Newsletter

Issue 36: April 2024 Edition

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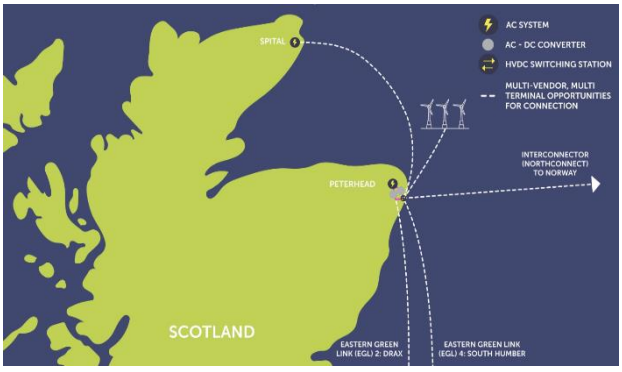
The National HVDC Centre

Welcome to our spring edition of the HVDC Centre newsletter.

Whilst not *quite* in spring, January saw the publication of ENTSO-e (EU organisation of TSOs) publish an Offshore Networks Development plan for Europe through to 2050. It's a formidable vision, including DC networks, and consideration of future deployment. But big visions need to be delivered in considered steps; this newsletter covers many of the key stages that demonstrate and enable DC networks, areas the Centre is proud to say it's been at the cutting edge of. As always, please contact us to find out more.

Aquila Patents Summary

The HVDC Centre is leading Multi-Vendor Terminal development in Project Aquila. Kicked-off in July 2022, the project is progressing the developing a Multi-Terminal, Multi-Vendor DC-hub in Peterhead, establishing the foundations for DC-Grids in GB. Aquila is establishing robust and flexible HVDC network controls and is furthermore fostering collaboration and knowledge sharing among vendors, owners, industry stakeholders, academia, and government bodies.



Project Aquila has generated intellectual property related to multi-vendor interoperability and multi-terminal operations in an environment currently heavily patented, where individual Manufacturer IP and commercially sensitive delivery needs representing. Our approach does not need to "open-up" or compromise such IP; rather it characterises its effect within a common DC network control.

By patenting this IP, we aim to ensure that this common interoperable control strategy is equally available to all vendors, enabling Multi-Terminal Girds to be developed. These 3 filed Patents are summarised below.

Multi-Vendor Multi-Terminal Control	This Patent covers advanced control system for coordinating HVDC converters supplied by different vendors in a multi-terminal configuration. This enables smooth power flow orchestration between all terminals.
Multi-Vendor Multi-Terminal Operability	This patent relates to interoperability protocols and interfaces that allow seamless operational control of multi-vendor converter stations across a range of configurations and outages to maximise the availability of an integrated HVDC grid.
Multi-Vendor Multi-Terminal Stability	This patent is for unique stabilisation techniques to maintain reliability and prevent cascading failures across multi-vendor multi-terminal HVDC networks.

These patents provide a world-first means of unlocking Multi-Vendor Multi-Terminal operation of DC networks and also include functions that single vendor solutions would benefit from. We have demonstrated these controls within a test environment including vendor controls, aiming to complete testing later this year

Isioma Okoh

The National HVDC Centre

HND 1 Offshore Designs Grid Code Project

In March 2024 (that's definitely Spring), the ESO updated its offshore electricity network design called the Pathway to 2030 Holistic Network Design (HND). The original HND connected 23 GW of offshore wind power and "beyond 2030" helps deliver a further 21GW on top of that towards the UK Government's target of 50 GW by the mid –2030s'.

It foresees more and more DC links leading to a meshed AC-DC grids as represented in the diagram. Whilst this has many consenting, cost and supply chain advantages it is more complex in nature and requires care in its implementation- to avoid dynamic interactions, oscillations, and low inertia related stability issues both onshore and offshore.

The Electricity System Operator has tasked The National HVDC Centre with modelling the offshore HND1 networks, and indeed others identified in the picture opposite, with an aim to inform the evolution of existing technical codes and standards.

The HVDC Centre is currently developing models of the HND1 offshore networks, testing their energisation and implementation stages, and will conduct stability and dynamic studies on the planned network. This is being achieved using real-time EMT simulation. The reason being the range of tests involved and the ability to use functional design models which have been tested against and integrated with vendor solutions.

The model will interface with the onshore AC system to understand the practical considerations of delivering integrated offshore AC and DC systems. This includes the operation and performance requirements necessary to meet onshore codes and standards whilst respecting the needs of offshore connections. This work seek to identify relevant areas of technical code clarification/ addition.

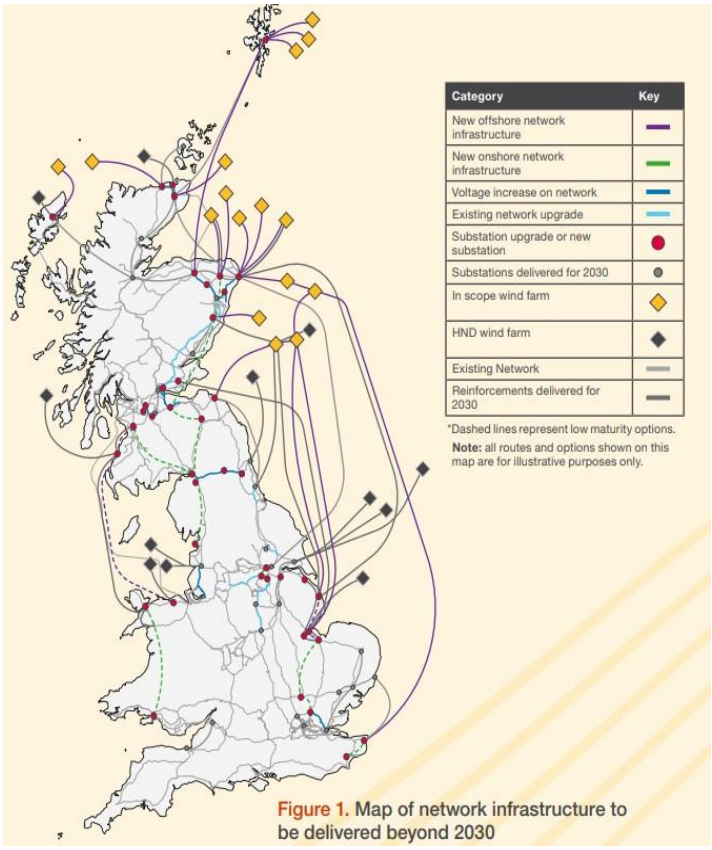


Figure 1. Map of network infrastructure to be delivered beyond 2030

For more information on HND please visit : ESO HND Beyond 2030

Nikhil Sharma

Network DC

This Strategic Innovation Fund (SIF) "Beta" Phase project on DC circuit breakers (DCCB) is currently in the process of tendering to find DCCB manufacturers to participate in the detailed power systems simulation and reliability assessment to be undertaken over the next couple of years. The HVDC Centre is working with SuperGrid Institute and the University of Edinburgh on defining the control and protection philosophy for a possible future DC grid including DCCBs. A combined paper on this approach will be discussed at this year's CIGRE symposium in Paris (see next page).

THE UNIVERSITY of EDINBURGH

SuperGrid Institute
Shaping power transmission

Later in the project our facilities will be used for testing hardware or software replicas of the DCCB control systems, helping to demonstrate behaviour and thereby de-risk and accelerate the use of DCCBs in the GB transmission system. We are also engaging with others in Europe and beyond doing related work on DCCBs and their use in extending HVDC grids.

Colin Foote

The National HVDC Centre

HVDC-WISE Project Update

This important European project is almost halfway through, and the 14 partners are working hard on the latest outputs. This includes updates on the innovative control and protection methods that will be further investigated using realistic use cases in the second half of the project. The HVDC Centre is leading Task 7.2, which is focused on real-time and electromagnetic transient (EMT) modelling and simulation to test different HVDC architectures, including novel control and protection, with a model that is representative of the GB transmission system.

OPAL-RT TECHNOLOGIES

As well as utilising our extensive RTDS® facility and high-performance desktop computers, the HVDC-WISE funding from UK Research & Innovation is being used to invest in complementary simulation capability from Opal-RT Technologies. This new facility will further extend the Centre's capability and flexibility, opening new opportunities for supporting HVDC and related projects and helping to accelerate the industry's Net Zero transition.

Colin Foote

CIGRE

Together with project partners in several organisations, the Centre has co-authored three papers that will be published at the CIGRE Paris Session in August 2024. These are related to recent work at the Centre on multi-purpose interconnectors, DC circuit breakers, and the reliability and resilience of future hybrid AC/DC grids. Ben Marshall and Colin Foote will be attending the conference and participating in the leading global forum for the electricity transmission industry. We hope to see you there!

Paris Session 2024 | cigre For power system expertise

Publications and other forms of knowledge dissemination are among the core purposes of the HVDC Centre. We will continue to share project outcomes, raise awareness, and support learning on HVDC and real-time simulation across the industry.

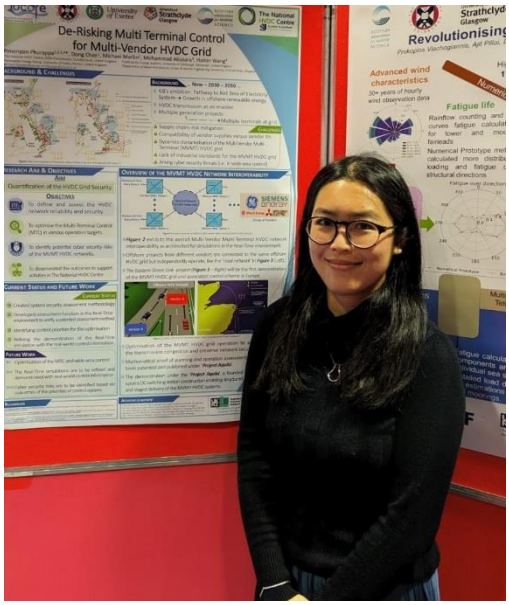
Colin Foote

Scottish Labour Conference 2024

On 16 February 2024, The National HVDC Centre joined the presentation panel for the Skill Day at SSE's Clean Power Pavilion at the Scottish Labour Party Conference 2024 at the Scottish Event Campus in Glasgow.

Our HVDC Technology Manager, Ben Marshall, took the stage to showcase the Centre's operations and the invaluable contributions of its workforce towards delivering the Pathway to 2030. His presentation not only provided crucial information on HVDC technology to the audience, but also underscored the human aspect behind the journey to net zero.

Ben was accompanied by Peach Phurappa, a research engineer at the Centre, exhibiting her industrial research project through a poster presentation. Her project is hosted by the HVDC Centre in collaboration with the Industrial CDT in Offshore Renewable Energy (IDCORE). The project aims to quantify the security of the HVDC grid by mitigating risks associated with multi-terminal control in the multi-vendor HVDC system. The anticipated outcomes of the project will complement the Project Aquila Interoperability Package.



Notably, Peach also exhibited her poster at the IDCORE Company Days event on 22– 23 February 2024, where she received the Best Research Poster prize. This dual recognition underscores the significance of the workforce at The National HVDC Centre and its industrial and academic engagements in advancing the energy sector's resilience and sustainability while accelerating the GB net zero transition.

Peach Phurappa

To find out more, please contact us to discuss or to arrange a visit:
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