

## NIA Project Registration and PEA Document

### Date of Submission

Feb 2014

### Project Reference Number

NIA\_NGET0142

## Project Registration

### Project Title

Assessment of Distributed Generation Behaviour during Frequency Disturbances

### Project Reference Number

NIA\_NGET0142

### Project Licensee(s)

National Energy System Operator

### Project Start

April 2014

### Project Duration

0 years and 11 months

### Nominated Project Contact(s)

National Grid SO Innovation Team

### Project Budget

£275,000.00

## Summary

The work will provide a comprehensive view of distributed generation types and susceptibility to RoCoF for the entire GB synchronous network. The feasibility and implications of using revised protection settings to avoid coincident distributed generation losses during loss of infeed events will be established.

## Third Party Collaborators

The University of Manchester

## Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

## Problem Being Solved

System inertia is reducing with increasing levels of asynchronously connected generation (including wind and solar). Industry agreed generation background scenarios indicate that this trend will continue as more renewables are connected. With reduced system inertia, higher rate of change of frequency (RoCoF) will occur on GB networks for unplanned events causing large losses of infeed (e.g. loss of a large generating unit or an interconnector bipole) Without intervention, the higher RoCoF will trip distributed generation where loss of mains protection is provided through RoCoF type protections.

## Method(s)

### Research

This work will provide a clearer understanding of smaller (<5MW) distributed generation installations, how these would behave in the event of system disturbances and the techniques that can be applied to protect the distribution network and generators from damage in an islanding event. This will enable more efficient and reliable operation of the GB system both at transmission and distribution level. The work is supported by National Grid as National Electricity Transmission System Operator and the GB Distribution Network Owners (DNO's).

No comprehensive information exists for generation types and loss of mains protections for distributed generation installations of <5MW. The first stage of this work would create a GB view (by DNO area) for such distributed generation. This would utilize any existing information sources including DNO data, DECC data, Supplier data etc. Putting in place this information will enable an appropriately representative model of system behaviour for events impacting system frequency (eg loss of infeed).

Without intervention, lower levels of system inertia will result in higher RoCoF for secured infeed losses and coincident tripping of distributed generation. The second part of this work will evaluate the feasibility of using higher RoCoF protection settings for distributed generation on DNO networks. This will involve the detailed modelling of distributed generator behaviour during events that give rise to high RoCoF and islanding.

### Scope

The work will provide a comprehensive view of distributed generation types and susceptibility to RoCoF for the entire GB synchronous network. The feasibility and implications of using revised protection settings to avoid coincident distributed generation losses during loss of infeed events will be established.

### Objective(s)

The key objectives are to reduce operational costs and to enable increased system access for asynchronous generation types including renewable generation (wind, solar).

If measures are not taken to ensure distributed generation is less susceptible to RoCoF events, then increased operating costs are likely to result through the curtailment of large infeed risks or the operation of synchronous generation in favour of asynchronous generation to manage RoCoF risks. Potential increases in system operating costs by 2018/19 are forecast to be £250m per annum, rising to in excess of £1000m per annum by 2025.

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

n/a

### Success Criteria

- 1) The provision of a comprehensive GB wide model (by DNO) for distributed generation installations of <5MW including the generation and loss of mains protection types.
- 2) A risk assessment that will enable decisions to be made on changes to protection settings on existing generation and what protections and settings should be used for further distributed generation.

### Project Partners and External Funding

The work will be taken forward with DNO's and managed through the ENA.

No external funding.

### Potential for New Learning

The work will provide new information to National Grid and DNO's on the behaviour of the total system during frequency disturbances and the behaviour of the distribution networks in island conditions

### Scale of Project

To provide an understanding of GB system behaviour during RoCoF events, a GB wide view of distributed generation is needed. The work is only valid if a comprehensive GB view is formed.

## Technology Readiness at Start

TRL2 Invention and Research

## Technology Readiness at End

TRL5 Pilot Scale

## Geographical Area

The works is to provide a view for the overall GB network including transmission and distribution networks.

## Revenue Allowed for the RIIO Settlement

None

## Indicative Total NIA Project Expenditure

Total project expenditure is expected to be £275,000.

## 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)

With increasing levels of asynchronous generation, potential increases in system operating costs by 2018/19 are forecast to be £250m per annum, rising to in excess of £1000m per annum by 2025, if system robustness to RoCoF is not increased. The cost incurred is the Balancing Service cost of curtailing infeed losses and having to synchronise additional generators to provide inertia, displacing renewable driven non-synchronous generation such as wind.

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

Not required for research projects

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

The Method provides a single approach to RoCoF on all distributed generators across the GB networks.

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

Implementing changes to RoCoF protection could cost around £30m. This could comprise work to change distributed generation protections and protection settings. This project will assist in quantifying these 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

National Grid would have better information to understand total system performance during system incidents involving frequency deviations. This would enable balancing services costs to be reduced in the future if it is possible to change RoCoF protection settings and could reduce costs during the transition to new settings.

Distribution Network Operators would gain improved information about small generation connected to their networks. They will better understand local distribution system performance in the event of incidents that island local demand and generation. This will inform the future development of distributed voltage, reactive power and active power control policies as levels of distributed generation increase and will support the wider objectives of facilitating access to the distribution network, particularly for low carbon generation sources such as photovoltaic

### 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

- ☒ 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.

There are no other similar projects being carried out at present.

### 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