CIGRE Study Committee B4

PROPOSAL FOR THE CREATION OF A Task Force

WG N° B4.XX	**Name of Convenor: John Gleadow (Australia/UK)** **E-mail address**: john.gleadow@directc.com
Strategic Directions #[2]: 1	**Technical Issues #[3]: 3, 4**
The WG applies to distribution networks[4]: No TF-77	
Potential Benefit of WG work #[6]: 1, 2, 3, 4	
Title of the Task Force: AC Fault response options for VSC HVDC Converters	

Scope, deliverables and proposed time schedule of the Group:

Background:

The reduction in synchronous generation is leading some TSO's (Transmission System Operator's) to look at alternative sources of power infeed to provide a large reactive power during AC system faults to maintain some minimum AC system voltage remote from the fault.

One concept being proposed for future HVDC schemes is to utilise a type of converter control system and converter design which rapidly responds to changes in terminal voltage in a similar way to a synchronous machine, hence the term Virtual Synchronous Machine (VSM) is used. With a VSM the magnitude of reactive current during an AC fault is not constrained to be within the active power rating of the converter but rather it can be significantly higher in order to provide maximum AC system support.

Some alternative options have also been proposed, where the converter essentially remains as a current controlling device; but, even in some of these options, the fault current requirement may become the rating case for the converter hardware.

Part of the perceived need of the TSO is not only to have a large reactive fault current but also, to be able to deliver this rapidly in response to an AC system fault. This is referred to as FFCI (Fast Fault Current Injection). The perception is that present day VSC controllers, which act to control the current seen by the power electronic converters, are not sufficiently fast enough to meet the future AC grid needs. A second perceived problem with FFCI requirement is that it can create temporary overvoltages following ac fault clearing in low short circuit level grid conditions.

Changing the fault response of a HVDC converter, considering FFCI, specifying fault currents greater than the converters active power rating, or even adopting a VSM type control concept will have an impact on both the converter hardware design, its rating, its losses and the effective utilisation of the capital investment by the owner.

Scope:

The objectives for the Task Force will be to set out the AC system needs as defined by several TSO's, the options achievable with a VSC HVDC converter and the implications on capacity, cost and losses that any changes to the VSC HVDC equipment would incur.

The Task Force would be complimentary to JWG C2/B4.38 as it will focus more on converter equipment aspects where JWG C2/B4.38 has more an overall system design and operation focus.

The following activities will be undertaken

1. Problem definition – A brief review of the challenges faced by the AC grid with little or no synchronous generation.

2. Specification options – Summary of the range of performance options for grid connected HVDC during a fault.

3. Model simulation - Studies using EMT models -
   These will provide a simplified model of the VSC HVDC and compare the response to a fault for several alternative basic design approaches.

   Comparison between the performance achieved of the alternative control principles considered will be made.

4. Converter valve ratings will be compared along with the impact on available active power utilisation and associated losses.

5. Converter valve protections and overall converter protection system design will be compared.

6. Identification of the benefits and capitalised costs/disadvantageous of each approach.

7. Key areas of uncertainty will be identified.

8. Recommendations made for future work.

Deliverables:

Task Force Paper to be published in ELECTRA

Time Schedule: start: October 2017 **Final Report**: October 2018

Approval by SC B4 Chair:

M. M. Rashwan

Date: October 16, 2017

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