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

Mar 2016

Project Reference Number

NIA_SPT_1601

Project Registration

Project Title

Power 2 Tower: Stage 1 Energy Harvesting Feasibility

Project Reference Number

NIA_SPT_1601

Project Licensee(s)

SP Energy Networks Transmission

Project Start

March 2016

Project Duration

2 years and 10 months

Nominated Project Contact(s)

James Yu (Future Networks Manager)

Project Budget

£100,000.00

Summary

Project stages

The main focus of Power 2 Tower: Stage 1 Energy Harvesting Feasibility is covered in Stage 1, the successful output of which will determine the exact specifications of stages 2 and 3. High-level overviews of stages 2 and 3 are provided, but the precise detail will depend on how efficiently energy can be harvested from an OHL and a separate proposal for stages 2 and 3 will be provided towards the end of stage 1.

- Stage 1: Energy harvesting feasibility (15 months)

- Stage 2: Wireless communication (TBC)

- Stage 3: Prototype development and trialling (TBC)

***Stage 1: Energy harvesting feasibility*.** The main challenge of this stage is to identify the most technically appropriate method of harvesting energy from the OHL. The level of 'appropriateness' will depend on the ease of application, cost of hardware, minimum energy yield over 24 hours and anticipated reliability of hardware.

***Proposed Stage 2: Wireless communication*.** The data bandwidth of the system will be influenced by the distance over which the wireless transmission is made and the available power for the communications device. Due to the highly serial nature of the proposed system it will be advantageous for a TMH unit to be able to communicate with units on non-adjacent towers to allow an element of redundancy. Since the OHL may be taken out of service, thus powering down the monitoring system, a fail-safe method of rapidly re-establishing contact between the TMH units will be required. A suitable protocol to perform the anticipated communications tasks will be identified together with the wireless hardware. A series of tests to determine the distance of transmission, as a function of transmitter power, along an OHL route will be required. The successful output of this stage will become a design specification for stage 3.

Proposed Stage 3: Prototype development and trialling. The pre-requisites for this stage are the exact details of how the energy will be harvested from the OHL, and the wireless hardware and software to be employed. With these details available, a prototype design for the device can be established. The design approach will be to establish a generic platform on which an application specific monitoring system could be implemented. By analysing all potential applications for the platform, consideration can be given to the range of the inputs required. It is anticipated that features commonly found on smart phones, e.g. GPS, accelerometers, analogue data acquisition, will be incorporated as standard since these functions are now highly developed, readily available and are power minimisation compliant. The external casing of the TMH unit will require particular attention with the respect to the operation, environment and installation requirements.

Third Party Collaborators

Elimpus Ltd

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

There are many requirements for monitoring along the length of, or at specific points on, overhead lines (OHL) – examples include dynamic line rating, partial discharge measurement on tower based cable sealing ends and fault location. However, the provision of 230 Vac single phase supplies to individual towers to power the monitoring equipment is problematic and unlikely to yield economically viable solutions.

Method(s)

This project aims to investigate the feasibility of a monitoring system that can be used along the length of a transmission line, comprising of tower-mounted, wirelessly communicating monitoring platforms which are powered by energy harvesting from the immediate environs of the OHL tower. Thus, measurements made from one tower can be wirelessly transmitted to the next tower and so on until the data reaches an access point, such as a substation or a fibre optic cable joint. Hence, the tower-mounted hardware (TMH) units will have three functions:

1. Power management

2. Local monitoring

3. Store and forward node for adjacent TMH units

Scope

Project stages

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Objective(s)

The following objectives for stage 1 have been identified below; the successful outcomes of which will be used to develop future work packages.

- Technology investigation and design of harvesting devices, including review of the market. (This stage has partially been completed during initial scoping studies and has identified three main technologies)

    1. Electric Field
    2. Aeolian Vibration
    3. Earth Wire Current

- Trial of harvesting devices, suited to the 3 energy sources described, on an OHL tower. Develop a measurement system that can be attached to a transmission tower to record the outputs from the trial devices
- Produce a report which summarises the findings and makes recommendations for stages 2 & 3.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be considered successful if the outputs from the objectives allow for further investigation and product development.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The project size reflects the low TRL level of the technology. Future work may include the wide scale trial and testing on a representative location

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

Research – onsite trials on single transmission towers in the Glasgow area

Revenue Allowed for the RIIO Settlement

There is no revenue provisoins in the RIIO settlement

Indicative Total NIA Project Expenditure

£100,000

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)

It is anticipated that significant benefits could be realised if the solution proves successful, ranging from the ability to install safety monitoring equipment to dynamic line rating equipment and commuinication to remote towers. A full analysis of the potential benefits cannot be assessed until phase 1 has been completed.

Please provide a calculation of the expected benefits the Solution

The is a Research proejct therefore financial benefits have not been evaluated at this stage.

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

The method will be replicable across all Network Licensee areas where there is a requirement to deploy sensing and communication equipment on remote HV / transmission assets

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

The costs to roll out this solution will be at the discretion of the respective DNOs and their internal policy requirements. However further investigation into the potential benefits this solution could offer UK customers will be established as the project progresses.

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

All networks operators have similar challenges when trying to install and monitor remote assets. This solution represents an opportunity to deploy sensors and communication assets on transmission towers without the need to install expensive LV infrastructure

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.

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