Bringing energy to your door

NIA ENWL006 Sentinel

Progress Report

31 July 2021

VERSION HISTORY

Version	Date	Author	Status	Comments
V1.0	12.07.21	Kieran Bailey	Final	

REVIEW

Name	Role	Date
Lucy Eyquem	Innovation PMO Manager	20.07.21
Dan Randles	Head of Innovation	20.07.21

APPROVAL

Name	Role	Date
Steve Cox	Engineering & Technical Director	20.07.21

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GLOSSARY

Term	Description
HV	High voltage
LV	Low voltage
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	7 years 3 months
Nominated project contact(s)	Kieran Bailey (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.

During the installation phase, our partner identified issues with hardware due to exposure to widely varying environmental conditions resulting in the need to upgrade measurement leads and to provide additional equipotential bonding.

Unfortunately, the ongoing pandemic has affected the initial upgrade programme with many landowners refusing access to land.

A revised programme of works was introduced to upgrade 5 circuits fully, with a view to completing the remaining upgrades on the remaining circuits.

As of the end March 2021, 60 upgrades had been completed, with 3 of the trial circuits fully upgraded and operational. The remaining 9 units are planned to be upgraded by end of July 2021, completing the revised interim programme to have 5 circuits completed.

On the 28th February and 7th March 2021 further live tests were carried out to test the signal injection (TDR) and impedance based technologies.

The results of both tests were successful providing accurate fault locations. The lowered line tests carried out on the 7th March has highlighted several areas that require further investigation and development. Understanding the effects of network topology on the signal will be necessary to understand the range of a lowered line detection scheme. This will be achieved through modelling of how the signals interact with the different network topologies. The change in the network response due to a lowered line is much weaker than the changes due to environmental factors. Further work is necessary to develop efficient methods to characterise natural network changes such that a lowered line can be clearly distinguished without causing a high false alarm rate.

Based on testing in March 2021 several improvements to the fault location algorithms and triggering have been identified and these are being introduced into the algorithm.

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.

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

Due to the voltage measurement issues and the need for upgrades a restoration plan has been implemented to change voltage measurement leads and to install the temporary solution to voltage sensors. Modifications will be carried out on 5 circuits before being rolled out across the whole trial network.

7 LESSONS LEARNED FOR FUTURE PROJECTS

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.

With such a ground-breaking project there have been several reasons to revisit many of the sites on several occasions.

For future projects which present such technical and logistical challenges the TRL consideration should be given to a higher level for initial live testing on the high voltage overhead line network. Future projects of this nature should consider the use of the Power Networks Demonstration Centre (PNDC) or similar facilities for initial live robust testing.

8 THE OUTCOME OF THE PROJECT

Not applicable.

9 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.

10 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.

11 PLANNED IMPLEMENTATION

Not applicable.

12 OTHER COMMENTS

Not applicable.