

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

Aug 2021

### Project Reference Number

NIA\_SPEN\_0061

## Project Registration

### Project Title

Innovative Replacement for Underground Substations

### Project Reference Number

NIA\_SPEN\_0061

### Project Licensee(s)

SP Energy Networks Distribution

### Project Start

September 2021

### Project Duration

2 years and 2 months

### Nominated Project Contact(s)

Ranit Edgar

### Project Budget

£200,000.00

## Summary

During ED2 SPEN intend to remove 79 legacy UG secondary substations as part of modernisation work. The current proposed baseline solution consists of removing the existing equipment, relocating to the nearest convenient land, and replacing with a standard over ground enclosure.

This project aims to eliminate the identified risk of relocation site suitability/availability. Studies will be carried out to assess the feasibility of combining an innovative transformer design with power electronics.

Innovating the transformer design allows installation at the existing location resulting in potential land cost savings, reduced excavation disruptions/CO2 emissions and protection of green space.

Adoption of power electronics could provide a greater capacity to accommodate new LCTs, a more efficient network through phase/power balancing reducing costs for customers.

### Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

## Problem Being Solved

This project aims to eliminate the identified risk of relocation site suitability/availability. As the substations are (generally) located in built up areas, the closest piece of convenient land suitable for a standard over-ground enclosure can be located very far away. Once a piece of land has been identified the lengthy and potentially expensive process of acquisition could lead to delays and/or delivery exceeding the budget.

## Method(s)

The intended method to solve the problem will be a technical solution. Through studies we will identify and assess the capability of

different power electronic devices (PEDs) that could be used in place of underground transformers. It is intended that the PEDs will occupy the same footprint as the existing underground transformers.

## Scope

Facilitate a full study covering the potential Power Electronic Device (PED) solutions currently used out with the sector, this will include for each identified solution, scope for distribution network applications, including detailed practical requirements and a CBA for each.

From the findings of the study - if proven through the CBA – this project could provide a range of financial benefits for each of the 79 UG Substations the solution is applied too. Immediate savings will come from no land purchase and reduced cable costs (unit cost and civil costs). Over time reduced losses on the network will save money. Furthermore, reduced reinforcement costs in the future as the PED are better equipped to facilitate the expected increase in LCTs.

From an environmental point of view reusing existing locations will protect green space which would otherwise be destroyed/disturbed during the relocation. Reducing the amount of cable required provides a reduction in the CO2 produced from both the manufacturing and civil works.

Stakeholder relations with our customers can also be positively impacted by the reduction in civil works providing the consumer benefit of less disruption to their day to day life.

## Objective(s)

Identify a solution which can be installed in the existing location of UG substation.

Highlight the full range of PED solutions and assess the feasibility of each.

Outline the technical and practical requirements for deployment of innovative PED.

Produce a CBA of proposed PED.

Develop a decision-making procedure to select optimum solution.

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

N/a

## Success Criteria

This project will be viewed as a success if it can clearly demonstrate via a CBA the most cost effective solution(s) to replace UG transformers.

## Project Partners and External Funding

This project will run as a partnership with Cardiff University and TNEI Group who will be carrying out the studies on behalf of SP Energy Networks. TNEI and Cardiff University will be working in collaboration, each completing a set of tasks. Cardiff University will focus on the power electronics solutions and TNEI Ltd will carry out research, complete network studies and submit a final report.

Polaris Diagnostics Ltd will be used as a consultancy to lend technical expertise in the area of power networks and will assist SPEN in the appraisal of the proposed solutions.

There are no other funding partners on this project.

## Potential for New Learning

The potential for identifying a new Business as Usual for substation renovation/replacement. If a solution achieves the objectives as previously stated, the solution could be adopted by more than just the 79 UG substation cases which this project focuses on.

This project also provides an opportunity to trial 'smarter' secondary substations to practically assess the benefits of PEDs.

## Scale of Project

The scale of the project is currently bounded to desktop studies.

The study itself will only consider a handful of sites in depth. Therefore, the potential benefits are large in comparison to the investment being made at this stage.

## Technology Readiness at Start

TRL3 Proof of Concept

## Technology Readiness at End

TRL5 Pilot Scale

## Geographical Area

The project will take place within SP Distribution, in particular Ayrshire district.

## Revenue Allowed for the RIIO Settlement

There is no revenue allowed at the current RIIO settlement.

## Indicative Total NIA Project Expenditure

£200,000 reclaimed through RIIO1.

## Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

### Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

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:

N/a

### 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 (RIIO-1 projects only)

This will be determined as part of the CBAs for the solutions considered as part of the project.

#### Please provide a calculation of the expected benefits the Solution

This is a research project therefore this is not required.

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

The work may be applicable to any licensee across GB who are looking to replace underground substations or find innovative alternatives to secondary substations.

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

These will be determined as part of the CBAs for the solutions considered as part of the project.

### Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project 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

RIIO-2 Projects

- 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

The project is expecting to generate learning that can be disseminated to all relevant network licensees in the area of underground substation management and best practice in asset management. This learning will be shared with the GB licensees via conferences and best practice fora.

### Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

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.

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

A search was conducted on the smarter networks portal and no other projects investigating underground substation replacements were found.

### 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

Underground substations are approximately 50 years old and there has been no initiative to replace them previously. Faults identified recently and with uptake of PVs, ASHPs and EVs there is need to address underground substations. While our ED-2 plan identifies these substations and includes allowance for decommissioning and relocation of 79 substations, it is not always viable to relocate them. Therefore, a research is being carried out to identify other available solutions.

### Relevant Foreground IPR

Through this project, foreground IPR on topology and control algorithm of the proposed PED solution will be potentially developed.

### Data Access Details

Access to data must be requested by contacting SPInnovation@spenergynetworks.com or the project contact.

Please provide the following information in your request:

Affiliation, position and contact details of requesting party

Relevant project and type of data required

Reasons for requesting this data and evidence that this data will be used in the interest of the UK network electricity customers

How data will be shared internally and externally by the requesting party

Any data request deemed unsuitable for sharing will be highlighted to the appropriate requesting party. After receiving the request, we will provide the estimated date for completing the data provision based on other requests and our team workload at that time. All requested data remains the property of SP Energy Networks.

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

Alternative underground substation replacement methods based on PEDs have no proven business case and therefore SPEN will not fund as a part of our business as usual activities.

**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**

Without NIA funding the commercial risk associated with the trial could not be borne by the business. This is the reason for the required support of the NIA fund.

**This project has been approved by a senior member of staff**

Yes