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

Nov 2019

Project Reference Number

NIA_UKPN0053

Project Registration

Project Title

Storm Resilience

Project Reference Number

NIA_UKPN0053

Project Licensee(s)

UK Power Networks

Project Start

December 2019

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Boris-Emanuel Yazadzhiyan, Mark Bateman

Project Budget

£664,943.00

Summary

This project supports the drive to be an even more reliable network operator through improving the resilience during severe events. The initiative is split across two work streams:

Work stream 1 – Lightning into PowerON:
This work stream will trial a proof of concept where UK Power Networks' Network Management System (PowerOn) will receive lightning strikes locations in real time via an API developed by an international weather consultancy. These locations will be linked to poles and to the network diagram using time and distance parameters to enable verification of the reason behind circuit-breaker opening and disconnecting the circuit. After this mapping is established, a dedicated alarm will be created in PowerOn to notify control engineers that the faulted circuit was likely struck by lightning. This could reduce CIs and CMLs associated with lightning strikes.

Work stream 2 – Resource estimation:
We will gain access to advanced weather forecast parameters from stations across the UK Power Networks licence areas. This work stream will trial the concept of using predictive analytics to combine historic fault data to weather parameters. This will build on and enhance our existing capabilities to forecast the impact of severe weather. The novelty will be within the development of the link between high frequency sampled weather data and the distribution network. This will ultimately drive a numerical prediction of weather related fault volumes and locations. These forecasts will provide a probabilistic view of the storm impact and quantify the expected level of risk each weather event presents.

As part of the project, the resources required to adequately manage the severe weather will be forecasted as well, by leveraging the valuable experience of our emergency planning team.

Ultimately, this will trial a system capable to forecasting, planning and responding to severe weather events more effectively and optimise resource requirements – thus reducing the impact of outages to customers and controlling costs.

Nominated Contact Email Address(es)

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Problem Being Solved

Severe weather events have an adverse effect on the distribution network because they result in high volumes of unplanned power outages. These faults are a consequence of the unpredictable and/or sudden changes in the weather and create challenges for:

• Reconnecting customers as quickly as possible following a lightning strike

If a circuit-breaker trip is caused by a lightning strike, UK Power Networks' procedures allow a tele-close after 30 minutes. In the case of lightning storms causing multiple faults the Network Control Manager has the authority to waive the 30 minutes wait (this happens 5-10 times a year). This waiting period adversely affects the duration of customer supply interruptions, caused by non-damage faults. At the same time it has been found that if lightning strike was the reason for circuit breaker operation (which is not always known), reclosing it before 30-minute waiting period did not result in any adverse impact on the operation of the network or the assets. However, the currently used lightning map does not give UK Power Networks control engineers sufficient confidence to reliably link lightning strikes to affected circuits.

• Allocating sufficient resources at optimum locations to ensure the volume and severity of faults are managed

The emergency escalation process is invoked every time severe weather is forecast. Weather parameters from the Met Office are reviewed and a response plan is developed and put in place. This plan is re-evaluated and updated every few hours with up to date weather data.
Currently, the available weather information is limited and not directly matched to the electricity network, which makes resource estimation complex and in some cases suboptimal.

Method(s)

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Scope

Work stream 1 – Lightning into PowerOn:
• Secure API connection between supplier and PowerOn;
• Mapping of lightning strike locations to poles geographically and capability to adjust time and distance parameters in order to link strikes to circuits;
• Development of the verificiation algorithm and alarms; and
• Trial of solution in order to capture sufficient lightning activity and prove the concept on the live system.

Work stream 2 – Resource estimation:
• Probabilistic forecast model development and matching of weather data to historic network faults;
• Development of a resource calculation demonstrator;
• Design of front end interface;
• Update current solution and build of the probabilistic and resource forecasting; and
• Trial the solution to capture severe weather activity and prove the concept on the live system.

Objective(s)

This project aims to:

1. Develop and trial solutions which support the readiness for severe weather through:
a. Work stream 1 – Linking near real time lightning data to the network; and

b.Work stream 2 – Analysing weather parameters and fault data to provide resource estimation and fault volume forecasts.

2. Determine how to present the outputs in a consistent, verifiable and easy to use manner for:
a. Work stream 1 – confirmation that a fault is a result of a lightning strike; and
b. Work stream 2 – probabilistic forecast of fault volumes and recommended resources.

Ultimately, the main project objective, consistent across both work streams, is to improve the network reliability during severe weather days and minimise the disruption to our customers.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Work stream 1:
- The lightning data is communicated to the network management system;
- Lightning strike locations are matched to network assets or fault events;
- The impact of the solution is tracked and the accuracy is determined;
- The benefit to our stakeholders is tracked; and

Work stream 2:
- The weather forecasts are matched to the network;
- The number of faults and their likelihood are forecast with the probabilistic model;
- The resource required to adequately prepare for the storm is recommended;
- The impact of the solution is tracked and the accuracy is determined; and
- The benefits to our stakeholders is tracked.

Project Partners and External Funding

There is no external funding for this project.

Work stream 1:
- GE, the supplier of UK Power Networks' network management system, will develop the API connection and lightning strikes data mapping algorithm; and

- MeteoGroup will provide lightning data and the API through which we will receive it.

Work stream 2:
- MeteoGroup will provide the weather data, and develop the probabilistic forecast and resource estimation.

Potential for New Learning

Work stream 1 – This work stream will ascertain whether lightning strikes can be linked to circuits on network diagram with sufficiently high accuracy to allow for associated CI and CML reduction by reducing the fault impact to a Short Interruption (SI).

Work stream 2 – This work stream will trial a novel enhancement to emergency planning, by combining high frequency sampled weather and network data.

Scale of Project

London Power Networks (LPN) has a fully underground network and is therefore excluded form this project, as it is less succeptible to lightning or wind caused faults.
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Work stream 1:
The trials will run in South Eastern Power Networks (SPN) area of UK Power Networks. This area is smaller than Eastern Power Networks (EPN), which sees the majority of lightning activity (70% on average of total UK Power Networks' lightning-related CIs and CMLs), but large enough to capture sufficient data during the allocated trial period.

If the scale of this work stream was smaller, the risk of not testing the solution during lightning events is too great to justify the project.

Work stream 2:
The trials will run in EPN and SPN to ensure the fault forecast and resource estimation models are trained with ample volume of historic data. The trial for this work stream is highly dependant on severe weather events occurring during the trial, and as such a smaller trial area is insufficient for the project.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

Work stream 1 will cover the SPN licence area, while work stream 2 will cover both EPN and SPN licence areas.

Revenue Allowed for the RIIO Settlement

No allowance was made in RIIO Settlement for this work.

Indicative Total NIA Project Expenditure

£664,943

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)

If both work stream 1 and work stream 2 are successful the gross annual savings (excluding any costs) are forecast to be £566,540 across EPN and SPN.

Please provide a calculation of the expected benefits the Solution

Assumptions:

- Base cost – Annual cost of current lightning map (which cannot provide the functionality developed as part of this project) and historic CML performance;
- Method cost – annual cost of the lightning data is estimated and will be confirmed as part of the project development;
- Benefits – based on the expected improvement in performance on "poor weather" days, those which have more than double the average fault volumes;
- Solution impact is based on the historic lightning faults between 2011 and 2018 and weather faults between 2014 and 2018;
- The solution will improve the network reliability by reducing the impact faults caused by lightning strikes have on the network and improve both resourcing and performance on bad weather days; and
- Assumed this solution will improve network reliability by 20%, and improve resourcing and performance on half bad weather day faults.

	2020/21	2021/22	2022/23
Base Cost (£)	£45,440	£43,930	£42,470
Method Cost (£)	£126,640	£122,430	£118,360
Benefit (£)	£371,750	£359,390	£347,440
Cash flow (£)	£199,670	£193,030	£186,610
NPV - Total		£579,310	

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

Both solutions developed as part of this project are scalable across GB networks. The service / data suppliers have indicated the on-going annual licence cost for work stream 1 (£ 41k) and work stream 2 (£ 90k) will remain consistent as the ones planned for UK Power Networks roll-out.

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

Cost per DNO (annual, post roll-out):
Annually this is £131k with some additional assumed up-front costs per licence area. Roll-out across all GB DNOs (excluding EPN, LPN and SPN) – £1.58m

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

The project learning will be useful to all network licensee groups as severe weather is not exclusive to the UK Power Networks area. The learning can directly be used to support emergency planning and lightning restoration initiatives that GB networks undertake.

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.

After studying the projects registered on the Smarter Networks portal, UK Power Networks has not identified any projects aiming to achieve the same outcomes. UK Power Networks is aware of our recent project in the weather/fault forecasting space and one by SPEN (Improving Storm Resilience and Readiness through Data Analytics). We have discussed this initiative with SPEN and agreed there is benefitial learning to be unlocked through this project over and above theirs. We are also aware of work on lightning prediction by NPG (under the Lightning Prediction project). We are not aware of an projects undertaken by other DNOs as part of their BaU activities.
It is noted that other network operators are interested in the progress of this project and "fast following" if successful. UK Power Networks will proceed with this project and keep all interested network operators as informed stakeholders.

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

UK Power Networks always looks for solutions that could help to improve network reliability. However, until now, UK Power Networks did match real-time lightning strikes to the network which was limiting the benefits of the lightning map (which can only visualise lightning strikes on the map, but not link them to specific circuits). The project is innovative, because there are no attempts previously made to link lightning strikes to faults in real time.

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

Due to the risks involved in the project (e.g. quality of the lightning data, reliability of the API connection for use in operation, probabilistic weather data matched to electrical assets, estimating resources required) and uncertainty in the scale of potential benefits that can be delivered across our licence areas, these activities would not form part of our business as usual activities. In order to progress innovation funding which absorbs significant risk in implementation, 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

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 generated the amount of benefits suitable for business-as-usual application or there were insufficient storms (lightning and severe weather events) during the trial periods. This risk will be managed through the development, testing and trial process. If the project is successful, it will result in a technical solution and an operational procedure which will improve security of supply. The specific details regarding the benefits are captured under section 2c of this document.

This project has been approved by a senior member of staff

☑ Yes