CIGRE Study Committee A3

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

WG N° A3.40	**Name of Convenor: Dr. Christian Heinrich** (GERMANY) **E-mail address**: christian.heinrich@siemens.com	
Strategic Directions #[2]: 1	**Technical Issues #[3]:** 1, 3	
The WG applies to distribution networks[4]: Yes		
Potential Benefit of WG work #[6]: 1, 4		
Title of the Group: Technical requirements and field experiences with MV DC switching equipment		

Scope, deliverables and proposed time schedule of the Group:

Background:

Applications and field experience with HVDC switching equipment are increasing in line with the increasing use of HVDC grids to provide economical and reliable long distance bulk energy transmission.

CIGRE WG B4.52 published TB 533 “HVDC Grid feasibility study” in 2013 and CIGRE JWG A3/B4.34 published TB 683 “Technical requirements and specifications of HVDC switching equipment” in 2017. Applications of HVDC circuit breakers for multi-terminal HVDC networks are still limited due to economic and reliability reasons and there is a lack of field experience, however there are extensive reports of LVDC (*less than 1000 V) and MVDC (*up to 52 kV) circuit breakers with different technologies used in industrial and railway networks. For example, 480 V 10 kA circuit breakers with arc voltage current limiting scheme are used in industrial networks such as a communication data centre. 1500 V 100 kA high speed circuit breakers with active resonant current injection scheme are used in railway networks. However, there are no standards covering the interrupting capability of these LVDC and MVDC switching equipment.

The proliferation of renewables in the recent years resulted in high penetration of Distributed Energy Resources (DER), and Energy Storage systems. Unlike conventional bulk and remote power generation, such as coal-fired, gas and nuclear power plants, DER systems are decentralized, modular and more flexible technologies with smaller capacity, that are located close to the load areas. Integration of DER and storage systems into Low Voltage networks can lead to insufficient network capacity and rive a need to increase the capacity in the Medium Voltage networks. Under these conditions, MVDC grids can be used to reduce power losses further and improve the efficiency, power quality and reliability of the power supply. For this purpose, the MVDC load break switches and MVDC circuit breakers are required to interrupt DC currents; typically in times that are much less than interruption in AC systems.

In 2015, CIGRE WG C6.31 was established in order to investigate MVDC feasibility and system benefits. Also, there are ongoing independent investigations in different countries. For example, FEN (Flexible Electrical Networks, Research Center) FNN (Forum Network technology/ Network operation) is investigating design and operation of future MVDC grids in Germany.

The working group will first collect available field experience of LVDC and MVDC switching equipment used in different applications and investigate whether their technical requirements and testing considerations can meet the recent requirements under changing the MV and LV network conditions due to massive penetrations of DER and Energy Storage systems. The investigation will be undertaken with the close collaboration of SC B4 experts. For this purpose, SC B4 will send a liaison member to the WG.s

Note: *The definitions of LV and MV for DC circuit breakers will be also discussed based on the WG investigations for different applications. Similar to AC, there are no clear definitions on these terms.

Scope:

The scope of the working group is as follows:

1. Collect the field experiences of MVDC switching equipment to interrupt the DC load and fault current in MV applications up to 52 kV
2. Review the existing prototypes and state of the art of MV DC switching equipment up to 52kV.
3. Review experiences of monitoring and diagnosing the interrupting performance with MV DC switching equipment
4. Investigate the technical requirements for MVDC switching equipment used in different system configurations such as a point-to-point or multi-terminals MV grids, and understand the switching phenomena in MVDC grids
5. Summarize the technical requirements for the MVDC circuit breakers (compared with those for AC circuit breakers and HVDC circuit breakers)
6. Recommend testing requirements for MVDC switching equipment

Deliverables:

☒ Technical Brochure and Executive summary in Electra

☒ Electra report

☒ Tutorial[5]

Time Schedule: March 2018 **Final Report**: 2022

Approval by Technical Committee Chairman: M. Waldron

Date: 01/03/2018

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