International Technical Council

Presented by Alex Cruickshank

Hobart – 15/11/2018

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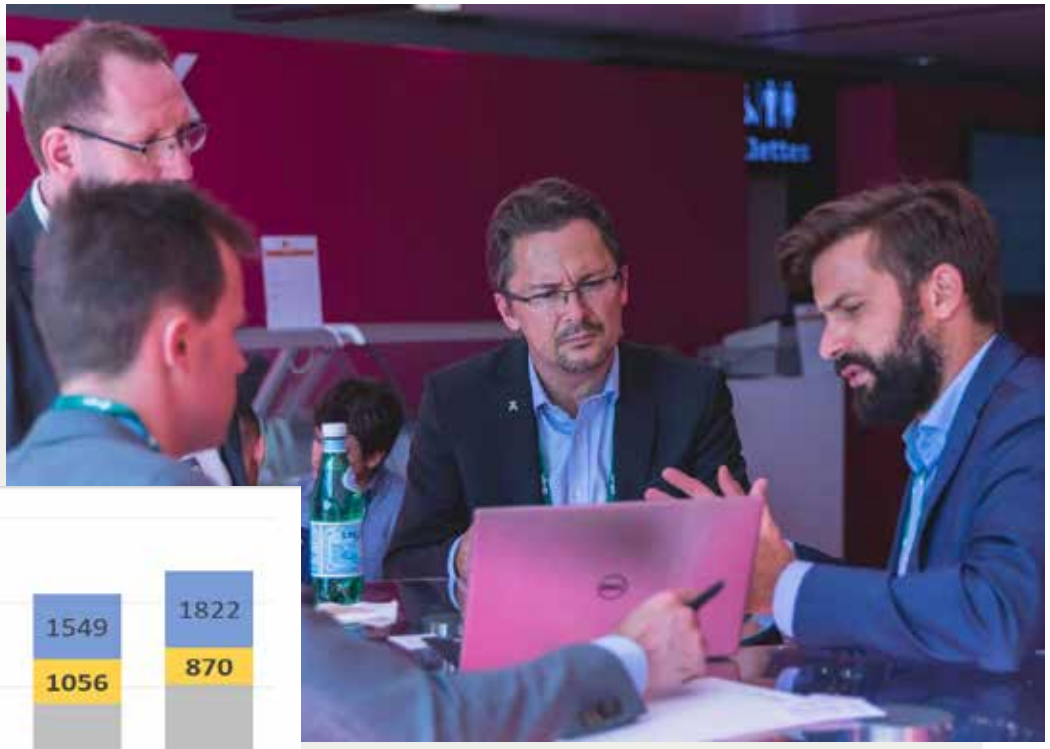
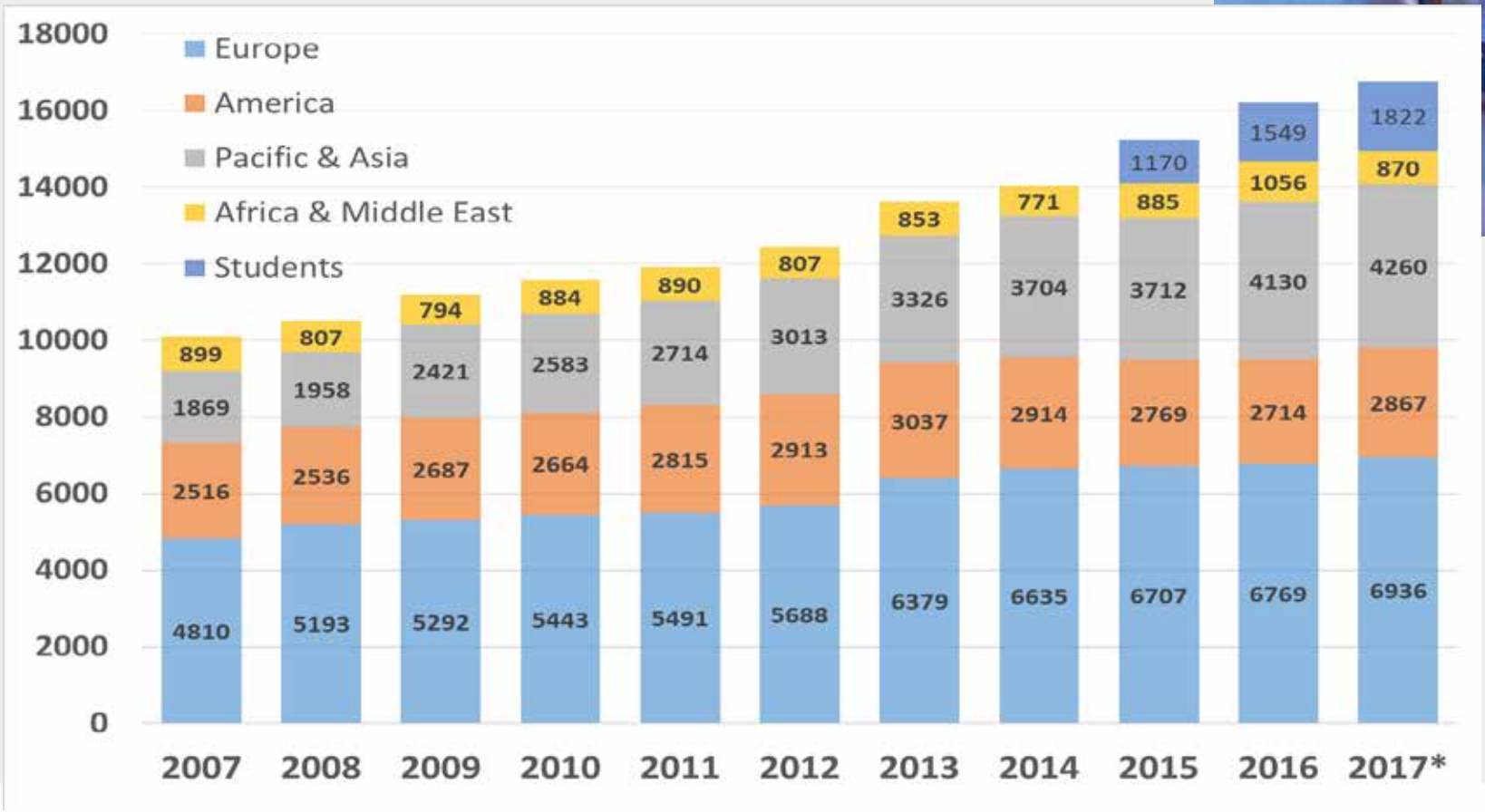
CIGRE membership

- Steady growth but slowing
- Student membership is successful





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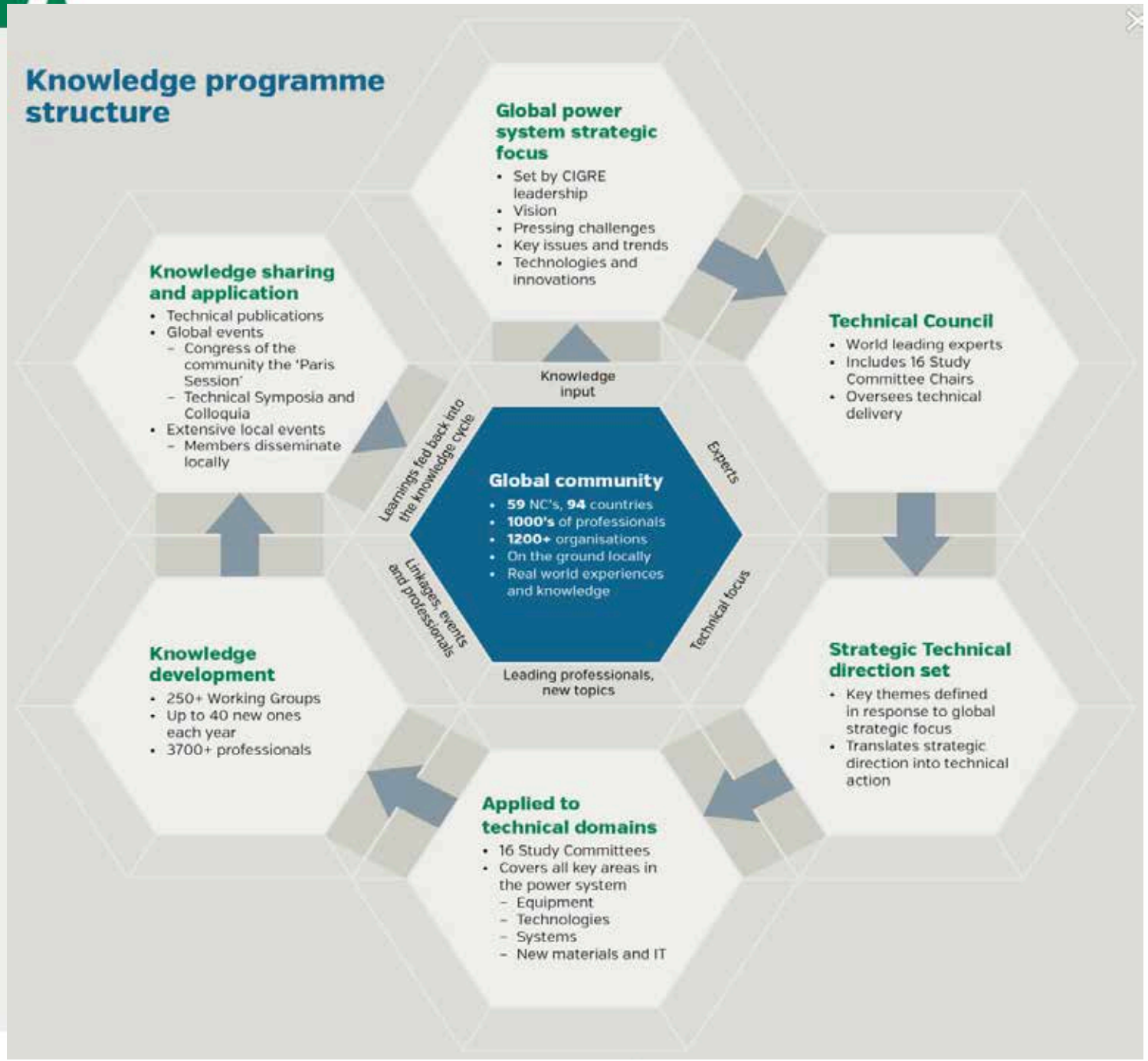
New Brand

- New look and feel è
- Marketing plan
- Membership drive
- Position CIGRE experts
- Collaboration
  - IEC – ACTAD
  - IEEE
  - GEIDCO
  - ENTSO-e
  - CIRED
  - CEATI
- LinkedIn
- Twitter
- YouTube

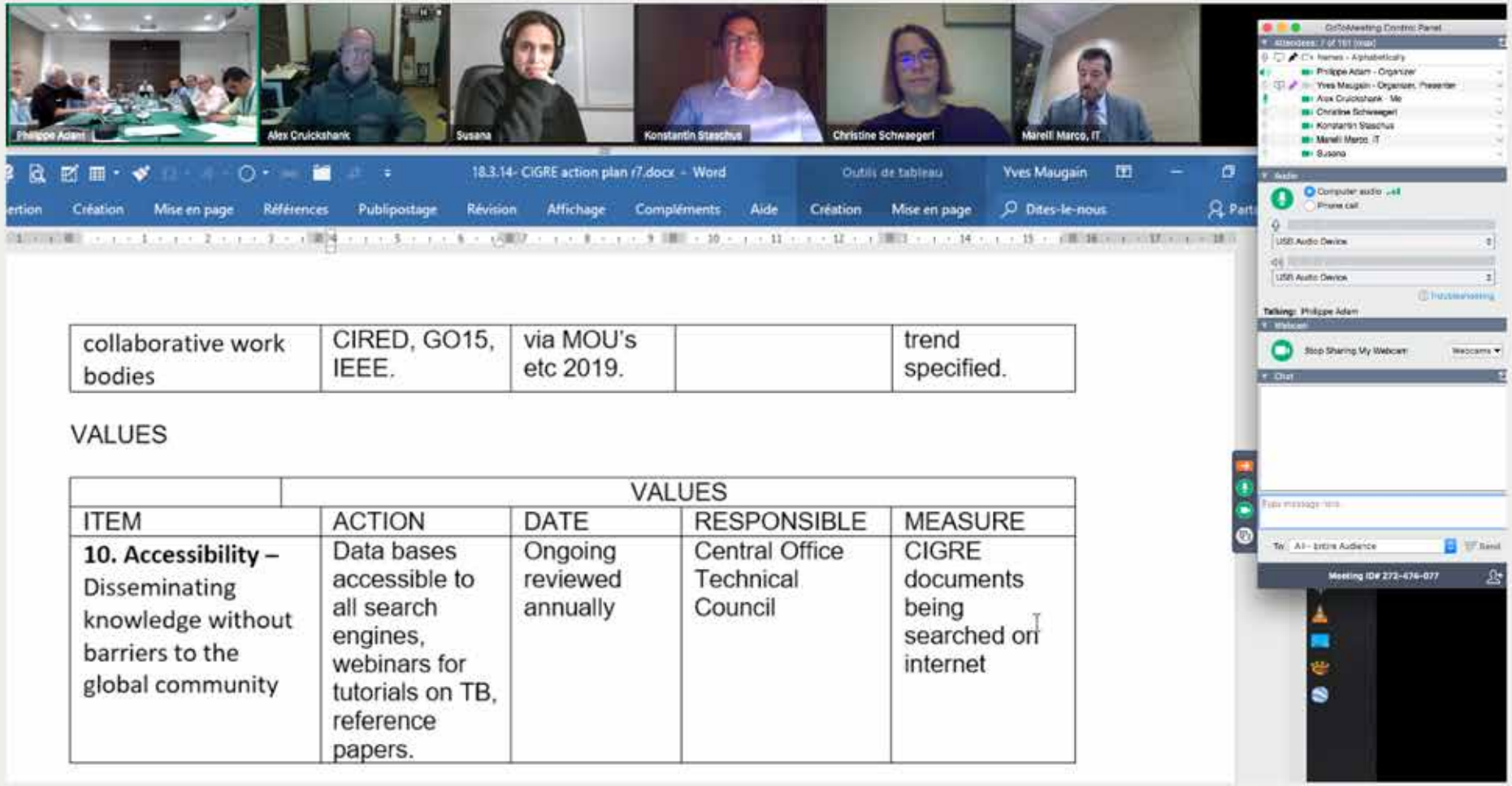


Improved tools

- Website
- e-CIGRE
- KMS
- Tutorials
- Seminars
- Webinars
  - TBs
  - Topics
  - ≤1 hour
- LinkedIn
- YouTube

➢ CO Tools

- Go to Meeting, Go to Webinar
- Survey tools



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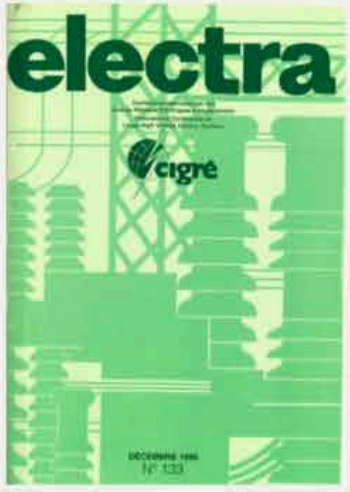
Electra of the future

No more printed Electra from February 2019

1974



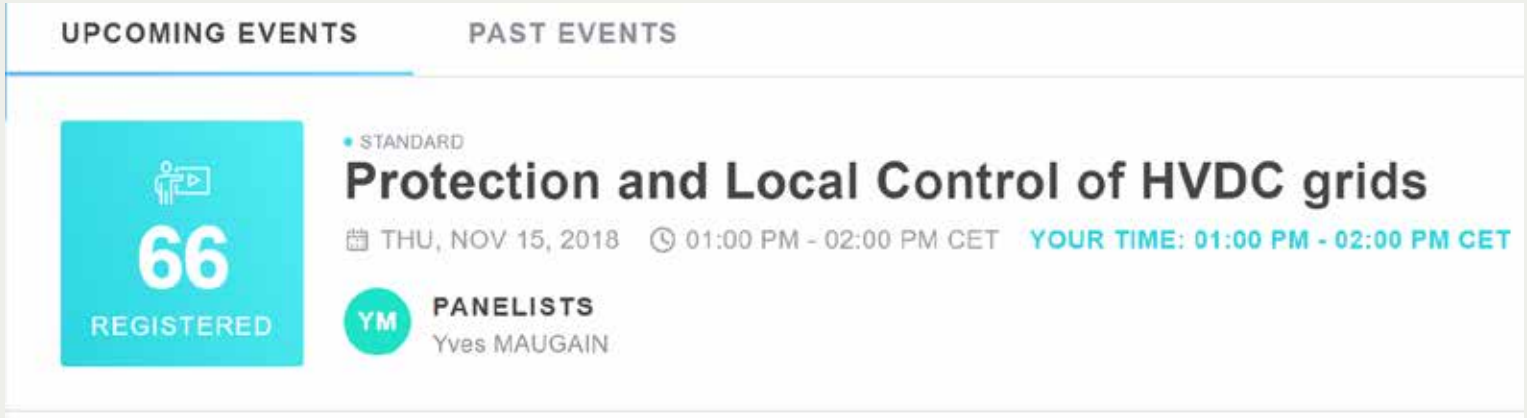
1990

2018

2020

PDF version from February 2019 until Digital Electra is available

First CIGRE webinar on 15th November 2018



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Some statistics from the 2018 Session

- 3797 registrations **(+16%)**
- 3575 delegate badges delivered **(+15%)**
- 349 companions **(+12%)**
- 5512 badges to visitors + exhibitors + SC/WG members **(+50%)**
- 302 exhibitors **(+ 16%)**
- 4100 users of the APP **(+128%)**
- 4855 users of m.cigre.org **(+644%)**

Attendances

- Women in engineering – 222
- Large disturbance workshop – 439
- Conference: Integrated power system: Changing from consumers to prosumers - 744
- NGN – 100


Source: CIGRE

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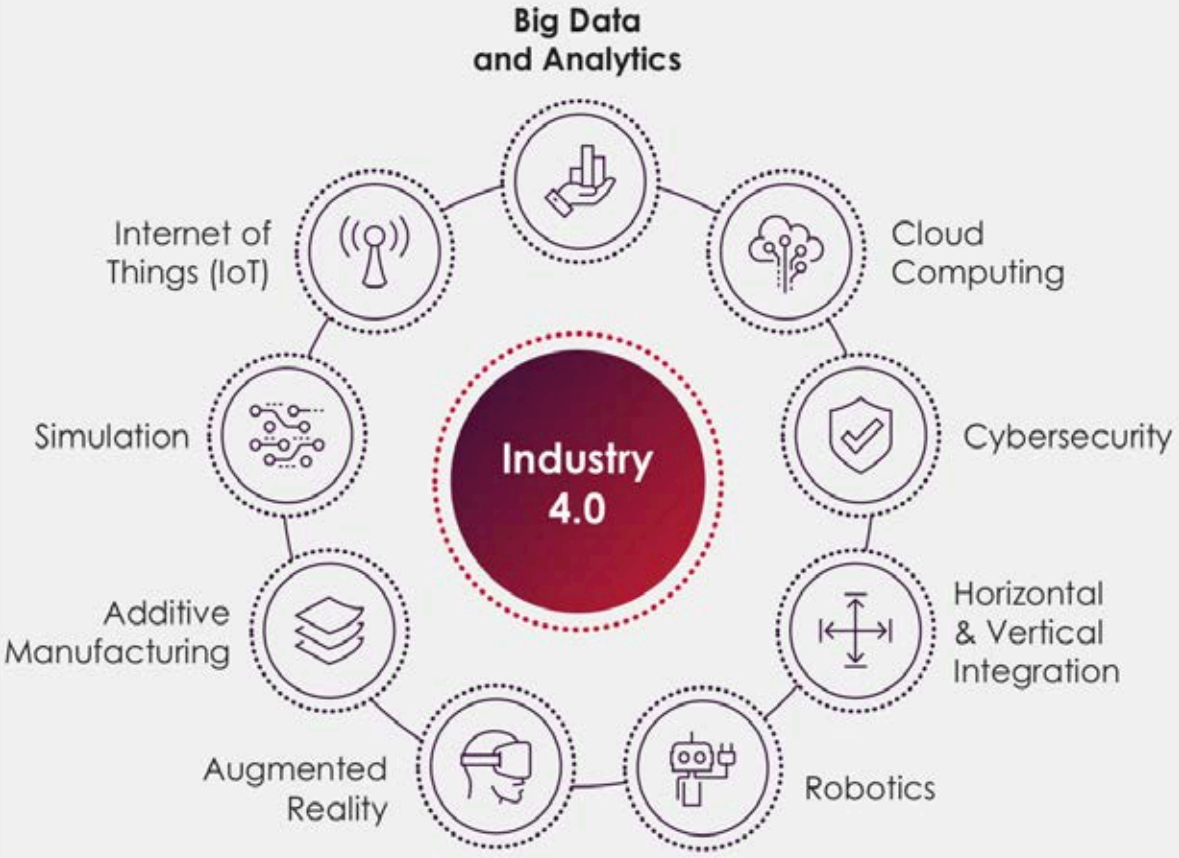
Opening Session and Panel

- Audrey Zibelman, from AEMO
  - Industry 4.0
  - DER, Smarts, IOT, Big data
  - Transformational change
- Opening Panel Session
  - Sustainable development
  - Resilient supply
  - Ensuring access
  - African partnership



Source: Audrey Zibelman, Opening Session

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Africa – the big project for CIGRE and the World Bank

- All Study Committees have been asked what they can contribute

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CEO Event

§ Attended by 102 CEOs from 44 countries

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Leadership Circle

CEO Forum | Paris Session 47

Edition 1 October 2018

§ Faster results
  – Papers at conferences
  – Seminars or Webinars

§ Involve regulators
  – Not actually new
  – Need to make CIGRE attractive

§ Communicate to senior managers
  – EG: In the Loop

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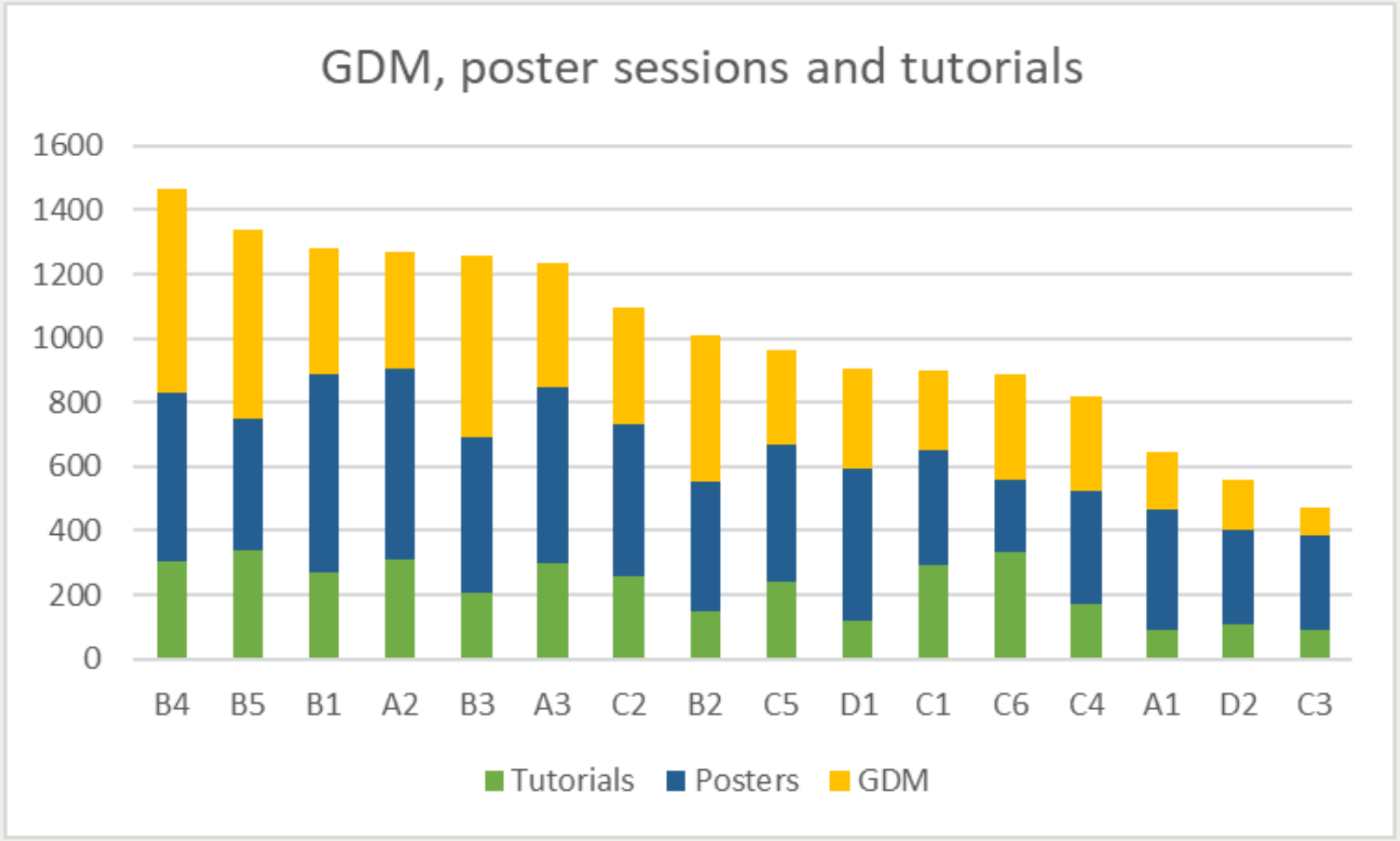
Attendance by Study Committee



Electronic Posters a success

- 3 slides per person
- 3 hours for discussions
- Well attended
- Successful format, to be repeated

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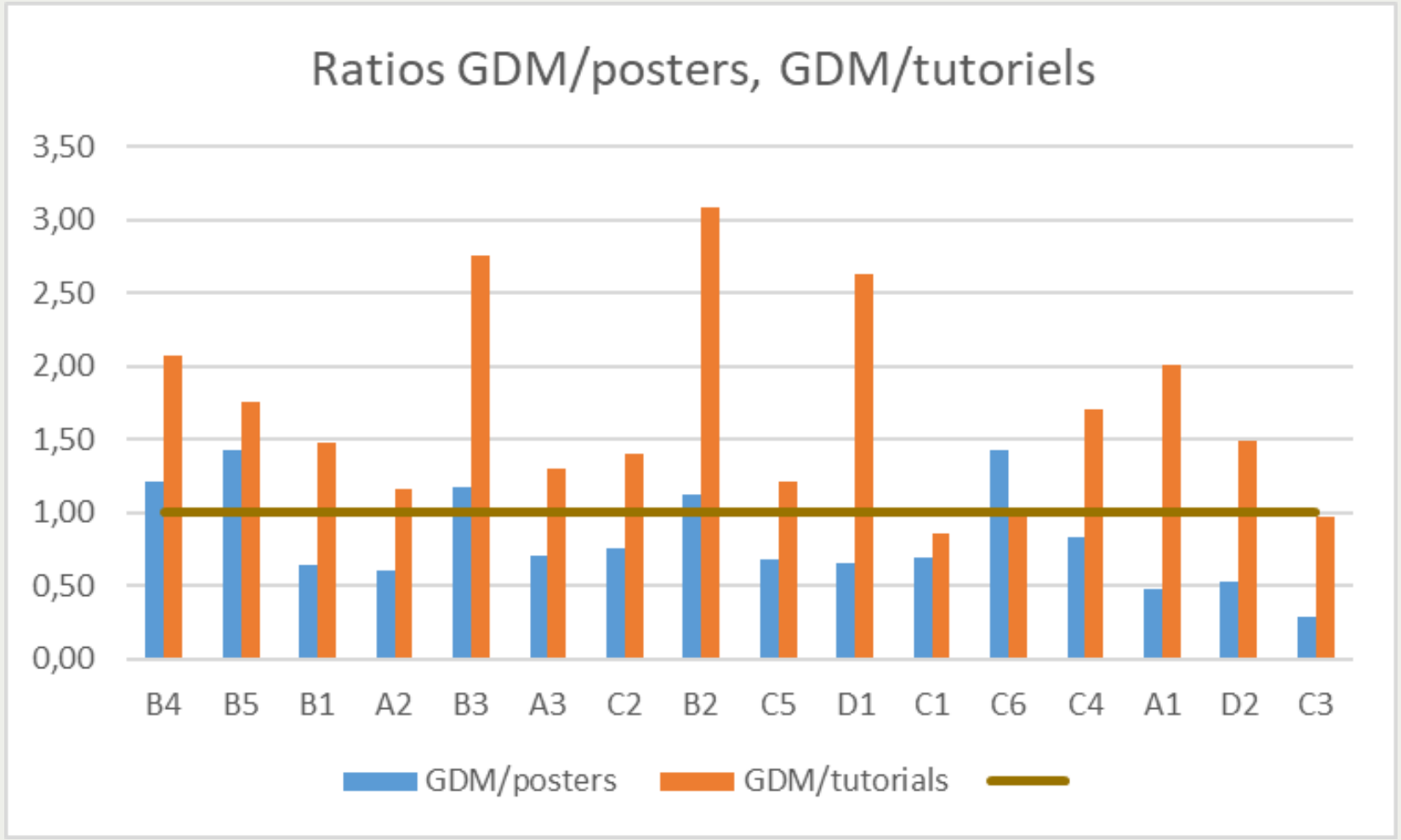
Posters and tutorials adding to the Session



Preparation of the 2020 Session

STEPS	DATES
Publication of the **call for papers** (preferential subjects)	1st December 2018
Deadline for the **submission of synopses** by the National Committees	28th June 2019
Deadline for the **evaluation of the synopses** by the Study Committees	30th September 2019
Notification to the authors by the Central Office	15th October 2019
Deadline for the submission of the **full papers** by the Authors	14th February 2020
Deadline for the production of **Special Reports**	29th May 2020

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Symposia and other events

- 2018 Session
- Symposia planning
  - Aalborg (Denmark) from 3rd to 7th June 2019,
  - Chengdu (China) from 20th to 25th September 2019,
  - Ljubljana (Slovenia) in June 2021,
  - Tokyo (Japan) on 10-16 October 2021.
  - Cairns (Australia) on 4-7 September 2023
- Other CIGRE events
  - Support to the preparation of the joint CIGRE-IEC conference on UHV AC & DC in Hakodate on 23-26 April 2019
- CIGRE Centenary
  - On the agenda of the Steering Committee.

Presented by Tri Tran - Convener

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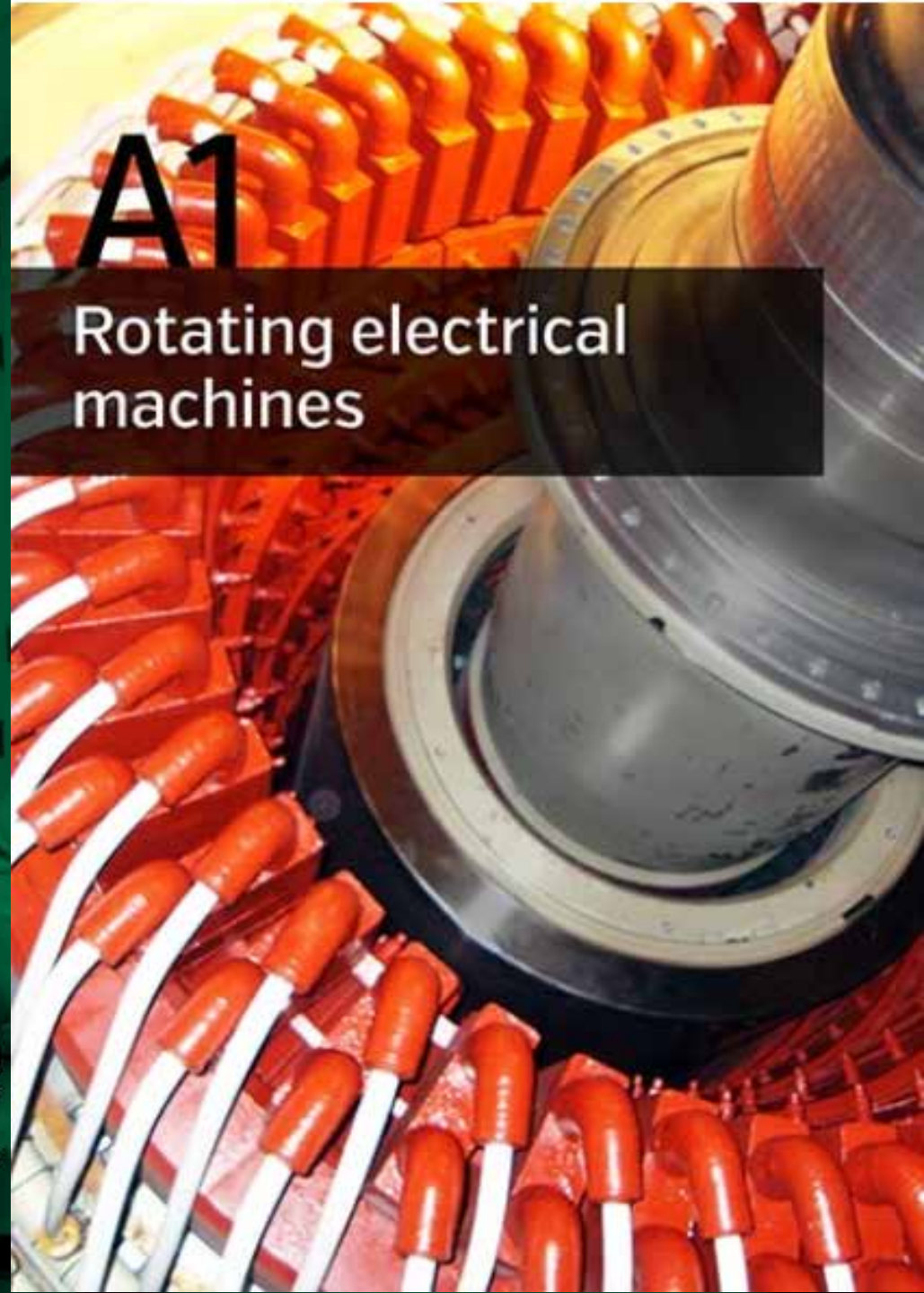
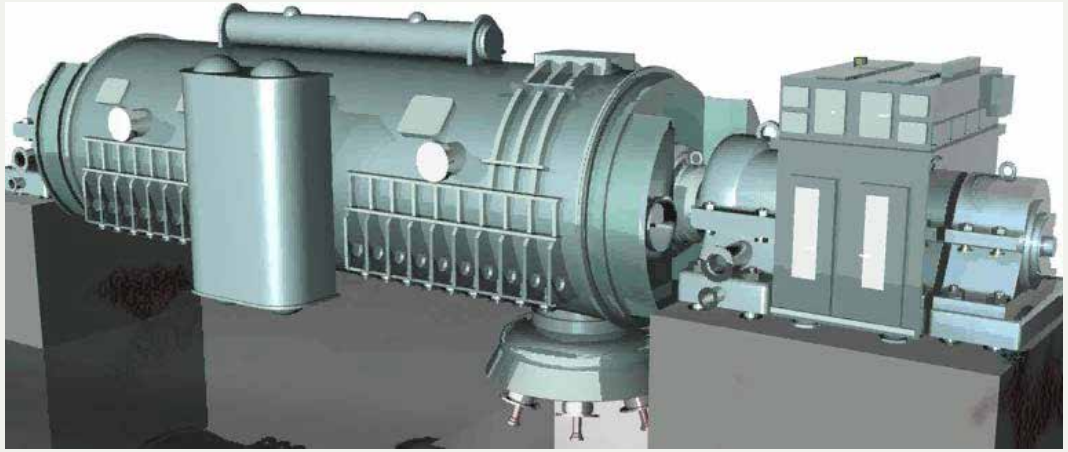
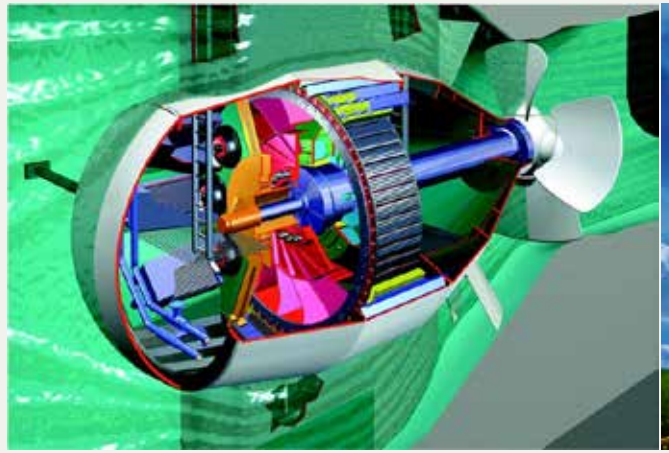


SC A1 Overview

Study Committee Purpose

SC A1 focuses on the development of new technologies and the international exchange of information and knowledge in the field of rotating electrical machines, to add value to this information and knowledge by means of synthesizing state-of-the-art practices and developing guidelines and recommendations.





SC A1 Overview

Four Advisory Groups / Study Areas

- **Turbo generators:** condition assessment, maintenance, refurbishment, power upgrade, asset management and long term health assessment of such plant.
- **Hydro Generators:** condition assessment, maintenance, refurbishment, power upgrade, asset management and long term health assessment of such plant.
- **Non-conventional Rotating Machines**: focus on wind turbine generators and superconducting machines. In addition review of grid codes as impact on generators.
- **Large Motors and Drives:** focus on Motors >1kV and >500kW. Benefits of High Efficiency Motors, Variable Speed Drives (VSD) on motors and impact of flexible operation of motors.

SC A1 Overview

Key Area of Interest

- Asset Management to extend the life of existing generators or to recommend their replacement
- Machine monitoring, diagnosis and prognosis to perform optimal maintenance
- Renewable generation which may be connected directly to the transmission and distribution or even directly to consumers setting up microgrids.
- Enhancements in the construction of large turbo and hydro generators
- High efficiency rotating electrical machines with new materials, improving cooling and insulation systems in generators and motors.
- Large motors and high efficiency motors
- Utilization of Polymer nano-composites as near-future HV electrical insulation in rotating machines

2018 International Events – Paris Session 47

Working Groups meeting and progress report

- 20 current WG presentations and progress reports
- 2 WG (A1-29, A1-37) finished
- 4 WG (A1-33, A1-39, A1-48, A1-50) at final stage
- 2 new WG (A1-63, A1-65) proposed with TOR, starting soon.

Preferrential Subjects

- PS1 – Generation Mix of the future
- PS2 – Asset Management of Electrical Machines
- PS3 – Developments of rotating electrical machines and operational experience
- Total of 26 technical papers were accepted and presented at the Paris Posters sessions

Tutorial

- Revisiting the fundamentals of magnetic saturation in salient pole synchronous generators

Relevance to Australia

Turbo and hydro generators

- Recently completed Technical Brochure 690 - Vibration and stability problems met in New, Old and Refurbished Hydro-generators, Root Causes and Consequences
- New WG A1-29 Guide on New Generator - Grid Interaction Requirements. Highly relevant to prevention of wide spread state blackout similar to that in 2016 in South Australia.
- New WG A1-37 Generator Stator windings support systems experience. Highly relevant to the old turbo and hydro generators

Presented by Ross Willoughby - Convener

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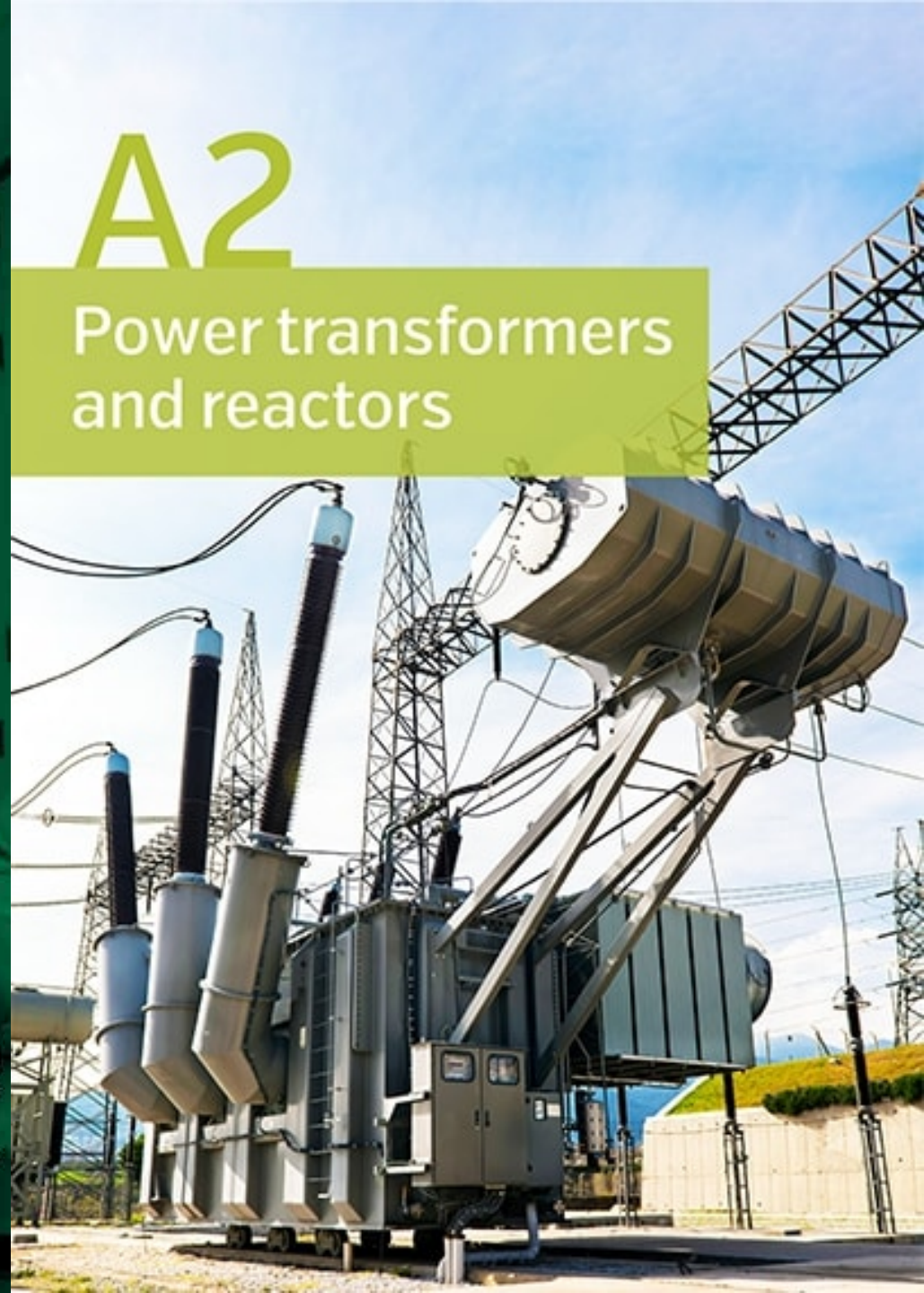
A2

Power transformers and reactors



SC A2 Overview

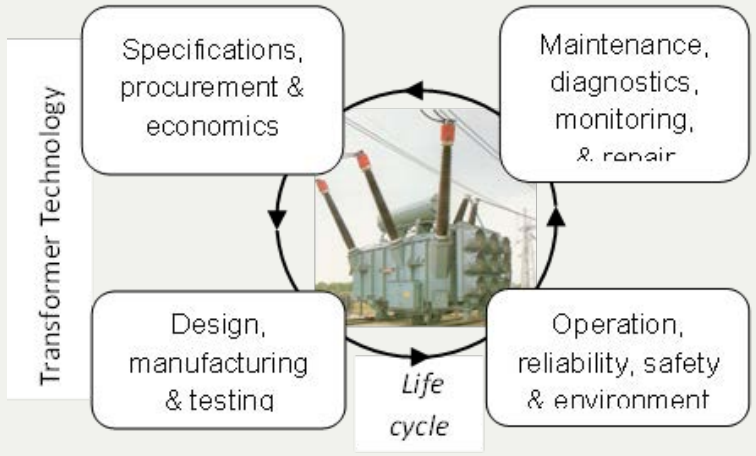
Study Committee Scope

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

Specific Activities of SC A2 :

Covers the life cycle of a transformer in 4 key domains:

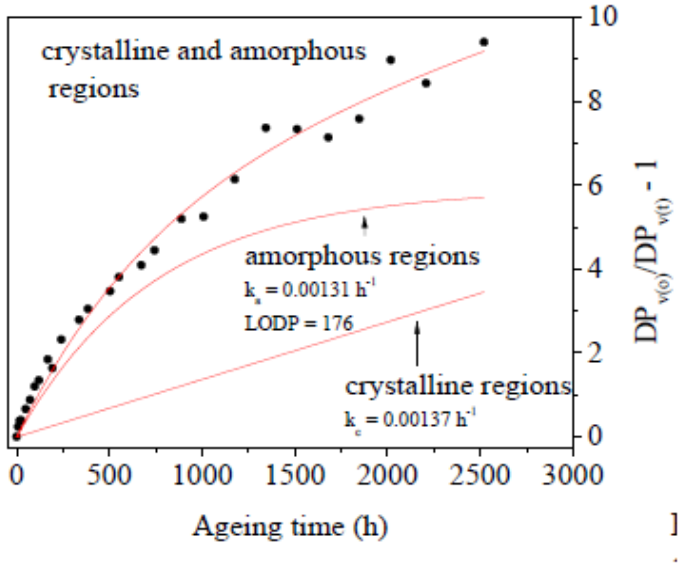
- Specification, procurement and economics
- Design, manufacturing and testing
- Operation, reliability, safety and environmental impact
- Maintenance, diagnostics, monitoring and repair



2018 Paris Session

A2 Tutorial – Transformer Ageing, Failures and Forensics Analysis

- DP as a S/C withstand or remnant life indicator.
- TB 735 “Transformer Post-Mortem Analysis” (SC A2) and TB 738 “Ageing Liquid-Impregnated Cellulose for Power Transformers” (SC D1) provide solid foundation of techniques and interpretation to properly assess ageing
- BEWARE the surprisingly dangerous or incorrect disassembly shown in TB



Example of the ageing of a standard kraft paper in their different phases.

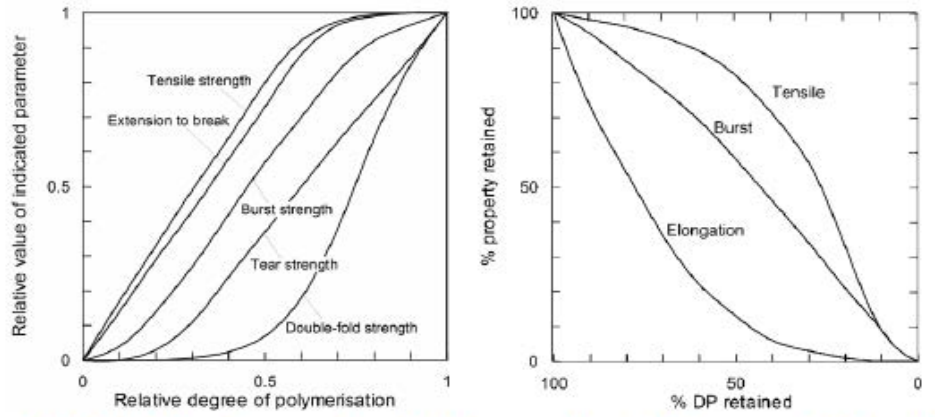


Figure 31: (a) Relative decrease of mechanical parameters with decrease of DP of cellulose

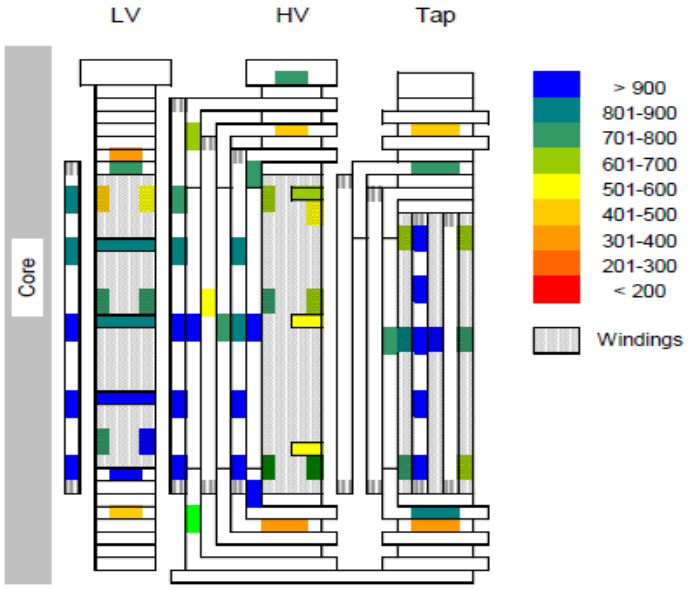
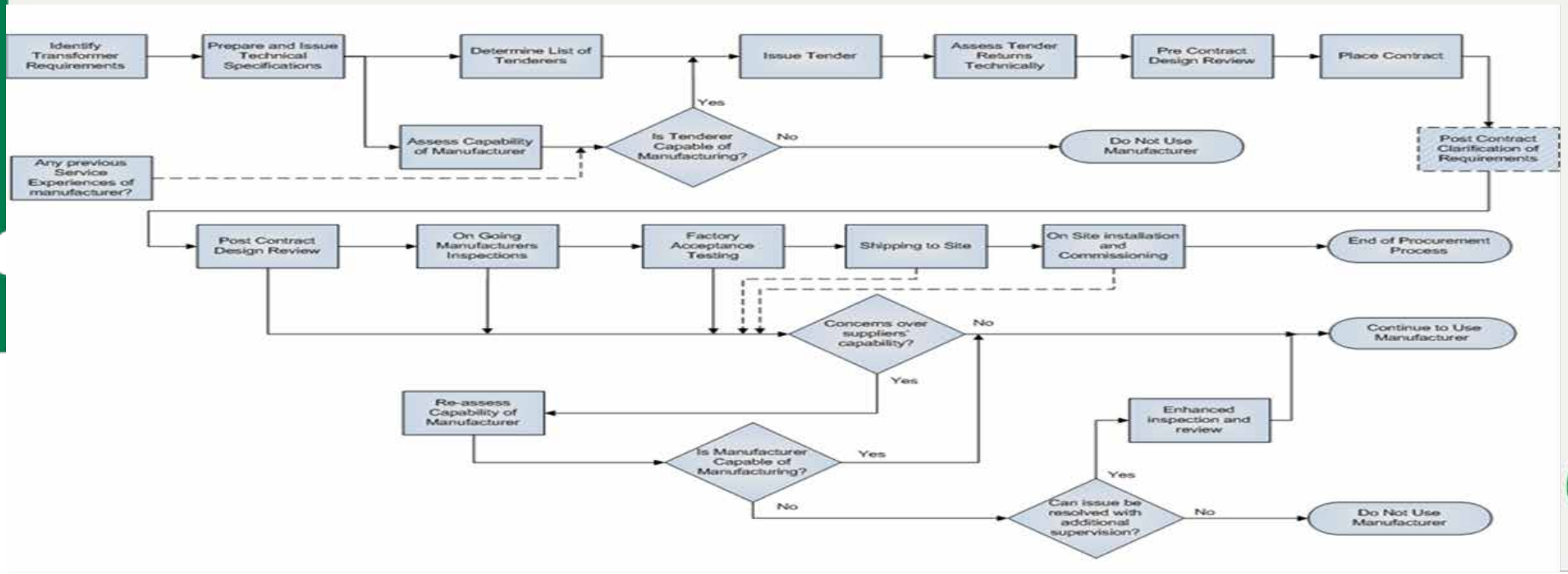


Figure 4.5 DP-profile of a 31.5 MVA transformer after 48 years of service

2018 Paris Session

- **SC A2 has formed new Advisory Group - Green Book on Transformer Procurement**
  - The work would amalgamate and develop the existing material used in the trilogy TBs 528-529-530 for procurement process
  - Add the new work of TB 673 Transportation and WG A2.58 Installation, Pre-commissioning & Trial Operation



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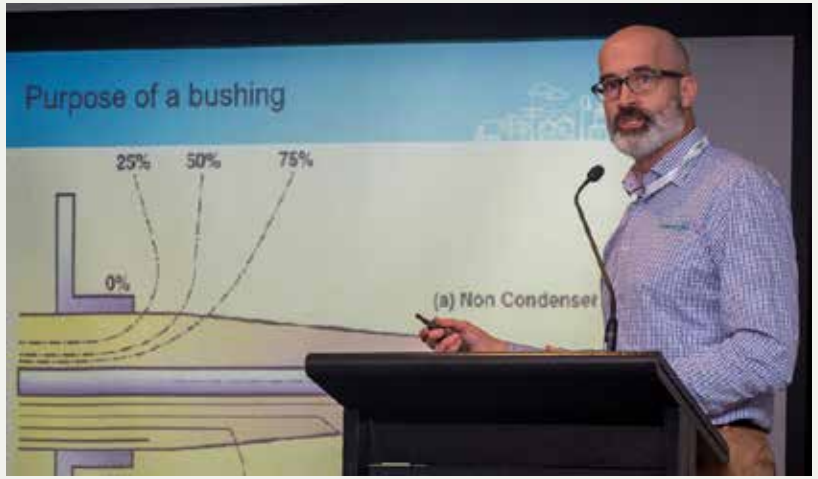
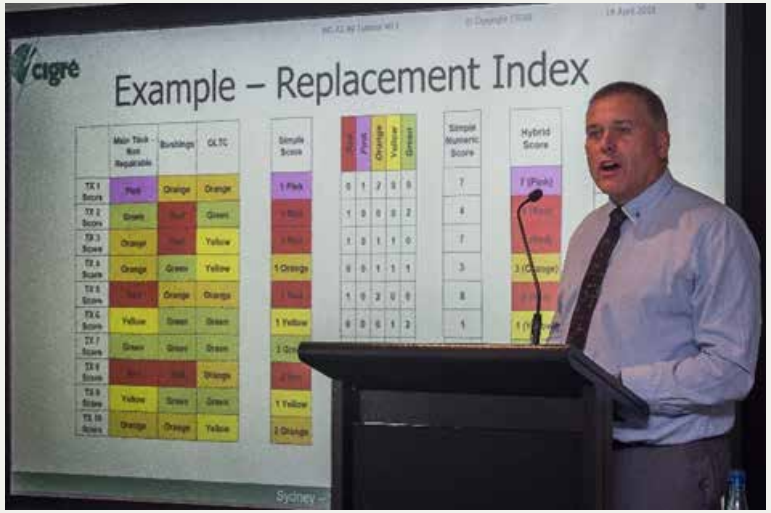
2018 AU/NZ Activities

Cigre Event – 1 Day Workshop

"Transformers – Condition Assessment with a Focus on Bushings – an interactive workshop" was held on 16 April

- ü **6 speakers (2 utilities, 1 WG convener, 1 test equipment vendor, 2 from insurance company)**
- ü **84 delegates**
- ü **2 Tutorials**
- ü **Expert Panel**
- ü **Highly relevant to address bushing risk and avoid expensive failures**





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Relevance to Australia

- SC A2 has produced a long series of TB with very high relevance to the Australian electrical industry.
- TB 445 Guide for transformer maintenance has one of the highest hits on the e-cigre site for TB downloads
- 735 Post-mortem Analysis
- 673 Guide on transformer transportation
- 655 Technology and utilization of oil-immersed shunt reactors
- 642 Transformer reliability survey
- 630 Guide on Transformer intelligent condition monitoring
- 625 Copper sulphide long term mitigation and risk assessment
- 537 Guide for transformer fire safety practices
- 528/529/530 Guides to assess the capability of a transformer manufacturer, design review for power transformers, and preparation of specifications for power transformers

There are some major changes coming from IEEE, IEC and CIGRE guides and standards on the interpretation of DGA.

Active Australian participation in A2 WGs – both representative members and conveners eg A2.49 and A2.58

NGN interest and involvement too

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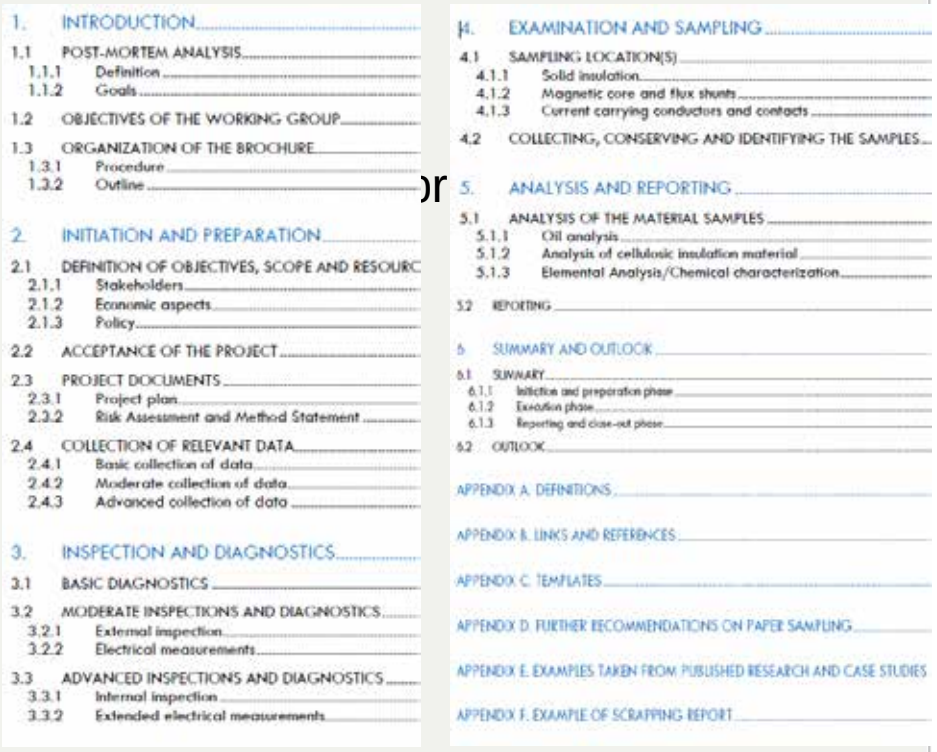
2018 Deliverables

Technical Brochures

- TB 735 – Transformer Post-mortem Analysis.



- **WGs nearing completion with a TB expected late 2018 or early 2019**
  - WG A2.43 – Bushing reliability
  - WG A2.49 – Condition assessment of power transformers

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Presented by Wayne Pepper - Convener

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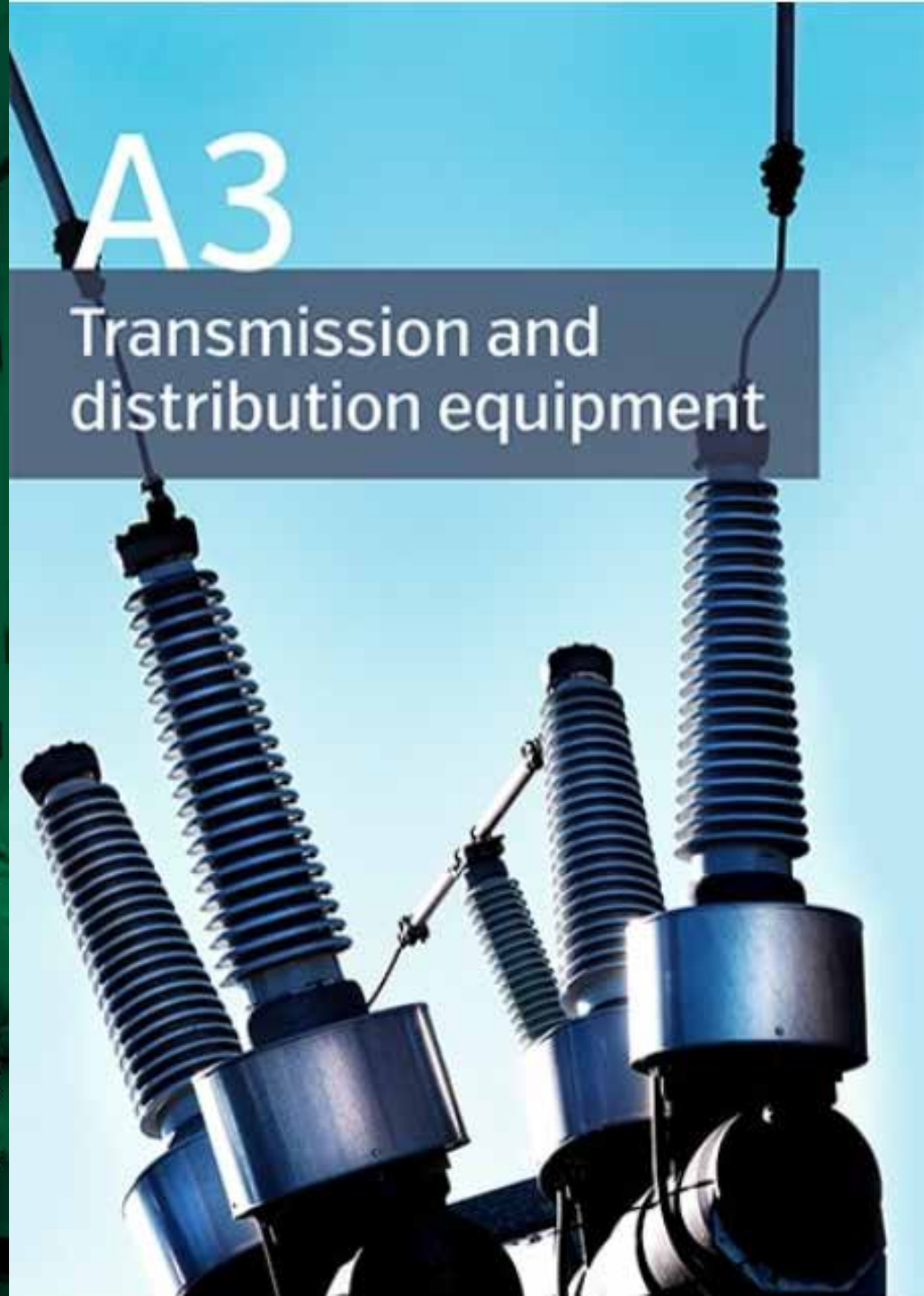
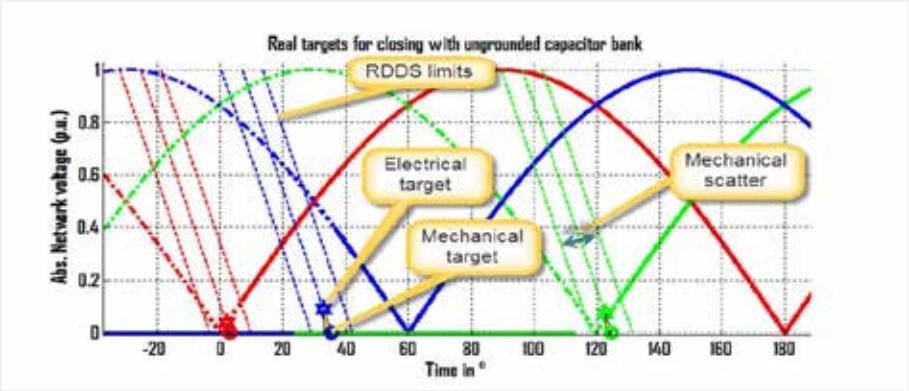
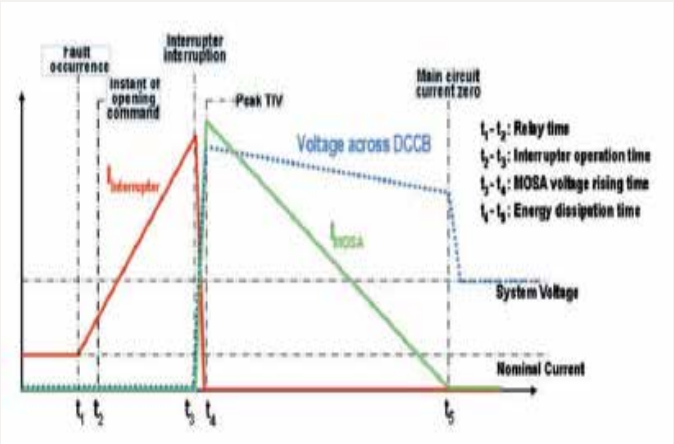


2018 Paris Session

A3 Poster and Technical Session

- New format in poster sessions using PowerPoint presentation on display screens. A3 Poster session convenor was AP-A3 representative.
- A3 technical session introduced new format, with a lesser number of accepted but quality contributions, combined with experts giving 15 minute technical discussion on the relevant topics, such as Controlled switching, HV equipment type testing, HVDC circuit breaker design, and technical comparison of SF_6 free gases.
- A3 Papers relevant to Australia/NZ included topics on:-
  - Instrument Tx explosive failures
  - Equipment usage in digital substations
  - Outdoor insulators
  - Capacitive current switching





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2018 Paris Session

Technical Exhibition

- Three major Gas-Insulated-Switchgear equipment suppliers had demonstration units showing the future for high voltage SF_6 free switchgear.
- Each Paris Session presents the opportunity to show development of SF_6 free HV equipment.
- Session papers are written in A3, B3 and D1 SC's detailing the development works done, further type testing and results of trials being carried out in this area.
- WG's have been established to in several SC's to look at different facets of the SF_6 free gas mixtures. A3 is looking into switching performance of the different gases.
- For Australia, since the carbon tax was repealed in 2014 there has been little emphasis on reducing SF_6 usage, however it is envisaged with mandated legislation in other counties to wind back SF_6 usage, the newer SF_6 free alternatives will be taken up here.
- Most users would like a greenhouse friendly alternative to SF_6, a gas that can has the same technical features and similar usability.

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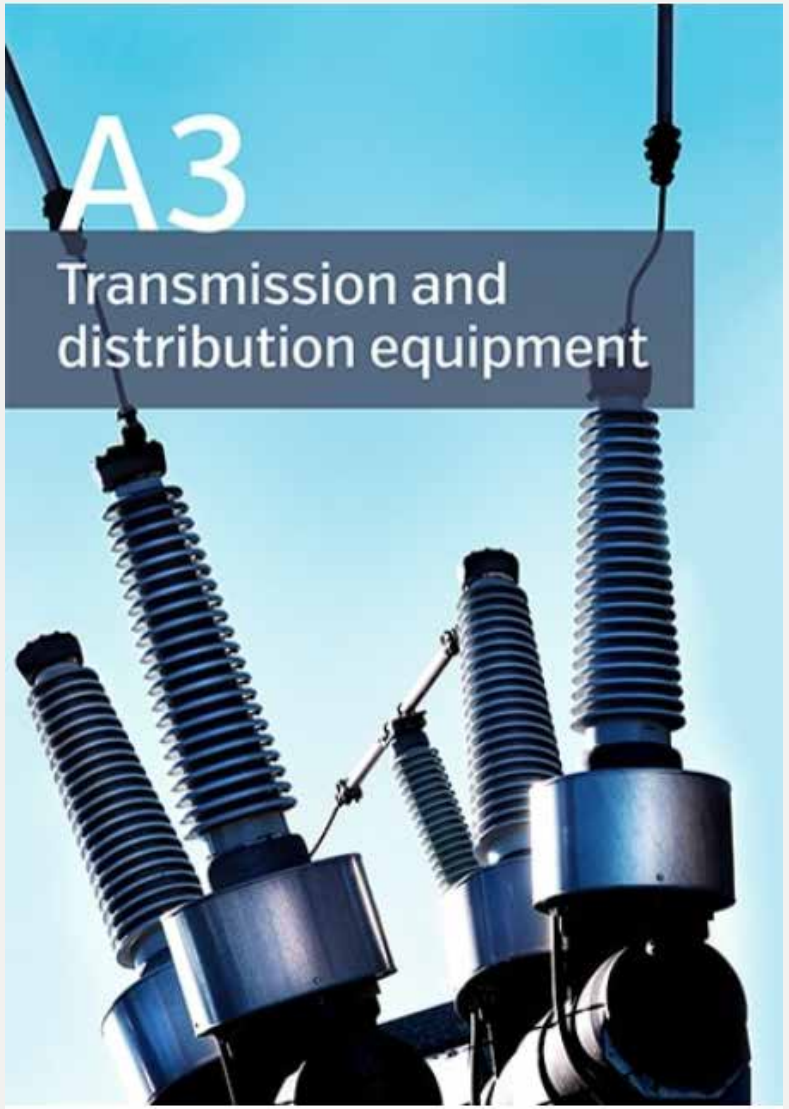
2018 International Activities

SC A3

- A3 had change of name to include Distribution equipment.
- New A3 SC Convenor commenced following Paris Session – with technical experience from the Distribution equipment area.
- Additional eight A3 SC representatives to cover Distribution equipment area.
- Initiated new Equipment reliability survey covering 2014 - 2017 period. Retrospective survey using spreadsheet to capture data.
- 3 WG's completed their activities, with 3 new WG's commencing and another 3-4 WG's to start in 2019. Currently 10 WG's active.
- In September 2019, A3 SC meeting will be in Bucharest, Romania, with Condition Monitoring, Diagnosis and Maintenance (CMDM) conference.



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2018 AU/NZ Activities

2018 AP-A3 Meeting in Hobart this week hosted by TasNetworks

- 10 attendees
- Discussion points:-
  - Local and International CIGRE matters since last meeting – 2017 A3 SC and 2018 Paris session, A3 SC matters, WG activities and surveys
  - Utility and Vendor reports – New equipment, ageing equipment risk assessments, equipment failures presentations, procurement issues, SF_6 management and equipment leak issues
- Tour of Creek Road 110/33kV Substation

- AP A3 providing information to A3 WG surveys on capacitor switching and reliability survey.
- AP-A3 provided Paris Session A3 Technical contribution on Instrument Tx failures
- AP A3 member on new WG on IT failure analysis

Photo from AP A3 substation tour to be inserted following meeting on Wednesday

2018 Deliverables

Technical Brochures

- TB 737 – Non-intrusive methods for condition assessment of distribution and transmission switchgear.
- TB 725 – Aging high voltage substation equipment and possible mitigation techniques (AU WG convenor).
- TB 716 – System condition for and probability of out-of-phase – (A3/B5/C4).

Green Book

- A3 Green Book – “Switching Equipment” published in August 2018
  - AU contribution to chapter on “Lifetime Management of Equipment”
- Contributing to a chapter in future C1 Green Book on “Asset Management”

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B1

Insulated cables

Presented by Russell Wheatland - Convener

Hobart – 15/11/2018

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2018 Paris Session : B1 Insulated Cables

3,600 delegates among 9600 participants from 98 countries
16 tutorials sessions held with a total attendance of 3,600
Australia has a member on each of the 16 SCs
More than 300 exhibitors
CIGRE World Bank joint initiative for "Africa“
The World Bank has the money
CIGRE has the technical knowledge of what is needed

Opening Ceremony

Keynote Speaker Audrey ZIBELMAN

- ü **CEO Australian Energy Market Operator AEMO**
- ü **Delivered vision of electricity markets & business models of the future**
- ü **Global look at the changes effecting the power networks around the world**
- ü **Australia is leading the world in adapting to these changes**

2018 Paris Session : B1 Insulated Cables

Study Committee Meeting

- ü 35 member countries and over 100 people in attendance
- ü Australia is seen as a valuable member
- ü Several AP B1 members acknowledged for their contributions
- ü SC B1 is one of the most interactive with other SCs

Tutorial Sessions

- ü All SCs held a Tutorial session on the outcome of one of their Working Groups
- ü The B1 Tutorial was attended by over 300 people
  - Fault location on land and submarine links
- ü With 3600 attending over the week period = average of 225
  - Insulated power cables continue to have a growing popularity as they interface with more and more HV assets

2018 Paris Session : B1 Insulated Cables

Goals of the Study Committee

The main goals of SC B1 are the following

- **to promote and to contribute effectively to the progress in insulated cable systems technology**
- **to facilitate the integration of insulated cable systems in electric power networks and in the environment covering the complete life cycle of cables**
- **to maintain its leading position in the field of power cables by providing unbiased and neutral information on all essential cable aspects**
- **to 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**
- **to monitor and assess current trends in cable technology**

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2018 International Activities

- **AORC Meeting**
  - ü **Active engagement with the AORC B1 Panel**
  - ü **Providing a link with fast growing regional economies**
  - ü **2017 meeting held in India**
    - **SC B1 chairman (Marco Morelli) attended for half a day**
    - **Change-over convenor Australia to Japan**
  - ü **2019 meeting scheduled for March in Bali**

JiCable 19

- ü **Scheduled for June 2019**
- ü **Premier world wide power cable conference**

2018 AU/NZ Activities

- AP B1 has strengthened its links with NZ, taking on 2 new Kiwi members
- AP B1 now has 25 active members with four from over the ditch
- CIGRE is now actively engaging with MV assets, with some AP B1 members engaged in MV only networks
- The Network of AP B1 members has been active this past year
  - MV cable accessory forum due to termination and joint failures in the field
  - Planning for a cable seminar to present several tutorials
  - Planning a Cable Failure database for AU/NZ utilities
- HV and EHV cable systems are growing in popularity
  - Expanding populations in capital cities of both countries
  - Redevelopment of city areas wanting to remove overhead infrastructure
  - The push for more renewable, distributed generation
  - Renewed pressure on aged infrastructure replacement
  - Increased use of GIS with cable entry options
- With now no HV cable manufacturing capability in the region, forums such as CIGRE provide invaluable links to off-shore utilities and suppliers.

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2018 Deliverables

Technical Brochures

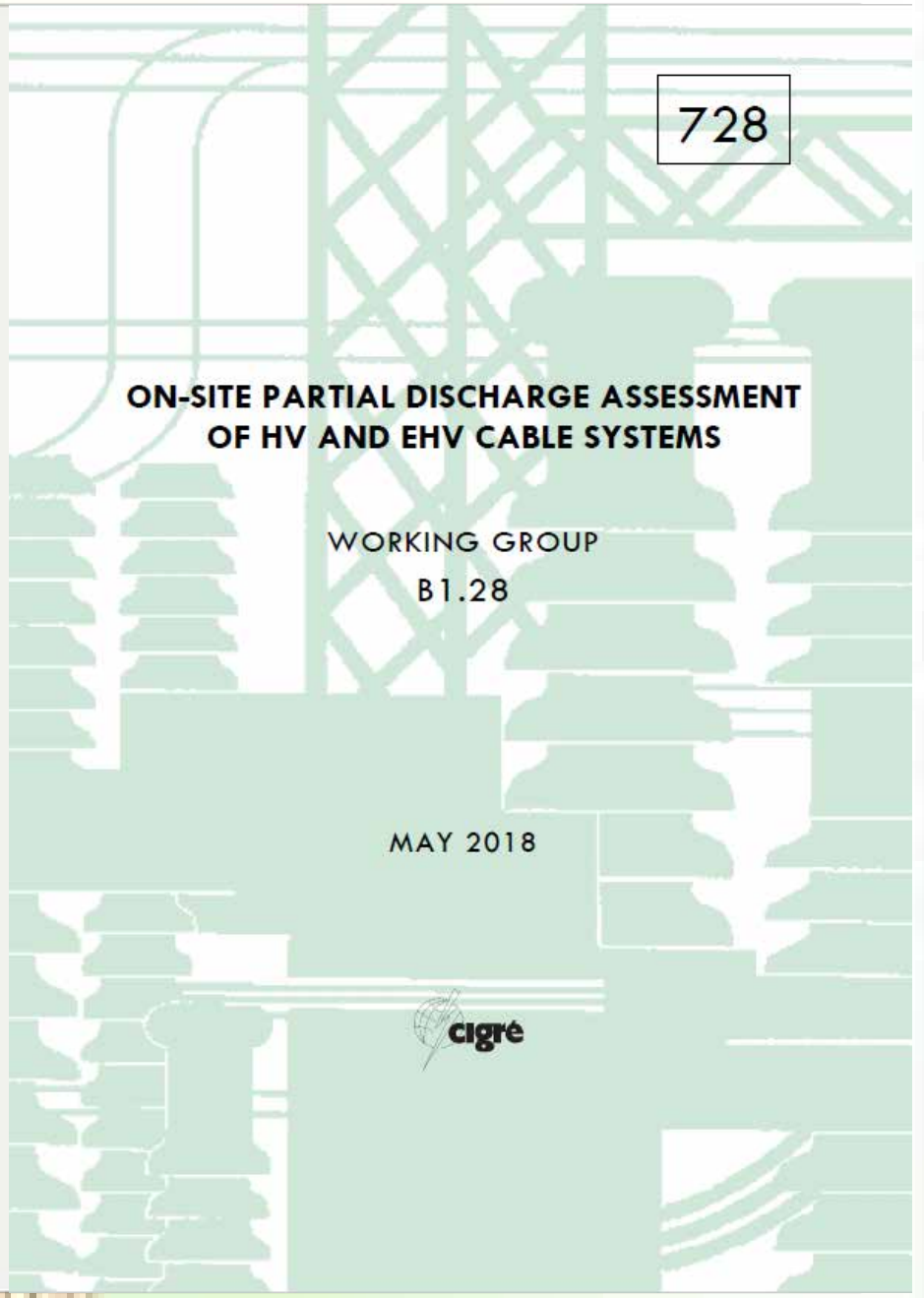
TB 720 - Fire issues for insulated cable installed in air

TB 722 - Recommendations for additional testing for submarine cables from 6 kV (Um = 7.2 kV) up to 60 kV (Um = 72.5 kV)

TB 728 - On-site Partial Discharge Assessment of HV and EHV cable systems

TB xxx[1] Thermal monitoring of cable circuits and grid operators' use of dynamic rating systems

TB xxy[1] Conductor Connectors: Mechanical and Electrical Test



Note 1 : The central office has already been informed that SC B1 will propose a high number of reports to be published as TBs in the near future, but central office does not want to allocate TB numbers until the paper has been approved by the Chairman and the documents related to the TB (Executive Summary and Abstract) are provided. Once the number has been allocated, the brochure will be immediately made available on e-CIGRE

Thank You

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B2

Overhead lines

Presented by John McCormack - Convener

Hobart – 15/11/2018

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2018 Paris Session: Highlights

1. B2 Paper & Poster Sessions; WG research and presentations

a) OHL Asset Management: evolution from time-based to condition-based monitoring & replacement strategies for assessment of conductors and hardware components

Relevance to AU/NZ: Asset management practices in Australia are well advanced and some utilities have advanced beyond condition based component assessment and introduced risk based Asset Mgt practices.

b) Sustainability of OHL components:

i) Mitigation of extreme corrosive : Case Study - galvanised coatings stripped from lattice towers after only 5 years of service in coastal regions of Peru.

ii) Residual life of OHL conductor & fittings: Component degradation models; Asset condition monitoring technologies.

Relevance to AU/NZ: Evaluation of residual life and developing cost-effective methods for asset life extension of are paramount for all utilities managing an aging asset base.

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2018 Paris Session: Highlights

1. B2 Paper & Poster Sessions; WG research and presentations

c) OHL Security: network-wide structure refurbishment to reduce risk exposure of line failures subject to extreme weather events

Relevance to AU/NZ: I'm from South Australia – do I need to say more!

2. Paris Tutorials

SCC3 EMF - Time to Reassure: update on current understanding of EMF effects on human physiology

- Magnetic field varies across the earth; In Paris, the field is about twice the strength as Brazil.
- Current research continues to conclude that EMF is highly UNLIKELY to be harmful to humans.
- Interesting fact: When next in the Palais des Congress, rotate 360 degrees within 1 second & you will experience an electric field 5x higher than recommended for sustained exposure. You can inform curious bystanders you are conducting a scientific experiment (whilst being removed by security).
- Research continues…. the I/N Agency for Research into Cancer still lists EMF as a "possible" cause of cancer.

Relevance to AU/NZ: All AU/NZ utilities adopt a policy of at least "prudent avoidance" regarding EMF exposure to the public. There are cases where utilities have been required to take significant measures to comply with external socio-community planning conditions to reduce EMF fields.

2018 Paris Session: Highlights

2. Paris Tutorials (cont)

SCB2 HTLS conductor installation & handling: summary of WG findings/conclusions

- HTLS (High temperature low sag) conductor is installed in circuits to improve power line transfer capability; typically used by utilities constrained from establishing new OHL corridors
- Operated at 200-250ºC; resultant sag is similar to conventional conductor
- Disadvantages: high losses, cost, some HTLS require specialised skills/tools to install.

Relevance to AU/NZ: To date, a small number of circuits in Australia comprise HTLS conductor. Widespread deployment is unlikely until local utilities are faced with the same constraints as their European counterparts.

3. Women In Engineering

- 300+ attendees including around 25% male CIGRE members
- Women represent 8% CIGRE members whom actively contribute to WG's; 10% of WG convenors; 4 of the 16 SC Chairs; approx. 12% total CIGRE membership.
- At the highest level, CIGRE management support & encourage the active contribution of women in the industry.
- Presentations focussed on exhorting women to take up the challenge.
- Good coffee, croissants and fruit provided for lunch.

Relevance to AU/NZ: Most, if not all, power industry participants actively seeking to engage with and encourage women into the industry in engineering and other technical roles.

2018 Paris Session: Highlights

4. SCB2 TAG07 Asset Management and Reliability

- **AP member appointment as TAG07 Convenor**
- **New Developments of TAG07 Strategy:**

  - selection of regional representatives to focus on local industry needs
  - focus groups/task force appointed to identify potential areas of interest for future WG
  - Proposed new topics include:

    * Asset Management principles – ask the “why” (WG typically focussed on the "how”)
    * Construction technology and safety (incl Helicopter construction)
    * Logistics Management for Emergency Restoration of OHL

    Safety in Design

    (* = TAG07 members appointed at Paris TAG07meeting to lead development of ToR)

  Relevance to AU/NZ:

  - Opportunity to directly influence B2 strategic direction for the benefit of AU/NZ members
  - Nomination of potential AU/NZ convenors to expedite greater level of involvement and return to local industry.

2018 AU/NZ Activities – APB2

Strategy:

- ü Engage with broader industry (eg DNSP, Research Establishments, potential members)
- ü Invite targeted persons to interact with APB2 via CiGRE KMS “Specialist” status
- ü Encourage NGN participation

Panel Meeting – Hobart, November 2018

- WG progress reports
- ToR review – UAV’s, MV/LV conductor, Risk Management, Foundations, Lightning performance, OHL assets & fire
- Case Studies:
  - Novel structure designs for European OHL
  - Safe Management of Helicopter Line Construction
  - Conductor noise testing
  - Conductor Degradation & Serviceability assessment
  - Dynamic Line Rating
- NGN presentations
  - Mitigation Strategies for Bird Strikes on OHL
  - WG 55 Tutorial: Conductors for the Uprating Overhead Lines
- 29 Attendees including 6 invited guests, and 3 NGN reps, ANC representative (Terry Killen)

Next Panel Meeting & Technical Seminar – Sydney, 2019

- Seminar Theme: Asset Performance of OHL Assets (tbc)

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2018 Deliverables: Publications

WG	Title	Status	Ref.
B2.23	Geotechnical and structural design of foundations for HV & UHV Lines	Final draft due 2018	
B2.24	Qualification of HV and UHV Overhead Line Supports under static and dynamic Loads	Final draft due 2018	
B2.40	Calculations of the electrical distances between live parts and obstacles for OHL	Final draft Early 2019	
B2.45	Vegetation fire characteristics and potential impacts on OHL performance	Publication pending (2019)	
B2.47	Guide for repair of conductors & conductor fitting systems	Published 2017	TB 708
B2.48	Experience with non-conventional conductor	Published 2017	TB 695

2018 Deliverables: Publications

WG	Title	Status	Ref.
B2.50	Safe handling of fittings and conductors	Final review Due 2018	
B2.51	Methods for optimized design of overhead transmission lines	Published 2016	TB 638
B2.52	The use of robotic in assessment and maintenance of OH	Published 2018	TB 731
B2.53	Management guidelines for outsourcing OHTL technical expertise	Publication pending (2019)	TB 744
B2.55	Conductors for the Uprating of Existing Overhead Line	Final Draft Due 2018	
B2.56	Ground Potential Rise at Overhead AC Transmission Line Structures during Faults	Published 2018	TB 694

2018 Deliverables: Publications

WG	Title	Status	Ref.
JWG C3/ B1/B2.13	Environmental Issues for Transmission Lines in Rural & Urban Areas	Final review Due 2018	
	Calculation accuracy of high-temperature sag for ACSR in existing lines	Published June 2017	CSE 7
	Efficient Computation and Experimental Validation of ACSR OHL Conductors under Tension and Bending	Published October 2017	CSE 9

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Presented by Crina Costan - Convener

Hobart – 15/11/2018

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B3

Substations and electrical installations

SC B3 Overview

Our Mission

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

Scope SC B3

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

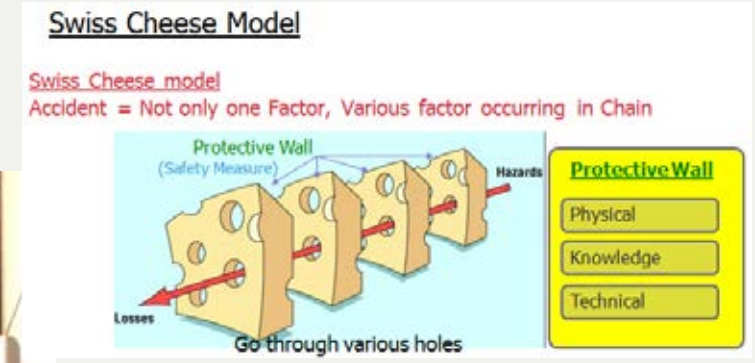
2018 Paris Session

- 7 Working Group (WG) Meetings:
- SF_6 Green Book on Sat - Sun Aug 25-26
- B3 Annual **Study Committee Meeting**, 40 countries represented.
- B3 **Poster Session,** 35 posters displayed : 484 visitors
- B3 **Tutorial** "*Low-Cost Substations in Developing Countries*" :206 registered attendees
- B3 **Discussion Meeting:** 568 attendees, 56 prepared, plus 89 spontaneous contributions
- The AP.B3 had 7 contributions
- B3 Workshop **"Safe Working in Substations"** : 70 attendees

Paris B3.46 Workshop – August 31

"Safe Working in Substations"

- 70 attendees
- combined into 8 working teams



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B3 Working Group Meetings in Paris

WG.B3.34: Expected impact of future grid concept

WG.B3.38: Management of risk in substations

WG. B3.43: Contemporary solutions for low cost substations

WG.B3.45: Application of non-SF_6 gases or gas-mixtures in MV and HV GIS

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

WG.B3.49: Review of substation busbar component reliability

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

SF_6 Green Book

B3 Current and Future Meetings and Events

AP. B3 Substation Conference – Hunter Valley Nov-Dec 2019

Chairing IEEE Power and Energy Society in Victoria

Contribution to IEEE standards

Future B3 meetings:

- 2019 Symposium in Chengdu, China - with C6; and also B5, C1, C3, and D2
- 2021 Symposium in Bucharest, Romania – with A2
- 2023 – New Delhi, India or Cairns, Australia?

Other Future events:

- IEC Conference on UHV AC/DC Trends – Hakodate, Japan April 23-26, 2019
- Conference on Condition Monitoring – Bucharest, Romania Sept 7-13, 2019

B3 Deliverables

B3 has 26 active WG's, 3 recent Technical Brochures, with the Substation Green Book now published and available for sale or download:

- ü TB 723 "SF_6 Measurement Guide" WG 40
- ü TB 734 "Management of Risk in Substations " WG 38
- ü TB 740 "Contemporary Design of Low Cost Substations in Developing Countries" WG 43

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AP.B3 New WG Members

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

Bill Carman as Correspondent Member

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

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

Created a Mirror Panel for WG.B3.53 in AP comprising: Robert Li, Dan Tang, Michael Verrier, Kerry Williams

WG.B3.54 Earthing System Testing Methods

Stephen Palmer WG Convener

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

Crina Costan: as Correspondent Member

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

Todd Margitich: Member

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

Perry Tonking as Correspondent Member

Australian Contributions to WG.B3

Adams	Bob	Full Member	M	WG B3.43
Addison	Gabriel	Young Member	M	WG B3.43
Arora	Nipun	Young Member	M	WG B3.43
Carman	Bill	Convener	M	WG B3.35
Carman	Bill	Corresponding	M	WG B3.52
CHEANG	Andrew	Full Member	M	WG B3.38
Cole	Peter	Corresponding	M	WG B3.48
Costan	Crina	Corresponding	F	WG.B3.55
Dantalis	James	Corresponding	M	WG B3.47
KLEPAC	Angela	Full Member	F	WG B3.38
KRIEG	Terry	Corresponding	M	WG B3.43
KRIEG	Terry	Corresponding	M	WG B3.46
KRIEG	Terry	Corresponding	M	WG B3.47
KRIEG	Terry	Corresponding	M	WG B3.49
Laubi	Andreas	Corresponding	M	WG B3.50
Lee	Terry	Full Member	M	WG.B53
LI	Yi	Corresponding	M	WG B3.47
LOPEZ-ROLDAN	Jose	Full Member	M	WG B3.24
Margitich	Todd	Full Member	M	
MCCORMACK	John	Corresponding	M	WG B3.39
Palmer	Stephen	Secretary	M	WG B3.35
Palmer	Stephen	Convener	M	WG B3.35
Perkins	Derek	Corresponding	M	WG.B3.53
QUACH	Minh	Corresponding	M	WG B3.39
RAYAPROLU	Ram	Corresponding	M	WG B3.39
Ridgley	Matthew	Corresponding	M	WG B3.42
Tonking	Peregrine	Convener	M	WG B3.43
Tonking	Peregrine	Corresponding	M	WG B3.46
Verrier	Michael	Corresponding	M	WG B3.48
Verrier	Michael	Member	M	WG.B3.53

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Presented by John Wright-Smith

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B4

DC systems and power electronics

2018 Paris Session

SC B4 Activities During 2018 Paris Session

- B4 Poster Session – Monday 27 August
- Technical Session – Tuesday 28 August
  - AP B4 Submitted three interventions.
- Study Committee Meeting – Friday 31 August 2018
  - 80 attendees, including 23 out of 24 Regular Members.
  - Presentations from all Working Group Convenors (19 WGs).
- B4 cooperated in two tutorials
  - B4 & CENELEC Workshop: “System aspects of HVDC grids” on Wednesday 29 August; and
  - A3 & B 4 Workshop: “DC circuit breakers” on Thursday 30 August.

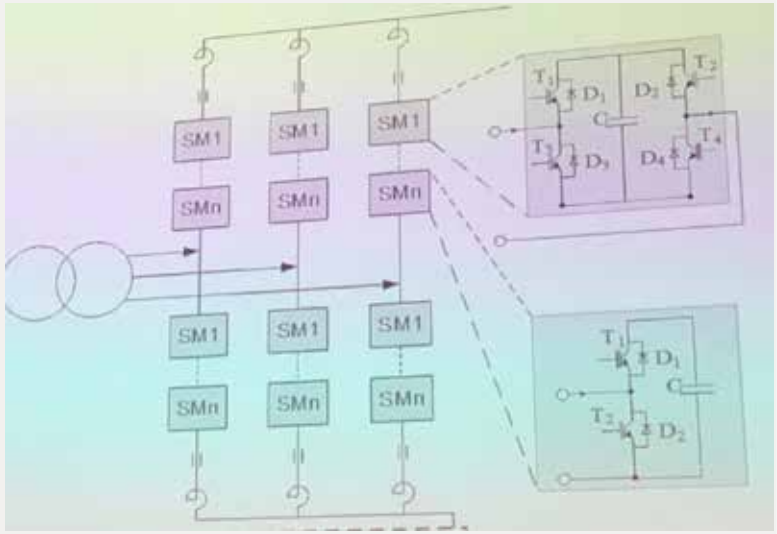
Other Observations

- Continued strong interest in HVDC.
- Bigger exhibition hall with more interaction.
- Much talk about DC applications at lower voltages as well as pushing the voltage limits for larger point to point applications.
- A lot of exhibitors related to HVDC, FACTS and MV DC

2018 Paris Session

Increase in Voltage Source Converter (VSC) Applications

- Increasing number of HVDC and VSC projects underway for a variety of applications, across the globe.
- Things are getting big! A 5GW VSC transmission project currently being developed in China.
- Innovative control strategies applied to VSC projects to support weakening AC transmission systems.
- Innovative ways to make long distance VSC transmission using overhead lines more viable including:
  - Development of DC circuit breaker technology;
  - Applications utilising a combination of full bridge and half bridge sub-modules or poles to minimise cost and lower losses;
  - Applications combining LCC and VSC converters (for the same reasons).
- Relevance to Australia:
  - Potential applications for use of VSC technology for increased interconnection.
  - Increased viability of very long distance overhead line DC transmission, for long interconnectors or to connect very remote generation sources to the load centres.



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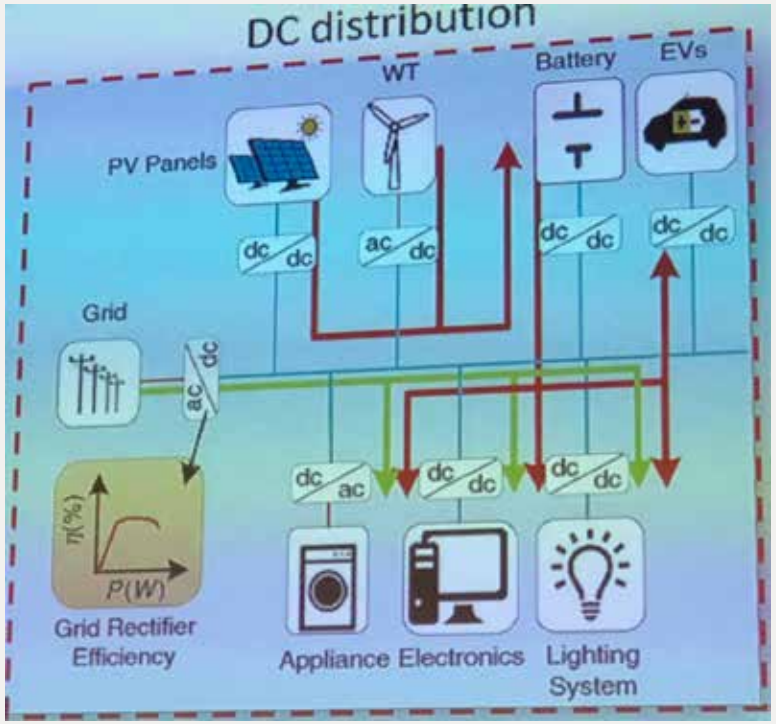
2018 Paris Session

Increased Focus on Medium Voltage DC Applications

- B4 change in name “DC” instead of HVDC.
- A new joint working group with C6 to investigate “Medium Voltage DC distribution systems”.
- Point to point applications at “medium” DC voltage – for example, Angle-DC project in the UK converting 33kV AC line to ±27kV, 30.5MW DC.
- Distribution applications, seeking to connect both AC and DC loads directly to DC generation through the distribution network. Pilot project in China - Tangjia Bay - ±10kV and ±375V distribution levels.
- Potential applications in Australia include:
  - Supply to smaller or remote islands in Asia-Pacific region.
  - Potential to get more capacity out of existing single or two wire AC networks through conversion to DC application.
  - Micro or Mini Grid applications for direction connection of DC generation including Renewable energy and storage.



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2018 International Activities

HVDC Compendium

- An online compendium of all in-service HVDC systems around the world.
- Provides data sheets on more than 100 HVDC projects globally

FACTS Green Book

- CIGRE has produced a series of “text book” style references, referred to as the “Green Books”.
- B4 is preparing their first, on the topic of Flexible AC Transmission Systems (FACTS).
- Scheduled for completion end of 2019.

Performance Surveys

- HVDC survey carried out every two years since 1970.
- SVC/STATCOM performance survey outcomes first reported in 2017.
- Provides a good reference for HVDC, SVC and STATCOM availability, reliability and operational performance.

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2018 AU/NZ Activities

AP B4 submitted three interventions during Paris 2018

Key Contributions of AP B4 Members to the FACTS Green Book Under Development

Representative on the AP B4 Advisory Group (AG-01)

VSC HVDC Common Terms Document:

- AP B4 Convenor assigned to develop a “Common Terms and Description” document for VSC HVDC technology including the topology, definitions, symbols as well as configurations.

AP B4 Convenor assigned to be Special Reporter for 2020 Paris Session

Participation on International Working Groups and Task Forces:

- Task Force TF B4.77 – “AC Fault response options for VSC HVDC Converters”
- JWG C6/B4.37 – “Medium Voltage DC distribution systems”

Annual AP B4 Meeting held in Melbourne on 12-13 November 2018

2018 Deliverables

Technical Brochures

- TB 713 - Designing HVDC Grids for Optimal Reliability and Availability performance.
- TB717 - Protocol for reporting operational performance of FACTS
- TB739 - Protection and Local Control of HVDC grids

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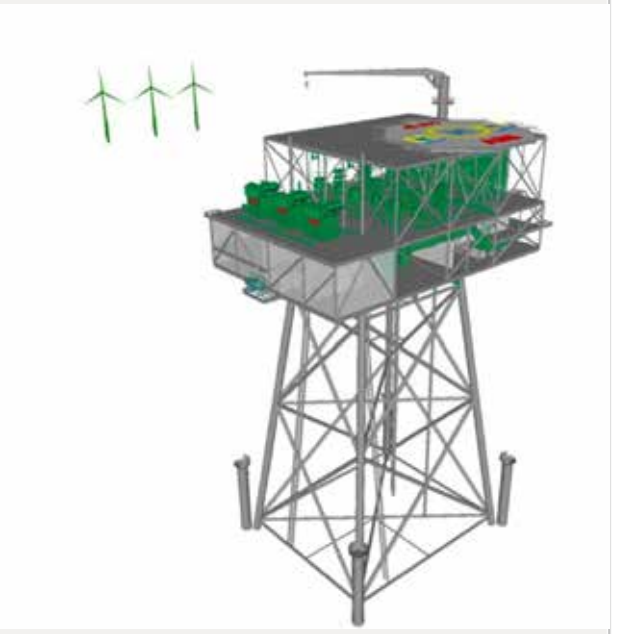
AP B4 Activities – Relevance to Australia and NZ

- HVDC, particularly Voltage Source Converters (VSC), can play a key role in the development of the power system in Australia, with opportunities to apply this technology to:
  - ü Transmission interconnection between states and regions;
  - ü Long distance transmission from bulk generation / renewable energy sources; and
  - ü Off-shore wind farms.
- Research and development into operation of HVDC links as Virtual Synchronous Machines (VSM) and recent projects where HVDC links are being controlled to be “seen” to perform just like AC links (but with the other benefits that HVDC and VSC provide as well) make HVDC interconnection a viable option for Australia.
  - ü Australia has representation on TF B4.77 “AC Fault response options for VSC HVDC Converters”



Source: CIGRE TB370 p89

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AP B4 Activities – Relevance to Australia and NZ

- Australia's long service experience with SVCs and STATCOMs is helping to contribute to a good reference for FACTS performance and in turn, we can use the data and experience from other countries to optimise the performance of our existing (and future) facilities.
  - ü AP B4 members are significant contributors to the new SVC/STATCOM performance surveys
- Opportunities for the application of Medium Voltage DC (MVDC) concepts within the Australia-Pacific region, including the connection of remote islands and potential for MW long distance supply to rural areas
  - ü Two AP B4 members are participating in the new JWG C6/B4.37 – "Medium Voltage DC distribution systems"

Source: CIGRE SCB4 Colloquium 2011

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B5

Protection and automation

Presented by Peter Bishop - Convener

Hobart – 15/11/2018

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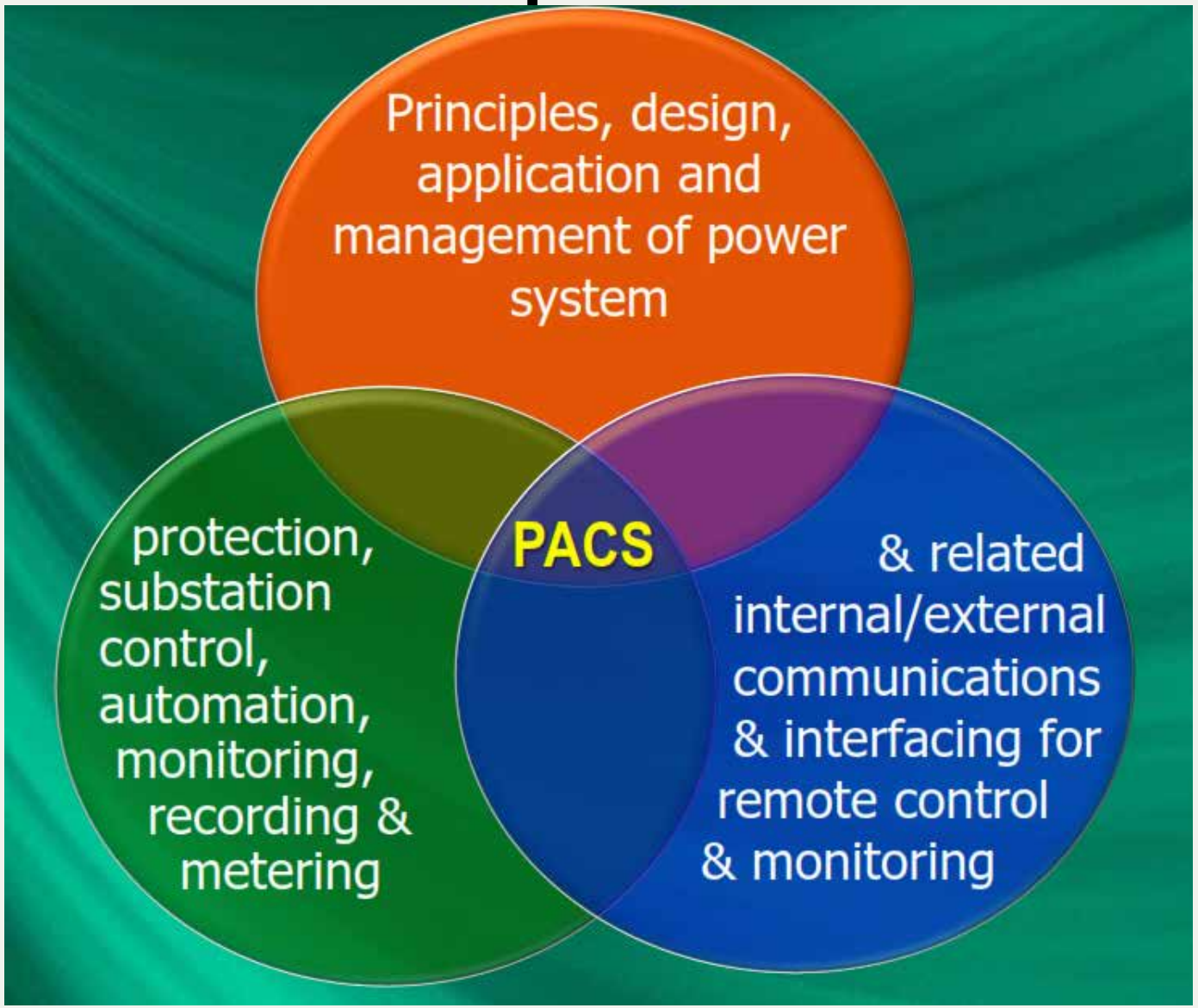
Contents

- Scope of Study Committee B5 – Protection & Automation
- Worldwide Issues at Paris impacting Protection
- Current Issues for B5 Protection & Automation Agenda
- Current B5 Working Groups
- Paris Protection Feedback
- Associated Relevance in Australia/New Zealand
- AU B5 Activities
- 2018 Deliverables involving SC B5

Study Committee B5 Scope



PACS = Protection, Automation & Control Systems

Worldwide Issues from Paris impacting Protection

- **Move away from coal** and in some cases **nuclear** generation – *Changes to power system configuration*
- Politically accelerated **move to renewable generation** including distributed energy resources – ***system protection studies*** *to deal with fault levels and voltage regulation with different power flows*
- **More interconnected systems** to meet demand and respond to events – *more* ***protection co-ordination across boundaries***
- **Data sharing** from consumers to distributors to transmission operators to generators – ***Wide area remedial action schemes*** - ***Frequency response schemes at more granular level***
- Large Weather related and power system configuration related **Power System Disturbances** with security/reliability concerns – Ensuring protection studies include correct inputs from new generation technology – **Load shedding and splitting schemes** adjust to take account of loss and distributed energy resources

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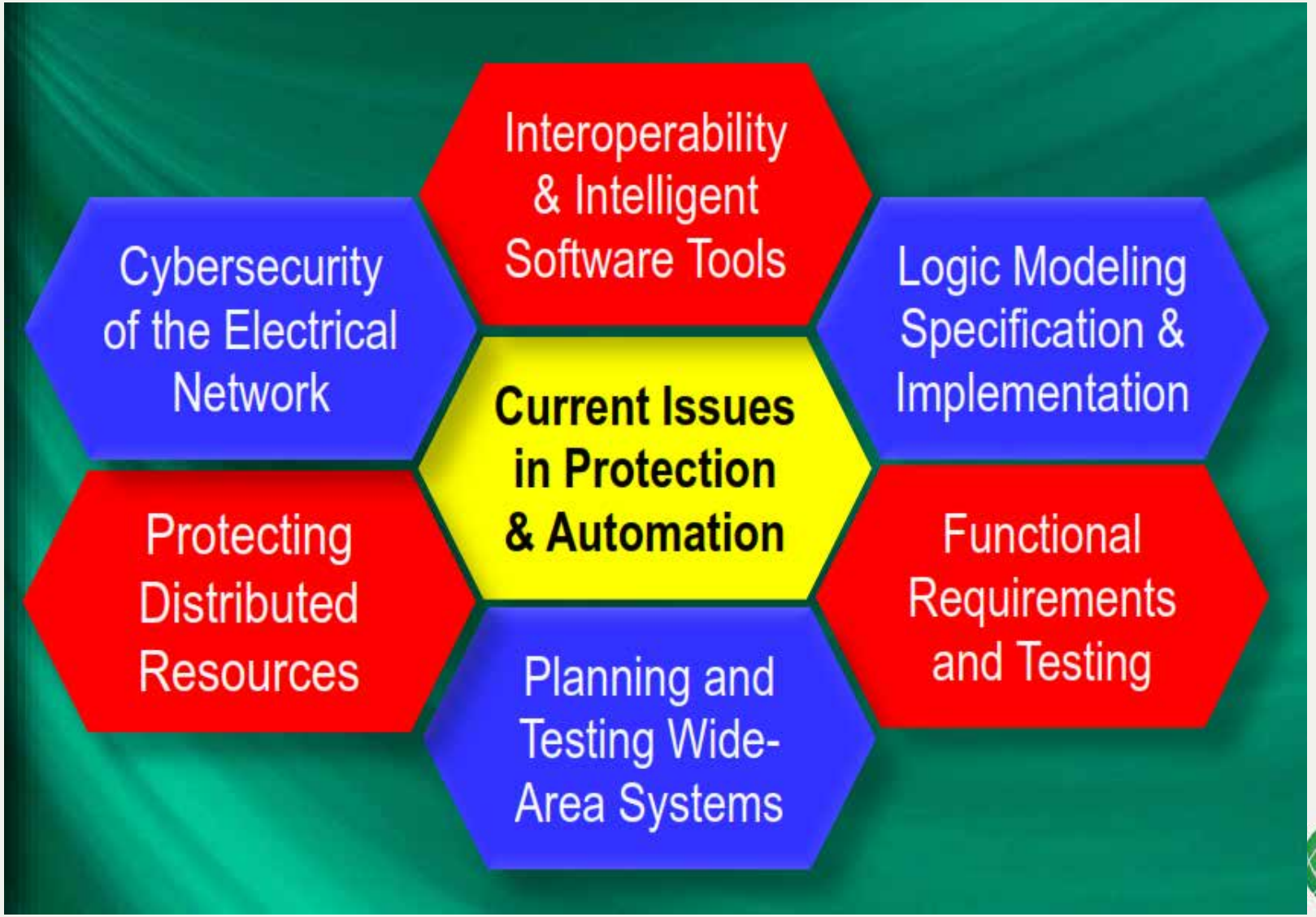
Current Issues for B5 Protection & Automation Agenda



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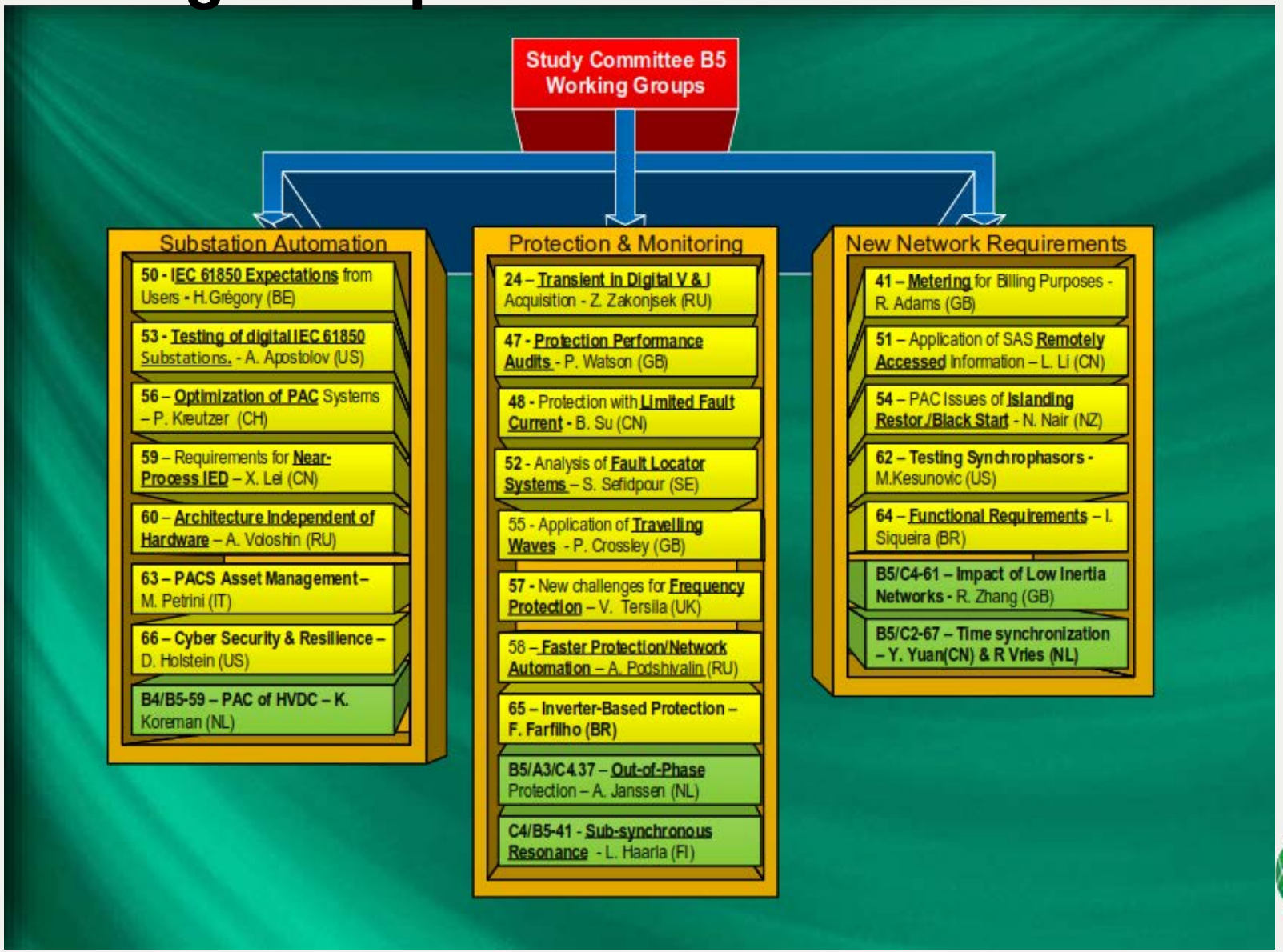
Current Working Groups



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2018 Paris Session - Protection Under Emergency Conditions

Key highlight – AUFLS challenges with Renewables

- Adjusting load to shed as distributed generation changes – Also which feeder to shed – Communications explored
- Renewables can affect frequency response and modified scheme criteria considered

Figure 1 - EDP Distribuição Energy Storage System

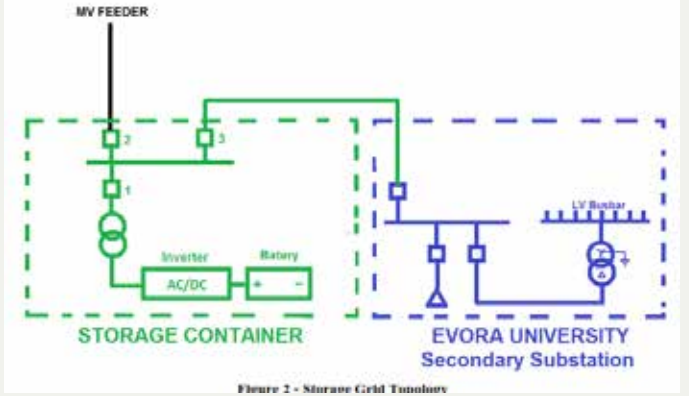


Figure 2 - Storage Grid Topology

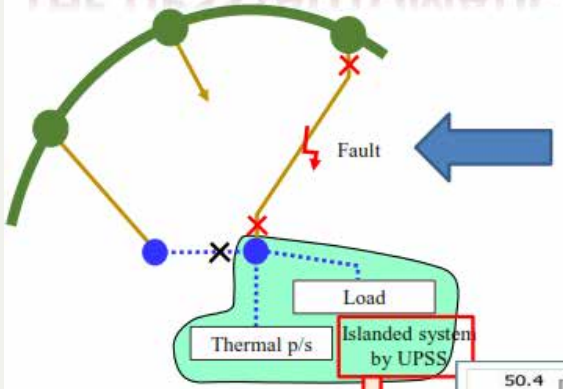
Key highlight – Considerations of Batteries to assist islanding in distribution systems

- Battery keep lights on and provides fluctuation suppression
- Auto reconnection considered
- Control can be complicated
- Size/Design to protect battery and system

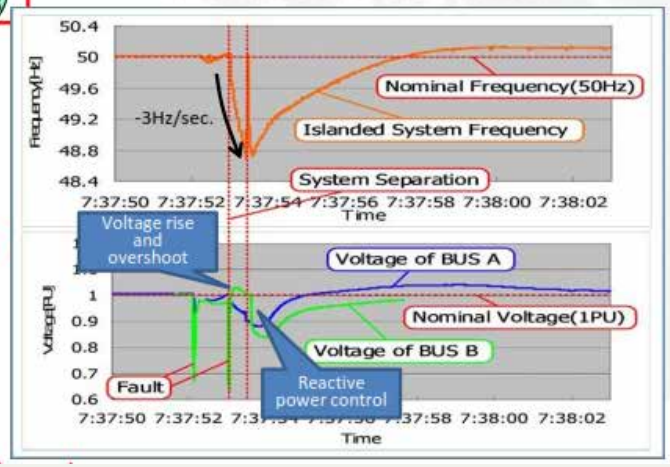
2018 Paris Session - Protection Under Emergency Conditions

Key highlight – Experience in Managing System Islanding & Reconnection

THE UPSS (AUTOMATIC ISLANDING SYSTEM)

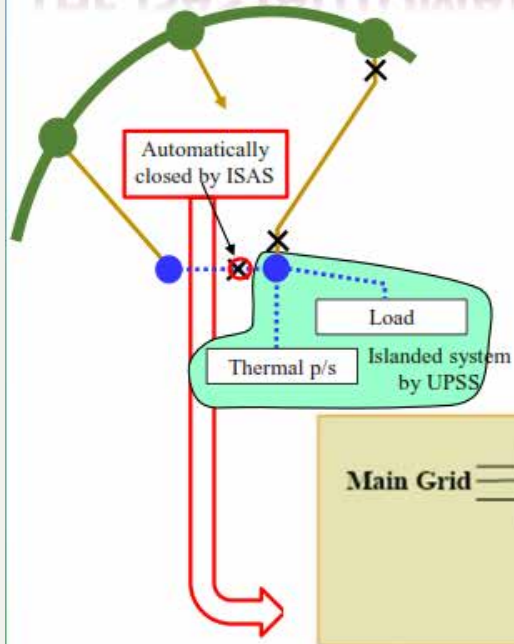


ACTUAL RECORD OF CONTROL

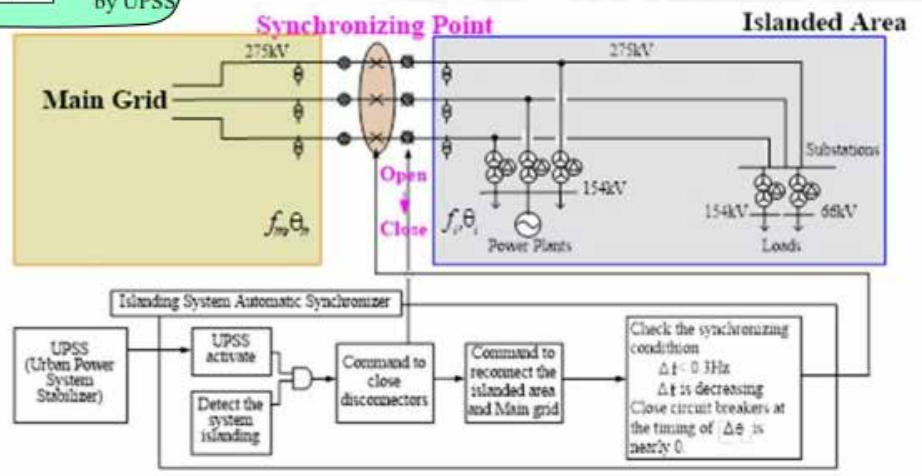


TEPCO originally developed and applied the UPSS (Urban Power System Stabilizer), an automatic islanding formation system with an important load in central Tokyo

THE ISAS (AUTOMATIC RE-SYNCHRONIZER)



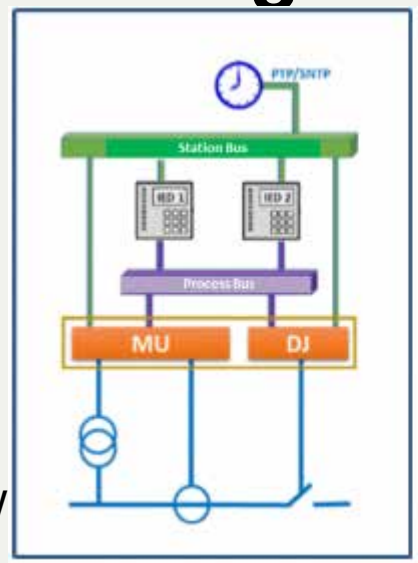
the ISAS is developed and deployed to reconnect the islanded system to the main grid automatically.

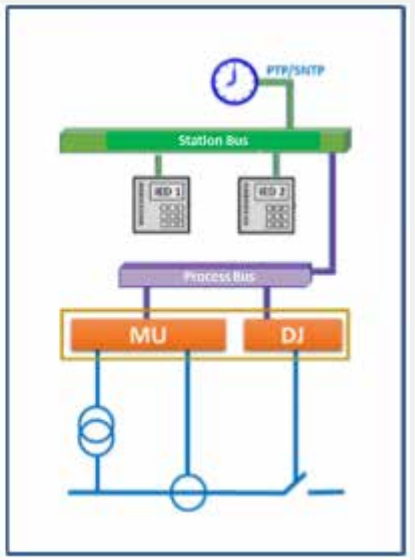


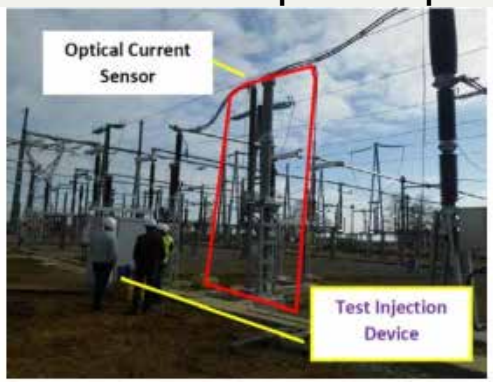
2018 Paris Session – Experience and Practice with IEC61850 Process Bus (Digital CT/VT Signals)

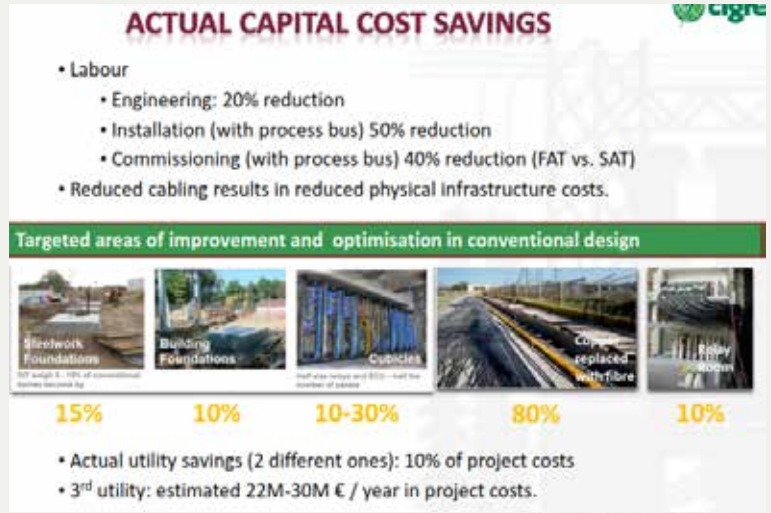
Key highlights

- Greater use of fibre for CT/VT signals to relays
- Consideration of alternative architecture practices
  - Same fibre bus for process and station signals?
- Consideration of test practice using latest standard features and with schemes comprising Optical CTs
- Consensus that generally IEC61850 fibre schemes save money compared to wired based schemes for new sites and where wires require replacing





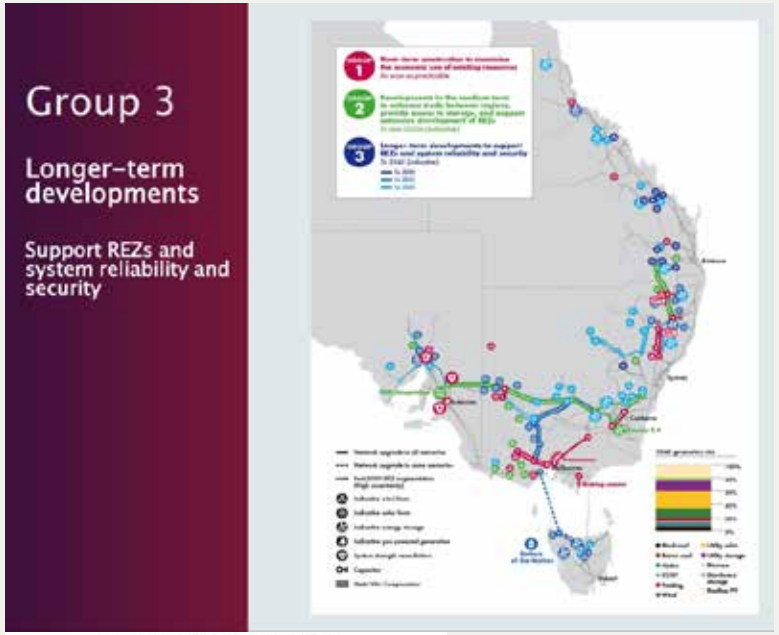




Associated Relevance in Australia/New Zealand

All Paris items discussed have an Australia/New Zealand relevance:

- 14 AUS/NZ Special Reporter Contributions were made at Paris
- Protection issues exist for increased use of renewable generation - Windfarm and Solar sites
- State/Island interconnection issues exist
- Islanding issues and events have occurred
- Automatic Under frequency load shedding challenges exist for changing distribution and grid systems
- Digital substations using IEC61850 process bus are being designed and applied



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2018 AU/NZ B5 Activities

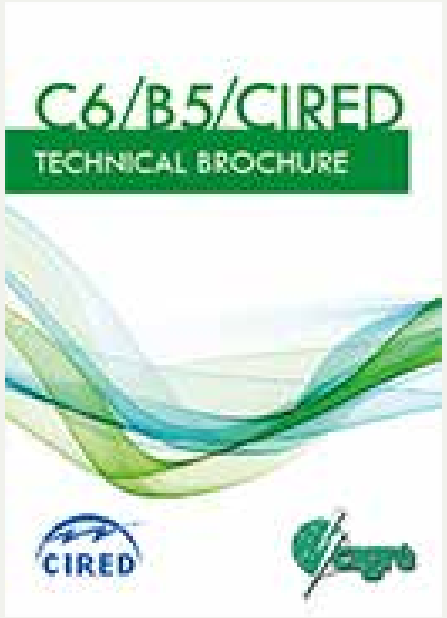
2018 Panel meeting held in Christchurch NZ

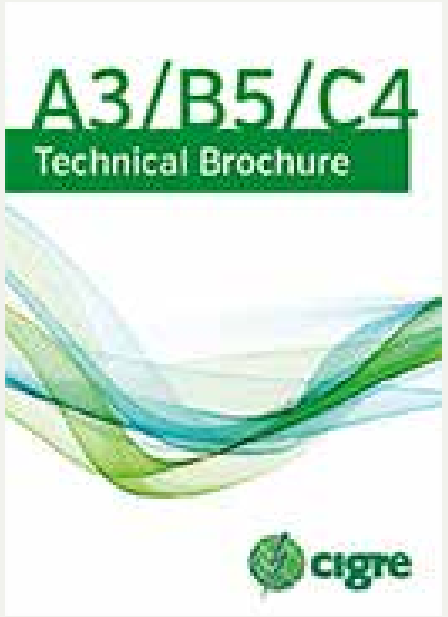
- 21 representatives attended
- 14 AU B5 working group representative updates given
- Planned for AU B5 2019 SEAPAC conference
- Reviewed Paris Special Reporter Questions
  - Developed 14 AU contributions for Paris
- Shared local issues
  - Commissioning of Transgrid's first Digital Substation
  - Update of Snowy Hydro's 2GW Hydro generation scheme
  - Tas Network's adaptive under frequency load shedding scheme
  - Western Power's MMS wide area control scheme
  - Southern Australia and NZ plans for Future Power System
- Technical visit to Lancaster Park site affected by 2011 Christchurch Earthquakes

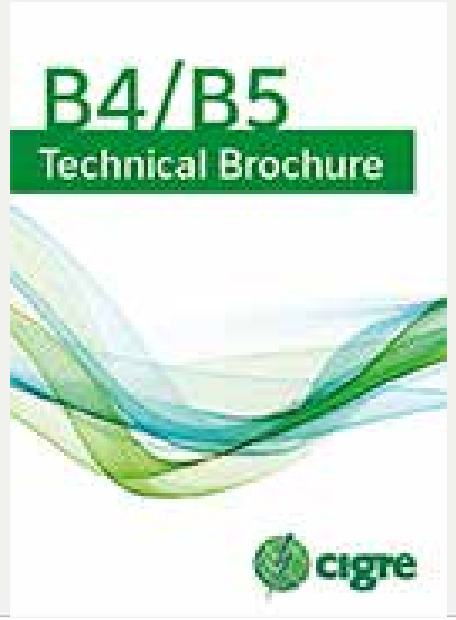
2018 Deliverables

Technical Brochures

- JWG C6/B5/CIRED TB 711 - **Control and Automation Systems for Electricity Distribution Networks of the Future**
- JWG A3/B5/C4 TB 716 – **System Conditions for and probability of Out of Phase.**
- JWG B4/B5 TB 739 – **Protection and Local Control of HVDC Grids.**







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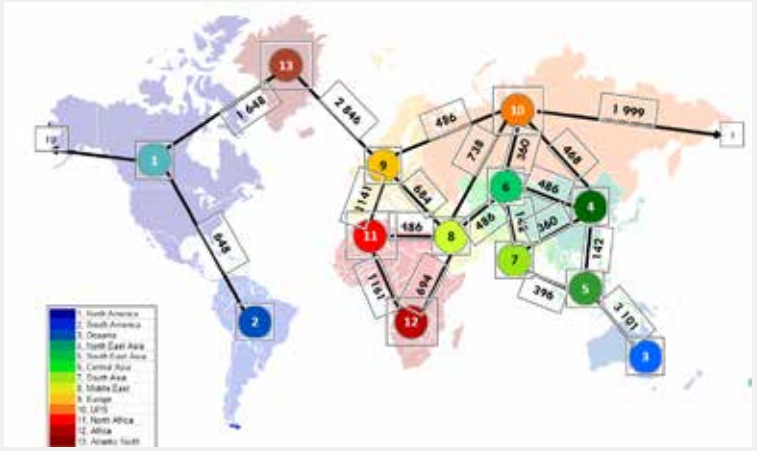
Hobart – 15/11/2018

2018 Paris Session

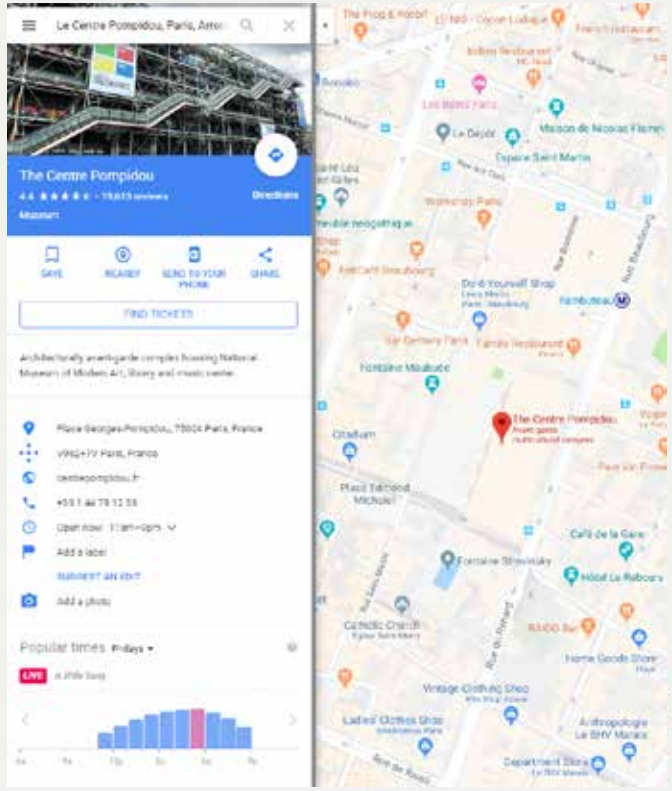
SC C1 tutorial on the pre-feasibility study of a global electricity network

- **Cigre is the only organisation with the global reach to be able to develop the input data needed for such a study.**
- **The working group includes 27 power system planning experts coming from 17 countries covering all the continents.**

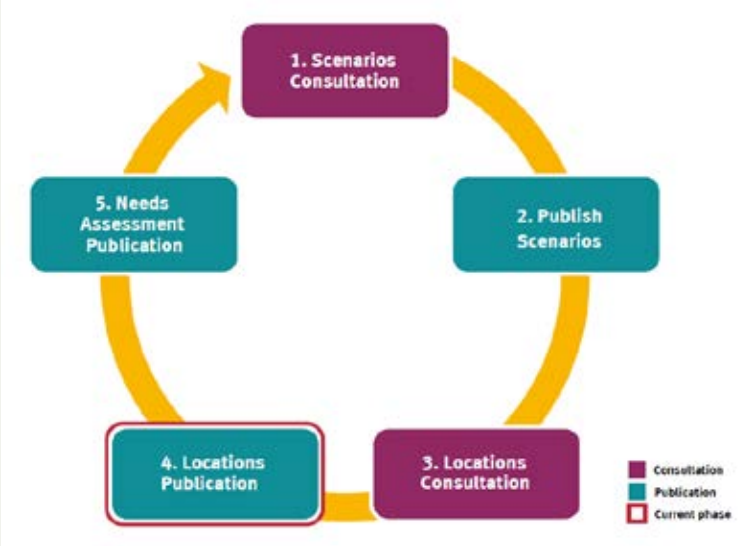


Forecasting mobile electricity demand

- **Paper on “Using SMARTPHONE GPS data to characterise Destination EV charging demand”**
- **NZ: EV demand at new inland port**
  - Heavy transport hub?
  - Long distance travellers?
  - Inland Port Staff?



2018 Paris Session

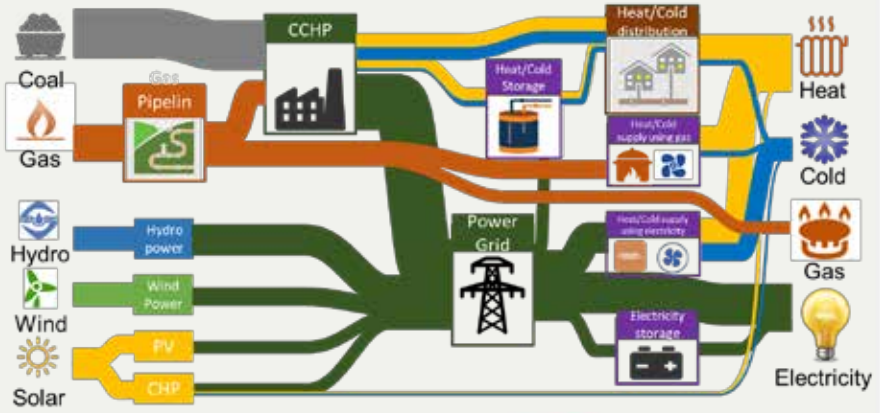


Importance of Stakeholder consultation

- Several countries reported Instances where consultation provided unexpected benefit
- NZ: Stakeholders concerned with fault levels for grid reconfiguration

Coordinated planning across multiple energy systems

- Chinese presentation
- Relevant for decarbonisation strategies



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2018 International Activities

Green Book on Asset Management underway

- Graeme Ancell is a co-editor
- NZ contributors
- Looking for Australian case studies in general and for aging assets specifically

Future working groups (in development)

- Follow-up from C1.35 (Global Electricity Network)
- Review evolving existing and new expansion planning tools to include the value of distributed generation and customer flexibility
- Methods to extract the value from high penetration of EVs, customer storage and demand response
- Requirements for asset analytic systems

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2018 AU/NZ Activities

AUC1 Meeting in Hobart this week

Australian/New Zealand participation

- **WG C1.22: Investment decisions in a changing and uncertain environment – Cynthia Liu**
- **WG C1.23: Transmission Investment Decision Points and Trees - Graeme Ancell**
- **WG C1.34: ISO Series 55000 Standards: General Process Assessment Steps and Information Requirements for Utilities – Marshall Brenton**
- **WG C1.38: Valuation as a comprehensive approach to asset management in view of emerging development**
- **WG C1.39: Optimal power system planning under growing uncertainty -Herath Samarakoon, Christian Schafer**
- **Green Book on Asset Management**

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2018 Deliverables

Upcoming Technical Brochures

WG C1.22: New investment decision processes and regulatory practices required to deal with changing economic drivers (Dec 18)

WG C1.23: Transmission investment decision points and trees management in view of emerging development (Early 19)

WG C1.33: Interface & Allocation Issues in multi-party and/or cross-jurisdiction power infrastructures projects (Dec 19)

WG C1.34: ISO Series 55000 Standards: General Process Assessment Steps and Information Requirements for Utilities (May 19)

WG C1.35: Global electricity network feasibility study (May 19)

WG C1/C4.36: Review of the Metropolitan area power system development trends taking into account new generation, grid and information technologies (Oct 19)

WG C1.38: Valuation as a comprehensive approach to asset (Jun 19)

WG C1.39: Optimal power system planning under growing uncertainty (End 2019)

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2018 Paris Session

Opening Address by Audrey Zibelman (AEMO)

- Huge changes being seen across most aspects of the power system
- The power system is becoming a platform for consumers to transact across, not just be passive recipients of a service
- Australia is a postcard from the future

Large Disturbance Workshop

- South Australia blackout provided insights into both technical learnings from the event, and the policy and market repercussions as well
- Having both aspects of the same event presented was commented on favourably

2018 International Activities

C2 Group Discussion Meeting

- Ø45 papers with over 360 attendees
- Key themes of relevance to Australia
- ØImproving operations across TSO/DSO boundaries
- ØChanging operational responses under reduced inertia conditions
- ØApplications of PMUs to assist operational actions

C2 Tutorial on TSO/DSO interaction and co-ordination

- ØOver 250 attendees

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2018 AU/NZ Activities

A focus has been getting more AP C2 members involved in WG activities

- Each new WG this year has a different Australian participant
- Technology now facilitates greater level of participation than previously – but timezones remain a challenge

Panel meeting was held in Adelaide on 16 October

- Increasing involvement from DNSPs

In 2019 will be looking for opportunities for joint activity with other Panels

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2018 Deliverables

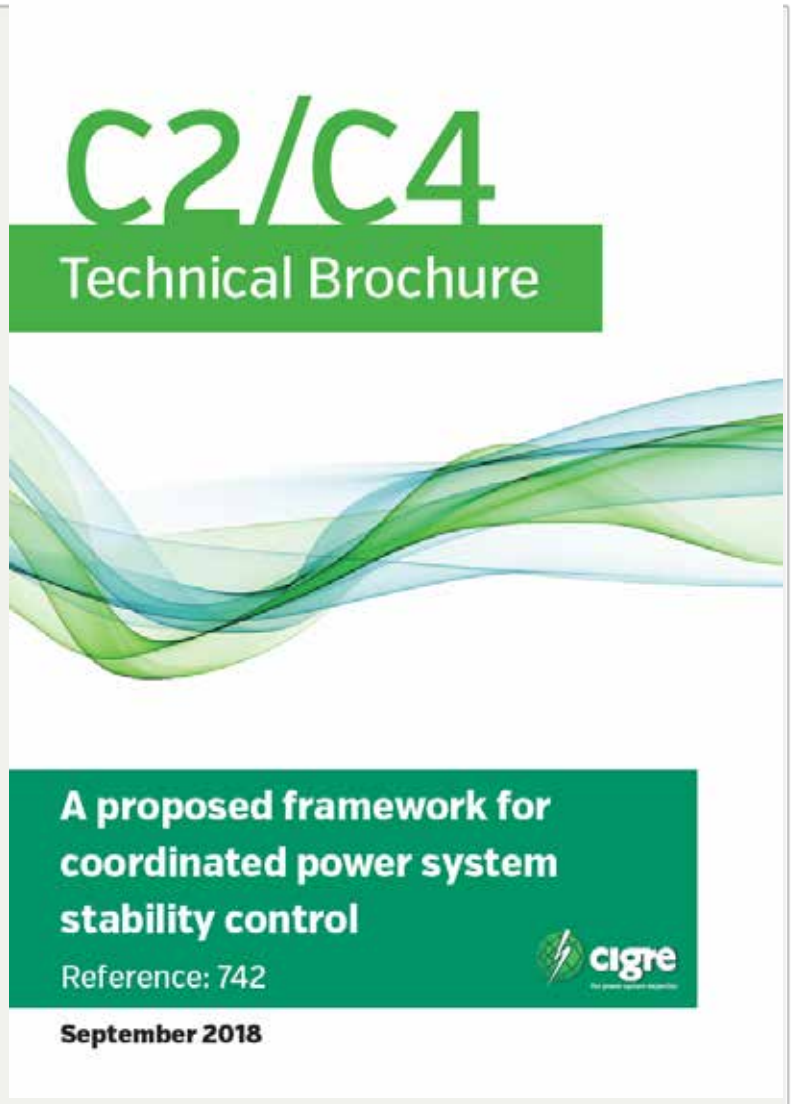
Technical Brochures

TB712 – System Restoration Procedure and Practices (WG C2.23)

TB732 – Advanced Utility Data Management and Analytics for Improved Operation Situational Awareness of EPU Operations (JWG D2/C2.41

TB733 – System Operation Emphasising DSO/TSO Interaction and Coordination (JWG C2/C6.36)

TB742 – A Proposed Framework for Coordinated Power System Stability Control (JWG C2/C4.37)



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2018 Paris Session

Working Group C3.19 – EMF Management

- Significant loss of knowledge
- Remains the key issue when opposing powerlines
- Guidelines
- Assessing exposure
- Medical implants
- Dealing with uncertainty
- Risk communication
- Reducing magnetic fields
- Common FAQs

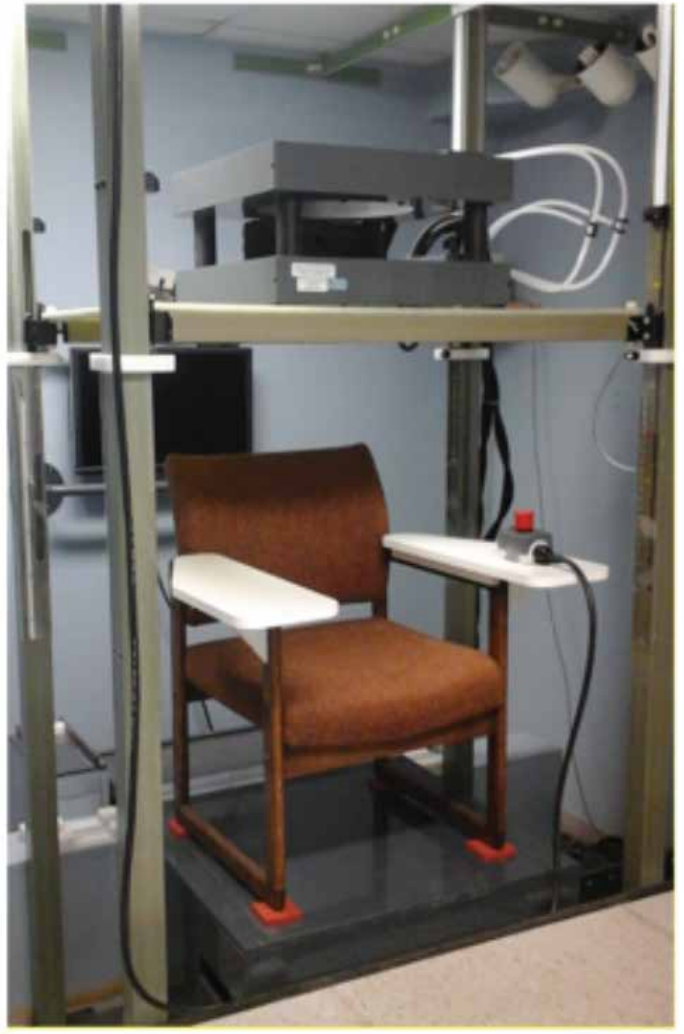

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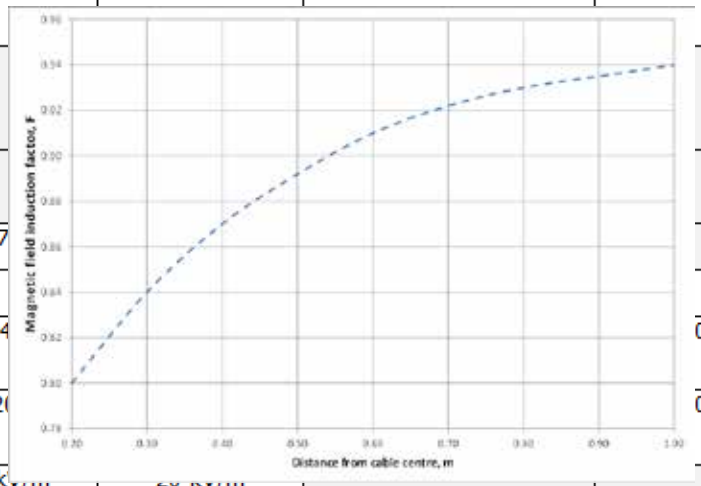
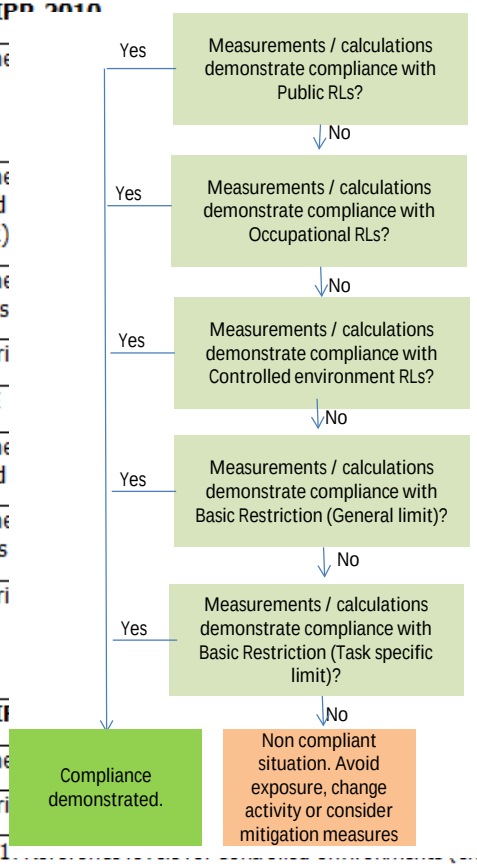
Table 4.3 Reference levels and limits for IEEE and ICNIRP

	50Hz fields reference levels			60Hz fields reference levels			Static fields limits	
	Public	Occupational	Controlled environment	Public	Occupational	Controlled environment	Public	Occupational
ICNIRP 2010							**ICNIRP 2009**	
Magne				200 uT	1,000 uT	See **Note 3**	400,000 uT	
Magne (head trunk)								2,000,000 uT
Magne (limbs								8,000,000 uT
Electri				4.167				
IEEE								
Magne (head				904			0 uT	353,000 uT
Magne (arms				63,2(			0 uT	353,000 uT
Electri				5 k				
ICNI								
Magne				83.33 uT	416.67 uT			
Electri				4.17 kV/m	8.33 kV/m			





See XX for definition of public exposure

See XX for definition of occupational exposure

See XX for definition of controlled environment

See XX for definition of Basic Restriction (General)

See XX for definition of Basic Restriction (Specific)

Note 1: [illegible] in ICNIRP 2010, however, sufficient information is provided to derive these for PNS effects only.
Note 2: Reference levels for controlled environments defined as High Action levels are included in the DIRECTIVE 2013/35/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 June 2013
Note 3: ICNIRP 2010 does not provide sufficient information to be able to calculate these

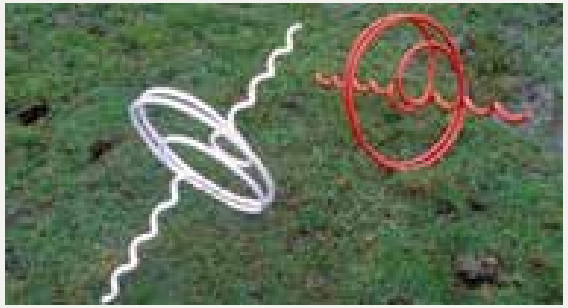
2018 Paris Session

WG C3.16 - Interactions between electric infrastructure and wildlife

- Design, construction, operation, maintenance and dismantling
- Birdlife key focus
- Type, colour, species, season and environmental characteristics












2018 International Activities

Active Working Groups

- WG C3.01 EMF and Health
- WG C3.09 Corridor management.
- WG C3.12 Methodologies for GHG inventory and reporting for T&D utilities
- WG C3.14 Impact of environmental liability on transmission and distribution activities
- WG C3.15 Best environmental and socio-economic practices for improving public acceptance of high voltage substations
- WG C3.16 Interactions between electric infrastructure and wildlife
- WG C3.17 Interaction between wildlife and emerging RES and submarine cables
- WG C3.18 Eco-friendly approaches in Transmission and Distribution
- WG C3.19 Responsible management of the EMF Issue
- WG C3.20 Sustainable development goals in the electric power sector

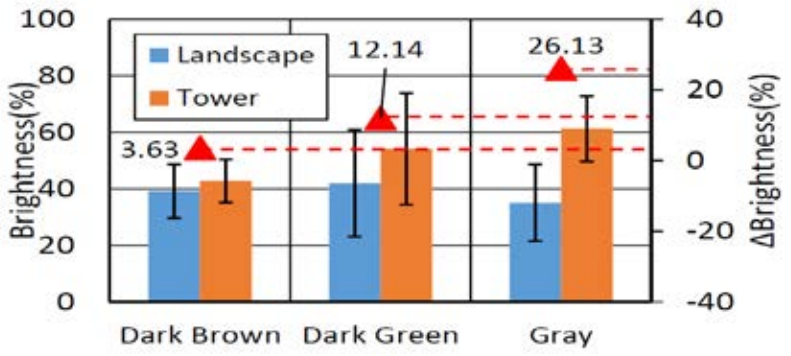


Fig. 7 Analysis of the brightness in March
Bar : SD, △: difference in saturation between the landscape and tower.

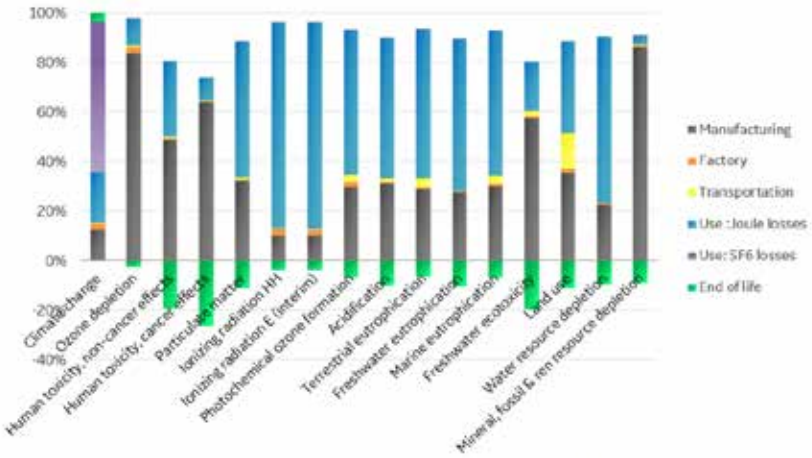


Figure 3. Life Cycle Assessment results for the F35-145kV (SF_6)

2018 AU/NZ Activities

Involvement in C3 International

- AP members active in 4 working groups

Involvement in Paris 2018

- 2 AP members present
- Special Reporter
- Convenor of Working Group

Activity in Australia

- Meeting in Sydney
- Disbanding of ENA Reference Groups
- Symposium in Cairns in 2023

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Belgium

Netherlands

Norway

Norway

Argentina

Spain

Switzerland

Sweden

Russia

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Australia

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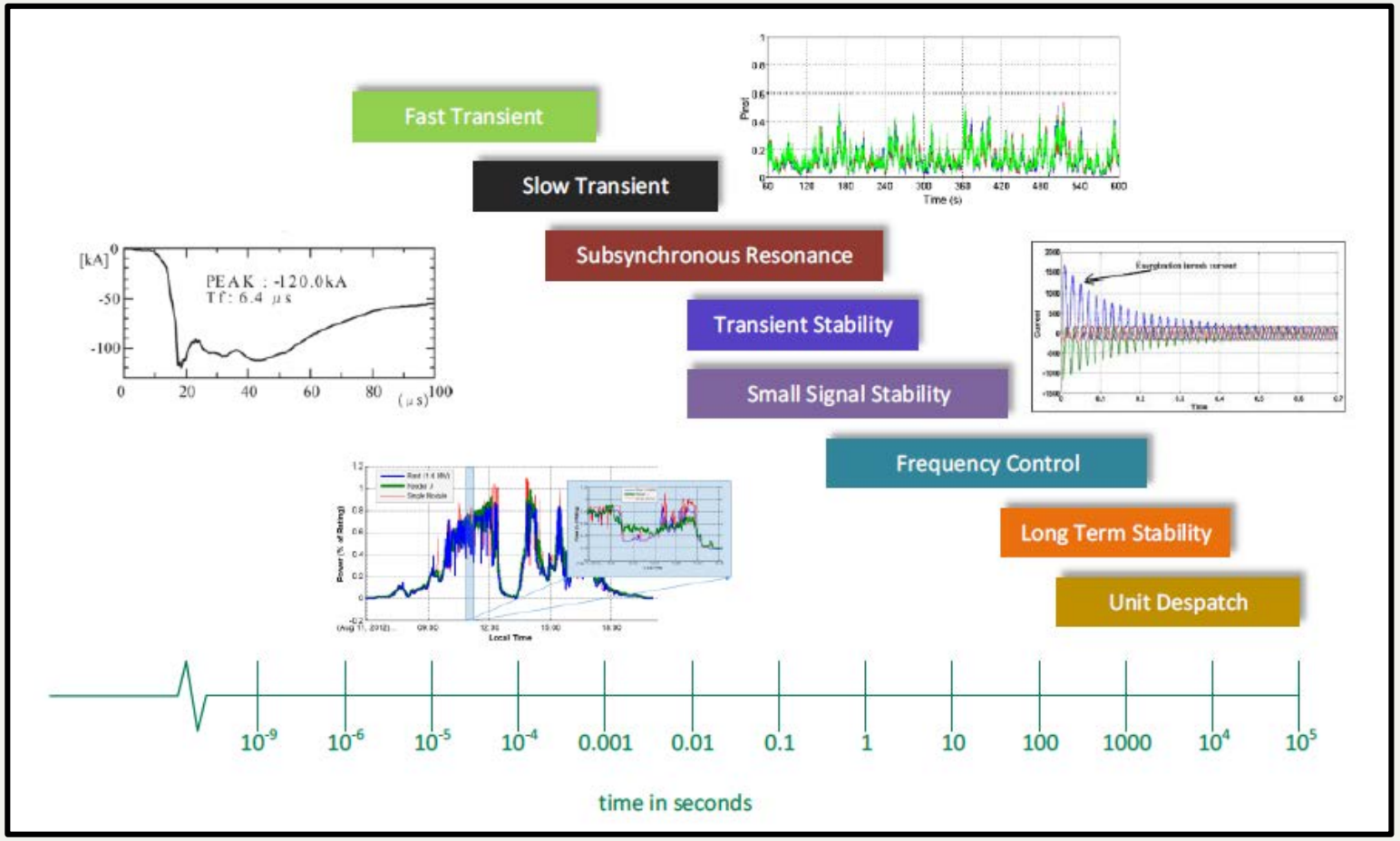
C4

Power system technical performance

SC C4 - Scope



- Power quality
- Electromagnetic Compatibility and Interference (EMC/EMI)
- Insulation Co-ordination
- Lightning
- Power Systems Dynamics and Numerical Analysis

2018 Paris Session

Highlight #1:

The role of distribution and transmission operators?

- Question from audience member during C2 Meeting.
- “Who is looking after overall grid stability?”
- Concept of joint planning and information sharing now being openly discussed as issues for many countries.
- Raises a further question: Who has all the information necessary to manage overall grid stability?
- Modelling and performance management of distributed (embedded) energy resources is already a very significant issue which will continue to develop.
- Australia is well aware of the issues and has commenced with the development of some practical solutions, e.g. ARENA project to develop an improved composite load model inclusive of PV characteristics.

2018 Paris Session

Highlight #2:

Global realisation that inertia and system strength are significant issues.

- The need for and specification of synchronous condensers is being actively talked about. An almost defunct technology is now seeing a resurgence!
- Frequency control and managing rate of change of frequency (ROCOF) are being seen as issues requiring appropriate consideration, even on continental Europe.
- How to deliver frequency control services from solar and wind farms has become a mainstream topic.
- The use of energy storage technologies (batteries and super capacitors) to supplement generation based frequency control is an idea gaining traction.
- Again, Australia is at the forefront (if not leading) developments in some of these areas, e.g. Hornsdale Power Reserve.

Not all MW are equal!

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2018 International Activities

SC C4 Working Groups (WG)

- WGs are the ‘engine room’ of CIGRE.
- At August 2018, 29 WGs involving study committee (SC) C4.
- Breakdown by sub-topic:

  Power quality, 4

  Electromagnetic Compatibility and Interference (EMC/EMI), 4

  Insulation Co-ordination, 5

  Lightning, 6

  Power Systems Dynamics and Numerical Analysis, 10

- Increasing dominance of inverter connected renewable energy systems is driving significant activity in C4.
- Australia has representatives on eight (8) WG’s at present.

				Nb Experts	
SC	Nb WG	Nb countries	Nb Positions	Nb experts	of which Nb Ladies
A1	28	40	408	301	4
A2	15	44	435	367	37
A3	9	29	189	181	12
B1	30	34	432	347	34
B2	18	44	576	385	23
B3	17	45	444	353	26
B4	17	32	460	386	38
B5	23	36	423	366	18
C1	11	36	218	196	28
C2	7	33	151	143	16
C3	8	30	149	106	33
C4	32	54	697	587	42
C5	8	32	125	106	17
C6	9	34	201	175	16
D1	25	39	626	443	38
D2	11	39	260	227	18
All SC	240	72	5470	3986	336

Stats at end of 2017:

- C4 had the highest number of people on WGs
- C4 had the most women on WGs.

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2018 International Activities

Examples of WGs with direct relevance for Australia

WG C4.23	Guide to procedures for estimating the lightning performance of transmission lines
WG C4.44	EMC for large photovoltaic systems
WG C4.47	Power system resilience
JWG C4/B4.38	Network modelling for harmonic studies.
JWG A1/C4.52	Wind generators and frequency-active power control of power systems.
JWG B5/C4.61	Impact of low inertia network on protection and control.
JWG C2/C4.41	Impact of high penetration of inverter-based generation on system inertia of networks.

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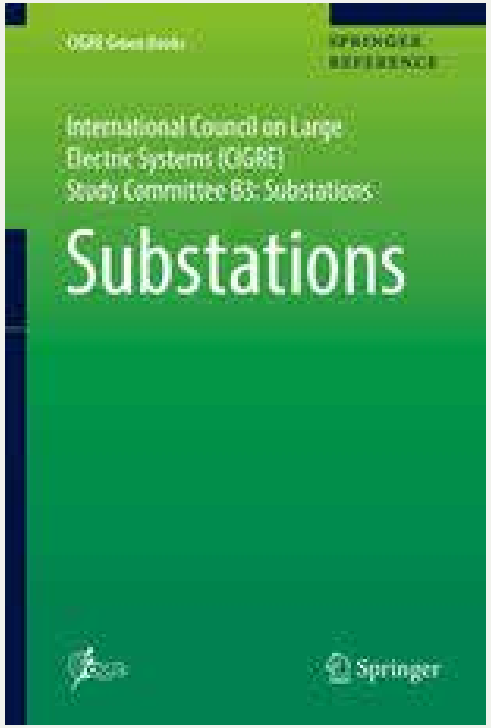
2018 International Activities

Green Books (in progress)

- Are the CIGRE flagship reference, intended to describe the ‘state of the art’.
- **“*Electricity Supply Systems of the Future*”**
  - C4 will provide a complete section on foreseeable and potential system technical performance issues.
  - Australian input to Chapter 13 “System Dynamics”.
  - Publication is due in August 2020.
- **“*FACTS Devices*”**
  - Publication is being led by SC B4
  - C4 providing specific technical input on “Commissioning tests for FACTS devices” (chapter lead is from Australia!).



2018 International Activities

Significant upcoming events

CIGRE Symposium 2019 (3-6 June), Aalborg, Denmark,

- "*Going Offshore – Challenges of the future power grid*"
- C4 is the lead Study Committee.
- Receipt of abstracts has now closed.
- Aware (so far) of one abstract accepted from Australia.
- **"Procurement of pumped storage system strength services to increase the hosting capacity of non-synchronous generation: A Tasmanian Case Study"**
- Submitted by Christopher Wembridge (Hydro Tasmania) and Daniel Fracalossi (TasNetworks).

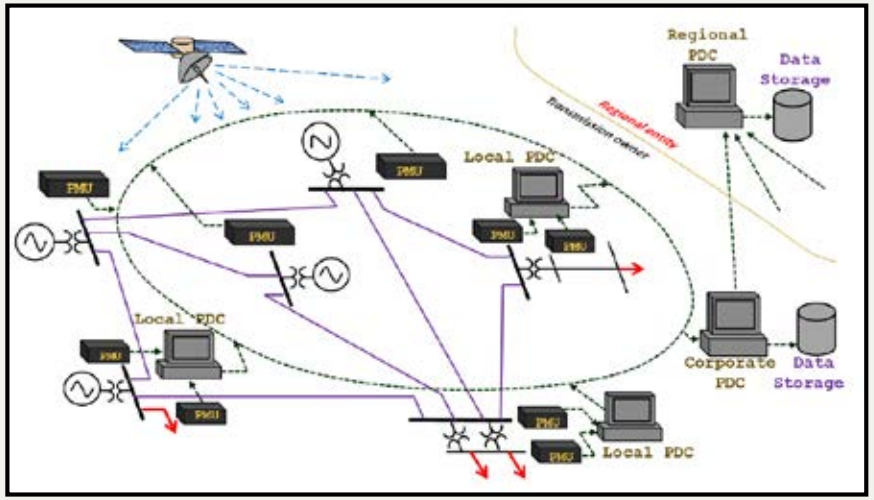
Event includes a one day tour of the ANHOLT offshore wind farm.

2018 AU/NZ Activities

(A) AU-C4 Technical Seminar – 13/14 August 2018

"Application of synchrophasor solutions for the monitoring and control of power systems"

- Held at the University of Wollongong, Innovation Campus.
- Fortunate to obtain the support of three international guest speakers from the University of Manitoba and Teshmont (Canada).
- Based on CIGRE Technical Brochure 702
- The course covered technical fundamentals together with practical applications of Phasor Measurement Units (PMU) and associated technologies including communication systems.



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2018 AU/NZ Activities

Knowledge and learnings in

Knowledge and learnings out (our experiences)

(C) Paris General Session 2018

- Five papers accepted and presented in Paris.
- Notable interest observed during SC C4 Poster Session.

(D) Ongoing contributions to WG and other industry activities

- Nineteen (19) CIGRE Australia members are represented on active C4 WG.
  - Have implemented a ‘shadow working group’ for C2/C4.41 due to the level of interest from Australia.
  - “*Impact of high penetration of inverter based generation on system inertia of networks*”.
- AU C4 members are actively involved in preparation of two ‘Green Books’
- AU C4 members continue to support the work of Standards Australia and the International Electrotechnical Commission (IEC).

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2018 Deliverables

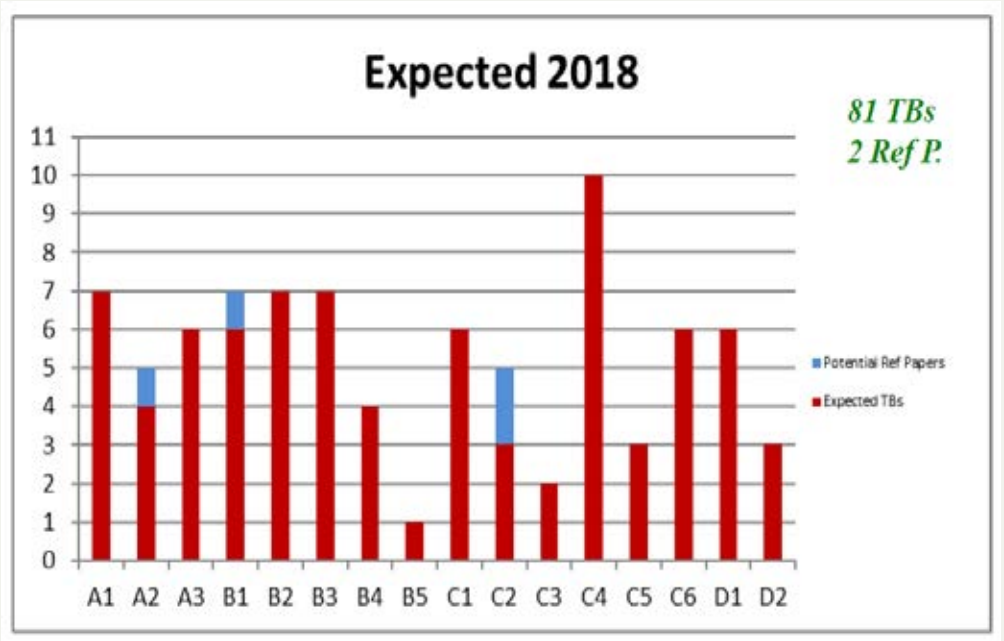
Technical Brochures (Published in 2018)

- TB 716: System conditions for and probability of out-of-phase.
- TB 718(*): Benchmarking of power quality performance in transmission systems.
- TB 719: Power quality and EMC issues associated with future electricity networks.
- TB 727(*): Modelling and dynamic performance of inverter based generation in power system transmission and distribution studies.
- TB 736: Power system test cases for EMT type simulation studies.
- TB 742: (C2/C4 JWG) A proposed framework for coordinated power system stability control

Technical Brochures (Imminent)

- TB 7XX(*): Understanding of the geomagnetic storm environment for high voltage power grids.

Planned Technical Brochure Publications for 2018



(*) indicates AU-C4 involvement

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2018 Deliverables

CIGRE Science and Engineering Journal

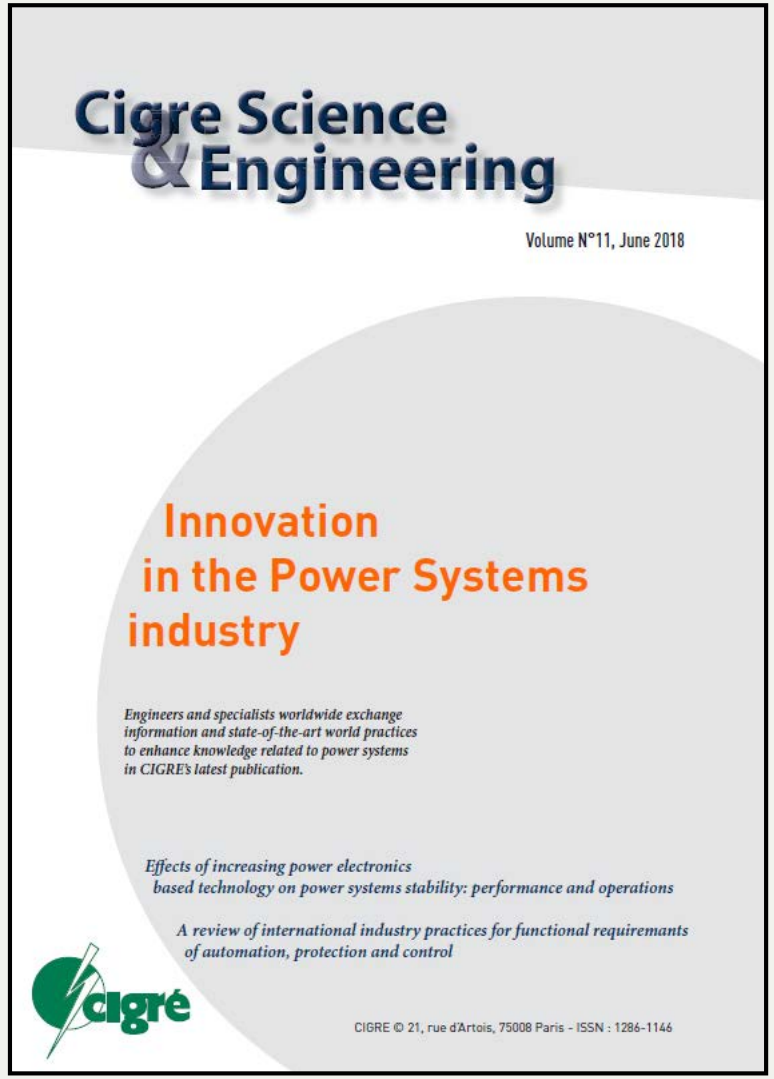
The journal is intended to broaden CIGRE's publication of scientific articles of interest to members and industry.

Access to the CSE Journal is **ABSOLUTELY FREE! @ https://e-cigre.org**

- **June 2018: Joint Publication, SC C4 and C2 (*)**

  "*Effects of increasing power electronics based technology on power system stability: Performance and operations***"**

- **Throughout 2017, ten C4 related papers were published.**
- **Expect at least this number by close of 2018, some examples:**
- System inertia and Rate of Change of Frequency (RoCoF) with increasing non-synchronous renewable energy penetration.
- Providing primary frequency response from photovoltaic power plants.
- Analysis of reduced order models representing active distribution grids in power system stability studies.



Relevant to Australia? Absolute no brainer!

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Thankyou and please enjoy your stay in Hobart.

Andrew Halley, AU C4 Convenor

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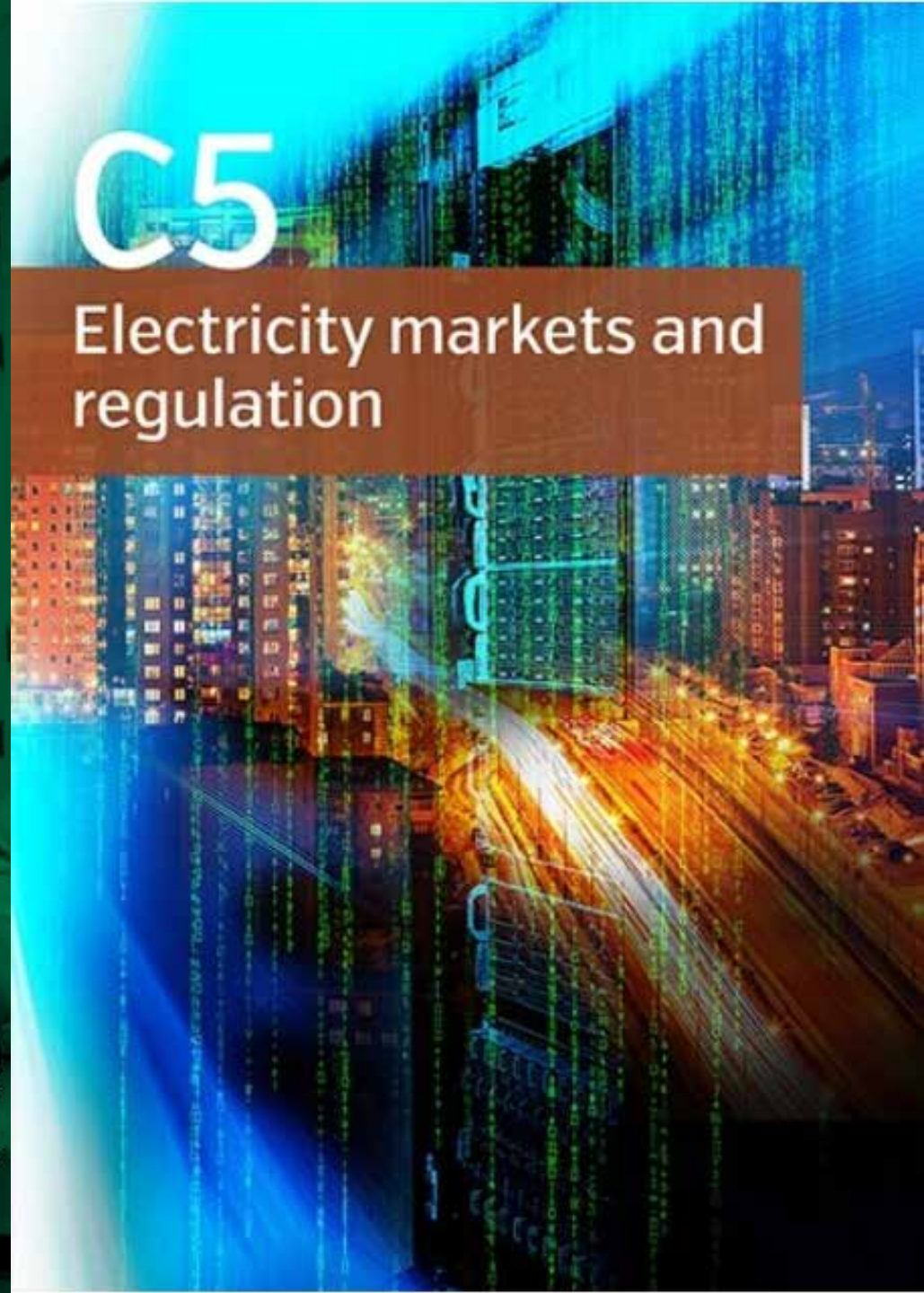

2018 Paris Session
highlights/value for Australia

Australia is not unique

- Strong recognition that in many countries existing regulatory incentives and market prices are inadequate to accommodate emerging technologies
- Australia (as we know) is no exception, even if it is at the forefront in some areas. There are many lessons to be learned about how to tackle the gap

Distribution/Transmission interface is more critical as embedded resources impact system wide and are affected by market wide outcomes

- Examples from international experience valuable for Aus debate, for example Ireland, US

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2018 Paris Session

Gate closure & settlement interval

- Lessons from other markets moving to 5 minute settlement
- The NEM is to shift to 5 minute settlement providing examples of risks and advances in software

VCR/VoLL

- The calculation and use remains an issue in the NEM and WA. Some further (if limited discussion) in Paris
- Intermittency leading to greater volatility and impacting risk is customer interruption – at what cost should generation, transmission and distribution be introduced to mitigate. Lessons from elsewhere – a still emerging topic confounded by subsidies and tariff distortions

2018 AU/NZ Activities

Primarily contributions to working groups and Paris session

- Value of customer service
- Drivers for rule change
- Integration (or not) of environmental measures

Paper for Paris Session (poster session)

- entitled ‘the evolution of embedded networks and localised markets in Australia’ (Cruickshank, Rose, Thorpe)

Interventions (3) for Paris

Contributions to market chapter for CIGRE book on power systems coordinated by P Southwell (Thorpe and Cruickshank)

Joint organiser (led by A Cruickshank) of market disturbance workshop in Paris

Annual meeting held in July in Melbourne, hosted by AEMO

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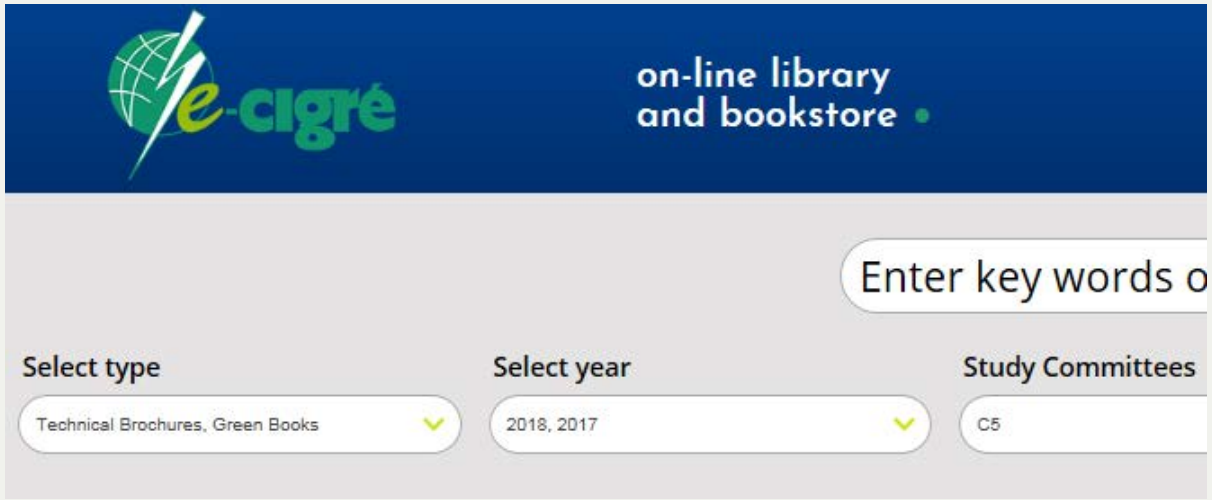
2018 Deliverables

Technical Brochures

- Cost of electric service, cost allocation methods and residential rate trends WG C5-16
- Exploring the market based value of smart grids WG C5-24
- Wholesale Market Price Caps WG C5-23



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Presented by Ray Brown - Convener

Hobart – 15/11/2018

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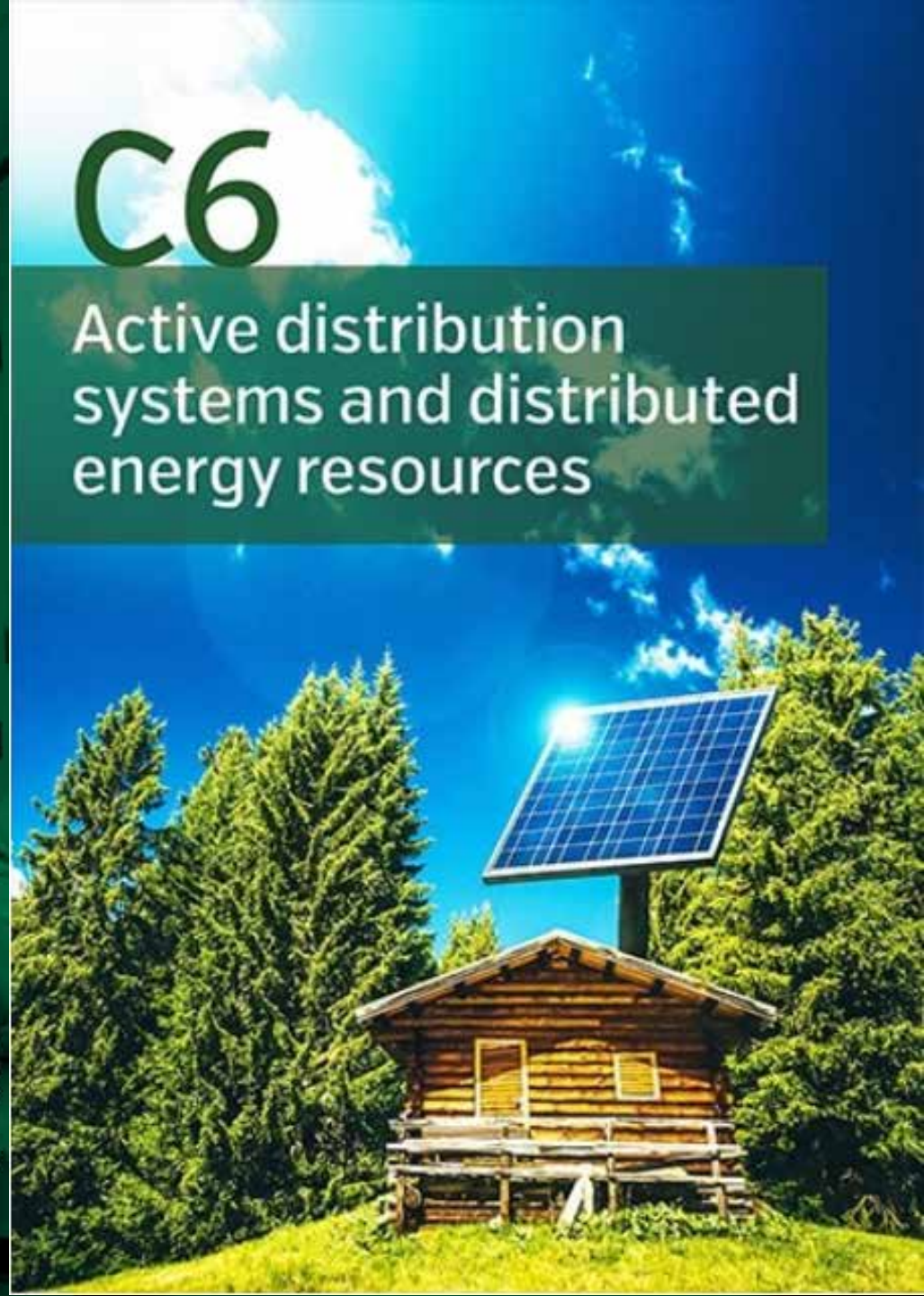


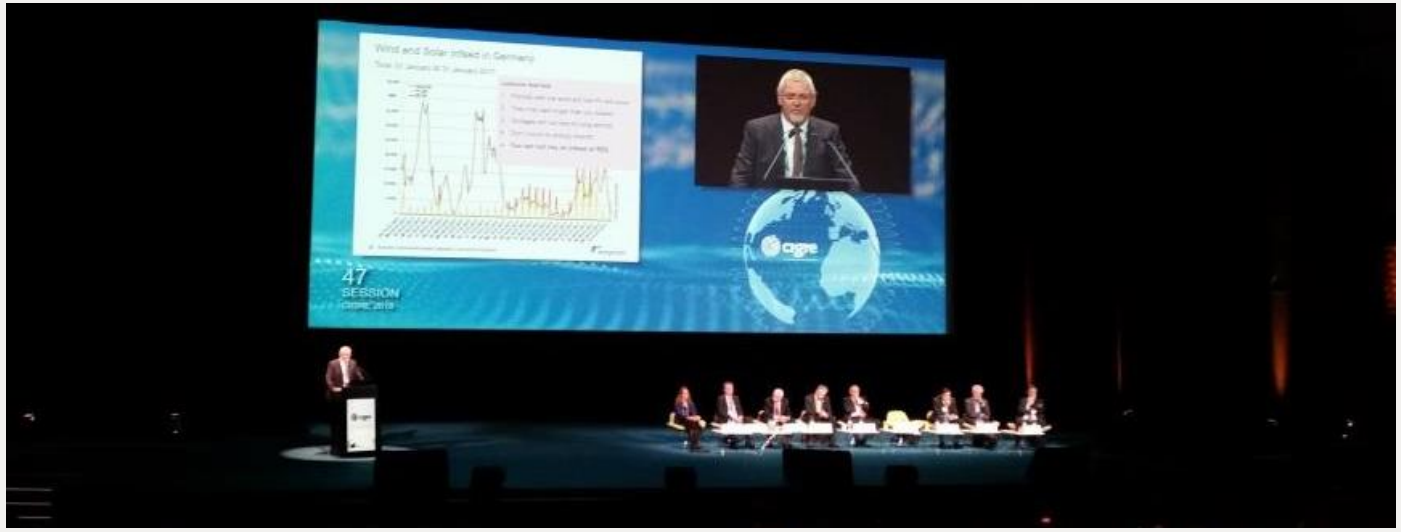
SC C6 Overview

Principal Areas of Interest

- Assessment of the technical impacts which a more widespread adoption of DER could impose on the whole energy system and of enabling technologies and innovative solutions for DER integration in active distribution networks

Main Areas of Attention

- Enabling technologies
- Innovative solutions for DER
- Storage technologies
- New approaches to configure distribution systems
- Consumer integration & empowerment
- Smart cities



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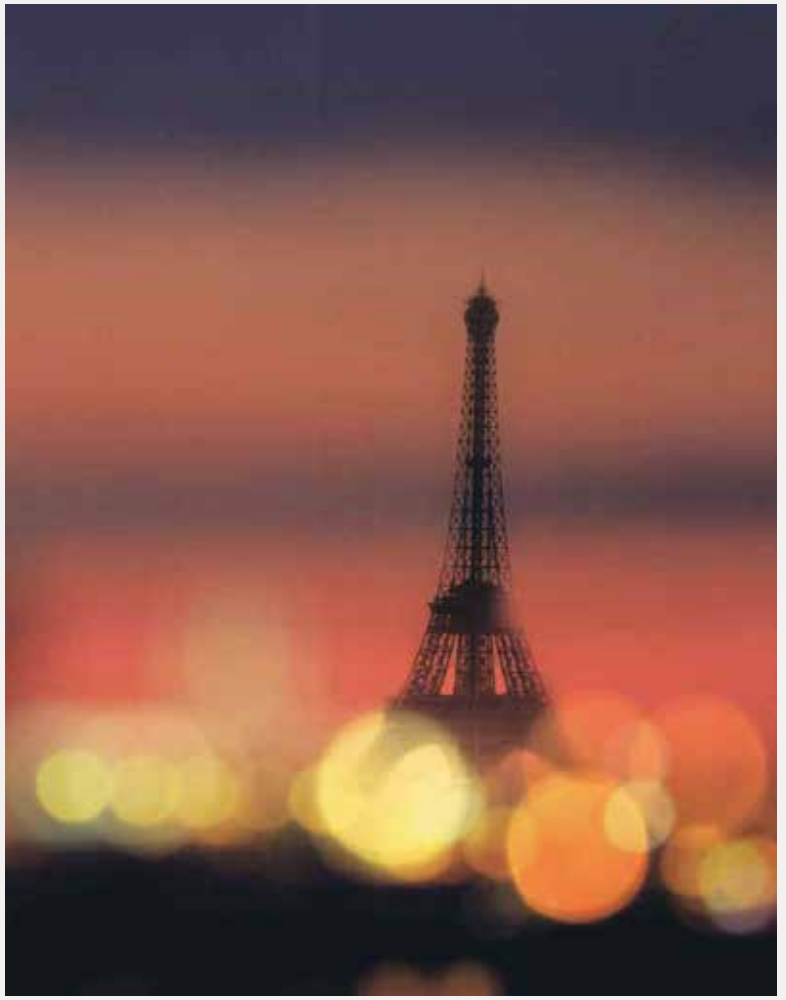
2018 Paris Session

Preferential Subjects

- Achieving Flexibility through Strategic Distribution Planning
- Energy Storage in Distribution Systems
- Intelligent Electrification for All

Tutorial

- Application of Battery Storage Systems in Distribution Systems
- Approximately 400 registrations



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2018 AU/NZ Activities

Australia Panel C6 Meeting - Perth - November 2018

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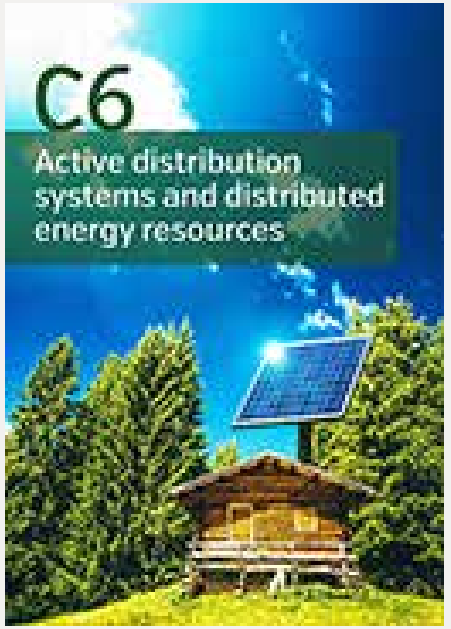
2018 Deliverables

Technical Brochures

- TB 711 - Control and Automation Systems for Electricity Distribution Networks of the Future (JWG C6/B5/CIRED)
- TB 721 - The Impact of Battery Energy Storage Systems on Distribution Networks
- TB 726 - Asset Management for Distribution Networks with High Penetration of Distributed Energy Resources
- TB 727 – Modelling of Inverter-Based Generation for Power System Dynamic Studies (JWG C4/C6/CIRED)
- TB 733 - System Operation Emphasising DSO/TSO Interaction and Coordination (JWG C2/C6)



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Upcoming Activities

CIDER 2019 - Melbourne

- 20-21 August 2019
- Pullman Melbourne on the Park

ATC Seminar 2018

CIDER 19

2nd edition of the Conference for the Integration of Distributed Energy Resources in the Asia Pacific region is hosted by the CIGRE Australia C6 Panel.

The challenge

Across the world 1.9 trillion dollars is set to be invested in DER in the next 10 years*.

As a result, power industry organisations **across the Asia Pacific region are increasingly** facing technical challenges around the integration of distributed energy resources (DER) into existing and future networks.

Get the technical solutions

CIGRE Australia, in its role as a facilitator of technical know-how and best practice, is pleased to introduce CIDER 19, the 3rd edition of the Conference on Integration of DER into our networks.

This forum facilitates practical information sharing between utilities, product manufacturers and communities. It sets out the challenges and opportunities presented by these technologies and will help us all build a road map for workable technical solutions.

*source: NAVIGANT research

Why is CIDER unique?

This event will be run with a view to addressing real world commercial and technical issues in a practical knowledge sharing environment. This means utilities and product suppliers can attend and participate, focusing on technical issues, practical technical conversations and genuine solutions.

Who should attend

- Utility companies
- Distributed energy generators/proponents
- Community/Energy stakeholders/ developers
- Industry consultants
- Academics
- Product suppliers

Exhibitors and sponsors

Companies seeking to **grow their profiles in this emerging industry will find a** high number of utility based engineers and technical leaders at CIDER. A range of sponsorship and exhibition packages for reaching these key audiences will be available.

At a glance

- Targeted 120+ delegates
- 28 papers presented in 2017
- 11 exhibitors and sponsors in 2017
- Networking dinner
- Open forum discussions

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Upcoming Activities

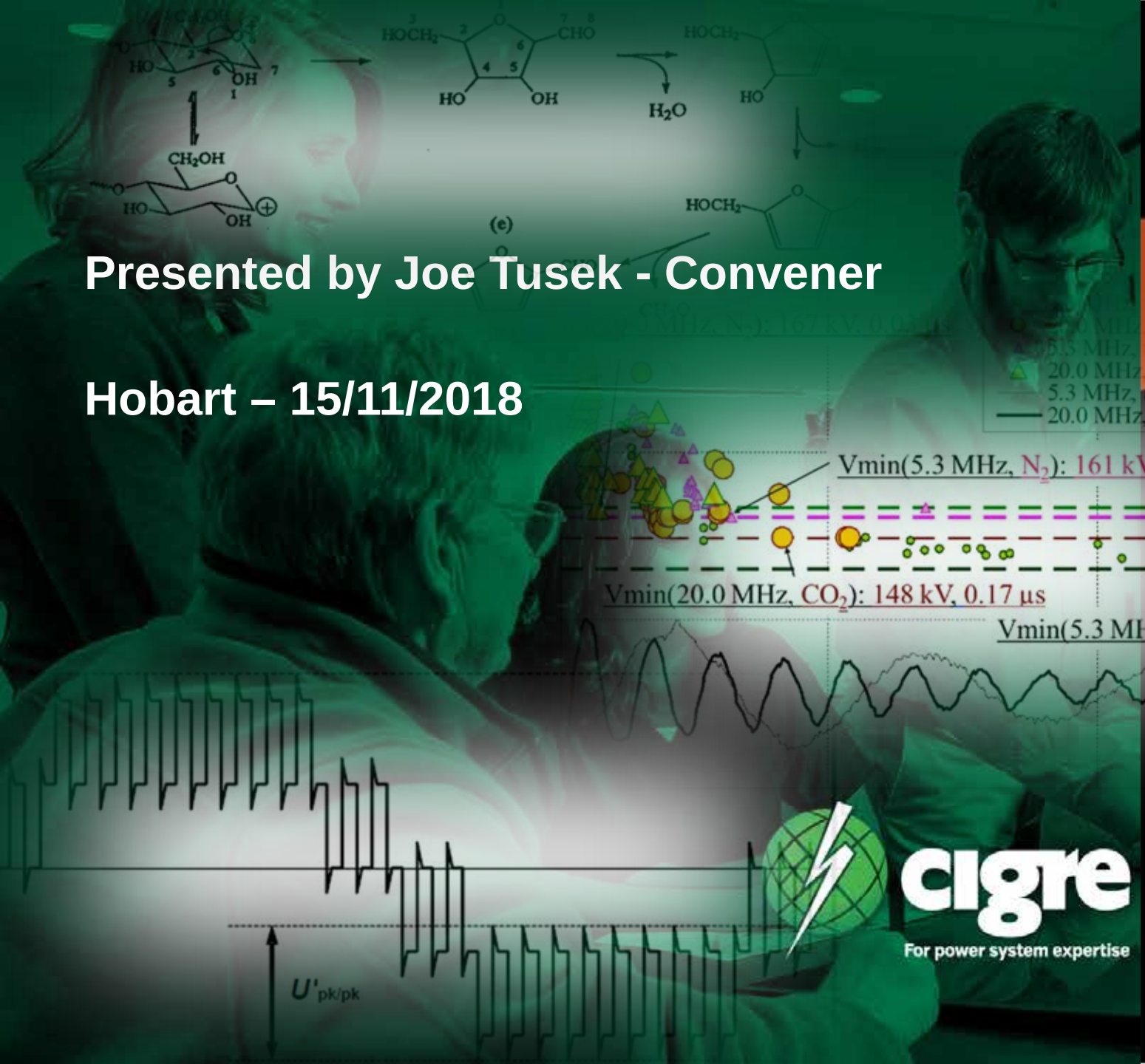
CIGRE Symposium - CIDER 2023 - Cairns

D1

Materials and emerging test techniques

Presented by Joe Tusek - Convener

Hobart – 15/11/2018



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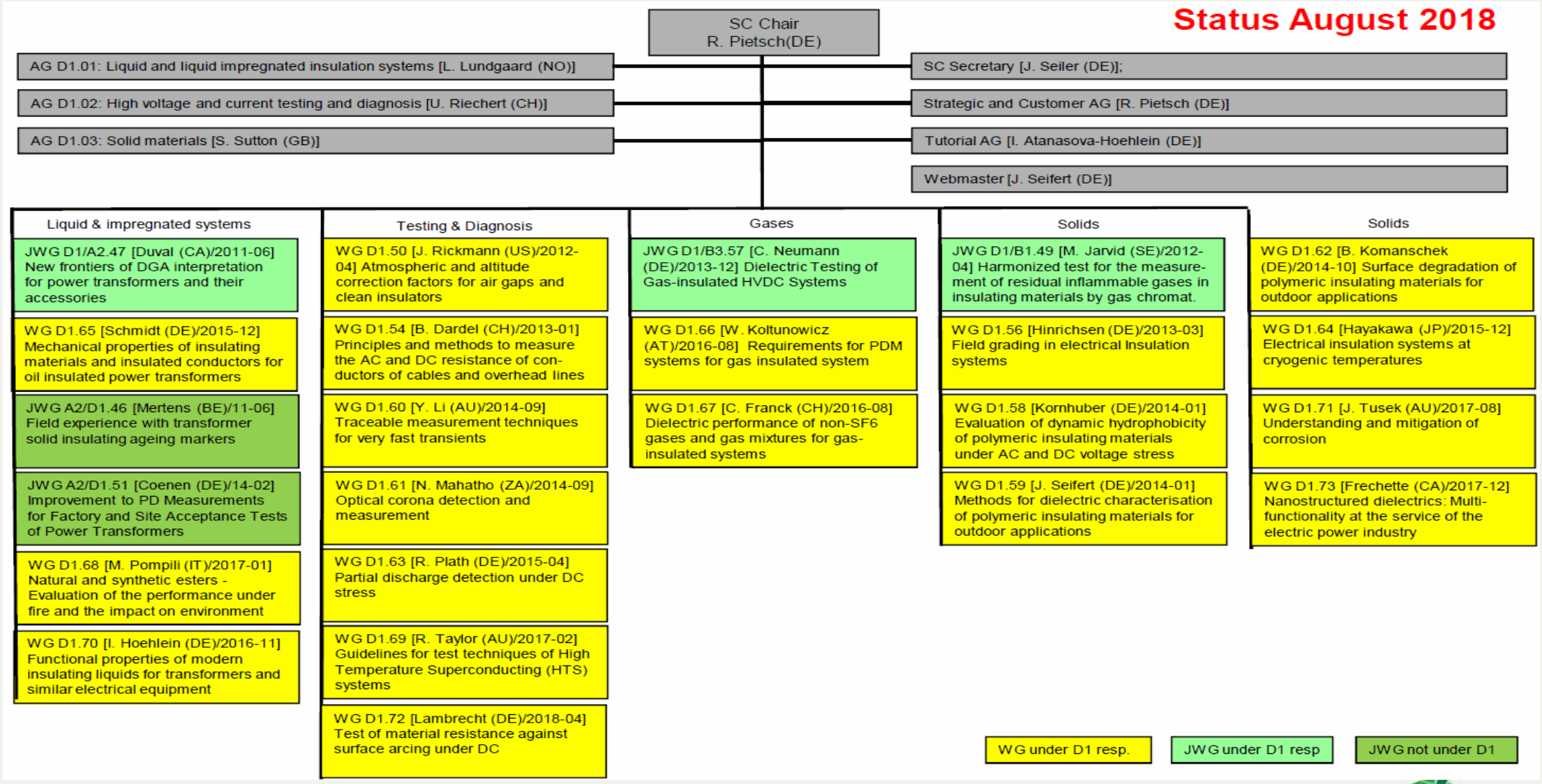
Status August 2018



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2018 Paris Session

SF6 Alternatives

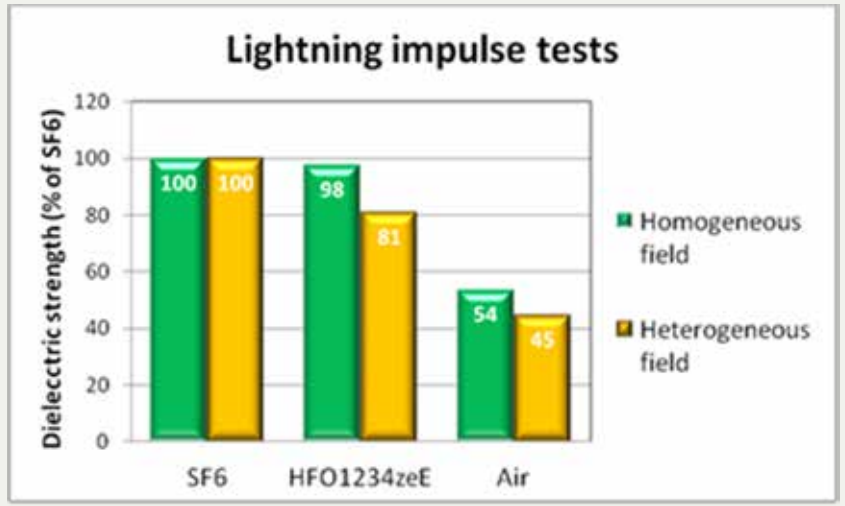
- HFO1234zeE
- $C_4F_7N/CO_2/O_2$
- C5 perfluorinated ketone
- Vacuum to 145kV heading for 245kV

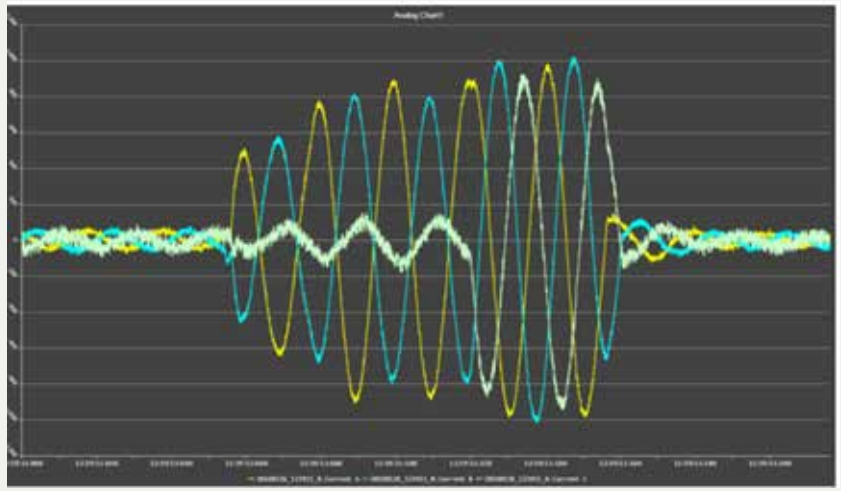
Alternative gases with GWP <1 are now being commercialised. Vacuum breaker to voltages of 145kV will be for sale in 2019. Organisations need to start thinking about gas handling and certification.

Moderate through faults directly linked to failures

- 11 high current event in 3 days
- Below protection operation levels
- Direct input into Condition Index and maintenance

Improvements to maintenance and cost outcomes through better monitoring of network currents.





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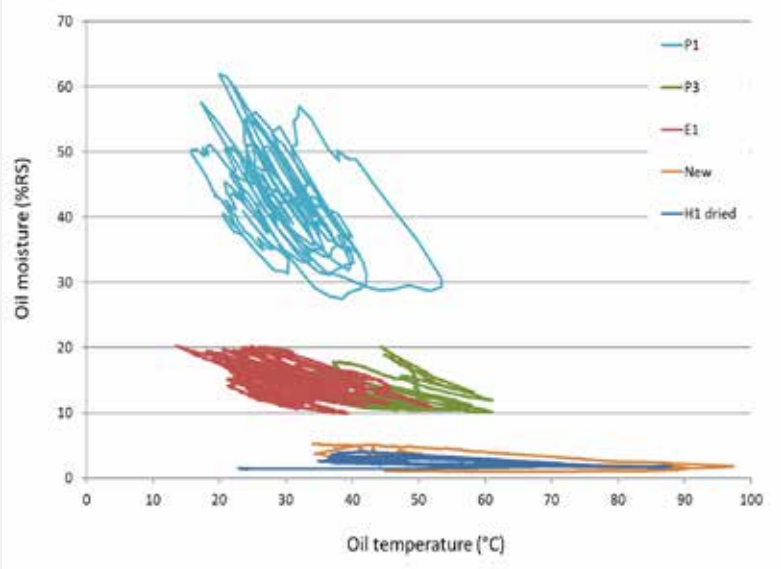
2018 Paris Session

Transformer Oil Moisture Dynamics

- New knowledge on monitoring moisture dynamics
- Capacitive moisture sensor
- Enables better control of paper/oil moisture

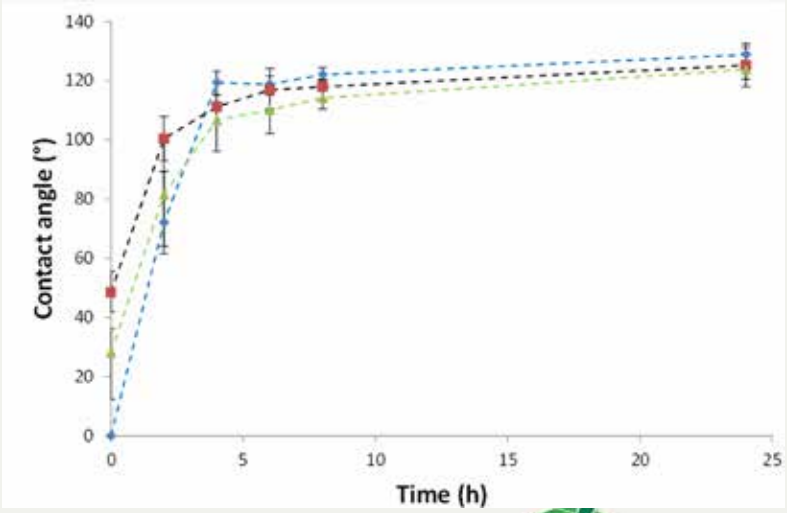
Will enable reduced moisture related degradation and risk.



Recovery of Hydrophobicity in Polymeric Insulators

- Restored properties after cleaning
- Hours

Better understanding and management of polymeric insulation.



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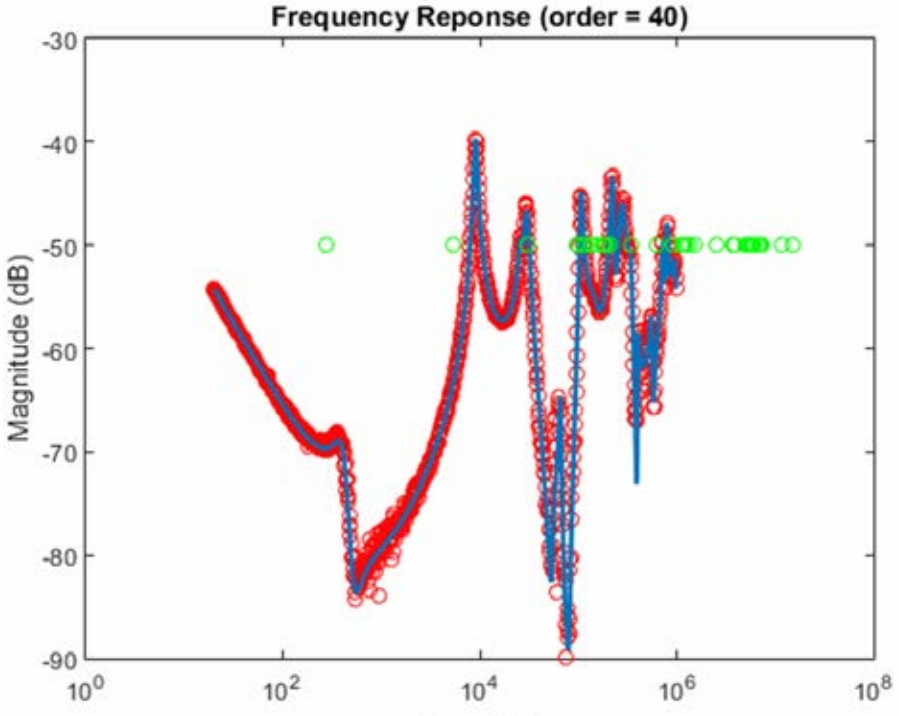
2018 AU/NZ D1 Activities



Highlight

- **Meeting held 6-7 Nov 2018 in Newcastle**
- **New developments**
  - Wooden pole condition assessment
  - DC arcing fault detection
  - Transformer Frequency Response Analysis
  - VT calibration with gas capacitors
  - Performance of DC dividers for very fast transients
- **Participating in WG's**

D1.48	**Properties of insulating materials under VLF voltages**
D1.59	Methods for dielectric characterisation of polymeric insulating materials for outdoor applications
D1.60	Traceable measurement techniques for very fast transients
D1.50	Atmospheric and altitude correction factors for air gaps and clean insulators
D1.69	Guidelines for test techniques of High Temperature Superconducting (HTS) systems
D1.71	Understanding and mitigating corrosion

- **Convenors for WG D1.60, D1.50, D1.69 and D1.71**
- **D1 is a hub for know-how in measurement, testing and diagnostics. Through a combination of industry, academia**

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2018 AU/NZ D1 Activities

D1 Papers

- ü **D1-310 Parametric Frequency Response Interpretation using Frequency Localising Basis Functions - J. Tusek**
- ü **D1-320 Steep-front impulse voltage tests on high-voltage equipment – Dr Y. Li**
- ü **A2-302 The Emerging Role of FRA as a Required Commissioning Test - J. Tusek**
- ü **C6-312 Learning from a 3.275 MW Utility Scale PV Plant Project: Update and New Remarks – Prof T. Saha.**

– **Carrying out fundamental research in FRA to eliminate most measurement errors.**

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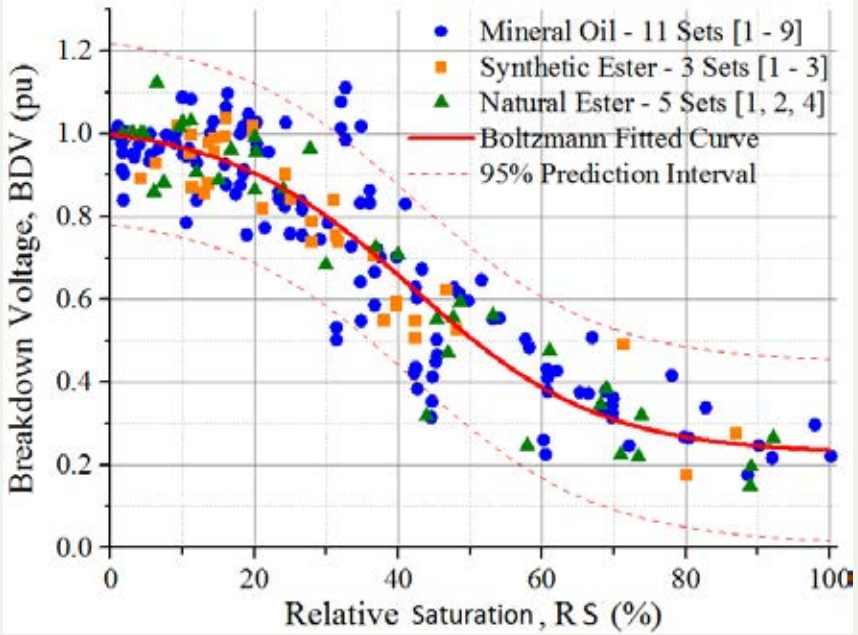
2018 Deliverables

Technical Brochures

- TB XXX – Understanding and mitigating corrosion.
- TB 741 - Moisture measurement and assessment in transformer insulation - Evaluation of chemical methods and moisture capacitive sensors - 2018
- TB 738 - Ageing of liquid impregnated cellulose for power transformers- 2018
- TB 730 - Dry air, N2, CO2, and N2/SF6 mixtures for gas-insulated systems - 2018
- TB 706 - Guidelines for the use of statistics and statistical tools on life data - 2017
- TB 705 - Guidelines for altitude correction of pollution performance of insulators - 2017
- TB 703 - Insulation degradation under fast, repetitive voltage pulses - 2017
- TB 691 - Pollution test of naturally and artificially contaminated insulators - 2017
- TB 676 - Partial discharges in transformers – 2017



D2

INFORMATION SYSTEMS & TELECOMMUNICATION

Presented by Victor Tan - Convener

Hobart – 15/11/2018

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SC D2 Overview

Purpose

- Promote the interchange of technical knowledge, information and experience between all countries in the fields of power industry telecommunications, information and telecontrol systems. APD2 also provides a forum for information sharing and representation of local issues affecting its members.

Study Areas

- **Information Systems:** EPU-specific IS areas, asset management, customer relationship, smart meter systems, situational awareness
- **Cyber security:** Security policy and standards**,** securing EPU assets, technical security controls, risks and mitigation
- **Telecommunication:** Design, planning and operation of networks, optimising current technologies, emerging technologies, high availability, networks supporting time-sensitive and other EPU applications

2018 Paris Session

Changing landscape of the Electricity Industry – impact of renewables, the agile electric utility, emerging information technologies bring new possibilities

Specific areas:

- Cyber security is continuing to be a hot topic
- Legacy integration and migration of systems
- Taking advantage of emerging technologies – SDN/NFV, Big Data, AI, ML, blockchain

2018 Paris Session D2 Highlights

Papers and Discussion Group Meeting:

- 23 papers
- >100 attendees in the Group Discussion Meeting
- 29 contributions (short comments based on paper topics)

Australia Contributions:

- Special Reporter
- 2 papers
- 3 posters

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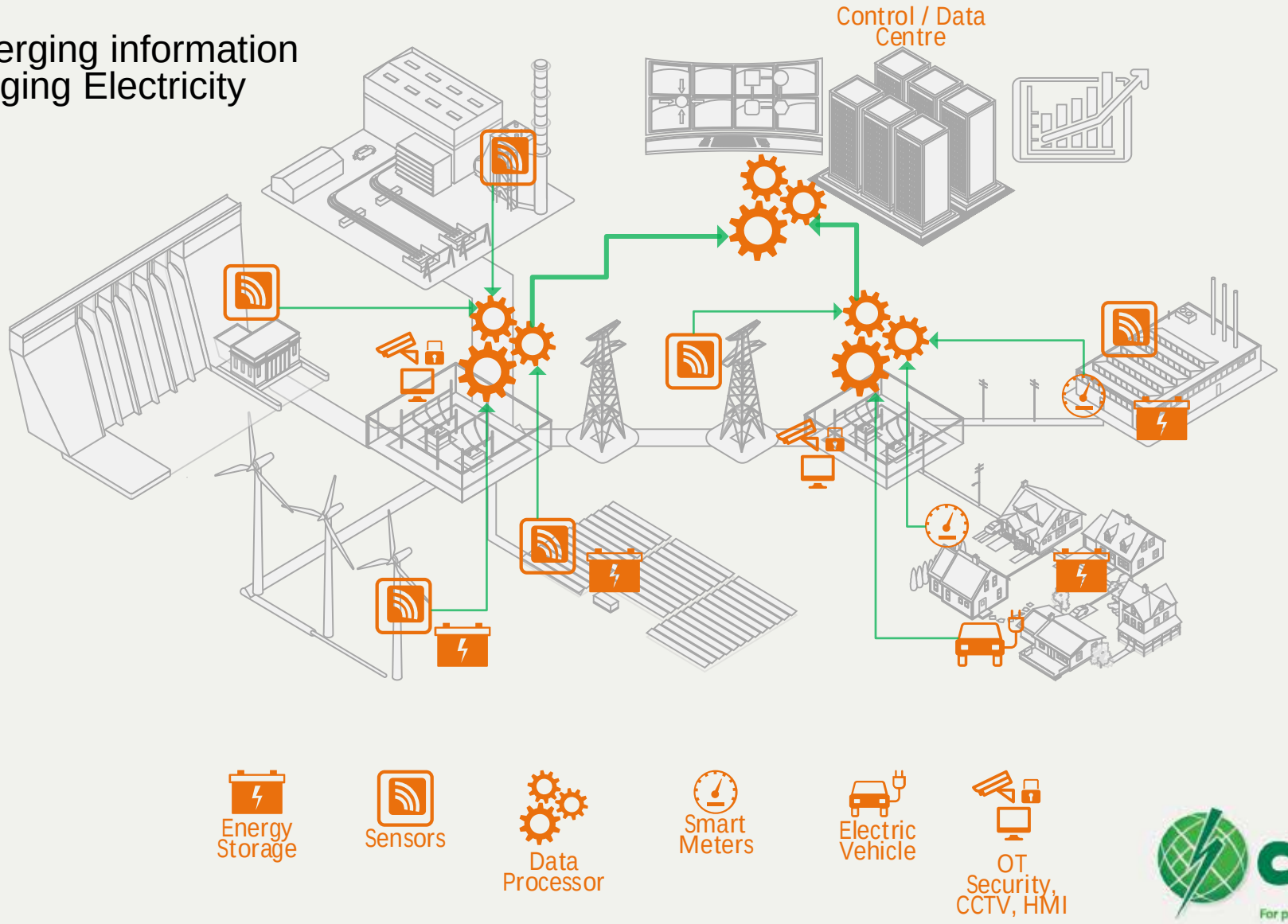
Relevance to Australia

Taking advantage of emerging information technologies in the changing Electricity industry



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2018 Deliverables

Technical Brochures an Publications

- TB 685 – “Communication solutions for information exchange in the smart delivery of electrical energy” (**Australian Contributor: Louise Watts, SA Power Networks**)
- TB 698 – “Framework for EPU operators to manage the response to a cyber-initiated threat to their critical infrastructure” (**Australian Contributor: Victor Tan, PSC Australia**)
- TB 732 – “Advanced utility data management and analytics for improved operation situational awareness of EPU operations” (**Australian Contributor: Rohan Fernandez, ElectraNet**)
- TB TBD – “Design, Deployment and Maintenance of Optical Cables Associated to Overhead Transmission Lines”

2018 Australian Activities

Australia D2 Panel Meeting held in Darwin: 24 – 26 July 2018.

§ 28 attendees

§ Guest speakers from PowerWater, Cisco, Nokia and Telstra

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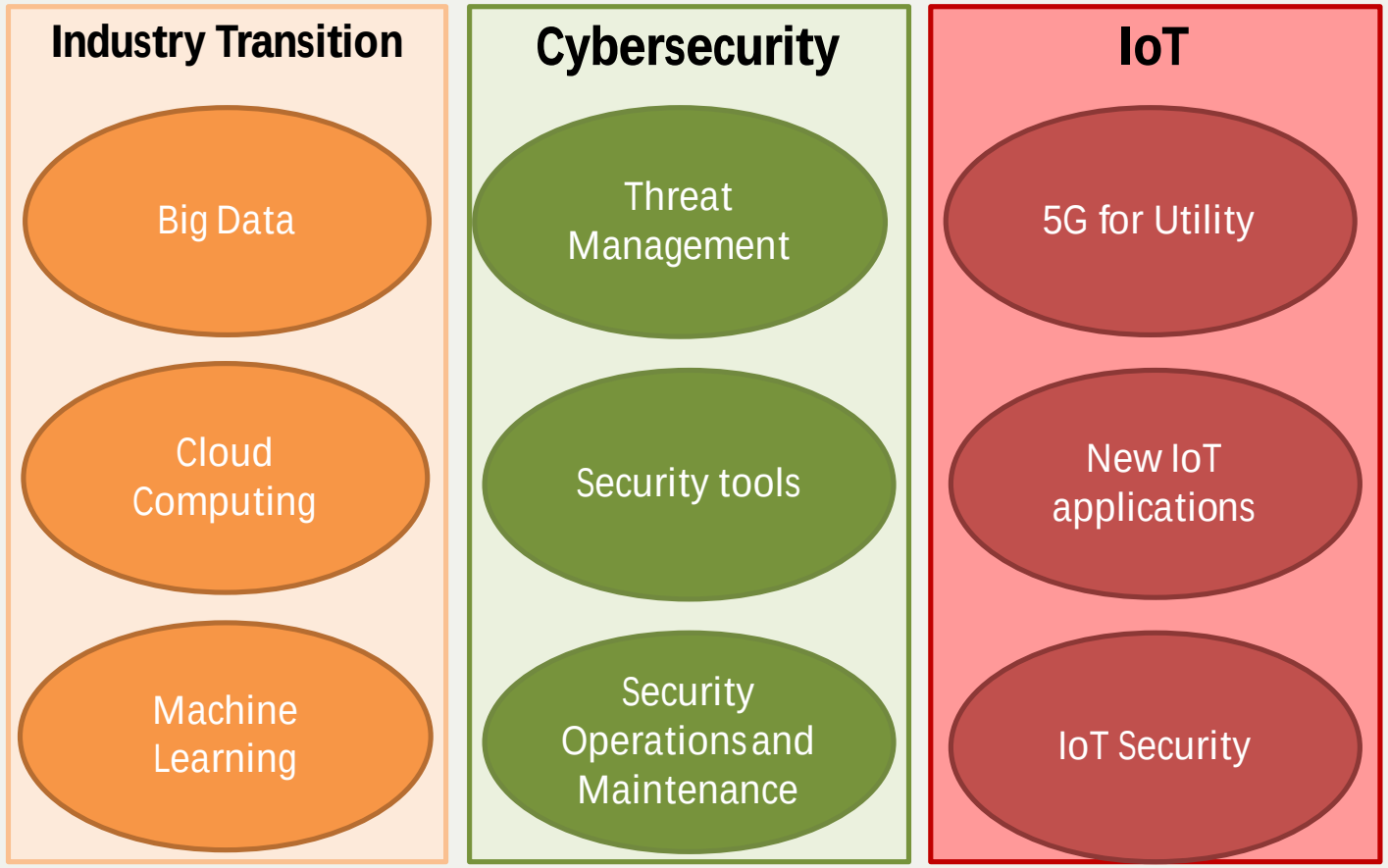
2017 Australian Activities

International Issues & How They Relate to You & Your Organisation



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Looking Forward

2019:

- July – Australia D2 Panel meeting (venue TBD)
- June – CIGRE D2 Symposium in Helsinki