WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Date of Submission

Apr 2018

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

LV Sensitive Earth Fault Protection

Project Reference

NIA_WPD_030

Project Licensee(s)

Western Power Distribution

Project Start Date

March 2018

Project Duration

1 year and 3 months

Nominated Project Contact(s)

P Jewell

Project Budget

£166,835

Problem(s)

Although safe methods of working on energized LV feeders have been developed and are common practice across all GB DNOs, they cannot prevent accidental contact between workers and live conductors. Such accidents result in injury and can result in death.

The protection typically applied to the LV distribution network, in the form of LV feeder fuses, provides protection against large currents due to short circuits. The fuses avoid rapid heating and physical disruption of network components. This protection therefore can prevent physical injury of people near network components in the event of a network fault. However this protection is not designed to, and is not able to, respond to the low levels of current caused by accidental human contact, which can deliver a fatal electric shock.

Method(s)

Sensitive Earth Fault Protection for LV Feeders. This would be installed as a temporary retrofit before the commencement of any live working and removed after the work has completed. The additional protection would act to help prevent severe injury or death from inadvertent human contact with a live phase conductor during work on an LV feeder.

The protection device that is required must therefore detect that contact has occurred and remove the supply before severe injury or death occurs. Survival from electric shock is dependent on the magnitude and duration of current flow. Therefore, there might be a useful trade-off between the required sensitivity of detection (and hence false negatives) and the speed of action of a device to remove supply.

It is preferable for the device(s) to be easily fitted and removed in a relatively short time so as not to significantly increase the time typically required to carry out work on an LV feeder.

It is preferable for the fitting and removal of the device(s) to not require any supply interruptions.

Scope

This project aims to develop and prove the efficacy of methods which may be readily applied to the existing system to remove the supply in the event of a dangerous inadvertent contact with a live conductor when live work is being undertaken on the LV distribution system.

A previous, WPD internally funded, project considered the potential application of existing, fast acting LV switching devices to cause an LV feeder to be shorted to earth, hence rupturing the LV fuse and removing the electrical supply from the feeder before the flow of electric current could cause a fatality. It established that a good quality earth connection can readily be made in LV substations, suitable for carrying current from a direct short to earth in the substation and causing the local protection to operate within sufficient time. It also established that the risk of fitting additional protection equipment is lower than the existing risk of live working. That project provides comfort that providing a method to detect accidental contact could be practically achieved, then it should be possible to implement appropriate fast-acting protection.

This project seeks to determine a method which can detect the inadvertent contact and take fast action to remove the supplies and make the situation safe.

The project has been established as a staged programme of work targeted at achieving the project aims in the shortest and most cost-effective manner.

A number of possible approaches have been identified and those which have been judged to have the greatest chance of success will be investigated first. If these do not meet the requirements set out by Western Power Distribution then the project will investigate the other options in order of the lowest to highest estimated cost, complexity and practicality of rollout. Conversely, some elements of the project which are currently within scope will probably be de-scoped as learning from the project improves understanding.

Objectives(s)

The project naturally divides into three workstreams:

A workstream to test alternative methods to detect contact between a human and a live phase conductor, select the preferred option then produce and test a prototype detection device

A workstream to define and test a retrofit device which can act on receipt of a signal to cause mains supply to be quickly removed from an LV feeder.

A workstream to integrate the prototype supply interruption and detection devices and then test them in the field.

Success Criteria

The project will be a success if either of the following conditions are met:

A prototype device or system which can readily be applied to the LV network has been successfully developed which can further improve the safety of live LV working.

It is established that any system which may be developed whilst able to detect contact does not improve the safety of live LV working either by virtue of its application making the overall task more hazardous or being unable to prevent false positives from the detection system leading to unnecessary additional supply interruptions.

Technology Readiness Level at Start

TRL 3

Technology Readiness Level at Completion

TRL 7

Project Partners and External Funding

EA Technology

Potential for New Learning

The means to apply existing technologies, combined in a novel manner, to deliver increased levels of safety of “live line” workers.

Scale of Project

Desk study, trials in a representative environment, trials on one or more LV feeders.

Geographical Area

The project is applicable across all licence areas.

Revenue Allowed for in the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£150,152

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 the GB the Network Licensee must justify repeating it as part of a Project) equipment (including control and communications systems and software)	X
A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)	X
A specific novel operational practice directly related to the operation of the Network Licensee's System	X

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

The project would generate learning which could be used to enable the development of a system which offers improved safety for those staff which are engaged in necessary live working on the underground LV network. Any such system is expected to be equally applicable to other GB DNOs, because of the similarity in design and operation of LV feeders in GB DNOs.

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

The objectives of WPD's innovation are to:

develop new smart techniques that will accommodate increased load and generation at lower costs than conventional reinforcement;

improve performance against one or more of our core goals of safety, customer service, reliability, the environment or cost effectiveness;

ensure solutions are compatible with the existing network;

deliver solutions so that they become business as usual;

provide value for money

ref. WPD Innovation Strategy (2016) section 6.2

This project aims to improve performance against the core safety goal, by seeking to develop a solution which will further improve safety for live LV working which is compatible with the existing network and can become business as usual. The project aims to identify the most cost-effective way of achieving these innovation goals, thereby producing the best value for money solution that can be identified.

This project lies within the innovation development area: Network performance and efficiency: ref. WPD Innovation Strategy (2016) section 6.1.

2b. Is the default IPR position being applied?

Yes	X

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

Yes	X

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

The project does not address delivery of simple financial savings but is rather targeted at exploring the scope to further improve the safety of our employees when undertaking necessary live LV working to maintain supplies to our customers.

Later in the project we will assess benefits against the HSE valuations for injury and fatality.

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).

This is a research project. If successful, it will result in safety benefits but will not deliver financial savings. Later in the project we will assess benefits against the HSE valuations for injury and fatality.

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.

If successful it is likely that the method would be replicable across the GB underground LV network.

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

There are approximately 1000 LV jointing teams in WPD.

Assuming that WPD has 1/3 of GB DNO jointers then we estimate 3000 LV jointing teams in the UK.

Assuming that a BAU solution would cost £1000 per jointing team for detection, communication and actuation equipment then the cost of rolling out the Method across GB would be £3,000,000.

2d. Does not Lead to Unnecessary Duplication

Yes	X

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

No other network licensee is currently undertaking a project of this type under NIA.

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

Additional Governance Requirements

Please identify

that the project is innovative (ie not business as usual) and has an unproven business case where the risk warrants a limited Research and Development or Demonstration Project to demonstrate its effectiveness	X

i) Please identify why the project is innovative and has not been tried before

The nature of the LV network with multiple earthed neutral points and numerous parallel return paths for neutral current diversion makes it difficult to detect low levels of current leakage such as may be caused by accidental human contact leading to a fatal electric shock. The protection typically applied to the LV distribution network in the form of LV feeder fuses serves to provide both phase to phase and phase to earth protection and is not able to respond to the low levels of current which can deliver a fatal electric shock. Existing methods of working are considered sufficiently safe, as judged by the relevant H&S regulatory bodies, however these methods of working cannot prevent accidental contact and consequent electric shocks which could result in death. It is generally believed that current practice represents the highest level of safety that can be economically achieved. The degree of difficulty of creating a Method, which can detect the inadvertent contact of a worker with a live conductor of the LV distribution network and then act to shut down the supply to remove the danger, has hitherto ben regarded as too high. Therefore, increasing the level of safety by these means have not been tried before.

ii) Please identify why the Network Licensee will not fund such a Project as part of its business as usual activities

The probability of successfully creating the method is considered too low to be funded as part of business as usual activities. If successful, then the benefits from the project would accrue to all GB DNOS because, if applied, the method would increase the level of safety of LV network workers within all GB DNOs.

iii) Please identify why the Project can only be undertaken with the support of the NIA, including reference to the specific risks (eg commercial, technical, operational or regulatory) associated with the Project

Commercial: The project benefits would accrue to all GB DNOs and will not result in a financial benefit to WPD. Technical: The degree of difficulty is high and creation of the Method has not, to our knowledge, been attempted before. For these reasons, the project would not be undertaken without support of the NIA.

Approved by senior member of staff