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 2014

Project Reference Number

NIA_NGET0135

Project Registration

Project Title

Enhanced Sensor Development (ICASE Award)

Project Reference Number

NIA_NGET0135

Project Licensee(s)

National Grid Electricity Transmission

Project Start

October 2012

Project Duration

4 years and 1 month

Nominated Project Contact(s)

Carl Johnstone

Project Budget

£294,000.00

Summary

This project will target the development of a flexible energy harvesting wireless sensor network (EHWSN) which is capable of monitoring a range of parameters. The initial sensor nodes will be designed to be retrofitted to a standard NG pipeline marker post and employ a range of sensors that are primarily focused on monitoring the immediate soil/environmental conditions adjacent to the pipeline corridor.

The network nodes and control software will be developed to harmonise the energy harvesting requirements with the provision of reliable data platform improving its quality and easing interpretation. EHWSN could provide a widespread monitoring capability for National Grid, and the development of a network capability to ensure robustness in the event of hub failures or the need to add new nodes are seen as a key requirements and the concepts behind these requirements will be developed.

The EHWSN iCASE will provide an in service demonstration of the suitability of the energy harvesting sensor technology but it will also provide the guidelines for future expansion of this technology into a wide ranging monitoring network.

Sensor development, employing the latest advances in optical attenuation reducing techniques, will offer improved performance of plastic optical fibres. While these sensors require laser sources and are thus not initially considered suitable for energy harvesting modules, they offer large distinct long range (>100m) monitoring capability which will have applicability across a number of areas of NG's asset infrastructure.

The project will be developing a range of sensitised fibres which have some cross over with the EHWSN programme which will, in the main, use short range sensors and will benefit considerably from the development of sensors with improved detection and lower energy requirements.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

One major aspect of the continued safe and efficient maintenance of the gas and electricity transmission systems is the ability to incorporate sufficient cost effective remote asset monitoring capability. This is particularly relevant to National Grid's considerable quantities of buried asset but the envisaged solutions would have applicability for all NG assets.
Some of the key requirements of these systems are considered to be:
a) Modularity such that a range of parameters can be measured simultaneously.
b) Reliable but selective data reporting.
c) Each monitoring node can form part of a holistic network without the need for external power requirements.

The latest developments in low energy sensor technologies and the widespread interest in energy harvesting wireless sensor networks (EHWSNs) offers the potential to develop a widespread remote monitoring capability. EHWSNs have a small footprint, can be retrofitted and function in an off-line manner to match the functionality of the monitored asset systems minimising data redundancy but monitor a range of parameters simultaneously. This allows various network nodes to monitor parameters appropriate to the asset at the respective location.

Method(s)

Research

Enhanced Sensor development incorporating latest remote wireless energy harvesting network integrating and optical fibre technologies. This iCASE project will have two inter-related deliverables as follows:

1. To develop and trial an energy harvesting wireless sensor network (EHWSN) utilising the existing pipeline marker post infrastructure as possible mounting points. The hardware development will explore the suitability of harvesting sufficient energy from the ambient environment under typical UK climatic conditions to power and monitor (data manage) any sensors coupled to the hub. Dedicated monitoring and control software will aim to enhance energy harvesting and data quality.
2. The development of a set of improved plastic optical fibres (POF) which incorporate the use of low loss polymer coatings to increase usable lengths and thus enable extended sensor networks.

Scope

This project will target the development of a flexible energy harvesting wireless sensor network (EHWSN) which is capable of monitoring a range of parameters. The initial sensor nodes will be designed to be retrofitted to a standard NG pipeline marker post and employ a range of sensors that are primarily focused on monitoring the immediate soil/environmental conditions adjacent to the pipeline corridor.

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Objective(s)

The programme will demonstrate the capability of a remote pipeline asset monitoring hub incorporating energy harvesting and low power sensor techniques.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This work will give National Grid a significant practical and theoretical understanding of low energy sensors and energy harvesting techniques. These techniques are envisaged to have a wide range of potential applications across National Grid's asset infrastructure.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

Work is both lab-based and field-based, providing EHWSN demonstration module(s) and an improved set of long and short range plastic optical fibres (POF) sensors.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The work will be conducted in Manchester and at field locaitons yet to be determined.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

NGET NIA project expenditure is £81,000.

National Grid Gas Transmission NIA expenditure is £78,000

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)

Local remote monitoring is envisaged to offer numerous benefits in terms of preventative maintenance and fast response to asset failure. If EHWSN and improved optical sensors are widely adopted across National Grid the potential asset health/investment efficiency benefits are estimated to be in the order of low £100k/annum.

Please provide a calculation of the expected benefits the Solution

Not required for a research project

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

The project will provide an holistic remote asset monitoring capability which could be applied to operational sites and buried assets on both the gas and electricity transmission system. There would be also direct applicability within the distribution sectors.

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

It is estimated that implementation could cost ~£20,000 per sensor hub. A hub might include, but not be limited to, an above ground instillation (AGI) or section of pipeline.

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

- [ ] 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 development of low energy sensors and energy harvesting techniques will offer potential to all Network Licensees who have similar asset monitoring issues.

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

- [x] Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

Is the default IPR position being applied?

- [x] 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.

n/a

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