NIA Project Annual Progress Report Document

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Date of Submission

Jul 2024

Project Reference Number

NIA2_NGESO046

Project Progress

Project Title

STARTZ (Stability Requirements Calculation Toward Net-Zero)

Project Reference Number

NIA2_NGESO046

Project Start Date

March 2023

Project Duration

1 year and 6 months

Nominated Project Contact(s)

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Scope

Decarbonisation is bringing technical challenges that include the management of potential stability issues caused by the reduction in inertia and short circuit levels. In order to overcome potential stability problems while keeping economic and secure operation, NOA Stability Pathfinder projects have been looking to find and procure alternative sources of stability support.

One key aspect to the NOA Stability Pathfinder project or any other future stability services procurement process is the calculation of future system stability needs. Overestimation or underestimation of system needs potentially represents, respectively, unnecessary costs for consumers or system vulnerability with increased risk of blackouts.
The current methodology to calculate the system stability needs is based on several assumptions, criteria and simplifications that should be revised and improved following network evolving and energy landscape transition. Also, since a number of future generation and demand dispatches are considered, a higher level of automation in the calculation process is required.

This project will review the current methods of calculating system stability and identify areas of improvement, performing the analysis on a sufficiently granular representation of the active and passive network components in the GB system. Bases on this analysis, It will apply automation and other necessary methods (machine learning) to manage additional computational burden of using detailed network representation.

Objectives

The existing tool to compute system needs is a standalone process and is not integrated with any of the NOA tools or ETYS models. The calculations are based on empirical formulas. At the same time, the year-round analysis computes hourly generation and demand dispatches to identify the amount and the location of the services that need to be procured. These dispatches have a temporal variation which is captured through a time series analysis. The current tool is, however, not able to consider spatial uncertainty for inertia assessment, as the model is a lumped representation of the GB system. This project, therefore, seeks to achieve three main objectives:

1. Review the current methods of calculating system stability needs and identify areas of improvement.
2. Perform the analysis on a sufficiently granular representation of the active and passive network components in the GB system.

3. Implement automation and other necessary methods (machine learning) to manage additional computational burden of using detailed network representation.

Success Criteria

The project will be considered successful if the following criteria are met:

- Creation of an improved methodology and associated new tools which will interface with the detailed DIgSILENT Powerfactory model of the GB system to allow year-round calculating of system stability needs.
- Development of the ability to perform granular calculations of year-round system stability needs by implementing a set of automation and machine learning techniques.
- Validation of the new tool's output against accurate outputs from DIgSILENT Powerfactory and the measured values from ESO operation.
- Dissemination and training for learnings and tools developed in the project.

Performance Compared to the Original Project Aims, Objectives and Success Criteria

National Grid Electricity System Operator ("NGESO") has endeavoured to prepare the published report ("Report") in respect of STARTZ (Stability Requirements Calculation Toward Net-Zero), NIA2_NGESO046 ("Project") in a manner which is, as far as possible, objective, using information collected and compiled by NG and its Project partners ("Publishers"). Any intellectual property rights developed in the course of the Project and used in the Report shall be owned by the Publishers (as agreed between NG and the Project partners).

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The project is split into three work packages (WPs) and seven main deliverables. WP1 consists of reviewing the current methods of calculating system stability needs and identifying areas of improvement. Due to data sharing arrangements the WP1 deliverables have been pushed back a few of months until updated security agreements are in place to allow the sharing of confidential information.
WP1 is now completed and produced the first deliverable of the project. The WP1 report have included a review of the current methods for calculating system stability needs and identify areas of improvement, specifically looking at inertia, short circuit level and voltage. Following completion of WP1, WP2 is now focusing on implementing alternate methods based on the findings of WP1, which will include workshops with key stakeholders to gather scenario data and reviewing the Electricity Ten Year Statement (ETYS) model to then perform the analysis on a sufficiently granular representation of the active and passive network components in the GB System. The key deliverables in WP2 include a machine learning approach to resolve system convergence issue, a scoring system to evaluate different indices and the automation framework for system needs assessment. The WP2 is scheduled to complete in July 204 with WP2 report formed.
WP3 is not started yet but has been planned to conduct in Aug-Dec of 2024, which will continue tasks initiated from WP2 and including workshop, training, and final tool handover etc.

Required Modifications to the Planned Approach During the Course of the Project

Due to the nature of the project, some of the data which needed to be shared with our project partner, TNEI, was classed as confidential. This has meant that we have had to upgrade some of the security levels within the contract before the data can be shared, hence pushing back some of the WP1 deliverables and the following WP2 & WP3 timeline.

Lessons Learnt for Future Projects

Data sharing especially confidential or sensitive data sharing between NGESO and NIA project partner would be paid more attention for proper arrangement and timeline plan.
Set a clearer and more practical procedure and policy to facilitate data sharing between NGESO and external project partner including security measurement & check, data sharing/storage facility and relative NDA, data protection policy etc.
Work to improve appropriate data classification to allow more useful data could be shared with project partner.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

The WP1 report provides a summary of the current methods for calculating inertia, short circuit, and voltage management requirements in the GB system. To extend these methods to a scenario-based year-round analysis, a review of different indices is included in the report. These indices are available in literature for different applications, and not every index is appropriate for the purpose of the project. To aide in the selection of a subset of indices that are most suitable, a qualitative comparison is included in the report along with suggestions for further implementation in WP2. Furthermore, the report covers the fundamentals of unsupervised machine learning methods such as different clustering algorithms. These algorithms can be used in an innovative way to resolve the problem of non-convergence of load flow solutions and is pivotal to the success of this project.

WP2 report will cover the development of the power factory automation framework to interface with the detailed GB system model. This framework will allow ESO to study half-hourly scenarios using data from the market dispatch simulator for system needs assessment. The details of the framework along with the machine learning approach for load flow convergence, the different indices for system needs calculation and a scoring system for final index selection will be included in this report.

Some of the key deliverables through WP1 & WP2 are a comprehensive literature review of indices for inertia and short circuit calculation, a DIgSILENT power factory automation framework, a machine learning approach to resolve network convergence issues, voltage profiling algorithm, and system needs assessment for half-hourly scenarios.

A paper on the initial work on the machine learning algorithm for network convergence is accepted for presentation in CIGRE Paris 2024.

Data Access

Details on how network or consumption data arising in the course of NIA funded projects can be requested by interested parties, and the terms on which such data will be made available by National Grid can be found in our publicly available “Data sharing policy related to NIC/NIA projects” and www.nationalgrideso.com/innovation.

National Grid Electricity System Operator already publishes much of the data arising from our NIC/NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published.

Foreground IPR

The following foreground IPR is expected to be generated in the course of the project:

An improved methodology and associated new tools which will interface with the detailed DIgSILENT Powerfactory model of the GB system to allow year-round calculation of system stability needs.
Training materials for learnings and tools developed in the project.