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

Jun 2015

Project Reference Number

NIA_UKPN0007

Project Registration

Project Title

Detection of Broken/Low Hanging Overhead Line Conductors

Project Reference Number

NIA_UKPN0007

Project Licensee(s)

UK Power Networks

Project Start

February 2014

Project Duration

5 years and 9 months

Nominated Project Contact(s)

Maxi Faridi

Project Budget

£772,900.00

Summary

Investigation and trial of the following technologies to detect low hanging/fallen overhead line conductors:

- The potential use of high impedance earth fault protection that is recently commercially available for protection purposes.
- Detection through implementing greater sensitivity of Sensitive Earth Fault (SEF) settings on existing sites measurements over time using check currents to avoid protection maloperation.
- The use of mechanical sensors to detect broken and low hanging conductors.

All the above activities will be investigated to determine whether there is likely to be an innovative solution that can be further developed to provide a comprehensive and reliable detection method for deployment on distribution networks.

Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

Problem Being Solved

The detection of broken and low hanging conductors has been a long standing issue with British DNOs and their equivalent industry organisations across the globe and can present an obvious safety hazard to the general public. Currently, there is no proven and commercially available technology for the reliable detection of this condition.

Method(s)

Investigation and trial use of techniques using existing protection technology and mechanical sensors to detect the presence of broken or low hanging overhead line conductors, which may present a safety hazard to the public. Where the use of existing protection technology is proven to successfully detect such events, UK Power Networks may seek opportunities to develop these technologies further if the expected benefits to its end customers and other DNOs are significantly more.

Scope

Investigation and trial of the following technologies to detect low hanging/fallen overhead line conductors:

- The potential use of high impedance earth fault protection that is recently commercially available for protection purposes.
- Detection through implementing greater sensitivity of Sensitive Earth Fault (SEF) settings on existing sites measurements over time using check currents to avoid protection maloperation.
- The use of mechanical sensors to detect broken and low hanging conductors.

All the above activities will be investigated to determine whether there is likely to be an innovative solution that can be further developed to provide a comprehensive and reliable detection method for deployment on distribution networks.

Objective(s)

Develop and prove the feasibility of system or combination of systems that can be deployed on the UK Power Networks overhead distribution network in areas where fallen or low hanging conductors are likely to cause the greatest hazard to the general public and other stakeholders.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The development of a system or systems that fully meets UK Power Networks' requirements and fulfils all the project's objectives.

Project Partners and External Funding

EA Technology - Trial installations of alternative relays for electrical detection of low hanging conductors

Nexans - Development of sensors to enable mechanical detection of low hanging conductors

Potential for New Learning

This is a technical project requiring expert assessment of different concepts for broken and low hanging conductor detection. A successful outcome will yield a solution that has eluded DNOs across the globe for many years.

If UK Power Networks can deliver a solution, it will place us at the forefront of solutions in this area such that we are a point of reference to the wider industry both in the UK and worldwide. It will also provide a solution to a hazardous network event that can place general public and other stakeholders at risk.
Update November 2017-
To ensure that the mechanical sensor solution is a commercially viable product for all DNO's, we have decided to extend the timescales of the project by an additional nine months. This will allow us to resolve some technical issues we are facing, relating to the firmware that sends alarms to our control systems when detecting a broken or low hanging overhead line conductor.

conductor.

Update August 2018-

The first part of the project concentrating on the evaluation of existing protection system technologies to detect the presence of broken or low hanging conductors has been successfully completed, in line with the project timescales. A number of different types of protection systems were investigated, including a revised system of sensitive earth fault (SEF). A high impedance earth fault protection system was found to be the most effective. Laboratory testing showed that this system provided the required level of sensitivity to detect such faults. It was planned to install two sensors of the most effective type at 15 sites in the EPN and SPN regions, to prove that the units are capable of detecting the presence of broken or fallen over headline conductors, under real life conditions. The installation of these sensors has been delayed by the following two issues:

Delayed delivery of the final 30 sensors required for the trial. This was caused by problems experienced by the supplier in relation to the integration of the hardware and software required to make sure that the sensor will function as designed. These were finally delivered in late July 2018.
The difficulty in identifying a test site which is capable of facilitating the connection of a sensor onto a "live" 11kV overhead line. This is key to ensure that the devices are robust enough to be installed using live line techniques. This will now take place in August once UK Power Networks commissions its Live Line training facility at Frant in Kent.

Due to the above unexpected delays, the devices are not able to be installed in May 2018 as was initially planned. Thus the need to extend the project timescale by 7 months.

Update March 2019

The identification of 15 sites for the live line installation of the 30 trial sensors was successfully completed and all of the sensors were delivered to UK Power Networks for field trial, in line with current project plan. However, following the installation of the first sensors on the live network, some unexpected issues related to the communication and interface with UK Power Networks SCADA were experienced, caused by the software configuration.

The supplier was engaged to update the sensors with right configuration to resolve the issues and a software fix has now been identified; and is ready for deployment. However, following this communication issue, there is not enough time left in the project plan to install and test all of the sensors, for a period of time long enough to gain meaningful results.

As such, UK Power Network proposes to increase the project timescale by 6 months to enable completion of the trial of the 30 sensors at 15 already identified sites and of their testing in real world conditions.

Scale of Project

Small scale trials of the developed system on the overhead line networks in the EPN and SPN licence areas.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

Eastern and South East England.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£534,600

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)

The key savings that could be achieved by deploying this solution are reduced costs associated with undergrounding low hanging conductor lines. Currently, the cost associated with undergrounding lines is approx. £9,000 per 3 spans of line that are undergrounded. Alternatively, UK Power Networks could use Nexans' solution at a cost of approx. £1,600 per site.

When considering a full scale deployment:

- A cost saving is expected to be achieved for sites that would have been undergrounded.
- A reduction in risk of injuries or fatalities could be achieved as more high risk circuits could be monitored (compared to the number of sites that would have been undergrounded).

Please provide a calculation of the expected benefits the Solution

The expected financial benefits at the project scale (3 sites in SPN and EPN) excluding any safety benefits are:

Base cost: £27,000

Based on the assumption that 3 sites (3 spans per site) are undergrounded at a cost of £9,000 each.

Method cost: £5,615

The NPV based on a cost of £1,600 per site, for 3 sites, and including the maintenance cost of £200 per year over the RIIO ED1 period to 2022/23.

Financial Benefits: £21,385 (Base cost - Method cost)

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

We believe that all DNOs are likely to have overhead line sites where the ESQCR risk requires this type of solution.

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

Based on the following assumptions, it is estimated that the roll-out cost to GB would be approximately £6m

- 600 Very high Risk sites across two 2 DNO License areas for UK Power Networks (EPN and SPN).
- Total number of license areas the solution could be deployed to: 13 (excluding LPN).
- Cost of deploying the solution per site: £1,600

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 development and testing of such systems will lead to them being made commercially available to all Network Licensees, who are affected by this common industry wide problem.

Conductors in overhead lines when down/broken generate faults that are sometimes challenging to detect in distribution networks. Traditional methods of detection have been based on some form of zero sequence current detection but this does have limitations, including principally, the impedance of the fault path and the sensitivity of the protection device to detect this type of fault. The project will help UK Power Networks more reliably detect broken or low hanging conductors and hence understand the condition of our assets, improve our fault performance and minimise any associated risk to the general public and other stakeholders caused by such conditions. As well as providing more sensitive electrical detection for broken/downed conductors, the introduction of mechanical sensors at key locations will enhance detection of conditions where there is a sudden change in conductor tension which may be indicative of a broken/downed conductor, or failure of a supporting mechanism where the conductor has not fallen to ground but presents a hazard due to reduced ground clearance.

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.

UK Power Network is not aware of any similar projects which are being undertaken by GB DNOs covered by the NIA or any other outside funding initiative.

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 solution is innovative as the mechanical sensors trialled is not an off-the shelf device and has been designed in collaboration with the supplier to be trialled on the network to test the technology. Where the use of existing protection technology is proven to successfully detect such events, UK Power Networks, as part of this project, seek opportunities as part of this project to develop these technologies further if the expected benefits to its end customers and other DNOs are significantly more. An early prototype unit was developed for testing prior to building more rugged units for site trials. It is necessary to carry out testing of the developed sensors, however it is neither practical nor safe to install an unproven device developed on the live network. Furthermore, highly sensitive sensors will enable an innovative approach towards the detection through implementing greater sensitivity of Sensitive Earth Fault (SEF) settings on existing sites measurements over time using check currents to avoid protection mal-operation. It is believed this innovative technology will help improve safety of our network by detecting low hanging conductors that are likely to cause greater hazard to the general public and other stakeholders.

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 there is no existing off-the shelf solution towards the detection of low hanging conductor without further development to avoid mal-operation of network protection settings, there is a significant piece of development work in this project to develop the sensors. In section 3.2 of the NIA Governance document, the DNOs are encouraged to pursue different types of Methods and Solutions. The development of mechanical sensors, and the associated benefits, are in an area that has not received a great amount of attention from any Innovation stimulus. Due to the risk involved in the project and not fully knowing whether the benefits can be delivered across our licence areas, these activities would not form part of our business as usual activities. In order to progress an innovative project which carries significant risk in implementation, additional innovation funding is required as a stimulus.

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 project can only be undertaken as an innovation pilot given the operational risks associated with the deployment of an unproven solution in network operations. The proposed approach towards the detection of low hanging conductors has an unproven business case, and the range of potential benefits should be tested before it can be deployed. As noted in the NIA guidance, certain projects are speculative in nature and yield uncertain commercial returns. This is the case for this project. There is a commercial risk that the solution developed as part of the project is not adopted by the stakeholders involved following the trial period. This could be due to the fact that the solution has not reach the level of maturity required for business-as-usual application. This risk is being mitigated against through early engagement with stakeholders and ensuring requirements are clearly defined and documented. If the project is successful, it will have proven a number of technical solutions and business processes which will improve network reliability. The specific details regarding the benefits are captured under section 2b of this document.

This project has been approved by a senior member of staff

☑ Yes