Date of Submission

May 2021

NIA Project Registration and PEA Document

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.

Project Registration

Project Title

Informed Lightning Protection

Project Reference

NIA_SSEN_0035

Project Licensee(s)

Scottish Hydro Electric Power Distribution and Southern Electric Power Distribution

Project Start Date

March 2019

Project Duration

4 years and 0 months

Nominated Project Contact(s)

Joe McNeil

Project Budget

£521,000.00

Nominated Contact Email Address(es)

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Problem(s)

Lightning strikes are known to cause a significant number of supply interruptions to our customers. In our Scottish Network, lighting strikes are the second highest cause of customer interruptions and minutes lost and in our Southern Network it is the fifth highest cause. Therefore, there is a need to reduce the impact that lighting related faults have on our customers.

One method of reducing lightning related faults is to install surge arresters. Present practice of installing surge arresters involves identifying circuits that historically experience large numbers of lighting related faults and applying blanket coverage of surge arresters on these circuits i.e. installing surge arresters on every third pole. However, many of our circuits extend long distances i.e. over 30km in length, which means thousands of surge arresters would be necessary for blanket protection. Not only is this expensive but it may be ineffective as lightning may only strike in small hot spots around the network. There is a need to identify where lightning hot spot locations occur and to understand the impacts of supply interruptions to our customers in these areas. This will help inform us on where to install surge arresters for maximum prevention of supply interruptions at minimum cost. To do this, we plan on combining multiple data sets e.g. lightning strike location data, ground resistance data, etc. and perform advanced data analytics to identify key locations for surge arresters to be installed.

Our surge arresters are designed to withstand multiple lightning strikes and operate for about 12 years. However, many of these surge arresters can fail prematurely without ever experiencing or protecting against a lightning strike. So, rather than preventing supply interruptions, they can cause them. Furthermore, it is difficult to diagnose when one of these types of surge arresters has failed as often there are no visible signs of failure. This increases the time taken to identify and fix/replace the failed arrester, which means customers are potentially off supply for long periods of time or money is spent on expensive and carbon intensive diesel generators. There is a need to perform an in-depth trial of surge arresters with the ability to disconnect, which are designed to sacrifice themselves in the event of a lightning strike or premature failure. This will prevent supply interruptions occurring and make it easier for field staff to identify which surge arresters have failed (as the earth lead will have disconnected), so they can be more easily replaced.

Method(s)

Lightning Development Phases

Phase 1a – Data Analytics Pre-Execution Phase. This phase involves preparation work to ensure the execution phase runs smoothly. Specifically, it involves the following tasks

- Define model success criteria
- Create model requirements specification
- Provide Data Analytics Team (DAT) with necessary data sources required to implement functional requirements
- Perform data compatibility testing
- Perform GDPR & Security Assessment

Phase 1b– Data Analytics Execution Phase. This is the actual ‘analytical’ phase of the project, where a geospatial model is created to analyse various data inputs including:

- Lightning strike location data
- Customer number data
- Lightning IIS fault data
- Lightning Opex data

· Ground resistivity data
· GIS asset data

The objective of this phase is to identify high risk areas or 'hot spots' where lightning protection should be installed. Both probability of strike and impact of strike will be utilised in the identification process i.e. high-risk sites will not only be susceptible to lightning strikes, but also contain a significant number of customers that are at risk of experiencing a lightning related outage.

Phase 2 – Internal review of high risk sites: Once the high-risk sites have been identified, the specific sections of these circuits, identified for lightning protection, will be reviewed internally. This is to confirm they are suitable for protection e.g. confirm no investment is planned to take place that may address the lightning issue and to sense check that these are suitable for protection.

Phase 3 – Lightning protection procurement: Surge arresters will be installed on the network i.e. surge arresters with earth lead disconnects. Surge arresters with earth leads that disconnect can prevent outages from occurring if the surge arrester unit faults. This is a common occurrence that can lead to an unplanned outage.We will also consider the installation of novel surge arresters, such as those with drop out mounts, that are able to prevent the need for unplanned outages after the arrester is spent or reaches end of life.

Phase 4 – Installation: Lightning protection equipment will be installed in locations defined by the data analytics model.

Phase 5 – Monitoring & Analysing: Weekly monitoring of IIS and strike data will take place, possibly moving to fortnightly or monthly depending on the value of frequent monitoring. Annual reporting will take place detailing lightning strike frequency and IIS costs on selected locations. Any learning will also be detailed here e.g. faulty equipment, issues, etc.

Phase 6 – Reporting, Dissemination & Closedown: learnings derived from the project will be used to create new policy and processes on lighting protection investment methodology. Any learning will be shared with the wider DNO community.

Scope

· Only 11kV and 33kV circuits will be protected.
· Protection will target lightning related faults only.
· Development of the lightning model is for analytical purposes only.
Results will be reviewed over a four-year period, but this time scale can be shortened if objectives are met earlier.

Objectives(s)

1) Develop a 'point in time' lightning analysis tool that can be used to locate lightning protection equipment in the most optimal way i.e. integrate various data sets and update visual display as described in phase 1a and 1b above.

2) Install lightning protection equipment in 'optimal' locations provided by the lightning analysis tool.

3) Monitor and analyse fault data to confirm effectiveness of lightning protection.

4) Update internal policies and procedures if the project is successful.

5) Share learnings with wider audience.

Success Criteria

The project will be a success if:

1) A point in time analytical tool is sufficiently developed so that it can integrate the different data sources described in phase 1b and perform advanced analytics, so that it can be used for the purpose of deciding where to place lightning protection equipment down to the nearest pole.

2) We install lightning protection equipment safely, on time and within budget.

3) We prove the effectiveness of this methodology for protecting against lightning related faults from a cost and fault reduction point of view.

Technology Readiness Level at Start

TRL 1

Technology Readiness Level at Completion

TRL 8

Project Partners and External Funding

N/A

Potential for New Learning

The findings from this project will:

1) Discover if this methodology is effective for protecting against lightning faults.

2) Determine the effectiveness of surge arresters with disconnects on the network.

3) Advance the geo-spatial analytical capabilities of digital tools in the field of lightning protection.

Scale of Project

This project is focusing primarily on lightning analysis, of which limited data sets are available and as such should not be overly complex. It is expected that the modelling phase will take about 3 months in total to complete.

Investment in lightning protection equipment will not be large as we are trialling new kit to determine its effectiveness on the network and funds are limited.

The length of the project is expected to be about 4 years. This is due to the randomness associated with lighting. It may therefore take some time before we can form conclusions on the success of the project.

Geographical Area

This project will be located across both our Scottish & Southern regions.

Revenue Allowed for in the RIIO Settlement

None. No allowance was provided for additional protection against lightning.

Indicative Total NIA Project Expenditure

£521k

Project Eligibility Assessment

Specific Requirements 1

1a. A 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 the GB the Network Licensee must justify repeating it as part of a Project) equipment (including control and communications systems and software)	X
A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)	X
A specific novel operational practice directly related to the operation of the Network Licensee's System	X
A specific novel commercial arrangement	

Specific Requirements 2

2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

Please explain how the learning that will be generated could be used by relevant Network Licenses.

1) Adopting the methodology used in this project to analyse lightning risk on their networks.

2) Using the learning generated by this project to create a similar digital application.

3) Installing new more cost-effective surge arresters that have been trialled in the UK as a result of this project.

Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

This project addresses the 'reliability' challenge. It aims to reduce both customer interruptions (Cis) and customer minutes lost (CMLs) by reducing the number of lightning faults on our network.

2b. Is the default IPR position being applied?

Yes	X

2c. Has the Potential to Deliver Net Financial Benefits to Customers?

Yes	X

Please provide an estimate of the saving if the Problem is solved.

£210k per annum (depending on how many circuits are protected).

Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost - Method Cost, Against Agreed Baseline).

Assumptions

· Incentive Interruption Scheme (IIS) costs are used to demonstrate savings. These are the costs Ofgem use to reflect the value of customer minutes lost and customer interruptions from a monetary point of view. No capital savings are expected to be realised by this project. Some operational savings from reduced use of diesel generators are expected, but have not been included here.

· Costs and savings are spread over a 12-year period, which is the average expected life span of lightning protection equipment (surge arresters).

· Project costs i.e. model development, project management time, etc. have been excluded in order to calculate the benefits of this in a business as usual environment.

· This project is assumed successful and as a result 30 circuits at high risk of experiencing lightning faults will be protected.

· Optimal location of lightning protection will reduce IIS costs by 50% per circuit.

Base cost

Scenario: 30 circuits with no lightning protection.

30 circuits with high risk of experiencing lightning faults @£25k average annual lightning related IIS costs per circuit = £750k IIS cost per annum and £9m over 12 years.

Method cost

Scenario: 30 circuits with 'optimal' lightning protection.

Lightning protection equipment procurement & installation: 30 circuits @ £50k per circuit = £1.5m over 12 years.

50% reduction in lightning faults due to protection = £4.5m over 12 years

Total method cost = £4.5m+£1.5m = £6m over 12 years

Base cost of £9m – Method cost of £6m = £3m saving over 12 years or £250k per annum

Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

This method can be rolled out to all GB DNO regions. The frequency of lightning strikes and lightning related faults will determine the possible savings.

Assuming savings are similar across all 8 DNO regions in the UK:

£3m x 8 = £24m GB savings over 12 years or £2m per annum (average).

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

Assuming costs are similar for all 8 DNO regions in the UK:

£6m x 8 = £48m costs over 12 years or £4m per annum (average).

2d. Does not Lead to Unnecessary Duplication

Yes	X

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

Presently there is no analytical tool that is able to perform geospatial analytical capabilities while integrating several data sources in order to determine optimal location of lightning protection equipment. This project builds on the learnings from an existing technology (Lightning tracker app) that was created as part of an NIA project and thus advances our capabilities and understanding in the field of lightning.

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

N/A

Additional Governance Requirements

Please identify

that the project is innovative (ie not business as usual) and has an unproven business case where the risk warrants a limited Research and Development or Demonstration Project to demonstrate its effectiveness	X

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

This project is combining multiple data sets i.e. historic lightning strike information, customer numbers, ground resistance, historic fault costs and geospatial network assets. Advanced data analytics will be performed to see if there are any correlations between these data sources to see if we can determine probability of strikes occurring in specific network areas. The innovation here is utilizing data analytics to determine where these lightning hot spots are located and to see if it is possible to predict where lightning strikes will occur in the future. This has not been tried before as advanced data analytics such as machine learning is still relatively novel. Data was also more expensive and of lower quality in the past. With the advancement of data analytics and cheaper, higher quality data being made available this project has now become commercially worthwhile

ii) Please identify why the Network Licensee will not fund such a Project as part of its business as usual activities

The project is not running BaU as there is too much uncertainty on whether the data analytics outputs will prove to be successful. A fair amount of resources is needed to be invested into data analytics and then additional resources are required for installation of surge arresters to test if the data analytics outputs are applicable in the real worldi.e. If we install surge arresters in locations specified to be 'high risk' do we actually reduce customer interruptions and minutes lost? There is also a long testing phase, around 4 years, to prove that the data analytics methodology will work. As a result of this uncertainty and long project time it can't be considered BaU or funded with money reserved for BaU activities that could otherwise be spent in less risky projects.

iii) Please identify why the Project can only be undertaken with the support of the NIA, including reference to the specific risks (eg commercial, technical, operational or regulatory) associated with the Project

This project can only be funded via NIA as it is unprovenand contains the following risks Technical: Data analytics is attempting to prove that a more effective methodology to install lightning protection equipment is feasible, but at this stage we don't know if it will be feasible. The project may determine there is no link between multiple data sources and that lightning can't effectively be predicted in this way. Commercial: Surge arresters need to be installed in order to prove whether the data analytics suggested methodology to install lightning protection works in a real-worldenvironment. It is possible that it works in a modelled environment, but not a real-worldenvironment

This project has been approved by a senior member of staff

Scottish & Southern Electricity Networks