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# NIA Project Registration and PEA Document

### Date of Submission

Mar 2019

### Project Reference Number

NIA_UKPN0048

## Project Registration

### Project Title

Unified Protection

### Project Reference Number

NIA_UKPN0048

### Project Licensee(s)

UK Power Networks

### Project Start

April 2019

### Project Duration

2 years and 11 months

### Nominated Project Contact(s)

Colin Scoble, John Moutafidis

### Project Budget

£765,254.00

### Summary

The network is becoming increasingly complex and there is not enough certainty of what functions may be required or even available in the future for protection to meet changing network topologies.
DNOs are often required to extend busbars and modify protection schemes for new connections and load growth projects. However current relay replacement programmes miss opportunities for the implementation of advanced protection functions, due to the trend of implementing a like-for-like replacement strategy. When replacement programs are undertaken, existing equipment is replaced with similar relays to avoid additional work for hardware modification associated with functionality enhancement. There are also multiple IEDs (Intelligent Electronic Devices) being installed on the network such as protection relays, RTUs (Remote Terminal Units), power quality meters, disturbance recorders which means multiple tools from multiple vendors need to be maintained by the field staff, creating a large training and familiarisation burden for the business.
This project will trial a new substation centralised protection system. The project method will verify and validate the use of this system for the protection of future substations. The learning generated will enable UK Power Networks and other DNOs to develop and demonstrate control functions based on such equipment in other future projects, including our proposed NIC project “Constellation”. Instead of having local protection relays on each substation bay, a central system will be used within a substation. This system can be modified and upgraded via software and does not require new plant for the introduction of new functions or bays. There is a limit to the number of bays that a single device can support, so the system cannot be expanded indefinitely. For the purpose of the trial demonstration, the system will be installed in parallel to the existing protection scheme. It will receive measurements but the trip signals will not be connected to the switchgear. Monthly visits will be scheduled to the substation to retrieve data, analyse and compare with existing protection performance by protection experts from the technical standards team. The financial results from installation and commissioning will also provide useful information for the financial case for the device adoption. Additionally, modern standard designs adhering to IEC 61850 will be produced in order transfer the learnings from the project and subsequently facilitate a wider supplier procurement event.

### Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

## Problem Being Solved

The network is becoming increasingly complex and there is not enough certainty of what functions may be required or even available in the future for protection to meet changing network topologies.
DNOs are often required to extend busbars and modify protection schemes for new connections and load growth projects. However current relay replacement programmes miss opportunities for the implementation of advanced protection functions, due to the trend of implementing a like-for-like replacement strategy. When replacement programs are undertaken, existing equipment is replaced with similar relays to avoid additional work for hardware modification associated with functionality enhancement. There are also multiple IEDs (Intelligent Electronic Devices) being installed on the network such as protection relays, RTUs (Remote Terminal Units), power quality meters, disturbance recorders which means multiple tools from multiple vendors need to be maintained by the field staff, creating a large training and familiarisation burden for the business.

## Method(s)

This project will trial a new substation centralised protection system. The project method will verify and validate the use of this system for the protection of future substations. Additionally, the future requirements of distribution substations will be developed and aligned with the wider DSO strategy as part of this project.
Instead of having local protection relays on each substation bay, a central system will be used within a substation. This system can be modified and upgraded via software and does not require new plant for the introduction of new functions or bays. There is a limit to the number of bays that a single device can support, so the system cannot be expanded indefinitely. For the purpose of the trial demonstration, the system will be installed in parallel to the existing protection scheme. It will receive measurements but the trip signals will not be connected to the switchgear. Monthly visits will be scheduled to the substation to retrieve data, analyse and compare with existing protection performance by protection experts from the technical standards team. The financial results from installation and commissioning will also provide useful information for the financial case for the device adoption. Additionally, modern standard designs adhering to IEC 61850 will be produced in order transfer the learnings from the project and subsequently facilitate a wider supplier procurement event.

Edit March 2021:
A 12 month time extension was applied to the project extending it to March 2022. This will allow the project to fulfil one of its initial objectives, to analyse the performance of the new protection system under trial. The number of faults during the trial period originally planned was not sufficient to conduct analysis but the extension covers winter 2021/22 where we expect enough faults will occur. This will also give opportunity for more knowledge sharing with the industry. There will be no change to the overall cost of the project.

## Scope

This methodology of a substation centralised protection system, based on the international standard IEC 61850, has not been previously trialled. The project's success will be determined by the delivery of the following:

1. Design IEC 61850 protection specifications and templates for the centralised solution of a typical substation with a single busbar, two transformer primary site;

2. Identify a suitable trial substation;

3. Install and monitor performance of the ABB SSC600 and ABB REF615 merging units on a trial substation;

4. Prove interoperability of other vendor merging units with ABB SSC600;

5. Prove interoperability of ABB REF615 with GE Central Unit, provided that GE release their product this year;

6. Benchmark engineering efficiencies and holistic costs of existing protection relays solution with the new central unit concept; and

7. Develop roadmap and plans of follow on work.

## Objective(s)

1. Analyse reliability, availability and cost-efficiency of a new protection philosophy that relies on a central unit with multi-functions instead of a traditional multiple single-function IEDs

2. Production of specifications
3. Procurement of multi-vendor solutions based on specifications outputs from this project
4. Run workshops demonstrating the Centralised system to key stakeholders; Engineering Design, Commissioning teams, Operational teams
5. Generate learning to inform industry.

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

n/a

## Success Criteria

The success of the project is based on the successful testing of centralised protection device and the captrure of learning and knowledge generated. In order for the technology to be adopted as BAU, the new method should perform equal or better than the current protection schemes based on the analysis of operation logs retrieved from the trialled devices, compared to the ones retrieved from conventional equipment. The project should provide the necessary evidence to make the decision. Regardless of the performance of the new technology, the project will provide invaluable learnings for future projects and support the transition to digitalised substations.
The financial results from installation and commissioning will also provide useful information for the financial case for the device adoption. This is a first of its kind installation for UK Power Networks, so the installation and commissioning costs are based on assumptions of required labour. The project will provide solid understanding of these costs for future reference.
Additionally, modern standard designs for according to IEC 61850 standard will be produced in order to take the learning from the project and go to a wider supplier procurement event.

## Project Partners and External Funding

n/a

## Potential for New Learning

- The standards team will be continuously involved in the development and will champion knowledge sharing in the future.
- Training material will be produced at the end of the project. Workshops will be run to share knowledge
- We will proactively share learning with other DNOs. The project Lead participates in the appropriate ENA panels and therefore will keep other DNOs informed about the project
- Learning will be shared through the Annual project reviews and also all innovation events run by UK Power Networks
- Finally, all the learning generated by the trial and the skills acquired by the engineers involved will be used in the future to expand functionality usage beyond protection to localised control and other smart functions. As more functionality is added to the devices provided by the market, further innovation projects will be made possible to extract more value out the same equipment.

## Scale of Project

The project will trial the minimum possible scale of the device which is a single busbar substation while providing all the necessary background knowledge and standardisation work.

## Technology Readiness at Start

TRL4 Bench Scale Research

## Technology Readiness at End

TRL7 Inactive Commissioning

## Geographical Area

In the area covered by South Eastern Power Networks.

## Revenue Allowed for the RIIO Settlement

The project ends at the start of 2021 therefore there is not much time left in RIIO-ED1 to deliver benefits. A high level analysis indicates that the forecasted savings are £270k for the RIIO-ED1 period.

## Indicative Total NIA Project Expenditure

£765,254

# 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)

The new protection system method could save approximately £100k each time it is deployed. Based on the pace of replacement programs for the first years of RIIO-ED1 and discussions with subject matter experts, we made a hypothesis that the proposed solution can be deployed two times a year initially and scale up to five. As such the method could provide a saving of £200-500k in future value per year. This does not cover some of the intangible benefits which are:

- Less labour to install and test means less time on site so safer way to deliver work;
- Easier to upgrade protection for new connections;
- Having a futureproof system removes the need for replacement programs; and
- Less engineering time needed because of using international standardised solutions.

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

Base Cost = £205k Method Cost = £105k

The full extent of benefits is not easy to evaluate at this point in time. Some of the benefits provided are based on the ability to expand, which is triggered by new connections. Additionally as the device functionality increases it should be able to replace more of the current functions and claim more benefits for the same investment.

At the end of the project, the RIIO-ED1 price control will be in its final two years. A slower adoption of one site per year has been assumed, until more engineers are trained and competent in the usage of this new system. Therefore the discounted net present value for the two use cases in RIIO-ED1 is £200k . As the solution gets wider adoption and becomes business as usual in RIIO-ED2, the savings are expected to increase.

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

The solution is replicable across all GB. As this is a very innovative method for substation protection, an area traditionally resistant to change, we forecast slow adoption until wider confidence is built in the system. Moreover, protection suppliers will need to produce similar solutions so the commercial market is healthy and competitive. We can assume an initial 10% adoption or one to two

applications per DNO. Eventually if the system is proven and stakeholder are satisfied, it could be widely adopted.
A conservative estimate is that one in four substation installations could potentially use the new method being trailled in this project.
Based on information from RIGS tables there could be 16 commissioned systems per year.

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

The solution package has an approximate cost of £60-70k. The other costs include design, installation, testing and commissioning as well as equipment costs. They are specific to each DNO so it would be difficult to make assumptions for GB wide deployment. Depending on the pace of adoption, the costs will vary. Based on the assumption that about 16 systems could be commissioned annually, the total cost would be about £960k to £1120k. This solution is replacing other material costs so the net amount will be positive.

### 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

We will share the results of the trials so other Network Licenses can develop the confidence to use the system in their network. Other Network Licenses can then use the same solution in their protection replacement programs to reduce engineering costs and materials.

### 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

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

### 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.

The proposed solution will be the first in GB, and very likely first in the world. Besides a trial project of a prototype in Finland, we are not aware of another use case worldwide.

### 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

While there were trials of centralised protection systems in the past in GB, they all used proprietary systems. The device that will be trialled in this project is based on the international standard IEC 61850 which will enable DNOs to competitively procure a system at the end of this project. This is the first product avaialbe globally combining a centralised protection system with IEC61850. Only one trial of this device's early prototype where the software part of the solution was loaded on a market available "physical device" has been undertaken in a pilot project by a Finnish DNO. A visit to the site of trial was made where the prototype was shown by the Finnish DNO engineers. However the development of the product has progressed so there are considerable differences, including that now an actual purposed made industrial computer is used for the device. We will be the first in the world to trial this system with the hardware and physical device specifically designed for this solution.

### Relevant Foreground IPR

n/a

### 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

The risk of using such a device is considerable, new engineering knowledge, new tools to test equipment, new methodologies are needed. Therefore such a trial would not be feasible as a business as usual activity. Additionally the project will help identify and quantify other benefits that seem intangible at the moment which makes the initial business difficult to fit to the risk profile of the business. Due to the risk involved in the project and not fully knowing whether the benefits can be delivered across our licence areas, these activities would not form part of our business as usual activities. In order to progress an innovative project which carries significant risk in implementation, additional innovation funding is required as a stimulus.

### 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 as explained above poses commercial challenges due considerable part of the benefits (engineering time reduction, standardisation, wiring time reduction etc.) being intangible at the moment. Moreover there are considerable technical challenges and lack of knowledge within the business about IEC 61850 that requires funding for training and equipment. The project can only be undertaken as an innovation pilot given the operational risks associated with the deployment of an unproven solution in network operations. 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. 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. 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 have proven a number of technical solutions and business processes which will improve customer service.

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

☑ Yes