Substations & HV Installations Study Committee B3 Updates

Mark Osborne : CIGRE UK B3 Regular Member

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Agenda

- Introduction
- B3 Study Committee Headlines
- Paris 2024 Session
- Working Group updates
- UK B3 Technical Panel
- Discussion on B3 UK Issues
- CIGRE 2023 Cairns Symposium highlights

Scope

- Development of new concepts in substation configuration and operation
- The role that substations play in delivering consumer benefits
- Utilising new technologies and experiences to optimise substation design.
  - Integration of intelligence for digitalization on substations
- Substation ownership issues & Life-cycle management

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Study Committee B3 Organisational Structure - Effective on April 2023

Strategic Advisory Group (Koji Kawakita)

Quality Assurance Team (Terry Krieg, John Finn, Colm Twomey)

SC B3 Secretary (Samuek Nguefeu)

Chairperson
Koji Kawakita

Customer Advisory Group (John Randolph)

Tutorial Advisory Group (Hugh Cunningham)

Study Committee
24 Regular Members, 4 Regular Additional Members, 15 Observer Members + 4 Area Advisors, WG Convenors

Workiing Areas: AA1	AA2	AA3	AA4
Substation Concepts and Development Advisor: Mark Osborne	Gas Insulated Substations Advisor: Mark Kuschel	Air Insulated Substation Advisor: Mark McVey	Substation Management & Digital Integtation Advisor: Johan Smit
B3.49 Review of substation busbar components reliability	B3.41 Mobile Substations Incorporating HV GIS	B3.58 Knowledge Transfer of Substation Engineering and Experiences	B3.56 Application of 3D Technologies in Substation Engineering Works
B3.52 Neutral Grounding Mode Selection and Fault Handling for Substation in Distribution Grid	B3.50 Concepts for on-site HV testing of GIS	B3.64 Guidelines on Optimising Seismic Design of Substations for Power Resiliency	B3.61 Risk and asset health-based decision making in existing substations
B3.54 Earthing System Test Methods	JWG B3/A3.59 Guidelines for SF6 end-of-life treatment of T&D equipment (>1kV) in Substations		JWG B3/D2.62 Life-long Supervision and Management of Substations by use of Sensors, Mobile Devices, Information and Communication
B3.65 Guidelines for the Selection and Design of escape routes for substations rated above 1kV AC and 1.5 kV DC	JWG B3/A3.60 User guide for non-SF6 gases and gas mixtures in Substations		
JWG B1/B3.74 Recommendations for a performance guideline of Polymer Insulated Busbars	JWG B3/D1.63 Guideline for assessing the toxicity of used SF6 gas onsite and in the lab of T&D equipment above 1 kV in substations		
	JWG B1/B3/D1.79 Recommendations for dielectric testing of HVDC gas insulated system cable sealing ends	Greenbook Project 2 - SF6 Guidebook	Joint WG led by Other SCs

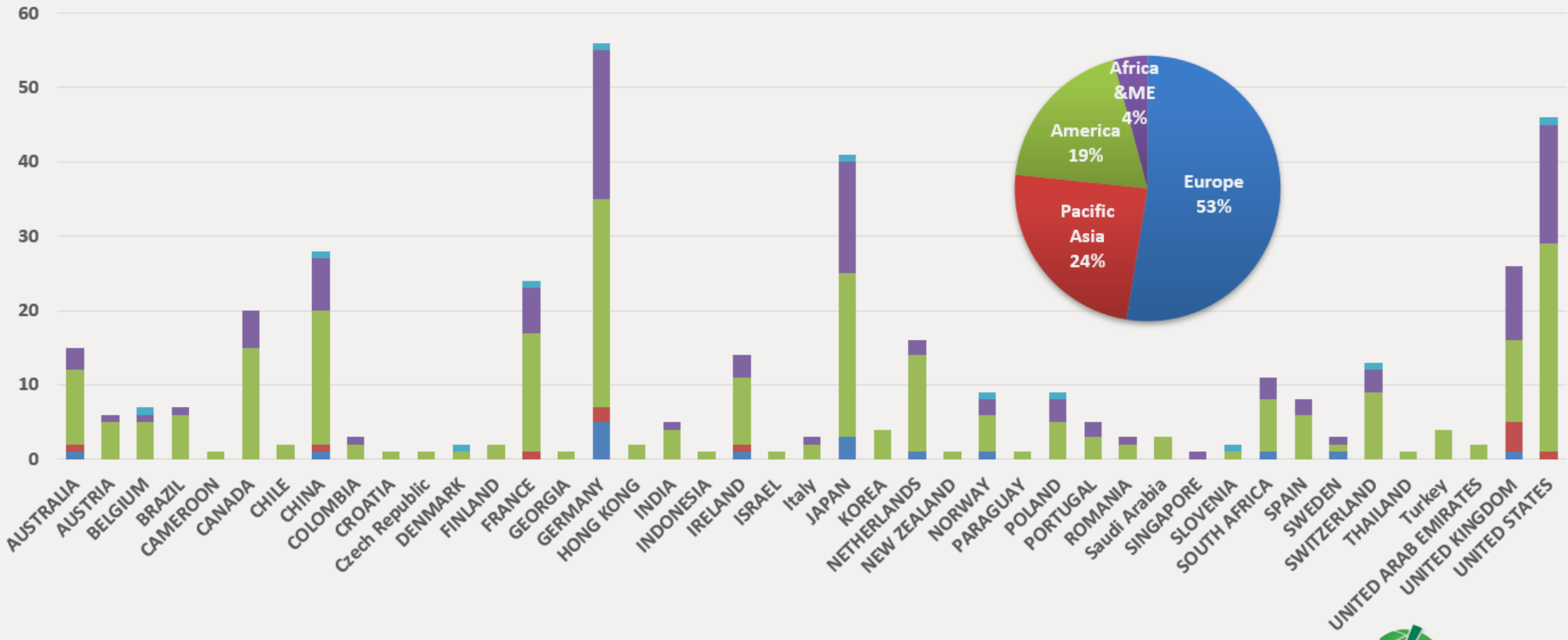
JWG B3/A2/A3/C3/D1.66

Guidelines for Life Cycle Assessment in Substations considering the carbon footprint evaluation

Special Project

SC B3 WGs Membership

356 individual experts representing **44** countries, demonstrating the **diversity** of **expertise across the globe.**



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Active B3 Working Groups

WG #	Title of Working Group	Convener	Country
B3.49	Review of substation busbar components reliability	Milan Radosavljević	Sweden
B3.50	Concepts for on-site HV testing of GIS	Mark Reuter	Germany
B3.52	Neutral Grounding Mode Selection and Fault Handling for Substation in Distribution Grid	Jinzhong Li	China
B3.54	Earthing System Test Methods	Stephen Palmer	Australia
B3.56	Application of 3D Technologies in Substation Engineering Works	Philip König	South Africa
B3/A3.59	Guidelines for SF6 end-of-life treatment of T&D equipment (>1kV) in Substations	Maik Hyrenbach	Germany
B3/A3.60	User guide for non-SF6 gases and gas mixtures in Substations	Piet Knol	Netherland
B3.61	Risk and asset health-based decision making in existing substations	Jan Bednarik	Ireland
B3/D2.62	Life-long Supervision and Management of Substations by use of Sensors, Mobile Devices, Information and Communication Technologies	Nocolaie Fantana	Germany
B3/D1.63	Guideline for assessing the toxicity of used SF6 gas onsite and in the lab of T&D equipment above 1 kV in substations	Roland Kurte	Germany
B3.64	Guidelines on Optimising Seismic Design of Substations for Power Resiliency	Atsushi Eto	Japan
B3.65	Guidelines for the Selection and Design of escape routes for substations rated above 1kV AC and 1.5 kV DC	Espen Masvik	Norway
Greenbook	SF6 Greenbook	Daniel Staiger	Germany

Recently published B3 Technical Brochures

TB number	Title	WG
TB 920	Concepts for on-site HV testing of GIS after installation, extension, retrofit or repair	B3.50
TB 914	Guidelines for SF6 end-of-life treatment of T&D equipment (>1kV) in Substation.	B3/A3.59
TB 907	Mobile Substations Incorporating HV GIS (UK WG Convenor Paul Fletcher)	B3.41
TB 898	Knowledge transfer of substation engineering and experiences (Dedicated to John Nixon, was the original WG convenor, who unfortunately we lost in 2022)	B3.58
TB 895	Impact on Engineering and Lifetime management of Outdoor GIS	B3.57
TB 886	Guidelines for Fire Risk Management in Substations	B3.53

CIGRE members can freely download TBs from e-cigre: https://e-cigre.org/

Paris Session 2024

Details

- 25-30 August 2024, Palais des Congress
- Clashes with the Olympics and Para-Olympics –
- B3 General Discussion Meeting Wed 24th August
- 99 paper submissions - an all-time record!!
- Venue: Grand Amphitheatre

B3 Tutorial – date TBC

- Guidelines for SF6 end-of-life treatment of T&D equipment (>1 kV) in substations (TB 914)

Poster Session – date TBC

- Each author has the opportunity to receive questions and comments on their paper

B3 Study Committee meeting – 22nd August

CIGRE Paris Session 2024 Preferential Subjects

PS1 Challenges & new solutions in T&D substation design and construction for energy transition:

- Design impacts on substations from on-offshore wind, PV, hydrogen, small modular reactors, EV charging infrastructure etc.
- New functions in substations (energy storage, synchronous compensators, etc.).
- HV-MV DC substation and GIS/GIL application for a DC network.

PS2: Return on operational experiences for substation management:

- Challenges of managing assets: Initiatives to strengthen resilience, reliability and security, best practice and end-of-life management considering sustainability aspects.
- Lessons learned from operational experience from SF6 alternatives solutions, digital transformation solutions and digital substation.
- New competencies for new technologies, knowledge transfer methods and high standards of education in engineering skills.

2025 CIGRE events including SCB3

B3/A3 Forum in Klingenberg,

- Germany on 24-30 March 2025
- Hosted by German NC and supported by WIKA. SAG and WG meetings are scheduled.
- Many WG meetings, Tutorials and workshops will be scheduled.

Symposium in Montreal, Canada on Sep-Oct 2025

- Date and venue: TBA.
- B3 regular meeting and WG meetings will be scheduled.

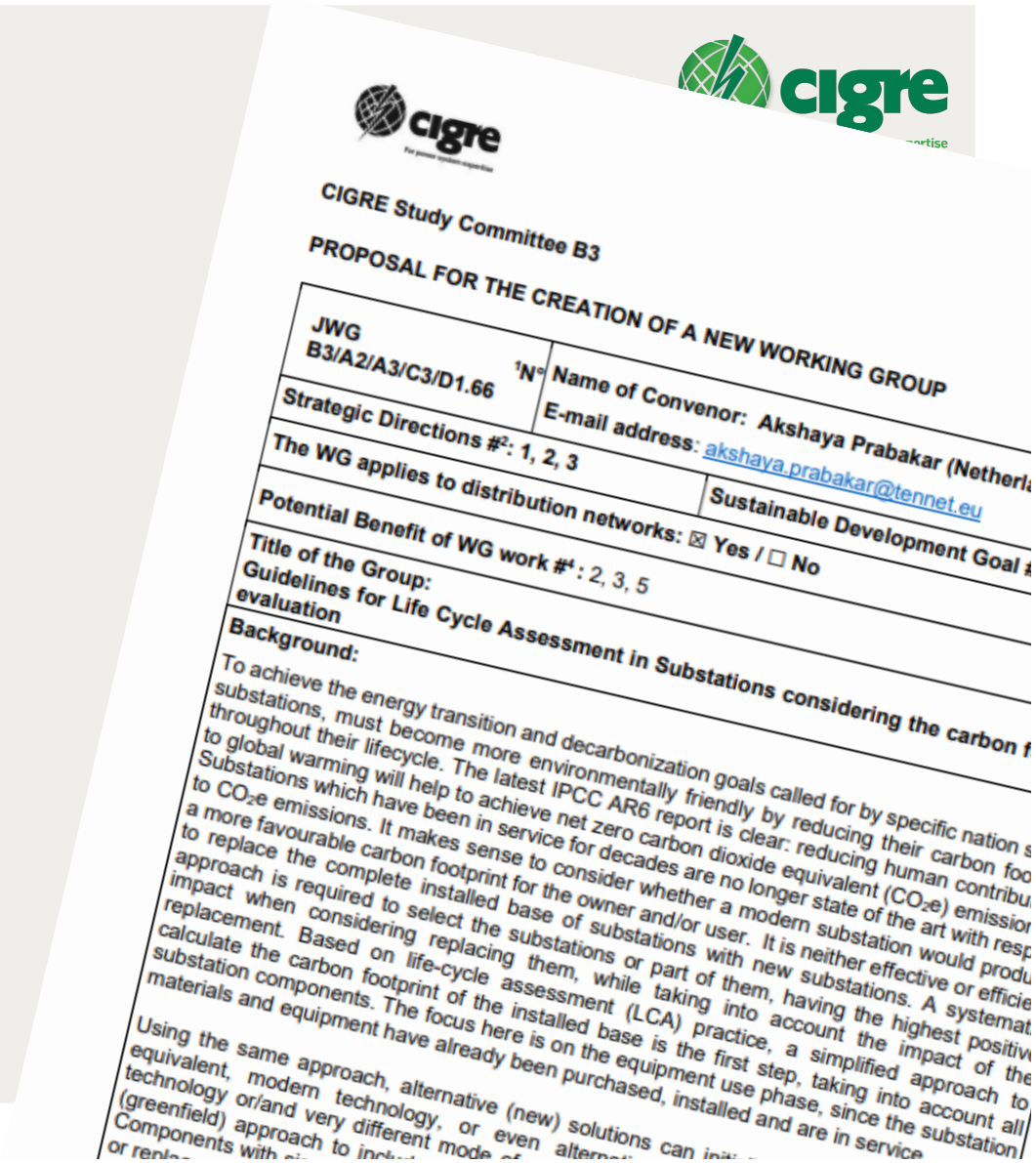
Symposium in Trondheim, Norway on 12-15 May 2025

- Venue: Clarion Hotel Trondheim
- B3 participates in Trondheim, but SC B3 stepped down from co-chair.
- No B3 regular meeting is scheduled.

New Joint Working Group

B3/A2/A3/C3/D1.66

- Guidelines for Lifecycle Assessment in Substations considering the carbon foot print evaluation
- Convenor: Prabakar AKSHAYA, Netherlands, TenneT
- This JWG considers evaluation of CO2-based carbon footprint along the substation life (design/ engineering/ manufacturing/ construction/ O&M/ dismantling).
- Nomination of JWG members with CV to be sent to B3 Chair.



CIGRE Study Committee B3

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

JWG B3/A2/A3/C3/D1.66	[1]N°	Name of Convenor: Akshaya Prabakar (Netherl E-mail address: akshaya.prabakar@tennet.eu
Strategic Directions #[2]: 1, 2, 3		Sustainable Development Goal #
The WG applies to distribution networks: ☒ Yes / ☐ No		
Potential Benefit of WG work #[4]: 2, 3, 5		
Title of the Group: Guidelines for Life Cycle Assessment in Substations considering the carbon f evaluation		

Background:

To achieve the energy transition and decarbonization goals called for by specific nation s
substations, must become more environmentally friendly by reducing their carbon foo
throughout their lifecycle. The latest IPCC AR6 report is clear: reducing human contribu
to global warming will help to achieve net zero carbon dioxide equivalent (CO_2e) emissio
Substations which have been in service for decades are no longer state of the art with resp
to CO_2e emissions. It makes sense to consider whether a modern substation would produ
a more favourable carbon footprint for the owner and/or user. It is neither effective or efficie
to replace the complete installed base of substations or part of them, having the highest positiv
approach is required to select the substations with new substations. A systemat
impact when considering replacing them, while taking into account the impact of the
replacement. Based on life-cycle assessment (LCA) practice, a simplified approach to
calculate the carbon footprint of the installed base is the first step, taking into account all
substation components. The focus here is on the equipment use phase, since the substation
materials and equipment have already been purchased, installed and are in service

Using the same approach, alternative (new) solutions can
equivalent, modern technology, or even
technology or/and very different mode
(greenfield) approach to
Components with
or

CIGRE Recognition

B3 Outstanding service award

- Tony Lujia Chen.

Future topics of interest from B3 Study Committee

AA1 Substation Concepts

- Guidelines for Managing Black Start Resilience in substations (possible Crina Costan)
- Offshore Substation Operational Experience (proposal Simon Waddington)
- Earthing system design guidelines for high voltage systems (possible Stephen Palmer)
- Harmonization of voltage designations and definitions across different HVDC component technologies (convenor Bruno Bisewski) - TF

AA2 GIS, GIL, SF6 and Alternative Gases

- Operational safety of Medium Voltage GIS in case of abnormal leakage (Maik Hyrenbach)
- Temperature rise limits increase for lighter products (proposal Sergio Feitoza Costa)
- Guidelines for end-of-life treatment for substations > 1 kV (by JWG B3/A3.59 done)
- Return of operational experiences of SF6 free equipment (after JWG B3/A3.60)
- SF6 Green Book – Daniel Staiger; draft expected 2024

AA3 Air Insulated Substations

- Process Requirements for Commissioning and Inspecting Substations

AA4 Substation Management

- Guidelines for Life Cycle Assessment in Substations considering the carbon footprint evaluation (proposal new ToR—Akshaya Prabakar)

Scope

- Transitioning the electricity industry to a lower carbon future. 1300 attendees, 400+ from overseas, 40 countries, 11 Study Committee meetings. 69 exhibitors, 20 parallel events (CIDRE, SEAPAC etc..)
- End to End Energy Transfer - towards a Carbon Free Age - not just Carbon Neutral or Net Zero

Australia's Energy Challenge

Energy and People

- Focus on jobs, stable energy prices and sustainability
- Queensland - $60bn investment by 2032 for the Olympics.
- Peak demand of 10GW. Funded via tax on coal.
- Adding 7GW pumped hydro, plus 18GW of IBR.
- 2000km of new circuits.
- New players with different mindsets

Key Issues

- National Policy focus F-Gas Regs - no current Australian legislation
- Resources – massive need to Train and Retain – 200,000 required
- Weather related impact on the networks
- Expanding an ageing infrastructure
- Network harmonics and voltage rise - series capacitors in VSCs contribution
- Low SCL networks (typically 1.8-2.4) coupled with high Impedance transformers
- EV charging out stripping network reinforcement
- Rolling out 500kV - closing resistors and point on wave switching required
- Vandalism of remote assets

OEM world perspective

Industrialisation of the energy transition

- Transmission will be key to the transition
- This will be beyond BAU
- Need to understand the constraints in the supply chain including resource
- Look at the global picture rather than the local picture

Standardisation

- The scale of effort requires standardised solutions, partnering and simplification of the procurement process
- Work with what we already have. OEMS are getting more selective, seeking a Risk reward margin, ideally like a pipeline of work

Example

- EU North Sea is the Green Engine 300GW of wind, Tennet 14x2GW HVDC packages. Same design
- Emerging HVDC standards

New Types of Projects impacting substation design

Small Modular Reactor (SMR)

- Modular nuclear design for Energy provision & Hydrogen Electrolysis.
- Typically 50MW units which can be combined into larger groups e.g. upto 300MW.
- Commercialised brought to site on a truck/boat
- 50yr lifetime, small carbon footprint. Can provide system inertia and stability
- Substation requirements - essentially a **generator**, but with electrolysis facilities.

Energy Islands - Denmark

- Typically 3GW AC on the island and then DC interconnection.
- Island to produce Hydrogen. Bornholm multiterminal DC new 400kV substation.
- Environmental compatibility - physical appearance.
- Concern around increases in SCL required from 40kA to 63kA – even up to 80kA.