CIGRE Study Committee B4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG B4.100	**Name of Convenor:** Chandana Karawita (CANADA) **E-mail address**: ckarawita@tgs.biz
Strategic Directions #[2]: 1,2,3	**Sustainable Development Goal #[3]:7,9,11,13**
The WG applies to distribution networks: ☐ Yes / ☒ No	
Potential Benefit of WG work #[4] : 1,2,3,4,5	
Title of the Group: Dynamic Active and Reactive Power Supporting Devices for VSC HVDC Systems	

Scope, deliverables and proposed time schedule of the WG:

Background:

Modular multi-level VSC HVDC converters are now commonly used in many power transmission applications. Many recent applications involve weak or isolated AC grids with a low percentage of conventional synchronous generation. There are a number of unique challenges associated with these high renewable generation applications and frequently, it is necessary to implement other dynamic devices to maintain a stable and improved performance.

DC choppers located at the dc bus of the onshore converters (also known as dynamic braking systems) are commonly used in VSC HVDC systems connected to isolated offshore wind farms to avoid having to trip offshore wind generation during transient onshore grid disturbances. The choppers are designed to absorb the generator power that cannot be delivered to the onshore grid during the disturbance to keep the offshore wind farms operational during and after the disturbance.

In some recent projects connected to isolated or weak onshore grids, AC choppers connected in the offshore AC grid have been considered instead of the DC choppers to provide this function. This can be a cost-effective solution and it has the advantage that it can avoid generation tripping during DC side faults.

Some project developers are also considering adding synchronous condensers (SC) at the terminal of the onshore VSC HVDC systems connected to very weak AC grids. The synchronous condensers improve the short circuit strength and provide inertia as well as reactive power support. Another alternative is to add STATCOMS at the VSC HVDC terminals to control the AC voltage (i.e., reactive power support) while allowing the VSC HVDC systems to prioritize active power/frequency control.

Even with DC choppers, synchronous condensers and/or STATCOMS can still be used. They are functioning for different purposes. DC choppers are used to absorb the active power while SC/STATCOM is used to provide inertia and dynamic reactive power during disturbance. They are all what is called as “supporting devices”.

The technical requirements and the dynamic performance of the DC and AC choppers have not been described in detail in available technical brochures. Only the generic performance of DC choppers has been discussed in some of the technical brochures related to offshore VSC HVDC systems. Some technical brochures have included evaluations of technical performance of synchronous condensers and STATCOMS. However, the role of these

devices as supporting devices for VSC HVDC systems have not yet been addressed adequately.

Purpose/Objective/Benefit of this work:

The purpose of this working group would be to evaluate the dynamic devices such as AC and DC choppers, synchronous condensers and STATCOMS as supporting devices for VSC HVDC systems. The main focus would be on AC and DC choppers.

Scope:

The working group would investigate and report on:

1. The available technology, the dynamic performance requirements and the pros and cons of the DC and AC choppers will be evaluated. The application of them in point to point VSC HVDC systems as well as muti-terminal systems such as energy islands will be investigated.
2. The role of synchronous condensers to improve the performance and stability of VSC HVDC systems connected to weak AC grids will be investigated. The performance in both grid following and grid forming applications will be evaluated.
3. The feasibility of utilizing STATCOMS to provide the voltage/reactive power support at the VSC HVDC terminals will be evaluated. The added benefits on the VSC HVDC systems in terms of having more room for active power and frequency control will be identified.
4. This technical brochure will provide the guidelines for selecting the best suited supporting devices for the VSC HVDC systems.

Remarks:

- TB 619: HVDC Connection of Offshore Wind Power Plants *(this has defined basic requirements of DC choppers connected to VSC HVDC systems)*
- TB 885: Guide on the Assessment, Specification and Design of Synchronous Condenser for Power System with Predominance of Low or Zero Inertia Generators *(This is the most relevant TB based on synchronous condensers, This will be referred to evaluate the impact on VSC HVDC systems)*
- TB 872: Static Var Compensator/STATCOM performance survey results – 2017 and 2019 *(STATCOM performance)*
- TB 663: Guidelines for the procurement and testing of STATCOMS - *(STATCOM performance)*
- TB 237: Static Synchronous Compensator (STATCOM) for Arc Furnace And Flicker Compensation *(STATCOM performance)*
- TB 144: Static Synchronous Compensator (STATCOM) - *(STATCOM performance)*

Deliverables:

☒ Annual Progress and Activity Report to Study Committee
☒ Technical Brochure and Executive Summary in Electra
☐ Electra Report
☐ Future Connections
☐ CIGRE Science & Engineering (CSE) Journal
☒ Tutorial
☒ Webinar

Time Schedule:

- Recruit members (National Committees) Q4 2023
- Develop final work plan Q2 2024

• Draft TB for Study Committee Review	Q4 2025
• Final TB	Q2 2026
• Tutorial	Q3 2026
• Webinar	Q2 2026
Time Schedule: Start : January 2024	**Final report** : June 2026
Approval by Technical Council Chairman:  **Date**: October 25th, 2023	

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

WG Membership: refer Comments at end of document.

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.

Comments:

1) CIGRE Official Study Committee Rules: WG Membership

https://www.cigre.org/GB/about/official-documents

a. Only one member per country (by exception of SC Chair)

b. WG nominees must first be supported by their National Committee (or local SC Member) as an appropriate representative of their country.

c. Acceptance of the nomination is granted by the SC Chair and advised to the WG Convener

2) Collaboration Space

https://www.cigre.org/article/GB/collaborative-tools-2

CIGRE will provision the WG with a dedicated Knowledge Management System Space.

The WG will use the KMS for drafting collaboration, capture and retention of discussion and meeting records.

Official country WG Members will be sent registration instructions by the Convener.

Official country WG Members may request the WG Convener to allow additional access for an extra national subject matter specialist to aid in the work at the national level, including NGN members.