CIGRE Study Committee B4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG* N° B4.75	**Name of Convenor :** Dr. Christian Rathke (DE) **E-mail address**: Christian.Rathke@tennet.eu
Technical Issues # : 3	**Strategic Directions # : 1**
The WG applies to distribution networks : Yes	
Title of the Group: Feasibility Study for assessment of lab losses measurement of VSC valves	

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, because of the increased need to integrate new renewable energy sources (e.g. off shore wind) the desire to convert ac lines to dc lines and the advantages of VSC compared to traditional LCC HVDC technologies, such as better voltage and reactive power support and controllability.

With the first Modular Multi-level Converter application of VSC HVDC technology in 2010, the VSC HVDC technology has found wider applications, due to its advantages of flexibility in balancing among functional performance, losses, reliability and maintainability. Since transmission losses are directly related to the investment and operational costs, they are one of most important factors for VSC HVDC project evaluation. Unlike LCC converter stations, VSC valve losses are the main part of the total converter station losses therefore the determination and evaluation of the VSC valve losses becomes more important.

Presently, the losses of VSC valves are determined based on calculation methods of IEC 62751-1 and -2. The calculation method requires detailed information such as the parameters of semiconductor devices, VSC valve design characteristics and operating modes, which usually are not directly available for HVDC system purchaser/user who consequently finds it difficult to evaluate the calculated losses results.

The purpose of this WG is to perform a feasibility study to assess laboratory loss measurement methods on VSC valves for loss calculation evaluation purposes and to make recommendations considering the pros & cons of such measurements versus methods in IEC 62751. A similar approach was established on loss measurements during factory acceptance tests for converter transformers long ago and eventually became part of IEC 61378-2.

The scope of this WG will be limited to the assessment of losses measurement on VSC valves / modules under operational test in laboratory environment.

Scope :

1. Review existing losses measurement methods for power electronic devices and valve modules in laboratory environment;

2. Identify typical cases for losses measurements in terms of measuring object (i.e. single power module or a valve section), load current and voltage, switching frequency, cooling water condition, etc..;

3. Identify procedure for representation of real operating current and voltage wave forms including switching frequencies of the semiconductor devices during loss measurements. Analyze practical aspects for same.

4. Study calculation uncertainties, such as junction temperature estimate and the interpolation method of the losses-related parameters;

5. Determine measurement uncertainties and their implications for different loss measurement methods, measuring accuracy, influential factors (e.g. loading factor, power factor, MMC levels), limitations and tolerances; (It is assumed that the measurements cannot reflect all relevant operating conditions and realistic operating duties; during the measurements the actual operating conditions such as environmental temperatures, air flow etc. inside the valve structures / valve hall might not be represented correctly / adequately, how to address this)

6. Feasibility / suitability of loss measurements taking different topologies / different designs of the VSC converters into account.

7. Collect cases of site loss measurements and compare the results with laboratory measurement results and calculation results;

8. Evaluate the benefit of additional lab loss measurements which will have an impact on cost and time vs the analytical approach (as also used in LCC projects), including uncertainties, measurement errors etc. of such lab measurements. Also analyze if these methods should be used to establish a method for a type of VSC topology or should these be measured for each delivery project, or alternatively if these measurements might be used to provide input values / parameters for the calculations in accordance with the IEC standards (to increase the accuracy of calculation results)

9. VSC valve losses measurement methods in the test laboratory and recommendation whether to use those methods considering results of proposed feasibility study.

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

Time Schedule : start : November 2016 **Final report** : 2019

Comments from Chairmen of SCs concerned :

Approval by Technical Committee Chairman : M. Wald
Date : 31/10/2016

(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