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_NGSO0036

Project Registration

Project Title

NIA_NGSO0036

Project Reference

NIA_NGSO0036

Project Licensee(s)

National Grid Electricity System Operator

Project Start Date

June 2020

Project Duration

1 year and 6 months

Nominated Project Contact(s)

Sami Abdelrahman

Project Budget

£340,000.00

Summary

In this project, we will explore, develop and test cutting-edge automated and probabilistic approaches for modelling of angular stability. This will enable year-round boundary capability calculation for stability accounting for a number of sources of variability and uncertainty and enabling ESO to consider the possible issues across the system.

Nominated Contact Email Address(es)

box.SO.Innovation@nationalgrid.com

Problem(s)

Due to decline in traditional synchronous generators and increase in converter-based generation, the transmission system is expected to see more localised stability issues which are expected to drive costs on the networks in the future. Currently, National Grid Electricity System Operator (ESO) undertakes stability studies with focus on areas with known issues of stability or anticipated issues based on Future Energy Scenarios (FES) projection. The power system modelling tools and techniques that are currently used for stability studies are time consuming.

Due to this, it is not practical to study a wide range of network and generation background scenarios that reflect all the possible sources of uncertainty (e.g. interconnector flows) and variability (e.g. wind speeds) that can affect the network condition, or to assess every boundary in the system. This could mean that, in the future, ESO could overestimate or underestimate boundary transfer capability, where there are unforeseen stability issues, leading to higher and potentially inefficient constraint costs.

Method(s)

This project will be completed across four work packages.
WP1: Initiation & Review.
WP2: Development & Reduced-scale Testing.
WP3: Trialling on Full GB Model.
WP4: Future Roadmap & Plan for Implementation.

Scope

There is increasing uncertainty (e.g. load composition, line flows through interconnectors) and variability (e.g. wind speed) in power system operating conditions and parameters. The changes in the system operating conditions are happening faster, are more complex and are occurring in places where previously there were no issues. There is an expectation of more angular stability issues in the future due to reduction in synchronous generation and system inertia (e.g. as reported in the FES).

Lack of automation in the assessment of stability means that the ESO has to prioritise boundary calculation due to computation time – analysis can be very time consuming and so is focussed on specific areas of the transmission network. For long term planning, power system analysis is currently carried out using deterministic approaches (e.g. selected background studies such as Winter Average Cold Spell – ACS demand or summer minimum demand). These technical studies do not consider all the variability and uncertainty associated with future energy scenarios which could have a significant impact on stability. In the future, this might lead to under- or over-estimated transfer capabilities and sub-optimal techno-economic solutions.

In this project, we will explore, develop and test cutting-edge automated and probabilistic approaches for modelling of angular stability. This will enable year-round boundary capability calculation for stability accounting for a number of sources of variability and uncertainty and enabling ESO to consider the possible issues across the system. This work will be completed across four work packages:

WP1: In this initiation work package, we will review academic literature, review the overlap and available learning from existing and ongoing work, and identify any policy and practical barriers that could affect possible implementation. In this work package TNEI will engage closely with ESO during the annual ETYS/NOA cycle to understand how new angular stability modelling methods will fit into the process and ensure the development of fit for purpose tools.

WP2: In the development work package, we will trial the most promising methods on published test networks or reduced GB networks, to explore how different approaches perform in terms of e.g. accuracy, computation time. This will include methods for (i) screening the network to identify previously unforeseen stability issues, (ii) automated probabilistic evaluation of stability issues, (iii) quantify the uncertainty within the model and key model parameters, and (iv) development of a probabilistic model that captures correlations between demand and renewable generation.

WP3: In the trialling work package, we will engage with the Network Development teams during the 2021/22 Electricity Ten Year Statement (ETYS) and Network Operability Assessment (NOA) planning cycle, testing the most promising methods on the full GB electricity transmission system models. The learnings, where applicable, will also be shared with other relevant ESO teams like the Operability teams.

WP4: In the final work package, we will produce a plan for later implementing the tools into business-as-usual, and produce a roadmap for possible future changes (e.g. in regulation or planning standards) that could help deliver further value for GB energy consumers.

Deliverables: These will include (i) innovative automated tools to possibly be used in the ETYS and NOA, to carry out automated probabilistic stability analysis for stability evaluation processes (e.g. probabilistic demand and renewable generation conditions model, method to screen networks for stability issues, probabilistic tool that supports automated power system analysis using Powerfactory) (ii) reports detailing the development and demonstration of these methods (iii) results from the models that are suitable for sharing with third parties (i.e. in NOA and ETYS publications), and (iv) a roadmap and evidence for further future development.

Objective(s)

The objectives of this project are to explore the use of cutting-edge techniques (combining traditional power systems stability analysis and statistical modelling), and whether these allow the ESO to better understand the risk and uncertainty associated with angular stability on the GB electricity system. The result of this will be to produce automated tools to allow efficient stability evaluation for more snapshots and locations in the system.

This could help the ESO to make more optimal economic decisions with respect to secure and stable operation of the system.

Success Criteria

The project will be a success if the developed tools will provide the ESO the capacity to accurately and efficiently evaluate stability constraints for more regions and more snapshots, with a Roadmap to integrate the tools within the ESO existing tools for the planning cycle of 2022/23.

Technology Readiness Level at Start

TRL 3

Technology Readiness Level at End

TRL 7

Potential for New Learning

True

Scale of Project

The project is desk-based.

Geographical Area

The project activities will be desk based.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

£340,000.00

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.

This project fits against the following strategic priority areas as identified by the ESO in its Innovation Strategy published March 2020:
System stability

- Improve our understanding of how the system behaves with lower levels of inertia

Constraint management

- Explore sophisticated new tools and techniques for forecasting constraints of all types and in different scenarios of supply and demand
- Develop new tools and processes for decision making under uncertainty

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.

Proactive optimal decision making will help prevent future inefficient constraint cost. As an example, in 2019 the ESO spent ~£200m on RoCoF constraints. A 1% saving in a cost of this magnitude would mean >£10m NPV over 10 years. This project will help to assess the benefits more robustly.

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).

The 1% saving quoted in the section above is an estimate based on the assumption the improved evaluation of stability will allow ESO to improve the network option selection which in turn reduce future constraint costs. These savings would be realised by Network companies and are difficult for the ESO to quantify, the example above indicates that even a small improvement in constraint costs would have a significant financial benefit.

More accurate estimates could be calculated by the ESO, by comparing the annual NOA CBA results of the improved NOA decisions after applying the enhanced stability analysis in the NOA 2021/22.

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 project aims to deliver an efficient probabilistic stability assessment methodology/ies and tools that could provide improved outputs for all relevant ESO processes (e.g. NOA, stability pathfinder, other NIAs/NICs, etc). The tools can also utilized by TOs to evaluate stability in their networks.

It will be implemented by the ESO to improve the 2022 NOA process, which will inform system-wide investment decisions.

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

The project will identify and compare a number of probabilistic stability methodologies with different associated levels of cost (due to e.g. computational resource, time resource, data inputs etc) and accuracy, and develop, test and trial the most promising. As some of the project deliverables are software tools, a minor roll out cost might be needed, e.g. to increase hardware capabilities.

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

☑ Yes