

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

Jan 2014

### Project Reference Number

NIA\_NGET0039

## Project Registration

### Project Title

A Combined Approach to Wind Profile Prediction

### Project Reference Number

NIA\_NGET0039

### Project Licensee(s)

National Grid Electricity System Operator

### Project Start

September 2011

### Project Duration

4 years and 1 month

### Nominated Project Contact(s)

David Lenaghan

### Project Budget

£100,000.00

## Summary

The project will investigate the modelling of atmospheric behaviour and interaction between wind and turbine at the level of an individual turbine.

### Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

## Problem Being Solved

Wind profile (including speed and direction) prediction at different scales (short-term, mid-term and long-term) plays a crucial role for efficient operation of wind turbines and wind power prediction. This problem can be approached in two different ways: one is based on statistical signal processing techniques and both linear and nonlinear (such as artificial neural networks) models can be employed either separately or combined together for profile prediction; on the other hand, wind/atmospheric flow analysis is a classical problem in computational fluid dynamics (CFD) in applied mathematics, which employs various numerical methods and algorithms, although it is an extremely time-consuming process with high computational complexity.

There is a need to improve forecast techniques to enable the optimum balance between sophisticated modelling and cost to be identified.

## Method(s)

### Research

This project will develop efficient and effective algorithms for wind profile prediction based on synergies between the signal processing approach and the computational fluid dynamics approach.

## Scope

The project will investigate the modelling of atmospheric behaviour and interaction between wind and turbine at the level of an individual turbine.

## Objective(s)

The objective of this project is to cost effectively reduce the amount of reserve required to cover wind forecast error.

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

n/a

## Success Criteria

- A final report describing prediction methodology and level of accuracy improvement achieved.
- Costs benefits evaluation of different degrees of modelling detail and associated reduction in forecast error.
- Modelling source code,

## Project Partners and External Funding

Project Supplier – University of Sheffield.

External fund of £61,000 from EPSRC

## Potential for New Learning

This project will generate learning in respect of the extent to which wind power generation forecasting accuracy can be improved using CFD and signal processing, how much reserve to cover forecast error can be reduced and at what cost.

## Scale of Project

The scale of the project is a desktop study and academic investigation

## Technology Readiness at Start

TRL2 Invention and Research

## Technology Readiness at End

TRL3 Proof of Concept

## Geographical Area

This work is being undertaken in Sheffield.

## Revenue Allowed for the RIIO Settlement

None.

## Indicative Total NIA Project Expenditure

The indicative total NIA project expenditure is as follows;

IFI= £24k

NIA= £16k

## 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 project will enhance National Grid's ability to forecast wind power performance on a month-by-months basis.

The current level of wind power forecast accuracy is about 6% of capacity. The current capacity is 6800MW and this means that the mean absolute error is 400MW over the course of an average winter month. This error has to be rebalanced by the control room using bids and offers. The average price being around £50/MWh. For a whole month this would approximate to £14.4m. If nothing further is done to improve accuracy then this error is expected to increase with the increasing installed capacity of wind power. This project is expected to deliver an improvement of 1 percentage point and therefore reduce the average error to 5%. With the current numbers this will provide a saving of 60MW. This equates to a saving of £2.2m in system balancing costs per month.

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

Not applicable as this is a research project.

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

The learning from this project is related to managing the impact on system balancing of directly connected wind farms, which is of GB system wide relevance.

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

The project will recommend an optimised approach to forecasting wind power output. The cost of rolling this out across the GB system is not yet clear as it depends on the recommendations that will come from the project. It is likely that further development to integrate these recommendations into day to day operations will be required at which time roll out costs will be established.

### 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 system operability theme in NGET's innovation strategy with a focus on smarter system operation to enable efficient operation with the network challenges posed by wind generation.

- 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.**

Upon review of other licensees IFI annual reports and academic knowledge in the area, the project manager has confirmed that to the best of his knowledge this is a unique piece of work.

**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