CIGRE Study Committee B4

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

WG* N° B4.64	**Name of Convenor : Carl BARKER** (UK)
Technical Issues # (2): 3	**Strategic Directions # (3): 1**
The WG applies to distribution networks (4): No	
Title of the Group:	**Impact of AC System Characteristics on the Performance of HVDC schemes**

Scope, deliverables and proposed time schedule of the Group :

Background :

A well established practice within the HVDC industry is to use Short Circuit Ratio (SCR) and Equivalent Short Circuit Ratio (ESCR) as a rapid assessment of whether a given rating of converter can be utilised when connected to an AC system with a certain Short Circuit Level (SCL). However, in recent years there have been new developments in technology, both of the generators and HVDC converters. For example the generators in a typical wind farms will provide a very low SCL, but are active devices and are capable of voltage support. New HVDC technologies, such as Capacitor Commutated Converters (CCC) and Voltage Sourced Converters (VSC) HVDC may be able to operate at a lower SCR, and VSC HVDC can also actively provide voltage support for the ac network, within rating and control limits. The presence in the ac networks of many HVDC converters of potentially different technologies or Flexible AC Transmission components such as STATCOM's and series compensation, in close electrical proximity, affect the characteristics of the network.

Against this background the usability of SCR and ESCR as a simple tool for stability assessment of new HVDC schemes needs to be re-assessed.

The proposed Technical Brochure (TB) would present simple time domain transient analysis models which relate the simple SCR / ESCR assessment to the observed results. The conclusion of the TB would be how SCR / ESCR should be applied today or, if it is judged by the WG that these simple assessments are no longer suitable, an alternative assessment method will be proposed.

Scope :

1. Brief review of the alternative High Voltage Direct Current (HVDC) solutions to be considered in the TB; Line-Commutated Converters (LCCs), Capacitor-Commutated Converter (CCC) and Voltage Source Converter (VSC).

2. Brief review of existing measures of prospective HVDC performance within an AC system, considering Short Circuit Ratio (SCR), Effective Short Circuit Ratio (ESCR), Critical Effective Short Circuit Ratio (CESCR) and Multi-Infeed Effective Short Circuit Ratio (MIESCR). Examples will be presented to illustrate the meaning of these terms.

3. Review of some significant types of generation to be connected to a HVDC converter for export. Many renewable sources of energy consist of power electronics in their output stage and therefore have limited short circuit capacity. These sources may also have reactive power control or voltage control which can impact on the interaction with a HVDC converter. Co-ordination with WG B4.55 and B4.62 will be required.

4. The topology of AC systems to which HVDC converters are exporting power can have an impact of the measurable performance of the interconnection. In particular having the bulk load close to the HVDC converter under low Short Circuit Level (SCL) conditions can improve the maximum transferable power between the HVDC converter and the load. This will be reviewed and an assessment means considered.

5. VSC HVDC converters are able to dynamically control reactive power as well as active power within rating boundaries. This dynamic reactive power control can be used to support the exporting or importing AC system. Simple dynamic models will be considered and a method of assessing the impact of reactive power capability on the active power import capability will be considered.

6. Other forms of reactive power compensation already exists in the AC system today in the form of Static Var Compensators (SVC's), Static Compensators (STATCOM's) and series compensation. Do these elements, in particular those in shunt, mean that an LCC converter can behave as a VSC? How these components impact on the SCR / ESCR will be considered along with their impact on VSC HVDC converters.

7. AC systems consisting of multiple LCC HVDC infeeds have been considered in a previous CIGRE WG (B4.41). This brochure will review how the conclusions of the previous study are impacted by the use of CCC and VSC converters.

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

Time Schedule : start : March 2013 **Final report** : 2016

Comments from Chairmen of SCs concerned : Bjarne Andersen, members from other SCs are welcome to join this WG, if they are able to contribute.

Approval by Technical Committee Chairman :
Date : 25/02/2013

(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