CIGRE Study Committee C2

PROPOSAL FOR THE CREATION OF A NEW JOINT WORKING GROUP C2/B4.43

JWG C2/B4.43	**Name of Convenor: Christer Norlander** **E-mail address**: christer.norlander@svk.se
Strategic Directions #[2]: 1, 2	**Sustainable Development Goal #[3]: 7,9**
The JWG applies to distribution networks: ☐ Yes / ☒ No	
Potential Benefit of JWG work #[4] : 1,2,4,5	
Title of the Group: The impact of offshore wind power hybrid AC/DC connections on system operations and system design	

Scope, deliverables and proposed time schedule of the JWG:

Background:

In the spirit of the global energy transition to a more sustainable world, large numbers of offshore wind power are connected to the onshore grids which create (new) operational challenges for the (onshore) system operators. The technical possibilities to address when designing and operating such connections and the increasing complexity in the power system will, among others, be investigated.

Operating onshore AC/DC hybrid grids is already common practice in many countries (e.g. Brazil, USA, China, Canada, South Africa). This knowledge and experiences can be very useful for offshore AC/DC hybrid grids.
The specific design with VSC technology and the way offshore wind power installations are being operated will be investigated together with ideas for new design and operating concepts.

The Joint Working Group aims to investigate how system operators deal with the following topics:

- resilience (see WG B4.78 Cyber Asset Management for HVDC and FACTS) in the technical design of offshore wind power installations
- multi-purpose and multi-vendor interconnectors (WG B4.85 – “Interoperability in HVDC systems based on partially open-source software).

Further focus will be on the understanding of the needed interaction between the technical design and the operational concepts for the offshore grid and the onshore grid where the following topics will be addressed:

- requirements to cope with maximum power outage
- restoration after onshore and offshore disturbances
- the way maintenance and outages are handled
- operation of multi-terminal offshore AC/DC hybrid meshed grids with DC-breakers
- dynamic phenomena such as frequency and power swings (stability) and inertia
- harmonics and events that urge for quick ramping power.

The above topics will impact the design of the offshore grid in terms of topology, redundancy, protection schemes and requirements for overload conditions of assets. Besides that also relevant market design topics will be addressed. In TB 821 “Capabilities and requirements definition for power electronics based technology for secure and efficient system operation and control” have been investigated and to a certain extend offshore

design was considered as well.

The Joint Working Group will identify existing practises, methodologies and procedures for design and operation, and how this works in real life, describing the effects/impacts, degrees of freedom and investigate lessons learned and prepare recommendations.

Proposal(s) will be prepared on:

- Which standardization and harmonization requirements for technical design and operation are beneficial
- Operational and technical design concepts for future offshore wind power infrastructure including a meshed offshore grid
- How to realize a resilient and robust interoperability.

The outcome is expected to support the way system operators look at their future projects of onshore & offshore wind power connections in terms of technical design and operation.

Scope:

The objective of the Joint Working Group is to investigate:

- how system operators and wind farm developers design and operate their infrastructure to the offshore wind power installations
- which practices exist
- what are lessons learnt in practical examples
- ideas and investigations done for the future technical design and operation of their infrastructure to the offshore wind power installations and on the interaction with onshore grids.

The integration of the knowledge gained in a concise and compact Technical Brochure should help stakeholders decide how to design and operate the infrastructure to the onshore & offshore wind power installations.

The activities will focus on:

1. Reviewing previous CIGRE (SC C2, SC B4, JWG C2/B4) and other work (for instance from ENTSO-E) in this domain.
2. Survey the world wide experiences with onshore & offshore wind power installations
3. Describe the impact experienced with already existing onshore & offshore wind power installations
4. Identify and describe best practises
5. Investigate possible strategies for future design and operation of the infrastructure to the onshore & offshore wind power installations.

It is relevant that the JWG will consist of participants from power system operators and wind farm developers, vendors, consultants and the academic world.

Deliverables:

☒ Technical Brochure and Executive Summary in Electra
☒ Electra article
☐ Future Connections newsletter
☐ CSE
☒ Tutorial
☒ Webinar

Time Schedule: start: July 2022	**Final Report**: May 2024
• Prepare TB structure	July 2022
• Preparing survey	August 2022
• Collecting survey results	November 2022
• Analysing survey results	January 2023
• Electra article	October 2023
• Review first draft for TB	December 2023
• Develop revised draft of TB	February 2024
• Final TB (executive summary in Electra)	April 2024
• Tutorial	2024
• Webinar	2024
Approval by Technical Council Chairman: **Date**: July 7th, 2022	

Notes: [1] Working Group (WG) or Joint WG (JWG), [2] See attached Table 1, [3] See attached Table 2 and CIGRE reference Paper: Sustainability – at the heart of CIGRE's work. [4] See attached Table 3.

Table 1: Strategic directions of the Technical Council

1	The electrical power system of the future reinforcing the End-to-End nature of CIGRE: respond to speed of changes in the industry by preparing and disseminating state-of-the-art technological advances
2	Making the best use of the existing systems
3	Focus on the environment and sustainability (in case the WG shows a direct contribution to at least one SDG)
4	Preparation of material readable for non-technical audience

Table 2: Environmental requirements and sustainable development goals

	CIGRE selected the 7 SDGs that are the most relevant to CIGRE. In case the WG work refers to other SDGs or do not address any specific SDG, it will be quoted 0.
0	Other SDGs or not applied
7	**SDG 7: Affordable and clean energy** Increase share of renewable energy; e.g. expand infrastructure for supplying sustainable energy services; ensure universal access to affordable, reliable, and modern energy services; energy efficiency; facilitate access to clean energy research and technology
9	**SDG 9: Industry, innovation and infrastructure** Facilitate sustainable infrastructure development; facilitate technological and technical support
11	**SDG 11: Sustainable cities and communities** Increase attention on sustainable and resilient buildings utilizing local (raw) materials, power for electric vehicles, strengthening long-line transmission and distribution systems to import necessary power to cities, developing micro-grids to reinforce the sustainable nature of cities; protect and safeguard the world's cultural and natural heritage; reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and waste management

12	**SDG 12: Responsible consumption and production** E.g. Promote public procurement practices that are sustainable; address reducing use of SF6 and promote alternatives, encourage companies to adopt sustainable practices and to integrate sustainability information into their reporting cycle, address inefficient fossil-fuel subsidies that encourage wasteful consumption
13	**SDG 13: Climate action** E.g. Increase share of renewable or other CO_2-free energy; energy efficiency; expand infrastructure for supplying sustainable energy; strengthen resilience and adaptive capacity to climate-related hazards and natural disasters; integrate climate change measures into national policies, strategies and planning; improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
14	**SDG 14: Life below water** E.g. Effects of offshore windfarms; effects of submarine cables on sea-life
15	**SDG 15: Life on land** E.g. Attention for vegetation management; bird collisions; integration of substations and lines into the landscape

Table 3: Potential benefit of work

1	Commercial, business, social and economic benefits for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical directions
5	Guide or survey related to existing techniques; or an update on past work or previous Technical Brochures
6	Work likely to contribute to improved safety.