NIA Project Registration and PEA Document

Date of Submission

Jan 2021

Project Reference Number

NIA_UKPN0071

Project Registration

Project Title

Smart Cable Guard

Project Reference Number

NIA_UKPN0071

Project Licensee(s)

UK Power Networks

Project Start

February 2021

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Michael Quinn

Project Budget

£435,281.00

Summary

At present UK Power Networks (UKPN) are observing approximately 1,900 underground high voltage HV (HV) cable failures per year, across 45,000 km of HV cables. This requires a large expenditure on unscheduled repairs. There is currently no solution in the UK that allows online monitoring of Partial Discharge (PD) of HV cables as well as locating a fault or incipient faults further than the first leg of the feeder. There are a number of solutions which look at PD from the Primary substation however these only measure the first leg out of a feeder and they also require further location to find the exact location of the fault or PD.

Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

Problem Being Solved

At present UK Power Networks (UKPN) are observing approximately 1,900 underground high voltage HV (HV) cable failures per year, across 45,000 km of HV cables. This requires a large expenditure on unscheduled repairs. There is currently no solution in the UK that allows online monitoring of Partial Discharge (PD) of HV cables as well as locating a fault or incipient faults further than the first leg of the feeder. There are a number of solutions which look at PD from the Primary substation however these only measure the first leg out of a feeder and they also require further location to find the exact location of the fault or PD.

Method(s)

The method being explored by this project will be to trial the Smart Cable Guard (SCG) equipment manufactured by DNVGL. SCG aims to detect and locates PD that occurs because of weak spots in the cable insulation or joints. Weak spots in the cable generating PD are in most cases an indication of an eventual failure.

SCG may detect such PD activity or weak spots and pinpoint their location with an accuracy of 1% of the cable length being monitored by the system. This is may be of great value to Distribution Network Operators (DNOs) in making the optimal financial decisions about

the proactive repair/ replacement work of cables at a reduced cost which may be planned in advance.

Scope

This project will be carried out in three phases ;

1.   Phase 1 – Site selection and survey. This will involve selecting circuits to monitor and checking these with DNVGL to see if they believe monitoring those circuits will be possible. Carrying out site surveys on the sites where the units would be installed to check their earthing arrangements and general arrangement on site. Extracting the cable data from the GIS system and feed into the DNVGL tool. Once this is done then DNVGL will then deliver the hardware and draft a detailed commissioning plan.

2.   Phase 2 – Installation of the units on site. This Phase will involve installing the units at the substations within the SPN network this will be a combination of operational teams and DNVGL staff working together. During the install there will be training for UKPN engineers in the installation of the equipment. Once each unit is on site there will need to be synchronisation of the sensors with the DNVGL systems.

3.   Phase 3 – Monitoring phase. This phase will be carried out over 18 months. This will see DNVGL monitor the outputs of the units in conjunction with UKPN asset engineers to establish where weak points are. When weak spots are identified a decision may be made whether to actively repair the circuit or not. If it is chosen to proactively act then operational staff will proactively the highlight the weak spots and send samples for forensic analysis.

Evaluation and closedown – when the project has come to an end there will be analysis of the benefits of the project and move into BAU.

Objective(s)

The main objective is to establish if this technology can be used on UKPN's network and how it may be used to plan for repairs proactively. The project will entail trialling the equipment and testing its capability in identifying weak spots and fault locations. Cable samples will then be taken from the weak spots and analysed. There will also be an element of leaving the weak spots on the network and seeing how the PD behaves between the time it is picked up to the point of failure.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The following success criteria will be assigned to this project;

·   The devices will monitor for PD on the network

·   Should there be cable samples that are taken during an active repair, they may be used to show that there was PD on that section of cable and therefore would have failed had it not been proactively repaired.

Project Partners and External Funding

The project partner for this project is DNVGL.

Potential for New Learning

The expected learning outcomes would be to establish if the equipment works effectively on the UKPN network and the length of cable that can be effectively monitored by the equipment.

Another potential learning outcome would be establishing if certain types of joints/cables have certain PD signatures as they approach failure.

Scale of Project

The trial will be being conducted using 20 units. This number was chosen to allow a mixture of monitoring worst performing cable sections as well as trialling the method of monitoring a feeder. This may provide the highest probability of testing the device and location of PD or faults on the SPN network.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The trial is being conducted in SPN, specific locations will be determined within the project.

Revenue Allowed for the RIIO Settlement

There has been no expenditure allowed within RIIO-ED1 to proactively fix faults based on PD readings. This is due to not having the technology in place to detect PD on the network on a large scale due to the large expense of doing this and the practicality of locating the source of the PD with the existing units on the market.

Indicative Total NIA Project Expenditure

£435,281

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)

We expect that if deployed across our networks, the proposed solution can deliver savings in the order of £443k per year from the reduction in repair costs of HV cables by adopting a proactive approach. These benefits would start accruing in the subsequent years after the initial deployment period, and after upfront costs are paid for.

Please provide a calculation of the expected benefits the Solution

Method Cost:
Assuming total of 210 units are deployed, we will spend a further £862k to purchase an additional 190 units (to supplement original 20 units from the trial). There is also the annual monitoring cost is £133k for 210 units.

Assuming each unit can detect 0.5 pre faults per year, 105 proactive repairs can occur, with each one costing an estimated £3.3k to repair. Thus the annual cost of proactive repairs is £347k.

This implies that the method cost has two components, the upfront capital costs of £862k and the total recurring cost of £480k.

Base cost:

Assuming we let the 105 incipient issues develop fully into faults, the annual base cost for unscheduled fault repairs is £923k.

Financial Benefits
In the first year of operation, the benefits are negative, at - £420k due to the upfront capital costs. In the subsequent years, the annual savings are £443k. Thus, over a five year period after commencement, this may see a reduction in our HV cable repair expenditure in the order of £1.35m.

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

All DNOs should be able to adopt this providing their networks have an accessible Earth strap. The benefits for doing so would be similar to those stated above.

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

The cost of carrying out a roll out will be dependent on the number of units and the procurement approach of each company. Assuming that the costs are scaled proportionally from UKPN to the remaining 11 licence areas, the costs are £3.16m.

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

Using the learnings from this project, other Network Licenses may be able to analyse how effective using this technology would be on their network. Should they decide that it is cost effective for them they may work with DNVGL to adopt on to their networks.

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.

By looking at existing literature on smarter networks portal, we have established that this device is unique and has not been trialled on GB DNOs Networks. The supplier has a patent on the device and has informed us that we are the first GB DNO to trial this equipment. As such, there will be no unnecessary duplication on 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

This project is innovative as it uses two sensors rather than one to allow better location of PD and increase the accuracy of the location, thus mitigating the need for further investigation.

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

UK Power Networks does not have the expertise or resources to develop or install such equipment as part of business as usual (BAU) activities. As such, this project does carry with it significant development costs, and a degree of risk, that neither the business, nor manufacturers are willing to undertake.

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 technical and operational risks associated with the deployment of an unproven solution. As noted in the NIA guidance, certain projects are speculative in nature and yield uncertain results. 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 reach the level of maturity required for business-as-usual application. This risk is being mitigated against through this small scale project and by ensuring requirements are clearly defined and documented. If the project is successful, it will have a technical report on the economical and technical benefits of using this solution. 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