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NIA Project Registration and PEA Document

Date of Submission

Feb 2023

Project Reference Number

NIA2_NGESO040

Project Registration

Project Title

DETECTS II

Project Reference Number

NIA2_NGESO040

Project Licensee(s)

National Grid Electricity System Operator

Project Start

March 2023

Project Duration

1 year and 0 months

Nominated Project Contact(s)

Sami Abdelrahman (ESO)

Project Budget

£150,000.00

Summary

Across the GB grid, more power is being contributed by wind turbines, solar farms and HVDC links, and this increase is expected to continue as we transition to a zero-carbon energy system. At present, all of these power sources use grid-following converters. The original DETECTS project confirmed that the proliferation of grid-following converters in the South East Coast part of the GB grid, revealed limitations in the ESO's existing software tools to calculate accurate stability limits. The ESO requires a suitable method for calculating stability limits to ensure security of power supplies from the grid is to be maintained.

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

Across the GB grid, more power is being contributed by wind turbines, solar farms and HVDC links, and this increase is expected to continue as we transition to a zero carbon energy system. At present, all of these power sources use grid-following converters. The original DETECTS project confirmed that the proliferation of grid-following converters in the South East Coast part of the GB grid, revealed limitations in the ESO's existing software tools to calculate accurate stability limits. The ESO requires a suitable method for calculating stability limits to ensure security of power supplies from the grid is to be maintained.

Method(s)

The original DETECTS project developed a prototype system (TRL: 6) for the analysis of stability in the South East Coast. This included existing commercial software already in use within the ESO (PSCAD), software independently written by Transmission Excellence prior to the original DETECTS project (TXSims), a PSCAD model of the GB grid independently created by Transmission Excellence, and "black box" models obtained and integrated by Transmission Excellence as part of the original DETECTS project.

DETECTS II will take this system to the pilot demonstration stage (TRL: 7), with the software and model being licenced to the ESO and

training provided to employees to use the integrated analysis system prototyped by the original DETECTS project. This Method combines both commercial aspects (e.g. licencing of software and models) and technical aspects (e.g. the use of the integrated software and model to analyse the South East Coast as part of actual planning and operation of the transmission system).

In line with the ENA's ENIP document, the risk rating is scored Low:

- TRL Steps = 1 (TRL change 1)
- Cost = 1 (<£500k)
- Suppliers = 1 (1 Supplier)
- Data Assumptions = 1
- Total =4 (Low)

Scope

The work is to comprise:

- Licensing of software and model.
- Setup of software and model on ESO computer.
- Training of ESO employees to use the model of the South East Coast.
- Use of the model to determine stability limits of South East Coast; includes ongoing technical support by Transmission Excellence.

Objective(s)

The objectives of this project are to:

1. Deliver practical tools for the application of advanced grid modelling for system operations.
2. Validate the stability limits in the South East Coast by utilising suitable high-fidelity models of converters and applying EMT based analysis.
3. Deliver training and support to the ESO in the use of the advanced modelling tools developed.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has been assessed as having a neutral impact on customers in vulnerable situations because it is a transmission project.

Success Criteria

This project will be regarded as successful if:

1. The software is successfully installed on ESO equipment and training is provided to all relevant ESO employees.
2. The software enables the ESO to more accurately calculate the stability limit(s) for the South East Coast.

Project Partners and External Funding

The work will be executed by Transmission Excellence Ltd, no external funding required.

Potential for New Learning

The main expected learnings come from the pilot-stage demonstration (TRL: 7) of using an electromagnetic transient simulation tool (PSCAD), and manufacturer-provided detailed converter models ("black box" models) to undertake stability limit calculation as part of the actual planning and operation of the grid. Within this, noteworthy areas of learning include experiences from:

- Automation of model building
- Practical use of the tools and models to assist in the planning and operation of a part of the GB grid

Learnings produced in the course of the project will be disseminated through discussions with the ESO, relevant Transmission Owners (TOs) and through public dissemination routes such as webinars and conferences.

Scale of Project

The project is small in scale, carried out with one project partner over 12 months. The scale is appropriate to provide the level of model detail needed to accurately calculate stability limits.

Technology Readiness at Start

Technology Readiness at End

TRL6 Large Scale

TRL7 Inactive Commissioning

Geographical Area

The “South East Coast” (the 400kV substations that lie along the overhead line route from Bolney to Cleve Hill inclusive) is to be used as the area for the “pilot demonstration” associated with TRL 7. Ultimately (i.e. beyond the scope and timing of DETECTS II) it may be applied across much wider parts of the GB grid.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£150,000

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:

The project will facilitate the energy system transition by:

- Ensuring security of supply to electricity consumers, despite the stability challenges created by the growing integration of grid-following converters (a type of AC/DC converter which is used in all current designs of wind turbine, solar farm, and HVDC links).
- Avoiding unnecessary restrictions on the deployment or use of renewable generation that is based on grid-following converters (all current designs of wind turbine and solar farm are in this category).
- Avoiding unnecessary over-investment in transmission (e.g. synchronous compensation), with excessive investment being needed due to uncertainty regarding the true stability limit.

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)

N/A

Please provide a calculation of the expected benefits the Solution

As the level of grid-following converter use continues to grow, the risk of instability will also rise. Without an accurate indication of the level of instability, the risk of serious system disturbances occurring increases, which could also have significant economic impact. For instance, a single major supply failure could cost up to £100m, even if it was limited to the South East Coast, and if a failure in the South East Coast triggered a national failure, the costs could be significantly higher. Understanding the new stability risks and when they occur will also enable the system to be operated more efficiently by avoiding unnecessary constraints.

The high-level benefits to consumers are reliable electricity supplies (avoiding the severe financial costs that would be associated with a major blackout), lower electricity wholesale costs (through avoiding unnecessary restrictions on the deployment or use of wind and solar, the lowest-cost sources of energy), and lower transmission tariffs (through avoidance of unnecessary investments to improve stability).

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

The software and modelling techniques being applied to the South East Coast in the DETETCS II project are equally applicable to other parts of the grid where high levels of grid-following converters and low fault levels mean that current stability assessment tools have limitations. It is very likely that this issue will occur in multiple parts of the GB grid as synchronous generation (e.g., coal, gas) is displaced by grid-following converters (e.g., wind, solar). Ultimately, it is estimated that there may be a dozen or more parts of the GB grid where similar stability issues will emerge over the next decade or so.

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

Rolling out the method across GB (i.e. to maybe a dozen parts of the grid, as noted above) would not require software tools or the GB-wide model of the GB grid to be re-written or re-licenced. Thus, the cost of applying the method to other parts of the grid would be modest (estimated £50-100k per grid region), with most of the cost being related to obtaining and integrating manufacturer (“black box”) models and validating the accuracy of the model.

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 new learning, in relation to the practical use of the software and model, is of immediate use to the ESO in its role as System Operator. It would also benefit National Grid Electricity Transmission (NGET) in its role as TO in the South East Coast.

If the method is subsequently rolled out more widely then this learning may also be applicable to other TOs.

In addition, learnings regarding the automation of model building (and automation tools generally) and obtaining manufacturer-provided detailed converter models for renewables and HVDC (and their testing and integration) may be more widely applied to other models, tools and software used by the ESO and TOs.

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

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.

No other projects using advanced modelling tools to undertake the accurate calculation of stability limits on the GB grid have been carried out.

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 concept of utilising EMT analysis for wider regions of the network is relatively new – specifically with the integration of number of black box models in the same region. As such there has been little research conducted in this area.

Relevant Foreground IPR

No foreground IPR expected to be generated in the project.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

1. A request for information via the Smarter Networks Portal at <https://smarter.energy.networks.org>, to contact select a project and click 'Contact Lead Network'. National Grid ESO already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
2. Via our Innovation website at <https://www.nationalgrideso.com/future-energy/innovation>.
3. Via our managed mailbox innovation@nationalgrideso.com.

Details on the terms on which such data will be made available by National Grid ESO can be found in our publicly available "Data sharing policy relating to NIC/NIA projects" at <https://www.nationalgrideso.com/document/168191/download>.

Please identify why the Network Licensees will not fund the project as part of it's business and usual activities

The proposed method is TRL 6, and therefore further investment is required to increase the TRL to the point where it can be considered ready for business-as-usual use (typically, a method that has been fully tested and approved, and is ready for roll-out as business-as-usual would be classed as TRL 8)).

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 support is required to bring the use of advanced modelling tools in the South East Coast from TRL 6 ("prototype") to TRL 7 ("pilot installation", with – in this case – the South East Coast being the area where new techniques are being piloted). As a result of the TRL currently being lower than necessary, the advanced modelling tools currently carry an unacceptable level of technical and operational risks.

As the method has not yet reached the level of maturity that would be required to be considered as business-as-usual, NIA support is required to pilot the approach and increase the TRL..

This project has been approved by a senior member of staff

Yes