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Project Aquila: an example of a planned multi-vendor, multi-terminal HVDC system

On 7th July 2022, the Offshore Transmission Network Review [1]; a UK Government driven process to unlock growth in Offshore Wind at Pace and scale delivered its "Holistic Network Design" of reinforcements and key strategic activities to meet 2030 delivery of Offshore wind targets. This included acceleration of Transmission projects and four "Pathfinder to 2030" projects [2]. Under the Pathfinders, UK government, the regulator Ofgem and Electricity System operator are committing to support trail-blazing projects that deliver new essential components for the post 2030 network, for which they will unblock regulatory policy and framework barriers to ensure their delivery.

Project Aquila is one of those four projects, and the only one of those projects led by an onshore transmission owner, with the others being taken forward by offshore generation developers undertaking also the design and delivery of Offshore Transmission System Development User Works (OTSDUW), as is common in GB for offshore projects. It is being delivered within a number of standard Business as Usual instruments of regulatory funding.

The context for Aquila (figure1) illustrates a range of coincidently timed, co-located HVDC reinforcements at the existing site of Peterhead, and the offshore wind connection needs in the North East of Scotland, all of the transmission projects having clear need cases, and accordingly have been approved to proceed under the GB Network Options Assessment process [3] which provides guidance on the development of the GB transmission system.

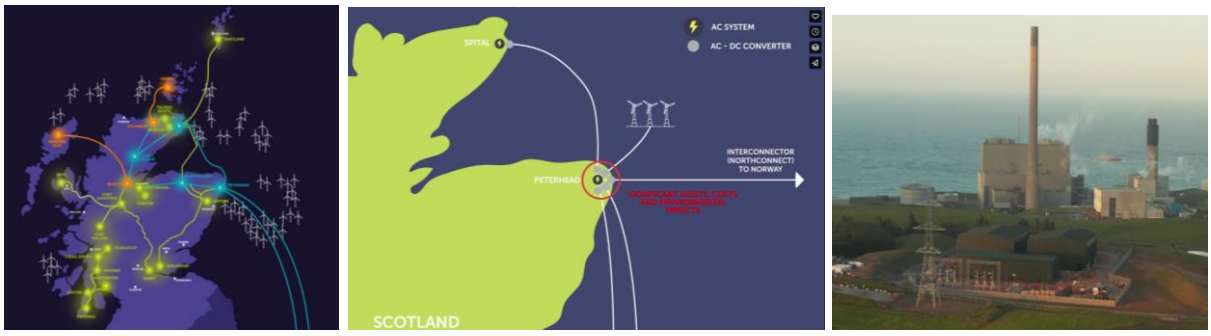

Figure 1: The development context for project Aquila; network, site, & pictured.

Project Aquila [4] is being taken forward by SSEN-Transmission, who own operate and develop the transmission network in the north of Scotland, and the National HVDC centre, which is a centre for simulation, training and insight in the de-risking of large scale converter integration into networks. Project Aquila delivers the following:

1. A DC Switching Station (DCSS) at Peterhead, located in the North East of Scotland allowing a multi-terminal arrangement to be established, limiting the number of required converters at Peterhead and providing environmental and cost saving benefit
2. A design which permits multi-vendor delivery of the multi-terminal arrangement and a variability in the terminals allocated to each arrangement via a DCSS design enabling "safe to fail", staged demonstration to take place.
3. The de-risking and specification and delivery of multi-vendor at the National HVDC centre via a process building on insights developed by the centre as part of its support

of the first Multi-terminal VSC-HVDC project in Europe; Caithness-Moray-Shetland [5], and its work to support implementation of DC networks under the EU-funded PROMOTioN project[6].

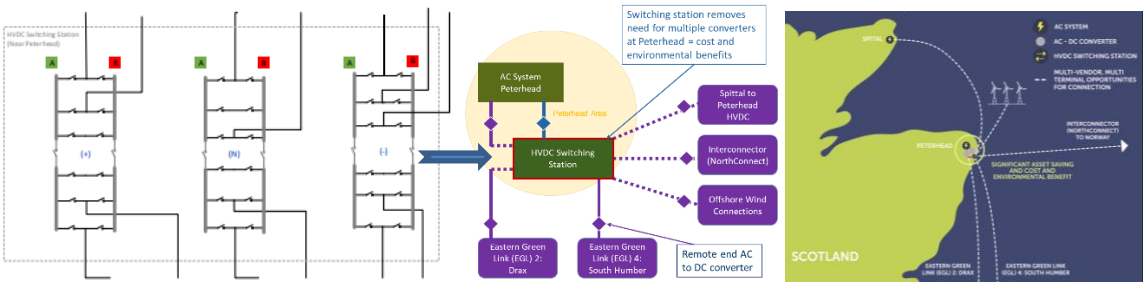

Figure 2: The high-level concept of project Aquila.

Project Aquila (figure 2 above) will take place with a focus surrounding 525kV rigid bi-pole arrangements developed to provide transmission reinforcement "Eastern Green Link" projects. The project uses the DCSS innovatively link these project terminals together such that by allocation to busbars A and B shown, both single vendor point to point and then via re-selection to a common busbar multi-vendor 3 or 4 terminal arrangements may be established. The introduction of a neutral switching arrangement within the DCSS also enabled further radial full 525kV bipoles to be integrated into the arrangement, with the connections between the DCSS and the converters at Peterhead serving as part of the full Bipole arrangement for these components delivering further resilience to the arrangement. No DC circuit breakers (DCCB) are shown, however with the introduction of section switches within the DCSS, the arrangement has been "future proofed" to that future capability. In its current form, a maximum of 4 connections of up to 1800MW capacity may be achieved; should future DCCB development occur this capacity could be potentially doubled. Figure 3 gives a summary of the activities, which will be disseminated more fully in due course, and include significant vendor support. In summary Multi-vendor can be achieved in process which respects and does not compromise Intellectual Property; but requires detailed simulation, testing and ownership of the overall solution and its specification.

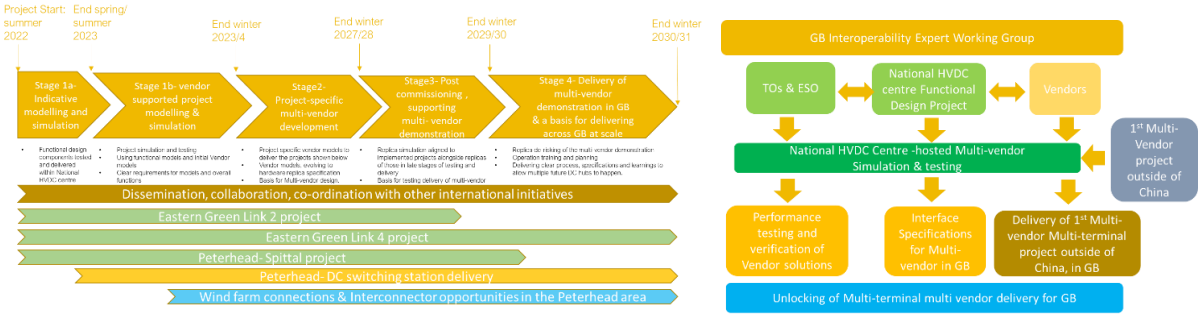

Figure 3: The activities of project Aquila in summary

1 Offshore transmission network review - GOV.UK (www.gov.uk)
2 Offshore Transmission Network Review: Pathfinder projects - GOV.UK (www.gov.uk)
3 Network Options Assessment (NOA) | National Grid ESO
4 Project Aquila on Vimeo
5 Caithness Moray HVDC Link | Hitachi Energy
6 PROMOTioN - Deliverables (promotion-offshore.net)