

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

Reliable, low-cost earth fault detection for radial OHL systems

Project Reference

NIA_ENWL007

Project Licensee(s)

Electricity North West Limited

Project Start Date

Oct 2015

Project Duration

2 Years

Nominated Project Contact(s)

Daniel Harber (Daniel.Harber@enwl.co.uk)

Project Budget

£350,000

Problem(s)

Rural distribution networks are largely comprised of long overhead lines, controlled via one or more circuit breakers and manually operated line switches, with typically low customer number densities. These networks often represent an operational challenge to network operators owing to the higher-than-average incidence of faults, the large geographic regions they serve, and the reduced availability of network automation. It is therefore imperative that reliable, robust, low-cost solutions are sought to advance the performance of these networks.

This project aims to target how network operators respond to faults, after they occur, by providing fault passage information to control engineers in real-time via SCADA. It builds upon existing architectures, already deployed for underground cable fault detection, using Earth Fault Passage Indicators and extending this functionality to rural OHLs.

Rural circuit configurations often give rise to longer-than-average restoration times during HV faults. This is due to the time it can take to locate the fault using traditional methods and to carry out the switching operations to restore supplies. Locating faults on these overhead networks traditionally involves operational staff patrolling a line on foot or by vehicle. Multiple faults in an area, which can occur during storm conditions, can become extremely resource-intensive and impact the restoration performance considerably.

In order to improve restoration times, DNOs need ways of reliably identifying the fault location with appropriate accuracy thus reducing the time taken to isolate faulty parts of the network. This project is proposing to develop a low cost OHL mounted fault passage sensor that can be deployed at volume on OHL networks.

Method(s)

Electricity North West is proposing to carry out a trial to develop a new low-cost overhead line fault passage indicator (FPI) that will reliably communicate back to the main network management system. These devices will communicate in real time via existing SCADA to allow control engineers to see if fault current has passed specified points on the network, thus significantly reducing the possible number of circuit sections where the fault may be situated. The newly developed FPIs will leverage existing architectures deployed for underground cable systems and will be installed at specified locations on Electricity North West overhead networks, based on a defined site selection methodology. Analysis will then be carried out on the performance of the system, based on monitoring data collected throughout the trial period.

Scope

Prototype overhead line FPI equipment will be installed at approximately 10 sites. Locations will be selected based on a range of factors including performance. The circuit selection will also consider the number of customers, the overall length of overhead line associated with the feeder and considerations towards straightforward installation. Monitoring equipment will need to be installed at the selected sites to gather data to support development of the required algorithms. The FPIs will be integrated via a DNP3 interface into Electricity North West's existing network management system and will be monitored via Nortech's iHost system.

Objective(s)

- To reduce the time taken to locate faults on rural OHL networks
- To develop a method for reliable detection of earth fault and over-current on OHL networks
- Install overhead line fault passage indicators for overcurrent and earth fault detection using live line techniques
- Develop a method of overhead line FPI installation with minimal commissioning and set-up and without need for shutdown (including location methodology and installation method statement)
- Understand the impact of overhead line FPIs on DNO's ability to locate faults more quickly and restore supplies to customers more efficiently

Success Criteria

1. Development of a Technical Engineering Specification for overhead line fault passage indicators
2. Installation and test procedures for overhead line FPIs
3. Communication to central system (iHost) with NMS compatibility via SCADA
4. Validation of overhead line FPI performance (reliable communications, earth fault detection, overcurrent detection)

Technology Readiness Level at Start

5

Technology Readiness Level at Completion

8

Project Partners and External Funding

Nortech Management Limited, providing £50,000 external funding.

Potential for New Learning

New learning will be generated throughout the project including:

- Technical Engineering Specification for overhead line FPIs
- Methodology for selecting the number and location of sites for effective FPI deployment
- Method statements for the installation of overhead line FPIs
- Data collection and analysis to characterise the behaviour of overhead line power flows before, during and after fault conditions

Learning from this project will be shared with the Network Operator community through tried and tested dissemination methods. Electricity North West will make the key learning available via project staff, at the annual LCNI conferences, annual reports and the project close-down report. We will also be available for discussions with interested DNOs.

Scale of Project

This project is expected to deploy overhead line fault passage indicator equipment in approximately 10 locations on Electricity North West 11/6.6kV networks.

This scale of deployment will allow us to cover different network topologies and target locations where the overhead line FPI could be of maximum benefit. These sites will be chosen based on a defined site selection methodology.

Geographical Area

The project will take place in Electricity North West's licence area. Specifically on rural overhead line 11/6.6kV networks.

Revenue Allowed for in the RIIO Settlement

This project aims to trial a new FPI technology for more effective fault response via network switching. No revenue for an equivalent technology was requested or allowed for in the RIIO settlement.

Indicative Total NIA Project Expenditure

300000

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 learning from this project will be relevant for any other Network Operator that is looking to detect faults in overhead line networks. The project will produce a site selection methodology used for targeting overhead line FPI deployment. As all Network Operators have overhead line networks this methodology could be adopted across the UK. The project will also produce a method statement for the installation of overhead line FPIs. This procedure will be relevant to all the other Network Operators.

Technical Engineering Specification will be developed for FPIs that are capable of detecting over-current and earth faults propagating through overhead line networks.

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

Electricity North West's Innovation Strategy has customer service at its heart. Key aspects of this strategy include keeping customers better informed, offering new services and improving quality of service. Customers supplied via HV overhead line networks, which are affected by prolonged loss of supply without this technology deployed, will benefit from ENW's more rapid actions in terms of responding to network faults.

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.

This project has the potential to improve the time taken to restore supplies in both single event and storm event situations. We approximated that this could result in a 20 minute improvement in time off supply for customers affected by OHL faults. Initial estimates, looking at the relevant population of HV circuits indicate that for single event situations, savings could be in the region of £1 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 reliability of rural networks.

It is estimated that use of FPIs on OHL networks could improve post fault location by 20 minutes versus traditional methods. For a typical OHL fault this could result in a reduction of approximately £2000 in IIS penalties and a further £250 in operator costs. More importantly customer satisfaction would be improved, particularly for worst-served customers.

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 are those where the fault restoration teams are able to reduce the time spent in locating faults by up to 20 minutes. This improvement is cumulative during atypical network 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.

As all DNOs have HV overhead line networks, of a similar construction to those in use in Electricity North West, this solution is readily applicable to all UK DNO systems.

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

The BaU target price for the roll-out of the solution across GB is £2000 per site – this includes the procurement and installation of FPI technologies.

2d. Does Not Lead to Unnecessary Duplication



i) Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

At present, a reliable, low-cost, easy-to-install earth fault and overcurrent fault detection system does not exist for HV OHL networks.

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