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

Nov 2024

Project Reference Number

NIA_ENWL_037

Project Registration

Project Title

Delta Detect

Project Reference Number

NIA_ENWL_037

Project Licensee(s)

Electricity North West

Project Start

November 2024

Project Duration

2 years and 4 months

Nominated Project Contact(s)

Mike Keddy

Project Budget

£1,150,000.00

Summary

DeltaDetect aim is to leverage the capability of existing LV monitoring devices at secondary substations and extend their functionality to monitor HV underground networks. To do this, existing LV monitoring will be adapted, and an innovative algorithm will be developed to reverse engineer signals from LV side of the transformer onto the HV network. By monitoring critical parameters, the system aims to identify abnormal conditions indicative of faults, such as insulation breakdown or equipment malfunction allowing for faults to be proactively detected, located, and repaired reducing downtime and leading to improved reliability and customer satisfaction.

Third Party Collaborators

Kelvatek

PNDC

University of Strathclyde

Nominated Contact Email Address(es)

innovation@enwl.co.uk

Problem Being Solved

There is an increasing reliance on the electricity network to accommodate low carbon technologies. The reliable and efficient operation of these networks is crucial for ensuring the uninterrupted supply of electricity to consumers. Faults and disturbances can occur, leading to power outages, equipment damage and safety hazards. Predicting, detecting, and locating these faults promptly is essential for minimising downtime, optimising maintenance efforts and improving network resilience. Traditionally, HV network monitoring has relied on costly and complex systems, often requiring extensive infrastructure and specialised equipment which has limited mass deployment on the network.

Method(s)

The project aim is to leverage the capability of existing LV monitoring devices at secondary substations and extend their functionality to monitor HV underground networks. To do this, existing LV monitoring will be adapted, and an innovative algorithm will be developed to reverse engineer signals from LV side of the transformer onto the HV network. By monitoring critical parameters such as voltage, current, power factor and harmonics the system aims to identify abnormal conditions indicative of faults, such as insulation breakdown or equipment malfunction allowing for faults to be proactively detected, located, and repaired reducing downtime and leading to improved reliability and customer satisfaction. The project development will be supported by lab testing and academic research into the modelling of normal network background events to enhance accuracy of fault prediction and detection.

Scope

The project will research into adapting the existing technology to be able to deliver benefits to the 6.6/11 kV ring main circuits.

The research will study how waveforms triggered and recorded by LV monitors on the secondary mains (0.4 kV) network around the ring can be used to help sectionalise the fault.

By predictively sensing faults, providing information on the section this fault is likely to lie in, it provides the DNO with an opportunity to find and effect a repair before any customers are affected.

The project will undertake research into adapting the existing technology and developing suitable algorithms to collect and process HV events. These algorithms would then be tested in a controlled lab trial.

The project is split into three tasks:

1. Research on Voltage dip and swell triggers –investigate novel voltage dip and swell triggers to enhance fault detection capabilities in high voltage underground ring main circuits.

2. Modelling of HV switching events - develop models of existing high voltage switching events and their impact on underground ring main circuits, aiding in fault prediction and localisation.

3. Testing - Conduct testing and validation in a lab to assess their performance under realistic operating conditions.

Objective(s)

The objectives are:

· Enhance reliability and resilience of high voltage underground ring main circuits to ensure uninterrupted energy supply, especially in areas with vulnerable customers.

· Provide a cost-effective solution for monitoring high voltage networks that delivers tangible benefits to consumers and the electricity distribution licensees.

· Conduct research and demonstrate the effectiveness of adapting LV monitoring technology for high voltage networks

Consumer Vulnerability Impact Assessment

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register.

This project has been assessed as having an overall positive impact on consumers in vulnerable situations. The assessment has identified that this project will look to reduce the number of disruptions to them in the home. Other considerations including the projects impact on supply, immediate health and safety in the home have been made in carrying out this assessment.

Success Criteria

· The project delivers a cost-effective solution for monitoring and detecting faulty sections of cable in high voltage underground ring main circuits.

Project Partners and External Funding

- Kelvatek
- University of Strathclyde

- Power Networks Demonstration Centre (PNDC)

Potential for New Learning

This project will generate insights and knowledge that can be utilised by all electricity distribution licensees to enhance network management practices.

Scale of Project

Desktop research project

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

North West England

Revenue Allowed for the RIIO Settlement

£0

Indicative Total NIA Project Expenditure

£1,035,000

Additional time has been needed by project partner, Camlin Energy (formerly Kelvatek), on modelling and simulation to improve the mathematical transformation and mapping between the HV & LV networks. The extraction and preparation of data done to date has proved more onerous and time consuming than planned. The work has also highlighted that additional review cycles will be required to ensure the quality of learning required is maintained. Extending the project timeline will enable subsequent tasks to be completed in full, all project outputs to be delivered, and expected outcomes to be realised.

Project Eligibility Assessment Part 1

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

Not applicable

How the Project has potential to benefit consumer in vulnerable situations:

Enhance reliability and resilience of high voltage underground ring main circuits to ensure uninterrupted energy supply, especially in areas with consumers in vulnerable situations.

The project will provide the following benefits:

1. Improved reliability: by leveraging LV monitoring technology adapted for 11 kV applications, the project aims to detect faults promptly, minimising downtime and ensuring uninterrupted energy supply to consumers, including those in vulnerable situations.2. Enhanced safety: swift fault detection and localisation reduce safety hazards associated with power outages and equipment malfunctions, benefiting all consumers, particularly those who rely heavily on continuous power supply for medical equipment or other essential needs.

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

Not applicable – RIIO-2 project

Please provide a calculation and/or description of the expected benefits of the solution

Not applicable – Research project

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

Not applicable – Research project

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

Not applicable – Research project

Requirement 3 / 1

Involve Research, Development or Demonstration

Projects 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

Involve Research, Development or Demonstration - Please select all that apply

☐ 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

All DNOs could apply the learning to their LV / HV networks to proactively detect and locate faults and improve network resilience for their customers.

N.A.

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. Networks must explicitly mention similar projects that they have considered and how these differ.

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

review of the Smarter Networks portal has shown that there is no other project registered which aims to meet the same objectives as DeltaDetect.

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

This project is the first time the use of LV monitoring to address the challenges of fault detection and localisation in high voltage underground ring main circuits has been investigated. The project addresses technical and operational risks associated with fault detection in high voltage networks, demonstrating the effectiveness of an innovative approach supported by NIA funding.

Relevant Foreground IPR

All data will be shared in line with the Electricity North West data sharing policy as published on our website. (https://www.enwl.co.uk/future-energy/innovation/our-innovation-strategy/our-innovation-data-sharing-policy/)

Data Access Details

Modification and product improvements – enhancing existing LV monitoring technology and enhancing its functionality to predict and detect HV network faults

Please identify why the Network Licensees will not fund the project as a part of it's business and usual activities

The solution is unproven and has a low TRL. Therefore, the innovative nature justifies its necessity beyond business-as-usual activities, highlighting the specific risks and challenges that warrant support from NIA funding.

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

No research has been undertaken into the technical feasibility of using LV acquired signals to accurately predict and detect HV faults and as such it is unproven Using NIA funding allows the solution to be researched effectively and tested in a controlled environment.

This project has been approved by a senior member of staff

☑ Yes