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

May 2021

Project Reference Number

NIA_UKPN0074

Project Registration

Project Title

LV Interconnected Pairs

Project Reference Number

NIA_UKPN0074

Project Licensee(s)

UK Power Networks

Project Start

May 2021

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Rona Mitchell, Robert Maxted, Geoff Polley

Project Budget

£661,000.00

Summary

Electricity networks contain equipment that operates at different voltage levels. Domestic customers are fed from the low voltage (LV) network. The LV network is fed from the high voltage (HV) network. The HV network is fed from the extra high voltage (EHV) network, and so on. When a fault occurs on the HV network, there is a cascading impact to the LV network that it feeds.

In more modern parts of the network, automation is used to prevent an LV outage when there is a HV fault. However, a large proportion of the LV network does not have any automation.

For the majority of LV networks, when a HV fault occurs, the LV network fed from the affected substation loses supply. This means that all customers fed from that substation experience a power cut.

Nominated Contact Email Address(es)

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Problem Being Solved

To minimise disruption to customers in urban areas, the existing approach is to restore the LV network before attending to the HV fault. To restore the LV network, field engineers attend the affected site and restore supplies manually by applying LV backfeeds.

The problem this project aims to solve is that HV faults impact a large number of customers, and areas without network automation are resource-intensive to restore quickly. This solution is only applicable to parts of the network where LV backfeeds are possible. The

interconnected pairs method is not suitable for deployment in more rural parts of the network.

Method(s)

Base Case:

- If a HV fault impacts a distribution substation with automation, supplies will automatically be restored. This is very quick.

- If a HV fault impacts a distribution substation without automation, supplies cannot be restored until field staff manually apply backfeeds, if possible.

Method description:

A distribution substation with automation is connected to a distribution substation without any automation. These become an 'interconnected pair', where the substation with automation is the 'donor' and the substation without automation is the 'receiver'. The 'receiver' substation is then able to benefit from the automation at the 'donor' substation.

A sequential explanation of the method:

· Interconnect a remotely-controlled and non-remotely-controlled substation to form an Interconnected Pair;

· In normal operation, the donor and receiver would not be interconnected;

· When a HV fault occurs, a modified software within the network automation would open a switch at the receiver substation to interconnect the donor and receiver before re-energising; and

· Both substations would then be energised.

Network automation takes less than five minutes to acknowledge a fault and take action. This method would reduce the time in which customers connected to the LV network experience a loss of supply in the event of a HV fault.

Scope

The scope of the project is to complete the design and trial of the 'interconnected pairs' methodology. The trial will cover up to a maximum of 30 pairs of secondary substations, spread across the LPN licence area, out of a total of 300 pairs of secondary substations that could benefit from this method. The preliminary design will also consider how many potential sites would benefit from this technology across the EPN and SPN regions. LPN was chosen for the trial project as it already has a high level of interconnection. This will make it quicker and easier to install the Interconnected Pairs method.

This project will be carried out across several work phases.

Phase 1: Preliminary design and specification

Phase 2: Detailed design

[f the first 2 phases are successful, the project will proceed to a trial]

Phase 3: Installation of equipment & trial
Phase 4: Project closedown

Objective(s)

- To understand whether or not the Interconnected Pairs method can be used to reduce customer interruptions in a more cost effective manner than installing stand-alone automation at more substations.

- To produce an initial scheme design that passes internal design review.

- Once the initial scheme design is approved, produce a detailed design which will define how and what is needed to make this

method successful.

- If detailed design is approved, to trial the method at one pair of sites. If successful, trial at a further 29 pairs of sites.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

N/A

Success Criteria

The project will be considered a success if sufficient development and learning takes place to understand whether the Interconnected Pairs method is appropriate for roll out to business as usual.

Whilst specific success criteria will be designed as part of the project, they will be based on:

- Difficulty of installing and maintaining the interconnected pairs method;
- Cost of implementing and maintaining the method;
- The impact of any dis-benefits as a result of the method;
- Confirming the safety of the method; and
- The operability of the method must be such that it does not add unnecessary complexity to network operation.

Project Partners and External Funding

This project will involve working with our incumbent automation provider to modify the automation and control system to support this new approach.

Potential for New Learning

The project closedown report will share learnings.

New learning is likely to include:

- Greater understanding of how automation can be used to support LV network operation; and
- How secondary substations can be retrofitted for successful network automation without a complete replacement of equipment, as per the current approach.

Scale of Project

The scale of the project is to complete a detailed design, implement the design and then test and trial at a maximum of 30 sites. This represents about 10% of the total number of sites we believe this method can be implemented to within the LPN licence area of UK Power Networks. Reducing the trial site quantity would increase the risk of the project by not being able to monitor and compare the savings, efficiency and impact of the method on the network. Including 30 sites in the trial also means that if issues arise at one site, the trial can still continue with enough sites to conclude the trial and document findings/results.

The LPN network has a high level of interconnection, which is why it was chosen as the trial site for this project.

The best type of network to install interconnected pairs is where there is a pre-existing cable linking two secondary substations. There is no technical reason why the solution would be less effective at a site without pre-existing cable interconnection. The benefit is that the overall solution will be cheaper to install if cable installation is not required. Therefore, the overall cost-benefit-analysis is better for two substations with an existing cable interconnection.

Technology Readiness at Start

Technology Readiness at End

TRL7 Inactive Commissioning	TRL9 Operations

Geographical Area

The trial will be undertaken in the LPN licence area of UK Power Networks. If successful, the technology could be rolled out to different parts of the UK Power Networks regions, and other DNOs. Within UKPN, there are approximately 1,000 substations that c

Revenue Allowed for the RIIO Settlement

There is no revenue in the ED1 settlement for taking advantage of interconnection to provide enhanced support to LV networks in the instance of HV faults.

Indicative Total NIA Project Expenditure

This project has no other external funding, therefore NIA expenditure = 90% x £661k = £594.9k.

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)

Although field staff will still be required to attend the initial HV fault, cost savings will arise from LV supplies being automatically restored by the method and therefore manual linking, fusing, switching activities will not have to take place on the network before the HV fault is investigated.

Please provide a calculation of the expected benefits the Solution

With the introduction of LV Interconnected Pairs, restoration times to those affected on the LV network will be reduced due to enhanced automation.

Gross financial benefit if all eligible substations received interconnected pairs technology: £1.75m per year

This is made up of CI and CML benefits.

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[benefit per substation = HV fault rate x customers per substation x time that automation would save]

On average, we estimate that it takes 90 minutes to apply a backfeed.

The potential benefits across LPN, EPN and SPN are technically the same. The actual benefits will vary on a case by case basis based on network behaviour, such as where HV faults occur. This is analogous to the benefits from the Automated Power Restoration Software, which are reported each year in the E6 submission. See page 27 onwards in this document for more information on APRS: http://library.ukpowernetworks.co.uk/library/en/EnvReports201617/Environment%20and%20Innovation%202016-17%20Commentary_Final.pdf

Assumptions for Base Cost.

For the base cost it is assumed that no additional equipment used and that normal business operation continues. Base cost = £530k

Assumptions for Method Cost.

The cost per site to implement this procedure is estimated to be £8k.

Assume all site installations take place in 2022

Method cost= £240k

Net financial benefit until the end of ED2 = £290k

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

The introduction of LV Interconnected Pairs is replicable to all non-remotely controlled substations within a radial circuit in reasonably close proximity to a remotely controlled substation. Within UK Power Networks, there are approximately 1,000 substations where this could be rolled out. Of these, 50% are 'easy' to implement, and 50% are more difficult.

The 'easy' sites to implement are ones where there is already a cable connecting it to another substation. This means that the 'donor' and 'receiver' substation are already connected, and therefore no groundworks would be required to establish the Interconnected Pair.

Other sites which require an interconnecting cable to be laid could still benefit from the Interconnected Pairs method, but the costs to implement would be higher.

It is expected that a similar number of substations could benefit from this technology across other DNOs.

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

The roll out costs will be made of:

- Procuring and installing a remote terminal unit and appropriate modifications at the donor substation.
- Laying an interconnecting cable if one does not already exist.
- The estimated cost for implementing this method per site is £8k. (This is assuming automation scripts have already been completed).

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

Successful implementation of the LV Interconnected pairs method within the LPN licence area of UK Power Networks will provide useful learning for the EPN and SPN licence areas of UK Power Networks and will be appropriate for other DNOs. These learnings will include the hardware and software technical specifications for an interconnected pairs regime.

Learnings around LV Interconnected Pairs and the detailed design and successful implementation of this design could lead to network reliability improvements for all DNOs.

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.

We are not aware of another DNO with a similar application.

After extensive research on the ENA Smarter Networks portal we are confident that no unnecessary duplication will occur in this project.

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

To our knowledge there are no other networks in GB that have investigated or researched this method. This project has not been tried at UK Power Networks before because:

- Our journey with network automation started at the higher voltages. This is consistent with the approach from other networks in the UK and internationally

- Now that this has been established, developing innovative automation approaches to the LV is an area of interest

- The remote terminal unit modifications required to implement the method are innovative and have not previously been attempted

Relevant Foreground IPR

This Section is not to be completed until we receive IPR guidelines from Ofgem

Data Access Details

N/A

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

There is risk associated with developing and testing a new method for network use. Developing and designing the LV Interconnected Pairs method is an innovative activity that is beyond the business as usual activities of UK Power Networks due to the modifications required for both network automation and the protection equipment located on site.

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

The project can only be undertaken as an innovation pilot given the operational risks associated with the deployment of an unproven solution on the network.

As noted in the NIA guidance, certain projects are speculative in nature and yield uncertain commercial returns. This is the case for with this project, as there is a commercial risk that the solution developed, as part of the project is not adopted by the stakeholders involved following the trial period. This could be due to the fact that the solution has not reached the level of maturity required for business-as-usual application or that the benefits are not as strong as forecasted. This risk is being mitigated against, through early engagement with stakeholders and ensuring requirements are clearly defined and documented. If the project is successful, it will produce a strong technical solution, which will lead to customer benefits. The specific details regarding the benefits are captured under section 2b of this document.

This project has been approved by a senior member of staff

☑ Yes