Newsletter

Issue 27: January 2022

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The National HVDC Centre

In this Newsletter, we discuss some of the implications of the recent ScotWind announcements, highlight our newest innovation projects, and share some of our work on the multi-terminal Shetland extension.

[photographs of the HVDC Centre Extension: Exterior, Protection Workshop, and Testing & Demonstration Workspace]

HVDC Centre Extension

After a number of Covid related delays, we are proud to open our extension to the Centre (photographed above).

This provides us with:

- **Protection Workspace:** a dedicated area for interfacing and testing protection relays and other hardware;
- **Testing & Demonstration Workspace:** used for Control Room training, and other demonstrations;
- **Collaboration Workplace:** used for FST of the Shetland multi-terminal extension, multi-vendor testing; and
- **Equipment Store:** Secure store for various hardware components.

These facilities, together with the additional engineers we are recruiting, allows us to offer an enhanced range of services.

Webinar & HVDC Operators' Forum

A couple of dates for your diary. We are hosting a webinar in February on HVDC technology choices; then in June we are planning to re-establish our annual HVDC Operators' Forum (as an in-person event).

HVDC Technology Choice for AC Grid Reinforcements

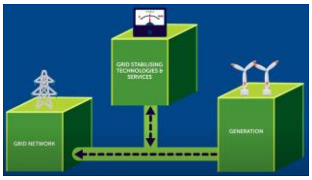
Date: Tuesday 15 February 2022
Time: 12:00-13:00 GMT
Register: https://forms.office.com/r/1NCKJtTEbr

2022 HVDC Operators' Forum

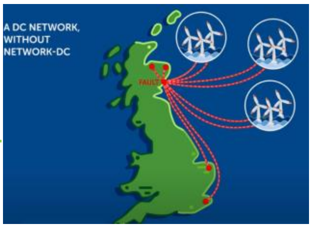
Date: Tuesday-Wednesday 21-22 June 2022
Time: All day
Details will be posted here: www.hvdccentre.com/events/

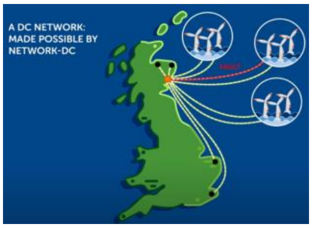
Strategic Innovation Fund (SIF) Projects

In collaboration with our project partners, the Centre is progressing two Strategic Innovation Fund (SIF) projects; Network-DC and INCENTIVE. Both these projects are key components of the HVDC R&D Strategy that we published last year (commissioned by BEIS & Ofgem).



- **Network-DC:** This project is concerned with the Innovation of the use of direct current circuit breakers (DCCB) to enable the connection of multiple offshore wind farms via a DC network. The objectives of the project are: Explore the cost-benefit of DCCB use and identify the roadmap to de-risk DCCB deployments.





- **INCENTIVE:** This project investigates and demonstrates innovative solutions for voltage, current (fault level and inertia supporting) and frequency control coupled with short-term energy storage at the onshore substation of existing or new offshore wind farms.

  The Project explores the role that short-term energy storage at the point of grid connection of offshore wind farms can play in stabilising the grid.

Linda Rowan

To find our more, please contact us to discuss or to arrange a visit:
01236 687240 | info@hvdccentre.com | hvdccentre.com

The National HVDC Centre

ScotWind Offshore Wind Leasing Announcement

On the 17 January, Crown Estate Scotland announced the outcome of the first offshore wind leasing round since offshore wind rights were devolved to Scotland. The leasing round process selected 17 projects with a total capacity of 24.8 GW. This is split between individual projects ranging in size from 495 MW to 2.9 GW [1].

The remote location of many of these project sites is such that new/novel floating wind turbines will need to be developed, whilst HVDC technology will be needed to connect them to the Transmission System.

Additionally, such a significant amount of additional wind generation will increase power flows from Scotland, south to load centres in the South of England. This is expected to drive the need for additional submarine HVDC links to reinforce the onshore AC transmission system to provide further capacity between Scotland and England. As a result, development of the ScotWind projects is expected to drive the development of new HVDC projects in the GB transmission system.

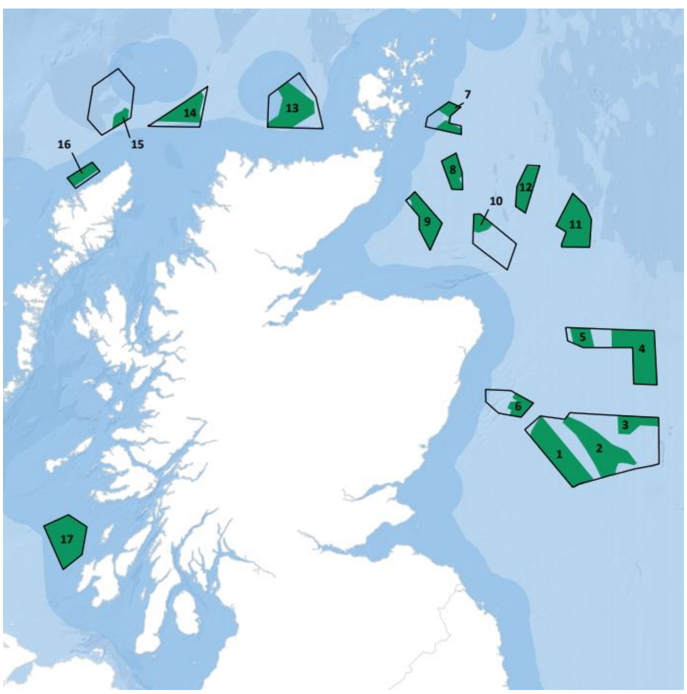


Figure 1 Map of ScotWind Project Areas [2]

[1] www.crownestatescotland.com/news/scotwind-offshore-wind-leasing-delivers-major-boost-to-scotlands-net-zero-aspirations

[2] www.crownestatescotland.com/resources/documents/scotwind-map-of-option-areas-170122

Fabian Moore

Interoperability: Making it Real

This month marked the record-breaking scale of nearly 25GW offshore lease area allocations for Scotwind.

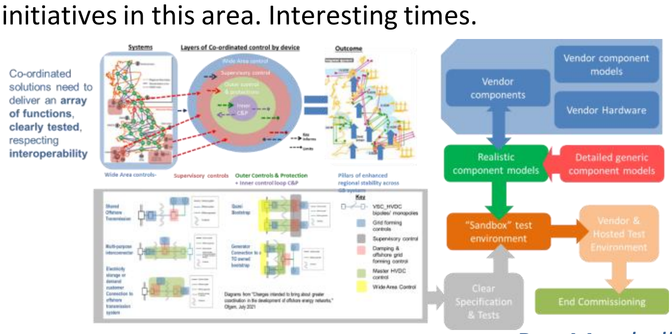
The Centre noted with interest the scale and geographic nature of these connections, many of which undoubtably requiring HVDC solutions, with some offshore areas close enough to be interconnected offshore, whereas others may consider more distant DC connected solutions, the specifics of which will no doubt evolve as the Holistic Network Design process reports later this year.

At the Centre, whilst not delivering this design specifically, we are acting as a client-side advisor across that work. This month Phase 2 stability pathfinder projects also enter a phase of technical demonstration of new Grid-forming solutions; something we also recommended in our phase 1 work could be a feature of co-ordinated offshore designs.

A common theme will be the need to achieve inter-operable solutions across power-electronic devices. At the December Cigre UK meeting, I described how to test Grid forming solutions - Grid Forming Technologies for the Net Zero Power Network - - CIGRE-UK and at the recent 2nd HVDC and offshore power transmission Prospero event 2nd HVDC & Offshore Power Transmission 2022 - Prospero Events Group how interoperability is tested more generally.

Finally, and again this month, this time in the US, New York State announced that it is making it a pre-requisite for tender for offshore HVDC windfarms to be meshed together within their offshore AC systems, following analysis into its benefits Brattle Consultants Release Report Analyzing the Costs and Benefits of a Meshed Offshore Grid for New York - Brattle.

Tennet, Amprion and 50 Hertz are similarly driving such solutions, with the resultant interoperability considerations needing to be managed. We were recently selected to advise at a NREL led Department of Energy study into interoperability of such arrangements and support a number of Horizon 2020 European initiatives in this area. Interesting times.



Ben Marshall

Floating Offshore Wind Turbines

Most of the ScotWind developments are proposed to comprise of floating turbines[3].

Wind power is stronger in the ocean than on land, hence the development of offshore wind in recent years. Until recently, because they were based on fixed structures, they could not be installed in very deep or complex seabed locations, something that has changed with the advent of floating structures. Wind turbines can now be installed on these platforms, which are anchored to the seabed by means of flexible anchors, chains, or steel cables.

Floating Offshore Wind Turbines

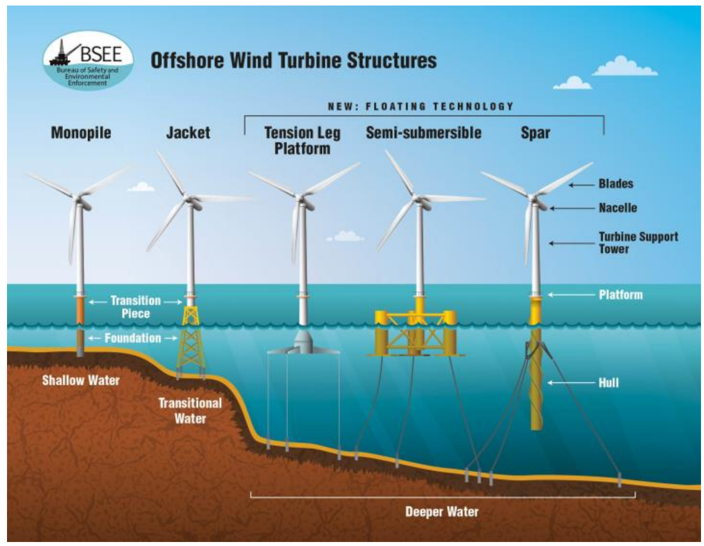
Offshore wind energy is a source of clean and renewable energy obtained by harnessing the power of the wind offshore, where it reaches a higher and more constant speed due to the lack of barriers. Its high potential and strategic added value, both at a socioeconomic and environmental level, make it one of the renewable sources that will play a crucial role in the decarbonisation process.

Floating offshore wind, based on floating structures rather than fixed structures, offers new opportunities and alternatives. Basically, it opens the door to sites further offshore by allowing the deployment of wind turbines in larger and deeper offshore areas with higher wind potential. It thus overcomes a stumbling block to providing clean, inexhaustible, and non-polluting energy for a more sustainable planet.

Among the advantages of floating offshore wind are the potentially low environmental impact and the ease of manufacture and installation, as the floating turbines and platforms can be built and assembled on land and then towed to the offshore installation site. In addition, as noted above, they can take advantage of the strong winds blowing in the deeper areas, which improves energy efficiency.

[3] www.crownestatescotland.com/news/scotwind-offshore-wind-leasing-delivers-major-boost-to-scotlands-net-zero-aspirations

Floating offshore wind energy is based on floating platforms for wind turbines. The choice of one type or another will depend on sea and seabed conditions, the winds in the area, the size of the wind turbine, the depth of the harbours, the manufacturing facilities or the availability and price of materials and equipment. Some of these are described below:



The different types of floating wind farms for Wind Turbine

- **Tension Leg Platform (TLP):** The newest and least tested concept: the platform does not actually float (after the wind turbine is installed), but 'floats' beneath the water surface secured by three to five tensioned steel cables.
- **Semi-submersible:** In this design several vertical cylinders joined by beams and braces provide buoyancy, secured to the seabed with anchors, creating a platform where the turbine can be installed.
- **Spar:** In this model, most of the weight is placed at the lowest possible point to provide stability. Buoyancy is provided by the geometry of a single cylinder, while stability is provided by the weight at the lowest point. As turbines become larger and larger, it requires very long cylinders to compensate for the weights, which makes this solution difficult to manufacture, transport and install.

Nikhil Sharma

The National HVDC Centre

Software-in-the-Loop Testing for Shetland

The next stage of our testing for Shetland will implement software-in-the-loop setup for the first time.

This involves running a ‘black box’ manufacturer supplied model of the controls for planned island connected generation in real-time in combination with our detailed model of the proposed Shetland network and the Replica control and protection cubicles we have for the CMS HVDC link.

Bringing these elements together will give us a detailed and very accurate picture of how these different devices connecting the island will interact. On top of our existing setup for the simulations with the Replicas we will be introducing an additional high-performance computer dedicated to running the vendor supplied real-time controller models. This additional tool for simulation allows us greater accuracy at the system level while maintaining the confidentiality of vendor IP in the real-time environment.

Ian Cowan

Caithness-Moray-Shetland Multi-Terminal FST and FAT at the HVDC Centre

The construction and commissioning of the third terminal of the Caithness Moray Shetland (CMS) multiterminal project going on at full pace at Kergord and Noss head. In relation to this the final Factory system test (FST) and Factory acceptance test (FAT) of the updated control and protection software will be conducted by Hitachi Energy along with SSEN and HVDC Centre using the CMS control and protection replica hosted at the Centre.

This FST and FAT would verify and demonstrate all the critical operational and dynamic contingent performance of the first European multiterminal VSC HVDC project.

These test are critical to de-risk the commissioning of the third converter terminal and DC switching station before it could become operational. More information on CMS commissioning is available here.

An arial photo of the Kergord construction site is below.

Bharath Ponnalagan

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01236 687240 | info@hvdccentre.com | hvdccentre.com