

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

Mar 2020

### Project Reference Number

NIA\_SHET\_0031

## Project Registration

### Project Title

Wake Induced Vibration Modelling

### Project Reference Number

NIA\_SHET\_0031

### Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

### Project Start

April 2020

### Project Duration

1 year and 10 months

### Nominated Project Contact(s)

Colin Mathieson

### Project Budget

£310,000.00

## Summary

SSEN continues to encourage the development of generation capability within its network. However, as a consequence of the growth, it is inevitable that some wind generation schemes may encroach or come close to existing on-shore infrastructure such as Transmission Overhead Lines. The question being posed is “what effect and at what proximity do wind generators introduce an undesirable effect on existing conductor configurations (single, twin, quad) and conductor types (ACSR, ACCC, HTLS and both round or trapezoidal) used on transmission overhead lines, specifically accelerated deterioration and ageing from wake induced vibration.

The Wake Induced Vibration Modelling will enable a means to consider the effects of this phenomena on the conductors of overhead line networks prior to the installation and construction of wind turbines or other wake induced systems.

### Nominated Contact Email Address(es)

transmissioninnovation@sse.com

## Problem Being Solved

SSEN continues to encourage the development of generation capability within its network. However, as a consequence of the growth, it is inevitable that some wind generation schemes may encroach or come close to existing on-shore infrastructure such as Transmission Overhead Lines. The question being posed is “what effect and at what proximity do wind generators introduce an undesirable effect on existing conductor configurations (single, twin, quad) and conductor types (ACSR, ACCC, HTLS and both round or trapezoidal) used on transmission overhead lines, specifically accelerated deterioration and ageing from wake induced vibration. The Wake Induced Vibration Modelling will enable a means to consider the effects of this phenomena on the conductors of overhead line networks prior to the installation and construction of wind turbines or other wake induced systems.

## Method(s)

Create simulation models using Computational Fluid Dynamics (CFD) or similar to illustrate how the wake effect from wind turbines

interacts with overhead line structures, conductors and components.

## Scope

In order to highlight specific spans of conductor that are at risk of increased vibration due to the installation of wind turbines, the following project stages are envisaged;

Measure conductor vibration and environmental conditions of existing transmission overhead line conductors before and after the installation of wind turbines.

Using Computational Fluid Dynamics (CFD) or similar develop models illustrating how wake effect from wind turbines interacts with overhead line structures, conductors and components.

Apply the results of the on-site conductor vibration and environmental monitoring data to the models to create an accurate representation of the wake effect of the wind turbines.

Use the models to explore if the wind turbine is inducing adverse vibrations and if so the likely impact on the existing overhead line conductor or associated assets.

## Objective(s)

The projects objectives are as follows;

To accurately model and understand the potential impact, due to wake induced vibration from wind turbine installations erected in proximity to existing transmission overhead line conductors

Provide guidance for future proposed installations of wind turbines in proximity to transmission overhead lines.

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

n/a

## Success Criteria

The project will be successful if there is the;

ability to accurately simulate and model the effect of wind turbine turbulence on overhead line conductors, replicating actual conditions and effects from the field.

provide the basis for conducting various scenarios to form appropriate recommendations and guidance for future similar proposed installations.

## Project Partners and External Funding

N/A

## Potential for New Learning

Predicting or modelling wake induced vibration effects of wind turbine installations on existing transmission overhead line structure, conductors and fittings has not been conducted in the UK. This project will allow network owners and operators to understand the effects of this phenomena and provide appropriate guidance relating to future wind turbine installations.

## Scale of Project

The scale initially considered is focused on the development and accuracy of the model using local conductor vibration and environmental data collected from an existing transmission overhead line, prior to and following the installation of wind turbines in the North of Scotland. This scale was chosen to ensure that benefits can be obtained, before a larger project is commissioned for more complex configurations.

## Technology Readiness at Start

TRL3 Proof of Concept

## Technology Readiness at End

TRL5 Pilot Scale

## Geographical Area

North of Scotland

## Revenue Allowed for the RIIO Settlement

None

## **Indicative Total NIA Project Expenditure**

The total expenditure expected from the project is £310,000. 90% (£279,000) of which 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:

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)

This is a research-based project, but if successful the project will be able to provide insight into how customer savings can be achieved.

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

This is a research-based project, but if successful the project will be able to provide insight into how customer savings can be achieved.

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

This method or model could be applied to all the GB Network Licensees. Learnings will be shared in order to assist with implementation.

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

N/A. This is a research-based project, but if successful the project will be able to provide insight into roll out costs.

### 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

All Network Licensees are experiencing the continued growth and expansion of wind generation schemes, some of which may be proposed in proximity to existing transmission overhead lines. These proposed installations, due to their proximity, may have a detrimental effect on the long-term performance of conductors and fittings of overhead lines. The learning from this project will be relevant across GB. The project results will provide guidance to SSEN and other Network Licensees in the UK on how to reduce the risk of accelerated fatigue and damage (due to vibration) of the conductors.

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

- Reliability of supply, reduction of outages and faults, rapid and effective response to faults
- Maintaining high system availability and the optimum level of redundancy

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.

A project which attempts to predict wake induced vibration from wind turbines to overhead line conductors in this manner has not been conducted in the UK.

### 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

The continued growth in wind generation schemes has led to existing proximity guidance being questioned. With no actual evidence to substantiate current guidance this project aims to model the performance of transmission overhead lines in proximity to proposed new wind turbine installations through the development of Computational Fluid Dynamics (CFD). Therefore, providing a means for more accurate and reliable guidance.

### 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**

No allowances have been made in the RIIO settlement for developing technology associated with wake induced vibration modelling. The results from the project may change guidance on how SSEN plan and implement change to its network.

### **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**

NIA funded projects reduce the commercial risk by providing investment specifically for R&D activities. There is a risk that if BaU funds were available, they could be re-allocated elsewhere to fund BaU needs that are deemed business critical. Without NIA funds this long-term vision of innovation development would not be possible.

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

Yes