

STAKEHOLDER CONSULTATION PROCESS OFFSHORE GRID NL

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1. Background Material

LITERATURE USED:

- HVDC Grid Code: "COMMISSION REGULATION (EU) 2016/1447 of 26 August 2016 establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules"
- IEC 60859
- TenneT Position Paper from 2015 for WoZ program: "ONL15-061-T3_Connection Point_PP_v1"

2. Scope and Considerations

For the roadmap offshore wind 2030 (routekaart windenergie op zee 2030) TenneT is tasked with the connection of several offshore wind farms up to 2030. The wind farm zones 'Hollandse kust West' and 'Ten Noorden van de Waddeneilanden' will be connected with TenneT's previously established and consulted standardized 700 MW grid connection concept. Due to its size and distance to shore, a new grid connection concept has been established for the wind farm zone IJmuiden Ver. The figure below shows a schematic cross-section of this new grid connection concept. Wind turbines are connected through 66 kV "inter-array" cables (in orange) to an offshore (HVDC) converter station. Using 2 GW high voltage (525 kV) export cables (in green) the electricity is transported to shore. TenneT will be responsible for the offshore grid, from the onshore substation up to and including, the offshore substation. TenneT intends to create a new standard HVDC grid connection concept for both connections to IJmuiden Ver and potential future far shore wind farms.

This paper describes how TenneT, as the offshore grid connection owner, proposes to deal with the Point of Common Coupling (PCC) and Grid Connection Point (GCP) at the offshore side of the transmission system.

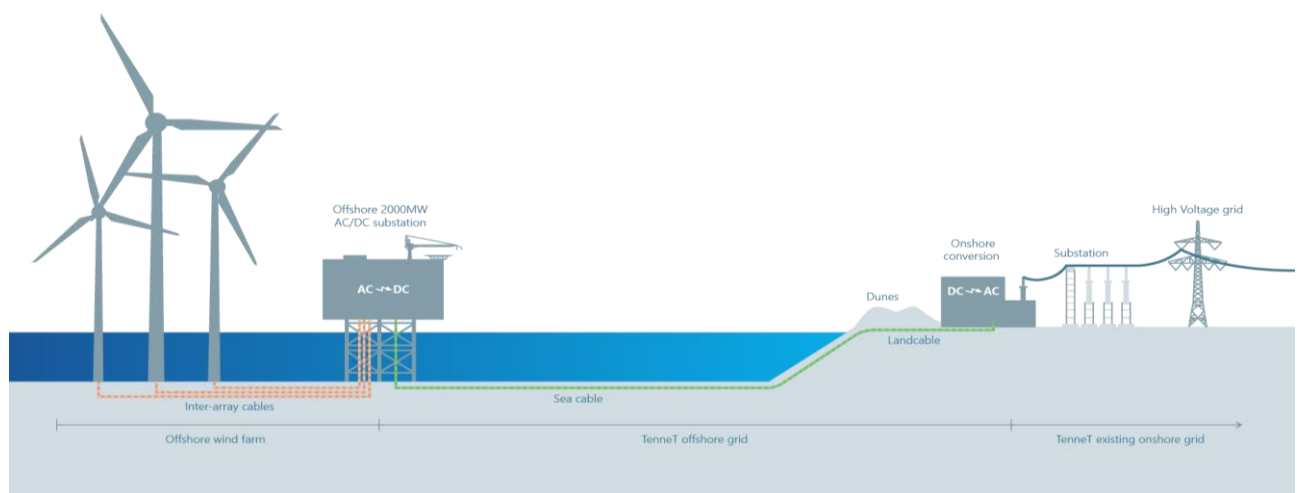


Figure 1 - HVDC grid connection concept

3. Definitions

TenneT is responsible for the realization and the operation of the offshore electricity grid which requires the definition of a Grid Connection Point (GCP) and a Point of Common Coupling (PCC) between TenneT and the offshore Power Park Module (PPM). This paper describes these definitions with underlying motivation.

Within the context of IJmuiden Ver offshore transmission system, as illustrated in Figure 2, the following definitions are given:

- *A power-generating facility, which in this case is an offshore wind farm (OWF), means a facility that converts primary energy into electrical energy connected to the network at one or more grid connection points (GCP).*
- *A power park module (PPM) means a unit or ensemble of units generating electricity, which is either non-synchronously connected to the network or connected through power electronics, and that also has a single GCP.*
- *A generator block (GB) means an ensemble of PPMs of one or more power-generating facilities which are connected to a common PCC and which can be controlled by common set-points.*
- *A GCP is defined as a point at which a PPM is connected to the HVDC system and for which the requirements of the grid code have to be fulfilled by the PPM.*
- *A point of common coupling (PCC) is defined as an AC bus bar system at the HVDC converter platform, which enables the connection of different GB's, neighbouring grids, auxiliary systems or other equipment of the HVDC converter platform and for which the requirements of the grid code have to be fulfilled by the remote end HVDC converter station.*

According to the ENTSO-E HVDC grid code: "HVDC interface point means a point at which HVDC equipment is connected to an AC network, at which technical specifications affecting the performance of the equipment can be prescribed". Therefore, the connection requirements for DC-connected PPM's, as described in the ENTSO-E and the Dutch implementation of the HVDC grid code, shall apply at the HVDC interface point of such systems. For the purposes of this position paper, the HVDC interface point shall be synonymous to the GCP for the OWF.

In physical terms, in the onshore grid of TenneT, customer connections are by definition part of the system. The policy applied for these customer connections is that the customer connection is owned by the customer, except for the bay in the HV installation of TenneT. These bays are maintained and operated by TenneT. This policy results in a logical interface between the connected party and TenneT, the connection terminal (line or cable) and the bay of TenneT. For connections with cables this physical interface is defined as the point between the cable termination and the switchgear installation in the substation. Operation of the switchgear bay is performed by the TenneT dispatch centre on request of the customer.

Also for offshore substations, TenneT maintains the same policy for PPM customer connections. The GCP between the offshore PPM and TenneT is specified at the cable termination of the inter array on the platform.

This, standardized by IEC 60859, defines a clear interface which is also applicable for responsibilities regarding the realisation, the operation as well as the maintenance phase. Next to that, it prevents different ownerships of the switchgear installation for the different functionalities such as connection of PPM's, transformer feeders, possible reactive power compensation and coupling of bus bars.

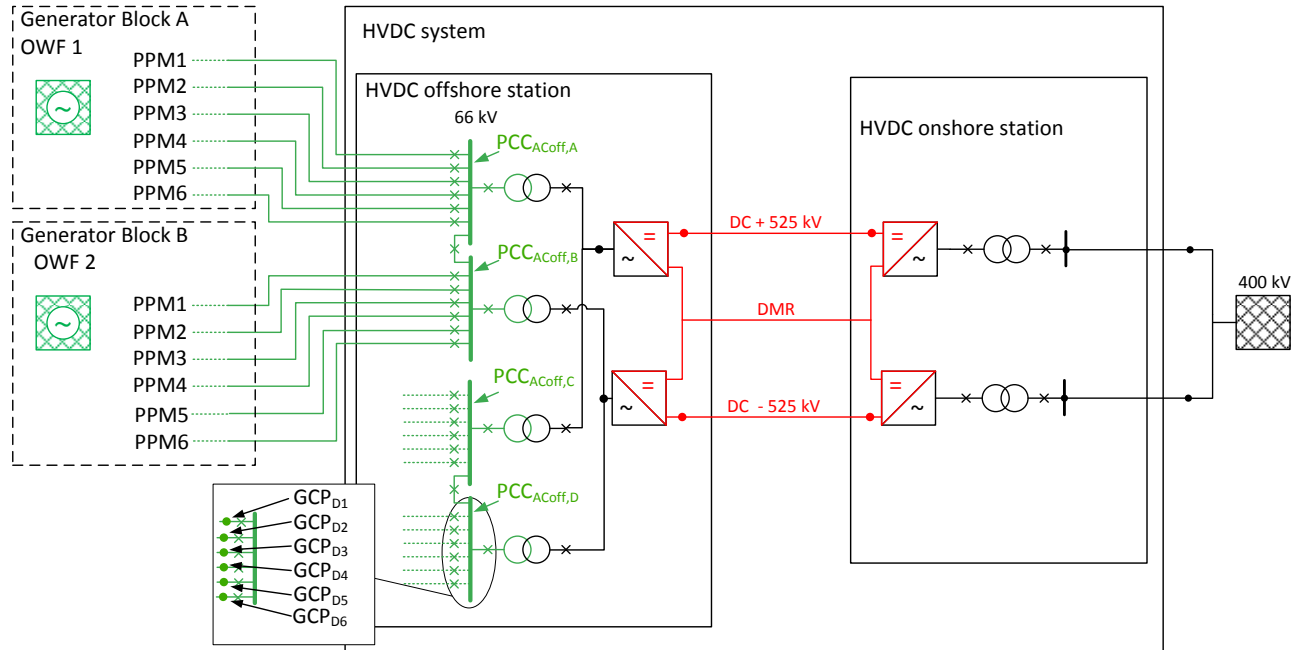


Figure 2: Illustration of the definitions

4. Position TenneT

The Grid Connection Point (GCP) for the offshore power park module (PPM) is specified right after the cable termination of the inter-array cables and before the switchgear on the HVDC platform of TenneT.

The Point of Common Coupling (PCC) is specified at the 66 kV AC bus of the HVDC platform of TenneT.
