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

Feb 2014

### Project Reference Number

NIA_NGET0029

## Project Registration

### Project Title

Optimising the operation of an integrated DC link within an AC system (ICase Award)

### Project Reference Number

NIA_NGET0029

### Project Licensee(s)

National Grid Electricity System Operator

### Project Start

October 2011

### Project Duration

3 years and 7 months

### Nominated Project Contact(s)

David Lenaghan

### Project Budget

£172,648.00

### Summary

The general scope of the project is to define how the system should be operated with the introduction of offshore HVDC lines to maximise the exploitation of renewable energy resources, especially wind, and the types and amounts of reserve that are likely to be required.

### Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

### Problem Being Solved

Determination of quite how the system should be operated in the latter part of the present decade and beyond will be critical to maximising the exploitation of the renewable energy resources in the north of Britain, especially Scotland. This presents a variety of questions that need to be clearly understood, this includes;

- the western HVDC 'bootstrap' is a line commutated converter system. How sensitive will its stable operation be to different generation despatches at the northern end? For example, will commutation continue to be robustly achieved when the only significant synchronous generation operating in Scotland is at Torness and Peterhead, with some situations in which only Peterhead might be running (for example, when Torness is being refuelled)?
- What type of fault on the HVDC link should be secured against, e.g. loss of a single bipole?
- How should the power transfer on the HVDC link be despatched in order for there to be security in respect of the total transfer out of Scotland? Would the need to secure against possible loss of an AC double circuit or a single bipole on the HVDC link dictate only a part-loading of the link relative to its capacity, a development of existing inter-tripping schemes or the carrying of some minimum amount of response and reserve within particular areas of the system, e.g. low frequency reserve in England?
- On the GB system as a whole, with significant wind power operating, with what frequency might generating plant need to be re-dispatched? What new problems would that present to operators?
- Assuming that the quality of a forecast of available wind power can be quantified alongside a central forecast, how could or should the information be used by the operator?

## Method(s)

**Research**

This project will utilise work previously undertaken by the University of Strathclyde which defines the characterisation of the wind resource to gain an understanding of possible ranges of

- availability of wind power,
- how it varies across Britain
- how it changes through periods of a few hours down to tens of minutes.

This analysis will be used to gain an understanding of the possible scenarios of 'final physical notifications' (FPNs) that might be submitted by generation operators to the GBSO. Advanced software tools will enable these scenarios to be sampled and tested in terms of impact on system operation and security. This will generate simulations and statistical analysis of patterns of behaviours that can be identified across a large set of scenarios. This will identify clusters of behaviours that can be summarised by rules analogous to those used in expert systems.

## Scope

The general scope of the project is to define how the system should be operated with the introduction of offshore HVDC lines to maximise the exploitation of renewable energy resources, especially wind, and the types and amounts of reserve that are likely to be required.

## Objective(s)

The objectives of the project include:-

- Study different scenarios of generation and contingencies in the UK grid to assess the stability of LCC HVDC representing the Western HVDC Link,
- Study the interaction of different HVDC technologies and potential for coordination between the technologies representing the Deeside area of the UK grid where multiple HVDC links will terminate in close proximity,
- Study of multiple HVDC infeeds to a simple AC node to assess potential for offshore AC hubs with LCC HVDC.

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

n/a

## Success Criteria

The success criteria of the project will be four annual reports, to include:-

- First year Report – summary of steady state analyses of power flows for different levels of dispatch on the HVDC link.
- Second Year Report – development of metrics and analysis environment for study of system stability.
- Third Year report – report on initial stability assessments.
- Final Report – including recommendations for operation of HVDC link.

## Project Partners and External Funding

University of Strathclyde

Engineering and Physical Sciences Research Council (EPSRC) provide £68,648 external funding

## Potential for New Learning

The study will enable a greater understanding of the risks associated with different levels of power dispatched pre-fault on the western HVDC link that is being operated in parallel with the AC and advice on suitable levels of dispatch on a parallel HVDC link

## Scale of Project

The scale of the project will be a desktop study

## Technology Readiness at Start

## Technology Readiness at End

| | |
|---|---|
| TRL2 Invention and Research | TRL3 Proof of Concept |

## Geographical Area

The research will be undertaken in Strathclyde

## Revenue Allowed for the RIIO Settlement

None

## Indicative Total NIA Project Expenditure

The total NIA project expenditure is £104,000

# 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 will assist in realizing the cost benefits generated from the DC connection between Scotland and England currently in the planning phase. It is estimated that this project will reduce constraint cost by 100MW. This is likely to occur approximately 876 hours (10%) of the time in the year providing an estimated saving £4.4 million per year.

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

Not required for a research project

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

The Method is of direct relevance to the Western HVDC link currently in construction and will also be of relevance to any future HVDC links that integrate into the AC network.

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

The implementation plan and costs of the project will be dependent on the learning outcomes; this will be defined during final year reports. The implications of these outcomes on the operational side of the business will be feed into the business via the National Grid project engineer.

## 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 develop key learning relating to the operation of offshore HVDC lines and integration with the AC network. This wil be of immediate relevance to Scottish Power Transmission and NGET with respect to the western HVDC link, and future relavance to SHE Transmission with respect to future HVDC links.

### 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.

To the best of our knowledge there are no other projects investigating the impact of offshore HVDC lines on the operation of the network

### 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