CIGRE Study Committee B4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP (1)

<table>
<tr><td>WG* N° B4.71</td><td colspan="2">Name of Convenor : Dr. Mojtaba Mohaddes(Canada)
E-mail address: mmohaddes@tgs.biz</td></tr>
<tr><td colspan="2">Technical Issues # (2): 3</td><td>Strategic Directions # (3): 1</td></tr>
<tr><td colspan="3">The WG applies to distribution networks (4): Yes (If DC is applied to distribution networks)</td></tr>
<tr><td colspan="3">Title of the Group: Application guide for the insulation coordination of Voltage Source Converter HVDC (VSC HVDC) stations</td></tr>
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Scope, deliverables and proposed time schedule of the Group :

Background :

HVDC VSC technology is spreading since its first application in 1997. It is predicted by the industry that it will expand even further, mainly because of the increased need for interconnectors and to integrate new renewable energy sources (e.g. off shore wind) and the conversion of ac lines to dc lines as well as its advantages compared to LCC HVDC technologies, such as better ac voltage and reactive power support and controllability.

Presently, there is no industrial guideline to address the insulation coordination aspect for equipment in VSC HVDC stations. It is necessary to initiate this task, similarly to the approach that was taken in the early days of the LCC technology. The objective of this WG is not to expose any VSC HVDC converter design secrets but more to study and define what faults shall be considered for the insulation coordination design of VSC HVDC stations. There are a number of converter topologies/types that can apply to a VSC converter. Some topologies such as the two and three level converters were used in the early VSC HVDC systems. However, since the introduction of the multilevel converter, VSC converter stations utilize the multilevel converter. Therefore not all types of VSC converters will be studied. The focus will be placed on modular multilevel converters. Both half-bridge and full-bridge configurations will be considered.

The scope of this WG will be limited to the VSC HVDC stations and will not cover insulation coordination of the ac network, HVDC cables or the HVDC overhead lines. However, the faults conditions that may impact both cables and overhead lines will be identified. The results will be shared with SC B1 and SC B2.

A key point for the insulation coordination is a good understanding of the over-voltages taking place in the converter stations caused by different events (faults both internal and external, blocking, etc.)

Scope :

1. Identify and define the most commonly used VSC HVDC system configurations. Namely bipolar and symmetrical monopoles.
2. Identify and define the most commonly used VSC topologies namely MMC half bridge, full bridge, Cascaded
3. Establish terminology to be used for the insulation coordination, taking as reference the IEC 60071-5.
4. Review the current practice of insulation coordination of VSC stations

5. Evaluate sources and types of overvoltages, taking into consideration the impact of earthing

6. Identify the critical internal and external fault events required for the insulation coordination consideration

7. Determine how to deal with such faults and location of the arrestors

8. Determine the locations and ratings of arresters and their impact

9. Recommend the necessary study tools

Deliverables : Report to be published in Electra or technical brochure with summary in Electra

Time Schedule : Start March 2015 **Final report** : 2018

Comments from Chairmen of SCs concerned :

Approval by Technical Committee Chairman : M. Waldron
Date : 10/02/2015

(1) Joint Working Group (JWG) - (2) See attached table 1 – (3) See attached table 2
(4) Delete as appropriate

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 within distribution level and to the upstream network.
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 (cf. 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