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

Dec 2015

Project Reference Number

NIA_SSEPD_0023

Project Registration

Project Title

Fault Passage Indicators for Sensitive Earth Faults

Project Reference Number

NIA_SSEPD_0023

Project Licensee(s)

Scottish and Southern Electricity Networks Distribution

Project Start

December 2015

Project Duration

2 years and 4 months

Nominated Project Contact(s)

SSEN Future Networks Team

Project Budget

£256,000.00

Summary

To establish the magnitude of reduction in Customer Minutes Lost (CMLs) achievable by locating SEF faults with a revised FPI supplied by Bowden Brothers and modified to be sensitive to currents as low as 4A through tests at PNDC, field trials and a post-trial evaluation.

Preceding Projects

NIA_SSEN_0037 - Low Voltage – Underground Fault Location Technologies (LV-UFLT)

Third Party Collaborators

Bowdens

Spring Europe

ACUTEST

Nominated Contact Email Address(es)

fnp.pmo@sse.com

Problem Being Solved

Many rural areas of GB are supplied by overhead lines operating at 11,000 to 33,000 volts, these are cheaper to construct and operate than underground cables operating at the same voltage. These overhead lines do not supply customers directly in most cases. They are usually connected to pole mounted transformers which change the voltage to 230v single phase or 400v three phase, for the final supply to customers. The overhead lines are usually operated with a section of line fed via a single circuit breaker at a primary sub station. There are often switching points between adjacent circuits, where the geography allows this thereby allowing

electricity to be re-routed via a different route to avoid faulted sections of overhead line.

Overhead lines are fitted with protection systems which detect faults which may damage the network due to high fault currents, and earth faults which can cause unsafe conditions to occur on the network. In order to detect the lowest earth fault currents, a system known as sensitive earth fault (SEF) protection is used. SEF can detect fault currents of as low as four amps (4A) in some cases which helps to prevent problems with broken wires remaining live on the ground.

In order to locate a fault on an overhead line after the protection system has operated to isolate the faulty section of the network, a number of techniques are used. These techniques range from patrolling of the overhead line by our staff, trying to re-energize the overhead line in a different configuration by opening and closing of air insulated switches and disconnecting links and by deploying fault passage indictors (FPI). These require that the line be re energized and to allow the protection system to operate again in the same way as re configuring the line. However several tests can be carried out at the same time by using more than one fault passage indicator. For many faults FPIs significantly improve the speed at which a DNO can locate a fault and then if feasible restore supplies to customers from alternative routes and then carry out repairs.

However the detection of faults at very low fault currents, as seen when only the SEF protection operates at Primary sub stations, or at pole mounted circuit breakers is not matched by the current generation of fault passage indicators. This means that for some earth faults with low fault current that we can not locate the fault using fault passage indicators. This means that we have to locate the fault by operation of switches and disconnecting links, before re-closing the circuit breaker which originally tripped. In general this results in more interruptions to customers and an increased time to locate a fault, when compared to the time taken to locate faults, where FPIs operate satisfactorily because of higher fault currents. While accounting for only 6% of faults on the SHEPD network SEF faults account for 11.8% of the Customer Interruptions and 8.3% of the Customer Hours lost.

Method(s)

A technical method is proposed and it involves carrying out tests on a revised FPI from Bowden Brothers which has been modified to detect SEF faults down to 4A. The tests will be performed at the Power Networks Demonstration Centre (PNDC) in Cumbernauld to ensure that the revised device has significantly improved sensitivity over our current range of FPIs. A trial of this device will be carried out in one of our Regions for a year to establish if it can successfully reduce the time taken to locate and isolate difficult to find SEF faults.

Scope

To establish the magnitude of reduction in Customer Minutes Lost (CMLs) achievable by locating SEF faults with a revised FPI supplied by Bowden Brothers and modified to be sensitive to currents as low as 4A through tests at PNDC, field trials and a post-trial evaluation.

Objective(s)

1. Determine, from testing, that the revised FPIs successfully meet the required standard
2. Train operational staff in the correct use of the revised FPIs
3. Perform a field trial with trained operational staff
4. Monitor and evaluate the reduction in customer hours lost per Customer affected by an SEF fault in the trial area when compared to previous years.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be successful if we are able to determine the ability of the revised FPI to reduce CMLs due to SEF faults.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The scale of this project is required to ensure that a number of SEF faults are worked upon within the one year field trial phase of the project. From experience, this is likely to number around 50 faults or about one per week. The scale of this project is therefore deemed appropriate for the magnitude of work needed to meet the project objectives.

Technology Readiness at Start

TRL7 Inactive Commissioning

Technology Readiness at End

TRL9 Operations

Geographical Area

Highland Region within SHEPD's licensed network area

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£256,000, 90% (£230,400) of which is allowable NIA expenditure

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)

A Cost-Benefit analysis has been carried out and shows that for Highland Region an estimated average saving in CMLs of 5 minutes per fault will result in a return over RIIO ED1 of £84,645

Please provide a calculation of the expected benefits the Solution

Base cost of faults in one region of SHEPD over RIIO-ED1is estimated to be £84,215,785

For the same region, the method cost would be estimated to be £84,131,000

Financial saving for region = £84,215,785 - £84,131,000 = £84,645

For this calculation SHEPD fault data has been split into the three operational regions with the Highland accounting for approximately 33% of the total number of faults. This means that the potential overall saving for SHEPD will be in the order of £252k in RIIO ED1 if the project is successful

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

The method proposed in this project can be rolled out to any rural distribution HV line where it is necessary to promptly locate and isolate SEF fault currents.

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

The cost of rollout of the method in GB is dependent on the aggregated size of the rural HV overhead line network operating at 11kV and 33kV. Based on the size of SHEPD's rural network which could benefit from this method, the cost of rollout of the method is estimated to be around £300,000. The overall rollout costs in GB are therefore estimated to be proportional to the ratio of the entire GB HV rural overhead line network at the aforementioned voltages to SHEPD's rural network.

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

If the product works then all relevant Network Licensees could make use of this technology to reduce CHLs on their networks.

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.

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

- [x] Yes