CIGRE Study Committees B4/A3

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP[1]

JWG B4/A3.80	**Name of Convenor: Dr. Junzheng Cao (China)** **E-mail address**: caojunzheng@sgepri.sgcc.com.cn	
Strategic Directions #[2]: 1		**Technical Issues #[3]: 3**
The WG applies to distribution networks[4]: No		
Potential Benefit of WG work #[6]: 2		
Title of the Group: HVDC Circuit Breakers - Technical Requirements, Stresses and Testing Methods to investigate the interaction with the system		

Scope, deliverables and proposed time schedule of the Group:

Background:

VSC-HVDC transmission is moving fast and is considered as the technology to realize the development and integration of large-scale renewable energy sources. In order to achieve high penetration and effective integration of the renewables and to mitigate the impacts of intermittent renewables on the power system，the relatively independent and adjacent VSC-HVDC systems can be interconnected together and step by step to form an HVDC grid. Such as the "Super Grid" plan in Europe and the Zhangbei ±500kV HVDC grid project in China. The key element to establish HVDC grids in terms of efficiency and reliability as well as controllability, is the realization of viable HVDC circuit breakers.

In 2013, technical brochure 533 "HVDC Grid feasibility study" prepared by WG B4.52 was published. This TB points out that "technical feasibility of building a large scale HVDC Grid requires that a fault has to be isolated very fast before it affects the HVDC voltage in other parts of the grid". Further, according to technical brochure 678 "Technical requirements and specifications of HVDC switching equipment" published by JWG A3/B4.34 in 2017, some HVDC circuit breakers prototypes have been completed and four categories of topologies were established: adopting a passive oscillating circuit method, a current oscillation system with active current injection, pure power-electronic devices in the nominal current path, a hybrid mechanical and power-electronic combination. The DC fault current can be quickly interrupted by the above stated technical solutions in the order of milliseconds. However, the interruption time will be a function of the circuit chosen.

The fault current interrupting requirements will be driven by the system requirements and the functional specifications. However, it is very important to define the corresponding stresses and test methods for HVDC circuit breakers to ensure that the HVDC circuit breakers do meet such requirements. It is necessary and important to provide guidelines on how and the methodology available for testing of the different types of HVDC circuit breakers will ensure that the stresses are not exceeded and the performance functions are met.

This WG will work in the close collaboration of SC A3. For this purpose, SC B4 will send a liaison to participate in WG A3.40. The detailed work will take into account technologies and results reported in the recent (August, 2018) collaborated CIGRE/IEEE workshop with the EU PROMOTioN project, as well as the results reported by IEC SC17A/AHG 60 (on HVDC switchgear).

Scope:

The objectives of this Working Group are to perform a technical requirement and stresses study to investigate the interaction between HVDC circuit breakers and the system from both simulation and experiment approaches. Based on the results of the study, the stresses imposed on the circuit breaker will be defined. Based on the above, the detailed technical requirements and required testing methods of HVDC circuit breakers will be proposed.

The following specific activities will be undertaken by the working group:

1 Describe basic configurations and overview of the HVDC circuit technologies available in the market and under research / development, including different designs of HVDC circuit breakers investigated in PROMOTioN project and other research projects in different countries.

2 Describe possible applications of HVDC circuit breaker and define technical requirements of HVDC CBs for these different applications;

3 Study specific component stresses (relevant to testing) under continuous operation, load switching and fault current switching. Specific attention will be given to behaviours due to operation of mechanical or hybrid switches, current commutation as well as energy dissipating processes within the equipment.

4 Specify testing methods for component and equipment;

5 Conclusions

Deliverables:

☒ Technical Brochure and Executive summary in Electra

☒ Electra report

☒ Tutorial[5]

☒ Webinar[5]

Time Schedule: start: January 2019 **Final Report**: August 2022

Approval by Technical Committee Chairman:

Date: November 22, 2018

Notes: [1] or Joint Working Group (JWG), [2] See attached Table 2, [3]See attached Table 1, [4] Delete as appropriate, [5] Presentation of the work done by the WG, [6] See attached Table 3

Table 1: Technical Issues of the TC project "Network of the Future" (cf. Electra 256 June 2011)

1	Active Distribution Networks resulting in bidirectional flows
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (ref. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non-technical audience

Table 3: Potential benefit of work

1	Commercial, business or economic benefit 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 direction
5	Guide or survey related to existing techniques. Or an update on past work or previous Technical Brochures
6	Work likely to have a safety or environmental benefit