Presented by Andrew Halley

Convener (2016)

Brisbane – 21/11/2019

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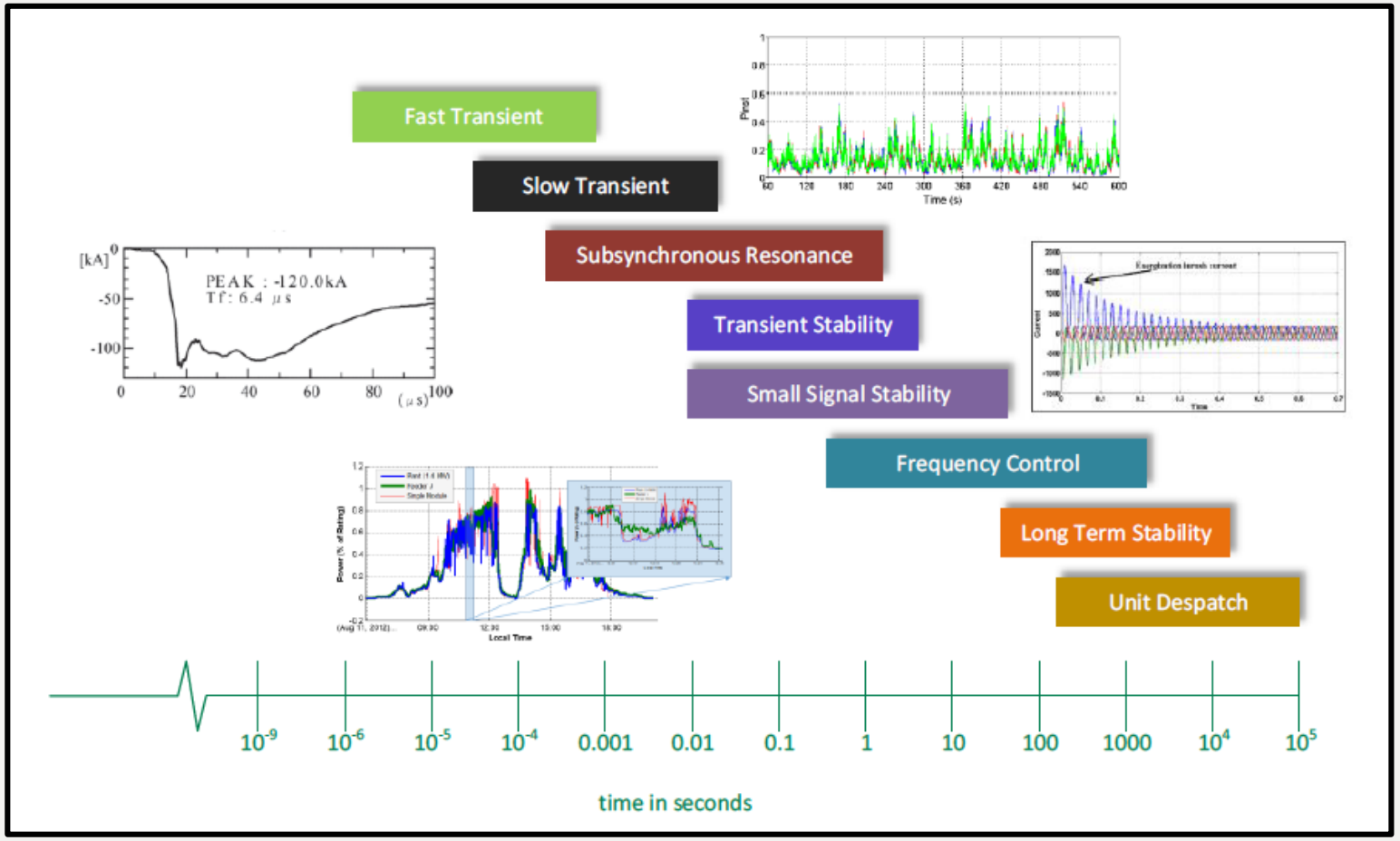
C4

Power system technical performance

SC C4 - Scope



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

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What's going on in C4? LOTS!

Working Groups – the CIGRE engine room

- Thirty five (35) active working groups in progress.
- Approximately one-third are PSDNA related (related to the changing generation mix and associated issues).
- Andrew's picks (highest relevance for Australia, my future reading list):
  - JWG C4.40/CIRED Revisions to IEC Technical Reports 61000-3-6, 61000-3-7, 61000-3-13, and 61000-3-14.
  - WG C4.47 Power system resilience.
  - WG C4.56 Electromagnetic transient simulation models for large-scale system impact studies in power systems having a high penetration of inverter connected generation.
  - JWG A1/C4.66 Guide on the assessment, specification and design of synchronous condensers for power systems with predominance of low or zero inertia generators.
  - JWG B5/C4.61 Impact of Low Inertia Network on Protection and Control

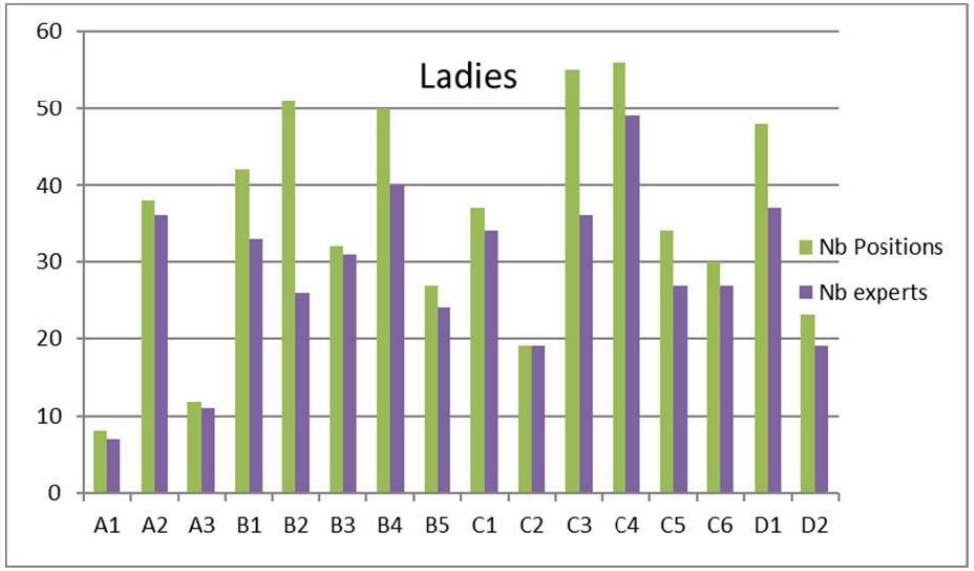
Power quality, 5

EMC/EMI, 5

Insulation co-ordination, 7

Lightning, 7

Power Systems Dynamics and Numerical Analysis, 11



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Publications since last ATC

Five Technical Brochures (TB) have been published since November 2018.

TB 742:	A proposed framework for coordinated power system stability control, WG C2/C4.37.
TB 745:	Issues related to spark discharges, WG C4.25.
TB 766:	Network modelling for harmonic studies, WG C4/B4.38.
TB 780:	Understanding of geomagnetic storm environment for high voltage power grids, WG C4.32.
TB 781:	Impact of soil-parameter frequency dependence on the response of grounding electrodes and on the lightning performance of electrical systems, WG C4.33

Consult the AU C4 Annual Report for a summary of Australian contributors to past and present working groups!

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Publications since last ATC

CIGRE Science and Engineering Journal (CSE) and Electra

CSE Journal Feature Article:

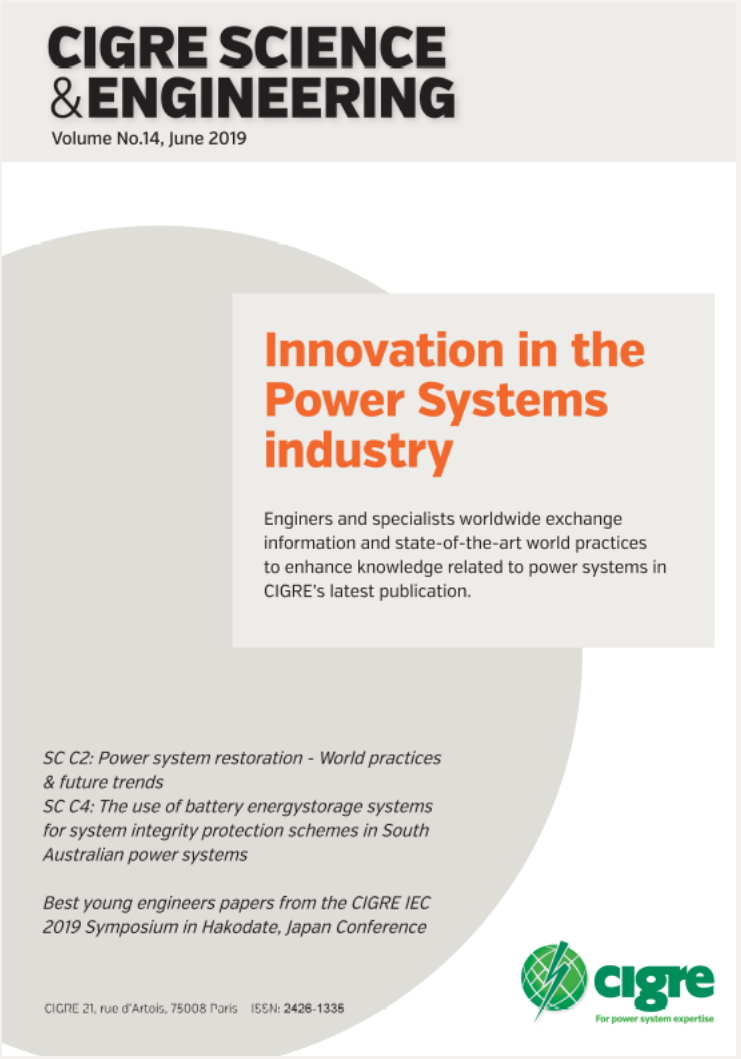
"***The use of battery energy storage systems for system integrity protection schemes in the South Australian power system***"

Document reference: CSE-014, June 2019

Reference paper by WG C4.47:

"***Defining power system resilience***",

Document reference: Electra RP-306-1.



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Publications since last ATC

Three C4 Webinars

"**Benchmarking of Power Quality Performance in Transmission Systems**", by Davor Vujatovic, Convener of WG C4.27. January 16, 2019. (64 attendees)

"**Modelling of inverter-based generation for power system dynamic studies**", by Koji Yamashita, Co-Covener of CIGRE JWG C4/C6.35/CIRED. Apr 4, 2019. (112 attendees)

"**A proposed framework for coordinated power system stability control**", by Yongjie Fang, convener of JWG C2/C4.37. Sep 5, 2019. (No data available)

Anholt Wind Farm (400 MW)
Offshore 220/33 kV substation
Danish Symposium 2019
(not related to webinars in any way but is a great graphic!)

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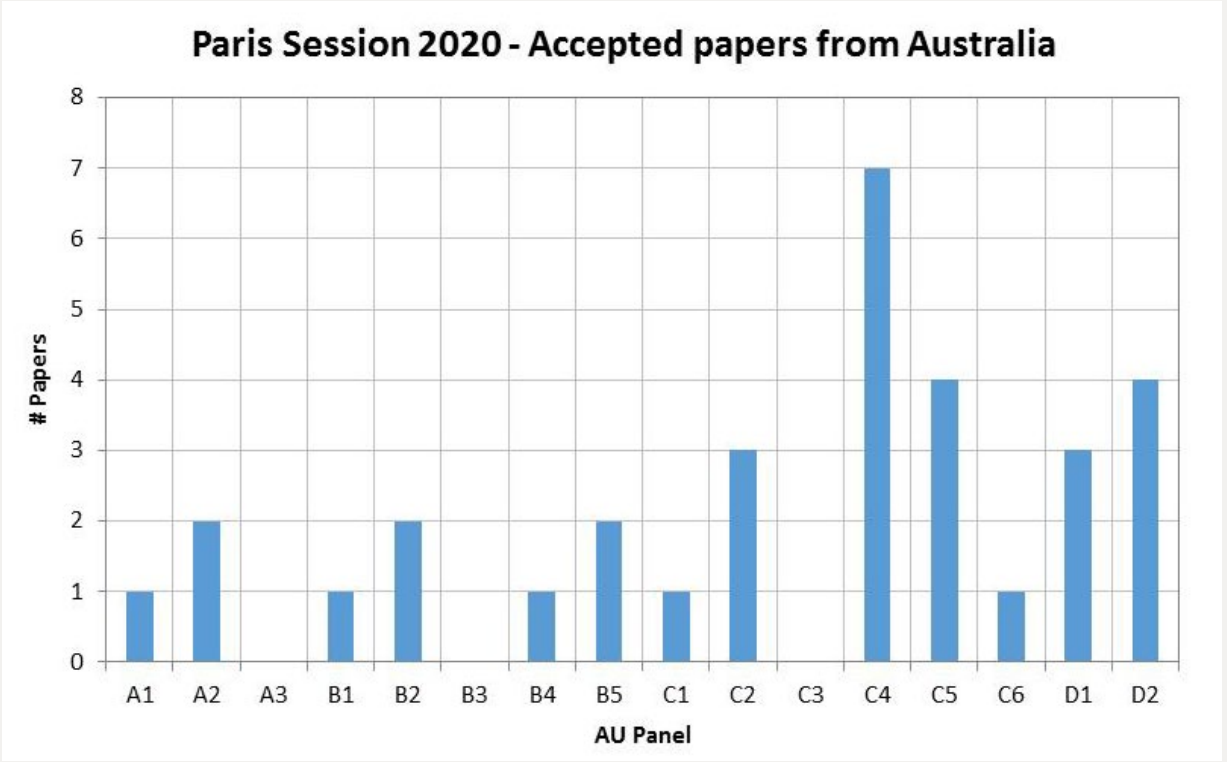
2020 Paris Session

Preferential subjects and AU-C4 accepted papers (7)

PS 1: Improving power system technical performance through the use of advanced methods, models and tools.

PS 2: Modelling of the future grid based on lessons learned from system events.

PS3: Methods, models and techniques for evaluating lightning, power quality and insulation coordination to enhance the performance of the evolving grid.



2020 Paris Session

Preferential subjects and AU-C4 accepted papers

Lead author	Paper #	Title
Neil Browne	520	Trends in power quality disturbance compatibility in Australia.
Nalin Pahalawatta	515	Power system analysis tools for supporting renewable generation connections.
Winodh Jayewardene	514	Holistic approach to modelling and tuning of a wind farm in conjunction with a synchronous condenser in a low system strength grid.
Greg Hesse	491	Monitoring and modelling of geomagnetically induced currents across the Australian National Electricity Market (NEM).
Babak Badrzadeh	499	Synchronous condenser solutions to replace synchronous generators for providing system strength in a large-scale power system – the South Australian experience.
Babak Badrzadeh	495	A large-scale electromagnetic transient model validation based on measured system disturbances.
Tony Morton	502	Generator fault current injection: Are system operators asking for the right thing?

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2020 Paris Session

Friday Workshop

May be offered in May/June 2020 in Australia as a practice run for Paris – Stay tuned…

"System strength – Concepts and associated technical issues for networks having a high penetration of power electronic interfaced generating systems"

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

Coordinators, Andrew Halley and Babak Badrzadeh

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2019 AU C4 Panel Meeting

Thursday 22 and Friday 23 August – Energy Queensland, Brisbane

- Closed panel meeting held on the Thursday with 24 attendees (including several EQ guests).
- Opening address and welcome from Peter Price, Executive General Manager of Strategy, Asset, Performance and Security)

- Open technical seminar was held on Friday, approx. 30 attendees

Terry Killen:	Update on CIGRE Australia activities.
Garry Melik:	EMF issues associated with air core reactors.
Vic Gosbell:	Harmonic compliance assessment - why is it such a difficult issue!
Andrew Halley:	Management of system strength and inertia in Tasmania.
Alex Baitch:	Issues with ferroresonance.
Michael Negnevitsky:	Enhancing flexibility, reliability, and resilience of isolated power systems via low-load and variable speed diesel integration.

Energy Queensland (Peter Kilby, Alan Louis):

- Managing the 230V transition and PQ performance.
- PQ challenges with distribution supply to remote areas having high penetrations of renewable generation.

Thanks EQ.
Thanks to all presenters.

Was a great two days!

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Thanks for listening.

Any questions

Andrew Halley,

AU C4 Convenor

Anholt Wind Farm (400 MW)

Technical Tour @ 2019 Danish Symposium

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