

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

### Project Reference Number

NIA\_SPEN\_0066

## Project Registration

### Project Title

Predict4Resilience - Discovery Continuity

### Project Reference Number

NIA\_SPEN\_0066

### Project Licensee(s)

SP Energy Networks Distribution

### Project Start

February 2022

### Project Duration

1 year and 11 months

### Nominated Project Contact(s)

Rui Rui

### Project Budget

£150,000.00

## Summary

Predict4Resilience - Discovery Continuity will inform the development of a "Weather Fault" tool which can:

- Forecast severe and extreme weather events;
- Improve the accuracy within the current forecasting window;
- Double the current forecasting window (up to 14 days ahead) and;
- Predict specific network faults and risks.

This project is in place to safeguard the delivery and continuity of the associated SIF project.

### Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

## Problem Being Solved

Severe and extreme weather events have a major impact on the electricity network, resulting in widespread network outages for significant period of time. Evidence has shown that climate change has contributed to longer and hotter heatwaves, more persistent droughts, more frequent wildfire, and more extreme rainfalls.

While we cannot control the weather, we can seek to predict it more accurately with longer visibility and identify its impact in order to protect our customers supply. In addition, we know that an increase in instability is resulting from a higher penetration of renewables – the impact on our network is that the same event in a low inertia system has the increased likelihood of causing an instability event. This combined issue must be addressed urgently.

Our opportunity is to use the recent advances in supercomputing and numerical weather prediction to combines state-of-art weather forecasting, novel statistical post-processing, power system modelling and resilience metrics to predict short-term extreme weather

impacts further into the future, identify weather-related faults in the 7-14 days window, and resultant faults on the network.

### Method(s)

A desktop feasibility study and analysis to identify the needs of a weather prediction tool and outline the architecture for the tool in line with best practice.

### Scope

- Supporting SIF discovery commencement through additional data gathering, formatting, reviewing and validation (primarily network fault analysis records and grid reference points)
- Considering the addition of topographical and ground permeation data sets
- Support and accelerate the transition to SIF alpha

### Objective(s)

- Maximise the success of discovery by feeding in additional data gathering, formatting, reviewing and validation to inform the SIF outcomes

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

N/A awaiting tool.

No impact has been identified that would cause adversity to any consumer vulnerability group (based on the PSR definition)

### Success Criteria

Maximise the success of discovery by feeding in additional data gathering, formatting, reviewing and validation to inform the SIF outcomes.

### Project Partners and External Funding

**Arup** is selected as partner because their previous experience on the NIA project Forward Resilience Measures collaborated with NGET. Moreover, Arup's own underlying energy resilience framework provides a holistic, practical and evidence-based approach to assess resilience, taking into consideration both the physical aspects and the less tangible aspects associated with human behaviour in order to enable a common understanding of interdependencies and vulnerabilities, sudden shocks and chronic stresses.

**The MET Office** is a partner for their scientific knowledge and expertise, and their previous experience on NIA projects such as Advanced Weather Forecast for Dynamic Line Rating. The MET office is also the owner of the weather data. The Met Office is recognised as a world leader in Numerical Weather Prediction.

**The University of Glasgow**, as the academic partner, have expertise in probabilistic forecasting, decision-making under uncertainty, and their extensive experience in energy forecasting.

This project is in place to safeguard the delivery and continuity of the associated SIF project.

### Potential for New Learning

We will provide learning on fault prediction further into the future than current methods, and how this can facilitate faster and more effective response to a fault.

### Scale of Project

Predict4Resilience - Discovery Continuity facilitates a small scale feasibility study. Following future phases, where we would see a demonstration of this platform successfully deployed within SPEN's control room, we envisage the following BAU approach:

The minimum weather and network data is fed using established data channels and secure SPEN servers following the same protocols that previous projects have followed to ensure continuity of data flow. These policies will be reviewed for appropriateness as part of a future phase, continuing to involve the end users.

### Technology Readiness at Start

TRL3 Proof of Concept

### Technology Readiness at End

TRL4 Bench Scale Research

**Geographical Area**

N/A

**Revenue Allowed for the RIIO Settlement**

None

**Indicative Total NIA Project Expenditure**

£150,000

## 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:

There are customers in areas at risk to extreme weather events. The proposed prediction tool would mitigate the impact weather can have on their electricity supply.

Where faults are unavoidable (such as in areas of higher risk), technicians will be dispatched to areas where faults are identified, for faults to be repaired earlier, and for customer minutes lost to be reduced as a result, benefiting consumers in vulnerable situations.

### 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)

N/A

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

This is a research-based project. Benefits will be quantified throughout the project.

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

The whole of the UK is at risk of extreme weather events. The findings from Predict4Resilience Phase 1 will facilitate a tool that is useful for the whole of the UK.

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

This is a research-based project. Roll out costs will be quantified throughout the project.

### 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 trialed 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

## RIO-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

Across the UK, network licencees anticipate and respond to faults due to extreme weather. the learnings produced by Predict4Resilience Phase 1 will allow all network operators to predict further into the future and respond to faults quickly and effectively.

### Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIO-1 only)

N/A

### 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.

This project is in place to safeguard the delivery and continuity of the associated SIF project.

We have conducted extensive research through a review of previous projects, engagement with UK TOs and ESO, as well as an online literature review.

Network fault innovations have focused on asset design, fragility and response to past weather conditions, and modelling the fault events over long periods of time for planning purposes; learning shows that the existing capability are both limited to short-term forecasting (hours to days ahead) or planning timescales.

Operational forecasting innovations have focused on supply & demand and dynamic line rating. Engagement with our users estimate many processes can be improved by quantifying these uncertainties and impacts.

No past project has considered probabilistic fault prediction and related decision-support, leaving a significant gap in control rooms' predictive capability.

### 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 in place to safeguard the delivery and continuity of the associated SIF project. No past project has considered probabilistic fault prediction and related decision-support, leaving a significant gap in control rooms' predictive capability.

This project requires innovation:

- **Weather-related fault prediction** has not benefited from advances in digital technologies due to historic records not being digitised and only a small number of studies have combined what is available with appropriate weather data. We will leverage newly digitised asset health data with numerical weather predictions in order to learn the relationship between predicted weather and actual faults in order to accurately predict the likelihood of fault occurring on across an entire electricity network for the first time.
- **Extended range forecasting** using numerical weather prediction to quantify the probability of future weather and related fault occurring in the days and weeks ahead. However, this weather data requires post-processing via statistical or machine learning methods in order that forecast are calibrated (i.e. that frequency of fault occurrence matches the predicted probability). The required statistical and/or machine learning methods do not exist.
- **Probabilistic power system analysis** is required to evaluate the impact of predicted fault (with associated uncertainty) into network impacts, such as customer minutes lost. Novel schemes for identifying key regions of the network where faults are most likely to impact service level are required to prioritise resource allocation and take preventative actions.

## Relevant Foreground IPR

The specific Relevant Foreground IPR is unknown for this project phase due to it being a feasibility study. If the project is successful and progresses to further phases where the identified optimal solution is being developed, Relevant Foreground IPR will be identified and reported.

## Data Access Details

Access to this data must be requested by contacting SPInnovation@spenergynetworks.com Please provide the following information in your request:

- Affiliation, position and contact details of requesting party
- Relevant project and type of data required
- Reasons for requesting this data and evidence that this data will be used in the interest of the UK network electricity customers
- How data will be shared internally and externally by the requesting party

Any data request deemed unsuitable for sharing will be highlighted to the appropriate requesting party. After receiving the request we will provide the estimated date for completing the data provision based on other requests and our team workload at that time. All requested data remains the property of SP Energy Networks.

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

There is no allowance within the SP Transmission RII0-2 business as usual funding that is appropriate to fund this innovation project.

## 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 has both technical and commercial risks including the safe and secure communication of data and developing a solution that is at least cost to the consumer. Due to the early TRL, the success of the project and associated financial benefits of the project cannot be determined at this stage therefore it can only be undertaken with the support of NIA. This NIA is in place to meet all user requirements of the SIF scope and to derisk the delivery.

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

Yes