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

Feb 2017

### Project Reference Number

NIA_NGET0205

## Project Registration

### Project Title

Vector Shift Initial Performance Assessment

### Project Reference Number

NIA_NGET0205

### Project Licensee(s)

National Grid Electricity System Operator

### Project Start

February 2017

### Project Duration

0 years and 5 months

### Nominated Project Contact(s)

Graham Stein

### Project Budget

£30,000.00

### Summary

The project will investigate the relative performance of Vector Shift and RoCoF based Loss of Mains protection as applied to distribution generation in GB.

### Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

### Problem Being Solved

Distribution Companies need their customers to install “Loss of Mains” protection. The protection is intended to shut distributed generation down safely when a local island is detected. Inappropriate settings lead to either: Islands not being detected putting equipment and personnel at risk; or large numbers of small generators shutting down simultaneously in response to a widespread disturbance (e.g. a frequency incident or secured faults). There is evidence that the settings currently recommended in the Distribution Code are inappropriate and a system incident on 21st May 2016 provided supporting evidence of their impact on the operation of the total (or whole) electricity system. There is therefore a need to review Vector Shift settings used in Great Britain (GB).

No information is available in GB or internationally which quantifies Vector Shift based Loss of Mains protection’s ability to detect power islands effectively or, discriminate between an islanding event or a network fault. An inability to conclude a review means the industry cannot agree an approach for Loss of Mains protection settings. Current settings cause £40m per year in Balancing Service costs.

### Method(s)

Extensive modelling of appropriate islanding scenarios and protection relay testing would ordinarily be required to recommend new Vector Shift setting which is resilient to network disturbances, and in terms of its ability to detect a genuine local power island.

However, the GC0079 joint Grid Code and Distribution Code workgroup has developed a specification for an initial assessment

which, if successful, will mean a complete assessment is not required. This initial assessment will evaluate whether Vector Shift protection is better or worse than RoCoF (Rate of Change of Frequency) techniques at detecting a power island. If it is worse, this demonstrates there is no good reason to use Vector Shift and it may be possible draw a conclusion that its use should be discontinued. This approach is feasible because of previous work which has quantified the performance of RoCoF based Loss of Mains protection techniques.

## Scope

The project will investigate the relative performance of Vector Shift and RoCoF based Loss of Mains protection as applied to distribution generation in GB.

## Objective(s)

Establish the relative performance of Vector Shift and RoCoF Loss of Mains techniques.

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

## Success Criteria

A clear quantified measure of Vector Shift Loss of Mains protection performance relative to RoCoF for a set of known and agreed combinations of network and generation technology.

## Project Partners and External Funding

University of Strathclyde

## Potential for New Learning

The project will establish the relative performance of Vector Shift techniques compared to RoCoF techniques in Loss of Mains protection. The reports generated from this project will be published on the ENA smarter networks portal. The project completion report will also be published on the National Grid website in the Grid Code workgroup section and its conclusions captured in any GC0079 workgroup report.

## Scale of Project

The Project makes use of equipment, models and approaches used in a previous project to evaluate RoCoF based Loss of Mains protection techniques (“Assessment of Distributed Generation Behaviour during Frequency Disturbances” - NIA_NGET0142) and is hence able to evaluate performance using an incremental research approach.

## Technology Readiness at Start

TRL2 Invention and Research

## Technology Readiness at End

TRL4 Bench Scale Research

## Geographical Area

Great Britain

## Revenue Allowed for the RIIO Settlement

None

## Indicative Total NIA Project Expenditure

NIA: £30,000

# 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:

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)

If appropriate Loss of Mains protection settings cannot be established it will not be possible to avoid at least £40M per year in Balancing Service costs. Further work will be required to deliver the full potential savings.

## Please provide a calculation of the expected benefits the Solution

This is a reasearch project only aimed at investigating the problem based on observable facts.  A detailed CBA is not possible at this stage and is not required.

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

The Method is applicable across GB distribution networks.

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

The implementation programme for protection setting changes is currently estimated at up to £50m in one-off costs.

## 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

The learning will be used in the development of proposals for new Loss of Mains protection settings for distributed generators as specified via the Distribution Code.

### 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 delivers consumer value by allowing us to improve both our risk management and understanding of distributed generation. These are two value themes within our System Operator innovation strategy.

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

### 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.

A review of the Smarter Networks Portal has been carried out to ensure there is no unnecessary duplication.

### 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

n/a

### 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

n/a

## 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

n/a

## This project has been approved by a senior member of staff

☑ Yes