TECHNICAL REQUIREMENTS FOR CONNECTIONS TO OFFSHORE HVDC GRIDS IN THE NORTH SEA

WINDEUROPE FEEDBACK ON THE COMPANION GUIDE

WindEurope welcomes Tractebel open format consultation on the Companion Guide developed under the framework of the ongoing EC study on "Technical requirements for connections to offshore HVDC grids in the North Sea".

General feedback

1. **Purpose of the study:** The document clarifies that this is a Companion Guide and not a binding document**. However, if the long term purpose of this work is to establish a basis for a complete review of the HVDC Network Code, this should be stated much more clearly, its development work should have been done based on a much more collaborative approach between TSOs, offshore generation stakeholders, non-TSO HVDC system developers, owners and operators, HVDC suppliers, and all other relevant stakeholders. Also, the dedicated consultation periods should have been much longer and corresponding to the analysis needs of such complex issues.**

2. **Interlinked HVDC systems:** The document should justify clearly the need for more harmonisation in case of **interlinked HVDC systems** as compared to what is commonly called today a "Hybrid Project" that is a single interconnector (between two countries) with offshore wind farms connected to it. The current HVDC Network Codes already address single interconnectors. The need for more harmonisation has not been clearly explained in the current document.

3. **HVDC system ownership and development: The document should reflect the fact that HVDC systems in Europe are today build, owned and operated also by non-TSO companies**. For example, as enabled by the UK Energy Act, the upcoming offshore transmission system will be developed by non-TSO companies such as Equinor, Vattenfall, Ørsted and others, and ultimately owned and operated by Offshore Transmission Owner (OFTO) regimes typically owned by financial (non-TSO) investors. The document should address this fact in each part it discusses about requirement formulation, coordination and exchange of information (for example, not only between TSOs and HVDC OEMs but also with other non-TSO HVDC system owners and operators).

4. **Compliance at AC/DC onshore/offshore interfaces**: The contractual Point of Coupling (PoC) may differ from country to country. In some countries HVDC systems may be required to fulfil requirements at all interfaces (onshore AC side, DC side, and offshore AC-side) whereas in other countries either offshore or onshore. This fact should be considered and noted in the document.

5. **Requirements on operating voltage ranges**: Chapter 7 presents a gap analysis of technical requirements for offshore "AC hubs" and how the current Network Codes should be complemented. This is a good high-level analysis, but some issues are not addressed:

   a. The document argues that the voltage range of operation of the offshore AC grid shall be bigger than ±5%, - up to ±10% or ±15%. To our understanding this would require overrated components as the power electronics components are designed for the highest voltage and the highest current (at low voltage) they need to comply with. Increasing the required operating voltage range would result in converters operating at high voltage (+10%) and low current (80% of the nominal), or at low voltage (-10%) and high current (100%), to have constant power output. **To justify such requirements, this document should include or recommend cost-benefit analysis to measure the impact of applying such operating ranges.**

   b. The same applies for frequency ranges. Furthermore, the consideration of "non-standard" frequency ranges is expected to be a costly choice, given that all components' testing will need to be repeated.

   c. There is no reflection on testing and coordination aspects between different projects at different life stages, e.g. if 56Hz are considered for a project today, what will be the cost implications for a new project to be connected in some years from now, having also to apply a 56Hz frequency.

6. **Consideration of AC and DC cables**: The technical requirements and parameters resulting from the necessary use of cables is not reflected at all in the document. Cables being the technology enabling the offshore grids, we would suggest considering the addition of some content in this matter. For example, Chapter 6 focuses on control and protection within the HVDC converters where the DC cable systems assumed to be utilized can be regarded as (almost, at least) a static component. Chapter 7 addresses the potential creation of "large offshore AC hubs" to connect both generation, loads, and HVDC VSC links, all connected via an AC system (i.e. AC cables) - but without addressing the potential impact the AC cables will have on the whole system pending on power rating, voltage levels and distances. There seems to be no consideration of the typical phenomena a large/long AC cable system, especially in combination with a weak AC system, may cause. For example, please see the figure below that includes "AC tie-line (long)".

   We would like to suggest the following comment in this vein: "*For a potential offshore isolated AC Hub, as described in Chapter 7, it is necessary to address the interaction between the involved AC cable systems and the rest of the AC Hub system, to correctly understand the expected technical challenges*"

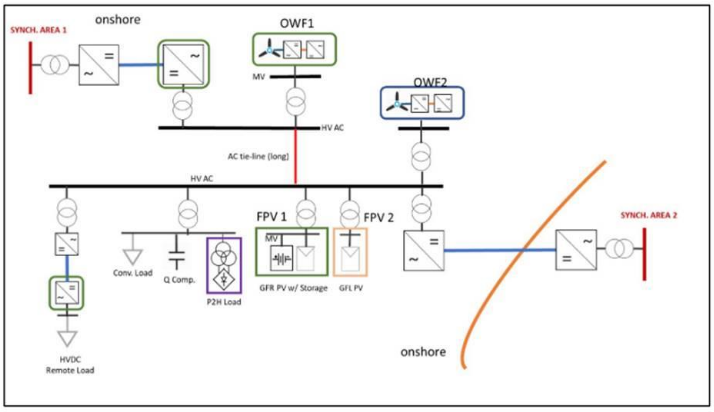

Figure 7-1: Generic Structure of an AC hub based Hybrid project: Wind, PV and Storage as well as conventional and P2X loads are included.

7. **Simulation Models**: For such big projects, in addition to RMS and EMT offline, real time simulations including replicas could be also recommended to de-risk the system. Real-time simulation with replicas is increasing in popularity in Europe; Today, RTE and RTEi have such a platform since 2011, recently the National HVDC centre (SSE) and REE have developed such real-time platforms while other TSOs are foreseen to develop similar labs.