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

Apr 2015

Project Reference Number

NIA_UKPN0003

Project Registration

Project Title

Smart Urban Low Voltage Network

Project Reference Number

NIA_UKPN0003

Project Licensee(s)

UK Power Networks

Project Start

December 2009

Project Duration

7 years and 4 months

Nominated Project Contact(s)

UKPN Innovation Team

Project Budget

£5,383,409.00

Summary

The scope covers:

1) Industrialisation of hardware (based on learning from the prototype deployment undertaken in the LV Remote Control & Automation IFI project), and development of a link box load monitoring device (non-switching) to retrofit into older cast iron link boxes. This activity has been completed under the original Tier 1 LCNF project.

2) Integration of LV hardware with a SCADA based control system utilising LV connectivity models. This activity has been completed under the original Tier 1 LCNF project.

3) Roll out of the technology and evaluation of the potential benefits which are expected to include reduced losses, increased capacity headroom, early visibility of emerging loading or power quality issues. A potential improvement in quality of supply of up to 75% has been identified in the trial area. This activity will be completed under NIA funding.

Nominated Contact Email Address(es)

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Problem Being Solved

The Smart Urban Low Voltage Network NIA project registration is the continuation of a previously funded IFI and T1 funded project of the same name. UK Power Networks wrote to Ofgem on 27 February 2015 outlining our request to extend the project using NIA funding.

The introduction of electric vehicles and other low carbon technologies, such as electric heat pumps or electric vehicle charging points are expected to drive electricity consumption far in excess of natural load growth. Traditional network reinforcement is unlikely to support this growth, and smarter management of the LV network will be required. To compound this, an increase in distributed

generation may have a significant impact on power flows and power quality (harmonics, phase imbalance, reverse power flows, etc.) throughout the LV network. Currently the understanding of the above effects is limited, and observations are difficult due to the limited visibility of the LV network.

An increased reliance on renewable distributed generation connected to the LV network, and higher dependence on electricity as an energy source is expected to lead to a greater focus on quality of supply. Customer interruptions due to LV faults will have greater consequences, and fast restoration of supplies will increase in priority. Existing LV fault restoration and fault location procedures involve time consuming manual processes, and LV fault location can be difficult, particularly in the case of underground cable transient faults.

Potentially avoidable load-related fuse operations present challenges on highly loaded and densely populated areas of urban LV network, and require substantial resources to manage. Without visibility and smart management of the LV network, there is the potential for the number of load related fuse operations to increase, as additional low carbon load connects to the LV network.

Method(s)

We will attempt to address these issues using technical solutions provided by new LV switching technology, in combination with advanced control software. Two strategically selected areas of LV network each comprising up to 20 secondary substations will be populated with the technology:

Area 1 (City Rd B South West feeders): This area has been selected because it has recently been changed to a radial running arrangement, and has been subject to load related fuse operations. It will be used to evaluate how proactive LV network management can improve performance, and optimise the use of existing LV plant. Studies utilising the additional visibility of the LV network will be performed to validate existing network models, investigate LV voltage levels and evaluate the level of LV harmonics.

Area 2 (City Rd B North West feeders): This area has been selected due to the high number of faults it has recently been subject to. Analysis on this network area will focus on the benefits to network performance offered by remote control and automated switching under normal and fault conditions. A number of case studies designed to allow the benefits of the system to be evaluated have been defined, and will be undertaken once a suitable number of devices are deployed.

These will enable us to establish under which circumstances the benefits from installing a more costly LV switching technology, outweigh the potentially cheaper traditional LV network management, and where the installation of such a smart system can offer value for money to the customers. In addition, the extensive load monitoring data collected throughout the duration of the trial will be made available to planning engineers and other business units for analysis.

Scope

The scope covers:

1) Industrialisation of hardware (based on learning from the prototype deployment undertaken in the LV Remote Control & Automation IFI project), and development of a link box load monitoring device (non-switching) to retrofit into older cast iron link boxes. This activity has been completed under the original Tier 1 LCNF project.

2) Integration of LV hardware with a SCADA based control system utilising LV connectivity models. This activity has been completed under the original Tier 1 LCNF project.

3) Roll out of the technology and evaluation of the potential benefits which are expected to include reduced losses, increased capacity headroom, early visibility of emerging loading or power quality issues. A potential improvement in quality of supply of up to 75% has been identified in the trial area. This activity will be completed under NIA funding.

Objective(s)

This project will demonstrate the business benefits of a large scale roll out of a technology that facilitates remote smart management of the LV network.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The following will be considered when assessing whether the project has been successful:

1) Connectivity models for the LV network areas chosen for the trial installations have been created.

2) Successful implementation of automated switching of the LV network is achieved (for fault scenarios and during load related supply interruptions e.g. non-fault fuse operations).

3) Reduction in load related CIs/CMLs is achieved in the trial areas, and the impact of faults on the LV network is reduced.

4) More effective management of the LV network can be demonstrated, by using the additional load monitoring data available to address, amongst other things, any over-loading of plant, phase imbalance, harmonic levels and enable planners to optimise network reinforcement designs.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

Two distinct LV network areas, presenting different network issues will be used to trial the technology; this will provide greater network diversity, and facilitate a thorough evaluation of all identified potential benefits. An effective deployment of the technology requires that the LV networks selected for the trial are densely populated with devices. For each area selected, approximately 40 secondary substations will be populated with 375 Circuit breakers, 750 switches and 70 Link Box monitoring devices will be deployed.

A trial of this scale will allow a representative number of network events to be captured, and sufficient active network switching opportunities to be created.

Technology Readiness at Start

TRL7 Inactive Commissioning

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The trial will take place in the North East of the London Power Networks area, with installations in secondary substations connected to feeders from the City Rd B primary substation. The trial installations will focus on two distinct areas of LV network most of which are situated in the London Borough of Islington.

Remote control and monitoring of the equipment will be managed from the control centre at Fore Hamlet, Ipswich. Although no physical installations will take place on the EPN and SPN areas, the feasibility of deploying the technology to networks outside of London, and additional applications for the technology will be considered (e.g. remotely operated pole mounted devices).

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

The project wrote to Ofgem on 27 February outlining the projects delays and UK Power Networks request to register the project as a NIA project. The project is currently underspent by £1,029,458 and is requesting £962,295 to deliver the project.

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)

Following the successful demonstration of the LV circuit breakers and linkbox switches, UK Power Networks estimates a CI/CML saving of £175K per year if the equipment is installed after the second time a fuse has operated on a network fault.

Please provide a calculation of the expected benefits the Solution

Base Cost: £577,752

Based on:

- Current cost of fuse op's per year (where replacing after 2)

- Operational expenditure relating to fuse ops

- Network Management

Method cost: £976,950

Based on:

- Trial on 50 sites

- Management of the network

Benefits: £1,045,137 NPV for the CI/CML savings over the RIIO Ed1 period to 2022/23

Financial benefits: £645,393 (Base cost - (Method Cost - benefits))

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

The LV Circuit Breakers and Link box switches developed as part of the Smart Urban Low Voltage Network Project can be replicated within all of the LV networks of Network licensees in GB.

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

The outline equipment costs for rolling out the method in a programme of 50 LV feeders per year in each Distribution Network Operators license area across GB is £7,588,350 per year.

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

The main learning that will be shared and discussed with other DNOs includes:

- An improved understanding of the LV network, and greater insight into the potential challenges DNOs are likely to face with the transition to a low carbon economy.
- How active network management of the LV network can optimise the use of existing LV plant, and potentially facilitate the connection of additional and low-carbon loads.
- The business benefits of creating an automated, self-healing LV network.
- How extensive load monitoring data can be utilised to enhance modelling of the LV network.

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 specific challenges are highlighted below:

- Lack of real time visibility of the LV network.
- Identification of network constraints and effectiveness of control actions.
- Reduction in load related CIs/CMLs resulting from forecast increase in distributed generation and connection of low carbon technologies.

☑ 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