



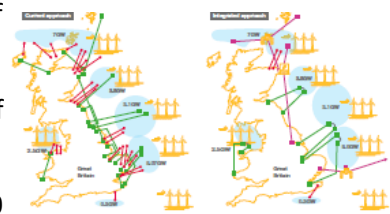
Welcome to the Autumn edition of our newsletter; as we continue our work across a variety of projects, a substantial construction project begins outside, extending the Centre's footprint and capabilities. In this newsletter we are excited to share some of the latest developments in our projects, as the Centre (quite literally) expands towards its transition into the next RIIO-T2 period in March 2021.

Integrated Offshore – 'winds of change'

Since June, the Centre (in a consortium with DNV-GL and EPNC) has been supporting the National Grid ESOs' Offshore Co-ordination project; for which the Centre has led the technical and conceptual network designs. This culminated with our delivery of the 'Holistic Approach to Offshore Transmission Planning' report together with the DNV-GL led CBA report on 30 September 2020.

Since then we have been supporting the ESO across a range of workshops both on the technical work itself and on how it informs the CBA. Viewed together, these two documents for the first time provide a strategic picture of the potential next 30 years of offshore wind growth and what this could mean for the projects, onshore transmission system and local coastal communities affected by an unparalleled growth in renewable technology.

Within this is a picture of how integrated planning and design could optimise the networks of 2030 and beyond, with over £1bn of potential saving realisable by 2030 and over £6bn of benefit by 2050 estimated.



It's easy to be mesmerised by such numbers and forget that the foundation of the analysis is a clear technical understanding of the current 'state of the art' for the component technologies combined with the insight of how they may be delivered together.

Further information can be found in the link below, and in the newsletter article on this topic: *found here:* www.nationalgrideso.com/future-energy/projects/offshore-coordination-project

Ben Marshall

Technical Webinars & Events

The National HVDC Centre delivered the following technical webinars & events to industry stakeholders.

- Habib presented at the RTDS spotlight series on: 'Derisking the deployment of HVDC projects; slides and recording available at: www.rtds.com/events/uss-week-2/
- On 9 September, Ian hosted the PROMOTiON WP9 demonstration event; slides and recording available at: www.hvdccentre.com/demonstration-of-dc-grid-protection-promotion-wp9-09-september-2020/
- On 4 August 2020, Ben and Daniel presented on GB design implementation, Technology Readiness and technical barriers/opportunity as part of the ESOs Offshore Co-ordination project; *slides available at:* www.nationalgrideso.com/document/176251/download
- Ian presented at the PROMOTiON final conference: www.promotion-offshore.net/news_events/final_conference_2020/
- At the IEEE PES 2020 General Meeting virtual conference (3-6 August 2020), Ben presented on real-time testing environments for utilities; materials available at: pes-gm.org/2020/
- At the CIGRE 2020 e-session (31 August to 1 September 2020), Daniel presented a paper on the key considerations for multi-vendor extension and testing of HVDC schemes.
- Ben presented a keynote speech to ICRERA 2020 conference on Renewable energy research; materials available at: www.icrera.org/
- Ben presented to New York operators NYSEDA/DSP conference on renewables integration; materials available at: www.nyserda.ny.gov/

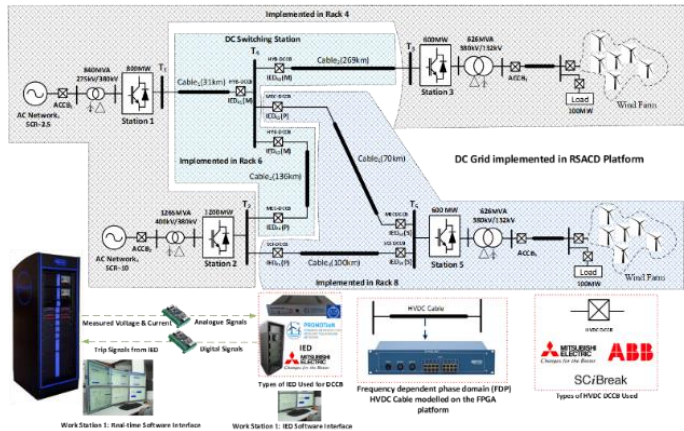
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A Farewell to PROMOTiON!

On 21 September 2020, the PROMOTiON project (one of Europe's largest energy research projects) completed its final close out event. After 4.5 years, €43 million and with 34 organisations involved in collaborative research to advance the readiness of meshed DC grids.

The goal of the PROMOTiON project was to progress the use of meshed offshore HVDC grids for connecting offshore wind farms to onshore and interconnectors. The objective of WP9 (Work Package 9), led by The National HVDC Centre, was to demonstrate DC grid protection solutions developed in the project using hardware-in-the-loop testing on a real-time platform.



Project Demonstration

On 9 September 2020, The National HVDC Centre was pleased to lead the final demonstration event (a virtual event) of WP9. The event brought together project partners, academics and stakeholders to demonstrate HVDC grid protection by integrating fully hardware implemented protection relays, or intelligent electronic devices (IEDs), within a simulated realistic HVDC grid model, combined with simulated realistic DC circuit breakers (DCCB); in a real-time environment.

HVDC grid model – The developed DC grid model is based on open-source HB-MMC converter models with high fidelity and control flexibility. This model provides excellent flexibility for further investigation into DC grid operations with different DC voltage control and power dispatch strategies, the interaction of AC and DC grids including voltage and/or frequency stability, system protection, integration of renewables etc.

DCCBs model - Various types of HVDC DC circuit breaker (DCCB) models have been examined and validated by WP6 in collaboration with industrial and academic partners within the PROMOTiON project. Three DCCBs topologies have been examined in WP9: ABB hybrid, Mitsubishi Electric mechanical and SciBreak DCCBs. The developed multi-vendor DCCBs implemented in the HVDC grid model provides excellent flexibility for further investigation into DC grid protection testing.

Protection IEDs - Two protection intelligent electronic devices (IEDs) prototypes were used for testing:

- PROMOTiON IED developed by KTH through the PROMOTiON project; and
- Industrial-grade hardware IED developed by Mitsubishi Electric.

Both IEDs prototypes were implanted within a realistic HVDC network to validate the detection and discrimination performance of the devices.

This demonstration event highlighted the effectiveness of using different protection IEDs along with various types of DCCBs for DC fault events in both radial and meshed HVDC grid, and emphasised the need for an accurate converter and DCCBs modelling.

The outputs inform both academia and industry on the use of hardware-in-the-loop testing to verify and increase the Technology Readiness Level (TRL) of the overall protection system of meshed and radial HVDC grids. It also provides solid groundwork for further studies to identify and mitigate protection risks for future large HVDC grids for HVDC grid developers, TOs and ESOs.



Project Dissemination

The full PROMOTiON project covers advances in technology to overcome the technical barriers and also those of a financial and regulatory nature.

The PROMOTiON [website](#) offers access to the project [deliverables](#) and [papers](#) produced and online content created for the final conference summarising all the project's learnings.

Key Takeaways

The TRL of the key enabling technologies have all been increased such that there is no longer a technical barrier to the creation of an offshore HVDC grid (although I'm sure there will still be a few challenges along the way!). This combined with the non-technical work undertaken allowed PROMOTiON to create a roadmap for the creation of the grid required to meet the offshore wind targets.

In the panel session of the final conference, bringing together manufacturers, TSOs and developers, it is clear that the ambition is there to create the grid. Indeed with the commitments from government and the plans such as the Danish energy islands the development of a North Sea HVDC grid it now seems almost inevitable.

Ian Cowan & Habibur Rahman

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COMPOSITE Project - testing multi-device performance

We have engaged RTEi to build on the foundational analysis experience of the Johann Svestrup multi-vendor HVDC integration study, to work with us to develop new approaches to defining the key tests & simulations and the associated data and other requirements needed across the process of designing, testing, commissioning and operating complex, multi-device connection solutions.

We are working closely with the ESO and TOs on this work, which intends to inform Grid Code compliance processes and feed into CIGRE B4 technical workbooks describing the future industry standard.

This work completes in March 2021; and further information is available at: www.hvdccentre.com/composite/

Oluwole Daniel Adeuyi

Dynamic Wide Area control of Convertors/FACTS devices

The National HVDC centre is working with SHE Transmission and GE Intelligent Systems, to investigate the potential to use a variety of PMUs (and other devices) to inform wide area control as key metrics of local system strength change within the onshore transmission system.

The National HVDC Centre has begun the process of comparative evaluations of devices, with these and a new Phasor Controller platform being used for detailed RTDS-HiL evaluation of the proposed system and device responses to it.

Within this, the Centre will incorporate a dedicated GPS time-stamping approach (consistent with what would be available practically) and via use of a communications emulator; interrupting, distorting and delaying communications between the control and associated devices in a realistic manner, to verify the robustness of the approach.

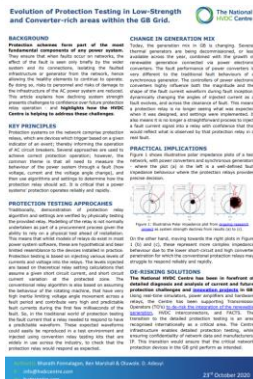
For further information on this project, refer to: www.smarternetworks.org/project/niashet0029

Ian Cowan & Islam Rohouma

Protection Testing Briefing Paper

Based on work undertaken at the Centre, we have published a briefing paper on the: 'Evolution of Protection Testing in Low-Strength and Converter-rich areas within the GB Grid'.

www.hvdccentre.com/library/evolution-of-protection-testing/



Bharath Ponnalagan & Oluwole Daniel Adeuyi

Journal Paper Published

Key research outcomes from the "Stability Assessment and Mitigation of Converter Interactions (Phase I)" project with the University of Strathclyde, have been published in the journal paper: www.hvdccentre.com/library/stability-assessment/

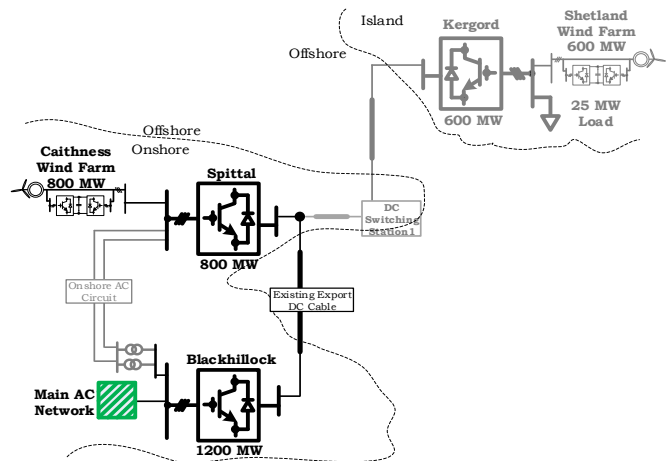
Habibur Rahman

The next stages of support for the Shetland extension of the Caithness-Moray link

Following the approved go ahead of the Shetland project into business as usual The National HVDC Centre is set to play a pivotal role in the de-risking of what will both be the first multi-terminal VSC-HVDC connection in Europe, and an excellent insight into the design of future multi-terminal offshore connections and Multi-Purpose interconnection going forward.

We have agreed a wide range of HVDC system, protection and wide area control verification, and other tests to take forward as the overall project drives forward over the next 3 years, putting into practice examples of analysis discussed earlier in this newsletter and in our various technical webinar over the last few years.

For the Centre this will provide great practical insight in the de-risking of future similar HVDC developments, with many such planned over the next decade.



Ben Marshall & Ian Cowan

And a big Welcome to Islam!

In September 2020, our team grew with Islam Rohouma joining us.



Islam comes with experience both working within the Power Networks Demonstration Centre nearby, and the ORE Catapult and is actively supporting the range of projects, equipment and models the Centre has and will be hosting over the next few years.

Simon Marshall

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