

## PROPOSAL FOR CREATION OF A NEW JOINT WORKING GROUP (JWG)

### Influence of Embedded HVDC Transmission on System Security and AC Network Performance

<b>JWG* N° C4/B4/C1- 604</b>	<b>Name of Convenor : <span style="color: red;">Sebastien Henry</span></b>
<b>Scope, deliverables and proposed time schedule of the Working Group :</b>	
<p><b>Background:</b> This JWG will draw from previous work done on HVDC systems in CIGRE in the areas of application of HVDC in low short circuit capacity areas, use of DC converters for reactive power control, commutation failure of HVDC, guide for upgrading transmission systems with HVDC transmission, economic assessment of HVDC links, voltage and power stability in AC/DC systems, and systems with multi DC infeed. This JWG will take the work further in the area of the interactions with the power system.</p> <p>The use of HVDC between regions of an AC network is being considered to an increasing extent because of the growing challenge of network development. HVDC may be considered if a long overhead line or cable connection is necessary, or because the conversion of an existing AC line to HVDC operation can achieve increased transfer capacity. Difficulties with building new overhead lines lead more and more to considering underground HVDC connections inside AC networks operating in parallel with AC lines. In addition, with the advent of off-shore wind generation, HVDC submarine cables are often the most suitable option, particularly for long distances under water. However, HVDC connections perform differently to AC connections during steady state, dynamic and transient conditions, and it would be useful for CIGRE to clearly identify these differences. The coordination between HVDC links and AC lines in parallel should be studied to enhance the understanding in the industry for the most effective utilization of these assets in transmission networks.</p> <p><b>Scope:</b></p> <ol style="list-style-type: none"><li>1. Brief overview of different HVDC technologies, including their technical performance during steady state, dynamics and transient conditions, and the configurations possible, including monopolar, bipolar and multi-terminal schemes. For the purpose of this JWG both thyristor based line commutated converter HVDC and Voltage Sourced Converter HVDC Transmission will be considered. Such an overview will also include the summary of the experience of existing networks with embedded HVDC schemes, including the reasons for choosing this solution.</li><li>2. Overview of past work within CIGRE with respect to background documents on HVDC and on their interaction with the AC network.</li><li>3. To identify and discuss the various system technical performance issues that need to be considered when an HVDC link is to be embedded within an ac network.</li><li>4. Development of a benchmark model that can be used to illustrate the investigation and resolution of AC/DC interaction issues associated with a HVDC link embedded in an AC network. Existing benchmark models can be considered as a starting point, e.g. the one used by B4 for its work on integration of large scale wind generation.</li><li>5. Using the benchmark model, provide examples of the AC network performance during and after faults in the HVDC schemes sending and receiving ac systems, DC line faults, partial or full trip of an HVDC scheme, tripping of a parallel AC line.</li><li>6. Determine the impact on the system security and system performance in case of the</li></ol>	

replacement of an AC line with a higher capacity HVDC link, and where relevant discuss potential mitigation measures.

7. Discussion and summary of the benefits that can be derived with respect to overall transfer capability of a combined AC and HVDC transfer link, through the dynamic control of power flow on the HVDC link.
8. Based on the above work, the WG may propose new ways of using HVDC to increase the capability of the AC network.

Issues such as voltage quality including harmonics, flicker and voltage steps will not be discussed, since these issues are typically resolved through adequate specification of the HVDC Link performance in these areas.

**Target Audience:**

Planning Engineers, Regulatory Bodies, Consultants, Manufacturers, and Investors in Merchant transmission connections.

**Deliverables:** Technical brochure with summary in Electra, and possibly report(s) to be published in Electra.

**Time Schedule : Start : 2009 Final report : 2011**

**Comments from Chairmen of SCs concerned:**

C4: AC system segmentation and conversion of AC circuits to DC can be successfully studied by considering the DC link as an integral element in an AC network. C4 will provide much needed expertise in overall power system modeling, analysis and system dynamic and technical performance.

B4: Opportunities and challenges are associated with embedding HVDC schemes within AC networks, and it is important that the various issues are well documented and understood. B4 will provide expertise in the areas of HVDC modeling and performance aspects.

C1: The number and importance of embedding HVDC schemes within AC networks is growing. The dynamics and other issues must be well understood.

**Approval by Technical Committee Chairman : Klaus Fröhlich**

**Date : 27/11/2009**