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

May 2021

Project Reference Number

NIA_SSEN_0056

Project Registration

Project Title

Inertia Measurement in Island Networks

Project Reference Number

NIA_SSEN_0056

Project Licensee(s)

Scottish and Southern Electricity Networks Distribution

Project Start

May 2021

Project Duration

0 years and 11 months

Nominated Project Contact(s)

Colin Mathieson

Project Budget

£485,000.00

Summary

This project aims to install measurement technology namely in the Western Isles to monitor power quality and inertia during extended network outages known as island mode. Data gathered from the project will be used to validate the existing network operating models used during island mode. In island mode, distributed generation (DG) is curtailed to 10% of network load with diesel generation supplying the bulk of electricity and network inertia. The learning from the project will inform future studies which may allow an increase in DG, which in turn will reduce the reliance on diesel generation reducing overall costs and carbon emissions. In increase in distributed generation will also increase the revenue to generators during extended outages, many of which are community operated.

Nominated Contact Email Address(es)

fnp.pmo@sse.com

Problem Being Solved

SHEPD currently supply energy to island groups across the north and west of Scotland, via a network of subsea cables. Many of these island groups, such as the Western Isles, have fixed generating sites, typically diesel powered, to maintain supplies in the event of a submarine cable fault. These islands in more recent years have had large volumes of renewable generation connected, whose output is severely constrained in the event of a submarine cable fault while the island is reliant on the diesel generating stations (referred to as island mode).

Presently, while in island mode, synchronous diesel generators at Battery Point and Arnish are used to provide the electricity and maintain network stability with only a small amount of export allowed from Distributed Generation (DG). Presently whilst the WI is operating in island mode the output from the DG units is curtailed to a maximum of 10% of load. Due to the age of the existing diesel generators there is a growing need to investigate the most economical strategy for maintaining a stable power supply on the island in the event of a submarine cable failure, while also ensuring minimal additional carbon emissions in line with net zero ambitions.

This project has been established to explore the possibility of allowing a larger percentage of the island DG to remain connected during a fault. The reduction in DG output results in additional operating costs for the diesel generators as well as the associated carbon impacts, it also results in reduced output from the embedded renewable generation many of which are operated by community

groups. There are significant diesel costs in operating the diesel generation and a loss in revenue to the DG owners due to the reduction in allowable output.
Currently there is limited network data and insufficient technical information available to carry out detailed stability studies when operating in island mode and as a result, conservative parameters are being used to determine the volumes of renewable DG which can be allowed to export.

Method(s)

This project looks to install measuring equipment panels within selected substations to allow the continuous recording of power quality and sampling of the inertia (rotating mass which ensures power frequency stability) of the Western Isles (WI) network when running in island mode. It is anticipated that by carrying out these measurements the following can be obtained:
• Power quality of the supply on the WI in island mode.
• Amount of system inertia under different network conditions during an extended period.
This data will be used to validate existing models and determine if additional renewable generation can still be accommodated in island mode, thus reducing costs to customers from prolonged diesel operation. The outputs from the project will also help inform the development of long-term solutions to replace the existing fleet of fixed diesels with lower carbon alternatives.

Scope

Monitoring technology to be deployed at key locations to allow the continuous recording of power quality and sampling of the inertia of the Western Isles (WI) network when running in island mode.
Data from the monitored system will be examined to measure power quality and establish the inertia of the system at the instant of the disturbance by -
• Installing additional Phasor based monitoring units at selected Primary substations to monitor power quality.
• Installing a load bank and electronic switch to create constant micro disturbance to the system, enabling continuous inertia measurement.
The findings from this project will be used directly to assess the effectiveness or the current Distribution system operating procedures during island mode. These findings will also be used in future studies aimed at reducing future reliance on diesel generation and the transition to net zero.

Objective(s)

The objectives of the project are –
• To gather detailed network data when in island mode.
• Determine if the power quality on the Western Isles whilst in island mode has the potential to facilitate additional embedded renewable generation volumes.
• Validate the following operating models whilst in island mode:
- SHEPD diesel generator parameters (Battery Point & Arnish).
- Distributed Generator parameters.
- Contribution of Western Isles load to inertia.
• Complete studies to confirm the amount of Distributed Generation export which can be allowed.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

N/A

Success Criteria

The project will be deemed as successful if all of the items in the scope, objectives and learnings are met which can be used by SHEPD to further enhance the understanding of the network when operating in island mode.

Project Partners and External Funding

N/A

Potential for New Learning

Clarification if the existing constraint levels applied to DG export in island mode are appropriate, or not. This will provide either greater certainty and evidence of the prudence of existing constraints or enhanced value to SHEPD and Renewables generators by allowing the reduction of the level of constraint.
• Potential for modification of the constraint parameters applied during extended/future outages (increased or decreased DG export allowed) resulting in more efficient utilisation of the network.
• Higher granularity and continuity of disturbance data which can be used to validate or invalidate the existing network operating

models.
Learnings from the project will be disseminated via internal and external stakeholder event which will be conducted during the project. The learnings will also be shared within the annual project report and at relevant dissemination events such as the Energy Networks Innovation Conference.

Scale of Project

This project is designed to get maximum learning for minimal cost. It is a small-scale project expected to provide learnings which could influence future process changes to potentially allow increased DG export and a reduction in diesel generation when operating in island mode. The project will install the minimal amount of measurement equipment to gain the required data; using any less equipment would result in an insufficient study. It is envisaged that other islanded communities will benefit from the knowledge gained which may lead to proposing new power source balances whilst in island mode. With increasing costs to operate diesel generation any learnings which could lead to a reduction in diesel generation are beneficial.
The project delivery timescales have been set to ensure the assessment is conducted whilst the Western Isles are operating in islanded mode.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

This project will be undertaken within the Scottish Hydro Electric Power Distribution licence area in Scotland namely the Western Isles.

Revenue Allowed for the RIIO Settlement

No allowance has been made for this type of monitoring within the RIIO-ED1 settlement. No savings are expected during project implementation; future savings may be possible depending on the outcomes of the project and future modification of current processes.

Indicative Total NIA Project Expenditure

The total expenditure expected from the project is £485,000. 90% of which £436,500 is allowable NIA expenditure.

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:

N/A

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)

Presently whilst the WI is operating in island mode the output from the DG units is curtailed to a maximum of 10% of load. Monitoring the network real-time whilst in island mode will provide a detailed investigation into the stability and power quality on the island. This investigation may help future process change which may allow DG output to be increased and reduce the volume of higher cost diesel generation used during extended outages.

Please provide a calculation of the expected benefits the Solution

This is an investigative research project, if results are positive then cost savings can be estimated from the project learning and be reported at the end of the project.

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

The learnings are mainly of interest to SHEPD due to the geographical composition of our network. The learnings could be further used to change processes within other areas of our network that also operate in islanded mode during extended outages.

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

The costs of rolling out the method across GB are dependent on the operation and geography of the rest of the GB network.

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)

The project aims to deliver benefits that can help with the transition to a low carbon future as detailed within the SSEN Innovation strategy. By potentially allowing an increase in DG export and reducing the use of diesel generation during future submarine cables outages there could be a net reduction in carbon emissions along with an increase in embedded renewable generation, many of which are operated by community groups.

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.

Scottish Hydro Electric Power Distribution is unique due the geographical composition of the network supplying many islands. No projects have been undertaken to assess the power quality and measure inertia when disconnected from the national grid/operating in island mode.

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

Power quality and inertia when in islanded mode have not been measured before, the learnings from the project will be used by SHEPD to determine if there can be a process change to increase DG during future extended outages. To date, no other projects have used power quality and inertia measurement technology to increase DG during extended outages. A change in process would demonstrate an innovative approach to managing islanded networks rather than continuing to operate with the same standard operating procedures.

Relevant Foreground IPR

No IPR will be generated during the project.

Data Access Details

See Network Innovation Competition (NIC) and Network Innovation Allowance (NIA) Data Sharing Procedure at https://www.ssen.co.uk/InnovationLibrary/Distribution/

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

NIA has been deemed the best method of supporting the delivery of this project. Development projects funded by NIA give suitable financial support to investigate areas for potential development that could not be funded by BAU as no allowance was made in the RIIO-ED1 settlement.

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

This project can only be undertaken with the support of NIA due to the overall costs and timescales required. Delays from investigating other funding methods would not support the timescales required to deliver the project when in islanded mode due to the impending submarine cable replacement. Similarly, there is a risk that the learnings may demonstrate that it might not be possible to increase or increase enough DG export in islanded mode to reduce the use of diesel and carbon emissions associated with it. NIA is the best method to fund an investigative project such as this.

This project has been approved by a senior member of staff

☑ Yes