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

Sep 2013

Project Reference Number

NIA_SPT_1308

Project Registration

Project Title

Dynamic Assessment of Wind Generation Synthetic Inertia Contribution to the GB Power System

Project Reference Number

NIA_SPT_1308

Project Licensee(s)

SP Energy Networks Transmission

Project Start

October 2013

Project Duration

2 years and 1 month

Nominated Project Contact(s)

James Yu (Future Networks Manager)

Project Budget

£85,000.00

Summary

This project is concerned with identifying the possible corrective control measures that can be taken to avoid or minimise pre-fault curtailment of generation in order to maintain system stability.

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

There is concern over the future stability of power systems as they incorporate reducing amounts of conventional synchronous machines and increasing quantities of wind farms. As a result there is an increased interest in the provision of synthetic inertia from wind power plants to introduce more stability to the system.

There are two main situations where the stability of the system could be improved by synthetic inertia:

- Firstly, during a major loss of generation or interconnection capacity

- Secondly, during a short-circuit fault on the system. In this case the fault results in an acceleration, usually limited by the inertia of a rotating plant, due to the reduced active power demand on generators in the vicinity of the fault. In particular in longitudinal power systems of in the long transmission lines between areas with concentrated generation and loads, such as the GB's North-South interconnectors.

Clearly, operation of wind generation on the power system will impact on the first swing stability of conventional synchronous machines following a network short circuit fault. However, the timescales for response to allow effective action to be taken in time to affect the first swing stability are challenging, with detection of a fault event within 10/20 ms, followed by initiation of response from the wind capacity within 60-80ms.

Method(s)

In the two cases outlined in the section above, synthetic inertia could improve the system as following:

- In the first case an inertial response from a converter-interfaced energy source, in the form of a temporarily increased real power contribution, would be desirable following the detection of a significant drop in the system frequency and/or increase the rate of change of frequency

- In the second case some form of response from wind farms (either through reducing/ceasing to supply power, or ideally, by sinking power from the accelerating system) is desirable.

In addition careful modelling of the power system, turbines, inverters and their control, could provide a good guide as to what can be expected from the wind plant, but the more difficult engineering challenge is the provision of a robust and reliably fast fault detection system.

Scope

This project is concerned with identifying the possible corrective control measures that can be taken to avoid or minimise pre-fault curtailment of generation in order to maintain system stability.

Objective(s)

The objectives of the work is as follows:

1. Investigate the potential contribution of wind farms to the GB system inertia focusing on the first-order inertial behaviour (i.e. first swing stability of conventional synchronous machines)

2. Assess wind farms' potential contribution to frequency stability

3. Detailed modelling of wind turbines (mechanical, power electronics and control systems) to examine the implications on the turbines themselves when providing synthetic inertia.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be deemed successful if the system stability is increased with the use of synthetic inertia, and as a result remains reliable.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project is designed to get maximum output from minimal cost as it will limit the investigation within the Scottish transmission network, while the learning can be shared with the whole GB licensees. Any smaller scale project would reduce the learning potential as it would not fully simulate real time network operation.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

SPT network, and north of B6.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

The total NIA expenditure is expected to be £85,000.

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:

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 aims to accelerate the adoption of IEC 61850 and IEC 60870-5-101. This will deliver financial benefits by the following means:

- Reduced engineering through re-usable designs
- Risk mitigation measures to safeguard the transmission network reliability
- Increased off-line studying capacities to explore the dynamic limitation of the transmission network
- More high-level expertise will be developed to understand the risks associated with low inertia network
- Potential contribution to the future close loop control

Please provide a calculation of the expected benefits the Solution

N/A

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

The study of the Scottish Network within the context of the GB transmission network will provide a valid reference for other transmission zone (boundaries). The active connection requests from new renewable generators can be found within each transmission licensee's area. From that point of view, the method developed in the proposal will be applicable to other transmission network (with increasing new renewable proportions).

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

As all works and the development of solutions using the facility will be completed by ScottishPower and Iberdrola staff, there will be full knowledge transfer within the ScottishPower/Iberdrola group. The research will be available to the other Network Operators and we envisage them using this learning and knowledge. We believe that manufacturers will be involved in the knowledge transfer process also. Consequently, it is not envisaged that there will be a cost to roll out a similar facility elsewhere.

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 will be focused on Scottish power's transmission network, and take into account the Scottish transmission network as a whole to some extent. This was due to the fact that the phenomenon might be more obvious when larger proportion of new renewable generators were connected to the network. However, the control parameters identified and the control philosophy will be the same and can be shared among licensees.

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.

n/a

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