



Presented by Babak Badrzadeh
AU-C4 Convener

Sydney – 27 November 2023

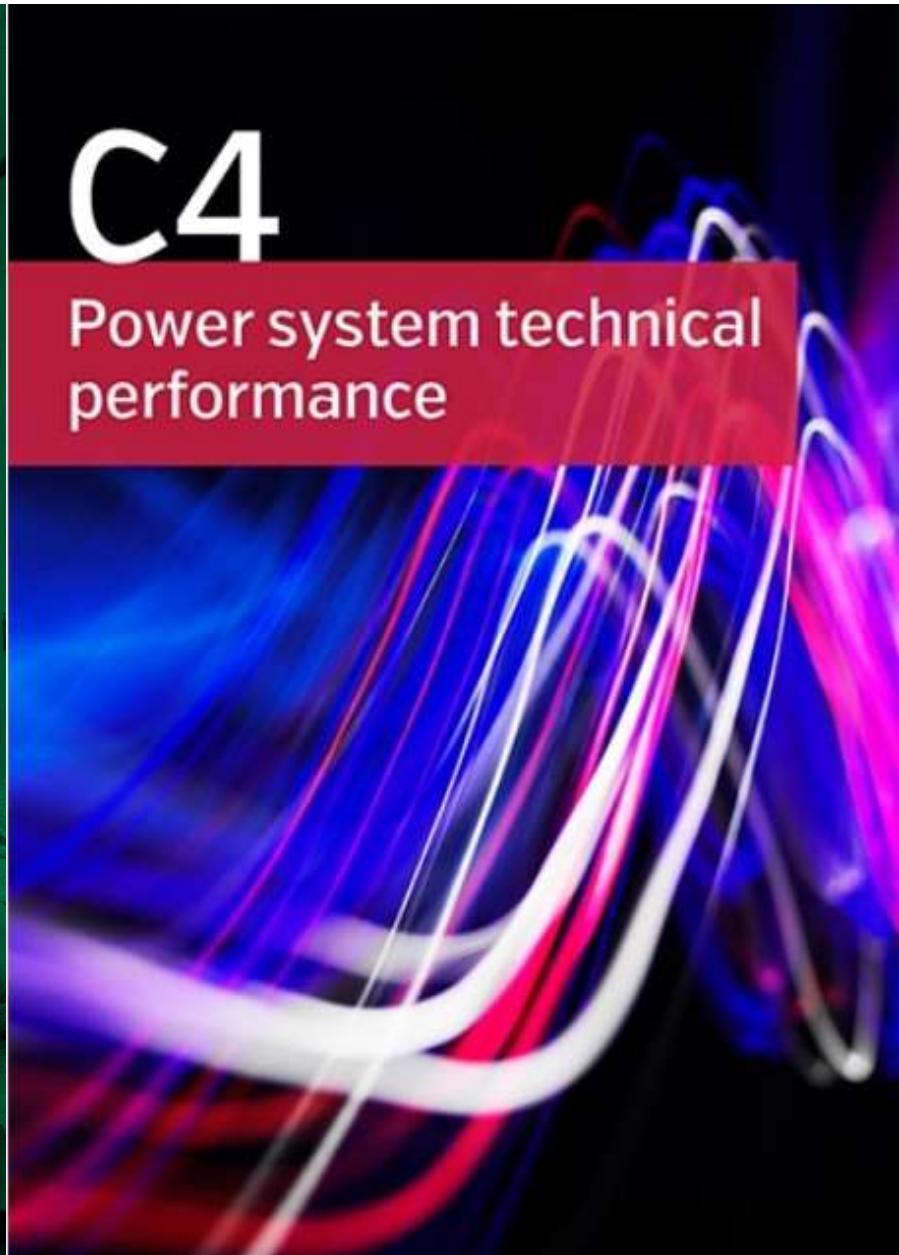


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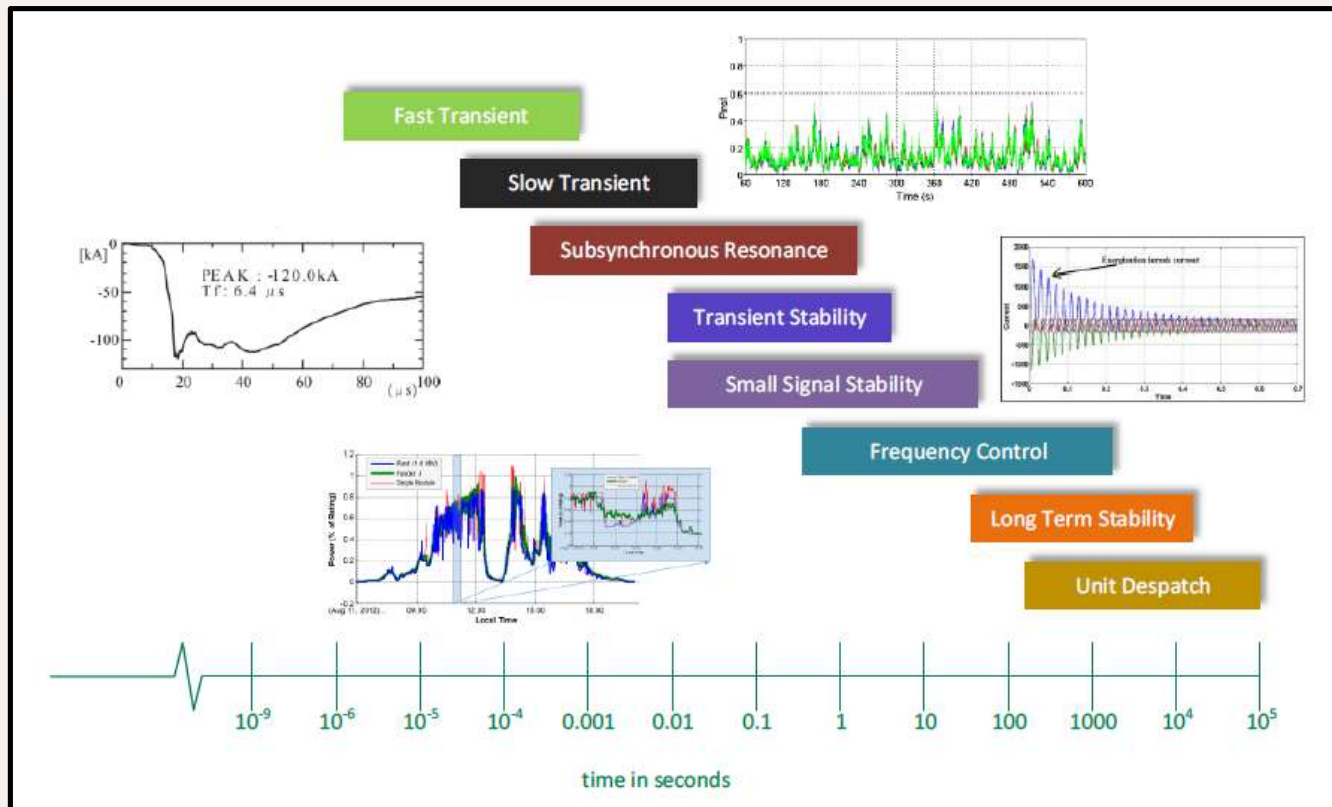
For power system expertise

C4

Power system technical
performance



SC C4 - Scope



- **PS1: Power Systems Dynamics and Numerical Analysis (PSDNA)**
- **PS2: Power quality (PQ)**
- **PS3:**
 - **Electromagnetic Compatibility and Interference (EMC/EMI)**
 - **Insulation Co-ordination (IC)**
 - **Lightning (L)**

Study Committee C4 - Composition

SC C4 Chair

Marta Val Escudero



Regular & Observer
Members

46 members – 43 countries

SC C4 Secretary

Genevieve Lietz



**Strategic Directions
Advisory Group
(SAG)**

**Customers
Advisory Group
(CAG)**

**Tutorials &
Conferences Advisory
Group (TAG)**

44 active WORKING GROUPS

What's going on in C4?

Working Groups

- Forty Three (44) active working groups in progress.
- **New working groups**
 - C4.67 – Lightning protection of hybrid overhead lines
 - C4.70 – Application of space-based lightning detection in power systems
 - C4.73 – Insulation coordination of HVDC overhead lines
 - C4.74 – Accurate line and cable models for steady-state and transient studies
 - C4.76 – Overvoltage protection in switching inductive devices with vacuum circuit breakers
 - JWG B4/C4.97 – Benchmarking simulation models for control interaction in meshed AC networks with multiple converters
 - JWG C4/A3/B2/B4.75 – Guide to procedures for the creation of contamination maps required for outdoor insulation coordination
- **Australian WG/JWG Conveners**
 - Jason David (C4.65)
 - Sachin Goyal (C4.71)
 - Christian Schaefer (C1/C4.46)

Power quality, 5

EMC/EMI, 5

Insulation co-ordination, 8

Lightning, 10

Power Systems Dynamics and Numerical Analysis, 16

Slide 4

JD0

To be update or deleted

Jason David, 2022-10-26T03:54:52.576

Technical Brochures published since last ATC meeting

Eight C4 Technical Brochures (TB) published in in the past 12 months

TB 913: Evaluation of Temporary Overvoltages in Power Systems due to Low Order Harmonic Resonances

TB 909: Guidelines for Subsynchronous Oscillation Studies in Power Electronics Dominated Power Systems

TB 900-904: High-Frequency Transformer and Reactor Models for Network Studies (Parts A – E)

TB 885: Guide on the assessment, specification and design of synchronous condenser for power system with predominance of low or zero inertia generators

Webinars since last ATC meeting

- WG C4. 56: Electromagnetic transient simulation models for large-scale system impact studies in power systems having a high penetration of inverter connected generation
 - Presenters: Babak Badrzadeh (Convener) (AU), Sorrell Grogan (AU), Jean Mahseredjian (CA)
 - The resultant TB 881 has been the second most downloaded TB of all SCs on e-CIGRE.
- Guidelines for subsynchronous oscillation studies – A summary of TB 909
- Modelling and analysis of power networks with high percentage of inverter resources

CIGRE Green Book:

Power System Dynamic Modelling and Analysis in Evolving Networks

- To be published in July 2024
- Likely presented as a workshop in 2024 Session
- Requested by CIGRE and Springer to be classified as a Major Reference Work (MRW)
- Hard copies to be available during the Paris Session
- Australian contribution
 - Editor: Babak Badrzadeh
 - Chapter Leader: Nilesh Modi
 - Key contributor to multiple chapters: Genevieve Lietz
 - Other key contributors
 - Sorrell Grogan
 - Andrew Halley
 - Sachin Goyal
 - Aditya Upadhye
 - Hitesh Bavarva

Australian Publications since last ATC

CIGRE Science and Engineering Journal (CSE)

- Oscillatory Interaction Between Large Scale IBR and Synchronous Generators in the NEM, E. Farahani, P. F. Mayer J. Tan, F. Spescha, M. Gordon, CSE 028, March 2023.
- Simulation of a Grid with 100% Inverter-Based Generation and Synchronous Condensers for Grid Reference, J.R. Ramamurthy, A. Jalali, N. Modi, F. Spescha, CSE 30, October 2023.
- Best C4 paper from Cairns Symposium (to be published in CSE)

Assessing the response of electric vehicles during network fault conditions

Evan Franklin, Nathan McKillop, James Lord and Chris Wembridge

ATC Seminar 2023

CIGRE SCIENCE
& ENGINEERING



 CIGRE SCIENCE & ENGINEERING

CSE N°30 October 2023



Australia and C4 Contributions to Cairns Symposium

Study Committee	Number of papers
SC A3	11
SC B1	6
SC B3	15
SC B5	30
SC C1	25
SC C2	29
SC C4	45
SC C5	19
SC C6	30
SC D1	11
SC D2	22
Grand Total	243

- ~70% of C4 Papers from Australia
- ~80% of which on PS1

Workshop

- C4 also organised a four-hour workshop on "new emerging forms of system stability" with more than 250 attendees.
- Australian contributors
 - Babak Badrzadeh (Chair)
 - Sachin Goyal
 - Huajie Gu
 - Qiming Zhang

Australian session Chais and Moderators

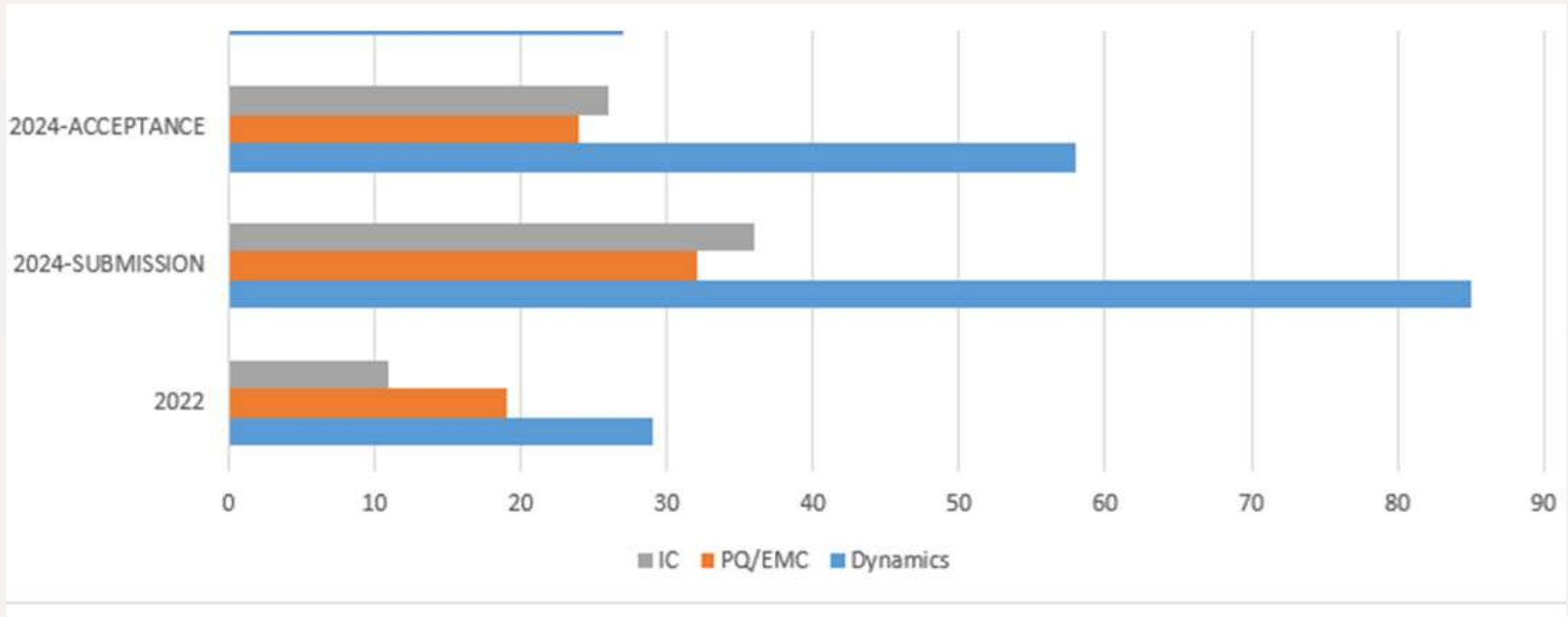
- Genevieve Lietz
- Babak Badrzadeh
- Tim Browne
- Andrew Halley
- Sorrell Grogan
- Nilesh Modi
- Sachin Goyal
- Hieu Nguyen

AU C4 Synopses for Paris 2024 Session

Synopsis title	PS	Authors	Affiliation
Methodologies including modelling tools and techniques, model validation, metrics and data analytics	1	Shahil Shah, Jingwei Lu, Nilesh Modi	NREL, AEMO
Large scale grid forming BESS replaces synchronous generation enabling high renewable penetration & low system load in Australia's major northern grid	1	Brendan Truong, Stanislav Cherevatskiy, Stephen Sproul, Vimeshan Pillay, Heath Lang	PWC, Hitachi Energy
Maximizing the Generator Hosting Capacity Using Grid-Forming BESS	1	Cheng Tan, Jiacheng Li, Athmi Jayawardena, Nalin Pahalawatta	Hatch
Development of A Type-4 Wind Turbine Generator Prototype To Test Grid-Forming Control Capabilities	1	Vishmidhan Ravindrababu, Siddhant Arya, Sean Leslie Martin, Harith Udawatte, Salah Hajtaleb, Behrooz Bahrani	Monash University
Impact of Inverter-Based Generating Systems on Synchronous Machine Subsynchronous Torsional Interactions	1	Aleksandar Karisik & Tony Bertes	DIGSILENT Pacific
Power Quality Assessment in Renewable Energy Zone	2	Yilun Sun, Jiacheng Li, Salim Anwari, Nalin Pahalawatta	Hatch

- Five synopses submitted and accepted.
- One re-assigned to C4, so a total of six accepted synopses for C4.

Overall C4 papers: 2022 vs 2024



- **Significant volume for a Friday GDM**
- **Likely another Special Reporter from AU for PS1**

AU C4 AGM presentations (2 September 2023, Cairns)

Presentation title	Presenter name
How initial screening can be used in IBR tuning for better system performance?	Manjula Dewadasa (remote)
Grid Connection Uncertainties from a Developer's Perspective - Renewable Energy and Green Hydrogen Development	Hieu Nguyen
Utility-Scale Hydrogen Electrolysers	Mehdi Ghazavi Dozein
Power System Simulation	Genevieve Lietz
Steps Towards Distribution-Connected Generation Standardisation & Transparency	Sorrell Grogan (remote)
Stability Enhancing Measures for Weak Grids Study - An ARENA-funded Study	Behrooz Bahrani
Small-signal and Transient Stability Analysis of inverter-based resources - A CSIRO/GPST Study	Behrooz Bahrani
Update on Transmission Network Operations and Planning Activities	Andrew Halley
Rethinking System Restart with High Penetration of DERs	Shabir Ahmadyar
Harmonic Amplification Factor Interpretation and Application	Tim Browne
Questionnaire on CIGRE WG C4.63 ("Harmonic power quality standards and compliance verification – a comparative assessment and practical guide")	Tim Browne
Impact and Management of Harmonics for Renewable Generators	Jason David (remote)
Avoiding Double-circuit Transmission-line Outages Caused by a Single Lightning Stroke	Don Geddy
Investigation of an insulation Coordination Failure	Peter Woloszyn
Relevant ElectraNet activities	Devinda Perera
The progress in developing the Future Network	Neville Watson
DC Coupled Hybrid Systems	Amir Mehrtash
Marinus Link	Paul Rayner

- 2024 AGM to be held as a two-day event.

Thanks for listening.

Any questions

Babak Badrzadeh,

AU C4 Convenor