Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Jul 2022

Project Reference Number

NIA_SPEN_0072

Project Registration

Project Title

Project Synthesis – Effective Regional Inertia Monitoring and Automatic Control with a Whole System Approach (T2)

Project Reference Number

NIA_SPEN_0072

Project Licensee(s)

SP Energy Networks Transmission

Project Start

April 2022

Project Duration

2 years and 0 months

Nominated Project Contact(s)

James Yu

Project Budget

£350,000.00

Summary

This project will quantify the potential viability of a range of technologies to act as network frequency response services across various timescales.

Third Party Collaborators

General Electric

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

The power network industry has made it their mission to be ready for zero carbon electricity by 2025. This is an important step towards the UK's commitment to achieve net zero carbon emissions by 2050 and a similar commitment made by the Scottish government.

There are also ambitious near-term low carbon targets for electricity, including a Scottish target to meet 100% of the demand for electricity from renewable resources by 2020. Meeting these challenging targets has a profound impact on the technical performance of the power system, impacting the requirements for services to sustain stable and secure operation of the grid.

It is critical that limits of frequency deviation and rate of change are respected to avoid customer outages and cascading failures. Increasing penetration of renewable generation and power electronic connections results in lower rotating inertia and faster frequency changes. This is particularly apparent in certain areas such as Scotland where the regional effects caused by long transmission

distances and low regional inertia can affect the network stability as well as causing high RoCoF (Rate of change of frequency) in the area. Advances in digital and communication technology enables a coordinated but distributed and effective local control which can lead to a more effective response and improved operational coordination. The integrated design and implementation of a locationally sensitive, wide area protection and control system have not been demonstrated anywhere yet.

Presently, electricity generated from renewables is often subject to curtailment across Scotland due to constraints in the transmission network, particularly on the boundary between Scotland and England. This curtailment results in payments to wind generators of around £100m p.a. to refrain from producing power. This study will explore the potential for Green Hydrogen to mitigate this issue, enabling more renewable generation to be utilized, while also representing a useful option for decarbonisation of the heat and transport sectors.

Method(s)

The project will take into account the learnings from existing and previous innovation projects such as EFCC, TDI2.0, VISOR and MIGRATE, by applying and monitoring 'Effective Regional Inertia' concept building on the infrastructure already established or trialled under those projects at different levels.
The project will take the following form:

- Requirements capture and specifications: defining the control capabilities and resource management software functional specifications. Will include functionality, infrastructure, performance and cyber security requirements.
- Control capability development and testing by appropriate simulations
- Criteria for potential demonstration
- Feasibility and development of integrating other technologies, such as AI

Initial development of software for coordination and tracking of resources. Analytics for machine learning, prediction, response evaluation.

- A Cost Benefit Analysis to predict the impact of deployment to the UK Grid.

Additionally, this study will look to go beyond a previous collaboration between SPEN and SGN [under NIA funded feasibility study investigating the potential for Hydrogen generation in East Fife]. The studies provided feasibilities, and business sensitivities, to show that generating Hydrogen from electrolysis can be viable when there is sufficient cheap electricity from a renewable energy source. The study revealed that the co-location of the hydrogen production facility and the potentially curtailed wind can be a key to the business case. The example of Neart na Gaoithe Offshore Wind Farm was provided where estimated savings of £25-30m could have been made should a connection have been made into Fife rather in East Lothian, showing that there may be significant benefits in network planning through use of Hydrogen as a cross vector energy solution.

Scope

Detailed Design and Benefit/Cost Analysis, supported by simulation and literature study outputs

Objective(s)

The overall aim of this project is to quantify the potential viability of a range of technologies to act as network frequency response services across various timescales. The aims of the project can be broken down as follows:

- Establish the technical requirements for the various levels of frequency response provision
- Conduct a gap analysis to establish the TRL of the available generation, demand, storage and vector shift solutions
- Report on the viability of the various technologies, including an indicative roadmap of how low TRL technologies might be accelerated to be included in a whole energy system solution.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

As this is mainly a research and design project, there is not significant potential for this project to impact customer vulnerability.

Success Criteria

The success of this project will depend on completion of investigations to understand and quantify the capabilities of various generation, demand, storage and vector shift technologies to provide frequency response solutions. Success criteria for the project are:

The dissemination of learning gained through the project.
Stakeholder satisfaction.

Project Partners and External Funding

SUPERGEN – Academic Partners, TBD - Industry Partner

Potential for New Learning

The project will provide new learning about:

Regional Inertia Monitoring, Whole Energy System Deployment, Vector Shift Technological Readiness, Green Hydrogen.

The learning from this project will be disseminated through the online learning portal and also through a workshop.

Scale of Project

This project will look to develop the technical specifications for a regional monitoring and response platform, as well as the viability of response technologies within the SPEN region If successful, the learning can be disseminated and a future project can use the information to develop future trials of a regionalized frequency response service. The scale of this project is deemed the minimum necessary to carry out the essential investigations and simulations required to fully investigate and report upon this problem area.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

There is no requirement for a specific geographical area, however it will be focussed on the SPEN network areas

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£600,000

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:

This project will assess and report on a number of Frequency Response solutions which can be implemented and deployed to assist in the transition of the energy system.

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)

Any solutions to the problem learned through this project's investigations will potentially be much more cost-effective than any frequency response options currently employed on the network. There may also be savings through preventing equipment damage. With an indicative preliminary analysis, it is concluded that potential for this project is as follows:

1. Synthesis response could be provided with a CAPEX of £14m and OPEX of £15.6m
2. Dynamic Balancing & Containment provided by BESS would incur CAPEX of £680m (with ~10 year battery life) and OPEX of £17M

Please provide a calculation of the expected benefits the Solution

N/A - Research Project

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

The project is looking into a problem that affects all network licensees, making any learning highly replicable.

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

Project will not lead to a rollout at this stage (feasibility study only).

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 trialled 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

N/A

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.

Checks on ENA Smarter Networks Portal revealed no other projects for this specific problem.

Internet searches reveal that this problem has been researched, however there is no research applicable to the SPEN network requirements. The aim of this project is to investigate this problem and any mitigation strategies that may exist and verify them with network studies.

One to one consultation has been carried out with each licensee during the development phase of this project.

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

Through public domain searches and 1-2-1 consulting, no project with the same scope has been identified; as such we can say this project scope is innovative.

Relevant Foreground IPR

N/A

Data Access Details

N/A

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

Due to the innovative nature of this project, NIA funding is required to de-risk the project and uplift the TRL.

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

Due to the innovative nature, NIA funding is required to de-risk the project and uplift the TRL. It has both technical and commercial risk as such a scheme has not been deployed in the UK before

This project has been approved by a senior member of staff

☑ Yes