electricity north west

Bringing energy to your door

NIA ENWL006 Sentinel

Progress Report

31 July 2020

VERSION HISTORY

Version	Date	Author	Status	Comments
V1.0		Kieran Bailey		

REVIEW

Name	Role	Date
Lucy Eyquem	Innovation PMO Manager	23.07.20
Dan Randles	Head of Innovation	29.07.20

APPROVAL

Name	Role	Date
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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.

As of end of March 2020 110 installations have been completed. Following a very wet autumn/winter 2019/2020 followed by COVID19 restrictions, access on to private land has not been possible, resulting in 32 installations being delayed.

Refinement of the algorithms and triggers for identifying faults is ongoing and is very much dependent on fault activity on the trial circuits. Due to the low number of real faults on the trial circuits high voltage, low voltage and low line clearance tests were developed and carried out in November 2019 on a live overhead line network. The results of these initial tests have given a high degree of confidence in the technology, identifying locations of applied HV faults within 200m of the exact fault location. A low line clearance test was carried out by effectively raising the ground plane to simulate a low hanging conductor. The results of this test identified a clear change in electrical characteristics at the exact fault location however this change was only seen by a number of closeup Sentinel units due to what was only a subtle change caused by using a pseudo earth test configuration rather than true earth. Further, more extensive testing is planned for later this year. These tests are being developed at present and will include a real high voltage low conductor scenario.

In January 2020 issues with erroneous voltage measurements were identified on a number of units, several months after installation. Investigations have shown that the voltage measurements were drifting due to;

1. Moisture ingress at the sensor leads, resolved by improving ingress protection around the connectors.
2. Environmental factors affecting voltage measurements, resolved by modifications around the voltage sensor crossarm assembly.

The above issues have impacted the plan and completion of installation. A programme of works is presently underway to upgrade installed systems.

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

Due to the voltage measurement issues highlighted above a restoration plan has been implemented to change voltage measurement leads and apply a design upgrade to the voltage sensor crossarm assembly. Modifications will be carried out on two trial circuits before being rolled out across the whole trial network. Following completion of the first two circuits a period of time will be allowed to monitor and assess stability.

7 LESSONS LEARNED FOR FUTURE PROJECTS

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

With such a ground-breaking project there have been many reasons to revisit many of the sites on a number of occasions. Experience has shown that it would be beneficial to test devices at a subset of locations, ensuring performance of early devices is robust and reliable before rolling out across a wider field trial.

For future projects which present such technical and logistical challenges the TRL should be at 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.