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NIA ENWL007
Reliable, Low Cost Earth Fault Detection for Radial OHL System Faults

NIA Progress Report

31 July 2017

VERSION HISTORY

Version	Date	Author	Status	Comments
v.1	25 May 2017	D Harber Project manager	Final	

REVIEW

Name	Role	Date
L Eyquem	Innovation Programme Assistant	10 July 2017
G Bryson	Innovation Engineer	10 July 2017
P Turner	Innovation Manager	16 July 2017

APPROVAL

Name	Role	Date
Steve Cox	Engineering & Technical Director	20 July 2017

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1 PROJECT BASICS

Project Title	Reliable, Low Cost Earth Fault Detection for Radial OHL System Faults
Project reference	NIA_ENWL007
Funding licensee(s)	Electricity North West Limited
Project start date	July 2016
Project duration	2 years
Nominated project contact(s)	Daniel Harber (Daniel.Harber@enwl.co.uk)

2 SCOPE

Prototype overhead line fault passage indicator (FPI) equipment will be installed at approximately ten sites. Locations will be selected based on a range of factors including performance. The circuit selection will also consider the number of customers, the overall length of overhead line associated with the feeder and considerations towards straightforward installation. Monitoring equipment will need to be installed at the selected sites to gather data to support development of the required algorithms. The FPIs will be integrated via a DNP3 interface into Electricity North West's existing network management system and will be monitored via Nortech's iHost system.

3 OBJECTIVES

- To reduce the time taken to locate faults on rural OHL networks
- To develop a method for reliable detection of earth fault and over-current on OHL networks
- Install overhead line fault passage indicators for over-current and earth fault detection using live line techniques
- Develop a method of overhead line FPI installation with minimal commissioning and set-up and without need for shutdown (including location methodology and installation method statement)
- Understand the impact of overhead line FPIs on a DNO's ability to locate faults more quickly and restore supplies to customers more efficiently.

4 SUCCESS CRITERIA

- Development of a technical engineering specification for overhead line fault passage indicators
- Installation and test procedures for overhead line FPIs

- Communication to central system (iHost) with NMS compatibility via SCADA
- Validation of overhead line FPI performance (reliable communications, earth fault detection, overcurrent detection).

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

In the past year, the project has progressed well such that two of its four success criteria are now fulfilled: (i) Installation and test procedures for overhead line FPIs; and (ii) Communication to central system (iHost) with NMS compatibility via SCADA.

The project is on track to meet its other two success criteria by project closedown.

The method for reliably detecting earth faults and over-current faults has been implemented and utilises sets of three clip-on-the-line sensors (one sensor is installed on each phase of the overhead line). The over-current fault detection method primarily uses high-precision current measurements. The earth-fault detection method uses a combination of current measurements and voltage presence measurements. This allows the overhead line fault passage indicators (OHL FPIs) to differentiate between network switching activities and fault conditions.

The functional requirements specification for overhead line FPIs, which was completed previously, will form the basis of the technical engineering specification.

The technical engineering specification will cover the following:

- Network and operational environment requirements (such as the rated installation voltage, withstand voltage, ingress protection rating and operating temperature range)
- Fault current detection requirements (including earth faults and overcurrent faults)
- Power supply and communications requirements
- Mounting, installation and maintenance requirements
- Design lifetime and availability.

The above criteria were used as the basis for specifying a series of factory and site acceptance tests. The factory acceptance tests were witnessed by Electricity North West in October 2016.

The method for OHL FPI installations has been specified and developed to minimise working-at-height risks, as well as minimising on-site set-up and commissioning requirements. The OHL FPI devices are self-powered, designing out the need for power supplies from pole-mounted transformers. In addition, the installation using live line techniques avoids the need for network shutdowns as part of the installation and commissioning process. In Q1 of 2017, teams from Electricity North West were trained by Nortech on the installation procedure.

Fig 5.1: ENW live line team installing a set of FPI units in Wrightington

The first three sets of units were installed in early May 2017 and Electricity North West is currently quantifying the benefits of locating faults more quickly and restoring supplies to customers more efficiently.

Performance against the other success criteria will be assessed in the final stages of the project.

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

There have been no required modifications to the planned approach.

7 LESSONS LEARNED FOR FUTURE PROJECTS

7.1 Overhead line clamping mechanism

During the installation of the voltage measurement devices, it was observed that an alternative vendor's OHL FPI products travel down the overhead line (about ten metres away from their original installation position).

It is recommended that any clip-on-the-line type sensors are secured in place on the line using DNO approved techniques (such as rubber bundling or conductor clamp). As part of factory acceptance testing, vendors should prove that OHL FPI devices can be securely attached to the line without any damage to the conductor through overtightening.

7.2 Load logging

Initial load logging results from the units installed in the field suggest that the load current could be lower, on average, than the values determined by network modelling packages. An

ancillary benefit of the OHL FPIs could be to inform planning activities, removing uncertainties, through improved visibility of the overhead line network and its relative loading levels.

8 THE OUTCOMES OF THE PROJECT

Not applicable.

9 PLANNED IMPLEMENTATION

Not applicable.

10 OTHER COMMENTS

Not applicable.