Take Aways Paris session B3

André Lathouwers, chair NC B3

Benoît Godeau, chair NC B3

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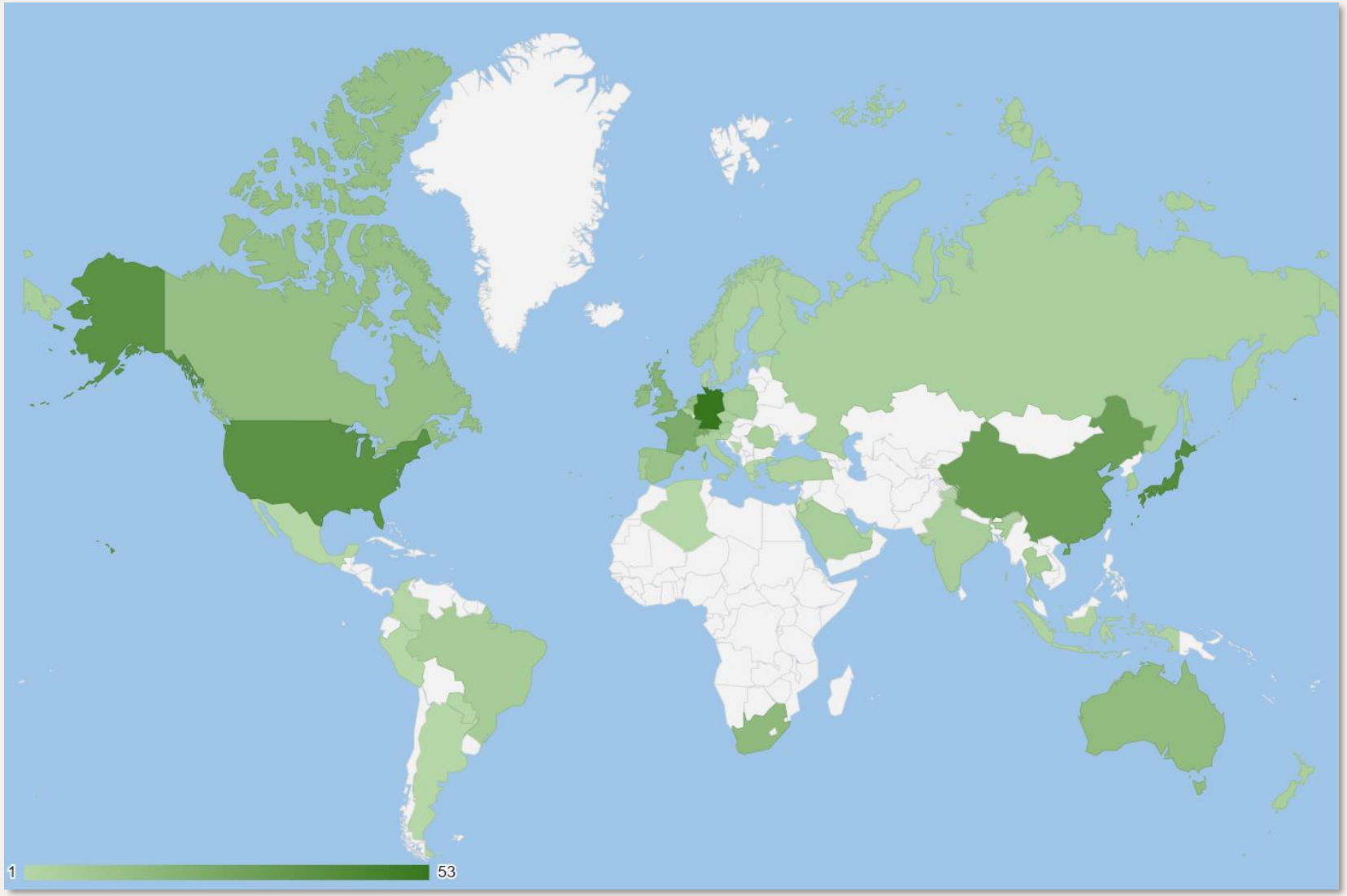
SC B3 Membership



B3 organised 24 regular member, 4 additional regular member, 15 observer member and WG member.

SAG, CAG,TAG, QA and Area advisor.

Working Groups organized 356 individual experts representing 44 countries, demonstrating the diversity of Study Committee membership and expertise across the globe.

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B3 Important Program

Date	Time	Program	Important role member
Mon, August 29	14:30-18:00	**B3 Poster Session**	Poster Session Chair: Colm Twomey (IE) B3 Chair
Tue, August 30	08:45-18:00	**B3 Group Discussion Meeting (GDM)** Contributions to Special Report	B3 Chair, B3 Secretary B3 Special Reporter, Remote QA moderator
Wed, August 31	0830-12:30	**A3/B3 Joint Workshop**: “SF6 alternatives for T&D substations and its switchgear”	TAG Chair A3, B3, D1
Wed, August 31	14:00-15:50	**B3 Tutorial**: “Asset health indices for equipment in existing substations”	TAG Chair: Hugh Cunningham (IE) Tutor: Jan Bednarik (IE)
Thu, September 1	09:00-18:00	**B3 Regular Meeting** B3 regular and regular additional must attend B3 observer is recommended to attend	B3 Chair, B3 Secretary B3 members, WG Convener SAG/CAG/TAG member
Fri, September 2	0830-12:30	**B3 Workshop**: “Knowledge transfer of substation engineering and experiences”	TAG Chair, B3 Chair B3.58 Convener: Akira Okada (JP) Moderator: Akira Okada (JP)

B3: Substations and electrical installations
Group Discussion Meeting (GDM)

PS1: Increased impact of clean energy transition on Substation Design (8 papers)

PS2: Sustainability Management Challenges in Substations (23 papers)

PS3: Integration of Intelligence on Substations (30 papers)

→ 71 papers were submitted from 18 countries

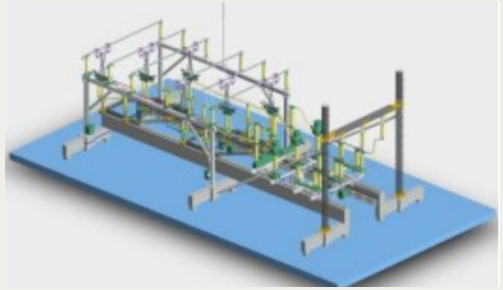
On the Tuesday Paris Group Meeting 48 prepared contributions:

- The challenges in connecting renewables and maintaining security of supply
- The impact that managing SF6 and the alternatives is generating within the sector
- The growing evolution of monitoring and applications, as smart devices and IEC61850 proliferates in the substation.

More precise: The Preferential Subjects for the 2022 Sessions

PS1. Increased impact of clean energy transition on Substation Design

- On-Offshore wind, PV, Geothermal, etc.
- Energy Storage, Hydrogen, Synchronous compensators, etc.
- GIS/GIL application for DC network



PS2. Sustainability Management Challenges in Substations

- External drivers for substation intervention (resilience, reliability, security of supply, life expectancy coordination, etc.
- SF6 alternatives and emission management, 3R (Reuse, Reduce, Recycle) of materials
- New set of skills for new technologies, Knowledge transfer and high standards of education in engineering skills

PS3. Integration of Intelligence on Substations (joint PS with B5)

- Data analytics, remote supervising & monitoring and autonomy application
- IoT and Machine learning applications based on Protection Automation and Control data including asset management, monitoring and data analysis
- Expectations and benefits from digital substation, IEC 61850 Principles and applications to substations

Connecting renewables and maintaining security of supply

Papers diverse

- BESS, battery energy storage system, LV
- Data center power supply, LV
- Commercials
- Mobile or temporary MV

SP1: Interesting contributions presented on site

Less inertia in the grid, so new solutions come up:

- Synchronous condensors
- Syn Con with fly wheel
- BESS using grid forming inverters, providing inertia, black stat and SRAS (system restart ancillary services support)

PS2: Sustainability Management Challenges in Substations

- Non-SF6 related contributions
- Some other issues:
  - BIM
  - HR
  - Knowledge transfer

SF6 and its alternatives

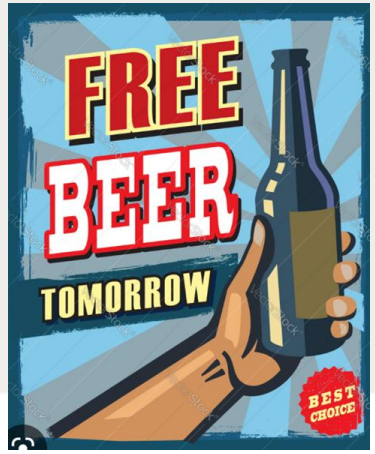
- Many contributions dealt with alternatives to SF6, mostly by the manufacturers.
- Conclusion (negative):
  - The other designs have disadvantages
  - Not much information on own alternatives
- Conclusions (positive):

  “It giet oan”, step by step alternatives become mature

SF_6 alternatives workshop

- Organised by A3, B3 and D1 (all 3 have issued Technical Brochures)
- Over crowded, TSO-driven

No repetition on non-SF6 in this presentation. See also A3.



SP2: asset life extension in Japan

- Request for adding bus sections and a bus coupler
- No space for furthr AIS
- GIS/GIB allowed to add bus sections and a bus coupler without site expansion

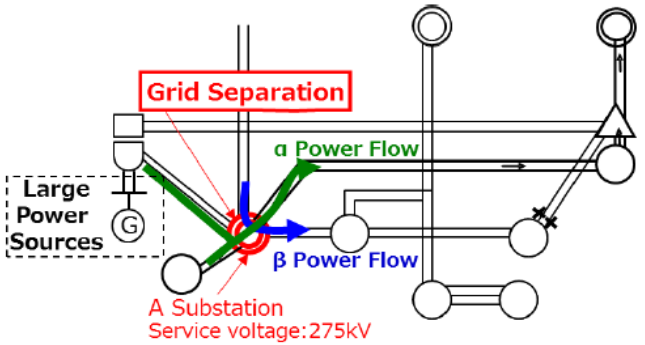


Fig. 1 Grid separation of power grid.

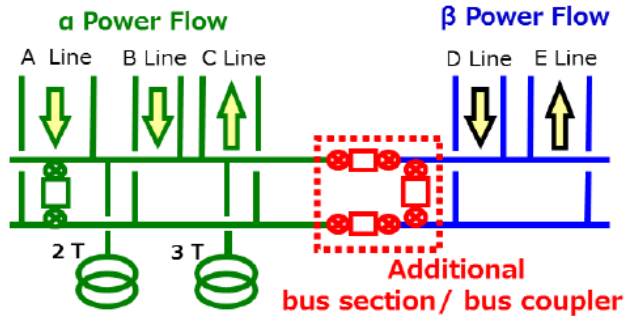


Fig. 2 Single line diagram.

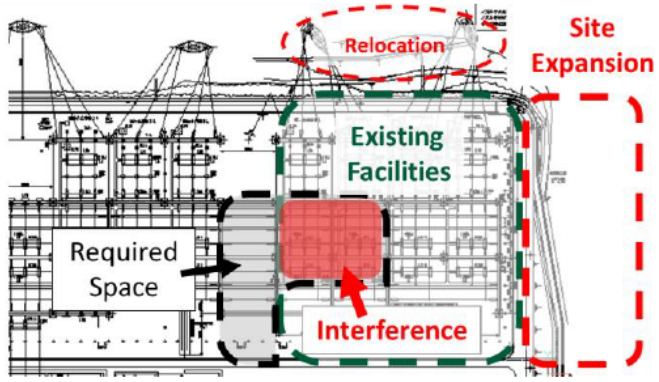


Fig. 3 Ground Plan
For air-insulated facilities extension.

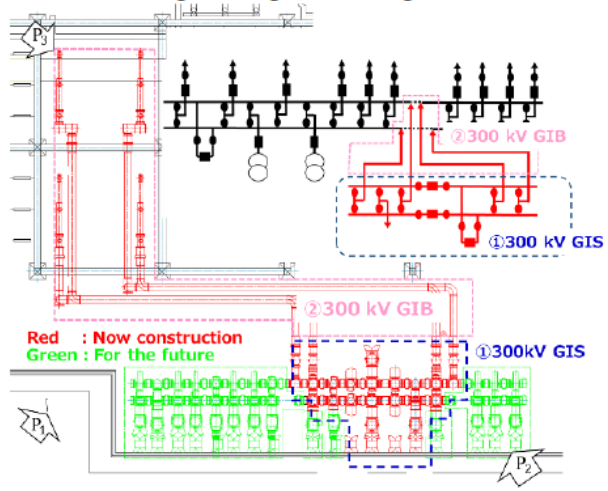


Fig. 4 Ground Plan and Single Line Diagram
For 300 kV GIS/GIB extension.

PS2: training and education

Some contributions highlighted the need for actions on internalization of maintenance skills and knwoledge to transfer them to the next generation.

Good to highlight in this gremium as well.

The need is everywhere, also in the Benelux

What to do? Own training places? Greenbooks?

- **Working Group B3.58** – “Knowledge Transfer of Substation Engineering and Experiences”. This working group began in 2020 and aims to foster ways that we can better share information on our chosen field of Substations. It will consider how best to transfer knowledge from veteran to young engineers, including the use of mentoring.

Actions for maintenance skills and knowledge to transfer them to next generation.

Because of these issues, utilities face the following challenges :

- How to keep up the quality of maintenance on aging equipment?
- How to pass on the skills and knowledge to young engineers.

Answer as presented:

- Create maintenance work manuals
- Create education and training facilities with a collection of decommissioned equipment
- In-house maintenance skills competition, technical certification system

SP3: Last but not least: B3&B5 Integration of intelligence on substations

Many TSO-contributions on same message:

New generation of Asset Health Index.

Health Index to obtain condition and end of life.

Where inspection data was obtained by inspection on site, including measurements now data obtained through EMS, sensors and protection devices (IEC 61850)

Now TSO-contributions instead of (data and components) manufacturers

Digital substation brings the IT into the OT

Equipment	Monitoring items	Sensor	Purpose		
			Degradation diagnosis	Life assessment	Efficiency of maintenance
GIS Overall	Gas pressure Slow leak	Gas pressure sensor Temperature sensor	✓		
GCB	Operating characteristics	DC clamp CT Travel sensor Auxiliary switch	✓	✓	✓
	Operation mechanism energy storage	DC/AC clamp CT Oil pressure sensor	✓	✓	
	Contact consumption	AC clamp CT	✓	✓	
DS/ES	Operating characteristics	DC clamp CT Operation check switch Temperature sensor	✓	✓	✓
OIT	Oil temperature	Temperature sensor	✓	✓	
	Oil level	Level sensor			✓
	Dissolved gas	Dissolved gas analysis unit	✓	✓	✓
Bushing	Partial discharge	PD sensor	✓	✓	
LTC	Driving torque	Torque sensor	✓	✓	✓

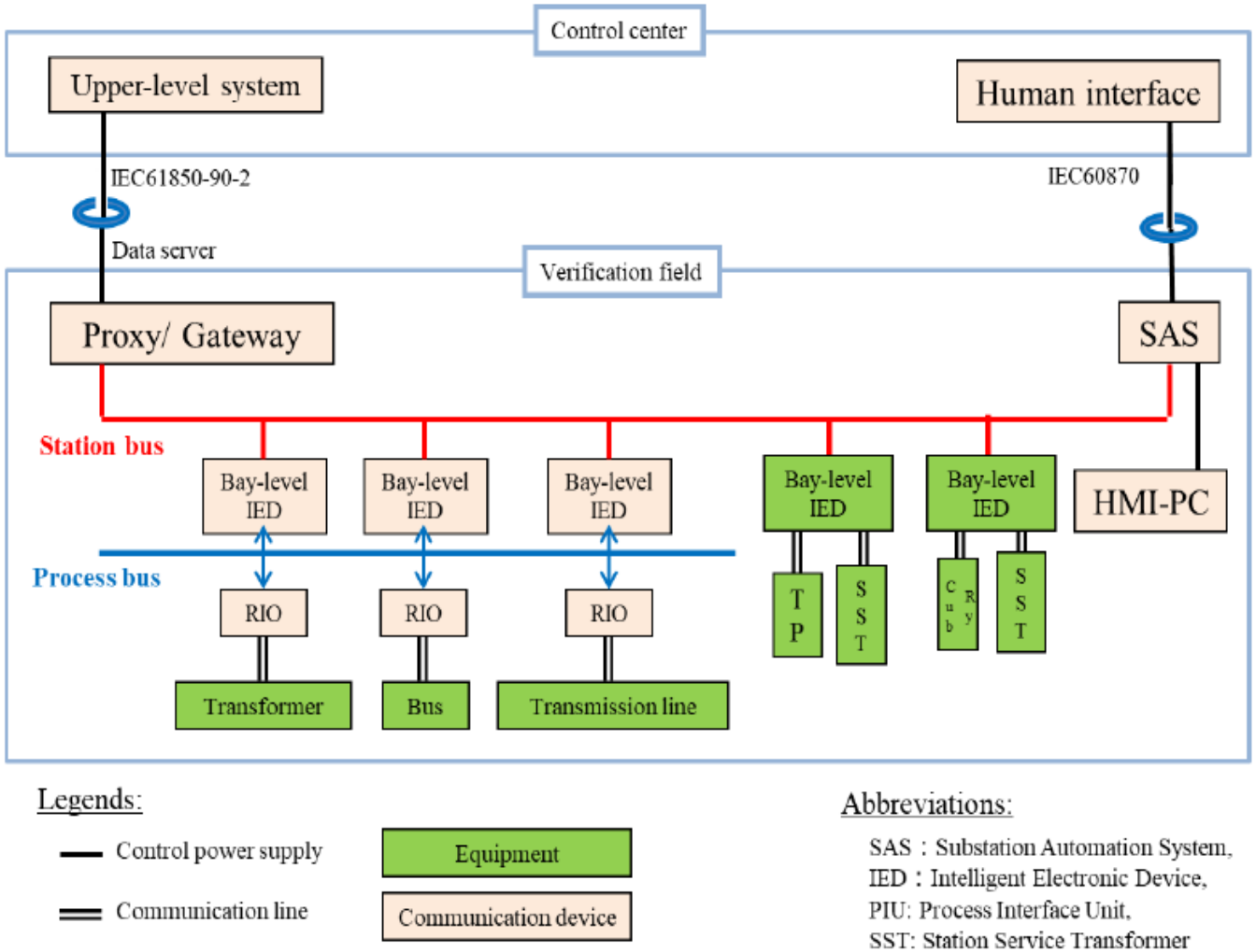


Figure 1 Overview of interoperability verification of communication device with IEC61850

From one contribution:

Cost-effectiveness of investment based on estimated conditions

- Mounting of sensors to equipment aged over 30 years
- Sensor repaired in 15 years and updated in 30 years
- An additional 10 years of service life prior to replacement (e.g. 60 to 70 years)
- Depreciation expense for 10 years included in the analysis
- Cost of data transmission is reflected
- Influence on sociatal benefits such as the avoidance of power outages is reflected

Digital substation brings the IT into the OT

The digital substation makes the energy management systems integrated into the IT of the enterprise:

- All data available from the substation can be consolidated in a BigData
- framework
- The condition monitoring will be based on all data from the overall system
- Asset management of the enterprise will manage IT elements but also primary
- devices, relays and edge devices
- New system management process could be inspired by IT process to
- automatically update devices without human interaction

New kind of device and replacement of wiring:

- Digital substation bring also new communication protocols and technics, reducing drastically the required wiring
- New kind of small wireless devices coming from the IoT reduce the needs to have specific devices with less flexibility

The impacts for the projects

- Integration with the IT will:
  - Reduce the cost of deployment and maintenance with a global infrastructure
  - Improve the overall quality with a global process improving traceability of all pieces and with reducing human interaction and risk of human errors
- The new kind of device and communication technics will:
  - Reduce the global foot print and cost of connection infrastructure
  - Improve maintainability of devices which can be easily replaced

SC B3 Structure 2022

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/Secretaries

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	B3.53 Guidelines for Fire Risk Management in Substations	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	B3.58 Knowledge Transfer of Substation Engineering and Experiences	B3.61 Risk and asset health-based decision making in existing substations
B3.54 Earthing System Test Methods	B3.57 Impact on Engineering and Lifetime Management of Outdoor HV GIS	B3.64 Guidelines on Optimising Seismic Design of Substations for Power Resiliency	JWG B3/D2.62 Life-long Supervision and Management of Substations by use of Sensors, Mobile Devices, Information and Communication Technologies
B3.65 Guidelines for the Selection and Design of escape routes for substations rated above 1kV AC and 1.5 kV DC	JWG B3/A3.59 Guidelines for SF6 end-of-life treatment of T&D equipment (>1kV) in Substations		
JWG B1/B3.74 Recommendations for a performance guideline of Polymer Insulated Busbars	JWG B3/A3.60 User guide for non-SF6 gases and gas mixtures in Substations	New WG in 2021/2022	
12 WGs, 6 JWGs, 1 Special project	JWG B3/D1.63 Guideline for assessing the toxicity of used SF6 gas onsite and in the lab of T&D equipment	Greenbook Project 2 - SF6 Guidebook	
	JWG B1/B3/D1.79 Recommendations for dielectric testing of HVDC gas insulated system cable sealing ends		

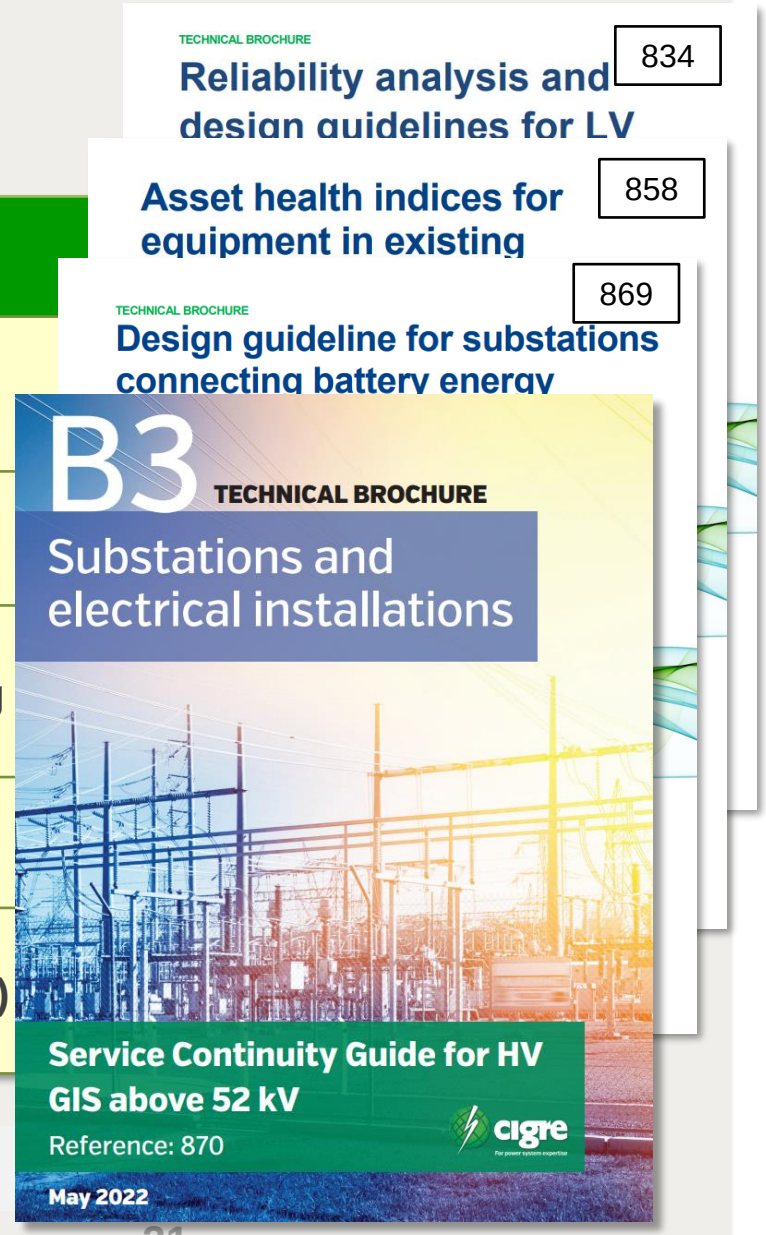
Legend:
- Current
- Joint WG led by B3
- Joint WG led by Other SCs
- Special Project

SC B3 WG convener

WG #	WG Title	Convener	Country
B3.41	Mobile Substations Incorporating HV GIS	Paul Fletcher	UK
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
B3.53	Guidelines for Fire Risk Management in Substations	Shinki Noguchi	Japan
B3.54	Earthing System Test Methods	Stephen Palmer	Australia
B3.56	Application of 3D Technologies in Substation Engineering Works	Philip König	South Africa
B3.57	Impact on Engineering and Lifetime Management of Outdoor HV GIS	Toshiyuki Saida	Japan
B3.58	Knowledge Transfer of Substation Engineering and Experiences	Akira Okada	Japan
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

B3 Publications 2021-2022

No.	WG	Title	Convener
834	B3.42	Reliability Analysis and Design Guidelines for LV AC Auxiliary Systems	Fan Jianbin (CN)
858	B3.48	Asset health indices for equipment in existing substations	Jan Bednarik (IE)
869	B3.55	Design guideline for substations connecting battery energy storage solutions (BESS)	Suriya Prungkhwunmuang (TH)
870	B3.39	Service Continuity Guide for HV GIS above 52 kV	Mark Kuschel (DE)
Soon	B3.53	Guidelines for Fire Risk Management in Substations	Shinki Noguchi (JP)



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2024 SC B3 Preferential Subjects (Proposal)

PS1 : Challenges & New Solutions in Design and Construction on T&D Substations for Energy Transition

- Design impacts on On-Offshore wind, PV, Hydrogen, EV charging infrastructure etc.
- New function in substation (energy storage, synchronous compensators, etc.)
- HV-MV DC substation and GIS/GIL application for DC network
- New design, manufacturing and construction toward circular economy

PS2 : Return on Operational Experiences for Sustainable Substation Management

- Initiatives to strengthen resilience, reliability and security
- Challenge of sustainable management (advanced asset management and end of life management)
- Lesson learned from operational experience of SF_6 alternatives solutions
- New findings from user experiences on digital transformation (DX) and digital substation
- New set of competency for new technologies, knowledge transfer and high standards of education in engineering skills