nationalgrid

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 0001

### Project Reference

NIA_NGSO0031

## Project Registration

### Project Title

NIA_NGSO0031

### Project Reference

NIA_NGSO0031

### Project Licensee(s)

National Grid Electricity System Operator

### Project Start Date

May 2020

### Project Duration

1 year and 0 months

### Nominated Project Contact(s)

Djaved Rostom

### Project Budget

£250,000.00

### Summary

The proportion of power that is injected into the GB grid via AC/DC converters is rising rapidly: modern wind turbines, battery storage, solar farms and HVDC links all use this technology. The previous NIA project 'Transient Voltage Stability of Inverter Dominated Grids and Options to Improve Stability' (NIA_NGET0187) identified that at high levels of converter use certain parts of the grid can become vulnerable to a new form of instability following fault conditions considered to be credible by the SQSS. This instability, which is caused by the way that the control systems within the converters operate, needs to be properly identified in ESO's studies if Britain's current high level of supply reliability is to be maintained.

The objectives of this project:

- Validating the conclusions of NIA_NGET0187 regarding grid stability.
- Research into practical tools for the application of advanced grid modelling for system operations.

### Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

### Problem(s)

The proportion of power that is injected into the GB grid via AC/DC converters is rising rapidly: modern wind turbines, battery storage, solar farms and HVDC links all use this technology. The previous NIA project 'Transient Voltage Stability of Inverter Dominated Grids and Options to Improve Stability' (NIA_NGET0187) identified that at high levels of converter use certain parts of the grid can become

vulnerable to a new form of instability following fault conditions considered to be credible by the SQSS. This instability, which is caused by the way that the control systems within the converters operate, needs to be properly identified in ESO's studies if Britain's current high level of supply reliability is to be maintained.

The studies undertaken as part of NIA_NGET0187 were based on a simplified representation of the GB grid, and used generic models for all converters. This meant that although NIA_NGET0187 demonstrated that converter-instability could exist in the GB context, it was not able to provide quantitative guidance for the conditions under which it would and would not occur (e.g. "to ensure stability no more than X MW of non-synchronous generation should run in this region"). Such guidelines are necessary for secure system operation. In addition, NIA_NGET0187 did not consider practical issues for system operation such as how to warn of grid situations requiring more detailed study, or providing guidance for undertaking such detailed studies.

## Method(s)

An advanced model of the most relevant part of the GB grid will be used which will be suitable for deriving quantitative operational guidance for this part of the grid. This will be done by:

i) Replacing many of the generic converter models with manufacturer-provided models.
ii) Using a more complete model of the wider British grid network.

In addition, work will be undertaken to research how the use of advanced models can be made more practical:
iii) Providing guidance on how ESO should use this type of advanced model.
iv) Investigating tools that help indicate where advanced models and more detailed stability analysis are necessary.

## Scope

The work is to comprise:

1. Obtaining suitable high-fidelity models of converters in the area of interest and integrating these into a suitable advanced model for stability simulations. Drawing conclusions regarding the implications for future grid security and grid modelling.
2. Providing "guidance notes" for ESO on the use of advanced models and techniques for conducting detailed stability analysis.
3. Investigating tools that would give "early warning" of situations on the grid where advanced modelling techniques and detailed analysis might be required to ensure stability.
4. Investigating whether the representation of grid demand needs to be upgraded.

## Objective(s)

- Validating the conclusions of NIA_NGET0187 regarding grid stability.
- Research into practical tools for the application of advanced grid modelling for system operations.

## Success Criteria

- A report on the stability of the part of the grid examined, including lessons learnt in obtaining high-fidelity ("black box") models of converters.
- A report providing guidance on the practical use of advanced grid models.
- Reports describing research into tools to help identify situations where advanced stability models and more detailed analyses are needed, and research into the representation of grid demand.

## Technology Readiness Level at Start

TRL 4

## Technology Readiness Level at End

TRL 6

## Potential for New Learning

True

## Scale of Project

The project involves detailed technical analysis and model enhancement, along with interfacing with manufacturers. It will take place over approximately 1 year.

## Geographical Area

Potential application to the whole GB grid

## Revenue Allowed for the RIIO Settlement

None.

## Indicative Total NIA Project Expenditure

£250,000.00

# Project Eligibility Assessment 1

## Specific Requirements 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 the GB the Network Licensee must justify repeating it as part of a Project) equipment (including control and communications systems and 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 Licensee's System

☐ A specific novel commercial arrangement

## Specific Requirements 2

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

**Please explain how the learning that will be generated could be used by relevant Network Licenses.**

### Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

The top priority identified by ESO in its innovation strategy is "System Stability". This project is directly relevant to the challenge of maintaining system stability as it allows the identification of situations where converters may cause grid instability – something which cannot be done confidently using the tools and models in general use today.

**Is the default IPR position being applied?**

☑ Yes

# Project Eligibility Assessment 2

**Potential Benefit to Customers**

### Please provide an estimate of the saving if the Problem is solved.

As the level of converter use continues to increase, the risk of instability will rise. If we do not have an accurate indication of the level of instability, then we risk serious system disturbances occurring, which could cause economic disruption of many millions of pounds. Understanding the new stability risks and when they occur will also enable the system to be operated more efficiently by avoiding unnecessary constraints.

### Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost - Method Cost, Against Agreed Baseline).

This project aims to reduce the likelihood of a system event occurring due to system instability, therefore the cost minus method approach is not applicable here.

### Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

The solution being explored would be applicable to all parts of the GB transmission system, and lessons could also be applied to distribution system modelling.

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

The results of this study will inform the assessment of the necessity, and potential costs, of a general roll-out of the method.

# Additional Governance Requirements

## Please identify

## i) Please identify why the project is innovative and has not been tried before

## ii) Please identify why the Network Licensee will not fund such a Project as part of its business as usual activities

## iii) Please identify why the Project can only be undertaken with the support of the NIA, including reference to the specific risks (eg commercial, technical, operational or regulatory) associated with the Project

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

- [x] Yes