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

Nov 2017

Project Reference Number

NIA_SPEN_0026

Project Registration

Project Title

Linkbox Monitoring using Narrow Band IoT

Project Reference Number

NIA_SPEN_0026

Project Licensee(s)

SP Energy Networks Distribution

Project Start

December 2017

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Andrew Mcdiarmid

Project Budget

£480,000.00

Summary

Project stages

To enable this proof of concept trail the following three stages are proposed:

- Stage 1: Development of low power sensor and communication

- Stage 2: Installation

- Stage 3: Monitoring and reporting

***Stage 1: Development*:** Two key areas have been identified. Firstly the development of a sensor to collect key asset condition information, and secondly ensuring that communications can be made to enable the transfer of data.

1. Sensor development – it has been identified that temperature is one of the key indicators of the condition and therefore will form the basis of this proof of concept. The development process will identify the ideal location to install the sensor on a variety of types and ages of link-boxes. This will ensure the sensor is fit for purpose and will not pose an increased risk to the effective operation of the asset or to employees or other stakeholders.

2. Communication – some limited lab testing has already been completed- however testing to ensure that communication can pass from the link-boxes will be established, and the locations will be identified based on the IoT infrastructure currently being rolled out by Vodafone

Stage 2: Installation: The installation of the units will be covered in two stages.

1. Limited rollout to 25 link-boxes to prove the communication work as required. This will allow an initial assessment of the design and installation procedures and inform stage 2.

2. This stage will involve the installation on monitors on up 100 sites to enable a longer term evaluation of the system.

Stage 3: Monitoring and Reporting This stage will look at three aspects – [1] accuracy and location of temperature sensing [2] reporting of incidents and [3] usability of data feed. The reporting of the project will inform SPEN and UK DNOs on the viability of this solution and any further development required such as alternative sensors or installation requirements, to allow for its adoption or to inform a wider scale trial

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

Link Boxes are a vital part of the electricity network providing network protection and isolation facilities in fault scenarios, helping to restore supply to customers more quickly and enabling increased flexibility in heavily loaded areas of the Low Voltage network. Currently inspectors visually assess the equipment every three years to ensure the lids are accessible, secure and level. Furthermore intrusive inspections are carried out at a range of frequencies from 1 year to 3 years depending on criticality. However these manual inspections are labour intensive with the current techniques relying heavily on visual inspection and the detection of heat/load from changes in the colour or integrity of visible link box components when viewed from the surface during the inspection.

Linkboxes are generally located up to 1m into the ground and have a cast iron 'bell housing' which fits over the live LV terminals. The linkbox is then covered with a concrete lid to fit flush with the footpath. This relatively harsh environment means that currently there is limited scope to collect and communicate online condition monitoring information from the linkboxes.

Method(s)

This project will aim to investigate the feasibility of utilising the benefits of Narrow Band (NB) IoT communication and low cost low sensors to automatically gather good quality data from Link Boxes easily and cheaply, and remove some of requirement to carry out manual inspections.

This new technology means it will now be possible to deploy monitoring and control solutions in areas where it has previously not been feasible due to insufficient cellular coverage (underground or in certain buildings), insufficient battery life and uneconomical cost. Recent advances in hardware and software technology together with NB-IoT mean all of these challenges can now be overcome.

Through the application of NB-IoT technology it will be possible to deliver a modular solution comprising multiple sensors, a long life battery and a NB-IoT modem which will address a wide variety of use cases for equipment in hard to reach areas, including: -

a. Temperature (for example, to be used in detecting failure of Link Boxes)

b. Light (for example, to detect when a man hole cover is lifted)

c. Power measurement (for example, to help detect abnormal fluctuations)

d. Motion detection (for example, to detect rodents)

e. Moisture (for example, to detect floods)

f. Smoke (for example, to detect fire)

This Proof of Concept (PoC) investigation will install monitoring devices on a limited range of linkboxes to establish whether the communication solution can provide a cost effective solution. A wider scale trail may follow depending on the success or otherwise of this PoC.

As part of this PoC, we will also trial a more conventional communications method and sensor system to allow a comprehensive comparison between the two solutions. This will require a wide rollout of the solutions and a longer period of monitoring and data gathering to prove each solution.

Scope

Project stages

To enable this proof of concept trail the following three stages are proposed:

- Stage 1: Development of low power sensor and communication

- Stage 2: Installation

- Stage 3: Monitoring and reporting

Stage 1: Development: Two key areas have been identified. Firstly the development of a sensor to collect key asset condition information, and secondly ensuring that communications can be made to enable the transfer of data.

1. Sensor development – it has been identified that temperature is one of the key indicators of the condition and therefore will form the basis of this proof of concept. The development process will identify the ideal location to install the sensor on a variety of types and ages of link-boxes. This will ensure the sensor is fit for purpose and will not pose an increased risk to the effective operation of the asset or to employees or other stakeholders.
2. Communication – some limited lab testing has already been completed- however testing to ensure that communication can pass from the link-boxes will be established, and the locations will be identified based on the IoT infrastructure currently being rolled out by Vodafone

Stage 2: Installation: The installation of the units will be covered in two stages.

1. Limited rollout to 25 link-boxes to prove the communication work as required. This will allow an initial assessment of the design and installation procedures and inform stage 2.
2. This stage will involve the installation on monitors on up 100 sites to enable a longer term evaluation of the system.

Stage 3: Monitoring and Reporting This stage will look at three aspects – [1] accuracy and location of temperature sensing [2] reporting of incidents and [3] usability of data feed. The reporting of the project will inform SPEN and UK DNOs on the viability of this solution and any further development required such as alternative sensors or installation requirements, to allow for its adoption or to inform a wider scale trial

Objective(s)

The objectives of the project are as follows:

Stage 1: Develop an online monitoring system for Linkboxes which will be able to gather and transmit key asset health information using NB IoT communications. The solution will have to be low cost and low maintenance.

Stage 2: Develop an installation procedures for the monitors which does not adversely impact the assets or result in increased risk for employees or members of the public.

Stage 3: Monitor the proof of concept trial over an extended period of time to gather information and make recommendations on the solution.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be consider a success if the learning provides the required level of information to make an informed decision on the viability of the solution to become business as usual.

Project Partners and External Funding

Vodafone – No external funding

Potential for New Learning

The outputs from this project will allow for significant new learning to be disseminated amongst UK network operators regarding the potential for automated monitoring of linkboxes; this is an issue with relevance across all DNOs, particularly in urban areas with extensive underground LV networks.

Scale of Project

The PoC project is intending to test a novel solution at a scale which maximises the benefits whilst ensuring customers get value for money. Future work may include the wide scale trial and testing on a larger-scale representative location.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

Trials within the Merseyside District, which has a high concentration of linkboxes.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

£480,000

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, however a full analysis of the potential benefits cannot be assessed until the project outputs are delivered. Initial analysis has suggested the following areas may benefit from this solution if proven during the project, and subsequently adopted as business as Usual

–Enable manual maintenance inspections to be reduced

–Enable proactive intervention on assets to mitigate risk

–Lead to a reduction in unplanned outages

–Provides Regulator with tangible evidence of SPEN action to address an increasingly highly visible network issue

Replacement of link boxes is prompted mainly by condition data obtained in compound filled boxes, with a visual inspection of the box and an inspection of the compound to assess and deformation which may indicate overheating in the past. In resin filled boxes there are very few visual signals that can be used to assess condition. In both cases, the limited visual condition data is more relevant to the top surface of the resin or compound and may hide issues on the underside of the box. A condition based approach with more inputs will refine this replacement assessment. In the UK in 2015/16 5,761 link boxes were replaced. If 5% of the replacements were deferred the benefit, assuming average replacement costs, would be 5,761 x 5% x ~£5000 = ~£1.4m

Please provide a calculation of the expected benefits the Solution

Base cost to monitor 25 high priority link-boxes using convention methods on an annual basis over three years = manual inspection cost £1500 x 3 = ~£4500

Method cost = manual inspection reset to 1 year in 3 + online monitoring solution and communication cost = £1500 + Communication Solution ~£100 X 25 = £4000

This saving equates to around ~£20 saving per link box over a 3 year period

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 LV Link-boxes

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

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

All networks operators have similar challenges when trying to communicate and monitor remote asset or critical assets. This solution represents an opportunity to deploy sensors and communication solution without the need to install expensive LV infrastructure. Additionally the learning from the project will easily transferable for alternative use cases where sensing of remote assets may be required.

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.

Narrowband IoT (NB-IoT) is a new standards based licensed cellular technology which only launched in 2017 (https://www.gsma.com/iot/narrow-band-internet-of-things-nb-iot/) in selected countries and which will not be commercially available in the UK until 2018 onwards

A review of all the other Network Licensees' IFI / NIA Annual Reports has been performed and no similar projects have been identified. SPEN has also forwarded this proposal to all members and highlighted its intentions at the ENA R&D managers meeting.

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

The trial of the NB IoT communications method is innovative as this solution is untrialled for our industry, and particularly for the linkbox monitoring application. This is also innovative due to the lack of a widespread solution for monitoring linkboxes.

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

As the NB IoT Trial has potential for benefits across all DNOs, and it is an unproven technology within our industry, it will benefit from NIA support.

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

The technical risks posed by this project are high due to the innovative technology which is unproven within our indiustry. This means the project may only be undertaken with the NIA support.

This project has been approved by a senior member of staff

☑ Yes