Date of Submission

September 2015

NIA Project Registration and PEA Document

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.

Project Registration

Project Title	Project Reference
Sentinel	NIA_ENWL006

Project Licensee(s)	Project Start Date	Project Duration
Electricity North West Limited	Sep 2015	4 Years

Nominated Project Contact(s)	Project Budget
Geraldine Bryson (geraldine.bryson@enwl.co.uk)	£4,000,000

Problem(s)

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.

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

Technology Readiness Level at Start	Technology Readiness Level at Completion
5	8

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 LCNI 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.

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 in 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

Specific Requirements 1

1a. A 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 systems and 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	☐

Specific Requirements 2

2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees ☒

Please answer one of the following:

i) Please explain how the learning that will be generated could be used by relevant Network Licenses.

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.

ii) Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

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.

2b. Is the default IPR position being applied?

Yes	☒
No	☐

If no, please answer i, ii, iii before continuing:

i) Demonstrate how the learning from the Project can be successfully disseminated to Network Licensees and other interested parties

ii) Describe any potential constraints or costs caused or resulting from, the imposed IPR arrangements

iii) Justify why the proposed IPR arrangements provide value for money for customers

2c. Has the Potential to Deliver Net Financial Benefits to Customers ☒

i) Please provide an estimate of the saving if the Problem is solved.

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.

ii) Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost – Method Cost, Against Agreed Baseline).

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.

iii) Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the Method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

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.

iv) 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.

2d. Does Not Lead to Unnecessary Duplication ☒

i) 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.

ii) If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.