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Bringing energy to your door

NIA ENWL006 Sentinel

Progress Report

31 July 2023

VERSION HISTORY

Version	Date	Author	Status	Comments
V1.0	27/07/2023	Ben Ingham	Final	

REVIEW

Name	Role	Date
Andrew Howard	Innovation Programme Manager	27/07/23
Geraldine Paterson	Innovation Manager	27/07/23

APPROVAL

Name	Role	Date
Victoria Turnham	Head of Network Innovation	30/07/23

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GLOSSARY

Term	Description
HV	High voltage
LV	Low voltage
ICCP	Inter-Control Communication Protocol
NIA	Network Innovation Allowance
OHL	Overhead line
PCB	Printed Circuit Board

1 PROJECT FUNDAMENTALS

Title	Sentinel
Project reference	NIA_ENWL006
Funding licensee(s)	Electricity North West Limited
Project start date	September 2015
Project duration	8 years 3 months
Nominated project contact(s)	innovation@enwl.co.uk

2 PROJECT SCOPE

The fault location equipment will be installed on approximately 10 – 20 high voltage (HV) networks, monitoring faults across the feeders. The precise numbers will be informed by the cost and the need to obtain data to support development. Networks will be chosen based on length of overhead line (OHL), 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.

3 OBJECTIVES

- 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 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 on UK distribution networks.

4 SUCCESS CRITERIA

- Development of functional specifications for fault location technologies
- Successful deployment of fault location techniques
- Specification for the integration of results from trial equipment into a central dashboard
- Verification of the accuracy of the techniques by confirming the fault location
- Understanding of how each technique works for the different network types.

5 PERFORMANCE COMPARED TO THE ORIGINAL PROJECT AIMS, OBJECTIVES AND SUCCESS CRITERIA

The project is on course to meet the original aims, objectives and criteria.

A revised programme of works was introduced to upgrade 5 trial circuits fully (65 units) which was completed in Q2 2021. All modifications were carried out on these units and they have been performing as expected since.

A number of real faults have been detected on the operational trial circuits for which technical reports have been produced. The results have, overall, been very positive with fault locations detected within an acceptable range.

The analysis of these faults has allowed for further refinements providing improved accuracy and learning as to the capability of the Time Domain Reflectometry technology.

The project was extended to develop the following;

- Automatic algorithm for pole location selection
- Improved Commissioning Tools for installation
- Integration into Electricity North West Network Management System (NMS)

Automatic algorithm for pole location selection

Initially pole locations were selected manually based on a simplified set of criteria. As different network configurations and topologies were presented it became apparent that to identify the best locations a more complex and advanced set of criteria was required to provide an optimal cost solution while maximising line coverage. The first version of this complex algorithm was available in May 2022.

Commissioning tools for installation

To aid the installation process tools were developed to carry out system health prechecks prior to installation on the overhead line.

Additionally, a web based application was developed to check operating parameters following energisation of the unit. The application can be used on both computers and phones, allowing the installation team to check that parameters such as voltage, current, communications, battery health and onboard CPU temperature are as expected prior to leaving site.

These tools were available from July 2022 and are being used as part of the ED deployment, which Linesight, which is the brand name for the sensing equipment.

Integration into Electricity North West Network Management System

The calculations to locate a fault following a trigger are performed by the Kelvatek Sentinel server. To ensure that the Electricity North West control room is informed, in real time, of faults detected it is necessary to integrate this Sentinel server with our NMS.

This integration will also provide the Sentinel server with the real time switch status of all switchable devices on the HV network enabling correct identification of fault locations.

Integration requires the development of a new Inter-Control Communication Protocol (ICCP) to provide switch status of telemetered and non-telemetered switching devices from our NMS system to the Kelvatek Sentinel Server.

For the status of non-telemetered devices our NMS provider, Schneider Electric, is required to further develop their software to provide an ICCP adapter which will serve these points.

The original design for this integration has been undergoing revision, primarily to enhance the cyber-security of the links given the changing threat level seen in the UK.

The link required to complete the integration are scheduled to go live by November 2023.

6 REQUIRED MODIFICATIONS TO THE PLANNED APPROACH DURING THE COURSE OF THE PROJECT

There was an issue with voltage measurements which has led to a requirement to upgrade the existing installations. A plan was developed and implemented to change the voltage measurement leads and install a temporary solution for the voltage sensors. Modifications were deployed on 5 circuits to prove effectiveness and the voltage sensor design has been updated to incorporate improvements.

The trial size of the project is ambitious. The work involved in planning outages on the HV system requires significant planning and coordination and involves various parties internal and external and to the main business.

Continuous engagement with the IT and OT teams has been essential to ensure that the architecture in use meets current best practice, especially around cyber-security. The dynamic nature of this space at present has led to an extension of the project being required to accommodate changes to the design.

As there have been changes and an extension to the project there has been an impact on project costs to cover the additional project management and design time. There were also costs associated with the commissioning sets which had not been anticipated when the project was originally scoped.

7 THE OUTCOME OF THE PROJECT

Not applicable.

8 DATA ACCESS

Electricity North West's innovation data sharing policy can be found on our website.

There has been no data collected in the course of this project.

9 FOREGROUND IPR

The project will trial two different techniques for fault location: impedance based and voltage gradient. The fault sensing technology used is an HV application of Kelvatek's existing LV technology hence the IPR will be owned by them. The technology will be made available for purchase from Kelvatek and the method used for the trials will be made available via Electricity North West for others to replicate the project.

10 PLANNED IMPLEMENTATION

Not applicable.

11 OTHER COMMENTS

Not applicable.