

Take aways Cigre 2020 e-edition

B3 Substations



cigre

For power system expertise

B3

CIGRE e-session 48, 2/3 september 2020



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For power system expertise

CIGRE's 16 domains of work each has a dedicated Study Committee

Group A – Equipment:

- A1 Rotating electrical machines
- A2 Power transformers and reactors
- A3 Transmission and distribution equipment

Group B – Technologies:

- B1 Insulated cables
- B2 Overhead lines
- B3 Substations and electrical installations**
- B4 DC systems and power electronics
- B5 Protection and automation

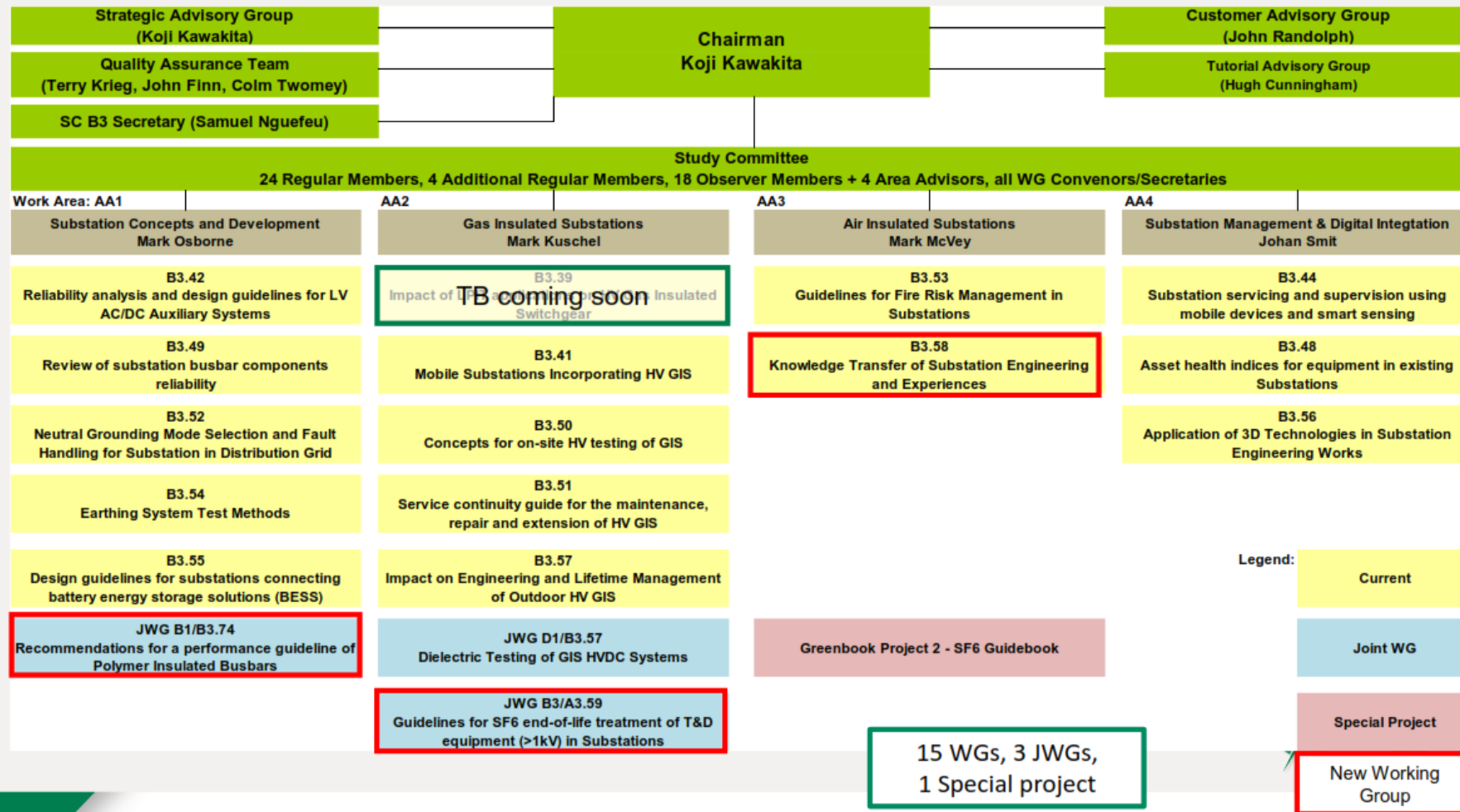
Group C – Systems:

- C1 Power system development and economics
- C2 Power system operation and control
- C3 Power system environmental performance
- C4 Power system technical performance
- C5 Electricity markets and regulation
- C6 Active distribution systems and distributed energy resources

Group D – New materials & IT:

- D1 Materials and emerging test techniques
- D2 Information systems and telecommunication

SC B3 Structure 2020 – after 2020 e-session -



Overzicht activiteiten 2019/2020

B3 Activities

Publication Technical Brochure 2019-2020

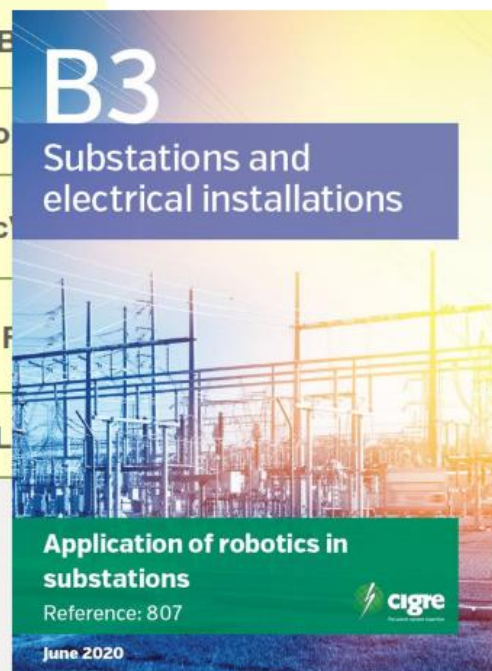
No.	WG	Title	
784	B1/B3.49	Standard design of a common dry type plug-in interface for GIS and power cable up to 145kV	P. MIREB
802	B3.45	Application of non-SF ₆ gases or mixtures in MV and HV GIS	Piet Kno
805	B3.46	Guidelines for Safe Work Methods in Substations	Mark Mc
807	B3.47	Application of Robotics in Substations	Jianbin F
Soon	B3.39	Impact of LPIT applications on HV Gas Insulated Switchgear	Robert L

CIGRE member free download from e-cigre: <https://e-cigre.org/>

Standard design of a common, dry type plug-in

Application of non-SF₆ gases or gas-mixtures in medium and high voltage gas-

Guidelines for safe work methods in substations



Cigre e-sessions 2020

CIGRE 2020 e-session general programme

17/08/2020

CHANNEL 1

CEST Time	Session
Mon. Aug. 24	
8:30 - 10:20	Opening ceremony
10:40 - 12:30	B4 Workshop
14:00 - 18:30	C6 Workshop

Tue. Aug. 25	
8:30 - 12:30	C4 Paper session 1
14:00 - 18:30	C4 Paper session 2

Wed. Aug. 26	
8:30 - 13:00	C4 Paper session 3
14:00 - 16:00	C4 Paper session 4

Thu. Aug. 27	
8:30 - 12:30	B5 Paper session 1
13:30 - 18:00	B5 Paper session 2

Fri. Aug. 28	
8:30 - 11:50	B5 Paper session 3
14:00 - 15:50	B5 Tutorial

CHANNEL 2

CEST Time	Session
Mon. Aug. 24	
8:30 - 10:20	
10:40 - 12:30	A3 Tutorial
14:00 - 18:30	C2-C5 Workshop

Tue. Aug. 25	
8:30 - 12:35	D2 Paper session 1
14:00 - 17:50	D2 Paper session 2

Wed. Aug. 26	
8:30 - 12:40	D2 Paper session 3
14:00 - 18:25	D2 Paper session 4

Thu. Aug. 27	
8:25 - 13:30	C6 Paper session 1
14:10 - 17:35	C6 Paper session 2

Fri. Aug. 28	
8:30 - 12:00	C6 Paper session 3
12:55 - 19:00	C2/C6 Paper session 1

CHANNEL 3

CEST Time	Session
Mon. Aug. 24	
8:30 - 10:20	
10:40 - 12:30	C6 Tutorial
14:00 - 18:30	C4 Workshop

Tue. Aug. 25	
11:00 - 12:30	C3 Paper session 1
13:25 - 17:00	C3 Paper session 2

Wed. Aug. 26	
8:55 - 12:30	A3 Paper session 1
13:55 - 18:15	A3 Paper session 2

Thu. Aug. 27	
8:30 - 12:25	C2 Paper session 1
14:00 - 17:45	C2 Paper session 2

Fri. Aug. 28	
8:30 - 11:50	C2 Paper session 3
14:00 - 15:00	ETIP-SNET
15:20 - 15:45	CIGRE - World Bank
16:00 - 17:00	NGN Forum

Aug. 31	
13:00 - 17:50	A2 Paper session 1
	A2 Paper session 2

Sep. 1	
12:10 - 15:50	A2 Paper session 3
	A2 Tutorial
16:30 - 18:30	C2 Tutorial

Sep. 2	
12:20 - 18:30	B2 Paper session 1
	B2 Paper session 2

Sep. 3	
13:50 - 15:50	B2 Paper session 3
	C1 Tutorial
16:30 - 18:30	B4 Tutorial

CHANNEL 4

CEST Time	Session
Mon. Aug. 24	
8:30 - 10:20	
10:40 - 12:30	C3 Tutorial
14:00 - 18:30	A3/B4 Workshop

Tue. Aug. 25	
8:55 - 12:45	A1 Paper session 1
14:00 - 15:50	A1 Tutorial
16:10 - 18:30	B2 Tutorial

Wed. Aug. 26	
8:55 - 12:35	A1 Paper session 2
14:00 - 15:50	B3 Tutorial
16:10 - 18:30	B1 Tutorial

Thu. Aug. 27	
8:25 - 12:20	A3 Paper session 3
14:00 - 15:50	D1 Tutorial
16:10 - 18:30	C4 Tutorial

Fri. Aug. 28	
8:30 - 10:20	D2 Tutorial
11:00 - 12:00	Thinksmartgrids
14:00 - 16:00	WIE forum

Mon. Aug. 31	
10:00 - 13:30	C1 Paper session 1
14:00 - 17:00	C1 Paper session 2

Tue. Sep. 1	
10:00 - 13:50	C1 Paper session 3
14:00 - 17:00	C1 Paper session 4

Wed. Sep. 2	
8:45 - 12:45	D1 Paper session 1
13:45 - 17:45	D1 Paper session 2

Thu. Sep. 3	
8:45 - 12:45	D1 Paper session 3
13:45 - 17:30	D1 Paper session 4

Wed. Sep. 2

9:00 - 12:05

[B3 Paper session 1](#)

13:30 - 16:45

[B3 Paper session 2](#)

Thu. Sep. 3

9:00 - 13:00

[B3 Paper session 3](#)

13:30 - 17:45

[B3 Paper session 4](#)

CIGRE - 2020 e-session / Paper presentations

Paper number	Paper title (B3 sessions)	Main author	Main author's country	Session of presentation	Day (CEST)
B3-104	TenneT's giant leap to be able to replace 140 substations within next 10 year, while in service and coming from different lay-outs	A. LATHOUWERS	NETHERLANDS	B3 - Session 1	Wed. Sep. 2
B3-302	Data to Decisions: Future-proof Integration of Substation Intelligence	G. RAJAPPAN	USA	B3 - Session 3	Thu. Sep. 3
B3-303	A fleet of digital substations at Alliander, a blessing after an intense learning curve	M. VAN RIET	NETHERLANDS	B3 - Session 3	Thu. Sep. 3
B3-306	Implementation of Artificial Neural Networks in Design of Steel Cap Plates of Substation Support Structures	OMER BURAK YUCEL	TURKEY	B3 - Session 3	Thu. Sep. 3
B3-307	Pre-Qualification Testing of Digital Substations	B. BAUM	NETHERLANDS	B3 - Session 3	Thu. Sep. 3
B3-207	Evolution of skills and managing competency in high voltage substation engineering design	T. CONDON	IRELAND	B3 - Session 4	Thu. Sep. 3
B3-208	A Novel Evaluation Method for the Integrity of Grounding Grids in High Voltage Substations Based on Magnetic Field Measurements	M. MISRA	NETHERLANDS	B3 - Session 4	Thu. Sep. 3
B3-209	Repair cost planning as a reliability factor	Y. ZHILKINA	RUSSIA	B3 - Session 4	Thu. Sep. 3

Draft 2022 B3 Preferential Subjects

PS 1: Increased impact of clean energy transition on Substations

- Offshore wind, PV, Geothermal, Bio-mass etc.
- Energy Storage, Hydrogen, Synchronous compensators, etc.
- DC GIS and DC substation for HVDC multi terminal systems

PS 2: Sustainable Challenges in Substations for Future Sustainability

- Substation design, operation and maintenance experiences against natural disasters and threats (terrorism, epidemic, physical/cyber, etc..)
- SF₆ alternatives, 3R (Reuse, Reduce, Recycle) of materials, visual impact, etc.
- Optimised asset decision making in existing substations, uprating & upgrading, dynamic rating, etc.
- New set of skills for new technologies, Knowledge transfer and high standards of education in engineering skills

PS 3: Integration of Intelligence on Substations

- Data analytics, remote supervising & monitoring and autonomy application
- Expectations and benefits from digital substation

SC B3 Strategic Plan 2018-2028 Review

Change of Operational Surroundings

In order to support the realization of a sustainable society, substations' research & development continues to make advances in new technologies and applications that give substation owners and operators the flexibility, security and stability they need to continue to expand their systems in an efficient and environmentally friendly manner.

- **Impact on substation design with integration of renewable energy resources, energy storage system and other installations;**
- **Mitigating environmental, health, safety and security impacts, includes reduction of carbon footprint;**
- **Optimising substation asset intervention (retrofit, uprating, upgrading, renewal, extensions);**
- **Increased substation operational efficiency and availability;**
- **Integration of intelligence for digitalization;**
- **Competency development and its management.**

These solutions are aimed to include the needs of developing communities and emerging economies, as well as those of the industrialized countries.

SC B3 Strategic Plan 2018-2028 Review

Main Technical Directions

- T1. New substation concepts:** Development of new concepts including bus arrangements, hybrid solutions, new applications and functions, distributed generation and power flow control systems including specification of corresponding design/layout criteria for substations constituting integral parts of totally optimised networks. Reduction of carbon footprint impact by new technologies.
- T2. Substation ownership issues:** Organisational aspects including human resource and training needs, in-service support, software management including quality control and maintenance. Management of assets including environmental, health, safety, and security.
- T3. Life cycle management:** Monitoring in-service experience, substation condition assessment, aspects of maintenance outsourcing, short-and long-term needs, opportunities for cost reduction, spare parts. Increased utilisation (life extension, upgrading, and dynamic loading), refurbishment /renovation concepts, and investment strategies, principles for combining existing and new equipment - taking into account specific demands from network-reliability and customer demand-side points of view.
- T4. Integration of intelligence for digitalization on substations:** New digital technologies (Artificial Intelligence, Internet of Things, 3-Dimensional technology etc.) and applications to be used in all types of substations, increased use of advanced information and communication technologies.

Een overzicht van activiteiten tijdens e-session 2020

Tue Aug 25: Annual **Study Committee Meeting**, 40 countries represented; 64 on-line participants

Wed Aug 26: **Tutorial** “Guidelines for Safe Work Methods in Substations”

- 107 GoToWebinar attendees

Thu Sep 2-3: **Paper Session**

- 430 registrations and 220 on-line attendees (max.), 49 authors,
- 200 spontaneous contributions (75 via web chat and 125 KMS) continues on the KMS!

Scope of the selected papers

- Research, development, design, construction, operation and maintenance and ongoing lifetime management
- Technical, economics, safety, environmental and social aspects
 - Improving reliability and availability, optimizing substation asset management, identifying best-value solutions
 - Minimizing environmental impact while recognizing social needs and priorities in facilitating the sustainable development of substations

2020 Preferential Subjects

PS 1 Design and Technologies

- Impact on design and installation of disruptive and emerging technologies
- Mitigating environmental, health, safety and security impacts
- Rapid deployment and cost effective contemporary solutions for electrification of developing communities

PS 2 Optimised Management

- Best practice in design of assets by optimising their life in a cost effective way
- Service continuity for maintenance, refurbishment and replacement
- Evolution of skills and managing competency

PS3 Integration of Intelligence

- Application of new concepts such as IoT and big data analytics
- Challenges and expectations for digitalized substations

25th August 2020
CIGRE e-session

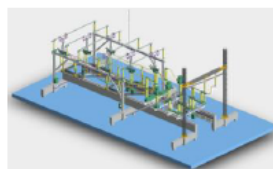
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Overzicht van de papers:

B3 Discussion Meeting – 2020 PS1 Paper Topics

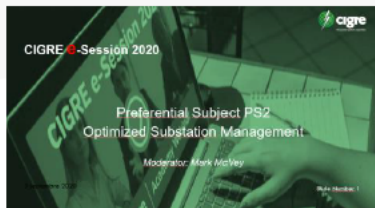
Special Reporter:
Mark OSBORNE (UK)

- HVDC converter station electric fields (Sweden)
- EMF exposure values (Portugal)
- health and safety partnership approach (France)
- arc flash hazards (Italy)
- water-oil separation (Brazil)
- seismic design optimization (Japan)
- modular green substations for BESS (Korea)
- replacing bulk number of substations with AIS or GIS modular designs (Netherlands)
- 420 kV GIS/cable interface issues (Norway), and GIS experience (Spain)
- 145kV clean-air GIS installation (Germany), 145kV alternative-gas GIS trial installation (France), and world's first non-SF6 420 kV GIS (Germany)
- SF6 breaker monitoring approach (Ukraine)
- offshore substation analysis (France), compact HVDC GIS (Switzerland), prototype HVDC GIS for meshed offshore grids (Switzerland), and 66kV offshore wind power interfaces (Switzerland).
- assessing optimal construction methods for new AIS (Colombia)
- flexible integration of phase-shifters (Germany)
- lightning protection for bus-node substations (Switzerland)

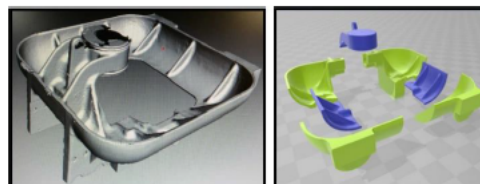


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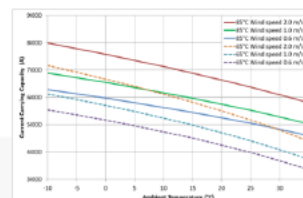
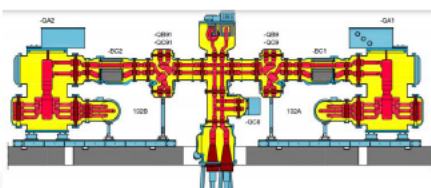
B3 Discussion Meeting – 2020 PS2 Paper Topics



Special Reporter:
Mark McVEY (USA)



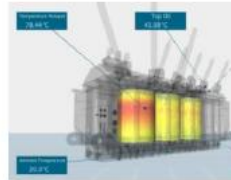
- Optimization of health indices for assets using Machine Learning Method (Korea)
- Aeolian vibration challenges at renewable substation (India)
- Maintenance, monitoring & strengthening of substation grounding (India)
- Refurbishment and replacement of aged 132 kV GIS (Norway)
- Value quantification for digital substations (Germany)
- Investigation on the dynamic rating of tubular busbars (Austria)
- Evolution of skills and managing competency in engineering design (Ireland)
- Novel evaluation method for the integrity of grounding grids based on magnetic field measurements (Netherlands)
- Non-intrusive diagnostic methods for AIS & GIS HV equipment (France)
- Integration of condition monitoring into substation asset risk management (USA)
- Additive manufacturing of spare parts for power equipment (Brazil)



B3 Discussion Meeting – 2020 PS3 Paper Topics

Special Reporter:
Uwe SCHICHLER (Austria)

- experiences with digital substations (Netherlands)
- intelligent IoT-connected substation equipment (Germany)
- green and digital 50 kV GIS (Netherlands)
- expectations, realities and opportunities for 3D/BIM/Digital twin (USA)
- future-proof integration of substation intelligence (USA)
- reconstruction experience with SVC analogue controller (Czech Republic)
- performance evaluation and comparison across conventional, non-conventional, analog and digital substation measurement chains (UK)
- pre-qualification testing of digital substations (Netherlands)
- digitalization solutions for planning, design, construction, operation and maintenance (Japan)
- innovation practices of maintenance operation scheme based on VR visualization (China)
- implementing artificial neural networks (ANN) for structure design (Turkey)
- using edge computing technology for power transformer monitoring (Korea)



Conclusie van B3-NL: (lezen verdeeld over de B3-leden)



Papers te clusteren in:

- Niet SF6
- Ontwikkelingen wereldwijd om stationsopbouw te standaardiseren
- HVDC
- Introductie digitalisatie
- WVTTK

Nieuwe gassen

- Zowel in Europa als bv in Korea wordt aan alternatieven voor SF6 gewerkt.
- Commerciële papers
- Driekleur aan alternatieven

Voor meer (algemene) informatie:

WG B3.45 Piet Knol

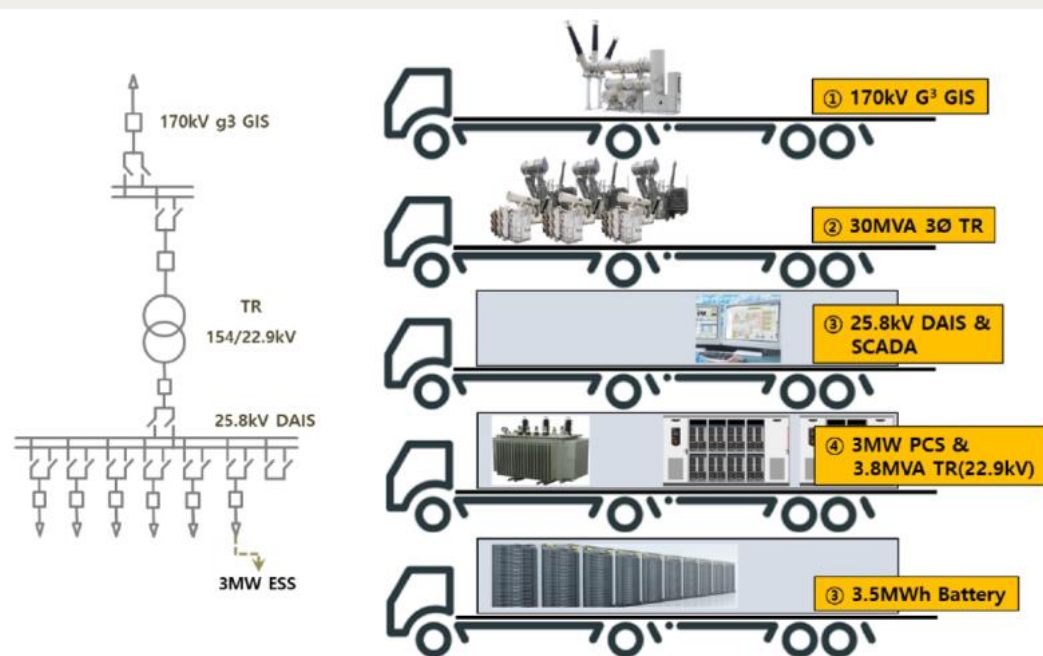
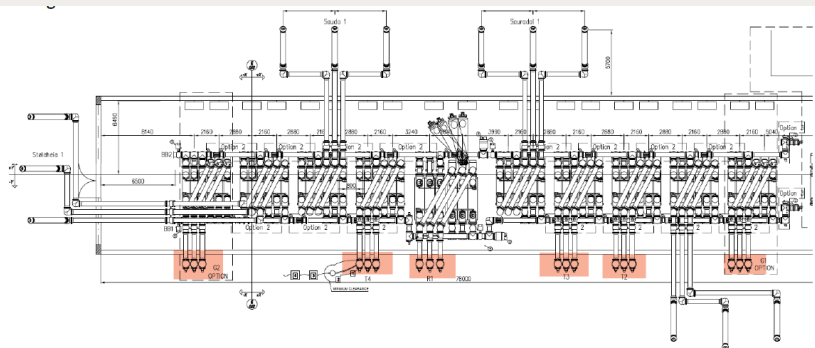
WG A3.41 René Smeets,
André Lathouwers



Low temp
application

standaardisatie

- Dwarsregeltrafo's: worden steeds vaker toegepast, dus tijd voor gestandaardiseerde plaatsing in (bestaande) onderstations (50Hz+Elia)
- 420 kV-GIS met (zwakke) kabeleindsluiting in aparte ruimte naast GIS, dus geen kelder (Stattnet)
- T.b.v. (snelle) aansluiting decentrale opwekking: station verdeeld over 4 opleggers (LSIS-Korea)
- Colombia, 220 kV versnelling
- NL: veldvervanging



Colombia, 220 kV

Table 1: Traditional vs. containerized approach for C&P panels

Activity	Design	Construction	Conventions
Traditional approach			
Control building	70 days	90 days	Design
Panels install, cabling, testing	60 days	30 days	Construction
Time used	190 days		Traditional approach
Containerized approach			
Panels install, cabling, testing	30 days	120 days(1)	Design
Time used	150 days		Fast-paced approach
		40 days	Time gained

(1) Container delivery from third-party included



Table 3: Onsite casting vs. precast approach for equipment foundations

Activity	Design	Construction		Conventions	
Traditional approach				<div></div>	Design
Equipment foundations	40 days	80 days		<div></div>	Construction
Time used	120 days			<div></div>	Traditional approach
Precast approach				<div></div>	Dead time
Equipment foundations	40 days	50 days (1)		<div></div>	Fast-paced approach
Time used	90 days		40 days	<div></div>	Time gained

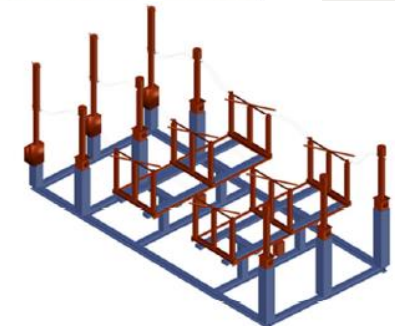
(1) Precast activities in warehouse included



Table 5: Onsite erection vs. skid-type bays preassembly approach

Activity	Design	Construction	Conventions
Traditional approach			<div>Design</div>
Equipment erection	(1)	120 days	<div>Construction</div>
Equipment connection		21 days	<div>Traditional approach</div>
Time used		120 days	<div>Dead time</div>
Precast approach			<div>Fast-paced approach</div>
Equipment erection	(1)	90 days	<div>Time gained</div>
Equipment connection		21 days	
Time used		90 days	30 days

(1) Design time for both approaches is the same



HVDC

HVDC is nieuw, dus bron voor discussies:

- Discussies voornamelijk over hoe te testen

Health index, digitalisatie

- Circuit breaker monitoring system, een trend om conditie anders vast te gaan stellen
- Dynamic resistance measurement en Röntgen
- Digitalisation of all new transmission equipment in a substation
- Drones
- Artificial Intelligence

WVTTK

- Safety
- Aardbevingen, seismic design optimization
- Gedachtenexperiment: hele station opdelen in 3-fasen
- Aardnet
- 3D- BIM, VR, drones

Verdere vragen:

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