

## NIA Project Registration and PEA Document

### Date of Submission

Jan 2014

### Project Reference Number

NIA\_NGET0119

## Project Registration

### Project Title

Project Samuel - Grid Data and Measurement Systems

### Project Reference Number

NIA\_NGET0119

### Project Licensee(s)

National Energy System Operator

### Project Start

December 2013

### Project Duration

1 year and 7 months

### Nominated Project Contact(s)

Michael Coldwell

### Project Budget

£620,400.00

## Summary

The GDMS Technologies uses the system frequency as a communication means to achieve instant 100% national coverage of all electrically connected devices of demand side loads and generation using an existing infrastructure. The system enables direct, instantaneous aggregate power consumption/generation measurements to be performed by the System Operator from the control room.

The GDMS system consists of a transmitter network made up of a number of load devices (resistive heating elements) whose power consumption is modulated in a desired pattern (i.e. a "code"). This pattern is then turned into minute (imperceptible at an operations level) changes of the grid frequency (modulation), and this modulation is subsequently decoded by the other part of the GDMS system – the receiver devices. These are installed onto domestic loads (e.g. hot water immersion heaters) and receive the transmitted codes from anywhere in the grid, and act accordingly.

The system will be operated remotely to enable greater visibility of available capacity and provide finer control for National Grid's control room to utilise demand side resources in system balancing (response and reserve). The system will also be a highly useful grid inertia analysis tool for National Grid and Network Licensees to provide unique visibility of grid inertia right into the distribution networks. As an operating system, by spreading the transmitted codes National Grid can ensure reliable and resilient broadcast communications and through the use of trusted encryption techniques and anonymised load groups, The system represents a highly secure communications and innovative aggregated measurement channel.

## Third Party Collaborators

Reactive Technologies Ltd

## Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

## Problem Being Solved

The cost of balancing the electricity transmission system will increase as more intermittent renewable generation is used. Demand consumer loads can help reduce this cost but these loads cannot be accurately calculated and are unable to be applied to energy balancing through response and reserve services. This is due to a lack of available, cost-effective communication systems which provides national coverage of electrical connection and which enable the instantaneous aggregate power measurement of enrolled electrical load devices. This leads to an increased cost to balance the system and challenges the integration of new renewable power generation.

## Method(s)

A Grid Data Measurement System (GDMS) is an existing technology by Reactive Technologies Limited, which has the potential of controlling and monitoring the demand side loads through a currently operational communication infrastructure. Project Samuel will research and pilot GDMS to investigate whether the system is a cost effective method to accurately calculate and control domestic demand-side loads for subsequent implementation within National Grid.

## Scope

The GDMS Technologies uses the system frequency as a communication means to achieve instant 100% national coverage of all electrically connected devices of demand side loads and generation using an existing infrastructure. The system enables direct, instantaneous aggregate power consumption/generation measurements to be performed by the System Operator from the control room.

The GDMS system consists of a transmitter network made up of a number of load devices (resistive heating elements) whose power consumption is modulated in a desired pattern (i.e. a "code"). This pattern is then turned into minute (imperceptible at an operations level) changes of the grid frequency (modulation), and this modulation is subsequently decoded by the other part of the GDMS system – the receiver devices. These are installed onto domestic loads (e.g. hot water immersion heaters) and receive the transmitted codes from anywhere in the grid, and act accordingly.

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A customer engagement plan will be presented to Ofgem for approval in advance of any end customer engagement activities

## Objective(s)

The main objectives of this project will be as followed;

- To develop a cost-effective communication system to accurately calculate and control domestic demand-side loads.
- To test and demonstrate whether the GDMS system can control and monitor the demand side loads through an existing operational communication infrastructure.

The key deliverables in achieving these objectives include:

- A risk mitigation study between project parties and external technical experts to identify and resolve practicability concerns relating to the systems operability on the network.
- The demonstration of the system to successfully transmit digital information to geographically distributed receivers across the whole of the UK
- The demonstration of the system to measure, analyse and monitor inertia/flex of the UK grid
- The validation of the communication system through the following fields;
  - The speed and reliability of the system

- The flexibility and programmability of the loads behaviour of the system
- How the system will be triggered to receive transmitted codes of different parameters of length, information and speed.

- Technical service qualification for the system operator to accept the use of GDMS technology based services for balancing and response or grid measurement.

The completion of a trial plan detailing the nature and scope of the instantaneous power measurement tests to be performed to clearly demonstrate the successful use of system frequency.

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

n/a

### Success Criteria

The success of the project will be based on the following outputs;

- A primary report demonstrating the identification and mitigation of risks
- A secondary report cataloging the installation of transmitters/receivers and testing.
- A concluding report to define the aggregated power measurement the test results, findings and conclusions.

### Project Partners and External Funding

Reactive Technologies Ltd & Scottish and Southern Energy Power Distribution

No external funding.

### Potential for New Learning

The communication system provides a whole new set of control tools and analysis capabilities for National Grid and DNO/DSOs as well as providing a means to engage domestic loads within the balancing process in a way that returns benefits to end customers and supports the transition to a low carbon economy. The learning and outcomes from the project will be disseminated through the ENA website, annual conference and reporting carried out by National Grid.

### Scale of Project

Each transmitter device will be a group of 4-6 resistive heater loads (chosen for their ease of operation and physical size) each 29kW to be located in ~24 sites across the UK. Each transmitter site will also have a receiver built-in to it (and so during the trial the actual transmitter capacity can be determined by using a proportion of the transmitters as receivers) and a further ~20 receivers (only receivers) will be deployed in the extremities of the GB system, making a total of up to ~44 receivers.

### Technology Readiness at Start

TRL7 Inactive Commissioning

### Technology Readiness at End

TRL8 Active Commissioning

### Geographical Area

Transmitter locations across UK – N.B. all to be sited within commercial premises for ease of access. Each Transmitter will also have the capability to act as a Receiver unit and other Receivers will also be distributed across UK.

### Revenue Allowed for the RIIO Settlement

Zero.

### Indicative Total NIA Project Expenditure

£620,400

## 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)

Over a 10 year period, GDMS receiver devices could be deployed on a similar scale to existing Radio Teleswitch receivers. This could enable up to a ~1GW of demand side capacity to be made available to National Grid, resulting in up to a 30% reduction in system balancing costs due to greater competition of supply. The approximate annual cost on reserve and response is project to set to be approximately £285 million by 2020; this could be reduced by up to 30%.

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

Base Cost - £285 million per year

Method Cost £200 - £257 million (based on a 10-30% reduction)

Difference – Between £28 and £85 million per year.

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

GDMS has the potential to provide 100% national coverage as a broadcast and measurement system. GDMS Receivers would then need to be deployed within the distribution networks of the UK at consumer premises on controllable loads.

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

The outline costs for establishing a nationwide GDMS transmission network are <£5M and to reach ~1GW of residential capacity across the UK is estimated to be in the order of ~£60M.

### 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 will meet the reliability, system operability and environmental outputs from National Grid's Innovation Strategy. The strategy of the network will improve due to a greater understanding and management of domestic demand-side loads.

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 similar approaches being employed to control and monitor on the commercial and industrial demand loads, this project is investigating the demonstration and implementation of domestic loads. No alternative system is currently being used in this way.

#### 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