Electricity Transmission

Enhance Power Flow Control Capacity of the GB Network

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31.10.2023

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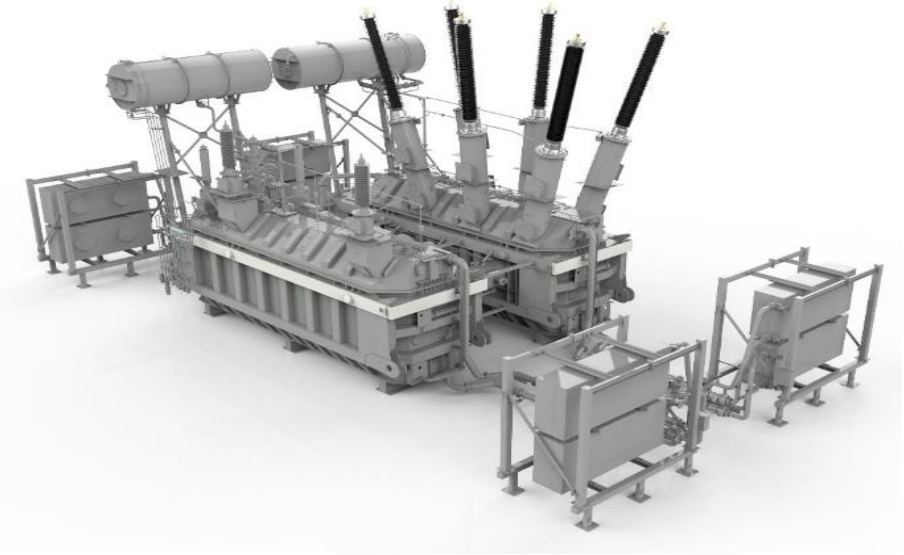
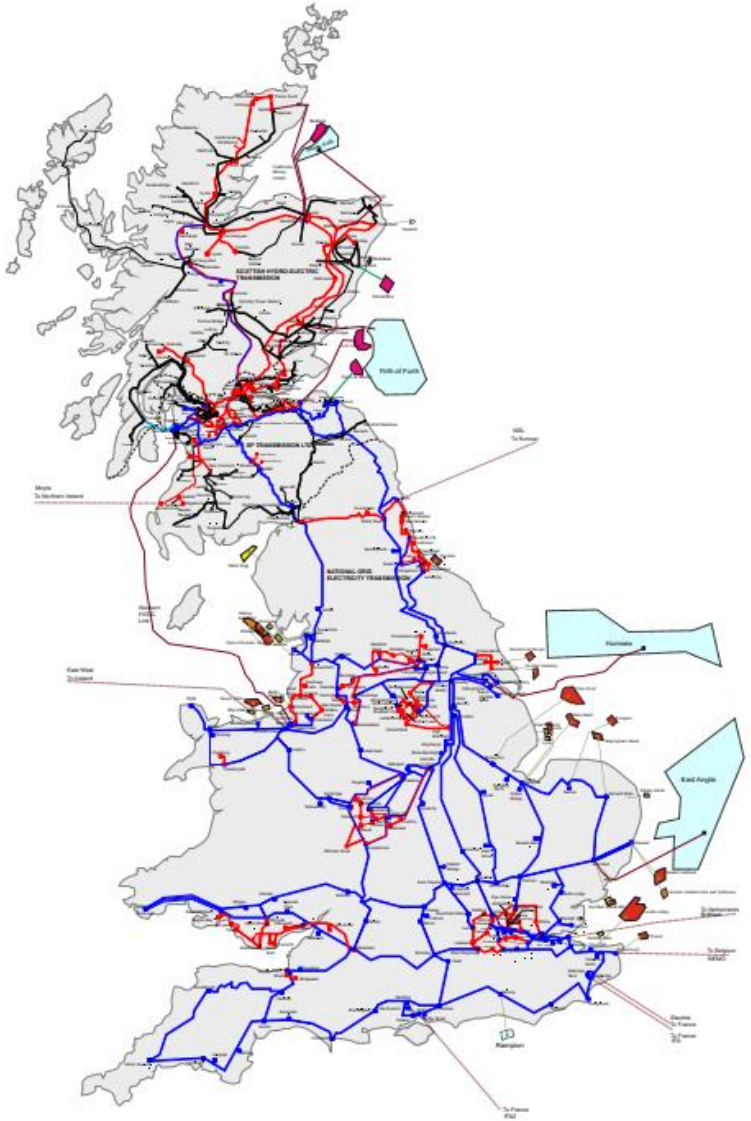
Background

- Transition to Net Zero requires significant increase in power transfer capabilities of GB network
- Needs to maximise the utilisation of existing assets and network capacity & enhance power flow control capability in the network
- Power Flow Control Device - Quadrature Boosters (QBs) in use

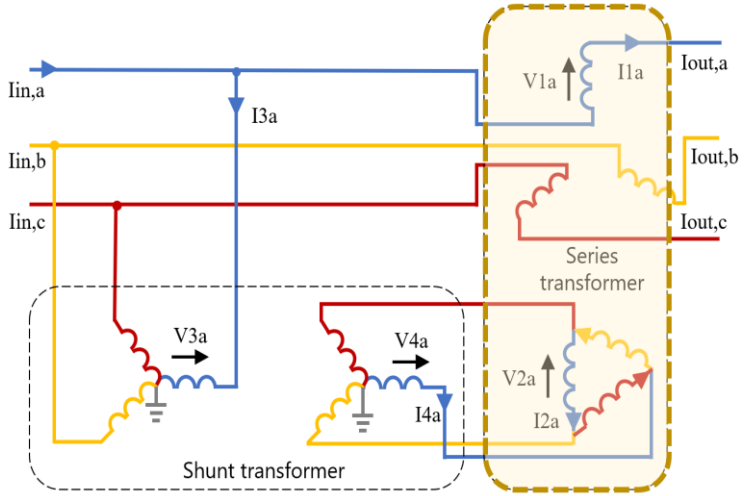




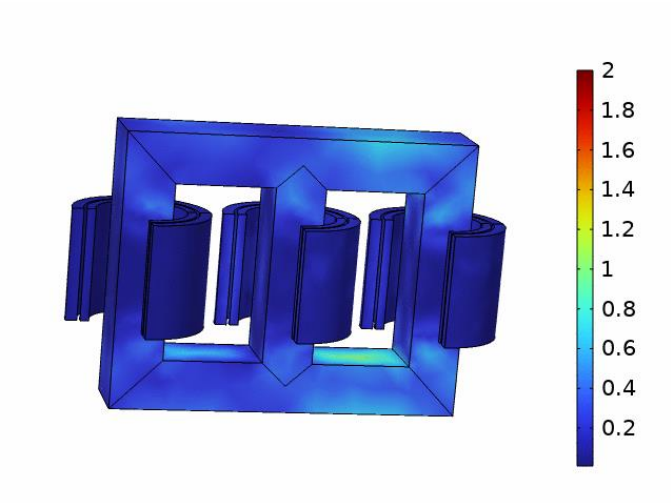
Twelve 400 kV & six 275 kV QBs installed in GB transmission network

Challenges

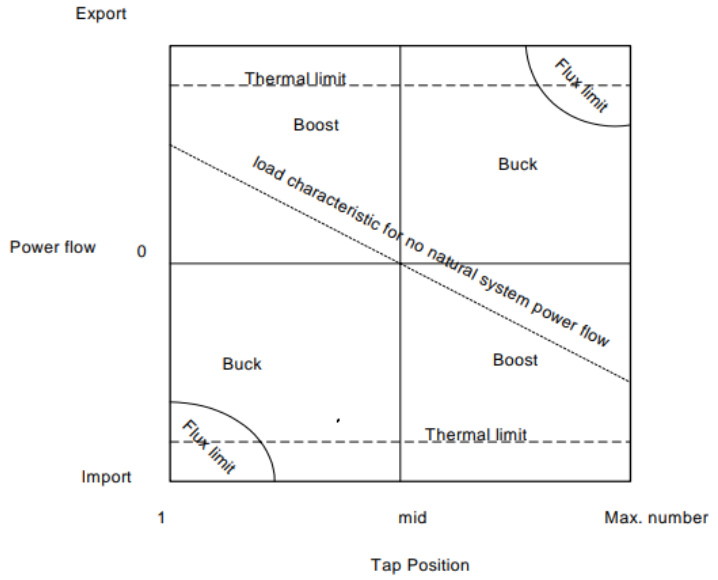
- Manual Operation (one tap movement at a time up to 15 taps within 20-min postfault at a single location)
- No available coordinated control of QBs at multiple locations
- Core flux saturation at extreme tap positions



QB wiring diagram



Main flux in 20 ms in Series Unit



What we aim to achieve?

Investigate solutions to fully utilise the capability of QBs to enhance power flow control:

- Enable a wider range of tap moving in post fault action
- Coordinated control of multiple QBs
- Improve the flexibility by new compact design of QBs
- Strategic sizing and location of the power flow control devices

Kicked off in October 2022

Duration: 24 months

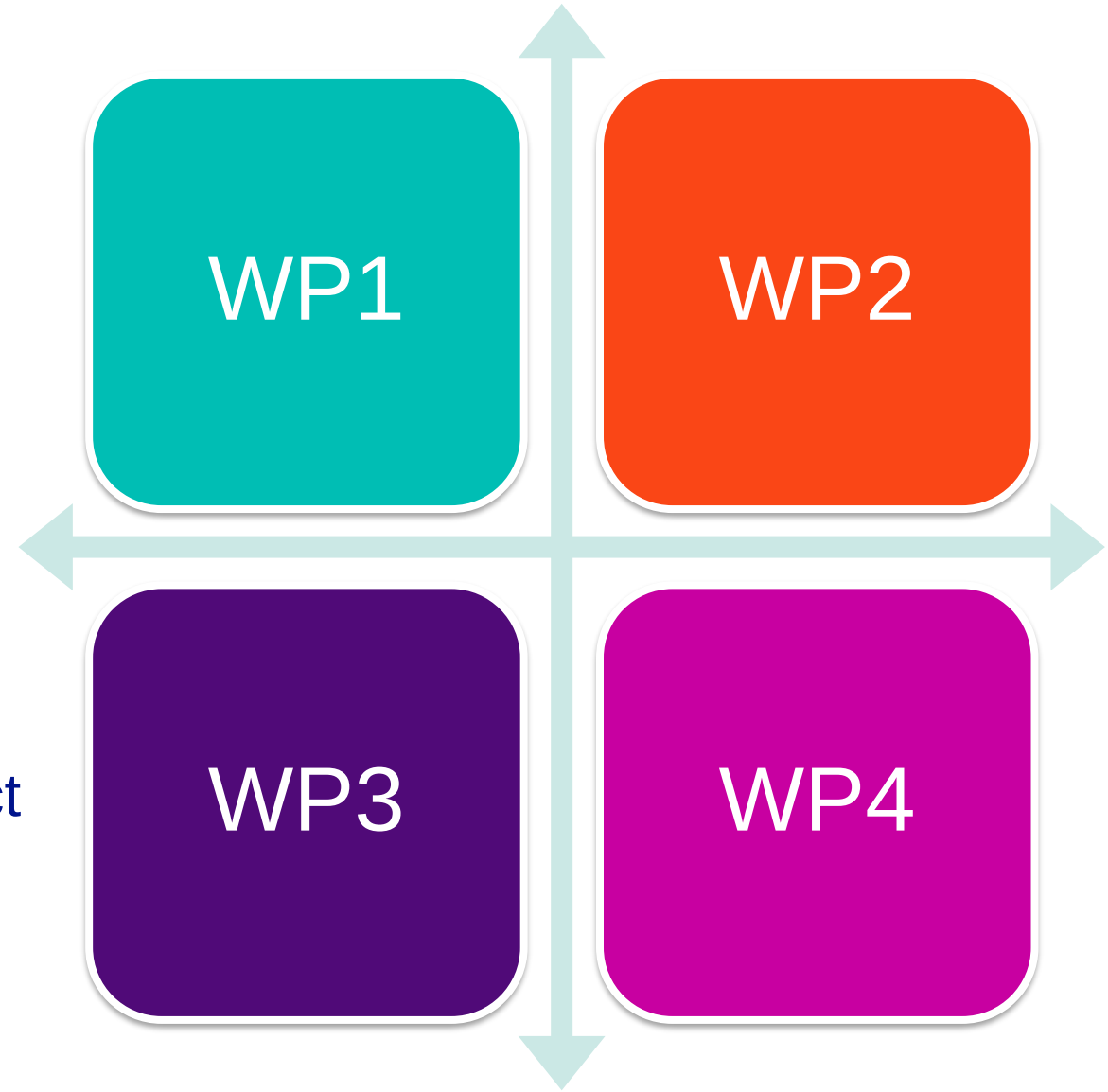
Partners

University of Exeter
Centre for Smart Grid

The University of Manchester

How we do?

Maximising power control capability of the existing QBs



Development of coordinated control of multiple QBs

Conceptual design of modular, compact mobile QBs/PSTs

Strategic sizing and location of power flow control devices

Key Outcomes to Date

Equipment Operational Constraints

- Throughput power
- Core flux density
- Tap range
- Tap moving speed

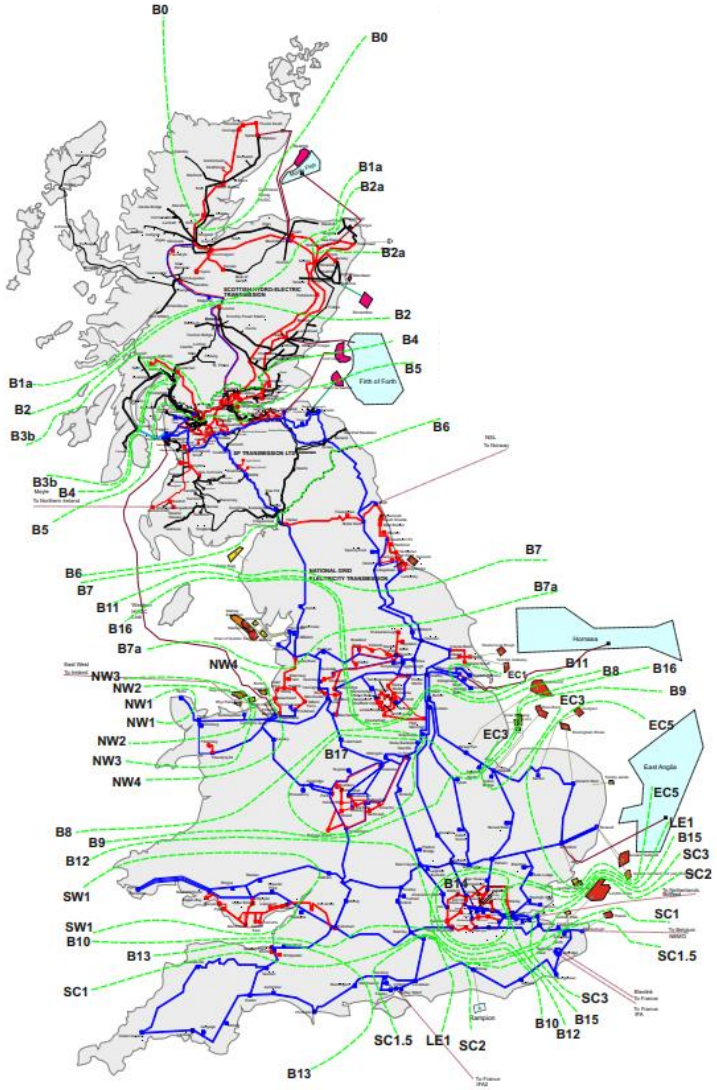
Influential Factors on PF Control Capability

- Grid topology
- Initial loading
- QB impedance

Simplified Approach of Coordinated Control

- Sensitivity per tap of each QB
- Preliminary algorithm development

Anticipated Project Outcomes



Identified potential to operate QBs postfault:

- Several taps per QB at a time
- Tap control allowed at multiple sites
- More tap movements within 20-min

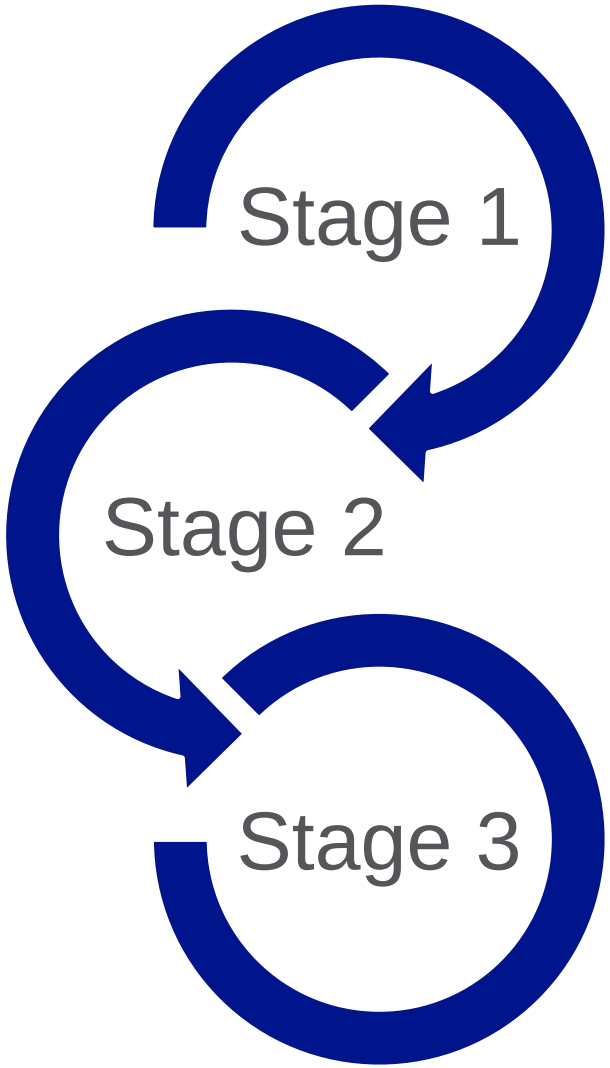
Benefits of automated coordinated control:

- Achieve higher boundary transfer capacity
- Hence reduce constraint costs

Innovative QB Design:

- Enhance flexibility & mobility of future QB devices

Next Steps



A holistic optimal solution to enhance the power flow control capability of the networks

Wide-area coordinated control of existing multiple power flow devices to optimise the power flow across critical boundaries in the network

Innovative design of modular QBs suitable for economic and flexible transportation between substations

System level research that focuses on the strategic sizing and location of future power flow control devices

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Q&A

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