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

Jul 2023

Project Reference Number

NIA_SHET_0042

Project Registration

Project Title

Pollution Monitoring

Project Reference Number

NIA_SHET_0042

Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

Project Start

July 2023

Project Duration

2 years and 9 months

Nominated Project Contact(s)

Brant Wilson - Innovation Portfolio Manager

Project Budget

£220,000.00

Summary

Severe pollution and harsh weather are one of the main issues for electric utilities causing flashovers and unplanned line outages. Currently, there is no pollution measurement information across the network. This project will use insulator leakage current monitoring sensors to capture and share information remotely. This will help characterise the risk of equipment degradation due to pollution and assist with designing and maintaining Overhead Lines (OHLs) in pollution-high-risk areas of the network. With this, early design mitigation
and maintenance procedures can be carried out to prevent faults due to flashovers.

Third Party Collaborators

La Granja Insulators

Nominated Contact Email Address(es)

transmissioninnovation@sse.com

Problem Being Solved

Currently, there is no pollution measurement information across the network. All insulator designs are based on the recommended minimum creepage distances (depending on the perceived site pollution severity) specified in our technical standard, originating from BS
EN 60815, which utilised the creepage values from past experiences with similar site conditions.

Accurate design of the insulators considering the localised pollution and weather parameters, plays a vital role in preventing flashovers and unplanned line outages. Therefore, accurate pollution measurement with the corresponding weather information will benefit the insulation design.

Method(s)

There are several measuring methods to evaluate the pollution contamination levels on external insulation; the most widely used methodologies for monitoring pollution are the equivalent salt deposit density (ESDD), non-soluble deposit density (NSDD), and leakage current. Unlike the ESDD/NSDD, the leakage current is a more meaningful parameter as it provides information on all the pollution flashover mechanism stages and indicates how close the insulator string is to flashover. With this, early design mitigation and maintenance procedures can be carried out to prevent faults due to flashovers. Additionally, the existing need for online monitoring places the leakage current as the most suitable method for that purpose due to its ability to carry out continuous measuring without handling the insulator.

The solution will be tested at a suitable overhead line which has a history of experiencing electrical faults, and one of the assumptions is that the root cause of increased faulting is the air pollution created by the nearby recycling site. The gathered data will be used to analyse the insulation condition as well as giving valuable insights in the selection, dimensioning, and design of the outdoor insulation of the monitored overhead line.

Data Quality Statement (DQS):
The project will be delivered under the NIA framework in line with OFGEM, ENA and SSEN Transmission internal policy. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal SharePoint platform ensuring access control, backup, and version management. Deliverables will be shared with other network licensees through the closedown reports on the Smarter Networks Portal.

Measurement Quality Statement (MQS):
The methodology used in this project will be subject to supplier's own quality assurance regime. Quality assurance processes and the source of data, measurement processes and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and will be made available for review.

In line with ENA's ENIP document, the cumulative risk score is scored as 5 = LOW from the sum of the risk thresholds below:

TRL Steps – 2 TRL Steps – Low (Score 1)
Cost – <£500,000 – Low (Score 1)
Number of suppliers – 1 – Low (Score 1)
Data – Assumptions known but will be defined within project – Medium (Score 2)

Scope

A system to monitor the condition of insulators on a six-span short section of a 132 kV Overhead Transmission Line (OHTL) at an extreme pollution case site, consisting of:

- 3 wireless sensors to measure and transmit intensity of leakage currents.
- 1 solar-powered base station to gather sensors' inputs, meteorological data, and battery backup.
- A data server with a web interface available for accessing and viewing the collected data.
- The chemical analysis of the RTV silicone material covering the insulators.

- Data collection and report production to make decisions about the planning and designs of the insulation in the concerned OHTL and beyond.

Financial benefits can be found in section 3.2.2.

Objective(s)

The main objective of the project is to use leakage current insulator monitoring sensors to characterise the risk of equipment degradation and determine if pollution is a contributing factor for OHLs in pollution-high-risk areas of the network.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative, or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register.

This project has been assessed as having an overall positive impact on consumers in vulnerable situations. The assessment has identified that this project will look to reduce the costs for households and reduce the occurrence and duration of supply interruptions. Other considerations including the projects impact on supply, immediate health and safety in the home have been made in carrying out this assessment.

Success Criteria

The project will be deemed as successful if all items in the scope, objectives and learnings are achieved. It is expected that, if successful, the trial will lead to implementing appropriate designs and maintenance strategies for OHL, reducing flashovers, improving the network's reliability, and reducing the number of financial penalties.

Project Partners and External Funding

SSEN Transmission will partner with Verescence La Granja Insulators to deliver Pollution Monitoring using NIA funding.

Potential for New Learning

Installing this monitoring equipment will generate valuable information about pollution levels and the effects on insulators. To date, insulator design and maintenance schedules are based on recommended minimum creepage distances (depending on the perceived site pollution severity).

This new learning will inform insulator design when establishing new OHLs and improve insulator maintenance schedules, which could be used to create a pollution map of our network in the future. There is also the opportunity for other TOs to benefit from the outputs of this project, enabling them to utilise this tested approach to pollution monitoring of OHLs. National Grid and SP Energy Networks have confirmed, via email, that they are interested in the outputs of this project and are open to providing technical input where possible.

The new learning will form part of the reporting throughout the project lifecycle, which will be shared with all relevant parties. The reports are aimed at helping SSEN, and other licensees, to adopt the smartest and most convenient decisions on the strategies, planning and designs of the insulation in the concerned OHTL and beyond.

Scale of Project

The project is designed to get maximum learning for minimal cost; if successful, the potential benefits are estimated to be £303k for the trial at the extreme case site. The data from this project will be used to provide information to enable preventative maintenance to occur before a flashover occurs again, reducing faults and the associated financial penalties. Although this trial is an extreme pollution case, this technology, if proven, can be used at sites where pollution has been caused by dust or salt near coastal sites. Any smaller scale project
would not allow the learning outcomes to be achieved.

Technology Readiness at Start

TRL7 Inactive Commissioning

Technology Readiness at End

TRL9 Operations

Geographical Area

The project will take place in SSEN Transmission’s license area in Scotland.

Revenue Allowed for the RIIO Settlement

No allowance has been made for this type of development within the RIIO-T2 settlement. No savings are expected during project implementation; future savings may be possible depending on the outcomes of the project and the future adoption of the learnings.

Indicative Total NIA Project Expenditure

The total NIA Expenditure for the project is £220,000, 90% (£198,000) is allowable NIA expenditure.

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:

As the SSEN Transmission network grows, OHL lines will be established or as required, replaced. Capturing and understanding pollution levels in the area will inform insulator design appropriate to the pollution level to prevent flashovers and undesirable line outages and provide the relevant information to allow for monitoring and preventative maintenance. Reducing the resultant unplanned line outage costs associated with renewable energy system transmission could assist in the SSEN Transmission RIIO-T2 business plan goal to transport the renewable electricity that powers 10 million homes, contribute to national Net-zero targets, provide benefit to customers, and meet the energy system transition objectives.

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

The primary impacts of this project on consumers in vulnerable situations is its potential to reduce the cost of electricity transmission in the North of Scotland while also reducing the occurrence and duration on supply interruptions.

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)

Not applicable.

Please provide a calculation of the expected benefits the Solution

If the system can reduce the number of unplanned outages caused by flashovers and/or the need to carry out maintenance, then this will reduce the costs for consumers. Financial penalties for faults will also be avoided. Having data regarding pollution risks could be useful information for communities to take steps to reduce pollution risks.

This project will seek to capture information that can characterise the risk of asset degradation from pollution. A short section of the 132kV OHL case site will be used as the innovation use case.

Data on the frequency of flashovers and their cause will be determined after the results of the trial, so at this stage the CBA conducted reflects the minimum investment case incorporating a risk factor using a simple probabilistic method. The risk analysis considered the below risks:

- Flashovers/faults are not caused by pollution.
- The reasons for the faults and flashovers faults were not properly diagnosed and continue to occur regardless of the implementation of the pollution monitoring projects.
- Despite information obtained on pollution and remedial design actions, flashovers due to pollution still occur.

The CBA compares the innovative monitoring system scenario with the counterfactual scenario of not installing the monitoring system at all in a short section of the extreme case site and so a high frequency of flashovers continues to occur. Benefits considered account

for the cost savings from outage avoidance and ignore any other co-benefits at this moment. Therefore, the potential lifetime risk-adjusted cost benefits have been calculated as follows –

• Counterfactual ("do nothing") base case: Outage cost (61 outages per lifetime x £12,000) = £732,000
• Innovative monitoring system case: Outage cost (8 outages per lifetime x £12,000) = £96,000
• Innovative monitoring system case: Monitoring system cost (supply £120,435 + installation £1,050) = £121,485
• Net risk-adjusted cost benefit: 66.7% x (£732,000 – £96,000) – £121,485 = £302,727

If this cost saving is capital budgeted considering our model's discount rate and depreciation is estimated to £108,288. Main assumptions considered:

• Asset life 45 years
• Lifetime flashover frequency scenarios for the risk analysis 10, 20, 40 faults.
• Average flashover outage cost £12k
• Average of 61 outages per lifetime at the case site
• Drop in faults using monitoring systems assumed 8 outages at case site per lifetime.
• Average outage duration 3 hours
• Probability of any kind of flashovers to occur 66.7%

The results showed that, the potential benefits considering risk are estimated to be at least £303k only from the avoidance of outages. The trial will help obtain more data on the cause of the degradation, with cost estimations being revisited on project completion. If successful, the dissemination of learnings can lead to further benefits being realised across similar schemes.

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

Using this monitoring technology could allow creation of a pollution map of our SSEN Transmission network in the future which could equally be replicated across GB allowing other TOs to use this tested approach to pollution monitoring of OHLs. The base learning, equipment specification and monitoring platform could be replicated across GB.

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

The costs of replicating the pollution monitoring solution across the rest of GB are not fully defined. Although the test site is an extreme pollution case, this technology, if proven, can be used at other sites that will be susceptible to pollution. The costs would be dependent on the type of site and the pollution problems it may be experiencing.

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

Installing this monitoring equipment will generate valuable information about pollution levels and the effects on insulators, to date, insulator design and maintenance schedules are based on recommended minimum creepage distances (depending on the perceived site pollution severity). This new learning will inform insulator design when establishing new OHLs and improve insulator maintenance schedules. We have received a note of support for the project from National Grid and SP Energy 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)

Not applicable.

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 ENA Smarter Networks portal has been reviewed to confirm that there is no duplication.

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

Not applicable.

Additional Governance And Document Upload

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

It is not yet proven that the monitoring equipment will be able to provide accurate and clear data, sufficient to base insulator design and maintenance decisions on. This solution is currently being trialled out with the UK (France, Spain, USA) but this is the first it will be tested within the UK.

Relevant Foreground IPR

Any new intellectual property which are completed as part of the NIA project will be made available to other relevant networks licensees. The suppliers historical and current background IP may be used or referenced as part of the project.

Data Access Details

See Strategic Innovation Fund (SIF) and Network Innovation Allowance (NIA) Data Sharing Procedure for Transmission Innovation Projects at: Data Sharing Procedure for Innovation Transmission RIIO-T2

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

This is a new monitoring solution that has only been trialled out with the UK, and needs to be better developed and validated before it can be introduced as business as usual. There are certain risks associated with the acquisition, utilisation, and the overall usefulness of the proposed technology and techniques in the scope which need to be tested first. Due to the TRL and risks associated with this project, NIA funding is the correct mechanism rather than BAU delivery.

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

As noted in the NIA guidance, certain projects are speculative in nature and yield uncertain commercial returns. This is the case with this project. There is a commercial risk that the solution trialled in the project is not adopted at the end of the project. This could be because some of the assumptions around the usefulness of the pollution monitoring solution and the predicted accuracy of the sensors. If the project is successful, it will have proven a technical and novel solution that can be adopted in existing and future design reducing the need for unplanned maintenance and cost to customers.

This project has been approved by a senior member of staff

- [x] Yes