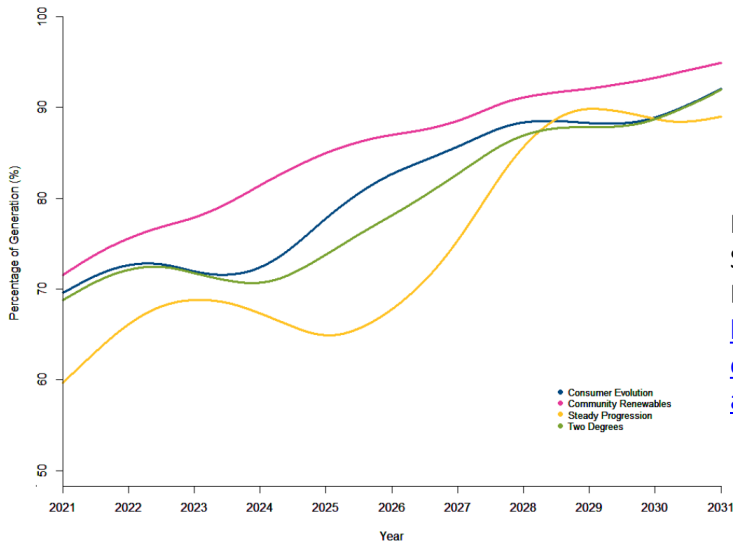


GB – Study of WAMPAC to De-Risk HVDC Integration

25th May 2021 | IEEE SGSMA | Panel 1: Role and Use Cases of Real Time Simulators (RTS) Towards Advancing and Deploying Synchrophasor Based Wide Area Monitoring Protection and Control (WAMPAC) Systems

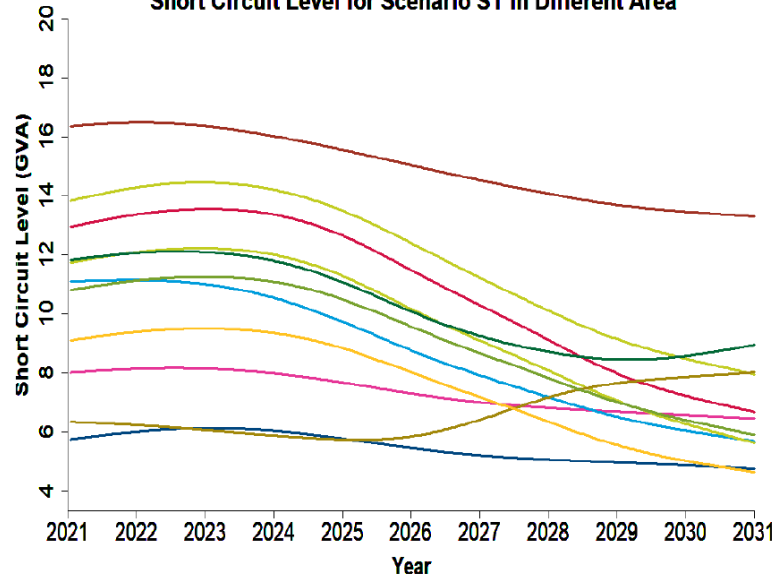
Ian Cowan, The National HVDC Centre





National Trends and Insights (A System Operability Framework Document), National Grid ESO, <https://www.nationalgrideso.com/document/190151/download>

Short Circuit Level for Scenario ST in Different Area



Development of HVDC Connections in GB

Current HVDC in GB

7 HVDC Links - Totalling: 8 GW

- Interconnectors:
 - 1) Cross Channel (IFA)
 - 2) Moyle
 - 3) BritNed
 - 4) EWHC
- New Interconnector:
 - 5) Nemo
- New Embedded Links:
 - 6) Cathness - Moray
 - 7) Western Link



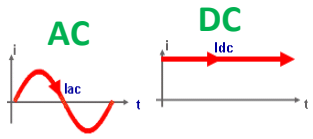
Future HVDC in GB

Up to 34 HVDC Links - Totalling: 45.45 GW



- New Island Links:
 - 8) Shetland
 - 9) Western Isles
- New Interconnectors:
 - 12) DuctLink
 - 13) MSL
 - 14) Aquind
 - 15) Viking
 - 16) GreenLink
 - 17) NorthConnect
 - 18) FAL
 - 19) FabLink
 - 20) NewConnect
 - 21) GridLink
- New Offshore Wind Connections:
 - 31) Dogger Bank
 - 32) Norfolk Vanguard
 - 34) Sofia
- New Embedded Links:
 - 10) Eastern Link 2
 - 11) Eastern Link 3
- Additional Interconnectors:
 - 26) Arish
 - 27) Atlantic Super Connection
 - 28) Continental Link

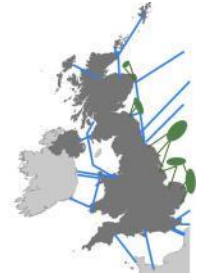
HVDC Centre Overview



High Voltage Direct Current (HVDC) is the most efficient way to transmit electricity over long distances...

... and a significant number of new HVDC links are planned in GB,

...however the deployment of HVDC brings a number of risks and challenges (incl. harmonic instability, adverse control interactions, cascading faults and turbine shaft resonant vibrations).




To anticipate and resolve these challenges, SSEN Transmission established a new collaborative National facility (funded through RIIO-T2), on behalf of Transmission Licensees



 The National HVDC Centre combines real-time simulators with replicas of HVDC control systems, in a new purpose built building; located next to the PNDC and Scottish Power's Training Centre in Cumbernauld.

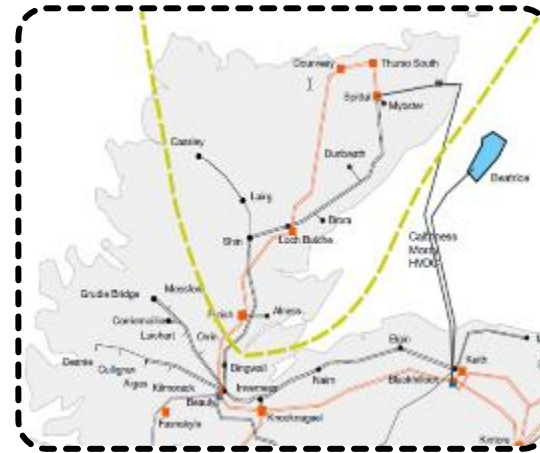


 The National HVDC Centre opened in April 2017; providing a world-class facility to support and de-risk the deployment and operation of HVDC solutions in GB.

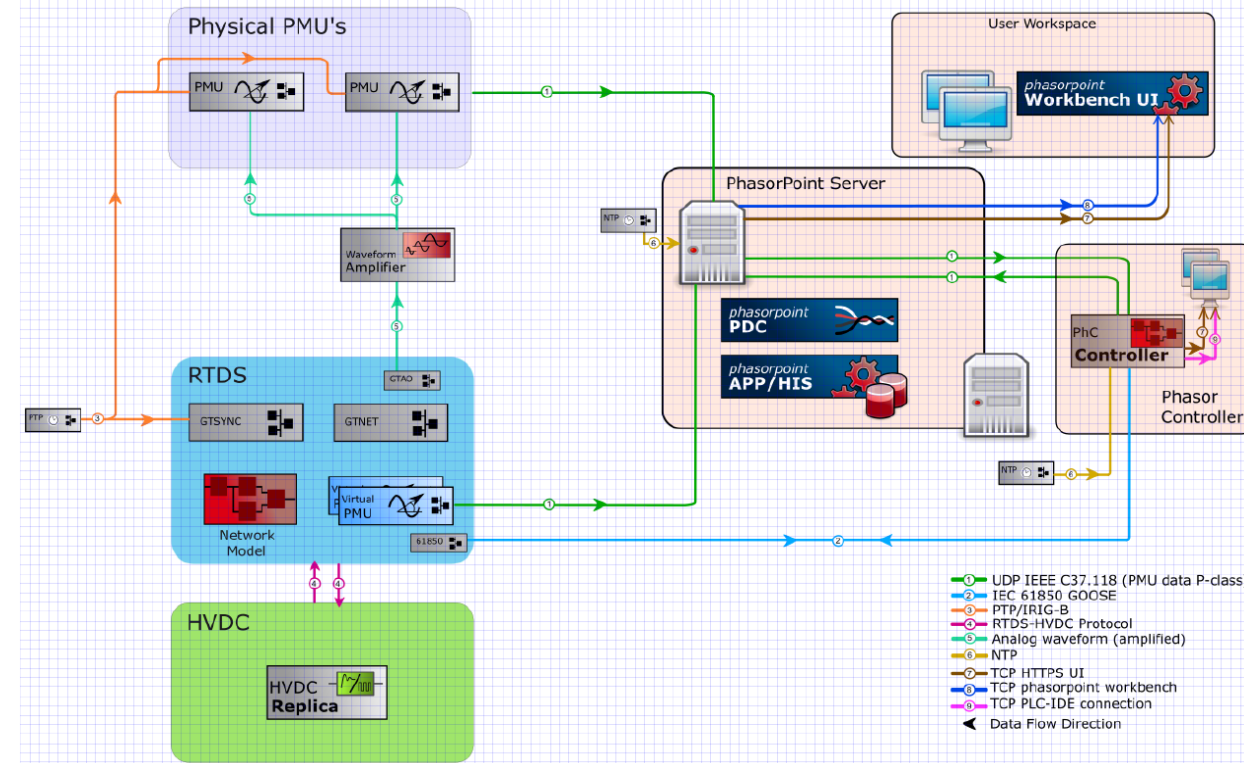


Current situation

- Variable fault level at Spittal terminal
- Control mode change required for stability
- Offline study fault level analysis used to identify tipping point configurations
- Secondary system breaker position solution being used



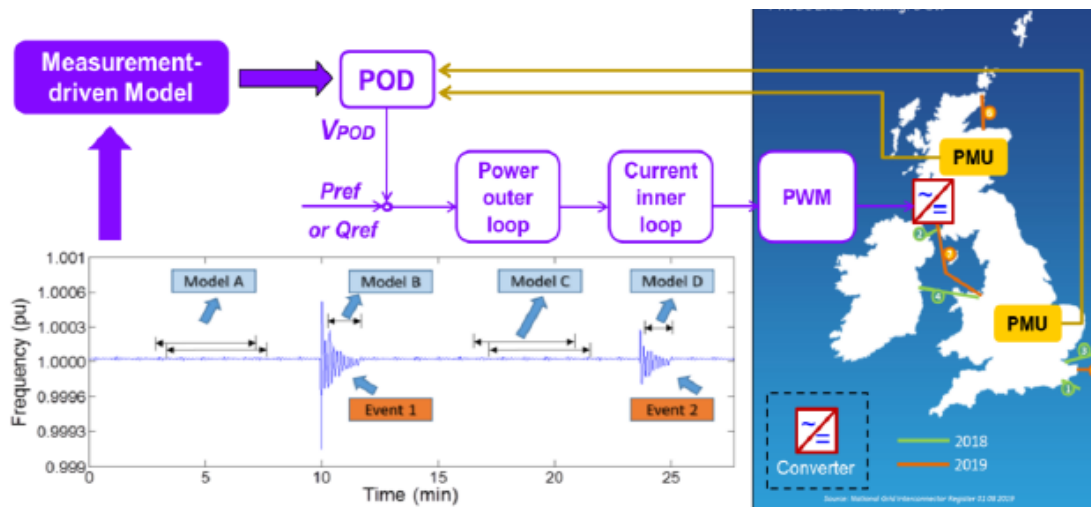
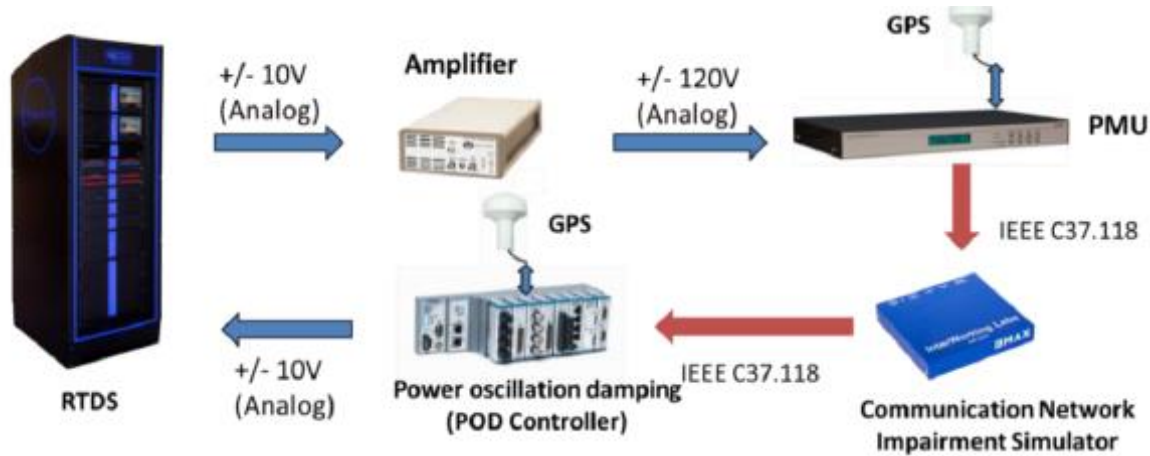
National Grid Electricity Ten Year Statement 2018



Purpose of project

- demonstrate capabilities to use Phasor Measurement Unit (PMU) data to derive real-time indicators of the state of the network.
- used to select an appropriate mode of operation by the HVDC control system.
- prove potential alternative to SSSNOB

Adaptive Power Oscillation Damping Control via HVDC/FACTS Devices Using Measurement-Driven Model



□ Purpose of project

- conventional plant is displaced by new renewable sources
- new modes and locations of oscillation emerging
- conventional generators remaining may be inappropriate to suppress these modes

□ Method for the studies

- focuses on the design and demonstration of a wide-area POD controller through HVDC links based on a measurement-driven approach
- A reduced 36-bus GB power grid model was used in this study
- Designed offline then moved to RTS HIL platform to validate proposed solution

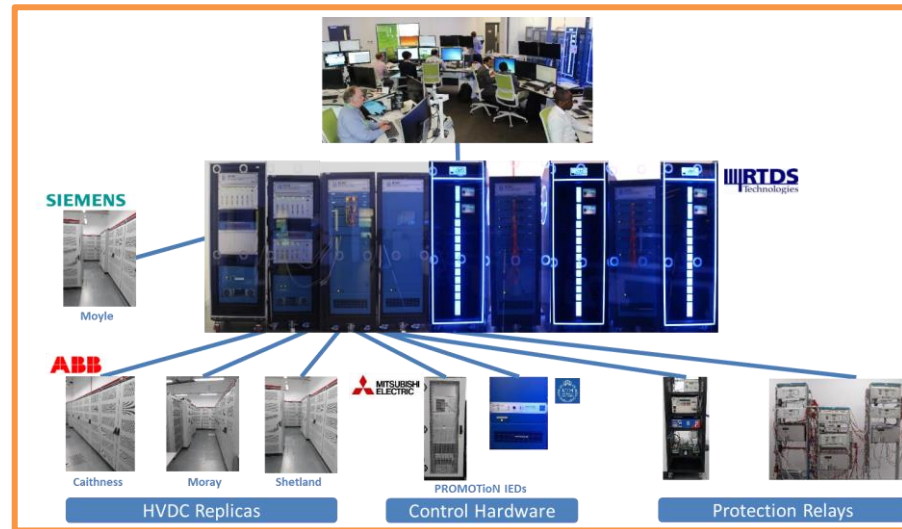
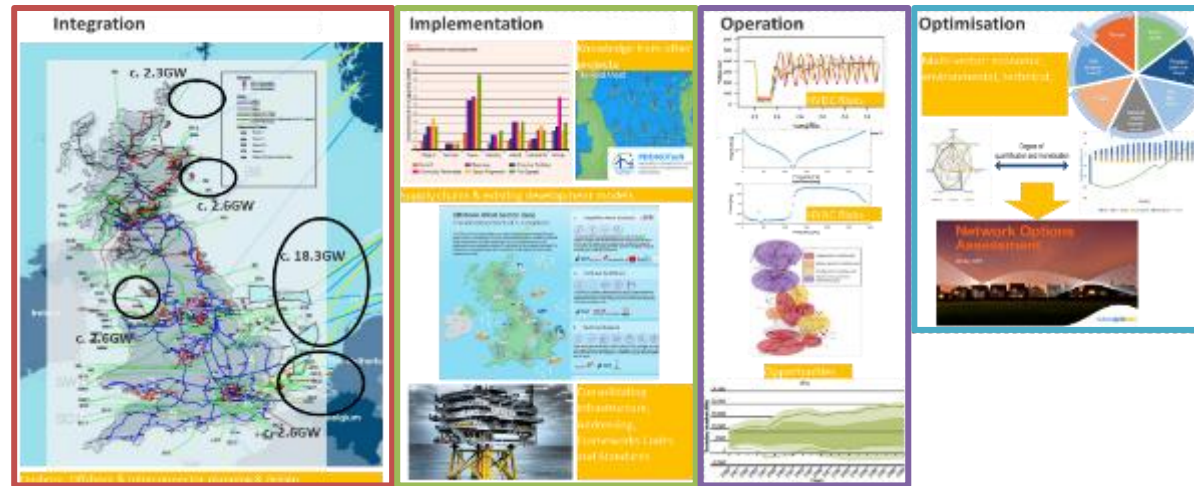
□ Outcomes

- performance of the designed POD controller was validated under different dispatches
- Findings show suppression of the targeted oscillation mode by modulating active power and/or reactive power of the selected HVDC link

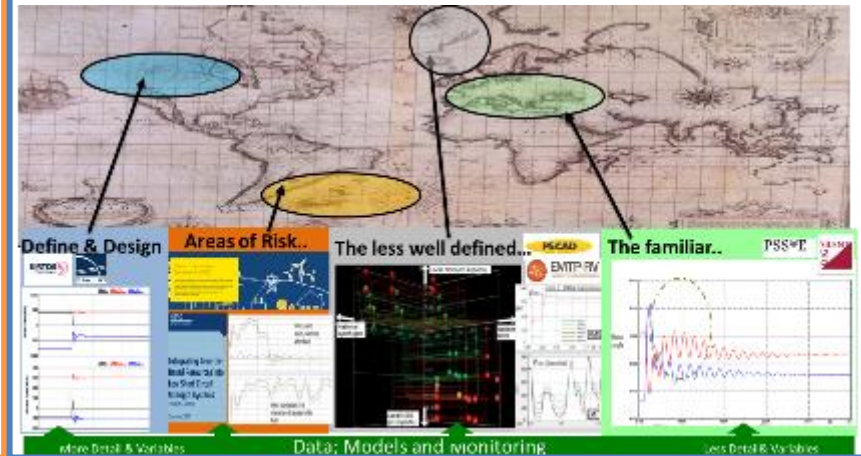
Real-Time Simulation to Enable WAMPAC to De-Risk HVDC Integration

Collaboration is required at different levels to successfully:

- De-risk HVDC deployment across onshore and offshore applications & stages;
- Integrate HVDC into electricity networks with more low-carbon technologies; &
- Develop devices, standards and codes in an optimised way.



A Map of Network Stability Analysis Re-drawn



Thanks for listening.

Any questions, please?

□ For further information, please visit www.hvdccentre.com ; OR email: info@hvdccentre.com



**The National
HVDC Centre**

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