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NIA ENWL006 Sentinel

Progress Report

31 July 2019

VERSION HISTORY

Version	Date	Author	Status	Comments
V1.0	10 June 2019	Kieran Bailey	Final	

REVIEW

Name	Role	Date
Lucy Eyquem	Innovation PMO Manager	03.07.19
Paul Turner	Innovation Manager	26.07.19

APPROVAL

Name	Role	Date
Steve Cox	Engineering & Technical Director	29.07.19

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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	4 years
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

Due to difficulties encountered during the manufacturing stage, design modifications, resource shortages and ability to access private land, the project duration has been extended with completion now being December 2022. The project is on course to meet the original aims, objectives and criteria.

The challenge for Sentinel is to integrate two technologies capable of providing distance to fault locations for low impedance (high current) faults and high impedance (low current) faults. The solution to low impedance faults is mature technology; however, the solution to high impedance faults including identification of low clearance lines is novel and innovative. The challenge is to not only develop the technologies to work independently but also to complement one another.

The first prototype device for high impedance fault identification went into the design and build phase in May 2016. The high impedance fault location system will use a high frequency signal injection method. In order to develop the algorithms, electromagnetic transient studies have been carried out using network data for multiple OHL circuits, typical of the environment/construction in which the devices will be deployed.

Device software has been developed to deliver basic functionality. System software and fault detection/location algorithms concepts have been developed and agreed. These components shall be refined as data becomes available from trials on test and customer networks.

Following the initial trials, design issues were identified with the prototype current sensor. Originally it was intended to use a wireless current sensor however studies showed that there is currently no device available to provide the power requirements. Focus then moved to developing a new Rogowski type current sensor. This progressed as far as prototype but was not approved for operational use and development was put on hold to find an alternative sensor. A current sensor has now been procured and following initial laboratory design and testing within the overall system architecture, a prototype is being developed. Design documentation, drawings and current sensor type test certificates have been issued. It is expected that the design will be approved and ready to be installed by August 2019.

The Sentinel system consists of two installations;

- Voltage only for high frequency signal injection
- Voltage and current for both high frequency signal injection and low impedance based faults

Since December 2018, 19 voltage only sentinel units have been installed onto the live system and these are all reporting back to the Kelvatek server. Analysis is ongoing to identify the operational trigger values for the previously developed algorithms.

The initial analysis has shown that the devices have a reach of approximately 1.5km. This aspect is being developed further, with a target reach of 5km.

The build of the Sentinel units has been affected by the ability of PCB manufacturers to procure components and fabricate the complex digital boards. This has severely impacted the delivery plan.

Resource issues both with the Sentinel build and installation have also resulted in delays. A review of resources has been undertaken resulting in a revised installation plan, with all units installed by Dec 2019.

During the initial installation gaining access on to private land has had its difficulties. This has been due to a range of issues but primarily down to ground conditions, time of year and produce grown.

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

There have been no changes to the planned approach

7 LESSONS LEARNED FOR FUTURE PROJECTS

The project is still in its early stages for purposes of lessons learned.

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.