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

Aug 2024

Project Reference Number

NIA_SHET_0048

Project Registration

Project Title

Year Ahead Outage Optimiser (YAhOO)

Project Reference Number

NIA_SHET_0048

Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

Project Start

September 2024

Project Duration

0 years and 10 months

Nominated Project Contact(s)

Brant Wilson – Innovation Portfolio Manager

Project Budget

£382,000.00

Summary

Planned outage management has become ever more challenging due to the increased volatility and complexity created by the massive integration of renewable energy sources on the electricity network and the reinforcement of the system to facilitate the transfer of increased generation volumes. This has generated additional manual work for outage planners, which, without process change, could become unmanageable. The Project aims to explore the use of decision support algorithms to improve the efficiency and effectiveness of planned outage management processes.

Third Party Collaborators

N-SIDE

Nominated Contact Email Address(es)

transmissioninnovation@sse.com

Problem Being Solved

The mission of SSEN Transmission is to ensure that the electricity network in Scotland can supply power in a reliable, efficient, and environmentally friendly manner. In this context, tackling planned outage management has become increasingly challenging due to the increased volatility from the massive integration of renewable energy sources on the electricity network and the reinforcement of the system to facilitate the transfer of increased generation volume creating additional manual work for the outage planners. Currently, our outage planning team creates and submits year-ahead outage plans to the ESO in week 27. These are scrutinised and approved by the ESO and afterward, it is outage planners' responsibility to maintain and amend the year-ahead plan. This is currently a manual, time, and effort-exhaustive process, carried out using Microsoft Excel. It is anticipated that as the network grows in complexity, so will the process of managing outage planning.

Method(s)

SSEN Transmission is exploring the use of decision support algorithms to improve the efficiency and effectiveness of its planned outage management process. Given the volume of outages planned, decision-support algorithms can help manage the complexity of changes and additions in the outage plan by automating the assessment of the impact of changes, offering proposed rescheduling solutions within defined parameters, and considering weighted variables. The project will look to understand the current outage planning process and design new algorithms for decision support, automation, and optimisation and build a decision-support model web application based on constraint programming to enhance the outage planning process. Finally, generated results and assessment of the benefits of the new methodology will be studied.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with OFGEM, ENA and SSEN Transmission internal policy. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal SharePoint platform ensuring access control, backup, and version management. Deliverables will be shared with other network licensees through the closedown reports on the Smarter Networks Portal.

Measurement Quality Statement (MQS):

The methodology used in this project will be subject to supplier's own quality assurance regime. Quality assurance processes and the source of data, measurement processes and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and will be made available for review.

In line with ENA's ENIP document, the cumulative risk score is scored as 5 = **LOW** from the sum of the risk thresholds below:

TRL Steps – 1 TRL Step – Low (Score 1)
Cost – <£500,000 – Low (Score 1)
Number of suppliers – 1 – Low (Score 1)
Data – Assumptions known but will be defined within project – Medium (Score 2)

Scope

Phase 1: Understand the current outage planning process and design new algorithms for decision support, automation, and optimisation.

The project will start with a design phase and, more specifically, a workshop with the outage planners to gain an understanding of the current processes and tools used to better identify how decision support algorithms can help support the outage planning process and keep the outage planning up to date.

Phase 2: Build a decision-support model based on constraint programming to enhance the outage planning process.

In phase 2, an optimisation model will be built considering all the operational and network constraints. The model's objective function will be to minimise changes in the planning when re-optimising while keeping the planning feasible and maximising the network availability and the volume of work delivered.

Phase 3: Generate results and assess the benefits of the new methodology (This test case will focus on the simulation of the yearplanning 2023 or 2022).

In phase 3, the model will be tested and validated using historical data provided by SSEN-T. The project's output will be a new decision support prototype tool for outage planning that will aim to make the outage planning process more efficient.

The end goal of this project is to have a prototype that can be used to test the new algorithms and gather feedback from our SSEN Transmission outage planners. The newly developed web application will not be automatically integrated with existing software systems used by SSEN-Transmission, but to ensure that the outputs of the tool are compatible with the current outage management process, the data will be uploaded in Excel format.

Financial benefits can be found in section 3.2.2.

Objective(s)

The objective of this project is to assess new methodologies and algorithms that could improve planned outage scheduling.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial, and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative, or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register. This project has been assessed as having a neutral impact, meaning that it does not have any effect on customers in vulnerable situations. This is because it is a Transmission project.

Success Criteria

The project will be deemed as successful if all items in the scope, objectives and learnings are achieved.

Project Partners and External Funding

SSEN Transmission will partner with N-SIDE to deliver Year Ahead Outage Optimiser (YAhOO) using Network Innovation Allowance (NIA) funding.

Potential for New Learning

The output of this project will be an outage planning optimisation tool in the form of a simple web application/user interface sitting in front of a set of decision algorithms. The optimised plan produced by the prototype tool will be validated against an existing year-ahead plan from 2022 or 2023 to assess efficiency against the current process. This is a benefit to the whole UK industry where there are similar challenges with optimising and planning outages with increasingly complex networks, however, the cyber security implications would need to be addressed before any business-as-usual adoption is rolled out pertinent to live outage planning information.

Learnings from the project will be disseminated via internal and external stakeholder event which will be conducted during the project. The learnings will also be shared within the annual project report and at relevant dissemination events such as the Energy Networks Innovation Summit.

Scale of Project

The project time frame is 9 months, is designed to get maximum learning for minimal cost and will be limited to year-ahead plans only. The end goal of this project is to have a prototype that can be used to test the new algorithms and gather feedback from our SSEN Transmission outage planners. By the close of the project the remaining barriers to bringing the newly developed methodology to operations will be identified.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL6 Large Scale

Geographical Area

The project will take place in the Scottish Hydro Electric Transmission license area in Scotland.

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 the future adoption of the learnings.

Indicative Total NIA Project Expenditure

The total NIA Expenditure for the project is £382,000, 90% (£343,800) is allowable NIA expenditure.

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:

As part of the energy system transition, there will be an increase in planned outages associated with network reinforcements and establishment of new connections as we progress towards 2030. This in turn, increases the volatility and complexity of outage planning creating additional challenges and manual work for our outage planners. The development work set out in this project will progress the concept of a decision-based tool that will support the optimisation and efficiency of planning and managing planned outages. This tool will help to facilitate the energy system transition by future-proofing outage planning and alleviating the pressure on our outage planning and control centres.

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

Not applicable.

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)

Not applicable.

Please provide a calculation of the expected benefits the Solution

There are several potential benefits with the successful development of this optimising outage planning prototype tool listed below.

• Improve the overall efficiency of the outage planning process, improve response times, and free up the team to add value to the outage planning function, such as improved engagement with key stakeholders.
• Future proofing – increased outage planning challenge to come as more renewables and reinforcement works are required with growing the network (increased complexity).
• Improved coordination with stakeholders by developing a more flexible approach to planned outages, achieved by creating a user-friendly software platform to enhance collaboration across multiple teams.

Cost Benefit Analysis (CBA)

The primary measurable benefit of this project is a potential reduction in response time of outage planners in processing change requests. For the current situation, it takes 5 hours for an outage planner to address a change request for the year-ahead plan and 4 hours for a current year request. With the algorithm in place, the processing time for a single change request will be reduced by 50%, leading to less working hours for outage planners assigned to change requests. There are some assumptions have been made to quantify the potential
benefits if the algorithm is applied across our network.

Assumptions

• The project cost is a one-off cost and is included in this analysis as the development cost.
• If this pilot project is successful, the next stage of this project will be integration with our network. The cost of the integration stage is

assumed to be 25% of the project cost and was factored in this analysis as part of the development cost. The integration cost will be revised once the project is completed, and next steps are defined.
• The number of change requests for the year-ahead plan is 905, and for the current year plan is 2720. This is assumed based on advice from subject matter experts (SME), historical data and NGESO published data. The number of change requests remain the same for both the base case and innovation case.
• By using the algorithm, it can help save 50% of the time to process a change request, regardless of whether it is within a year or for the year-ahead.
• The annual subscription cost is £50,000 as advised by the supplier.
• The capitalisation rate is 0% as this project does not involve any CAPEX.
• The value in CBA is demonstrated in 2018 real price as per Ofgem's requirement.

Results

• The estimated scaled benefit until the end of T3 is £1m and it can reach £6.2m over the lifetime of assets.
• There are some risks identified in this project, therefore we have applied the risk factor of 20% to the potential benefits. The risk adjusted lifetime benefit is £4.9m and it is estimated at £850k at the end of T3. In this case, benefit-cost ratio (BCR) up to the end of T3 is 3.2. This means that for £1 spending, it will return £3.2 by the end of T3. The lifetime BCR is 13.9 which means that for £1 spending, it can return £13.9 over the lifetime of 45 years. Annualise ROI is
18%.
• The benefit starts from the first year of implementation, which is 2026.
• To consider this project viable, the minimum efficiency level of the algorithm should be 8.5%. This means that the algorithm must reduce 8.5% of the response time to a change request to justify the initial development cost and the on-going subscription cost.

Key Risks

• Time and resources required to keep it up to date as the network changes and grows. This project is limited to the current network and will involve a comparison with existing year-ahead plans for 2022 or 2023 to allow for validation that the tool leads to optimised planning. Any future phases of this project will need to consider how changes to the network will be captured and maintained without significant time or resource investment.
• Repeated use of the tool with each request could cause multiple changes to a given outage. If that outage affects third parties and they are notified each time, it could become detrimental to our relationship with that customer. To mitigate the risk there could be a limit on the frequency of runs or putting a cap on the number of times a given outage can be repeatedly changed.

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

The learnings from this project are not limited to Scottish Hydro Electric Transmission, all transmission and distribution network operators across GB could benefit from this research work.

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

This research project is at low TRL level, consequently the costs for rolling out the method across GB network are not fully defined. If this project is successful, then there is the potential to use the outputs of the project to support roll out of the optimised outage planning tool across GB. The costs would be dependent on the proven solution and control centre requirements.

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

This project's learnings will apply to the other Transmission Owners and Distribution Operators who all have outage planning and management responsibilities and are facing similar challenges with optimising and planning outages with increasingly complex networks. There is potential for other TOs and our distribution colleagues to make use of the outputs of the project should the prototype tool be made commercially available in the future. Further funding would be required to transform the prototype into a platform which can be integrated with existing software systems.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

Not applicable.

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.

The Energy Networks Association Smarter Networks Portal was reviewed for any duplicating projects. A previous project led by National Grid ESO (NIA_NGSO0037 - Optimal Outage Planning System and NIA2_NGESO0011 - Optimal Outage Planning System (Continuation)) was the only other project found to be looking at optimising outage planning. However, the scope of that project was to add value by providing a solution to the imperative need for better integration of risk estimation into the planning optimisation so that the amount of work remains manageable for the network access planning (NAP) process, negating the need for engineers to manually run studies and feed into the outage planning. This previous project focused on optimising plans based on risk estimations, which are currently made on a worst-case scenario basis. The project looked at accounting for the potential impact of increasingly changing system conditions (generation, weather, etc.) or of changes to one outage due to other outages. This has historically been done using “rules of thumb”. This new project led by SSEN-T is focused on optimising year-ahead plans from the perspective of a TO who submits plans to the ESO for approval and then manages any changes to the plan thereafter, the decision-based algorithm prototype tool that will be created as part of this project aims to support this process and reduce time and resource spent on manually creating and maintaining these outage plans. Overall, these projects aim to overcome two separate challenges with two different sets of outputs and therefore they are not duplicating projects that we are currently aware of and believe that this project meets this eligibility requirement.

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 current process for outage planning and managing changes to the year-ahead plan is carried out using Microsoft Excel

spreadsheets and a manual, time, and effort-exhaustive process. It is anticipated that as the network grows in complexity, so will the process of managing outage planning. To help mitigate this, an opportunity to implement an innovative, smarter, easy-to-use tool/process has been identified.

Relevant Foreground IPR

Any new intellectual property which are completed as part of the NIA project will be made available to other relevant networks licensees. No background IPR is required.

Data Access Details

For information on how to request data gathered in the course of this project, see Strategic Innovation Fund (SIF) and Network Innovation Allowance (NIA) Data Sharing Procedure at https://www.ssen-transmission.co.uk/about-us/innovation/.

Additionally, data from this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the Strategic Innovation Fund (SIF) can be found or requested in the ways listed below:

• Via the Smarter Networks Portal at: https://smarter.energynetworks.org. To contact select a project and click 'Contact Lead Network'. SSEN Transmission 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 - SSEN Transmission (ssen-transmission.co.uk)
• Via our managed mailbox: transmissioninnovation@sse.com

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

NIA has been deemed the best method of supporting the delivery of this project. 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 RIIOT2 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

As noted in the NIA guidance, certain projects are speculative in nature and yield uncertain commercial returns. This is the case with this project. There is a commercial risk that the solution trialled in the project is not adopted at the end of the project into BAU due to the uncertainty and low level of TRL lowering the likelihood of success within the business. If this project is proven as successful, the next stage will be integration with our network. Any future phases of this project will need to consider how changes to the network will be captured and maintained without significant time or resource investment.

This project has been approved by a senior member of staff

☑ Yes