Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Feb 2024

Project Reference Number

NIA_SPEN_0091

Project Registration

Project Title

Interconnected HV secondary substation battery monitor

Project Reference Number

NIA_SPEN_0091

Project Licensee(s)

SP Energy Networks Distribution

Project Start

March 2024

Project Duration

2 years and 4 months

Nominated Project Contact(s)

Andrew Moon, Andras Nemeth

Project Budget

£249,950.00

Summary

Multiple times a year in interconnected HV distribution networks, the unit HV zone protection at the nearest upstream secondary substations is not tripping in the event of a network fault, due to faulty batteries. As a result, the upstream HV protection at the primary substation needs to clear the fault, and significantly more customers experience loss of supply than if the unit protection was operating correctly to isolate the fault to a smaller zone. The chance of this occurring can be significantly reduced by remote monitoring of the battery condition which is currently done by a yearly onsite inspection.
A basic automated battery monitoring system is proposed using the currently rolled-out LV Monitors. This system will be able to alert the operators when intervention is required, when the batteries may not be operating as intended, enabling earlier detection of faulty batteries and increasing operational reliability of the protection system in the event of a fault on the network.

Third Party Collaborators

EA Technology

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

Multiple times a year in interconnected HV distribution networks, the unit HV zone protection at the nearest upstream secondary substations is not tripping in the event of a network fault, due to faulty batteries. As a result, the upstream HV protection at the primary substation needs to clear the fault, and many more customers experience loss of supply than if the unit protection was operating correctly to isolate the fault to the minimum necessary zone. This results in significant, avoidable CI/CML occurs resulting in additional Ofgem penalties.

The primary issue is that the status of the batteries at these secondary substations with unit protection in interconnected HV distribution networks (X type secondary substations) are not currently being constantly, remotely monitored. Therefore, no immediate alarms are raised to maintenance personnel when the batteries supplying these HV protection devices are not functioning as intended. As a result, the network operator is unable to identify faulty battery systems before a fault event occurs.

There are no existing remote terminal units (RTUs) in X type secondary substations for the typically used battery monitoring system which would allow to raise alarms through the SCADA network. Currently the condition monitoring of the batteries are done during the yearly substation inspection meaning that a faulty battery could be undetected for up to a year possibly.

An automated battery monitoring system is proposed - without a new standalone dedicated battery management system to avoid introducing additional hardware into the substation in order to keep deployment costs low, and without the use of the typical RTU to avoid the high installation cost of new RTUs.

This system will use the VisNet LV monitors that are currently being installed in secondary substations and will be able to alert the operators when intervention is required, when the batteries may not be operating as intended. This will enable earlier detection of faulty batteries and increase operational reliability of the protection system in the event of a fault on the network.

Method(s)

A basic automated battery monitoring system is proposed - without a new standalone dedicated battery management system to avoid introducing additional hardware into the substation in order to keep deployment costs low, and without the use of the typical RTU to avoid the high installation cost of new RTUs.

This system will be able to alert the operators when intervention is required, when the batteries may not be operating as intended, enabling earlier detection of faulty batteries and increase operational reliability of the protection system in the event of a fault on the network.

Scope

As part of the initial trial, this project will explore how the existing VisNet LV Monitoring Hub (planned to be rolled out as part of RIIO ED2) can be used as the battery system monitor. However, the hardware must be compatible with LV monitoring devices other than the VisNet units (including Eneida's DeepGrid).

Work Package 1 – Feasibility

1 Months | March 2024 - April 2024 | Cost £5,000.00

EA Technology and SP Energy Networks.

Initial cost benefit analysis (CBA)

Confirm the design constraints: Existing batteries, Existing battery chargers, Solkor unit protection.

Other relevant parameters within the X type secondary substation.

Work Package 2 – Detailed Design

1 Months | April 2024 – May 2024 | Cost £10,000.00

EA Technology and SP Energy Networks.

Design and specify the DC interface cable between the battery charger and the VisNet LV Monitoring Hub device.

Confirm possible alarm conditions that capable to be monitored: Impedance, High volts, Low volts, Rectifier fail

Work Package 3 – Lab test

2 Months | May 2024 - June 2024 | Cost £10,000.00

EA Technology and SP Energy Networks.

Manufacture the DC interface cable with existing sample battery chargers, batteries, and VisNet LV Monitoring Hub devices.

Install the battery monitor system on the VisNet device.

Calibrate the VisNet LV Monitoring Hub device to determine the alarm thresholds and battery impedance.

Integrate the measurement outputs into the Detect User Interface.

Test and demonstrate the alarms for all agreed alarm conditions.

Provide training to SPEN staff for device installation.

Work Package 4 – Field Trial

6 Months | July 2024 - February 2025 | Cost £25,000.00

EA Technology and SP Energy Networks.

Field test battery monitoring systems in secondary substations.

Analyze results (monthly)

Summarize results of the trial

Following steps after the project for BAU rollout:

Update CBA according to study findings.

Integrate the outputs into DNO systems (LView, PowerOn DMS, etc.)

Trial other alternative LV monitoring device already installed in secondary substations such as Deepgrid from Eneida.

Objective(s)

1) To deliver a basic battery monitor system that would alert the network when investigation of the battery condition is required.

2) Quick and simple retrofit of the battery monitor system onto existing secondary substations with LV monitors.

3) To avoid installation of new major equipment by using existing devices already installed in the secondary substation (i.e., avoid installing new RTUs).

4) To avoid a single proprietary battery system solution – system concept must be compatible with multiple manufacturer devices, able to be implemented and integrated using more than just one product manufacturer.

5) To trial the system using one particular product.

Document the process for further use.

Consumer Vulnerability Impact Assessment

EA's SIM cards will be used for communication and EA's User Detect interface will be used for data visualization and analysis trial in order to provide isolation between the Battery Condition Monitor and SPEN's network to minimize the chance of any malfunctions caused by the BCM.

Upon successful delivery of the project the consumers should be less vulnerable as the device is aimed to decrease downtime on the network.

Success Criteria

1) 25 trial sites are commissioned as per scope

2) Operations room receives immediate alarms through Detect User Interface upon battery malfunction

3) All battery health data is available for the monitoring period for analysis

4) All required documentation is available for BAU rollout such as installation guide, cable specification

Project Partners and External Funding

Project partners delivering this project are EA Technology, the project will be wholly funded via NIA.

Potential for New Learning

1) Ability to retrofit a basic battery monitor system into existing secondary substations with minor modification works

2) Introduce new battery monitor solution with existing LV Monitors

Scale of Project

1) The project will deliver a small battery monitoring system, able to interface with existing equipment and be quickly retrofit into existing secondary substations.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

This project will cover the SPM Licence areas, where X type substations are used, but can be replicated in any other secondary substation.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£50,000.00

Project Eligibility Assessment Part 1

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

n/a

How the Project has potential to benefit consumer in vulnerable situations:

Delivery of the project will decrease the vulnerability of consumers as the installation of the device will lead to the decrease of downtime. Consequently, consumers will have a more robust and reliable power supply.

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved

N/A

Please provide a calculation and/or description of the expected benefits of the solution

From the historical data of outages caused by malfunction of batteries in X type substations it is estimated that the solution can reduce OFGEM penalties by £206,000 per year in case of a successful BUA implementation leading to an estimated £6.4 million NPV over 25 years.

Please provide an estimate of how replicable the Method is across GB

It will be easily replicable in any secondary substations. It will be the most applicable to secondary substations that currently do not have battery condition monitoring capabilities but have a VisNet LV monitors however the LV monitors can be installed easily in any secondary substations. For SP Manweb to role this out across all X type networks it will cost £2,045,607.

Please provide an outline of the costs of rolling out the Method across GB.

It was estimated in conjunction with EA Technology that a team can install 5 devices per day and a DC interconnector will cost a maximum of £250. In total the installation cost is estimated at £450/device assuming the substation already have an LV monitoring device. Currently we don't have information about the number of installed LV monitors in substations without BCM capabilities.

Requirement 3 / 1

Involve Research, Development or Demonstration

Projects must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☐ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☐ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

Involve Research, Development or Demonstration - Please select all that apply

☑ A specific piece of new equipment (including monitoring, control and communications systems and software)

☑ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☐ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☑ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

Provide a simple battery condition monitoring system without the installation of RTUs

Battery condition monitoring system hardware is designed be compatible with monitoring devices of more than one manufacturer and with any DNO networks.

n/a

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed. Networks must explicitly mention similar projects that they have considered and how these differ.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

It has been confirmed with other DNOs and LV monitor manufacturers that this solution does not exist yet and that there is not a more cost effective solution available on the market that meets all required criteria.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

LV monitors are new to most DNOs, SPEN is currently trialling the first few hundred devices. Consequently, this solution was not viable prior to the installation of the LV monitors. Additionally, traditional radial networks have RTUs in the secondary substations capable of battery condition monitoring so a similar solution is not necessary at those substations.

Relevant Foreground IPR

It was agreed with the project partner that the software update will be available with other VisNet LV monitors and there will not be an IP on the hardware as it is designed to work with any other LV monitoring equipment.

The project report will document the findings of trials of the prototype systems and a functional specification will be produced.

Data Access Details

https://www.spenergynetworks.co.uk/pages/data_sharing_policy.aspx

Please identify why the Network Licensees will not fund the project as a part of it's business and usual activities

This is an unproven technology, which requires significant testing and assessment to minimise risk of operation on the Network.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks (e.g. commercial, technical, operational or regulatory) associated with the project

There are significant technical and operational risks to the solution.

This project has been approved by a senior member of staff

- [x] Yes