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NIA Project Registration and PEA Document

Date of Submission

Sep 2015

Project Reference Number

NIA_ENWL006

Project Registration

Project Title

Sentinel

Project Reference Number

NIA_ENWL006

Project Licensee(s)

Electricity North West

Project Start

September 2015

Project Duration

8 years and 4 months

Nominated Project Contact(s)

Electricity North West Innovation Team

Project Budget

£4,000,000.00

Summary

The fault location equipment will be installed on approximately 10 – 20 HV networks, monitoring faults across the feeders – the precise numbers will be informed by the costs and the need to obtain data to support development. Networks will be chosen based on length of overhead line, earthing arrangement and network topology. Consideration will also be given to those circuits which have a higher incidence of faults. The fault sensing technologies will be integrated into a central dashboard which will display the results from all of the selected sites.

Nominated Contact Email Address(es)

innovation@enwl.co.uk

Problem Being Solved

DNOs have committed to improve customer service for all their stakeholders and Electricity North West's innovation strategy has customer service as a central theme. This includes keeping our customers better informed and offering new services and choice to customers while meeting the demands for improved quality of service. In recent years DNOs have come under scrutiny for their customer service particularly in respect to fault response during storms.

Storms mainly affect the rural areas of our network which are predominantly constructed from long lengths of overhead line with many branches. Traditionally when a fault occurs on a rural network it can be difficult to locate. Fault location on these networks normally involves staff patrolling a line either by foot or vehicle which increases the time to locate and subsequently time to restore supplies. Customers in rural areas affected by prolonged loss of supply could be reluctant to adopt low carbon technologies as this will increase their reliance on the electricity network which they may view as less reliable than those customers in urban areas. As well as impacting the availability of supply these faults can also become a safety hazard if not detected and repaired. Issues associated with broken conductors or pole cross arm connections which can result in conductors dropping onto objects below the line can be particularly hazardous and are sometimes difficult for traditional protection to detect.

In order to improve customer service, particularly to those affected by storm outages, and increase the confidence in the electricity network, we need to investigate alternative methods to assist with identifying the location of faults on overhead networks.

Method(s)

Electricity North West proposes to trial two different techniques for fault location, namely impedance based and voltage gradient. New advanced fault sensing technology which will allow detection of high impedance faults, typically associated with broken conductors, will be developed and deployed.

The two techniques will be trialled on a variety of network types eg radial, meshed, of varying line lengths (including those with sections of cable), resistance earthed, compensation earthing or solidly earthed. This will allow understanding of the performance of the techniques and which technique suits which network type. The Project will also provide a demonstration of how the different systems can be integrated into one central dashboard.

By developing novel fault location sensors which enable earlier detection and response to broken or damaged conductors, this Project will be able to improve the quality of supply for customers who experience weather related outages and improve the safety of the electricity distribution system.

Scope

The fault location equipment will be installed on approximately 10 – 20 HV networks, monitoring faults across the feeders – the precise numbers will be informed by the costs and the need to obtain data to support development. Networks will be chosen based on length of overhead line, earthing arrangement and network topology. Consideration will also be given to those circuits which have a higher incidence of faults.

The fault sensing technologies will be integrated into a central dashboard which will display the results from all of the selected sites.

Objective(s)

- To install a range of fault location equipment expected to cover two main techniques ie impedance based and travelling wave.
- To develop preferred methods for the installation of distance to fault systems including both equipment at the primary substation and distributed devices such as sensors on OHLs etc. This will include an assessment of the preferred location of the sensors and where/how precisely these sensors will be connected to the system.
- To compare and contrast the performance of the different techniques and/or different manufacturers against the different network types. The results of these trials will be used to inform specification and engineering policy for the application of HV distance to fault to UK distribution networks.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

1. Development of functional specifications for fault location technologies
2. Successful deployment of fault location techniques
3. Specification for the integration of results from trial equipment into a central dashboard
4. Verification of the accuracy of the techniques by confirming the fault location
5. Understanding of how each technique works for the different network types

Project Partners and External Funding

Kelvatek

The University of Manchester

Potential for New Learning

New learning will be generated throughout the Project duration.

Sentinel will develop functional specifications for novel distance to fault technologies which can improve DNO efficiency when locating faults and restoring customer supplies.

The trials will also deliver learning about what the optimal installation position of sensors will be for differing network types and topologies and an assessment of the performance of each of the techniques for reliability and accuracy.

Although this Project is aimed at rural networks, the same techniques may eventually be able to be applied to urban and suburban underground networks. This could lead to a much wider deployment in the future and Sentinel will seek to understand the extent to which the learning translates between circuit types.

Learning from this Project will be shared with the network operator community through tried and tested dissemination methods. Key to this will be learning materials and availability of Project personnel at the LCNl conferences in each delivery year and the annual and closedown reports. We will also be available for one to one discussions with interested DNOs.

Scale of Project

The Project is expected to deploy fault sensing equipment on approximately 10 -20 networks. This scale of deployment should allow us to cover all different network types with the different location techniques giving the opportunity for meaningful comparison.

The Project will also deploy a central dashboard to display the results in a manner which aids the central dispatch staff in deploying the right people to the right location.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The equipment will be deployed on networks owned by Electricity North West in those locations most likely to be affected by weather conditions (namely rural and overhead circuits.)

Revenue Allowed for the RIIO Settlement

This Project will develop new technologies to support storm response. No revenue for an equivalent technology was requested or allowed for in the RIIO settlement.

Indicative Total NIA Project Expenditure

£4,000,000

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)

Sentinel has the potential to improve time to restore in both single event and storm event situations. We approximate that this will result in a one hour improvement in time off for customers affected by faults. Initial estimates, looking at the relevant population of HV circuits indicate that for single event situations, savings could be in the region of £5 million per annum.

Please provide a calculation of the expected benefits the Solution

Expected financial benefits occur through improvements in safety, reliability and operational efficiency.

Safety benefits

As well as impacting the availability of supply, faults can also become a safety hazard if not detected and repaired. Issues associated with broken conductors or pole cross arm connections, which can result in conductors dropping onto objects below the line, can be particularly hazardous and are sometimes difficult for traditional protection to detect. One of the benefits of Sentinel is a more targeted response to faults which leads to a reduction in risks to the public associated with overhead line faults.

Reliability base cost calculation

Relevant circuits x average number of customer per circuit x average number of faults per annum x average supply interruption duration (ASID) x value of lost load

Reliability method cost calculation

Uses the same equation as above but the number of faults and the ASID numbers are both reduced.

Operational efficiency

Relevant circuits calculated by reducing, by one hour, the amount of time fault restoration teams spend locating faults. This improvement is cumulative in atypical events such as storms where operational resources are stretched owing to multiple concurrent faults.

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

No technical constraints are expected with application of Sentinel to any network. There is a financial consideration regarding the cost benefit of deployment that will be site specific.

Our initial calculations for a cost benefit assessment, explained above, indicate that Sentinel will have a positive cost benefit case at between 5 and 10% of all GB circuits.

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

To deploy Sentinel on one primary substation in GB will cost approximately £100 000.

This cost includes purchase of the sensor and installation costs, purchase and installation of RTUs for data collection and communications, calculation software and integration of the solution into the network management system of the network operator. In the ENW area we estimate a minimum of 50 sites where Sentinel will have a cost benefit.

Rollout of the Method will benefit from the development work undertaken in Sentinel and efficiencies of scale will be gained. Therefore, it is anticipated that the cost for other DNOs adopting Sentinel will decrease, making replication around 20% cheaper.

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 Project will produce a list of technology types. The list will highlight which network types each piece of equipment is most suited for and the accuracy of the equipment.

The Project will produce the installation procedures associated with each piece of equipment.

The Project will also produce the relevant specifications for the central dashboard that will allow other DNOs to install either as part of their existing systems or as a standalone item.

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 Electricity North West's innovation strategy for RIIO-ED1 has customer service at its heart and includes keeping customers better informed, offering new services and choice to both new and existing customers while meeting the demands for improved quality of service.

Customers in rural areas affected by prolonged loss of supply could be relatively reluctant to adopt low carbon technologies as this will increase their reliance on the electricity network which they may view as less reliable than urban customers.

By improving the fault response times we will be able to increase customer confidence in the electricity industry which may encourage them to purchase low carbon technologies which are heavily reliant on electricity.

- 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.

There have been many projects investigating fault detection and location for LV networks and some small IFI projects investigating either one particular technique or one particular vendor at a small scale for HV networks. This Project is the first to deploy multiple techniques from multiple vendors to allow a comparison to be undertaken with a view to informing the DNO community of the pros and cons of each.

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