Expert Group: Identification of Connection Requirements for Offshore Grids

- A status report of ongoing EG CROS progress in Phase II

15.06.2023

EG CROS chaired by ENTSO-E, under the Grid Connection European Stakeholders Committee

Presented by: Mario Ndreko (TenneT TSO GmbH), Adrian Gonzalez (ENTSO-E Secretariat)

Timeline of the EG CROS Phase II

New definitions for NC HVDC (1/2)

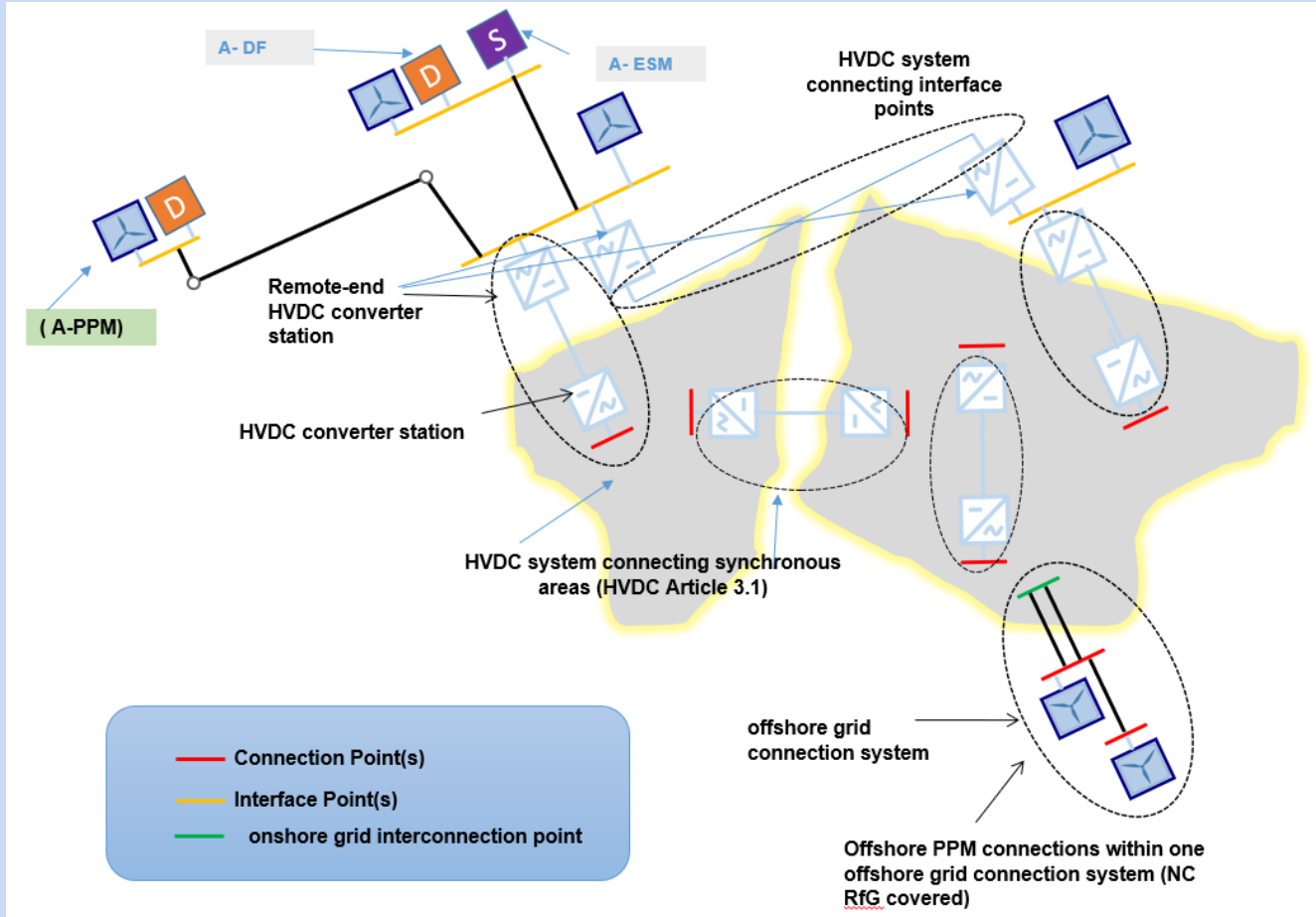
NC RfG

'connection point' means the AC interface at a synchronous area at which the power-generating module, demand facility, distribution system or HVDC system is connected to a transmission system, offshore network, distribution system, including closed distribution systems, or HVDC system, as identified in the connection agreement;

NC HVDC 2.0

NEW: 'Interface point' means a point of an AC network not being part of a synchronous area at which technical specifications affecting the performance of the relevant equipment can be prescribed as specified by the relevant TSO;

NEW: 'Remote-end HVDC Converter Station' means an HVDC converter station which is not synchronously connected to any synchronous area;



New definitions for NC HVDC (2/2)

NEW definitions:

- **'power-to-gas demand unit'** means a demand unit that converts electricity to gases (such as hydrogen or, with subsequent methanation, synthetic methane or other gases);
- **'Asynchronously connected power park module (A-PPM)'** means a power park module that is connected via an interface point to one or more remote-end HVDC converter stations;
- **'Asynchronously connected power-to-gas demand unit (A-PtGU)'** means a power-to-gas demand unit that is connected via an interface point to one or more remote end HVDC converter stations;
- **'Asynchronously connected electricity storage module (A-ESM)'** means an electricity storage module that is connected via an interface point to one or more remote end HVDC converter stations;
- **'Asynchronously connected demand facility (A-DF)'** means a facility which consumes electrical energy and is connected via an interface point to one or more remote end HVDC converter stations;

Summary of all amendment proposals that EG CROS will provide legal text

Amendments 1 - 15

Amendment 1: Article 3 (scope)

Amendment 2: Article 4 (application to existing HVDC systems)

Amendment 3: Article 12 (RoCoF withstand capability)

Amendment 4: Article 14 (Grid forming capability)

Amendment 5: Article 16: (Frequency control)

Amendment 6: Article 19: (short circuit contribution during faults)

Amendment 7: Article 35 (Priority ranking of protection and control)

Amendment 8: Article 36 (Changes to protection and control schemes and settings)

Amendment 9: Title III (increase of scope)

Amendment 10: Article 38 (scope)

Amendment 11: Article 39 (Frequency stability requirements)

Amendment 12: Article 40 (Reactive power and voltage requirements)

Amendment 13: FRT Capability of power to gas demand units

Amendment 14: Article 41 (Control requirements)

Amendment 15: Article 42 (Network characteristics)

Summary of all amendment proposals that EG CROS will provide legal text

Amendments 16 - 31

Amendment 16: Article 43 (Protection requirements)

Amendment 17: Article 44 (power quality)

Amendment 18: Article 45 (General system management requirements)

Amendment 19: NEW Article X (Grid forming capability)

Amendment 20: Article 37 (black start)

Amendment 21: Article 44 (power quality)

Amendment 22: Article 47 (Frequency stability requirements for remote-end HVDC converter station)

Amendment 23: Article 48 (voltage ranges, remote end HVDC station)

Amendment 24: Article 50 (power Quality)

Amendment 25: Article 52 (parameters and settings)

Amendment 26: Annex I (Frequency ranges referred to in Article 11)

Amendment 27: Annex II (FSM and LFSM O/U)

Amendment 28: Annex III (Voltage ranges)

Amendment 29: Annex V (FRT profile referred to Article 25)

Amendment 30: Annex VII (Voltage ranges and time periods referred to in Article 40)

Amendment 31: Annex VIII (Reactive power and voltage requirements referred to in Article 48)

Indicative amendment proposal: Grid Forming for HVDC systems in Art. 14

1. If specified by the relevant system operator, in coordination with the relevant TSO, **an HVDC system shall be capable of providing grid forming capability at its connection point** as defined by the following paragraphs:

(a) Within the HVDC system voltage, current and energy limits, the HVDC converter station shall be capable of behaving as a controllable voltage source behind an internal impedance (Thevenin source) during both the normal operation and immediately after a grid disturbance. The Thevenin source is characterized by its voltage amplitude, voltage phase angle, frequency and internal impedance all of which can be adjustable.

(b) During the first instance following a grid disturbance

[…]

(c) During the disturbance period and after the first instants

[…]

Indicative amendment proposal: LFSM-UC for PtG Demand Units

- capability for limited frequency sensitive mode — underfrequency consumption (LFSM-UC) for **asynchronously connected power-to-gas demand unit** based on the measured frequency at the power to gas demand unit interface point frequency or fast signal response as specified in paragraph 1 for the 50 Hz nominal system.

Indicative amendment proposal: Introduce FRT capability for asynchronously connected power to gas demand units (1/2)

With regard to fault-ride-through capability of asynchronously connected power-to-gas demand units:

a. The **asynchronously connected power-to-gas demand unit** shall, when operating above the minimum stable operating level, **be capable of staying connected to the network and continuing to operate stably after the power system has been disturbed by faults in the AC network according to a voltage-against-time-profile** in line with Figure XX at the interface point and with the set points in Tables X.1.1 and X.1.2.

b. The voltage-against-time-profile expresses a lower limit of the profile of the phase-to-phase voltages on the network voltage level during a symmetrical fault, as a function of time before, during and after the fault.

Indicative amendment proposal: Introduce FRT capability for asynchronously connected power to gas demand units (2/2)

c. When the network voltage resumes, after the fault has been cleared, to a value within the voltage range of 0,85 pu – 1,1 pu, a power-to-gas demand unit shall recover its active power output level at the connection point to:

- **80 %** of its pre-fault value with a recovery time that shall not exceed **a maximum of 5 s.**
- **90 %** of its pre-fault value with a recovery time that shall not exceed **a maximum of 20 s.**
- **95 %** of its pre-fault value with a recovery time that shall not exceed **a maximum of 30 s.**

d. Fault-ride-through capabilities in case of asymmetrical faults shall be specified by the relevant system operator.

Indicative amendment proposal: Article 47 (Frequency stability requirements for remote-end HVDC converter station)

[…]

4. **If two or more remote-end HVDC converter stations are connected to one or more interface points of the same AC network**, the remote-end HVDC converter stations and their respective HVDC systems shall be capable to continuously operate stably over the full operating range between maximum and minimum HVDC system active power transmission capacity and contribute to the frequency control of the remote-end HVDC system AC network they are connected to.

Indicative Amendment Proposal: Article 47 (Frequency stability requirements for remote-end HVDC converter station)

[…]

5. If paragraph 4 applies, **the relevant TSO in coordination with adjacent TSOs, shall specify a study in order to define coordinated frequency droop parameters of the remote-end HVDC converter stations** including power sharing ratio between the remote-end HVDC stations and their respective HVDC system. This study shall include also robustness during frequency step changes response and data provisions according to Article 29.

Indicative Amendment Proposal: Article 47 (Frequency stability requirements for remote-end HVDC converter station)

[…]

6. If grid forming capability as prescribed in Article 14.5 is requested and if it is specified by the relevant system operator, **the remote end HVDC converter station shall be capable of adjusting at its interface point the AC network frequency and voltage phase angle in order to use the synthetic inertia from A-PPM and A-ESM .**

Next steps

The EG CROS request ACER to approve the start of public consultation in GC ESC from 15th of July till 15th of August

Request for extension due to RfG and DCC amendment process: Final Report to be submitted as of 1st of October.