

Flexible Research Grant 2026 Prioritized Topics

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The Call: HVDC Centre Flexible Research Grant

1. Funding pot: up to two 1-year projects (indicative, budget to confirm)
2. Nature of project: Low to medium TRL (3-7)
3. Pathway towards higher TRL must be clear and relevant to HVDC Centre
4. Further Ofgem innovation (NIA or SIF) funding route possible
5. Indicative timeline: 3 months for assessment and 3 months contracting

(in prioritization order, 1 is the highest)

1. Control architecture of Wide-area AC/DC Power System.
2. Solving frequency-domain specifications to de-risk control interactions of HVDC grid.
3. Specifying converters for large-signal stability of HVDC grid.
4. Modelling of HVDC cables.
5. Modelling and de-risking data centres in weak grids.
6. Technology agnostic specifications of converters for grid integration.

- Converter domination
- Hybrid AC/DC
- HVDC and offshore renewables
- Data centres / onshore renewables
- What can be done to existing control architecture to de-risk reliability and resilience in future?

(2) Solving frequency-domain specifications to de-risk control interactions

- The specifications of converter impedance to ensure stability to comply with a series of inequations in frequency domain.
- From frequency-domain nodal analysis of an “n-node” HVDC grid, we can obtain the admittance matrix $Y(\omega)$ at the frequency ω :

$$Y(\omega) = Y_{conv} + Y_{net}, \text{ where } Y(\omega) = \{y_{ij}\},$$

- $Y_{conv} = \text{diag}\{y_{conv1}, y_{conv2}, \dots, y_{convn}\}$
- Y_{net} is known and corresponding to all the transfer branches between shunt components
- $Z = Y^{-1}, Z = \{z_{ij}\}$
- $Re[y_{ii}(\omega)z_{ii}(\omega)] > 0, (i, j = 1, 2, \dots, n)$
- How to efficiently solve the envelopes of y_{convi} ($i, j = 1, 2, \dots, n$)

to fulfil $Re[y_{ii}(\omega)z_{ii}(\omega)] > 0, (i, j = 1, 2, \dots, n)$ that can be fulfilled by converter design?

Dong Chen , Benjamin Marshall . Towards HVDC Interoperability - On Dominance of Nodal Impedance. *TechRxiv*. October 25, 2023. DOI: [10.36227/techrxiv.24412258.v1](https://doi.org/10.36227/techrxiv.24412258.v1)

- We have methodologies to assess converter impedance from DC side for a predictable small-signal stability.
- Can we develop specifications for large-signal stability?
- What kind of mathematical theory is practical?
- How to quantify the impact of operating point dependence in converter specification?
 - By outer-loop (or communication based) control, e.g. power control
 - By adaptive type control, e.g. model based predictive control (MPC)
 - By structural change of circuitry: protective operation, DC fault, blocking, etc.

(4) Modelling of HVDC Cables

- In an upfront project "Aquila Interoperability", we conclude that the required performance of converter control is highly influenced by cable impedances.
- Evidence shows that cables can interact with converter control and lead to oscillations as well.
- What can we do to acquire and validate accurate data of the frequency-domain transfer admittance of a bipolar HVDC cable section (before and after commissioning)?
- How do we quantify the sensitivities and uncertainties against operating conditions, such as ambient temperature, loading, etc.

- Scotland is exporting renewable power
- The power grid of Scotland is weak
- Development of AI is driving demand for data centres
- Data centre is heavy and highly variable load interfaced with active converters
- It is attractive to deploy AI load close to renewable generators
- What is the best way to model data centres for the benefit of transmission owners and the national operator?
- What are the risks and opportunities of deploying data centres in Scotland?
- What can be done in collaboration with AI to de-risk power system operation related to data centre?

- Methodologies to generate specifications of shunt components for grid connection
- Ensure predictable performance of AC grid
 - stability, robustness against measurements, and/or tracking performance of voltage and frequency, etc.)
- Vendor and/or technology agnostic
- Grid-forming and beyond

Thanks for listening.

Any questions or suggestions, please?

For further information, please visit www.hvdccentre.com or email info@hvdccentre.com



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