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 2016

Project Reference Number

NIA_NGET0192

Project Registration

Project Title

SIM - Samuel Inertia Element

Project Reference Number

NIA_NGET0192

Project Licensee(s)

National Energy System Operator

Project Start

August 2016

Project Duration

0 years and 11 months

Nominated Project Contact(s)

Michael Coldwell

Project Budget

£232,000.00

Summary

To directly measure system inertia over a 6 month period.

Preceding Projects

NGETEN03 - Enhanced Frequency Control Capability (EFCC)

Third Party Collaborators

Reactive Technologies Ltd

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

System inertia on the GB system is slowly declining, with the closure of aging power stations and the increased levels of renewable generation displacing conventional power stations. There is currently no known method, nor operational tools, to take a direct real-time measurement of system inertia. The real-time value of inertia on the GB system is currently estimated from known synchronised generator design parameters and an estimated value for that inertia contribution provided by the embedded generation within the Distribution Networks. This means that there will be inaccuracies in the determined inertia value. The project aims to test the

assumptions made in National Grid's current method for evaluating inertia as inaccuracies in the inertia calculation would either lead to increased balancing costs or a reduction in system security. With a network of real-time high precision Frequency Measurement Units already installed around GB, the project can also study the regional characteristics of inertia.

Method(s)

Research: This project will utilise the Grid Data Measurement System technology demonstrated in Project Samuel (NIA_NGET0119) to undertake a six month study of the GB transmission system inertia. The project will reuse the existing 5 load banks of 600kW each installed in the Samuel project to induce small changes in the system frequency by switching the loads on and off. In Phase 1 of this project, the load banks from Project Samuel will be remediated for the deliverables of Project SIM. Then switching sequences will be run, and the frequency data from a network of Frequency Measurement Units will be analysed to give an initial inertia estimate and prove that the method is robust, and comparable to the values presently calculated. Phase 2 will then continue the measurement period for 6 months, across times and days, to provide the full study data. Work will also be ongoing to refine switching and measurement techniques to attain the best accuracy possible. Noise on the system will be filtered out using signal analysis techniques to maximise the gain of the transmitted signal.

This project will be the first time that system inertia has been able to be measured from a direct real-time impulse-response approach, which potentially offers a more accurate way of measuring system inertia and being able to do so on an on-going basis.

Scope

To directly measure system inertia over a 6 month period.

Objective(s)

This project seeks to:
1. Verify if GB system inertia can be directly measured
2. Identify daily trends, over a six month period.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Measurement of system inertia comparable to current calculation.

Inertia measurements throughout the day and week for a 6 month period.

Project report detailing findings and capability to provide an ongoing operational service of inertia measurement.

Project Partners and External Funding

Reactive Technologies Ltd.

Potential for New Learning

This project aims to validate current inertia calculation methods, with the potential to better understand how the inertia contribution from demand fluctuates and whether there is a linear relationship. With 30 real-time Frequency Measurement Units already installed by Reactive across GB, there is also potential to explore any regional aspects of system inertia to better understand how the geographic location of a system event can affect the resulting impact that event will have, at national and regional levels. This project will be a comprehensive and unique way to better understand the propagation effects of system events and how their severity changes depending on current inertia levels. With deeper insights into the "live" behavior of the GB system and how this changes over time, there is the potential to better define the requirement for inertia services in the future.

Scale of Project

All 5 of the load banks are needed to produce a measurable effect on the system frequency.

The majority of the project cost is for engineering personnel to run the GDMS system, experiment with switching sequences, capture and analyse the data and present findings and observations on the behavior of inertia within the GB grid over time – hence the project scale is determined by the length of the project. A six month period was chosen in order to get inertia measurements across the

seasons, capturing the low inertia in summer and the higher inertia in winter.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The GB Network

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£232,000

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 the project determines that current inertia values are pessimistic, then system balancing costs could be reduced – with the benefit of lowering costs to end consumers.Currently a significant amount of money is spent managing inertia but it is not possible to quantify the benefits of the project as it is not known to what extent the measured value and calculated value will differ. Also with better insight into how inertia changes in the GB system over time and to be able to quantify inertia more accurately, more cost-effective new services can be developed to better manage the GB system in the future.

Please provide a calculation of the expected benefits the Solution

Research Project – project benefit will be a better understanding of system inertia, either leading to enhanced system security or reduced balancing costs depending on comparison with current calculation.

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

Frequency variation and inertia are both GB wide parameters, so the project needs to take place on a national scale to be able to study these. If the project determines a regionalised nature of inertia then Network Licensees may wish to investigate inertia effects within their network areas.

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

The trial will cover the GB network. However if suitable value exists then an operational service could be developed to extend the trial into a BAU arrangement. Commercialisation costs for this would fall on Reactive Technologies.

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

Any regional inertia effects explored by the project may be of interest to the Transmission Owners or Distribution Owners for example to investigate parameters of Rate of Change of Frequency Relays.

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

Risk Mitigation

☑ 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.

The project is not aware of any other project using a load with a known power to modulate the frequency and obtain a direct measurement of the inertia. Other projects are working on how to adapt to decreasing inertia on the system, for example Enhance Frequency Control Capability. This project aims to maximize the value from such projects by giving a better understanding of the current system inertia and how it changes over time.

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