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

Oct 2024

Project Reference Number

NIA2_NESO095

Project Registration

Project Title

Grid Connection Simulator tool (GridConnectX)

Project Reference Number

NIA2_NESO095

Project Licensee(s)

National Energy System Operator

Project Start

October 2024

Project Duration

1 year and 7 months

Nominated Project Contact(s)

innovation@nationalgrideso.com

Project Budget

£370,000.00

Summary

The TOTEM network innovation project NIA_SHET_0045 has developed a comprehensive PSCAD/EMTDC model of Great Britain's National Electricity Transmission System (NETS) to manage the transition towards high inverter-based generation, including wind and HVDC, aiming for Zero Carbon Operation by 2030.
Facing challenges in sharing confidential data for Grid connection studies, a new tool is proposed. This tool would allow vendor plant owners to connect their proprietary models at designated points for EMT studies without accessing sensitive network data. It would facilitate multi-vendor participation, secure data sharing, and reduces reliance on non-disclosure agreements, streamlining the process for grid connection studies.
This innovation enhances network stability, accelerates model validation, and supports the integration of renewables, benefiting operators, OEMs, and the broader energy sector.

Preceding Projects

NIA_SHET_0045 - TOTEM (Transmission Owner Tools for EMT Modelling) 2

Nominated Contact Email Address(es)

Innovation@neso.energy

Problem Being Solved

The current problem is that:

- In response to the August 2019 power outage blackout that affected over a million customers, modifications to Grid Code GC0141 now require Generators and HVDC Interconnector Owners to provide detailed and validated Electromagnetic Transient (EMT) models to ensure grid stability and to be used for studies like oscillations and interactions.
- For the new IBR connections, Users are requesting that NESO provide network models, and sometimes there is a need to share nearby user EMT models to ensure there is no negative interactions.
- Sharing models, especially third-party models, is a difficult process and sometimes involves lengthy discussion with regard to NDA and IP protection

Method(s)

The proposed Grid Connection simulation tool is a secure platform that enables plant owners as well as consultants to connect their models and perform Electromagnetic Transient (EMT) studies to National Grid wider-area EMT model, without accessing (or having visibility) of confidential network and OEMs data. The platform will introduce a range of innovations that will significantly reduce the time and cost required for NDAs to be agreed upon between all parties involved in grid connection studies and allow for a process of carrying out system studies, enabling quicker and more efficient compliance studies for new connections. The platform removes the need for 'best guess' using generic models by ensuring that the EMT models used in the grid connection studies are accurate and reflective of the actual behavior. It provides opportunities for sharing models to third parties without revealing any confidential data, resulting in better scenario modeling and whole-system decision making.

The project will be delivered through the following work packages:

- WP1 – PSCAD Cloud Infrastructure Assessment
- WP2 – Determination of Hardware and Software Needs
- WP3 – Security & Collaboration Framework
- WP4 – Proof of Concept Development.
- WP5 - User Accessibility
- WP6 - Automation Tool Development
- WP7 - Scaling the Proof of Concept to Full System Application
- WP8 - Comprehensive Testing and Validation
- WP9 - Knowledge Transfer and System Handover

In line with the ENA's ENIP document, the risk rating is scored Low.
TRL Steps = 2
Cost = 1 (£350k)
Suppliers = 1 (1 supplier)
Data Assumptions = 2
Total = 6 (Low)

Scope

The scope of this project is to develop a platform (tool) for efficient grid connection of renewable energy in GB system, ensuring grid stability, and safeguarding proprietary data during connection assessments. The platform will introduce a range of innovations that will significantly reduce the time and cost required for NDAs to be agreed upon between all parties involved in grid connection studies and allow for a process of carrying out system studies, enabling quicker and more efficient compliance studies for new connections.
The proposed Grid Connection Simulation Tool offers a multitude of advantages that could demonstrate a Mutually beneficial situation for an array of stakeholders within the energy sector:
For the NESO:
Operational Efficiency: They would experience enhanced operational efficiency through accurate EMT models, facilitating precise system planning and operation.
Integration of IBR: The platform expedites the integration of Inverter Based Resources, aligning with the NESO's goals for high renewable penetration.
For the Energy Sector:
Streamlined Processes: By reducing the reliance on NDAs, the Grid Connection simulation tool streamlines the process for new grid connections, enhancing overall sector efficiency.
Improved Decision-Making: It offers more accurate data for modeling, leading to informed decision-making and robust integration of renewable resources.

For Customers:
Cost Savings: Consumers can anticipate long-term savings through the enhanced efficiency of the grid connection process and the swift adoption of renewables.
Sustainability: The platform indirectly supports societal shifts towards sustainable energy and the achievement of net-zero carbon targets.
Financial Implications:
Cost Reduction: With connection delays at offshore wind farms currently presenting a significant cost up to 15 billion GBP (for the offshore wind project alone) according to Ofgem. This platform's streamlining capabilities could do its part in reducing these expenditures.
Performance and Efficiency Savings:
Time Efficiency: The Grid Connection simulation tool is expected to markedly enhance network planning and connection times, remove going back and forth between NESO and the OEM with trial and error, surpassing current Business as Usual scenarios.
Non-financial Benefits:
Collaboration and Confidentiality: The platform promotes a secure, collaborative environment for confidential data analysis, without compromising data integrity.
Support for UK's Energy Goals: Directly aids the UK in meeting its ambitious zero-carbon operation and 50 GW offshore wind targets by 2030.
By enabling the NESO, plant owners, consultants, Ofgem, academics, and the broader society to partake in this innovative approach, the Grid Connection Simulation Tool underscores the UK's commitment to leading in the renewable energy sector. The collaboration and information-sharing facilitated by the platform enhance decision-making processes, transcend organisational boundaries, and ensure superior outcomes for network operators, OEMs, the economy, and the environment, contributing to a resilient and sustainable energy infrastructure.

Objective(s)

- The establishment of a cloud based PSCAD simulation tool that would result in significant time savings for planning and operational studies due to parallel simulation capabilities.
- A dedicated hardware setup for the PSCAD platform, either in-house or at a third-party data center, that will minimize data exchange latency and thus not impact the overall simulation speed.
- Granting third-party users access to the simulation tool will encourage collaborative development without compromising NESO's proprietary data and model integrity.
- Implementing a proof of concept on a smaller region of the NG PSCAD model will effectively demonstrate the scalability of the platform for full NG system simulations.
- The development of specialized tools to automate tasks such as the extraction of specific network regions and the provision of approved signals will improve the efficiency of granting third-party access, thereby reducing the lead time for connection studies.

Consumer Vulnerability Impact Assessment

The proposed project will not impact on consumers in vulnerable situations, except to the extent that (if the project is successful) they will also benefit financially from reduced constraints and/or reduced transmission investment. There are no distributional impacts.

Success Criteria

- Evaluate the reduction in time and complexity for new grid connections, comparing times from application to connection before and after implementation.
- Assess protection of proprietary models and sensitive data based on stakeholder feedback on security and confidentiality.
- Measure improved collaboration between grid operators, renewable energy providers and / or other customers connecting to the network and other stakeholders through surveys and user feedback.
- Analyse the solution's adaptability to changing grid conditions and the integration of various renewable energy sources, using usage statistics and the platform's ability to handle diverse requests.
- Evaluate the project's impact on grid stability and renewable energy integration through technical performance metrics, including grid disturbances and renewable capacity connected.
- Assess cost savings for grid operators, energy providers, and potentially consumers by comparing the grid connection process efficiency and the necessity of NDAs and model validations before and after project implementa

Project Partners and External Funding

MHI will be carrying out the work, no external funding required.

Potential for New Learning

Expected Insights:

- Grid Connection: Insights into integrating renewable energy sources into the electrical grid, focusing on efficiency and scalability.
- Security and Data Protection: Development of methods to protect proprietary and sensitive data during grid connection studies.
- Simulation Software Applications: Use of PSCAD software for electromagnetic transient analysis in renewable energy projects, enhancing model accuracy and study reliability.
- Grid Stability and Reliability: Evaluation of new connection techniques and their impact on grid stability with high renewable energy penetration.

Dissemination of Learning:

- Technical Publications and Reports: Sharing findings through industry journals, conferences, and online platforms dedicated to energy sector advancements.
- Workshops and Webinars: Hosting sessions to discuss project outcomes, lessons learned, and best practices with stakeholders and the wider energy community.
- Collaborative Industry Meetings: Engaging with other energy sector entities to share insights and explore potential applications of the new knowledge.
- Online Platforms: Utilising project websites and social media to reach a broader audience, including academic institutions, industry professionals, and regulatory bodies.

Scale of Project

The project's scale is directly linked to its scope, which includes developing a platform for efficient grid connection of renewable energy, ensuring grid stability, and safeguarding proprietary data during connection assessments. The complexity of these specific objectives requires a comprehensive approach and substantial investment to achieve meaningful outcomes. A smaller project scope would not allow for the depth of development, testing, and validation necessary to address these technical challenges effectively, limiting the potential for impactful advancements and learning in the energy sector.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The project's R&D will take place at MHI headquarters in Canada. The outputs will be utilised in the GB NESO area of operations.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£370,000

Project Eligibility Assessment Part 1

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

The project is designed to significantly facilitate the energy system transition by enabling a more seamless integration of renewable energy sources into the electrical grid. By developing advanced grid connection processes and simulation tools, the project aims to overcome current barriers to renewable energy integration. This includes improving the accuracy and efficiency of grid connection studies, ensuring grid stability amidst increasing renewable energy penetration, and protecting sensitive data during the connection process. These advancements support the broader transition towards a sustainable, low-carbon energy system by making it easier and more cost-effective to connect renewable energy sources to the grid, thus accelerating the shift away from fossil fuels and towards renewable energy sources.

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

N/A

Please provide a calculation and/or description of the expected benefits of the solution

While specific financial figures require detailed project data and cost analysis, the framework for calculating expected benefits can be outlined as follows:
Expected Benefits Calculation:

Expected Benefits= Current Base Cost−Projected Method Cost
Where:

- **Current Base Cost** represents the total current expenses associated with grid connection studies, including costs of delays, extensive non-disclosure agreements (NDAs), and the use of generic models.
- **Projected Method Cost** reflects the anticipated expenses after implementing the new grid connection platform, which aims to reduce the time and costs related to NDAs, enhance the accuracy of grid connection studies through better data sharing mechanisms, and accelerate the process of integrating renewable energy sources.

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

The method from this project is designed for broad applicability across Great Britain, making it suitable for a wide range of sites within the electricity transmission, distribution, and renewable energy sectors. It addresses universal grid connection and renewable integration challenges, suggesting it could be rolled out across 100% of the Network Licensees' systems. With further investments, the project can be fully scalable and ensures it can support the nationwide transition towards a more sustainable energy system.

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

Outlining the costs for rolling out the method across Great Britain involves several key components, although specific figures would require detailed analysis. Here's a broad outline of potential cost categories:

- **Development and Testing**: Initial costs include further development of the method for scalability, testing across different grid configurations, and validation to ensure compatibility with existing systems.
- **Training and Implementation**: Costs to train staff at Network Licensees on using the new method, plus any additional resources needed for implementation.
- **Software and Hardware Upgrades**: Investment in necessary software upgrades or hardware to support the method, including secure data sharing and processing capabilities.
- **Integration with Existing Systems:** Costs associated with integrating the method into current operational practices and IT systems of Network Licensees.
- **Monitoring and Support:** Ongoing expenses for monitoring the method's performance, providing technical support, and making iterative improvements based on feedback.
- **Dissemination and Stakeholder Engagement:** Expenses related to communicating the method's rollout, engaging with stakeholders, and gathering input for continuous improvement.

These categories provide a framework for estimating the overall costs of the method's rollout across Great Britain. The actual cost will depend on the existing infrastructure's compatibility, the scale of training required, and the degree of customizsation needed for different parts of the grid.

Requirement 3 / 1

Involve Research, Development or Demonstration

Projects 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

Involve Research, Development or Demonstration - Please select all that apply

☑ 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 learnings and outcome of this project can also be beneficial to Transmission Owners to simplifying the process for grid connection studies by removing the need for extensive non-disclosure agreements, thereby speeding up the approval process for new connections. The platform enables effective scenario modelling and decision-making for the integration of Inverter Based Resources (IBR), enhancing model quality and network reliability.

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. Networks must explicitly mention similar projects that they have considered and how these differ.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

Upon the successful completion of the Grid Connection Simulator tool project, NESO will proceed with the productisation of this exceptional tool within the organisation. This tool will be utilised for BAU activities, marking a significant milestone for NESO as it will be the first of its kind. Consequently, there will be no duplication of efforts within the organisation.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

Not applicable

Additional Governance And Document Upload

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

The proposed approach of this project aims to develop a proof of concept for a web portal that grants external parties access to connect their EMT model to full GB system EMT model while ensuring restricted access to GB system EMT model. This project will establish a comprehensive framework for users' accessibility to the web portal including cyber security, simulation performance and data exchange protocols. This has not been tried before in GB system. Ultimately, the project will deliver a tool that allows external parties to conduct their connection generator compliance studies with complete GB system, thereby expediting their connection process.

Relevant Foreground IPR

Deliverables are reports along with PSCAD model for proof of concept and automation scripts.

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:

- A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click ‘Contact Lead Network’. NESO already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at Innovation | National Energy System Operator (neso.energy)
- Via our managed mailbox innovation@nationalenerygso.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 80797503.1 (neso.energy)

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

The development of suitable solutions (hardware, software requirements for the development of Grid Connection Simulation tool) and process required are not tested for the GB system. The solution requires verifications on security requirements so that IP rights of customers are not violated. Hence this project needs to define and verify the solution before BAU activities.

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

The development of suitable solutions (hardware, software requirements for the development of Grid Connection Simulation tool) and process required are not tested for the GB system. The solution requires verifications on security requirements so that IP rights of customers are not violated. Hence this project needs to investigate different approaches and propose a suitable solution before implementing this tool, through innovation.

This project has been approved by a senior member of staff

☑ Yes