CIGRE Study Committee B4 and A3

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

JWG [1]N° B4/A3.86	**Name of Convenor:** Zhiyuan He (China)
Strategic Directions #[2]: 1	**Sustainable Development Goal #[3]: 7, 9, 13**
The WG applies to distribution networks: ☐ Yes / ☒ No	
Potential Benefit of WG work #[4] :2 and 3	
Title of the Group: Fault Current Limiting Technologies for DC Grids	

Scope, deliverables and proposed time schedule of the WG:

Background:

Voltage Source Converters (VSC-HVDC) transmission technology has been widely researched and more than 30 VSC-HVDC schemes have been built worldwide. An HVDC grid is a DC network which can be developed gradually from point to point or multi-terminal HVDC system and formed by a number of converters interconnected with DC overhead lines/cables, partially meshed and partially radial.

SC B4 has established several WGs to investigate the feasibility and specific issues of DC Grids. As raised and expounded in CIGRE Technical Brochure (TB) 533 by Working Group B4.52 (HVDC Grid Feasibility Study) and further researched in CIGRE JWG B4/B5.59 (TB 739 - Protection and local control of HVDC-grids), DC faults in a DC grid will lead to high DC fault currents, which imposes not only high stresses on the converter components, but also requirements on the fault detection, control and protection C&P, communication, and DC breaker capability. The fast-developed fault currents can be effectively interrupted by applying fault current interrupting devices (i.e. DC circuit breakers) and/or suppressed by fault current limiting (FCL) devices.

Two joint WGs have been formed to address DC circuit breakers from different perspectives. JWGs A3/B4.34 (Technical requirements and specifications of HVDC switching equipment) describes the framework and prototypes of DC breakers while B4/A3.80 focus on establishing the technical requirements, stresses and testing methods for DC circuit breakers to ensure the reliable interruption of the DC fault current.

FCL technologies and devices have been researched and are being used successfully in the AC substations where the maximum short circuit current rating is being reached rapidly. On the DC side, many technical papers have been published addressing the principle and feasibility of various types of FCLs, such as superconducting FCL, solid-state FCL, and resistive type FCL, for the fault current control and limit in multi-terminal HVDC and DC grid application. In China, several different types of FCLs have been developed and the corresponding prototypes have been built. Thus, for the DC grid development, it would be beneficial to review the literature and to conduct global survey of the available DC fault current limiting technologies and devices. Subsequently, general guidelines for the selection of technology of DC FCL device can be prepared.

Scope:

The purpose of the proposed Joint Working Group is to start from the literature review and global survey of the available concepts and applications for fault current limiting devices. The WG will then assess and summarize the technologies and devices, identify the possible applications and technical requirements of DC FCL. Finally, the JWG will provide guidelines for users to select DC fault current limiting technologies and devices for their specific applications.

The JWG will cover following specific activities

1 Review the literature and conduct global survey (via questionnaire) on the existing DC fault current limiting (FCL) technologies and devices that have been published and developed.

2 Assess and summarize the DC FCL technologies and devices identified from both the literature review and global survey

3 Identify possible applications of DC FCLs in multi-terminal HVDC systems and DC grids and prepare the corresponding technical requirements for each application

4 Prepare the general guidelines for the selection of DC fault current limiting technologies and devices for different specific applications in DC multi-terminal systems and grids.

Deliverables:

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

Time Schedule: Start March 2020 **Final Report**: March 2022

Approval by Technical Council Chairman:

Date: February 8th, 2020

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.