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

Apr 2022

Project Reference Number

NIA_SHET_0037

Project Registration

Project Title

Probabilistic Modelling for Connection Studies

Project Reference Number

NIA_SHET_0037

Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

Project Start

March 2022

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Tim Sammon

Project Budget

£400,000.00

Summary

This project will explore how more dynamic “probabilistic” modelling could be used by Transmission network planners to account for complex factors which could yield more efficient development and connection processes. This would allow the connection of more renewable generation and flexibility assets and seeks to enable more efficient operation of the electricity system.
The main deliverable of this project is a prototype probabilistic planning toolkit and study process to apply to connection studies.

Nominated Contact Email Address(es)

transmissioninnovation@sse.com

Problem Being Solved

Scottish Hydro Electric Transmission (SHE Transmission) have received huge interest in grid connections for renewable generation and storage projects in the north of Scotland. The scale of connections is challenging the traditional (deterministic) approach to network planning, where a single onerous dispatch condition is used to test the network against the requirements of the Security and Quality of Supply Standard (SQSS) (i.e. testing the worst case scenario of their connection – minimum/maximum import/export), and reinforcements to the network are implemented where necessary to remain compliant with the SQSS. This approach was developed when the network was dominated by a few large fossil fuel generators feeding a passive and predictable demand - a very different world to the net zero future dominated by intermittent renewable generation feeding flexible demand and energy storage, with lower average load factors and complex weather-dependent dispatch patterns. This problem will be compounded by the recent ScotWind auction from the Scottish Crown Estate which will aim to increase Scotland’s existing offshore renewable generation capacity by up to 25GW.

The current deterministic connection assessment does not model this complexity.

It is possible that Transmission network planners could carry out more dynamic, probabilistic, modelling to account for complex factors which could yield more efficient development and connection of renewable generation and flexibility assets. This in turn may enable

more efficient operation of the electricity system.

Method(s)

• Develop a probabilistic planning process for transmission connection studies that models the random characteristics of generation and demand over a longer period based on probabilistic models.
• Carry out a case study to quantify and demonstrate potential efficiency benefits and any risks of using the new process.
• Subject to successful demonstration of benefits, provide a prototype probabilistic planning toolkit of datasets and data analysis techniques to carry out this process.

Scope

The main deliverable of this project is a prototype probabilistic planning toolkit and study process to apply to connection studies. The toolkit will generate statistics and visualisations to provide a detailed picture of network capacity under uncertainty. It will consist of a dataset and automated calculation processes. The toolkit will be developed with an architecture to achieve the computation requirements of the complex modelling whilst ensuring it runs in reasonable time, important for connection studies against the clock.

The prototype probabilistic planning toolkit will be made up of a series of components:

• Probabilistic models of generation, storage and load that represent the stochastic nature of each.
• A tool to sample from the probabilistic models to give an envelope of network dispatches.
• An interface to power system analysis software to generate a power system model for each sample.
• Search and optimisation algorithms to calculate network capacity on the sample, such as generation headroom, boundary capability, and expected energy curtailed.
• Tools to support iteration over multiple scenarios and reinforcement options to create a bespoke analysis process, to understand the need for projects across a range of uncertainty, such as generation scenarios, or the completion of different packages of projects.
• Tools to generate results summary tables and visualisations.
• Case studies to demonstrate the use of this approach compared to the deterministic approach currently in use and assess the benefit of wider adoption as business-as-usual.

Estimated Benefits:
This project is an investment in the planning processes used to define a capital investment programme of hundreds of millions of pounds over the current regulatory period alone. Improvement in investment decision making could result in substantial benefits in cost and in efficiency of connecting renewable generation and flexibility assets. The project will carry out a case study to quantify the benefit of adopting this approach as business-as-usual compared with the current deterministic approach.

Objective(s)

This project has the following objectives:

1. Develop a probabilistic planning process for transmission connection studies.
2. Evaluate the potential benefits of the probabilistic planning process when compared to existing BAU deterministic processes.
3. Create a prototype probabilistic planning toolkit of datasets and data analysis techniques to carry out this process.
4. Capture and disseminate the learning from this project and draft recommendations for future work.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

We do not expect the project to have a direct impact on consumers in vulnerable situations, as at this stage it only concerns the development of planning tools, models and processes. However, there has been significant interest in grid connections of generators that will facilitate the energy system transition, such as ScotWind, storage projects for the ESO's stability and constraint management pathfinder projects, and hydrogen electrolysers looking to utilise the oil and gas shipping infrastructure in the north of Scotland. This shows how the region could have a significant role to play in the energy system transition. If the conclusions to this project are positive, this project will allow SHE Transmission to identify and develop the most effective way to connect these projects with the optimal level of infrastructure to ensure minimal cost and impact to the environment and local communities.

Success Criteria

The project will be deemed successful if:

1. It provides an improved understanding of probabilistic planning processes for transmission connection studies.
2. It evaluates the potential benefits of the probabilistic planning process when compared to existing BAU planning processes.
3. It provides a prototype probabilistic planning toolkit that can be used by transmission planners to implement the new processes.
4. It disseminates any relevant learning from the project to the wider industry and offers recommendations for future work.

These success criteria will be assessed by competent Transmission Planning Subject Matter Experts (SMEs), the NIA project management team, and a suitable contractor/consultant.

Project Partners and External Funding

The project will be undertaken using NIA funding by Scottish Hydro Electric Transmission

Potential for New Learning

This project will develop learning in:
• Probabilistic modelling of generation and demand for transmission network planning.
• The use of data analytics to broaden the scope of power system studies to support network planning decision-making.
• The use of probabilistic assessments to assess new technology and commercial arrangements on the network.

• The potential benefits of probabilistic transmission connection assessments compared to existing BAU deterministic assessments.

Scale of Project

This is a desktop based project which will carry out computer simulations/modelling and evaluate connections processes. A smaller project would not be able to develop techniques and processes that are mature enough to be evaluated against existing BAU operations. The outcomes of this relatively small project could drive large efficiencies in the transmission connection process in the future.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

This project will take place within Scottish Hydro Electric Transmission's network area (it is desktop based).

Revenue Allowed for the RIIO Settlement

No allowance has been made for this type of development within the RIIO-T2 settlement. No savings are expected during project implementation; future savings may be possible depending on the outcomes of the project and future adoption of the created design(s).

Indicative Total NIA Project Expenditure

This project expenditure is estimated to be £400k, 90% (£360k) will come from the NIA fund allocation, whilst the remaining 10% (£40k) will be funded by SHE Transmission.

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:

There has been significant interest in grid connections of generators that will facilitate the energy system transition, such as ScotWind, storage projects for the ESO's stability and constraint management pathfinder projects, and hydrogen electrolysers looking to utilise the oil and gas shipping infrastructure in the north of Scotland. This shows how the region could have a significant role to play in the energy system transition. If the conclusions to this project are positive, this project will allow SHE Transmission to identify and develop the most effective way to connect these projects with the optimal level of infrastructure to ensure minimal cost and impact to the environment and local communities.

How the Project has potential to benefit consumer in vulnerable situations:

This project will enable SHE Transmission to identify the most economical and efficient way to develop the network for the transition to net zero at minimal cost to the consumer. This will reduce the bills of vulnerable consumers in the long-term. The project could lead to efficient project development in the north of Scotland and the ability to assess the potential of new technology and non-build solutions that will benefit the stakeholders and communities where we work, to avoid over- or under- investment that could lead to additional works in the future and further disruption.

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

This project is an investment in the planning processes used to define a capital investment programme of hundreds of millions of pounds over the current regulatory period alone. Improvement in investment decision making could result in substantial benefits in cost and in efficiency of connecting renewable generation and flexibility assets.
The project will carry out a case study to quantify the benefit of adopting this approach as business-as-usual compared with the current deterministic approach

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

This project's outputs are applicable to all Transmission Network Operators across GB. Future projects could refine it for use by other network operators (e.g. Distribution).

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

The costs of rolling this out across GB would be minimal as the learnings, models and datasets created by this project will be relevant for all GB transmission operators. They will only have to invest staff time aligning the new probabilistic processes with their own internal processes.

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

All Transmission Operators (TOs) follow the same GB codes and standards and are governed by similar license conditions. These similarities mean that improvements in the SHE Transmission connections process will be transferable to other TOs. Driving efficiencies in the connection processes will reduce the amount of reinforcement required on the network by releasing existing capacity and facilitate more renewable connections on the network. This is a goal shared by all network operators and the outputs from this project will help all GB TOs realise their ambitions.

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.

There have been minimal other explorations of probabilistic planning via innovation projects by TO's and ESO. This project focusses on transmission connection studies which is novel and has not been explored before, therefore avoiding any duplication.

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

This project will be a new approach to connection assessments in SHE Transmission with a step change in analytical complexity. It will provide a platform for new and innovative data analysis to improve the quality of decision making in Transmission System Planning and Investment. Probabilistic modelling is currently outwith BAU connections processes and the expectations set by our regulator Ofgem as well as the requirements and codes SHE Transmission must adhere to.

Relevant Foreground IPR

Anticipated foreground IPR will be associated with any computer models, datasets and processes that are created to implement probabilistic modelling in the transmission connections process.

Data Access Details

See Network Innovation Competition (NIC) and Network Innovation Allowance (NIA) Data Sharing Procedure at https://www.ssen.co.uk/InnovationLibrary/Distribution/

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

Probabilistic modelling is currently outwith BAU connections processes and the expectations set by our regulator Ofgem (as well as the requirements and codes SHE Transmission must adhere to). The commercial and regulatory risks of changing such a sensitive business process, which affects our connecting customers, mean that it is unlikely to be explored as part of a Transmission Operators business as usual activities. Particularly without fully understanding the possible benefits/impacts/risks of changing the processes. Development projects funded by NIA give suitable financial support to investigate areas for potential development that could not be funded by BAU as no allowance was made in the RIIO-T2 settlement.

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

All Transmission Operators (TOs) follow the same GB codes and standards and are governed by similar license conditions. These similarities mean that improvements in the connections processes by implementing probabilistic planning would benefit all TOs. Therefore innovation funding, and the collaborative learning dissemination it facilitates, would avoid all TOs creating bespoke solutions.

It is also not a certainty that probabilistic planning will offer a significant improvement over current BAU connection processes. The commercial and regulatory risk posed by exploring a step change in such an important business process which will affect our customers and our fellow TOs will be mitigated by the use of NIA funding.

This project has been approved by a senior member of staff

☑ Yes