

NIA Project Registration and PEA Document

Date of Submission

Mar 2023

Project Reference Number

NIA2_NGES042

Project Registration

Project Title

Revamp Interconnector Ramping Arrangements (RIRA)

Project Reference Number

NIA2_NGES042

Project Licensee(s)

National Energy System Operator

Project Start

February 2023

Project Duration

0 years and 3 months

Nominated Project Contact(s)

Louise Trodden

Project Budget

£300,000.00

Summary

National Grid Electricity System Operator (ESO) often encounters scenarios where cross-border markets react to the same price signals simultaneously, leading to rapid changes in interconnector (IC) flow and frequency deviations (potential swing to 12GW and a maximum ramp rate of 500MW/min when these interconnector ramp rates are combined). Multiple control room actions must be taken by the ESO to accommodate these large changes and managing them with a fixed ramp rate of 100MW/min is financially intensive.

With IC capacity due to double by 2030, the ESO will need additional operational tools to ensure security of supply. This project will develop a cost benefit analysis (CBA) review of possible solutions to help solve this issue.

Third Party Collaborators

baringa

Nominated Contact Email Address(es)

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Problem Being Solved

Scenarios are often encountered where cross-border markets react to the same price signals simultaneously, leading to rapid changes in interconnector flow and frequency deviations. When this occurs, multiple control room actions must be taken to accommodate these large changes safely, and securely (for example, pre-gate trading or ancillary actions) and managing these large

interconnector changes with a fixed ramp rate of 100MW/min is financially intensive.

There are five interconnectors which connect the Continental European markets to GB; IFA, IFA2 and ElecLink (France), Nemo Link (Belgium) and BritNed (Netherlands). This increases the potential swing to 12GW (when considering full import to export) and a maximum ramp rate of 500MW/min when these interconnector ramp rates are combined. The precedent set through the connection of IFA and BritNed of 100MW/min has been set for NemoLink, IFA2 and ElecLink. With the further, forecasted increases to cross-border capacity, current ramping arrangements may need to change to ensure security of supply. Ramping limits are lower on other borders at the request of their respective Transmission System Operators (TSOs), e.g.: EWIC/Moyle (Republic of Ireland and Northern Ireland respectively), are at 5MW/min and the North Sea Link (Norway) is limited to 30MW/min.

Additionally, interconnector's final positions are typically only confirmed 65-70 minutes prior to real time. This situation highlights that a change needs to be considered to ensure that system security measures can be appropriately controlled and accessed ahead of time and that the right balance is struck between operational flexibility and cost to consumers.

Analysis from May 2020 until March 2021 has identified 40 incidents of significant IC changes, 10 of which have caused frequency deviations. The frequency event modelling conducted to date has shown that the majority of those 40 events would cause frequency issues if the control room hadn't taken any balancing actions, for instance, taking bids and offers from plant. The control room engineers have also highlighted concerns about voltage instability which can occur in the SEIMP/ESTEX constraints zone where there are four operational interconnectors (IFA1, NEMO, Britned and ElecLink) as a result of the interconnectors all moving at the same time, resulting in having to manage large volumes of changes.

Article 119 of the System Operator Guidelines (SOGL) assigned obligations to the ESO and these remain an obligation post EU-exit. The subsequent Ofgem approved methodologies highlight that the ESO has the right to determine ramping arrangements, although further work is required to set this out within the GB frameworks. The current ramping arrangements have been trilaterally agreed between the ESO, the interconnector and the connected TSO. Therefore, any solution/s will need to be reviewed with all parties. This work allows for development of a solution to enable ramping arrangements for active power output of each HVDC interconnector to be mapped to the Grid Code within Balancing Code 1 (BC1), and the accompanying Annex of this section of the code.

The ESO is responsible for ensuring full compliance with the retained elements of SOGL. The ESO has raised a [Grid Code](#) modification to address the request by Ofgem to include interconnector ramping into the Grid Code. This project aims to identify the most viable solutions taking into consideration the operational challenges faced by the control room to ensure security of the network and cost effectiveness for consumers.

Method(s)

Through a phased approach a cost benefit analysis (CBA) review of possible solutions will be undertaken to identify a solution that delivers the most resilience to the network through security of supply and offers the most benefit to consumers through a reduction in balancing costs related to actions taken to ensure frequency issues do not arise.

Proposed activities

1. Create a data driven report to present findings
2. Conduct a CBA of potential solutions
3. Suggest alternative approaches or solutions where appropriate and include CBA

Phased approach of project

Phase 1: Initial review of data and options

Review initial options and identify additional options producing a long list for further analysis and consideration.

Available data to support the assessment will be identified (e.g. on control room event costs, cost of implementation of market reform options).

Deliverables: A long list of options and key features, and draft methodology.

Phase 2: Shortlisting of options

Develop a list of criteria to shortlist options – consider market and non-market-based options.

Score options against the evaluation criteria.

Deliverables: Criteria and their definition, scores for each option, and recommended shortlist.

Phase 3: Detailed analysis of shortlisted options

Generate results and draw on tools to estimate costs and benefits of the shortlisted options.

Assess (qualitatively) the wider advantages, disadvantages, and risks of each option – ensuring consideration of:

1. Costs/impacts to Interconnectors

- What are the commercial advantages and disadvantages of the options to solve this for interconnectors and do these outweigh consumer benefit by not taking expensive balancing actions?
- How do changes to the GB and EU power prices impact changes to interconnector flows. What impact does this have on the market should the ramping arrangements be reduced?

2. Costs to consumers

- Consideration of the costs to consumers (based on the options listed in the table above, or any recommendation provided) to be presented in a report.
- What are the costs and benefits of these options to consumers, markets in GB and where possible, across the border, operational costs for the SO and the interconnectors- including any imbalance on settlement periods. Are there impacts to the BM and/or costs for procurement of additional reserve/response?

3. Impacts to the EU TSO

- Does a slower ramp rate cause issues to the connected TSO?
- Are there costs that could impact EU TSO/Consumers?

Deliverables: Slide pack describing approach, assumptions, and results

Phase 4: Report drafting

Finalised report and findings presented to the ESO and the industry working group. The findings will be published and disseminated through the Smarter Networks Portal and included in industry workgroup papers on the ESO website.

Deliverables: Final PowerPoint report

In line with the ENA's ENIP document, the risk rating is scored Low.

- TRL Steps = 1 (TRL change 1)
- Cost = 1 (£500k)
- Suppliers = 1 (1 Supplier)
- Data Assumptions = 1
- Total = 4 (Low)

Scope

The ESO seeks a CBA review of solutions which can fulfil the requirements of Ofgem's decision letter and the obligations in Article 137 (3) (below). To do this, the ESO would like to understand which solution delivers the most resilience to the network through security of supply and offers the most benefit to consumers by a reduction in balancing costs related to actions taken to ensure frequency issues do not arise.

“Article 137 (3). All connecting TSOs of an HVDC interconnector shall have the right to determine in the LFC block operational agreement common restrictions for the active power output of that HVDC interconnector to limit its influence on the fulfilment of the FRCE target parameter of the connected LFC blocks by agreeing on ramping periods and/or maximum ramping rates for this HVDC interconnector. Those common restrictions shall not apply for imbalance netting, frequency coupling as well as cross-border activation of FRR and RR over HVDC interconnectors. All TSOs of the GB synchronous area shall coordinate these measures within the synchronous area.”

The CBA needs to ensure that the results consider how the solution/s impact the following from a compliance perspective in relation to SOGL Article 119 and 137 and operational challenges in the ENCC as a result of increased interconnection. Including the cost

impacts on consumers as a result of balancing actions taken close to real time.

It is expected that any modelling completed is done so based on the interconnectors that we have currently connected to the system and those which are due to connect up to 2025 (ESO net zero target) and 2050 GB net zero target so as to be forward looking.

Objective(s)

1. Complete a CBA and present a detailed report to outline the cost and benefits of solutions to satisfy drivers for change. This will provide the ESO with the recommendations to take to industry.
2. Complete modelling of shortlisted options, including all relevant assumptions and criteria used for shortlisting the options, and produce a recommendation based on these outputs.
3. Deliver a final report that presents a summary of the key findings and a recommendation to take forward.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

National Grid ESO does not have a direct relationship to end consumers, and therefore is unable to differentiate the impact on consumers and specifically those in vulnerable situations. However, benefits to all consumers are detailed further below.

Success Criteria

Ofgem have asked the ESO to incorporate HVDC interconnector ramping requirements into the Grid Code. The solution must meet the requirements set out in Article 137 (3). The ESO seeks a review of options to present a recommended solution/s which mitigates current challenges, whilst being resilient to the future. Whilst it supports the ESO in operating a secure and stable system, keeping the cost to consumers minimal.

For the solution to be viable, it should meet the following success criteria:

- enable transparency of interconnector ramping arrangements
- enable continued security of supply and decrease costs for the end GB consumer
- not be discriminatory to currently connected interconnectors and future interconnectors
- it may be market based
- benefit the end GB consumer and contribute to the social welfare in connected countries whilst benefiting the connected TSOs

Project Partners and External Funding

Baringa, no external funding contribution.

Potential for New Learning

This project is the first step in exploring improvements to interconnector ramping arrangements. This modelling will explore different options and create a CBA for each one. The results and the main learnings of the study will be shared with the industry.

Scale of Project

This project will span three months with Baringa delivering the work.

This is a research and analysis project and will explore potential solutions for changes to interconnector ramping arrangements.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

This project is looking at GB interconnectors and requires detailed analysis of operational and commercial impacts to ensure the solution is fit for purpose for the ESO, interconnectors, connected TSOs and wider industry.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£300,000

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

With IC capacity due to double by 2030, additional operational tools will be required to ensure security of supply as we transition to a zero-carbon energy system. Identifying the most suitable solutions to the challenges this presents (rapid changes in IC flow and frequency deviations), will reduce costly control room actions and reduce balancing costs for consumers.

How the Project has potential to benefit consumer in vulnerable situations:

N/A

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

Please provide a calculation of the expected benefits the Solution

Not required as this is a research project

Please provide an estimate of how replicable the Method is across GB

The scope of the project will cover the whole GB system (and interconnectors connected to (or due to connect by 2050) to GB).

Please provide an outline of the costs of rolling out the Method across GB.

The cost to rollout will be dependent on the final option chosen, which we are unable to provide at the point of registration.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

- A specific piece of new (i.e. unproven in GB, or where a method has been trialed outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).
- A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)
- A specific novel operational practice directly related to the operation of the Network Licensees system
- A specific novel commercial arrangement

RIIO-2 Projects

- A specific piece of new equipment (including monitoring, control and communications systems and software)
- A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven
- A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)
- A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology
- A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution
- A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

This project is the first step in exploring improvements to interconnector ramping arrangements. This modelling will explore different options and create a CBA for each one. The results and the main learnings of the study will be shared with industry. Depending on the analysis and outputs, this could provide suggestions to change the current interconnector ramping arrangements.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

N/A

Is the default IPR position being applied?

- Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

Although there are other interconnector focussed projects at present (detailed below) this project is a first and as such there should be no direct duplication.

- **Enduring Cross Border Balancing (NIA2_NGESO030)** - is linked to exchange of cross-border energy whereas RIRA is focussed on interconnector ramp rates
- **Future of Interconnectors (NIA2_NGESO015)** – is carrying out analysis to help inform the setting of future direction, RIRA aims to address a current operational challenge.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

- Since Brexit there have not been any workstreams to make retrospective changes to interconnector connection agreements.
- The UK has not published interconnector ramping rates previously and has not had the opportunity to evaluate the effectiveness of the arrangements currently in place in an increasingly interconnected system.
- It is unclear on what the optimum solution should be, which is why detailed modelling, and a CBA is required.
- The new relationships formed due to Brexit with UK-EU present very different challenges.
- The fluctuation in energy prices reinforces the need for GB to have greater interconnection capacity.
- The result of changing market signals close to real time requires the ESO to have more sophisticated ramping arrangements. This

will enable a more secure and stable system.

Relevant Foreground IPR

The following foreground IPR will be generated in the course of the project:

- Long list of options and key features
- Shortlist of solutions, the selection criteria and definitions, and scores for each option.
- Slide pack describing approach, assumptions, and results from detailed analysis of shortlisted options
- Final report with key findings and recommendations

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

1. A request for information via the Smarter Networks Portal at <https://smarter.energy.networks.org>, to contact select a project and click 'Contact Lead Network'. National Grid ESO already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
2. Via our Innovation website at <https://www.nationalgrideso.com/future-energy/innovation>.
3. Via our managed mailbox innovation@nationalgrideso.com.

Details on the terms on which such data will be made available by National Grid ESO can be found in our publicly available "Data sharing policy relating to NIC/NIA projects" at <https://www.nationalgrideso.com/document/168191/download>.

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

The low TRL and uncertainty about viable solutions means this project would not be funded as part of BAU activities.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

The project will develop and assess different ramping options. This requires external commercial, analytical and technical skillsets to support the ESO put forward a robust and justified recommendation that will be accepted by industry and European TSOs. The use of NIA funding will ensure all project outcomes and learnings are shared widely.

This project has been approved by a senior member of staff

Yes