Date of Submission

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Project Closedown Report Document

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Project Title

Phase Identification Unit to Assist in Underground Fault Location

Project Reference

NIA SSEN_0032

Funding Licensee(s)

SSEN

Project Start Date

Feb 2018

Project Duration

15 Months

Nominated Project Contact(s)

SSEN NIA Programme Delivery Manager – Joe McNeil

Year

2019

Scope

Phase identification has traditionally been targeted at connections teams to accurately identify the loading and imbalance on low voltage feeders emanating from secondary sub-stations allowing the preferred phase to be identified for new connections.

Similarly, verifying the accuracy of historical records in terms of phase connections has been a primary application of this technology.

Prior to the Project a very limited trial on the distribution low voltage network, identified that these units could accurately identify the phase to which the properties are connected to without entering the households. The unit is set to a reference phase at the appropriate secondary substation and by approaching customers properties the unit can identify if power is present and to which phase the house is connected.

When an open circuit occurs on the Low Voltage Network, establishing which customers are on or off supply is crucial information to the progression of the fault restoration or repair. If customers are not present (e.g. At work, Holiday, asleep or just simply out) and the customers cut out position is inside the house, It can lead to not knowing the customers supply information. This can lead to incorrect assumptions of where the starting point of the fault is. This can Lead to potential unnecessary excavations, impacting on the fault duration, and customer perception.

This functionality will be the basis of the trial in assessing whether the unit can assist with identifying fault zones more accurately. This could improve fault location, reducing excavations and improving restoration times.

Objective(s)

The Objectives of the Trial were: -

- Issue a select number of depot fault location teams with Phase Identification Units
- Initiate training for the teams and develop formal training, process and a procedure
- Evaluate equipment performance over a period of around 9 months in assisting fault location
- Create a robust methodology for attributing benefits to Phase Identification Units
- Acquire data and develop a detailed cost benefits analysis
- Document all results, conclusions and recommendations
- Evaluate project outcomes for possible adoption by BAU

Success Criteria

Several existing fault location technologies have been developed to substantially improve the re-connection of customers to the network at times of interruption due to faults.

However, none of them are 100% accurate in identifying the preferred location for the primary excavation point.

There are two criteria of success; either being achieved will result in a successful project.

1. Opportunities in customer interruptions/customer minutes lost performance improvement.
2. Where specific cut-outs are inaccessible success shall be measured as avoiding direct disturbance to customers to identify the fault location.

If the Phase Identification Unit can assist in the appropriate type of fault to narrow this excavation point to an area between two properties without overtly disturbing the householders or in situations where customers are absent from properties this is hoped to lead to continuing improvement in customer service and reconnection times.

Performance Compared to the Original Project Aims, Objectives and Success Criteria

Issue a select number of depot fault location teams with (PIU) Phase Identification Units – At the beginning of the trial 26 units were procured. 22 were issued to the identified field operatives in the control group in the South Operational Depots. The remaining units were used for training and demonstration purposes within SSEN and UKPN. From reviewing data, it was clear the units issued were being used more than was anticipated and for a wider range of tasks than was originally envisaged. Later in the project there was a redeployment to give other areas visibility and experience of using the PIU's. This objective has been fully achieved.

Initiate training for the teams, then develop process Training – A procedure and process document was developed for the deployment of PIU's. Training was provided by the supplier who also provided ongoing support throughout the project. Feedback from project meetings and workshops enabled processes and procedures to be modified. During the project, SSEN Training group were engaged to help prepare a roll-out training programme for Business as Usual (BAU).

Evaluate equipment performance over a period of around 9 months in assisting fault location including reinforcing further learning – A database was used to capture performance. This enabled BAU proposals. Support and training opportunities for field engineers were also identified through analysing the database entries. Additionally, regular project meetings and workshops identified positive outcomes and issues, enabling improvements.

Create a robust methodology for attributing benefits to Phase Identification Units - Project meetings and workshops identified improvements in methodology. Feedback has been logged along with case studies. This material is being used as part of dissemination.

Acquire data and develop a detailed cost benefits analysis – Data was captured on a database which enabled development of a cost benefit analysis for the BAU proposal.

Evaluate project outcomes for possible adoption by BAU – At this time the project is under consideration for BAU adoption within SSEN. In addition, through engagement, both UKPN and NPG have ordered units to investigate on their network.

Details of how the Project is investigating/solving the issue described in the NIA Project Registration Pro-forma. Details of how the Project is performing/performed relative to its aims, objectives and success criteria.

Required Modifications to the Planned Approach During the Course of the Project

There were no modifications to the planned approach.

The Network Licensee should state any changes to its planned methodology and describe why the planned approach proved to be inappropriate.

Lessons Learnt for Future Projects

Data collection of when the units were being used in the field by operatives was essential to determine the success of the project. This information was also crucial for a positive cost benefit analysis to be produced for BAU adoption.

Data collection at the beginning of the project was reliant on field engineers providing the information either by a phone call or an email sent to the project management team to record the usage of the units and how effective they were. This proved to be problematic and inconsistent mainly due to the demanding nature of field engineers' roles.

A change on how data and feedback was collected from the field was identified. A database developed by the supplier was set up to capture field information when the units where switched on, giving a location and confirmation that the unit was used. The project team could then monitor and create accurate usage reports required for the project.

The initial deployment of the units was mainly localised to one operational region. Whilst this was effective it meant that other operational regions did not have visibility of the project. A more even distribution of the units across all regions then took place.

The successful outcomes of this project have led to a business as usual proposal for a large scale deployment.

Recommendations on how the learning from the Project could be exploited further. This may include recommendations on what form of trialling will be required to move the Method to the next TRL. The Network Licensee should also state if the Project discovered significant problems with the trialled Methods. The Network Licensee should comment on the likelihood that the Method will be deployed on a large scale in future. The Network Licensee should discuss the effectiveness of any Research, Development or Demonstration undertaken.

The Outcomes of the Project

The 'Phase Identification Unit (PIU) to Assist in Underground Fault Location' project concludes that you can use a PIU to help locate underground cable faults. The PIU has proved to be a reliable device with a high level of accuracy. The project has identified that the PIU would be a suitable tool to be used by underground cable jointing teams and front-line Rapid Response Operatives as standard equipment.

The PIU provides an opportunity where customers' supply cannot be restored due to an open circuit fault, the PIU can reduce the overall repair time by identifying the last customer on and the first customer off. In situations where it is not possible to gain access to a residence's cut out this will also help in mitigating a certain number of Guaranteed Standard failures.

Two typical examples of how the PIUs can help manage faults on the network are as follows;

- A low voltage distribution network fault where one of the phase cores within the underground mains cable becomes open circuit. There are multiple customers not present in their properties making it difficult to establish customer supply status. This information is required so decisions can be made by the engineers to progress the fault repairs. Using the PIU can accurately assess the customer supply status enabling engineers to make correct decisions to progress fault repairs. This situation would typically save at least one excavation and reduce the duration of the unplanned outage.

- An opportunity where fused links in link boxes are used to quickly restore supplies on unplanned interruptions involving inter-connected networks. Prior to installing the fuse links the PIU can be used to identify which customers are off supply and phase information. This information can then be used to progress the unplanned interruption as a planned interruption. Excavations would then be carried out in the correct position with minimal number of customers affected when carrying out the planned repair. Again, this situation would typically save at least one excavation and reduce the duration of the unplanned outage.

To maximise the benefits of the PIU, process change would be recommended along with training on how to use the device. Training would also include fault scenarios in which the PIUs would be most beneficial.

The project methodology and improvements made to the PIU took the technical readiness level from TRL 7 to TRL 8

When available, comprehensive details of the Project's outcomes are to be reported. Where quantitative data is available to describe these outcomes, it should be included in the report. Wherever possible, the performance improvement attributable to the Project should be described. If the TRL of the Method has changed as a result of the Project, this should be reported. The Network Licensee should highlight any opportunities for future Projects to develop learning further.

Data Access Details

See Network Innovation Competition (NIC) and Network Innovation Allowance (NIA) Data Sharing Procedure at { HYPERLINK "https://www.ssen.co.uk/InnovationLibrary/Distribution/" }

A description of how any network or consumption data (anonymised where necessary) gathered in the course of the Project can be requested by interested parties. This requirement may be met by including a link to the publicly available data sharing policy.

Foreground IPR

No foreground IPR has been generated by this project.

A description of any foreground IPR that have been developed by the project and how this will be owned.

Planned Implementation

A business proposal has recommended a deployment of PIUs to low voltage network field engineers to be used in fault scenarios where an open circuit has occurred and access to customers' properties is unattainable.

The project has identified an opportunity where temporary restoration via link boxes can be used to restore supplies during unplanned interruptions on inter-connected networks. Prior to temporary restoration the PIU can be used to identify which customers are off supply and phase information. This information can then be used to progress the fault as a planned interruption. Excavations would then be carried out in the correct position with a reduced number of customers affected.

There will also be opportunities to utilize the PIU on unplanned faults on radial circuits. The PIU will provide information for accurate first excavation to provide full repair or a temporary strap to restore supplies.

Training and necessary processes have been identified and will be required to maximise benefits.

Other Comments

Additional learning and non-quantified benefits and opportunities

1. **Network Connectivity Model** – Opportunity to capture, map and confirm customer's phase directly on to our mapping systems.

2. **LV Fuse Replacements** – Confirmation of supplies restored after fuse replacements.

3. **Emergency Cut Out Faults** – One feeder removal required (2/3 IIS savings).

4. **New Connections** – Balancing the Network as we plan and connect new connections

5. **MIGS (Multiple Interruption Guaranteed Standard)** – Confirming right payments are made to customers

6. **Illegal Connections** – Confirm possible theft of electricity effectively and non-evasively

Standards Documents (Electricity projects only)

N/A