

# Cigre B4 Paris Session 2022 Key Take-Away's

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**cigre**

For power system expertise

# Outline

- Tutorials & Workshops
- Preferential subjects for 2022 Paris session
  - Insights of technical papers and presentations
- Overview of Working Groups (WG's)
  - Overview of finalized, ongoing, and recently started
- Preferential subjects for 2024 Paris session
- Upcoming and Future B4 activities

1<sup>st</sup> September – Palais de Congres (Paris)





# Summary: Preferential Subjects → B4 Paris Session 2022



## ■ PS 1 HVDC Systems and their Applications

- 49 papers accepted
- 14 questions raised by special reporters
- 41 prepared contributions

## ■ PS 2 DC for Distribution Systems

- 4 papers accepted
- 1 question raised by special reporter
- 3 prepared contributions

## ■ PS 3 FACTS and Power Electronics (PE)

- 8 papers accepted
- 2 questions raised by special reporter
- 8 prepared contribution

## ■ Special subjects → Grid Forming Converters

- 6 papers accepted
- 2 questions raised by special reporter
- 8 prepared contribution

## ■ 560 delegates in person and a few more remote delegates → hot topics

- 32 spontaneous contributions

## Various aspects of HVDC and MVDC systems, FACTS

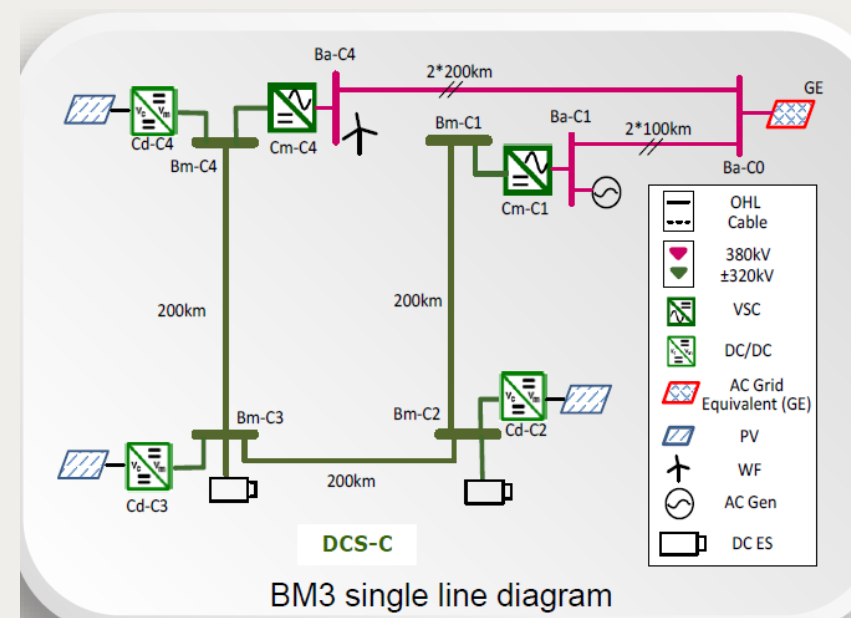
- HVDC Planning, Control, Protection, Operation, Design & Performance
- Fault Ride-Through & Clearing in VSC HVDC Applications
- HVDC Refurbishment
- Harmonics and Filtering in HVDC Applications
- Offshore HVDC DC Grids
- Multi-Terminal & Hybrid (LCC+VSC) HVDC Systems
- HVDC Multi-Vendor Issues
- Lab & Field Testing of HVDC & MVDC Applications, etc.
- HVDC Statistics, Reliability Availability & Maintainability (RAM)
- DC/DC Converters
- SVC & STATCOM Applications
- Other FACTS Applications
- Grid Forming Applications

# Tutorial 2022

- **DC Grid Benchmark Models for System Studies (WG B4.72)**
- Life extension of oil-filled static machines
- Field experience with vacuum switching devices
- A new era for submarine cables
- Coatings for power network equipment
- Asset health indices for equipment in existing substations
- Implementation, Benefits & constraints of Wide Area Protection
- Global Grids
- TSO-DSO cooperation – control center tools requirements
- Interaction between wildlife and electrical infrastructures
- Evaluation of temporary overvoltages in power system due to low order harmonic resonances
- Carbon pricing in wholesale electricity markets
- Electric vehicles as distributed energy resource systems
- Electric performance of new non-SF<sub>6</sub> gases and gas mixtures for gas-insulated systems
- Artificial intelligence application and technology in power systems

# Tutorial: DC Grid Benchmark Models for System Studies

- WG B4.72 → Comprehensive Technical Brochure → TB 804
- Establish HVDC grid benchmark models covering most of different HVDC grid applications for different types of system studies
- Global survey of existing multiterminal
- Developed seven HVDC grid benchmark models
  - Considering VSC, LCC HVDC and hybrid LCC/VSC DC grids
  - EMT models in PSCAD and/or EMTP
  - Load Flow (RMS) models with MATLAB, Digsilent
  - Real Time Simulation models (RTDS and Hypersim)

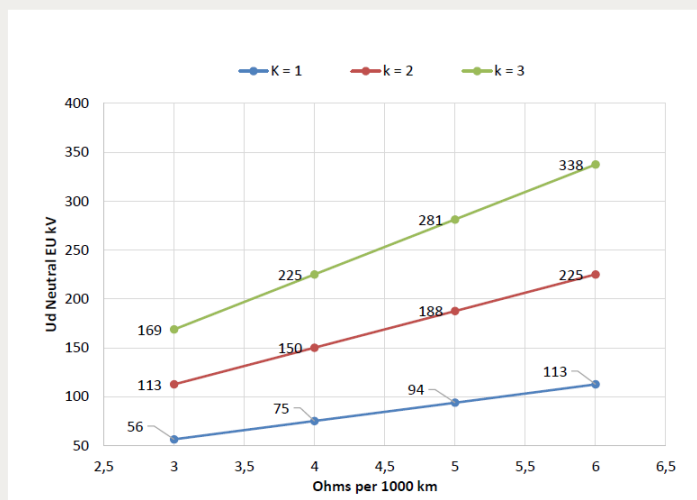


## Workshop:

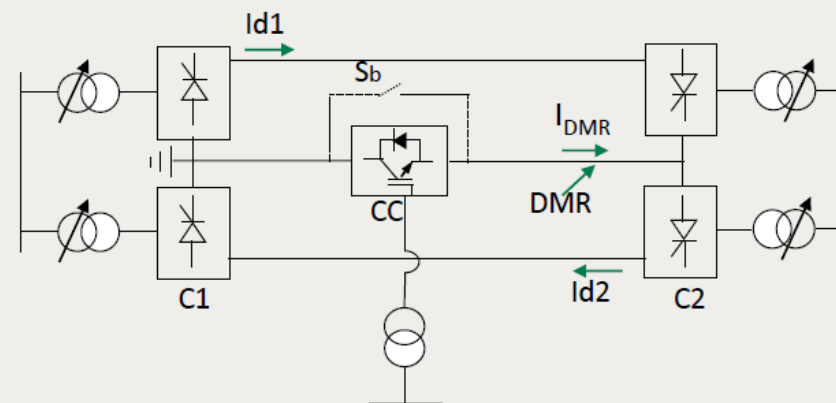
# EXTRA-LONG TRANSNATIONAL TRANSMISSION LINES → SC: B1-B2-B4-C1

## ■ B4 Contribution

- Compensation Methods for Voltage Drop Effect in Long HVDC Systems



Voltage rise in EU1 station when  $I_{dc}=1pu$  from China to EU1



- High impedance grounding will reduce the neutral voltage rise and fault current
- Compensating converter can reduce the neutral voltage and the tap changer range



## Overview of Completed Working Groups (WGs)

- B4.74 - Guide to Develop Real Time Simulation Models (RTSM) for HVDC Operational Studies (TB 864)
- B4.83 - Flexible AC Transmission Systems (FACTS) controllers commissioning, compliance testing and model validation tests (TB 867)
- **C6/B4.37 - Medium Voltage DC distribution systems (TB 875) - *(NL participation)***
- **B4/A3.80 – Design, test and application of HVDC circuit breakers (TB 873) – *(NL participation)***
- **C4/B4.52 – Guidelines for Sub-synchronous Oscillation Studies in Power Electronics Dominated Power Systems – *under 60-day review - (NL participation)***
- **AG B4.04 - Static Var Compensator/STATCOM performance survey results – 2017 and 2019 - *(NL participation)***

## Overview of WGs Expected to be finalized in 2022

- 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 (*NL participation*)**
- 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 (*NL participation*)**
- 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

# Overview of Ongoing Working Groups

- WG B4.85 – Interoperability in HVDC systems based on partially open-source software
- **JWG B4/A3.86 – Fault Current Limiting Technologies for DC Grids (*NL participation*)**
- **WG B4.87 – Voltage Source Converter (VSC) HVDC responses to disturbances and faults in AC systems which have low synchronous generation (*NL participation*)**
- **TF B4/B1.88 – Insulation coordination procedure for DC cable systems in HVDC stations with Voltage Source Converters (VSC) (*NL participation*)**
- 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

## Overview of recently started Working Groups

- WG B4.93 – Development of Grid-Forming Converters for Secure and Reliable Operation of Future Electricity Systems
- **JWG C4/B4.72 - Lightning and Switching Induced Electromagnetic Compatibility (EMC) issues in DC power systems and new emerging power electronics-based DC equipment (*NL participation*)**
- **JWG C2/B4.43 – The impact of Offshore Wind power hybrid AC/DC connections on System Operations and System Design (*NL participation*)**
- **B4.94 Application of VSC-HVDC in a System Black Start Restoration (*NL participation*)**

## New WG proposals

- JTF B1/B3/B4/C4/D1.95 Harmonization of voltage designations and definitions across different HVDC component technologies

# Preferential subjects Paris session 2024

- **PS1 : DC Equipment and Systems**

- Planning, design, performance, testing and commissioning of DC equipment and systems including Point to Point, Multiterminal and DC Grids including offshore DC systems
- Refurbishment and upgrade of existing DC systems
- Service and operating experience of DC converter stations and systems especially VSC based DC systems and offshore DC systems

- **PS2: FACTS and Power Electronics (PE)**

- Planning, design, performance, testing and commissioning of FACTS and other PE-interfaced devices
- Refurbishment and upgrade of existing FACTS and other PE devices
- Service and operating experience

- **PS3: New Technologies and Concepts of DC and FACTS enabling energy transition**

- New technologies/concepts to address network issues associated with green energy transition such as application of grid forming converters, multi-vendor interoperability.
- New concepts, technologies and design of DC converters and PE devices for both transmission and distribution systems including interfacing generation and storage to the network, energy hubs/islands, etc



## Upcoming CIGRE B4 activities

- Cigré B4 SC Meeting & Colloquium in Austria 2023 – Vienna, September 9 – 15, 2023.
- 2023 CIGRE/GCC Muscat Symposium
  - Symposium being planned for 6-8 March 2023 on “**Transition to Resilient Power Systems in Future Grids**”
  - The topic for B4 is “**Developments in HVDC Grid and Multi-terminal HVDC**”
  - B4 is one of the two leading SCs at this symposium.
- B4 has received the following invitations for future meetings:
  - Norway NC – 2024/2025 symposium
  - Israel NC – 2025 or 2027 symposium
  - India NC – 2025, 2027 or 2029 symposium

Thank you!