

# SC B4 HVDC and Power Electronics

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**cigre**

For power system expertise

# CIGRE Key Take Away's

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# Highlights

1. Completed Working Groups (WG's)
2. Progress of ongoing WG's
3. New WG's
4. Technical paper presentations during B4 e-session
5. Other SC B4 activities during the e-session
6. 2022 Session and preferential subjects



## Completed Working Groups (WG's)

- JWG C4/B4.38 Network modelling for harmonic studies (TB 766)
- B4.66 – Implications for harmonics and filtering of the staggered installation of HVDC converter stations in proximate locations (TB 798)
- B4.72 - DC grid benchmark models for system studies (TB 804)
- B4. 68 – Revision of Technical Brochure 92 – DC Harmonics and Filtering (TB 811)

# Progress of ongoing WG's

Title of WG	Targeted Completion Date	NL representation
B4.64: IMPACT OF AC SYSTEM CHARACTERISTICS ON THE PERFORMANCE OF HVDC SCHEMES	End of 2020	
WG B4-69 MINIMIZING LOSS OF TRANSMITTED POWER BY VSC DURING OVERHEAD LINE FAULT	End of 2020	✓
WG B4-70 GUIDE FOR ELECTROMAGNETIC TRANSIENT STUDIES INVOLVING VSC CONVERTERS	October 2020 for Cigre review	
WG B4-71 APPLICATION GUIDE FOR THE INSULATION COORDINATION OF VOLTAGE SOURCE CONVERTER HVDC (VSC HVDC) STATIONS	Q1 2021	
JWG B4/B1/C4.73 – SURGE AND EXTENDED OVERVOLTAGE TESTING OF HVDC CABLE SYSTEMS		
WG B4.74 - GUIDE TO DEVELOP REAL TIME SIMULATION MODELS (RTSM) FOR HVDC OPERATIONAL STUDIES	End of 2020	
WG B4.75 - FEASIBILITY STUDY FOR ASSESSMENT OF LAB LOSSES MEASUREMENT OF VSC VALVES	2021	✓
WG B4.76 - DC/DC CONVERTERS IN HVDC GRIDS AND FOR CONNECTIONS TO HVDC SYSTEMS	October 2020	

# Progress of ongoing WG's

Title of WG	Targeted Completion Date	NL representation
WG B4.78 - CYBER ASSET MANAGEMENT FOR HVDC/FACTS SYSTEMS	November 2020	
JWG C2/B4.38 - CAPABILITIES AND REQUIREMENTS DEFINITION FOR POWER ELECTRONICS BASED TECHNOLOGY FOR SECURE AND EFFICIENT SYSTEM OPERATION	End of 2020	✓
WG B4.79 - HYBRID LCC/VSC HVDC SYSTEMS	Jan 2022	✓
JWG C6/B4.37 - MEDIUM VOLTAGE DC DISTRIBUTION SYSTEMS		
JWG C4/B4.52 - GUIDELINES FOR SUB-SYNCHRONOUS OSCILLATION STUDIES IN POWER ELECTRONICS DOMINATED POWER SYSTEMS	Jan 2022	✓
JWG B4/A3.80 - HVDC CIRCUIT BREAKERS - TECHNICAL REQUIREMENTS, STRESSES AND TESTING METHODS TO INVESTIGATE THE INTERACTION WITH THE SYSTEM	April 2022	✓
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		

# Progress of ongoing WG's

Title of WG	Targeted Completion Date	NL representation
WG B4.83 - FLEXIBLE AC TRANSMISSION SYSTEMS (FACTS) CONTROLLERS' COMMISSIONING, COMPLIANCE TESTING AND MODEL VALIDATION TESTS		
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	Started recently	
JWG B4/A3.86 Fault Current Limiting Technologies for DC Grids	Started recently	
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)		✓
WG B4.89 - CONDITION HEALTH MONITORING AND PREDICTIVE MAINTENANCE OF HVDC CONVERTER STATIONS	September 2022	

## NEW WORKING GROUP PROPOSALS

1. POWER ELECTRONICS-BASED TRANSFORMER TECHNOLOGY, DESIGN, GRID INTEGRATION AND SERVICES PROVISION TO THE GRID
2. STATCOMS AT DISTRIBUTION VOLTAGES
3. OPERATION AND MAINTENANCE OF HVDC FACILITIES



# Technical paper presentations during B4 e-session

- B4 e-session paper presentations scheduled over two consecutive days:
  - Monday August 31
  - Tuesday September 1
- The presentations organized in four sessions, two sessions per day
- *List of technical papers relevant for NL follows in next slides...*

## Technical paper presentations during B4 e-session

- B4-202 A New Method for Distinguishing DC Line Faults in Flexible DC Distribution System
- B4-203 Development of Multi-Terminal DC link in Distribution Network
- B4-108 Black-start and system restoration utilizing the NEMO Modular Multilevel Converter – a practical test in the Belgian transmission system
- B4-120 Multi Terminal Extension of Embedded Point to Point VSC HVDC Schemes
- B4-123 Towards a deployment plan for a future European offshore grid: cost-benefit analysis of topologies
- B4-116 Planning and implementation of an HVDC link embedded in a low fault level AC system with high penetration of wind generation

## Technical paper presentations during B4 e-session

- B4-117 Levelized Energy Cost Improvement through Concept Selection and Availability Optimization for the Norfolk Windfarms' Export Links
- B4-125 Improving synthetic inertia provision by power electronic interfaced power sources to support future system stability
- B4-121 A new approach to operational type testing of HVDC valves
- B4-105 Simulation and Development of HVDC Control Room with Advanced HMI, Interface Systems, Analytical Tools and Cybersecurity Infrastructure and Monitoring
- B4-139 A Survey of the Reliability of HVDC Systems throughout World during 2017 – 2018
- B4-134 The Method of Components Critical Priority Assessment for HVDC Station Asset Management System

## Technical paper presentations during B4 e-session

- B4- NGN Gen Li Analysis and Protection of Valve-Side Single-Phase-to-Ground Faults in HB-MMC based Bipolar HVDC Systems
- B4-132 Calculation method for peak short-circuit currents for the security of HVDC grids
- B4-107 Towards a deployment plan for a future European offshore grid: development of topologies
- B4-129 Method for detecting of faulted section in cable-overhead HVDC line
- B4-110 Open-Source HVDC Control - a High-Level Perspective
- B4-111 European Experiences in HVDC System Reliability and Availability
- B4-112 Challenges of HVDC standardization in external insulation design of converter stations
- B4- 137 Assessment of protection strategy options for future DC grids

## Other SC B4 activities during the e-session

1. SC B4 tutorial: *Inverters in weak/isolated grids – operational aspects*
2. SC B4 Workshop: *Interaction assessment of VSC-HVDC links using EMT-type tools (from offline to real-time)*
3. SC A3/B4 Workshop (*PROMOTioN / CIGRE*)  
*Workshop on meshed offshore HVDC transmission grid development (HVDC Switchgear, HVDC grid protection, HVDC grid and offshore windfarm control, Meshed HVDC Grid Development)*

# 2022 Session and preferential subjects

- In 2022, Paris session will resume to normal schedule

## PS1 : HVDC systems and their applications

- Planning and implementation of new HVDC projects including need, justification, design, integration of renewables, environmental and economic assessment
- Application of new technologies including cyber security and advanced controls to address emerging network issues, DC grid, Multi-Terminal HVDC and hybrid HVDC systems
- Refurbishment and upgrade of existing HVDC systems, service and operating experience of converter stations including offshore converters, and implication on converter equipment resulting from the conversion of ac circuits to dc circuits

## PS2 : DC for distribution systems

- DC applications in distribution systems
- New concepts, technologies and designs of equipment

## PS 3: FACTS and Power Electronic (PE)

- Planning and implementation of new FACTS and other PE devices including need, justification, for integration of renewables, environmental and economic assessment
- Application of new technologies in FACTS and other PE devices including interfacing generation and storage to the network
- Refurbishment and upgrade of existing FACTS and other PE devices, service and operating experience