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

Dec 2013

Project Reference Number

NIA_NGET0053

Project Registration

Project Title

RESNET

Project Reference Number

NIA_NGET0053

Project Licensee(s)

National Grid Electricity Transmission

Project Start

September 2011

Project Duration

4 years and 10 months

Nominated Project Contact(s)

Doug Dodds

Project Budget

£1,075,000.00

Summary

The RESNET project is funded by EPSRC to allow researchers from the University of Manchester and the University of Newcastle to examine the future resilience of the UK electricity network to climate change. The resilience of the UK electricity network is being addressed on three fronts:

- Representation of changed performance of network components under future climatic conditions (operational resilience): We shall use reported datasets and models to construct performance curves of the system components under a range of climatic conditions (e.g. transmission line capacity for given ambient temperature). To represent the range of performance for each component type, and capture uncertainties in data, these will be presented as probability density functions.

- Risk of failure modelling of components under extreme weather events (infrastructure resilience): Fragility functions will be developed to describe failure of energy infrastructure from weather related phenomena (e.g. probability of transmission tower collapse as a function of wind speed). Relevant loading variables will be specified for each element and fragility functions subsequently established by (i) literature review and analysis of past events (e.g. failure patterns during the 1987 storm) (ii) interaction with our stakeholder partners and (iii) finite element analysis of selected components.

- Whole system modelling: We shall develop quantitative estimates of the effect of climate change on the day-to-day performance of the electricity grid, first using the existing National Grid and one or more existing distribution networks before analysing scenarios and adaptations from other work packages. Monte Carlo simulations will be used for each case with the difference in performance of the system between the base case and the modified cases measured using the following criteria: Increase in operating cost required to

maintain the standard level of service; Quantified demand response or load shedding needed to maintain service; Probability of customer outages and expected energy not served; Quantity of renewable energy spilled.

To address this dual challenge, the project will see the development of a comprehensive approach to analyse, at the UK scale, the resilience of the electricity network and the development of tools for testing adaptation measures that enhance the resilience of the network. The project will explore adaptations at a broad spatial scale and over extended timescales (2020, 2050 and 2080)

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

National Grid has previously completed work on the weather related risks to National Grid and how they may increase/ decrease with time. This work is investigating the electrical systems ability to cope with the changes that climate change will have specifically on the electricity transmission system. This work not only aims to incorporate the change in climate but also the change in supply and demand, which is predicted, with changing climate and a growing population.

The proposal also states that it will model the network on a nodal basis to enabling an investigation of the entire system.

This project is a result of an EPRSC research call on Climate change and was awarded to the University of Manchester and the University of Newcastle, it combines the system knowledge of Manchester Electrical Engineering department with the Tyndale centre, a leading centre on Climate change with Newcastle University's expertise in weather systems and structural knowledge.

Method(s)

This project proposes to use the following methods;

- Report describing models to link weather and operational performance of key transmission system components
- Development of framework to analyse impact of climate change on the UK electricity system through use of a whole system model.
- Report describing vulnerability of key transmission system components to extreme weather events
- Final product report

Scope

The RESNET project is funded by EPSRC to allow researchers from the University of Manchester and the University of Newcastle to examine the future resilience of the UK electricity network to climate change. The resilience of the UK electricity network is being addressed on three fronts:

(i) Representation of changed performance of network components under future climatic conditions (operational resilience): We shall use reported datasets and models to construct performance curves of the system components under a range of climatic conditions (e.g. transmission line capacity for given ambient temperature). To represent the range of performance for each component type, and capture uncertainties in data, these will be presented as probability density functions.

(ii) Risk of failure modelling of components under extreme weather events (infrastructure resilience): Fragility functions will be developed to describe failure of energy infrastructure from weather related phenomena (e.g. probability of transmission tower collapse as a function of wind speed). Relevant loading variables will be specified for each element and fragility functions subsequently established by (i) literature review and analysis of past events (e.g. failure patterns during the 1987 storm) (ii) interaction with our stakeholder partners and (iii) finite element analysis of selected components.

(iii) Whole system modelling: We shall develop quantitative estimates of the effect of climate change on the day-to-day performance of the electricity grid, first using the existing National Grid and one or more existing distribution networks before analysing scenarios and adaptations from other work packages. Monte Carlo simulations will be used for each case with the difference in performance of the system between the base case and the modified cases measured using the following criteria: Increase in operating cost required to maintain the standard level of service; Quantified demand response or load shedding needed to maintain service; Probability of customer outages and expected energy not served; Quantity of renewable energy spilled

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Objective(s)

To understand the impacts of climate change on the GB Transmission system.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Increase in knowledge on the impact of climate change on the GB systems assets for application within National Grid.

Project Partners and External Funding

Project Supplier – Manchester University, Newcastle University.
This project is funded through EPSRC (total project £1m) and National Grid are a supporting partner.

Potential for New Learning

Building on from the Met office work and the work identified in the DEFRA climate adaptation report this project has the potential to take the knowledge in this area further.

The knowledge of the project will be disseminated on the ENA Smarter Portal as well as on www.nationalgrid.com/innovation. This project will also be disseminated through relevant national and international conferences and industry and academic forums.

Scale of Project

Research projects based at Laboratory Levels.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

This project is being completed at various universities, including Newcastle and Manchester.

Revenue Allowed for the RIIO Settlement

Zero

Indicative Total NIA Project Expenditure

IFI - £96k

NIA -£137k

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)

The avoidance of system reinforcement to compensate for the change in climate and the resultant reduction in impact on all consumers. A major incident costs an estimated £2m or more due to flooding or related climate change impacts and in addition significant disruption to consumers and potentially financial impact.

Please provide a calculation of the expected benefits the Solution

Research Project - N/A

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

Fully applicable across the Transmission System

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

This knowledge will be embedded within National Grid as part of 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 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

n/a

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

This project addresses the environmental theme with application to the environment and reducing emission, in particular reduction in the impact of climate change on the electricity transmission networks.

☑ 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.

Given a review of our standard supply base, including EPRI, Universities and the ENA Smart Portal, National Grid confirm that work has not been completed before.

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

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

☑ Yes