CIGRE Study Committee B4

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

WG* N° B4.63	**Name of Convenor :** Les Brand (Australia) **E-mail address**: les.brand@pscconsulting.com
Technical Issues # (2): 3	**Strategic Directions # (3):** 1
The WG applies to distribution networks (4): No	
Title of the Group: Commissioning of VSC HVDC Schemes	

Scope, deliverables and proposed time schedule of the Group :

Background : Voltage Source Converter (VSC) technology has emerged as a commercially viable alternative to Line Commutated Converter (LCC) technology for certain applications of HVDC power transmission. With the first commercial VSC projects commissioned in 1999, there is now over decade of project and operational experience with this technology. VSC is also becoming the preferred, if not only, choice of technology for specific applications, including low power transfer applications, the connection of weak networks, offshore wind farm connections and DC grid developments.

The process for the commissioning of VSC projects has developed over the past decade, based initially on a similar process for commissioning LCC HVDC projects (e.g. Cigre Technical Brochure 97) and developed by the vendors and suppliers of VSC technology. Guidelines exist for the commissioning of LCC projects but not VSC projects. Whilst there are many similarities in the process and procedures for commissioning the two technologies, there are some notable and significant differences that justify the need for a separate Technical Brochure covering the commissioning requirements for VSC projects. Whilst the focus is on the VSC "project", the testing of the DC cables and their accessories and DC overhead lines is excluded from this TOR.

This WG will use the outcomes of other Cigre working groups (e.g. WG14-12, WGB4-37) and other relevant bodies (e.g. IEEE and IEC) as a starting point. WG team members will provide their knowledge and experience with the commissioning of VSC projects (of all VSC technologies) both past and present to develop similar guidelines specifically for VSC projects.

Scope : The Working Group will seek to develop a Technical Brochure which provides guidelines for the commissioning of VSC projects. As far as possible, the Technical Brochure will seek to be independent of the VSC technology (e.g. the topology of the converter).

1. Review the work done by CIGRE and other relevant bodies related to the commissioning of HVDC converter stations (e.g. WG14-12, TB 97) with a view to identifying significant differences between commissioning of VSC projects and LCC projects. Review work done to date on VSC commissioning, including the work done by WG B4-37 (TB 269).
2. Identify and develop the stages, sequence and structure for the commissioning of a VSC project, focusing on the on-site system and acceptance test elements for commissioning and also VSC specific equipment and sub-systems (e.g. IGBTs and IGBT modules, phase reactors etc). Off-site tests shall also be covered at a high level and from the point of view of its relationship with on-site testing.
3. Develop each stage of commissioning, including development of test objectives, procedure and acceptance criteria and preferred location in the commissioning

structure. Stages will include:

a. Off-site testing (e.g. factory performance/system tests, dynamic tests);
b. Equipment and sub-systems testing (only for VSC specific equipment);
c. Energization tests;
d. Terminal (reactive power only) tests;
e. End to end / system tests;
f. Steady state tests;
g. Power quality and interference tests;
h. Operation, black start and loss of auxiliary (disturbance) tests;
i. AC network interaction tests (e.g. staged faults, run-back and special protection schemes);
j. Customer acceptance tests; and
k. Trial operation.

And any other test stages identified by the WG members.

4. Develop guidelines and recommendations for:
   a. Documentation of the commissioning plan and commissioning test results;
   b. The relationship between the off-site and the site commissioning tests, including selection of on-site test "cases" and the cross-correlation/verification of site commissioning test results to the off-site test results;
   c. The specification of commissioning tests for VSC projects;
   d. Demonstrating compliance with specifications in situations where actual power flow conditions cannot be achieved in-situ (e.g. demonstration of the P-Q curve at high active and reactive power levels);
   e. High level commissioning issues specific to certain applications including off-shore VSC converter stations and commissioning of DC grids;
   f. Site management processes during commissioning and training opportunities for owner staff.

Deliverables : Technical brochure with summary in Electra

Time Schedule : start : January 2013 **Final report** : 2015

Comments from Chairmen of SCs concerned :

Approval by Technical Committee Chairman :
Date : 10/02/2013

(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