# Report to the CIGRE Australian Technical Council

# Study Committee SC B4 and Australian Panel AU B4 Activities

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Convenor CIGRE AU B4

AU B4 Report 2025

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# Scope of SC B4

## HVDC

*Source: Siemens*

## FACTS

*Source: GE*

## DC CONVERTERS

*Source: ABB*



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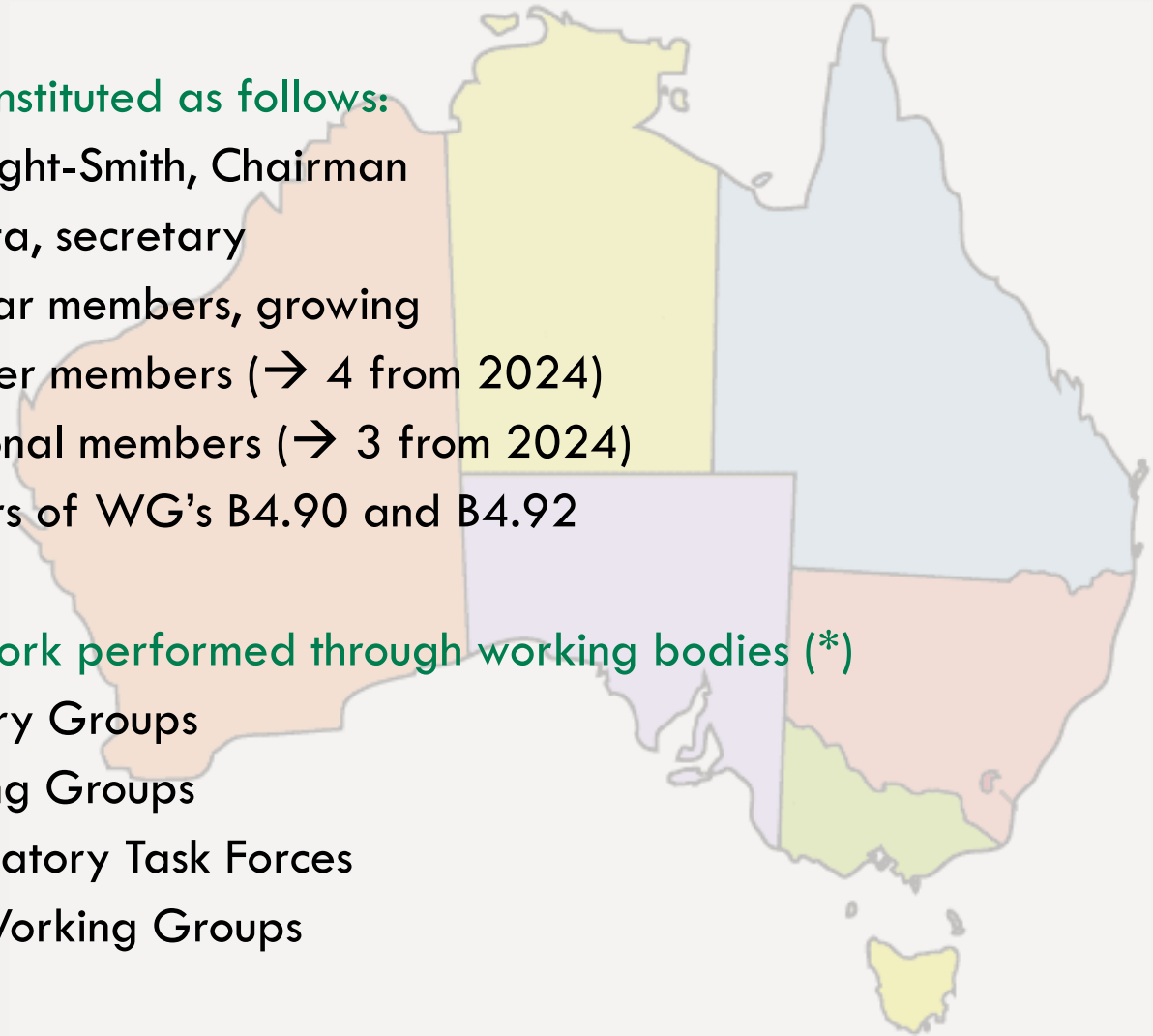
# Australian Panel AU B4 – HVDC and Power Electronics



SC B4 is constituted as follows:

- John Wright-Smith, Chairman
- Ash Gupta, secretary
- 36 regular members, growing
- 8 observer members (→ 4 from 2024)
- 4 additional members (→ 3 from 2024)
- Convenors of WG's B4.90 and B4.92

Technical work performed through working bodies (*)

- 3 Advisory Groups
- 2 Working Groups
- 4 preparatory Task Forces
- 2 Joint Working Groups

With participation of approx. 20 experts, 5% from Next Generation Network

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# 2025 AU B4 Panel Meeting – Adelaide

- 2025 Panel Meeting held in Adelaide 1st September, 2025

# Australian Panel AU B4 – HVDC and Power Electronics

Strategic advisory group on the topic of Energy Transition to deal with rapidly changing power system.

Goal is to review current and futures scopes of the SC B4 to see if there are overlap and if scope is clear, and to ensure CIGRE is meeting important aspects of the energy transmission.

Short-term 1-2 year actions, on energy transition topics including:

- Hydrogen
- Storage
- Solar PV and Wind Sources
- Grid & Flexibility
- Consumer Participation
- Sustainability and Climate
- Grids & Microgrids Integration

Sector CouplingB4 Current thoughts/activities in Energy Transition:

- HVDC is key enabler in the energy transition
- Standardization is key for producing more HVDC
- Work to break manufacturer secrecy and work together
- Need more energy storage experts in B4
- Hydrogen – HVDC is interface between hydrogen and system – need new WG and experts in hydrogen

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# Global Trends in HVDC

1. Rapid uptake of VSC-HVDC and long-distance renewable links. There's been a clear shift toward voltage-source converter (VSC)–based HVDC systems (rather than just line-commutated converter (LCC) systems), particularly for bringing remote renewable generation (wind, solar, hydro) into major load centres. This trend arises because VSC technology offers controllability, black-start capability, easier grid integration (including weak AC systems or islands), and fewer reactive-power/commutation issues compared with older LCC links.
2. Increasing voltages, capacities and multi-terminal/DC-grid ambition. Globally we are seeing HVDC links of ever-higher voltage (±800 kV and beyond) and capacity (several GW), as well as growing focus on multi-terminal HVDC (MTDC) or meshed DC networks rather than just point-to-point links. The "super-grid" concept (continental scale) is in view, though not yet ubiquitous.
3. As HVDC systems age and proliferate, operational reliability is drawing much more attention — maintenance, service life, monitoring and refurbishment matter. For example, the recent B4-10609 survey tracks world-wide HVDC system performance (2021-22) in terms of energy availability, outages, etc. e-cigre.org+1Also, papers on operation & maintenance (O&M) for both LCC and VSC systems emphasise that many newer owners/developers may lack historical O&M experience. CIGREThis signals that the "deployment" phase is transitioning toward "operate & maintain at scale", and that asset management, condition monitoring (e.g., thyristor degradation) are key. One study even examines thyristor ageing in operational HVDC links.
4. HVDC is becoming a more integral part of future grids (with lots of renewables, low inertia, variable flows). The systems are being required to provide more ancillary services (stability support, black-start, oscillation damping) and integrate with digital tools for monitoring, analysis and control. For example, papers in the B4 session show hybrid simulations (EMT + PDT) for power oscillation damping studies in an HVDC link. Also, working groups are actively working on modelling and equivalent representation of AC systems for HVDC studies (see WG B4/C4 on AC network equivalents), market and operational benefit studies (e.g., the Brattle/DNV report) emphasise how HVDC links provide flexibility, controllability and enable market/operational optimisation.

*Source: Siemens*

*Source: CSPG "Ongoing HVDC Project Introduction"*



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# Global Trends in FACTS

1. The FACTS device market is expanding steadily with a compound annual growth rate (CAGR) around 9%. This escalation reflects increasing demand for power-flow control, voltage support, grid flexibility, and the need to manage more variable energy sources.
2. As power systems incorporate more variable renewable generation (wind, solar) and operate with lower inertia or weaker AC networks, the utility case for FACTS devices intensifies.
3. Historically, many FACTS devices were installed for voltage support, reactive compensation or line flow control. The trend now is toward “system-services” roles: damping of oscillations, fast reactive injection, active power modulation, interaction with grid-codes, and more integrated control with wide-area measurement systems.
4. The trend lines show strong growth in Asia-Pacific (APAC) regions, driven by large transmission expansion, renewables build-out and grid upgrades. Also emerging is interest in asset health, maintenance of power-electronics heavy systems, retrofit of older FACTS devices, and whole-life costs rather than just CAPEX. As more FACTS get deployed, the “operate & maintain” phase becomes increasingly important (just like we see for HVDC).

*Source: Siemens*

*Source: Siemens*



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# Recent publications

***Published***

• B4.81 – Interac□on between nearby VSC-HVDC converters, FACTs devices, HV power electronic devices and conven□onal AC equipment – *TB934* – Kamran Sharifabadi

• B4.84 – Feasibility study and applica□on of electric energy storage systems embedded in HVDC systems – *TB935* – Hani Saad

***Finished 60-day review***

• B4.71 – Applica□on guide for the insula□on coordina□on of Voltage Source Converter HVDC (VSC HVDC) sta□ons – *finished 60-day review* – Mojtaba Mohaddes

• B4.79 – Hybrid LCC/VSC HVDC Systems – *finished 60-day review* – Hong Rao

• B4/B1/C4.73 – Surge and extended overvoltage evalua□on of HVDC cable systems for tes□ng - *finished 60-day review* – Markus Saltzer

***Under 60-day review***

• B4.82 – Guidelines for Use of Real-Code in EMT Models for HVDC, FACTS and Inverter based generators in Power System Analysis – *under 60-day review* – Garth Irwin

• B4.85 – Interoperability in HVDC systems based on par□ally open-source so□ware – *under 60-day review* – Staffan Norrga

Green Books on HVDC progress: HVDC Green Book is expected in 2025.

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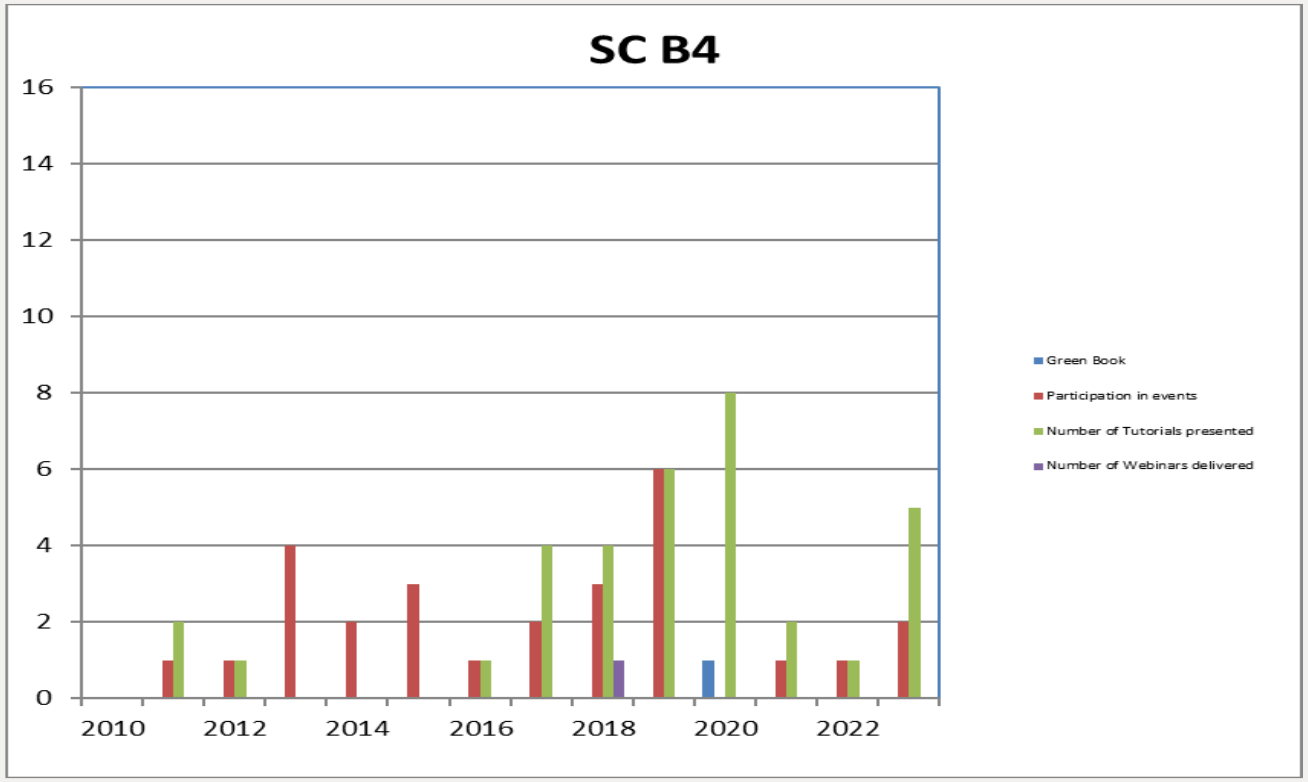
# Tutorials and webinars




Green bar is the number of tutorials presented

Most webinars are available at e-cigre.org as recordings

Next planned activities: See Event calendar at cigre.org

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# Active WGs and JWGs

- B4.64:  Impact of AC System Characteristics on the Performance of HVDC schemes
- WG B4-69 Minimizing loss of transmitted power by VSC during Overhead Line Fault
- WG B4-71: Application guide for the insulation coordination of Voltage Source Converter HVDC (VSC HVDC) stations
- JWG B4/B1/C4.73 – Surge and extended overvoltage testing of HVDC Cable Systems
- WG B4.79 – Hybrid LCC/VSC HVDC Systems
- WG B4.81 – Interaction between nearby VSC-HVDC converters, FACTs devices, HV power electronic devices and conventional AC equipment
- WG B4.82 – Guidelines for Use of Real-Code in EMT Models for HVDC, FACTS and Inverter based generators in Power Systems Analysis
- WG B4.84 – Feasibility study and application of electric energy storage systems embedded in HVDC systems
- WG B4.85 – Interoperability in HVDC systems based on partially open-source software
- JWG B4/A3.86 – Fault Current Limiting Technologies for DC Grids
- WG B4.87 – Voltage Source Converter (VSC) HVDC responses to disturbances and faults in AC systems which have low synchronous generation
- TF B4/B1.88 – Insulation coordination procedure for DC cable systems in HVDC stations with Voltage Source Converters (VSC)

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# Active WGs and JWGs

- WG B4.89 – Condition Health Monitoring and predictive maintenance of HVDC Converter Stations
- WG B4.90 – Operation and Maintenance of HVDC and FACTS Facilities
- WG B4.91 – Power-Electronics-Based Transformer Technology, Design, Grid Integration and Services Provision to the Distribution Grid
- WG B4.92 – STATCOMs at Distribution Voltages
- WG B4.93 – Development of Grid-Forming Converters for Secure and Reliable Operation of Future Electricity Systems
- JWG C2/B4.43 – The impact of Offshore Wind power hybrid AC/DC connections on System Operations and System Design
- WG B4.94 – Application of grid-forming VSC-HVDC system in black start restoration
- TF B1/B3/B4/C4/D1.95 – Harmonization of voltage designations and definitions across different HVDC component technologies
- JWG C4/B4.72 – Lightning and Switching Induced Electromagnetic Compatibility (EMC) issues in DC power systems and new emerging power electronics-based DC equipment
- WG B4.95 – Developments in Power Semiconductor Technologies and Applications in HVDC/FACTS
- WG B4.96 – HVDC connection of power system with high proportion of photovoltaic (PV) generation
- JWG C4/A3/B2/B4.75 – Guide to procedures for the creation of contamination maps required for outdoor insulation coordination
- JWG B4/C1.97 – Benchmarking of simulations models for control interaction in meshed AC networks with multiple converters
- JWG C1/B4.49 – Offshore transmission planning

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# New works / planned

## WG B4.102 – Technical Requirements and Scenario Considerations on Grid-Forming Capabilities of VSC-HVDC Systems

This is a new working group. Zhiyong presented on the scope, purpose, and schedule for the WG. Details are included in MOM-Annex 10.27.

## JWG B4/C4.103 – AC Network Equivalents for HVDC and FACTS Project Studies

This is a new WG. Hiranya presented on the scope, purpose, and schedule for the WG. Details are included in MOM-Annex 10.28.

## WG B4.104 – HVDC Digital Twin – concepts and roadmap Arkadiusz BUREK

No update on WG B4.104.

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2026 Events – Paris

2027 Events – To be advised

# Thank You For Your Time!

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