C3.18)

3. Preferential Subjects

Preferential subjects as selected by the C3 Study Committee for Paris 2018:

PS 1 : Effectiveness of environmental prevention, mitigation and compensation measures

- Methodologies and procedures for evaluation
- Results (does it work)?
- Experiences when the results are not in compliance with the expectations

PS 2: Mitigation of the visual impacts of electrical assets to increase public acceptance

- Mitigating measures, for example
- Design, materials and camouflaging techniques
- Location, landscaping design and vegetation
- Design to hide the assets or show them off
- Communication methods for showing the visual impacts to stakeholders.
- Do regulations and policies (incl financial limits from regulators) promote or hinder visual impact?

PS 3: Technical and environmental aspects of OHL

- Advantages and challenges of reducing environmental impacts
- Public acceptance (incl psychological elements)
- Innovative design
- Multi-material structures
- Compact lines
- Mitigation and design for external impacts

4. Proposed New Working Groups

The following proposed working groups were discussed at the 2017 annual C3 study committee meeting:

EMF brochure

- Proposed convenor is Australian James Hart.
- Technical brochure for Cigré members (not the public) to ensure that new employees have a reference document that addresses the recent loss of industry expertise.
- Provide information about how to communicate about EMF-issues with the public.
- Separate from C3.01, which is a WG for constant monitoring of new development/research within the field of EMF.



- A draft TOR has been circulated

Life Cycle Assessment of substations

- Proposal by RTE.
- TOR to be redrafted to expand scope.
- Further consultation required with B3 (needs substation expertise).

Characterisation EMF of UHVAC & DC

- Draft TOR drafted by Rong Zeng (China)
- Comments received from Michel Plante, will be sent by Henk Sanders to Carlos Wall for second opinion
- First impression: scope to large (AC & DC) and very technical, support of C4 required.

Effect of Carbon price grid planning and operations

- Proposal by RTE, first draft TOR by November

5. Specific Activities of the Australian Panel

The Australian Panel met in April 2017. The following issues were discussed:

- Assessment of abrasive blasting of towers and appropriate control measures
- GHS (single internationally agreed system of chemical classification and hazard communication) through labelling and Safety Data Sheets (SDS)
- PFOS - Perfluorooctane sulfonate are sometimes used in fire fighting foam now added to the Stockholm Convention on “Persistent Organic Pollutants” list
- Impacts on animals from exposure to zinc from towers/mono poles
- Aboriginal heritage management practices
- Fluid filled cables and the application of environmental risk assessment to both improve environmental performance and reduce expenditure
- Out of hours work restrictions
- Endangered wedge-tail interactions with powerlines
- Biodiversity legislation changes
- Environmental management for unregulated work
- Oil containment upgrade programs
- Animal caused outages
- Proposed Seminars or workshops for 2017/2018

There are currently no specific projects underway for AP C3. It was agreed that information dissemination from CIGRE International provided a valuable resource for members and that face to face meetings provided a valuable platform for information sharing.

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

Possible meeting with all C committees in 2021.

7. ANC Members on Working Groups

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

WG	Title	Australian Member
C3.01	EMF and health	James Hart
S3.09	Corridor management	Steven Martin
C3.14	Environmental liability	James Hart
C3.15	Improving public acceptance of substations	James Hart
C3.17	Interactions between wildlife and emerging renewable energy sources	



8. Membership of the Australian Panel

Name	Organisation	Type
James Hart (convenor)	Ausgrid	Distribution
Lynda Dawson	Powerlink Queensland	Transmission
Mark Paton	Energex	Distribution
Claire Royston	Western Power	T&D
Ed Parker	TasNetworks	T&D
Mike Lloyd	Essential Energy	Distribution
Michael Roberts	Endeavour Energy	Distribution
Sonya Bryce	Ergon Energy	Distribution
David Donehue	TransGrid	Transmission
Andrew Johnston	Electranet	Transmission
Colin Hoole	Powercor	Distribution

Convener: James Hart
Email: jhart@ausgrid.com.au
Phone: 02 9394 6659

AU-C4 System Technical Performance

1. Study Committee Scope

SC C4 considers methods and tools for analysis of power systems with particular emphasis on dynamic and transient operating conditions. The following broad topics of interest have been defined which span almost the entire range of phenomena and time frames that can impact on the overall performance of a power system, irrespective of its size and complexity:

1. Power Quality (PQ)

Benchmarking of PQ performance; Compatibility levels and indices; Measuring and monitoring systems, Correlation between lightning and PQ issues; Emissions coming from disturbing installations (e.g. power electronic interfaced generation and transmission equipment, as well as disturbing loads); Mitigation measures; Immunity of installations to PQ disturbances.

2. Electromagnetic Compatibility and Electromagnetic Interference (EMC/EMI)

Electromagnetic (EM) vulnerability; EMC in the vicinity of power systems; Requirements and solutions for HV substations and generating stations; Effects of intentional EMI on the power system; Understanding geomagnetic phenomena and impacts on the power system.

Health effects related to low frequency electromagnetic fields (EMF) are covered by SC C3, but when needed, related technical topics (measurement, calculations, mitigation, etc.) are covered by SC C4.

3. Insulation Co-ordination

Critical review of existing insulation practices; Specific issues for Ultra High Voltage (UHV) and High Voltage Direct Current (HVDC) systems; Interactions between the power system and transformers, with specific reference to transformer energisation studies; Resonance and ferro-resonance analysis; Interaction between long AC cables and the power system; Influence of system characteristics on circuit breaker operation such as Transient Recovery Voltages (TRV); Insulator pollution and the influence on transmission system performance.

4. Lightning

Critical review of lightning parameters and statistics; Attachment processes; Lightning performance of distribution and transmission lines with reference to the application of line surge arresters; Protection of low voltage lines; Protection of wind generators; Lightning location systems and associated data applications.

5. Power system performance, models and numerical analysis.

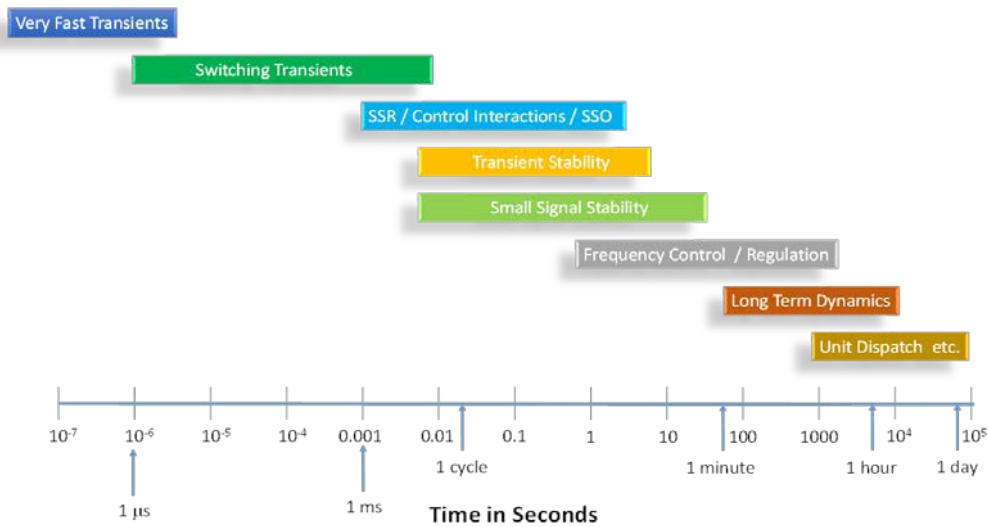
Methods and tools for the analysis and assessment of power balancing; Dynamic interaction between generation and transmission equipment; Influence of power converters and HVDC transmission on system security and AC network performance; Methods for modelling and aggregating components in active power networks; Modelling of renewable energy systems and inverter based technologies; Numerical EM analysis for surge propagation studies; Numerical techniques for the computation of very fast fronted transients including lightning strikes; Modelling of asymmetrical operating conditions experienced in power systems.

Inherent in all of these activities is the investigation and development of new tools, models, methods and techniques for the assessment and analysis of phenomena which can and do impact the performance of power systems.

The above issues also strongly relate to emerging Smart Grid technologies, with particular emphasis on power quality and advanced tools for the analysis of power system transients and dynamic performance. The development of analysis tools, models and calculation methodologies that appropriately account for the presence of significant embedded generation is now also a critical consideration given the prevalence of distributed energy sources in their various forms.

The range of power system phenomena relevant to SC C4 is conveniently summarised in Figure 1.

Figure 1: Diagrammatical representation of SC C4 main activities and associated analysis time frames



2. Key Activities

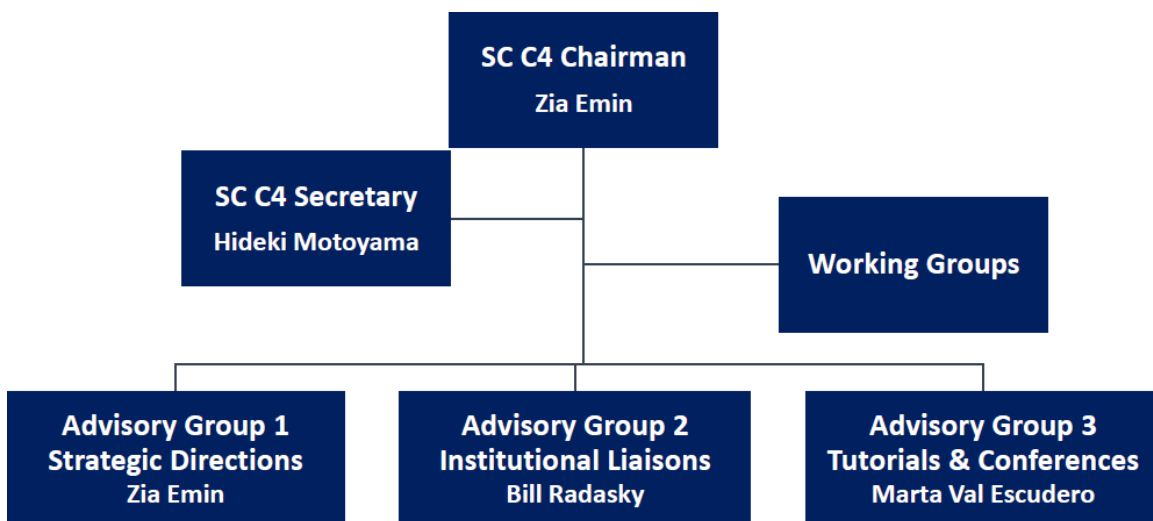
The attached presentation delivered at the 2017 ATC Technical Seminar highlights key activities and deliverables achieved during 2017 with a focus on those items most relevant to CIGRE Australia members.

3. Advisory Groups and Working Groups

The following information is current as of November 2017. Please note that some the information provided below may supersede the Study Committee Meeting notes (dating from May 2017) provided as part of the ATC presentation.

Three advisory groups, seventeen (17) working groups, and (14) fourteen joint working groups are currently active under the Study Committee. The structure of the C4 Study Committee and its Advisory Groups is as follows:

Figure 2: SC-C4 structure





From the Australian Panel of C4, Andrew Halley and Sarath Perera are both members of AG1. As the Australian Panel Convenor, Andrew is also a Regular Member of the Study Committee, being one of twenty four (24) national representatives.

A complete listing of active Working Groups currently being managed by the C4 Study Committee is provided in Table 1 below.

Table 1: Active Working Groups of SC-C4

WG #	Title	End 2017	Convener
<u>WG C4.503</u>	Numerical techniques for the computation of power systems, from steady-state to switching transients	Yes	<u>J.Mahseredjian (Canada)</u>
<u>WG C4.23</u>	Guide to Procedures for Estimating the Lightning Performance of Transmission Lines		<u>C. Engelbrecht (Netherlands)</u>
<u>JWG C4.24/CIRED</u>	Power Quality and EMC Issues associated with future electricity networks	Yes	<u>F. Zavoda (Canada)</u>
<u>WG C4.25</u>	Issues related to ELF Electromagnetic Field exposure and transient contact currents	Yes	<u>K. Kopsidas (UK)</u>
<u>WG C4.27</u>	Benchmarking of Power Quality Performance in Transmission Systems	Yes	<u>D. Vujatovic (UK)</u>
<u>WG C4.28</u>	Extrapolation of measured values of power frequency magnetic fields in the vicinity of power links		<u>P. E. Munhoz Rojas (Brazil)</u>
<u>WG C4.30</u>	EMC in Wind Generation Systems	Yes	<u>WH Siew (UK)</u>
<u>JWG C4.31/CIRED</u>	EMC between Communication Circuits and Power Systems		<u>D. Thomas (UK)</u>
<u>WG C4.32</u>	Understanding of the Geomagnetic Storm Environment for High Voltage Power Grids		<u>W. A. Radasky (USA)</u>
<u>WG C4.33</u>	Impact of Soil-Parameter Frequency Dependence on the Response of Grounding Electrodes and on the Lightning Performance of Electrical Systems	Yes	<u>S. Visacro (Brazil)</u>
<u>JWG C4/C6.35/CIRED</u>	Modelling and dynamic performance of inverter based generation in power system transmission and distribution studies	Yes	<u>K. Yamashita (Japan)</u>
<u>WG C4.36</u>	Winter Lightning – Parameters and Engineering Consequences for Wind Turbines		<u>M. Ishii (Japan)</u>
<u>WG C4.37</u>	Electromagnetic Computation Methods for Lightning Surge Studies with Emphasis on the FDTD Method	Yes	<u>Y. Baba (Japan)</u>
<u>JWG C4/B4.38</u>	Network Modelling for Harmonic Studies	Yes	<u>M. Val Escudero (Ireland)</u>



WG #	Title	End 2017	Convener
<u>WG C4.39</u>	Effectiveness of line surge arresters for lightning protection of overhead transmission lines		<u>K. Tsuge (Japan)</u>
<u>JWG C4.40/CIRED</u>	Revisions to IEC Technical Reports 61000-3-6, 61000-3-7, 61000-3-13, and 61000-3-14		<u>M. Halpin (USA)</u>
<u>JWG C4/B5.41</u>	Challenges with series compensation application in power systems when overcompensating lines		<u>L. Haarla (Finland)</u>
<u>JWG C4.42/CIRED</u>	Continuous assessment of low-order harmonic emissions from customer installations		<u>I. Papič (Slovenia)</u>
<u>WG C4.43</u>	Lightning problems and lightning risk management for nuclear power plants		<u>T. Shindo (Japan)</u>
<u>WG C4.44</u>	EMC for Large Photovoltaic Systems		<u>E. Salinas (Sweden)</u>
<u>WG C4.45</u>	Measuring techniques and characteristics of fast and very fast transient over voltages in substations and converter stations		<u>S. Xie (China)</u>
<u>WG C4.46</u>	Evaluation of Temporary Over Voltages in Power Systems due to Low Order Harmonic Resonances		<u>F. F. da Silva (Denmark)</u>
<u>WG C4.47</u>	Power System Resilience (PSR WG)		<u>M. van Harte (South Africa)</u>
<u>WG C4.48</u>	Overvoltage Withstand Characteristics of Power System Equipment 35-1200 kV		<u>I. Dudurych (Ireland)</u>
<u>JWG A2/C4.52</u>	High-frequency transformer and reactor models for network studies		<u>B. Gustavsen (Norway)</u>
<u>JWG A3/B5/C4.37</u>	System conditions for and probability of Out-of-Phase	Yes	<u>A. Janssen (Netherlands)</u>
<u>JWG A1/C4.52</u>	Wind generators and frequency-active power control of power systems		<u>N. Miller (USA)</u>
<u>JWG C2/C4.37</u>	Recommendations for Systematic Framework Design of Power System Stability Control		<u>Y. Fang (China)</u>
<u>JWG B4/B1/C4.73</u>	Surge and extended overvoltage testing of HVDC Cable Systems	Yes	<u>M. Saltzer (Sweden)</u>
<u>JWG B5/C4.61</u>	Impact of Low Inertia Network on Protection and Control		<u>R. Zhang (UK)</u>
<u>JWG C1/C4.36</u>	Review of Large City & Metropolitan Area power system development trends taking into account new generation, grid and information technologies.		<u>V. Jesus (Brazil)</u> <u>S. Utts (Russia)</u>



As indicated in Table 1, eleven (11) Working Groups are expecting to complete their activities in the near future. Table 2 summarises Working Groups that have recently completed their scopes of work and have been subsequently disbanded.

Table 2: Recently completed Working Groups and publications

WG #	Title	Convener	Technical Brochure (TB)	TB Publication Date
<u>WG C4.26</u>	Evaluation of Lightning Shielding Analysis Methods for EHV and UHV DC and AC Transmission Lines	JL. He (China)	TB704	November 2017
<u>WG C4.34</u>	Application of Phasor Measurement Units for monitoring power system dynamic performance	U. D. Annakkage (Canada)	TB702	November 2017
<u>JWG C4/C6.29</u>	Power Quality aspects of Solar Power	J. Smith (USA)	TB672	December 2016
<u>WG C4.305</u>	Practices in Insulation Coordination of Modern Electric Power Systems Aimed at the Reduction of the Insulation Level	A. S. Telento (Croatia)	No Published Technical Brochure	---
<u>WG C4.111</u>	Review of LV and MV Compatibility Levels for Voltage Fluctuation	M. Halpin (USA)	TB656	May 2016

4. ANC Members Contributing to Working Groups and Other Industry Activities

The following ANC members are contributing to C4 Working Groups.

Table 3: Australian representation on active C4 working groups

WG #	Australian representative	Status
<u>WG C4.503</u>	Phillip Nichols	Member
<u>JWG C4.24/CIRE</u>	Philip Ciufu (University of Wollongong)	Member
<u>WG C4.25</u>	Thanh Dovan	Member
<u>WG C4.27</u>	Sean Elphick (University of Wollongong)	Member
<u>WG C4.28</u>	Ben Li	Member
<u>WG C4.32</u>	Andrew Halley, Robert Adams Terry Killen	Member Corresponding
<u>JWG C4/C6.35/CIRE</u>	Andrew Halley, Robert Adams Jin Ma, Babak Badrzadeh, David Vowles	Member Corresponding
<u>C4.39</u>	Thomas Daly	Corresponding
<u>C4.40/CIRE</u>	Alex Baitch, Sarath Perera, Vic Gosbell	Member
<u>C4.42/CIRE</u>	Tim Browne, Sarath Perera, Vic Gosbell	Corresponding



ANC members aligned with AU-C4 are also contributing to a variety of other Study Committee working groups as well as technical committees associated with the International Electrotechnical Commission (IEC) and Standards Australia.

Table 4: Contributions to other Working Groups and relevant industry bodies

Reference	Australian representative	Contribution
<u>B4 Green Book on FACTS Devices</u>	Babak Badrzadeh	Lead Author, Chapter 22: “Commissioning tests for FACTS devices”
	Rizah Memisevic Andrew Van Eyk (ElectraNet) Peeter Muttik	Contributing members to Chapter 22
<u>IEC SC77A WG8: “Description of the electromagnetic environment associated with the disturbances present on electricity supply networks”.</u>	Alex Baitch	Member
<u>IEC Advisory Committee on Transmission and Distribution</u>	Alex Baitch	Member
<u>Standards Australia</u> <u>EL-034 Power Quality</u> <u>EL-043 High voltage installations</u>	Peeter Muttik Alex Baitch	Peeter is Chairman of EL-034 and a member of several of its sub-committees. Alex is a Member of both.
<u>JWG C1/C6.37/CIRED Optimal transmission and distribution investment decisions under increasing energy scenario uncertainty.</u>	Alex Baitch	Member
<u>IEC TC77 EMC</u>	Robert Adams	Australian Head of Delegation at the Stesa and Hangzhou Meetings. Head of Australian Delegation to the CISPR Meetings in Vladivostok. Also represented Energy Networks Australia (ENA) on this group.
<u>WG B3.43 Contemporary substation design for developing countries</u>	Robert Adams	Member

5. Proposed New Working Groups

The proposed Working Groups listed in Table 5 are currently under review by the C4 Study Committee.

It can be noted that three (3) new Working Groups were discussed and subsequently accepted by the Study Committee at its Dublin meeting. They are now fully approved and are also included in Table 1 above.

Table 5: Proposed Working Groups under consideration

Proposed	WG title	Status	Review Deadline
October 2017	WG_C4_50_Evaluation of Transient Performance of Grounding System in Substation and its Influence on Secondary System	Under review by SC	30 November 2017
October 2017	WG_C4_49_Wideband stability of grid-tied converter-based modern power systems	Under review by SC	30 November 2017
April 2017	WG_C4_48_Overvoltage Withstand Characteristics of HV Transmission Equipment	Accepted by SC C4, Approved by TC	
April 2017	WG_C4_47_Power System Resilience	Accepted by SC C4, Approved by TC	
April 2017	WG_C4_46_Evaluation of Temporary Over Voltages in Transmission Systems	Accepted by SC C4, Approved by TC	

6. Upcoming Events

The next C4 SC meeting will be held in conjunction with the 2018 General Session.

Key upcoming events for SC C4:

1. 2018 General Session, 26-31 August, Paris, France

Preferential subjects for the 2018 C4 Session are as follows:

PS1: System technical performance issues focusing on the effects of high level integration of power electronics based technologies:

- Power system stability control with particular emphasis on frequency and voltage control systems of converter based energy sources including their modelling and performance and challenges on series compensation and impact of micro-grids.
- Analysis, measurement, benchmarking and standardisation of power quality.
- EMC aspects of future power networks including ELF exposures.

PS 2: Developments and advances in modelling and evaluation of lightning performance and insulation coordination including:

- Estimation of lightning performance of transmission lines including detection, evaluation of shielding analysis methods and effectiveness of line surge arresters.
- Lightning protection of renewable and nuclear power plants including seasonal variations and risk management.
- Evaluation of surges and over voltages on OHL/cable systems, impact of harmonic resonances on temporary over voltages.

PS 3: Computational advances in tools, models, methodology and analysis of power system technical performance related issues:

- Frequency dependent modelling techniques for high frequency electrical transients and power quality assessments.
- Developments in lightning surge studies with particular emphasis on FDTD method and advances in grounding electrode modelling.
- Hybrid and real time simulation of system dynamic behaviour.



2. 2019 CIGRE-IEC Colloquium on EHV & UHV (AC&DC), 23-26 April 2019, Hakodate, Japan

- “New trends of advanced technology for efficient, economical and resilient power systems”.
- SC C4 is supporting the organisation of this event.
- <http://www.cigre.org/Events/Other-CIGRE-Events/CIGRE-IEC-2019-Conference-on-EHV-and-UHV-AC-DC>

3. 2019 CIGRE Symposium, 3-6 June, Aalborg, Denmark

- “Going Offshore – Challenges of the future power super grid”
- SC C4 is the lead organising committee for the 2019 symposium in Denmark.
- To be held in conjunction with International Study Committee Meetings (C1, C2, **C4**, B1, B2 and B4).

7. Completed and Proposed Activities

Australian Panels C4 and B4 delivered a successful Technical Seminar in Brisbane on the 9 and 10 November 2017. The seminar was titled “*The impact of power electronics on network performance and capability*” and was the first joint event organised by the two panels. The seminar was well supported, with seventy six (76) registered attendees including overseas representatives from New Zealand (3) and Germany (1). Feedback offered to date has been overwhelmingly positive suggesting that the format (a mix of 30 minute technical presentations and two longer workshop sessions) delivered value for the participants.

As Convenor of C4, I would like to extend my thanks to Les Brand (B4 Convenor) as well as Terry Killen and Kerry Williams (ANC Head Office) for their support and individual efforts in bringing the event together and making it a success.

AU-C4 has discussed running a similar event in 2018, again in conjunction with its annual panel meeting. While details are still to be fully developed, the preliminary concept is to offer a technical seminar on the theme “*The role of synchrophasor technology now and into the future*”. The event is likely to be held at the University of Wollongong on the 13 and 14 August to take advantage of a visit to Australia by Udaya Annakkage (Convenor of WG C4.34, see Table 2 above). Confirmation of arrangements will be communicated early in 2018.

8. Invitations for SC or WG’s to meet in Australia

No formal invitations have been extended to the C4 Study Committee to meet in Australia in the near term. Initial discussions have commenced with other Australian Panels about the potential of hosting the Cigre Symposium in 2023 which will likely occur in conjunction with a number of SC meetings.

An invitation has been extended to the Convenor of Working Group C4.40 (Mark Halpin, USA) to hold a meeting in Australia in March 2018. The meeting would most likely occur at the University of Wollongong. Details are still to be finalised.

9. Membership of the Australian Panel

The AU C4 Panel consists of twenty four (24) members. Negotiations are currently in progress with Endeavour Energy to populate a vacant position that the business is already funding. This will increase the total complement of the panel to twenty five (25) which includes one Next Generation Network (NGN) representative who also provides secretariat services to the Panel.



Table 6: Members of AU-C4 and their affiliation

Name	Organisation	Type
Alex Baitch	BES (Aust) Pty Ltd	Consulting
Babak Badrzadeh	Australian Energy Market Operator (AEMO)	System Operator
Tim Browne	PSC Australia	Consulting
Tom Daly	Consolidated Power Projects	NGN / Service Provider
Steve Fraser	SA Power Networks	Network Service Provider
Don Geddey	TransGrid	Network Service Provider
Vic Gosbell	University of Wollongong	Academia
Andrew Halley	Tasmanian Networks Pty Ltd	Network Service Provider
Chandana Herath	Essential Energy	Network Service Provider
Miron Janjic	BECA	Consulting / Service Provider
Viji Krishnaratnam	Energex Ltd	Network Service Provider
<u>Ben Li</u>	Ausnet Services	Network Service Provider
Ashwin Maharaj	ElectraNet	Network Service Provider
Garry Melik	Magshield Products International	Consulting
Rizah Memisevic	Powerlink Queensland	Network Service Provider
Peeter Muttik	GE Energy Connections (was Alstom Grid Aust)	Equipment Supplier
Michael Negnevitsky	University of Tasmania School of Engineering	Academia
Huuson Nguyen	Western Power	Network Service Provider
Sarath Perera	University of Wollongong	Academia
Brett Roberts	AUSGRID	Network Service Provider
David Roby	ABB Australia Pty Limited	Equipment Supplier
David Vowles	University of Adelaide	Academia
Neville Watson	University Of Canterbury	Academia
Ruchira Withanage	GHD Hill Michael	Consulting
<i>Under negotiation</i>	Endeavour Energy	Network Service Provider

For further information or questions, please contact:

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



AP C5 Markets and Regulation

1. Study Committee Scope

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

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

- market design, efficiency and regulation;
- integration of renewable resources into market structures;
- generation and transmission investment;
- congestion pricing and management; and,
- market governance arrangements

The study committee conducts the Market Disturbance portion of the Large Disturbance Workshop held on Monday during the General Session to:

- share experiences;
- learn from real life experiences of usual or extreme market circumstances; and
- examine the performance of various market designs and regulations.

2. Specific Activities of the Study Committee

The Study Committee met in Dublin in May in conjunction with Study Committees C1, C2, C3, C4, C6 and B2. All of the active Working Groups met in Dublin as well. The presentation contains more detail and the report from the seminar is available via the KMS.

The Study Committee is continuing its focus on market developments, as shown in the recent publications (see presentation), the preferential subjects (below) and the new working groups. In addition, there is proposal to examine market price formation in the presence of a carbon or similar price. In the summary to the Dublin Seminar

“In summary, the different parts of the world face similar challenges how to design appropriate support systems for renewable energy investment, how to integrate them into the market, and how to operate markets across different countries, inter alia to make best use of temporary regional surpluses and deficits in renewable generation. As the system incl. customer demand needs to become more flexible to better accommodate renewables fluctuations, electricity pricing methodologies need to receive increasing attention.” – Final report of the 2017 CIGRE Symposium in Dublin, page 15

Study Committee C5 is supporting Study Committee C1 in a joint working group with the IEC, examining the tasks required for an ACTAD committee 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 Study Committee is also running the Market Disturbance Workshop as part of the Large Disturbance workshop in cooperation with SC C2. The Call for Presentation will be released at the Technical Council meeting in November 2017 with a closing date of 12 March 2018. The Australian Panel will support and coordinate the Market Disturbance Workshop.

3. Preferential Subjects

The preferential subject for 2018 are:

PS 1 - The need to change business and regulatory models driven by increase in distributed resources, storage and demand response.

- Evolution of regulatory models given reduction in revenue and negative load growth.
- Evolution of regulatory models to accommodate distributed and/or renewable resources in a challenging economic situation.
- Optimal evolution of markets at all levels.



PS 2 - Impact of climate policy on electricity markets.

- Methods to adapt electricity markets given the trend to zero marginal cost resources and feasibility of such evolution.
- Market response to public policy driven intervention and methods by which markets can be utilized to implement public policy.
- Market design or regulatory changes that can be considered to make markets more resilient to such intervention.

PS 3 - Localized markets or microgrids interacting with wholesale markets.

- Methods to leverage markets for localized resources to provide system services.
- Market signals and schemes that can be utilized to harmonize and coordinate resources across transmission / distribution interface.
- Market design changes that can be considered at wholesale and retail level to manage localized resource interactions.

4. Proposed New Working Groups

All proposed working groups for SC C5 have been approved and are included in the table in section 7.

5. Specific Activities of the Australian Panel

The Australian Panel held a mini-seminar in association with its meeting in Wellington last May. The seminar covered developments in the NEM and the NZ markets. More detail is available in the presentation and the presentations from the day are available on the KMS.

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

An invitation has been extended to SC C5 to meet in Australia. The incoming Chair, however, is favouring a competing invitation from Canada.

7. ANC Members on Working Groups

The current 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	Mark Miller(C2)
WG C5.16	Market Cost of Electric Service	Alex Cruickshank*
WG C5.18	Market Price Signals	Joel Gilmore
WG C5.20	Evolution of Markets	Tim Baker* Julian Eggleston David Bowker (t) David Hoch
WG C5.21	Environmental Impacts on Markets	Greg Thorpe*
WG C5.22	Management of Systemic Market Risk in Electricity Markets	Greg Thorpe* Tim Baker Andrew Jones Alex Cruickshank
WG C5.23	Wholesale Market Price Caps	Ben Vanderwaal* Julian Eggleston Victor Francisco Alex Cruickshank
WG C5.24	Exploring the Market-based value of Smart Grid developments	Ramu Naidoo* Alex Cruickshank



Working Group	Title	AU/NZ Leader*/ Representative
WG C5.25	Regulation & Market design perspectives raised by new storage technologies	Gari Bickers Andrew Jones Ben Vanderwaal
WG C5-26	Auction markets and other procurement methods for demand	Gregor Verbic Victor Francisco
WG C5-27	Market Design for short term flexibility	Greg Thorpe John Cooper Tim Baker Alex Cruickshank

8. Membership of the Australian Panel

Name	Organisation	Type
Alex Cruickshank	Convenor	–
Charles Allen	Jacobs	Consultant
Tim Baker	Tim Baker Consulting	Consultant
Gari Bickers	Transpower	TNSP
Miguel Brandao	AGL Energy	Generator/Retailer
Michael Chiang	Ausnet Services	DNSP
Bess Clark	Tasnetworks	TNSP
Julian Eggleston	AEMC	Other
Victor Francisco	PSC Consulting	Consultant
Garth Gum Gee	GHD Consulting	Consultant
David Hoch	Engie	Generator
Rachel Johnson/ John Cooper	Hydro Tasmania	Generator/Retailer
Andrew Jones	Lloyds Register	Generator
Kevin Kehl	Powerlink	TNSP
Rainer Korte	ElectraNet	TNSP
Ramu Naidoo	Scientia Consulting	Consultant
Kody Ponds	NGN	–
Ian Rose	Ernst&Young	Consultant
David Swift	AEMO	Operator
Greg Thorpe	Oakley Greenwood	Consultant

Convener: Alex Cruickshank

Email: acruicks@me.com

Phone: 0402 060 881



AP C6 Dispersed Generation and Distribution Systems

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/dispersed 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/dispersed generation and to become an internationally recognised forum on this evolving subject.

2. Specific Activities of the Study Committee

The work of SC C6 in 2017 focused on continuing the contributions of the Working Groups, and the annual SC C6 meeting in Dublin as part of the Dublin Symposium.

AP C6 Convenor Ken Ash attended the Dublin C6 SC meeting on behalf of the AP C6 group, as well as a number of other Australian C6 representatives, including Alex Baitch.

Key issues and topics covered were:

- The C6 Chairperson, Christine Schwaegerl introduced Mr Geza Joos as the new SCC6 Secretary.
- The Technical Committee meeting of CIGRE was discussed and key recommendations were reviewed for SC members.
- Activities of the working groups was reviewed and discussed.
- Former C6 Chair Nikos Hatzigiorgiou has commenced the C6 Green Book.
- Preferential subjects for Paris 2018 were briefly discussed.
- A C6 strategy session was held to provide input for the C6 chair to take back to the CIGRE Technical Committee as the role of C6 and Distribution systems is being assessed.
- The location for the SC meeting in 2019 was confirmed as China, and the 2021 meeting will be in Slovenia.

3. Preferential Subjects

The preferential subjects nominated by the C6 Study Committee for the 2018 Paris Session are as follows:

PS 1: Exploiting flexibility in strategic distribution planning and operation - Managing resilience and congestion using distributed energy resources - Implementing demand response, customer empowerment and markets - Distributed resources asset management

PS 2: Energy storage in distribution systems - Deploying and managing energy storage (electrical, thermal etc.) - Exploiting transportation electrification - Multi-energy system and load interaction for energy efficiency

PS 3: Intelligent electrification for all - Electric energy systems for smart cities - Grid-connected microgrids - Off grid electrical systems for remote and rural deployment

4. Proposed New Working Groups

New Working Groups proposed for SC C6 are as follows:

- WG C6.33 Multi Energy Systems;
- WG C6.34 Flexibility & Grid Services from Distributed Energy Systems – Pierluigi Mancarella from AU will be convenor;
- WG C6.38 DER Aggregation Platforms.



5. Specific Activities of the Australian Panel

The AP C6 annual meeting was held in Sydney on Monday August 14th, hosted by Endeavor Energy, in conjunction with the Biannual CIDER 17 Conference.

The meeting was attended by 16 current C6 members, one NGN representative, and two guests/observer. The meeting discussed activities from the past 12 months, with reports of activities of the working groups, and discussed contributions for the CIDER conference on the following 2 days, and preparations for the 2018 Paris Session. Presentations were given by members during the meeting on topics of special interest.

CIGRE Australian Panel C6 also hosted the 2nd Biannual Conference on the Integration of Distributed Energy Resources (CIDER), in Sydney on August 15th and 16th. The conference was attended by over 100 delegates, included a technical exhibit area with 10 exhibitors, and included 32 presenters across 8 main sessions over the 2 days. The NGN also organised a panel session titled “The Future of Distributed Energy in Australia”, which was enjoyed by all attendees. The conference was organised by CIGRE National office, with help from an external conference consultant, and managed to run at a healthy profit.

The C6 team propose to run CIDER conferences every 2 years, in non-Paris years, co-located with the annual C6 Panel meeting. The next CIDER conference is proposed for Melbourne in 2019.

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

A proposal to hold a CIGRE Symposium in Cairns, Australia, in 2023 with SC C6 taking the lead role was approved by the CIGRE technical committee recently held in South Africa.

7. ANC Members on Working Groups

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

WG	Title	Australian Member
C6.28	Hybrid systems for off-grid power supply	Ken Ash
C6.29	Power Quality & PV’s	Albert Pohrs
C6.30	Impact of Battery Energy Storage	Michael Negnevetski
C6.31	MVDC Feasibility Study	
C6.32/D2	Utilisation of data from smart meter systems	Pierluigi Mancarella
C6.35	Modelling & Dynamic performance of inverter based generation in power system transmission & distribution studies	
C2/C6.36	System Operation Emphasising DSO/TSO Interaction	
AGC6.23	Terminology	Alex Baitch

8. Membership of the Australian Panel

Name	Organisation	Type
1 Ken Ash (Convenor)	HEG	Consultant
2 Alex Baitch	BES Baitch	Consultant
3 Ray Brown	RB Engineering	Consultant
4 Miguel Brandao	AGL	Industry



Name	Organisation	Type	
5	David Stephens	Horizon Power	Consultant
6	Wai Kin-Wong	Electranet	Transmission
7	Shervin Fani	Western Power	Distribution
8	Derek Jones	TasNetworks	Distribution
9	Victor Ho	SA Power Networks	Distribution
10	Gerard Ledwych	Qld Uni Technology	Academic
11	Sean Elphick	Uni of Wollongong	Academic
12	Michael Negnevitski	Uni of Tasmania	Academic
13	Peter Kilby	Energex	Distribution
14	Albert Pors	Endeavor Energy	Distribution
15	David Butler	Hydro Tasmania	Generation
16	Michelle Taylor	Ergon Energy	Distribution
17	Pierluigi Mancarella	Uni of Melbourne	Academic
18	Thomas Smolka	Reinhausen	Supplier
19	Pradip Verma	Pacific Power Association	Distribution
20	Jenny Reisz	AEMO	Regulator
21	John Fletcher	Uni of NSW	Academic
22	Olav Krause	Uni of QLD	Academic
23	Kody Ponds	NGN	

Convener: Ken Ash

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AP D1 MATERIALS AND EMERGING TEST TECHNIQUES

Study Committee Scope

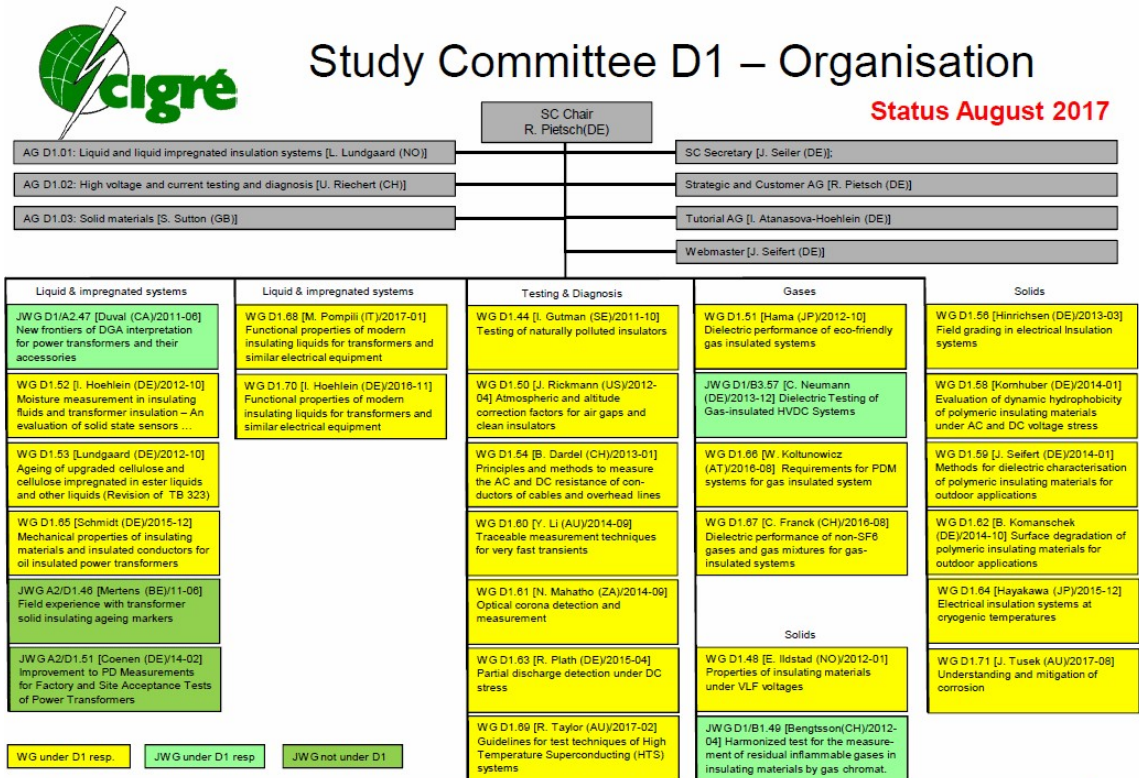
The D1 study committee deals with testing techniques and material developments that support HV plant. It is one of the horizontal committees and thus is a service provider to other SC's. Typically it partners with SC's to provide engineering and scientific input into their understanding of plant asset 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

1. Specific Activities of the Study Committee

The Study Committee has 27 WG and JWG's operating.



CIGRE Study Committee D1 – Organisation



The SC maintains the following liaisons with IEC Technical Committees to enable D1 to be responsive to IEC requirements for technical assistance in the production of standards.

1. IEC TC 2 Rotating Machinery
2. IEC TC 10 Fluids for Electrotechnical Applications
3. IEC TC 28 Insulation Co-ordination
4. IEC TC 33 Power Capacitors
5. IEC TC 36 Outdoor Insulators
6. IEC TC 42 High Voltage Test Techniques
7. IEC TC 112 Evaluation and Qualification of Electrical Insulating Materials and

SC D1 – The following Preferential Topics have been determined for Paris Session 47

PS 1 / HV DC insulation systems

- Measurement methods for validating electrical field simulations.
- New diagnostics for maintenance.
- Experience and requirements for new test procedures and standards.

PS 2 / Materials and ageing

- New stresses, e.g. from power electronics.
- Higher stress operating environment, e.g. compact applications.
- Materials with lower environmental footprint.

PS 3 / Testing, monitoring and diagnostics

- Experience and added value from online monitoring systems.
- Reliability of equipment and systems for testing, monitoring and diagnostics.
- Advanced condition assessment.

Brochures

The following brochures detailing results of working groups were issued in 2016-17

- TB 646 - HVDC Transformer Insulation: Oil Conductivity - JWG A2/D1.41
- TB 654 - UHF partial discharge detection system for GIS: Application guide for sensitivity verification – WG D1.25
- TB 661 - Functional nanomaterials for electric power industry Working Group – WG D1.40
- TB 662 - Guidelines for partial discharge detection using conventional (IEC 60270) and unconventional methods – WG D1.37
- TB 676 - Partial Discharges In Transformers – WG D1.28
- TB 691 - Pollution Test Of Naturally And Artificially Contaminated Insulators – WG D1.44

Events

Planned SC meetings

- 2017 SC D1 will meet in Winnipeg, Canada, October 2017
- 2018 SC D1 will meet in Paris, France, August, 2018
- 2019 SC D1 will meet in New Delhi, India



2. Proposed New Working Groups

There are no published proposals before SC D1 at present for new working groups. In general there are concerns in CIGRE that there are a minority of members contributing to too many working groups. This will now be monitored so as to prevent burnout of experts and retarding the progress of working groups due to over commitment of their experts.

3. Specific Activities of the Australian Panel

Annual Meeting of AP D1 was held on 7-8 Nov 2017 at the National Measurement Institute in Lindfield Sydney and sponsored by Dr Ilya Budovsky of NMI.

There were 10 members and several observers at the meeting. As a result of its mixed membership the discussions in this group range widely as members bring their perspective to issues from their various fields' of expertise and diverse interests.

During the meeting Dr Budovsky gave a tour of some of NMI's various standards and laboratories which was very insightful into the enormous amount of work and world leading expertise that resides within the facility.

The panel members gave reports covering,

- Single Wire Earth Return (SWER) high resistance fault monitoring technology
- Research into nanoparticle fillers for insulating materials
- Unusual Dissolved Gas Analysis (DGA) indications from windfarm transformers
- 145kV MVT failures failure investigation
- 66kV CB Failures failure investigation
- 275kC CT failure investigation
- 330kV Oil Insulated Paper bushing failure investigation
- Corrosive sulphur corrosion of tap changer contact silver
- Cable moisture investigation
- HV disconnecter problems
- Omicron VOLTANO VT and CT analyser measurement technology
- Australasian Transformer Innovation Centre
- Steep front time HV impulse measurements and divider characterisation
- New capability for NMI for field impulse calibration

The convenor also provided feedback on the Colloquium at Winnipeg, MB Canada, September 30 – October 6, 2017 and the meeting of the SC and made available the reports to the SC to members of the group.

Some statistics on the Winnipeg colloquium,

- There were 102 papers presented by A3 (24), B4(48) and D1(30)
- The D1 event unfortunately coincided with A2 meeting in Cracow Poland, which meant that many transformer related participants did not come to Winnipeg to make their report in person.
- During the event there was a major review of the brochure for D1.71 undertaken which is now mostly complete except for a few industry specific examples and a chapter on metals heavily utilised in the electro-technical community.
- At the time of writing this report there were no official statistics available, but my estimate was that attendance was in the order of 500.

Papers accepted for Paris Session in 2018 by D1 panel members,

- 1) SC D1 – PS3 - Y. Li and W. Yan, Steep impulse voltage tests on high-voltage equipment.
- 2) SC D1 – PS3 - J. Tusek , S. Wolinski, J. S. Welsh, Parametric Frequency Response Interpretation using Frequency Localising Basis Functions.
- 3) SC A2 – PS3 - J. Tusek, H Rahimpour, M. Cotton, R. Willoughby, The Emerging Role of FRA as a Required Commissioning Test.



4. ANC Members on Working Groups

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

WG	Title	Australian Member
D1.48	Properties of insulating materials under VLF voltages	Prof Trevor Blackburn and Hans Mayer
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
D1.50	Atmospheric and altitude correction factors for air gaps and clean insulators	Dr Yi Li
D1.69	Guidelines for test techniques of High Temperature Superconducting (HTS) systems	Richard Taylor
D1.71	Understanding and mitigating corrosion	Joe Tusek
A2.53	Objective interpretation methodology for the mechanical condition assessment of transformer windings using Frequency Response Analysis (FRA)	Joe Tusek (corresp.)
B3.47	Application of Robotics in Substations	Robert (Yi) Li
D1.51	Dielectric performance of eco-friendly gas insulated systems	Daniel Martin (corresp.)
D1.65	Mechanical properties of insulating materials for power transformers	Daniel Martin (corresp.)
SAG	Strategic Advisory Group	Joe Tusek
CAG	Customer Advisory Group	Joe Tusek

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

There is no opportunity for the SC to meet in Australia until 2021.



6. Membership of the Australian Panel

Name	Organisation	Type
Joe Tusek	Ampcontrol ETM	Consultant
Prasanna Wickramasuriya	Energex	Distribution
Florian Predl	Omicron	Manufacturer
Mark Cotton	AusNet Services	Transmission
Mohiner Pannu	Wilson Transformers	Manufacturer
Karl Haubner	Doble	Manufacturer
Phil Ramsay	Ausgrid	Distribution
Andrew Wilkinson	ElectraNet	Transmission
Robert Li	TransGrid	Transmission
Dharmendra Shah	Powerlink	Transmission
Prof Tapan Saha	University of Queensland	University
Dr Yi Li	National Measurement Institute	Other
Dr Toan Phung	University of NSW	University
Prof Trevor Blackburn	University of NSW	University
Hans Mayer	Occasional B1 liaison	Other

Convener: Joe Tusek
Email: joe.tusek@ampcontrolgroup.com
Phone: (02) 4941 5340



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, SC D2 has seen a shift where EPU's are becoming more data-centric rather than asset-centric.

The ability to generate and process data in large volumes for decision making presents an opportunity and challenges to EPU's to develop strategies around the use of emerging information and telecommunication technologies (IoT, Big Data, etc.) and integrate IT and T knowledge and processes with other engineering disciplines.

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.

3. Preferential Subjects

Preferential subjects selected by the Study Committee for the 2018 Paris Session are as follows:

- a) PS 1 : Opportunities and challenges in ICT applied to microgrid and DER
 - Communication solutions to remotely monitor and operate off-grid premises
 - Facilities for control, monitoring, physical security and safety.
 - Standards, interoperability and cyber security issues.

- b) PS 2: Potential applications and implementation of network and infrastructure virtualization
 - Opportunities and benefits using Software Defined Networking and Network Function Virtualization (SDN/NFV).
 - Issues identified in implementation and operation of virtualization architectures.
 - Strategies to operate a secure SDN/NFV deployment.

- c) PS 3: Maintaining reliable and secure operation in an evolving environment
 - ICT to support asset management and maintenance.
 - Life cycle management and integration of legacy and new devices.
 - Situational awareness, risk management and cyber incident responses.

4. Proposed New Working Groups

These are the new working groups raised and approved in 2017:

- D2.43 Enabling software defined networking for EPU telecom applications
- D2.44 Usage of Public or Private Wireless Communication Infrastructures for Monitoring and Maintenance of Grid Assets and Facilities

Other current active working groups are:

- JWGC6/D2.32 Utilization of smart meter system
- JWGD2/C2.41 Advanced Utility Data Management and Analytics for Improved Situational Awareness of EPU Operations



- D2.40 Cyber risks and cyber security for the next generation of digital systems in Electric Power Utilities
- D2.38 A framework for Electric Power Utility (EPU) operators to manage the response to a cyber-initiated threat to their critical infrastructure
- D2.42 Synchronization and time distribution in communication networks for time-sensitive distributed operational applications in the power grid
- JWGD2/B2.39 Design, deployment and maintenance of Optical Cables associated to Overhead HV Transmission Lines

5. Specific Activities of the Australian Panel

The Australia D2 Panel held its annual meeting in Canberra between 5 July 2017 and 7 July 2017, hosted by ActewAGL. Panel members are Information Systems, Security, and Telecommunications representatives from more than 15 EPU's across Australia and New Zealand.

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

A WG D2.43 meeting is being considered in Adelaide in early 2018.

7. ANC Members on Working Groups

The following are the AP representatives on current Working Groups.

WG	Title	Australian Member
JWG.D2/B2-39	Design, deployment and maintenance of Optical Cables associated to Overhead HV Transmission Lines	Rohan Fernandez
WG D2.38	A framework for Electric Power Utility (EPU) operators to manage the response to a cyber-initiated threat to their critical infrastructure	Victor Tan
WG D2.43	Enabling software defined networking for EPU telecom applications	Victor Tan

8. Membership of the Australian Panel

Name	Organisation	Type Vendor Tx Utility Dx Utility Consultant Academic
Victor Tan	PSC Consulting	C
David Taddeo	GHD Pty Ltd	V
Thoai Ton	Ausnet	T
David Paramandan	CommTel	D
Paul McKeen	Energex	D
John Hocking	Power and Water Corporation	T, D
Tony Myatt	SA Power Networks	D
Mark Mullins	Tesla Consultants	C
Mark Remmer	Powerlink	T
Aaron Gates	Western Power	T
Louise Watts	SA Power Networks	D
Bernard Harnett	PSC New Zealand	C
James Cole	ActewAGL	T, D
Rohan Fernandez	ElectraNet	T



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Name	Organisation	Type Vendor Tx Utility Dx Utility Consultant Academic
Glenn Firth	Ergon Energy	D
Aruna Yahampath	Endeavour Energy	D
Ken Wong	TasNetworks	T
Kiran Ramlagan	Horizon Power	D
Mark Jones	TransGrid	T
John Grace	Genesis Energy	D
Andy Hemming	Transpower	T

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Working Group A2.49

1. Working Group Scope

This working group's scope was to look at the information used to derive transformer assessment indices, the way that information is consolidated and how transformer assessment indices are used.

The working group will:

- Review existing CIGRE documents and other literature that relate to this subject; such as those related to testing and diagnostics.
- Determine what parameters of a power transformer need to be determined to fully assess the condition.
- Determine which of the parameters needs to be assessed individually to determine if urgent corrective action is needed.
- Determine how these parameters can be combined to determine the overall condition of the power transformer, and to determine how weightings can be assigned to the various parameters to develop an assessment index.
- Consider what other information may need to be considered in conjunction with the index to make asset management decisions. For example, criticality, performance, utilization, obsolescence etc.
- Determine how the health index and other critical information can be used to prioritise condition based maintenance replacement, or to make other asset management decisions.

A link to the Terms of Reference document for WG A2.49, and other A2 working groups, can be found at: <http://a2.cigre.org/What-is-SC-A2/Structure>

2. Working Group Activities

2.1 Meetings

The Working Group has now had 9 meetings as detailed below.

- Sydney - May 2013
- Zurich - September 2013
- Montreal - May 2014
- Paris - August 2014
- Boston - March 2015
- Shanghai - September 2015
- Delhi - Feb / March 2016
- Regensburg (Germany) – September 2016
- Krakow (Poland) – September 2017

2.2 Transformer Assessment

It was agreed at an early meeting that condition assessment should be based on failure modes. It was decided that the group should identify the failure modes that applied to each part of the transformer, and then identify the tests that should be considered to assess each failure mode.

Five sub-groups were established covering the following areas – Oil; Transformer Active Part; Bushings, Cable Boxes and Bus Ducts; OLTC & DETC; and Cooling Circuit, Tank and Other. Each group was to consider the following:

- Identify Possible Failure Modes & Deterioration mechanisms
- Identify tests / information / evidence to determine if part is deteriorating or has failed
- Discuss consequence of Failure (can it be fixed)
- Advanced diagnostics to better determine problem or gain more confidence
- Condition assessment of part (acceptance level)



Work has continued in these areas and resulted in the development of Chapters, which are now in “final draft” stage.

2.3 Development of a Transformer Assessment Index

It was agreed that different indices are required for different purposes. For example, a replacement index would identify transformers in poor condition that could not be easily repaired; and a repair or refurbishment index would identify transformers in poor condition that could be repaired. Indices could also be developed for other purposes, such as to highlight safety or environmental concerns. The idea of a composite index was also introduced. Such an index would have a non-scalar output and may show, for example, a transformer’s suitability for both replacement and repair.

It was also agreed that scoring of components or failure modes should be consistent so that a score of 8 for the Tap Changer should mean the same thing as a score of 8 for a bushing or other component. The concept of a scoring matrix has been introduced and a scoring matrix has been developed by the group. The need for weighting factors was also discussed. Although it was agreed that weighting may not be required in some cases, many members believed that weighting factors should be used, and it was again agreed that weighting factors should be applied consistently.

Methods of presenting the results of an index have been considered. Simple methods such as a “worst case” representation can be used as a simple scoring system. However, most users expect a numerical output. There has been a lot of discussion about how the assessment could be converted to a meaningful number that would not allow major problems to be hidden if a transformer was generally in good condition. A nonlinear scoring system could be considered to overcome this problem.

This work has been detailed in a Chapter which is now in “final draft” stage.

2.4 Other Issues to be Considered

The group has agreed that other issues need to be discussed in the brochure and have developed Chapters to cover these issues.

- Dealing with uncertainty – for a large fleet it is unlikely that all data will be available for all transformers being assessed, so methods of dealing with data that is not available are discussed. Furthermore, users should consider ways of indicating the confidence that they should have in the final assessment or score. A user will have a low confidence in an assessment based on estimated data or data that is several years old. Ideally, a measure of confidence should be available to the users in conjunction with any assessment score.
- Criticality Index – other information needs to be considered in conjunction with a transformer assessment. Although a score could be assigned to some of these issues e.g. criticality of load supplied, it is generally recommended that these scores are not included in the transformer assessment index. However, a criticality index could be developed to use in conjunction with the TAI.
- Probability of Failure – Although it is agreed that it is not possible to calculate a Probability of Failure (PoF) from a transformer assessment, ways to estimate the PoF are being documented.

Chapters have been prepared discussing these issues, but some are only an initial draft at this stage.

3. Working Group Program

It is hoped at this stage that a draft document for comment will be completed by April 2018, and that the document can be finalised, along with a tutorial and Electra article by this time. It is expected that a tutorial will be delivered in Australia in April 2018.

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Working Group A2.58 Site Installation and Pre-commissioning of Power Transformers and Shunt Reactors

1. Working Group Scope

The goal of the Working Group is to produce a guide that covers the full scope of the activities involved 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 has to define the important stages, tasks, deliverables, risks and competencies for these site activities. The ultimate goal is to assist all stakeholders realize consensus on expectations.

The working group will:

Review existing literature such as CIGRE TBs and IEEE C57.93 Installation and Maintenance of Power Transformers (currently under revision). Internet searches can be made for site installation procedures already in public domain. Members from manufacturers can review OEM text books, transformer manuals and their high-level procedures.

The TB will need to:

- Define the fundamental steps and processes involved with site installation and testing of transformers to ready them for commissioning.
- Discuss varied practices used for a spare transformer.
- Discuss precautions for spare parts management.
- Discuss importance of good commissioning practices.
- Discuss the requirements for trial operation of the transformer
- Conduct a survey for best practice in utilities, industries, transformer manufacturers and service providers.
- Provide a catalogue of real cases, illustrating different solutions implemented for typical and special cases

A link to the Terms of Reference document for WG A2.49, and other A2 working groups, can be found at: <http://a2.cigre.org/What-is-SC-A2/Structure>

2. Working Group Activities

The Working Group has now had 2 meetings as detailed below.

Meeting 1 – Sydney April 2017

A fundamental drawing for site installation is the general arrangement (or outline) drawing. It serves as a visual record of the extent of supply in the contract that is to be installed at site. The next important document for execution of site installation and pre-commissioning activities is the project plan and this is usually defined in a Gantt chart (or similar format). Using a Gantt Chart in the TB was thought to be a good way to show diagrammatically where the scope of our TB fits into an overall substation project plan and define the boundaries discussed in the ToR and, importantly, what project activity will not be discussed in the TB.

New issues raised for consideration included:

- General Arrangement (GA) drawing assists in defining demarcation between the transformer installation scope and activities for interfacing and connection of the transformer with the rest of the switchyard electrical infrastructure. The GA drawing defines the scope of supply from the transformer supplier
- CT checks, what is necessary for handover to protection technicians
- DETC setting decided



- Temporary power supplies for testing and implications if permanent power supply is not available yet at pre-commissioning stage. SAT performed with site power supplies.
- Errors when phase rotation of permanent power supply differs from temporary power supply
- Table to be created that defines interfacing/demarcation issues.

The role of FAT is to ensure a power transformers conforms with standards, compliance codes and meets the contract technical specification.

The role of SAT is to ensure a power transformer is safe for service, to obtain bench mark test results needed for condition monitoring, to help set trial operation criteria and to identify defects introduced after FAT. The need for HV dielectric tests to be included in SAT is usually only performed if high risk site tasks such as intrusive HV line lead site assembly, specialized transformer line termination arrangements (that were not available for FAT) or transport damage warrants the time, cost and logistics involved. SAT may also include specialized noise level checks beyond the scope of transformer standard FAT tests. A set of handover documents needs to be defined for SAT that is used for final commissioning. This should include an exceptions record.

Trial operation was included in the ToR for this WG and is usually defined to coincide with the period of placing a transformer into service within the defects liability or warranty period of a transformer supply contract. Trial operation involves using a judicious set of observations, checks, dielectric liquid tests, off-line electrical tests and possibly involve on-line continuous transformer monitoring through a defined initial operating period. These are performed to discern changes in condition, substantiate expected operating performance, and assist in the detection of latent defects. Acceptance criteria should be appropriately defined by the supplier and the purchaser/operator. The TB could consider listing guideline parameters of interest, provide guideline acceptance values and support those views with a survey on current industry practice.

Another action identified was to draft a questionnaire for dissemination via the SC and various NC to spark interest from other potential members. The Questionnaire is also to be used to seek a better understanding of who is performing installation activity. It asks for context of source of supply (domestic/overseas/both), who is performing installation activity (supplier/purchaser/local sub-contractors), to list SAT performed, and to state what value or importance does purchaser/operator hold on SAT.

Meeting 2 – Nuremberg August 2017

It was decided that three task forces should be formed to complete the first stage of the work. The tasks forces are, “Site Installation”, “Site Testing,” and “Trial Operation”.

The WG received a presentation from Mike Lau of Canada who chairs the IEEE working group that is revising C57.93 “Guide for Installation and Maintenance of Liquid Immersed Power Transformers”. Mike explained that under IEEE charter, all their documents undergo review and revision at least every 10 years.

The WG proposed the major topics or issues needing guidance in the Technical Brochure. A group brain storming session was used to list bullet point discussion points under each of the three TF headings. The items listed below under trial operation should prove to be of strong interest to the Australian electrical industry. This section of the TB is expected to guide most stakeholders on what can be regarded as reasonable technical expectations in a contractual context.

1. Trial operation/operation during warranty period
 - 1.1. Definition of trial operation and stakeholders
 - 1.2. Align with warranty period
 - 1.3. Accepted practices during warranty period
 - 1.4. Inspections, checks and tests
 - 1.5. Is transformer operating as expected, e. g. OLTC hunting, cooling switching



- 1.6. Defects liability period, discussion about typical defects
- 1.7. Maintenance
- 1.8. Operating conditions
- 1.9. Energization, no-load/load conditions, soak test
- 1.10. Role of DGA
- 1.11. Special considerations regarding spare transformers, moisture ingress, transformers not completely installed
- 1.12. Spare parts, storage, appropriate care, shelf life of gasket material

3. Working Group Program

It is planned at this stage that a draft Technical Brochure document ready for comment will be completed in time for the SC A2 meeting held during the 2020 Paris Session. The document can be finalized, along with a tutorial and Electra article by the 2021 Study Committee meeting.

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Working Group B2.64 Inspection and Testing of Equipment and Training for Live-Line Work on Overhead Lines

1. Working Group Scope

The working group has four main focus areas as illustrated in Figures 1 and 2.

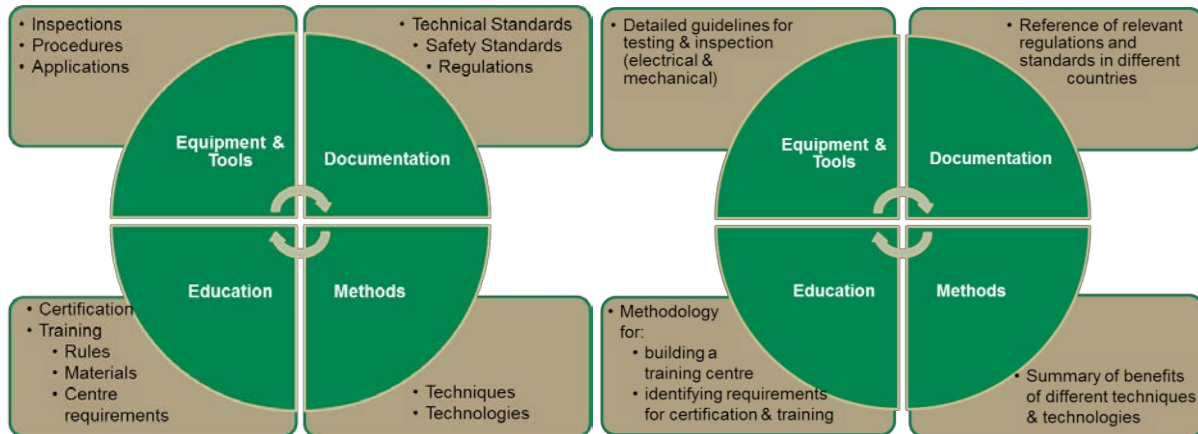


Figure 1. Working Group Objectives

Figure 2. Working Group Outputs

WG deliverables include: Brochure, Electra Article and Tutorial. See the [Terms of Reference](#) for more detailed information.

2. Working Group Activities

Working group meetings/activities are shown in the table below:

Activity	Location	Date
1 st WG Meeting	Mulhouse, France	Apr 2016
2 nd WG Meeting	Wurzburg, Germany	Oct 2016
3 rd WG Meeting	Strasbourg, France	Apr 2017
4 th WG Meeting	Toronto, Canada	21-22 Sep 2017
Survey Closed	-	31 Dec 2017
5 th WG Meeting (confirmed)	Bergen, Norway	13-14 Apr 2018
6 th WG Meeting (proposed)	Budapest, Hungary	Late 2018
WG deliverables completed	-	End 2018

This year's focus has been on the finalisation of the survey completed in May 2017 and obtaining survey responses. The brochure is also in the process of being drafted in two chapters; live line training, and live line equipment and tools.

For the Australian live line industry, the key takeaway is that there are vastly different approaches to live work throughout the world particularly in regard to the:

- Hierarchy of accountability and responsibilities during live work;
- Training and competency assessment regime and format;
- Preference for highly prescriptive work instructions for workers or general rules allowing for a flexible approach to activities; and the
- Frequency of testing and inspection of tools and equipment.

This is arguably not unexpected given the differences in network, regulatory environment and perception of live work as greater/lesser risk to linespersons than 'dead' work. However, one aspect seemed consistent across countries; the perceived lack of adequate regulations and oversight of low voltage live work.



3. Working Group Program

The program is currently progressing well. The forecast completion date has not changed. It is still anticipated that the deliverables will be completed by the end of 2018.

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Working Group B2.67 Assessment and Testing of Wood and Alternative Material Type Poles

1. Working Group Scope

Wood poles are widely used in distribution and transmission (up to 132kV) lines and are used under different climatic, operating and maintenance conditions. Most of these lines are 50+ years old. The operability under serviceability limit state condition and safe maintainability of these lines depend on reliable (but not conservative) testing and assessment of condition data of wood.

In the past 20 years several issues have been found to exist with wood poles which are often classified as unassisted wood pole failure. These types of failures posed risks on the operability and maintainability performances of wood poles, e.g. conductive poles caused electric shocks to linemen, degradation below ground caused pole failure without any extreme weather event, pole top rot proved dangerous to climb wood poles.

The goal of this WG is to-

- a) define what constitutes unassisted wood pole failure
- b) evaluate the reported number of unassisted wood pole failures worldwide to establish pros and cons of different types of timbers, their treatment, assessment and testing methods, and
- c) evaluate alternate pole material types.

The following scopes are identified to achieve the above goals-

- a) determine the present status of wood pole experience and extent of failures in utilities worldwide
- b) identify different types of timbers that are being used as powerline wood pole and to determine if there is any relation between timber types and the pole operational failure (pole top fire) or maintenance failure
- c) identify and qualify the range of available methods for testing and inspecting wood poles at time of delivery and subsequently in the field, especially with regard to pole top rot, to help utilities to ensure their reliable performance and maintenance personnel safety
- d) identify and discuss the various methods used to strengthen or reinforce degraded poles, including their impact on the foundation arrangement
- e) provide guidance on alternate preservatives/treatments and compare their potential environmental impacts
- f) provide guidance on the type of alternate pole materials, e.g. steel, concrete, composite, that are available and the available experience of their use. This will include describing relevant testing procedures for consideration for these pole types, for their purchase and maintenance. This WG excludes any coverage of Fibre Reinforced Polymer (FRP) Composite poles

Please contact at the email provided at the end of this report for the complete TOR.

2. Working Group Activities

The working group convened on 27th of May, 2017 in Dublin. The response to this working group was positive. We have members and observers from all over the world (North America, South America, Europe, Australia and New Zealand, India and Africa). Mr. Nathan Spencer (nathan@uriengineering.com) is the Secretary of this WG.

Mr. Nathan has attended the 2017 Annual Meeting of Treated Wood Council (TWC) at Washington, DC on Nov. 16-17 and presented the TOR and scope of this WG. We will have more interaction with TWC in future.

A survey paper is now at a final stage and will be circulated in January 2018. The survey questionnaires are prepared to get valuable input from the industry experts, suppliers and utility professionals from different parts of the world.

The questionnaires are grouped in six sections to cover basic utility asset information, pole failures, standards and specifications, reinforcement/ replacement, alternate materials and electrical properties. Many thanks to Mr. Andreas Beutel (BeutelAA@eskom.co.za) who have made a structured document of the survey questionnaires.



3. Working Group Program

The key dates of upcoming programs and deliverables issue dates are stated in the following table-

Item	Date of Draft Delivery	Expected date of Final Delivery
Draft Survey Document for WG members review	17-November-2017	12-January-2018
Floating the Survey	-	26-January-2018
2 nd WG Meeting (Webinar)		23-February-2018
Report on Survey findings	28-May-2018	02-July-2018
3 rd WG Meeting (Paris)		August-2018
Technical Brochure and Executive summary in Electra	31-October-2018	21-December-2018
Electra report	28-June-2019	31-August-2020
Tutorial	28-June-2019	31-August-2020

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Working Group B3.43 – Contemporary Solutions for Low Cost Substation Design for Developing Countries

1. Working Group Scope

The objective of this Working Group is to identify and discuss opportunities to lower the cost and improve the efficacy of the design of new substation assets within developing countries. The working group is establishing recommendations and guidance for the design of substations regarding design philosophy and process. This also relates to the construction, operation and maintenance of low-cost substations based on currently available equipment. The work has built upon existing documentation and is primarily focussed upon developing countries where significant challenges exist regarding resource availability to develop infrastructure.

The activity of the working group focusses on the locally and regionally available resources and the capability to develop sustainable solutions appropriate for the region. Specifically, the working group is working at delivering the following scope:

1. Seek engagement from organisations operating in the target regions with specialist expertise in deploying electricity substation infrastructure;
2. Conduct a survey of practices around the world for relevant high voltage and medium voltage installations;
3. Identify and assess currently available technologies for a range of low cost substations;
4. Consider the balance of plant impact (auxiliary systems, communications etc.) necessary to support a sustainable low-cost operation;
5. Consider lifetime challenges and mechanisms to evaluate whole life value since quoting actual costs in this report will be impractical;
6. Provide sufficient guidance to deliver practical solutions;
7. Consider CIGRE's role in support of the development of local expertise and skills;
8. Contribute to the development of relevant global technical standards.

2. Working Group Activities

This working group commenced on the 6th November 2015 and has just celebrated its second year of existence. The target completion was originally reported for the end of 2018, however, due to extraordinary progress, the workgroup is attempting to complete the production of its Technical Brochure 6 months ahead of schedule by the Paris 2018 Session. Currently, there are 15 representative members and 8 specialist or corresponding members. There are a further 25 observers. 14 countries are represented on the working group including 3 from Africa. The workgroup has continued to successfully utilise the CIGRE Knowledge Management System and presents an up-to-date site at the following address:

[SCB3 WG3.43](#)

During 2015/16 there were two (2) face-to-face and eight (8) Skype teleconferences. In 2017 the working group shifted to the use of WebEx as its preferred meeting tool. Since the last report in November 2016, the working group has convened a further 11 WebEx Video Conferences along with a single face-to-face meeting. The face-to-face meeting in South Africa was part of a global workshop established by the working group whereby over 22 representative countries along with major development partners, including the World Bank conducted the first ever workshop on Substation and Line Design for Developing Countries. The working group is due to hold its second face-to-face meeting in November.

The schedule of meetings for the past 12 months has been as follows:

1. WG Meeting #10 November 2016 Teleconference 8;
2. WG Meeting #11 December 2016 Teleconference 9;
3. WG Meeting #12 January 2017 Teleconference 10;
4. WG Meeting #13 March 2017 Face-to-Face 3 - Workshop Johannesburg South Africa;
5. WG Meeting #14 April 2017 Teleconference 11;
6. WG Meeting #15 May 2017 Teleconference - Data Analysis 1;
7. WG Meeting #16 June 2017 Teleconference 13 - Data Analysis 2;
8. WG Meeting #17 July 2017 Teleconference 12;
9. WG Meeting #18 July 2017 Teleconference – Data Analysis 3;
10. WG Meeting #19 September 2017 Teleconference – Data Analysis 4;



Working Group B4.63 – Testing and Commissioning of VSC HVDC Schemes

1. Working Group Scope

Voltage Source Converter (VSC) technology has emerged as a commercially viable alternative to Line Commutated Converter (LCC) technology for certain applications of HVDC power transmission. With the first commercial VSC projects commissioned in 1999, there is now over a decade of project and operational experience with this technology. VSC is also becoming the preferred, if not only, choice of technology for specific applications, including low power transfer applications, the connection of weak networks, offshore wind farm connections and DC grid developments.

The process for the commissioning of VSC projects has developed over the past decade, based initially on a similar process for commissioning LCC HVDC projects (e.g. CIGRE Technical Brochure 97) and developed by the vendors and suppliers of VSC technology. Guidelines exist for the commissioning of LCC projects but not VSC projects. Whilst there are many similarities in the process and procedures for commissioning the two technologies, there are some notable and significant differences that justify the need for a separate Technical Brochure covering the commissioning requirements for VSC projects.

The Working Group will seek to develop a Technical Brochure which provides guidelines for the commissioning of VSC projects. The working group will identify and develop the stages, sequence and structure for the commissioning of a VSC project, focusing on the off-site and on-site system and acceptance test elements for commissioning and also VSC specific equipment and sub-systems. The scope includes the development of each stage of commissioning, including the development of test objectives, procedure and acceptance criteria and preferred location in the commissioning structure.

Whilst the focus is on the VSC “project”, the testing of the DC cables and their accessories and DC overhead lines is excluded from the scope.

The Terms of Reference for the working group is available [here](#).

2. Working Group Activities

This working group commenced in on 10th February 2013. There are 18 regular members and 5 corresponding members, with 14 countries represented on the working group. There is a good spread on the working group of VSC vendors, VSC developers/owners and consultants.

There have been five “face to face” meetings and one teleconference completed

- Boston (USA), June 2013.
- Brasilia (Brazil), September 2013.
- Teleconference, May 2014.
- Paris (France), August 2014.
- Lund (Sweden), May 2015.
- Agra (India), September 2015.
- Oslo (Norway), April 2016.
- Paris (France), August 2016.
- Teleconference, May 2017.

The technical brochure was submitted for 60-day review on 29 January 2017. Comments were received back in early April and a teleconference was completed in May with the membership to discuss how to address all comments. A lot of comments were received and some significant changes to the technical brochure was required.

The final technical brochure was submitted to the Study Committee Chairman on 20 August 2017.

Technical Brochure 697 “Testing and Commissioning of VSC HVDC Systems” was published by CIGRE in late August.

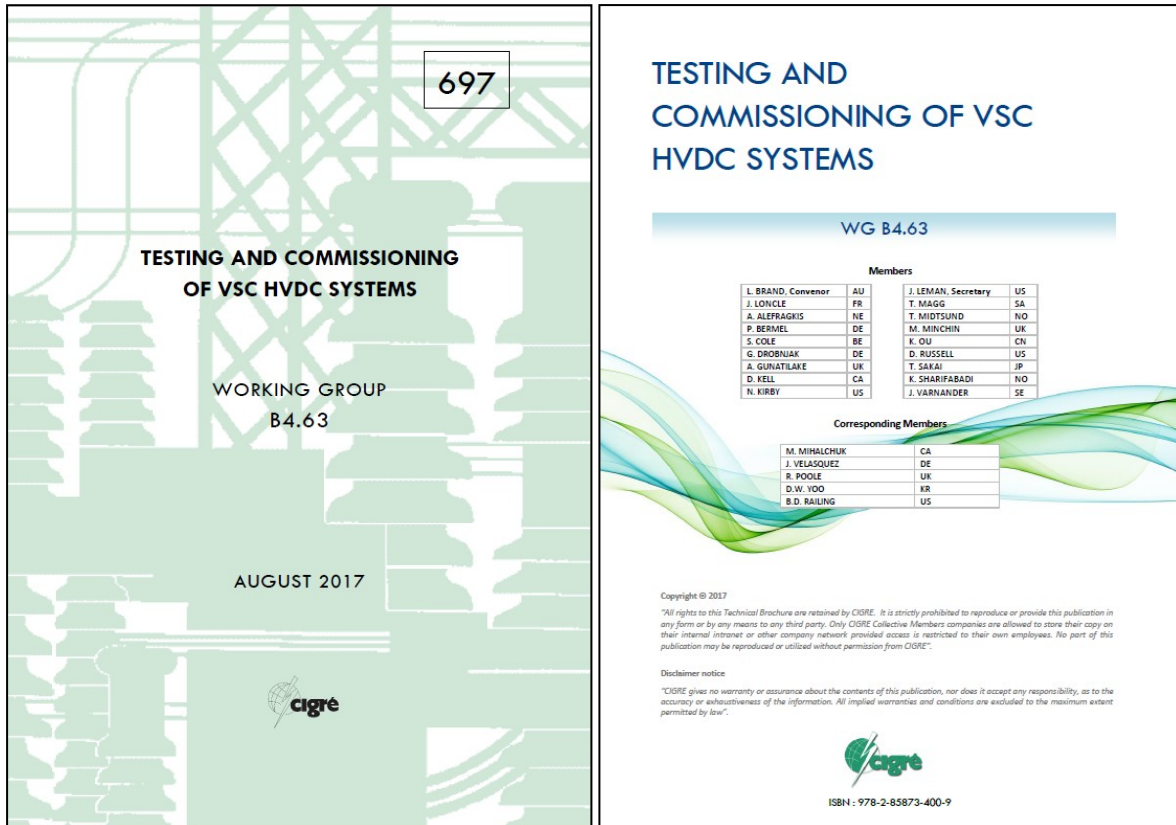
The Electra article of the same title was published in the October 2017 issue of Electra.



In relation to the Australian Power industry, recent events and issues on the power system has highlighted the need for future interconnection between the states. In most cases, HVDC transmission is a viable (or sometimes the only) option. Due to VSC resilience with weaker networks, and its potential to provide power system support and to potentially replicate the performance of synchronous machines, VSC HVDC transmission is a likely candidate for such interconnection. The outcomes of this working group provide a good high-level reference to anyone, of any background, who has a need to understand the requirements and process of testing and commissioning a VSC HVDC system – either as the network owner or operator or as a developer of the interconnector.

3. Working Group Program

The working group has completed its obligations, and the technical brochure (TB697) and Electra articles are now published.



I'd like to thank the CIGRE ANC for their support and assistance during for the last four years in my role as convenor.

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Working Group C1.38 name

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 working group has had two teleconferences in September and November to progress the literature review and survey design.

3. Working Group Program

Survey design will be complete in Q1 2018. The survey will be carried out in Q2 2018. Analysis and report writing will take place in Q2 to Q4 2018. The technical brochure and Electra article will be finished in December 2018.

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Working Group CIGRE/CIRED C4.40

1. Working Group Scope

Official Terms of reference

Background:

The Technical Reports 61000-3-6, -3-7, -3-13, and -3-14 deal with the assessment of emission limits for the connection of disturbing installations to the power system. These documents are approaching their maintenance cycle. The present versions were prepared by a SC C4 CIGRE WG (C4.103). There is a need to consider proposed revisions to each of these documents in light of significant changes in power grids, emissions from equipment, and equipment immunity. Changes in supply systems that could impact the subject Technical Reports include the reconfigurability features of so-called “smart grid” technology and systems and the incorporation of distributed generation at various voltage levels (but particularly LV and MV and other traditional radially-operated systems). Changes in emissions include high-frequency harmonics which are presently out-of-scope of the Technical Reports. Immunity characteristics, especially those associated with modern lighting with regard to voltage fluctuations, have appreciably changed. Lastly, the methods for allocation of planning levels to establish emission limits for users may become overly complex (or even inappropriate) for use in systems containing reconfigurable elements or distributed resources.

Scope:

The proposed scope of the task force is to:

1. Evaluate the suitability of the general limit allocation process in systems containing distributed resources and develop recommended changes (this applies to all four reports).
2. Evaluate the suitability of existing indices and limits (e.g., 95th percentile) for use in reconfigurable systems and recommend changes (this applies to all four reports).
3. Evaluate the suitability of the existing approach for allocating harmonic limits for higher-frequencies (above 2 kHz) and recommend changes (this applies largely to 61000-3-6 and -3-14).
4. Assess the effectiveness of 61000-3-7, -3-13, and -3-14 when fluctuating or unbalanced distributed resources are present (at any voltage level) and recommend changes.
5. Review industry experience with the present versions of the Reports and recommend changes as needed based on recent usage and experiences (this applies to all four reports).

Deliverables: Revised versions of each Technical Report with highlighted changes for review by IEC. Summary paper for publication in *Electra*. Panel sessions and presentations at CIGRE and CIRED session, colloquia and symposia.

Time Schedule : start : January 2015 Final report : 2018

Convener: Mark Halpin (USA)

2. Working Group Activities

Australian Contributions [University of Wollongong (UOW)]: UOW has the primary responsibility for the revisions related to IEC 61000.3.13 (voltage unbalance) and joint responsibility for IEC61000.3.14 (harmonics, flicker and voltage unbalance of large LV installations). Major inputs to the working group include introduction of the voltage droop concept for harmonic allocation and presentations on detailed work related to voltage unbalance management in transmission systems.

Previous meetings::

1. 31st Aug -1st Sept 2015, EDF – Clamart, Paris (Inaugural meeting)
2. 1st -2nd Feb 2016, Synergrid Offices, Brussels
3. 10th -11th May 2016, Knoxville
4. 29th - 30th Aug 2016, EDF –Saclay
5. 5th -6th Dec 2016, Dresden TUD



6. 6th- 7th March 2017, CESI Milan
7. 22nd-23rd May 2017, Dublin
8. 18th- 19th September 2017, EDF Saclay (Cancelled due to USA Convenor being affected by the Southern US extreme weather conditions which curtailed flights)

Future meetings

11th- 12th December 2017, Brussels

2- 4 meetings are expected to take place in 2018.

Contributions made in 2017 by UOW:

March meeting in Milan was not attended.

In the most recent meeting held in Dublin (May 2017), a document was tabled clarifying Stage 1 of voltage unbalance emission allocation process as described in the existing IEC/TR 61000.3.13. Generalised derivations were covered which encompass different connection types which can lead to voltage unbalance at an installation's point of connection. A clear definition now exists for what is implied by single phase power equivalent of an unbalanced installation.

Areas of particular relevance to the Australian Power Industry:

Power quality disturbance limit (harmonics, voltage fluctuations and flicker and voltage unbalance) allocation is of significant relevance to the power industry (both distribution and transmission level utilities) in an ongoing manner. Considering the increasing number of large and small power disturbing interfaces (power electronic) associated with renewable generating systems the allocation of limits has become more challenging. The development of reasonably robust and easy to apply methodologies (eg. which are not data intensive) are being sought by the utilities. The methodologies as covered in the existing Technical Reports 61000-3-6, -3-7, -3-13, and -3-14 are difficult to apply and are data intensive. Hence the proposed revisions that are being discussed and documented by the WG C4.40 are of significant relevance to the Australian utilities.

3. Working Group Program

Extensive discussions/presentations have been completed related to harmonic allocation in both distribution and transmission systems gathering the experiences within the utilities from where some of the working group members come from. Invited presentations have also been made by representatives from utilities.

Next meeting will take place in Brussels in December 2017. There have been discussions about holding the first meeting of 2018 at the University of Wollongong in March followed by several other meetings.

The drafting of the revisions to the Technical Reports 61000-3-6, -3-7, -3-13, and -3-14 is expected to commence in the near future.

4. Members in the working group representing Australia

Sarath Perera, University of Wollongong

Vic Gosbell, University of Wollongong

Alex Baitch, BES (Aust) Pty Ltd

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Working Group C5.22 The Management of Systemic Market Risk in Electricity Markets

1. Working Group Scope

This working group will collect information on various markets on the way in which systemic market risk is approached. The broad approach will be to assess:

- Is there a systemic risk in your market?
- How is the systemic risk addressed?
- Is a central counterparty or clearing house the solution?
- What other methods could be used to mitigate the risk?

For the purposes of this project it is proposed to define Systemic Risk in the following way:

Systemic risk is the risk of collapse of an entire market, as opposed to risk associated with any one individual entity, group or component of a system that can be contained within the market without harming the entire system. It can be defined as "market *system* instability, potentially catastrophic, caused or exacerbated by idiosyncratic events or conditions in intermediaries". It refers to the risks imposed by *interlinkages* and *interdependencies* in a system or market, where the failure of a single entity or cluster of entities can cause a cascading failure, which could potentially bankrupt or bring down the entire system or market.

A couple of examples which we expect to consider are:

- Where a very large market participant who is too big to fail does fail
- A very severe drought in a market heavily dependent on hydro-generation

The outcomes will be an assessment of the overall approaches which have been adopted and an attempt to categorise approaches and link these to basic market, cultural or geographic parameters.

2. Working Group Activities

The scope for the working group was approved in December 2016. Work commenced on an issues paper which was circulated to the working group in March 2017. A teleconference was organised for 26 April to progress the various issues. This led to a draft survey form being developed and discussed at a working group meeting in Dublin on 29 May attended by 18 working group members.

The survey was then finalised and sent to all working group members for a quality check. It was released to all C5 convenors on 15 September with a request for completed survey forms to be returned by 30 October. Response has been slow so further chasing of potential survey contributors has been instigated.

The issues which are of particular relevance to the Australian power industry are that the systemic risk of poor policy decisions and no coherent policy direction pose a significant risk to Australian energy markets. Affordability issues caused by the poor policy decisions are also a significant risk to the markets in Australia.

3. Working Group Program

The overall program of activities for the Working group is shown below.

• Start:	January 2017	Completed
• Develop final work plan and recruit members	March 2017	Completed
• First meeting (in Dublin) to discuss draft information form	May 2017	Completed
• Finalise information form and approach members	October 2017	Completed
• Compile data	February 2018	On track
• Analyze data	May 2018	On track

Deliverables : A technical brochure with summary in an Electra article

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Working Group D1.60 Traceable Measurement Techniques for Very Fast Transients

1. Working Group Scope

- 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.
- Literature survey of fast transient measurement techniques, not limited to, but relevant to high-voltage field, including hardware (dividers, probes) and digital algorithms.
- Coordinate development of suitable hardware and software for traceable measurements.
- Round-robin test of reference measurement systems (e.g., 100 kV, rise time 10 ns)

Full Terms of Reference (TOR) of WG D1.60 is available at

<http://www.cigre.org/Diaporama/CIGRE-active-Working-Groups>

Under “CIGRE Working Groups created in 2014”

2. Working Group Activities in 2017

- Two meetings were held in 2017. One in August 2017 in Buenos Aires during ISH2017 (International Symposium on High Voltage Engineering) and one in October 2017 in Winnipeg Canada. The meetings discussing investigation work performed by member laboratories on fast transient/steep impulse measurements. The meetings also discussed a round robin test of puncture test dividers and CIGRE brochure being written by the working group on traceable measurement techniques on fast transient voltages. The discussion at the WG D1.60 meeting brings direct benefit to Australia’s work in developing new capabilities in fast transient measurement and testing, and contribute to the establishment of the traceable measurement systems for fast transient voltages internationally. The planned round-robin test will also provide additional confidence to Australia’s new fast transient measurement/testing systems.
- Yi Li, the convenor of the working group also attended the CIGRE Study Committee D1 meeting in Winnipeg in October 2017, presenting the annual report of WG D1.60 to the meeting. Yi Li also participated the discussion of the present and future work of the study committee, including setting up new working groups.
- Yi Li also attended technical oral presentation sessions of 2017 CIGRE Colloquium & Exhibition in Winnipeg and participated discussions during the sessions, and visited most exhibitor’s stalls and discussed services that Australia can provide to them. The exhibitors included equipment manufacturers, electric utilities and testing laboratories.

3. Working Group Program

WG D1.60 is currently organising a round-robin test of fast dividers for the insulator puncture test. 4 laboratories will participate the test program, with the circulating divider to be provided by the Finish national measurement institute VTT. Australia’s National Measurement Institute will be one of the participants. The target date for the completion of the round-robin test is currently March 2018.

WG D1.60 has produced two drafts of the structure of the technical brochure and has allocated responsible members for each chapters or sections. The working group has also been accumulating historical literature on the subject. The target date for the next draft of the brochure is May 2018.

The next meeting of the working group is to be held in August 2018 in Paris during the 2018 CIGRE Paris Session.

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Working Group D1.69 “Guidelines for test techniques of High Temperature Superconducting (HTS) systems”

1. Working Group Scope

To study the existing HTS power installations and compile the relevant data that will assist the power industry to test HTS technology used in the transmission and distribution grid.

Special attention will be paid to:

- The present and future need for HTS power installations.
- Update on the status of field test experience of HTS power installations and comparison with existing guidelines.
- Aging of electrical insulation, superconductors and cooling systems.
- Failure mode analysis

The WG will summarise the best practices in the above mentioned topics and provide guidelines for test techniques of High Temperature Superconducting (HTS) systems.

2. Working Group Activities

Two meetings of WG D1.69 were held through calendar 2017. The first (kick-off) meeting was held at Queensland University of Technology, Brisbane on the 29th of June 2017. The second meeting was held at EUCAS, Geneva, on the 22nd of September 2017.

At present WG D1.69 has 10 members and two Observers. The Observers are Jun Fujikami as Liaison with (IEC) TC90, and Naoki Hayakawa, the Convenor of WG D1.64 (“Electrical Insulation Systems at Cryogenic Temperatures”).

The main achievements this year are the preliminary chapter allocations based on the scope dot points to WG member Leads. Content against these agreed chapter headings has already begun to be compiled in draft form. This chapter development will form the basis of the final CIGRE Technical Brochure.

The next proposed meeting will be in Shanghai in May 2018 with technical visits to operational HTS installations in Korea. These activities are being coordinated with WG D1.64 who will meet at the same venue. There will also be a public Technical Symposium open to all as part of this WG activity which will be a combined Symposium with members from D1.64.

QUT is hosting a seminar on the 14th and 15th of November entitled “Transmission and Distribution Power System Challenges” with input from AMSC, plus a workshop demonstration of an HTS based fault current limiter. At present, there are approximately 60 attendees from all sectors of the Australian Power Industry.

3. Working Group Program

The overall program of the activities of the Working group is to meet face-to-face at least once per year and to utilise applications such as SKYPE (or equivalents) to maintain contact with smaller groups on a more regular basis.

The final goal of WG D1.69 is producing the D1.69 Technical Brochure in 2020. The assignment of individual Leads to Brochure chapters has allowed the WG discussions to remain quite focused and productive. Plus facilitates the constructive continuation of this dialogue via SKYPE.

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Working Group D1.71 Understanding and mitigating corrosion

1. Working Group Scope

The working group was started in response to repeated requests by other SC's to the D1 Customer Advisory Group. There was strong belief that a lack of general corrosion knowledge and awareness amongst CIGRE members was resulting in considerable financial losses and poor performance of HV infrastructure.

The TOR can be accessed at

<http://www.cigre.org/Diaporama/CIGRE-active-Working-Groups>

2. Working Group Activities

The working group had its inaugural and only meeting at Winnipeg, CA., coinciding with the colloquium involving A3, B4 and D1 in 30 Sept – 6 Oct 2017.

Most of the work to date has been carried out by email and the brochure which is about 90% complete is essentially a basic knowledge and awareness guide for people who are not corrosion specialists.

It is envisaged that when the brochure is complete that a new working group will be formed that will produce a brochure covering specific cases and their mitigation.

The WG D1.71 brochure will be a good guide on corrosion and create a good reference document for CIGRE members.

3. Working Group Program

Most of the work to date has been carried out by email and the sole face-to-face meeting was held at Winnipeg. The brochure is about 90% complete and is expected to be finalised in the first quarter of 2018.

It is anticipated that there will be no further face-to-face meetings of the WG D1.71.

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CIGRE Workshop
“Transformers – Dealing with the Unforeseen – an Interactive Workshop”
represented by A2

1. Details of the Workshop

The workshop was held in Sydney at the Hilton Hotel on Monday 3 April, 2017, and was attended by 74 delegates and 11 speakers. The workshop was held in conjunction with Techcon Asia Pacific, which was held later at the same venue on the 4 and 5 April. The workshop operated using twin projectors for the 16:9 format powerpoint presentations. The delegates divided into three sub-groups (to each consider three problem scenarios) by partitioning the main room during the lunch break in readiness for the afternoon session.

2. Workshop Program

The day commenced with a series of presentations from speakers with utility, manufacturer, contractor, insurance and legal backgrounds. The presenters provided delegates with experience, guidance, advice and recommendations on how different stakeholders position themselves to deal with unforeseen events involving transformers.

Ross Willoughby & Terry Killen	Introductions & explanation of workshop proceedings.
Gary Russell (Powerlink)	What makes a good spec, issues that need to be considered, what is important & what is not, what if you need to change the spec during the contract period. FAT, SAT and what is deemed as fit for purpose
Muthu Subramaniam (Wilson Transformers)	The contract framework from a user perspective. The key commercial terms and conditions. Loss, liability and the role of insurance. The Business Branding and Customer relationship. Warranty period responsibilities
Mohindar Pannu (Wilson Transformers)	How to interpret a spec and design for the customer’s needs. What if they change design needs during manufacture, what if you can’t meet the spec requirements? Transformer operational duty (nameplate ratings versus operational reality)
Julian Guild (ABB)	Manufacturing issues, delivery schedules, cost to expedite or delay a unit already in progress. What if something goes wrong in the process and needs to be rebuilt, Rebuild from test failure or in-service failure
Tony McGrail (Doble)	Installation & Operation, getting a unit to site, installing & then commissioning for long term operation. What are the issues, causes of delays, why is it that all parts are not there but were in the factory, what if the unit is damaged in transit, what if on site repairs are needed? What if?
Wenyu Guo (Omicron)	Test & Commission - what are the issues for FAT & SAT. How do they differ and what does it mean if they do not match, what are acceptable pass/fail results? Distinguish pre-commissioning a transformer from commissioning a circuit in a substation and final energisation.
Simon Bartlett (University of QLD)	Asset Management network impact. If a unit does not perform as expected, what if it fails early in the warranty period or much later in life. Unplanned failure impacts, risks & cost to carry a spare. Can you accept a compromised unit or one that has undergone repairs before delivery?
Terence Lee & Terence Rademeyer (FM Global)	Insurance & risk network impact on cost. What are the key issues that insurance companies are looking for in a claim? Insurance risk for known weaknesses in design or manufacture, what affects premium costs for each unit & the entire fleet, some simple risk mitigation strategies. What can you do to lower the premiums?

Dan Howard & Stephen Fall (Clayton Utz)	1. Pre-contractual issues - what to avoid and what to do for good contracting. 2. Contractual Framework: - Operating in a Consortium - Importance of Specifications - Liability, limitations, insurance and indemnities - defect warranty obligations.
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These presentations provided the delegates with the background knowledge and tools for dealing with unforeseen transformer issues. In the afternoon, the delegates were given three scenarios to apply that knowledge. The delegates divided into three groups, and each group considered all three scenarios and were asked to report back into a main group session.

Scenario 1 Contract for supply of a new transformer – design change needed

Belated load studies determine that the specified tapping range is inadequate for meeting the permissible range in the bus voltage stipulated in a connection agreement. A larger tapping range is now required.

- What factors need to be considered and how might the issues be resolved? What issues would arise?

Scenario 2 Contract for supply of a new transformer – delay to civil works means the need to store transformer for another 8 months and the client wants the manufacturer to look after it.

- What factors need to be considered and how might the issues be resolved, what issues would arise (technical and commercial)? Consider both EXW and FIS contract situations.

Scenario 3 A situation that arises occasionally during site installation/ commissioning is the issue of measuring high moisture content at site.

A 132 kV transformer was delivered late to site in a rainy weather. There is enormous pressure applied by the Purchaser's project manager to adhere to the project deadlines requiring immediate installation. The supplier's erection contractor proceeds to erect the transformer during rainy weather. The transformer fails shortly after energizing. The Purchaser lodges an insurance claim against his insurer, who in turn tries to recover cost of the claim from the Contractor. This ignites a dispute that centres on how the water entered the transformer and who should pay for the cost of the damage.





Gary Russell – What makes a good specification



Muthu Subramaniam - The contract framework



Mohindar Pannu - Interpreting a spec for design



Julian Guild – Manufacturing - if it goes wrong



Tony McGrail – Installation & operation



Wenyu Guo – What issues for FAT & SAT



Simon Bartlet – Impact on the network



Terence Rademeyer & Terence Lee – Insurance Co. views on transformer risk, costs & premiums



Dan Howard & Stephen Fall – Contract framework and the legal viewpoint



Kerry Williams – One of the facilitators summarizing findings from one of the sub-groups



Facilitators and speakers in the panel session



3. Conclusion

The workshop provided delegates with viewpoints of speakers from diverse backgrounds and provided scenarios that show how situations can escalate to involve many stakeholders:

- the parties to a transformer supply contract
- the impact on the network
- customers
- insurance companies
- contract lawyers

The added value with running a CIGRE event together with the TechCon conference again proved popular with delegates. Almost all delegates attending the seminar also attended Techcon over the following 2 days. Some delegates may have attended the CIGRE seminar because they were already travelling to Sydney for Techcon. The delegate attendance at Techcon also increases when run in conjunction with a CIGRE event.

The Techcon organisers acted as event coordinators for CIGRE, and managed most of the logistical issues associated with arranging the seminar. Registration was also handled by the Techcon staff, allowing delegates to register for either or both conferences. Many of the costs, such as advertising, were also shared with Techcon.

The CIGRE workshop organisers were Terry Killen (ANC Executive Manager), Kerry Williams (Secretary ANC) and Ross Willoughby (Convener AP A2).



Overall the event was a success and CIGRE Australia received appreciative feedback from the delegates. The event also made some modest income for CIGRE Australia.

The affiliation of the speaker presenters (with AP A2 members **accented**):

Simon Bartlett (University of QLD), Stephen Fall (Clayton Utz), Julian Guild (ABB), **Wenyu Guo** (Omicron), Dan Howard (Clayton Utz), Tony McGrail (Doble UK), **Mohinder Pannu** (Wilson Transformers), **Gary Russell** (Powerlink), Muthu Subramaniam (Wilson Transformers), Terence Lee (FM Global), Terence Rademeyer (FM Global)

The scenario facilitators in the afternoon session were:

Tara-Lee Macathur (Egon Energy), **Thomas Smolka** (Reinhausen Australia) and **Kerry Williams** (K-BIK Power & ANC Secretary). By acting as reporters, the discussions could be efficiently recorded and summarised. This was crucial because of the limited time available and the need to discuss the findings when the workshop re-convened as a main body, in one large room, following the last refreshment break.

Event photography was from Peter Cole.

The event was chaired by Terry Killen (ANC Executive Manager) and Ross Willoughby (Convener AP A2).

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International Colloquium SC A3, B4 & D1

1. Theme

A3, B4 & D1 were invited to have a colloquium by the Canadian national committee.

As the D1 calendar of events was comprehensive and all the events were run as streams, there was not time to attend events by A3 and B4.

For D1 the preferential subjects were under the banner of Electrical Insulation Systems under AC and DC Voltage

PS1 - Field grading and space charge effects

PS2 - Emerging test techniques and diagnostic tools

PS3 - Properties and potential applications of new materials

2. Event

The event was held in Winnipeg, MB Canada, September 30 – October 6, 2017 at the RBC Convention Centre



3. Reason for the Event

SC D1 accepted an invitation from the Canadian national committee to be a part of a colloquium at Winnipeg CA. This city is the home of Manitoba Hydro, a world renowned organisation in hydro storage, DC links, power system analysis and cold climate power transmission.

4. Key Information

The SC meeting and session along with WG meetings took up most of the available time. The D1 session had 30 papers, B4 had 48 and A3 had 24. It was somewhat disappointing that some people who had papers were not there to present them. This was also the case for some WG convenors and their WG reports, mostly due to a clash with an A2 SC colloquium in Cracow Poland.

There were no papers presented by AP D1 members at the event.

WG D1.71, Understanding and mitigating corrosion met at Winnipeg a number of times and carried out a complete review of the brochure which incorporated all suggestions to bring the (+100pg) brochure much closer to finalisation.

The SC presented its yearly review and received all the reports from its WG, AG and various office holders.

5. Conclusions Relevant to CIGRÉ and the ANC

There is continuing progress on Eco Gases and Vacuum technology, with SF6 able to be replaced in most applications. Vacuum switchgear is now available up to 145kV. Eco gases with Global Warming Potential (GWP) of approximately 200 – 400 are becoming available as compared to SF6 which is 23,900 GWP.

Issues with long rod insulators resulting in a phenomenon termed flash-under where an arc strikes between the polymeric insulation and the fibreglass rod has been investigated and a new test for adhesion of the polymeric insulation is being developed.

WG D1-65 is involved in determining mechanical properties of insulating materials which will cover off an area that is not well codified and will assist people primarily involved in transformer manufacture to lock down specifications for their insulating components.

Overall the event was very well run and people associated with the event were every friendly and helpful. The venue was good and fit for the purpose. The city was not a significant draw card and I wonder if that had some impact on attendance which felt like it was down. The food was on average below expectations and the entertainment did not seem to go over very well. The compact nature of the locale made for easy access between hotels and the function centre, although the feeling of personal safety was not as high as for other events. One day it was -1°C at 8 am which was a bit challenging.

From unofficial reports the event was considered a success.

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