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

Jun 2026

Project Reference Number

NIA3_NESO003

Project Registration

Project Title

System Restoration Adaptation and Exploration Model (STREAM)

Project Reference Number

NIA3_NESO003

Project Licensee(s)

National Energy System Operator

Project Start

June 2026

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Innovation@neso.energy

Project Budget

£700,000.00

Summary

The current probabilistic restoration model, a bespoke, excel based tool developed by NESO over a decade ago, is increasingly challenged by the growing complexity of the energy system.
A recent audit identified the need to improve its maintainability and adaptability. This project aims to develop a new or significantly enhanced model l that is robust, flexible and aligned with the evolving energy landscape. The updated model will support more accurate and efficient assessment of restoration strategies, offering valuable insights into Great Britain's restoration capabilities. By addressing the limitations of the legacy tool, the project will ensure that NESO is equipped with a future-ready solution capable of supporting system resilience and compliance with emerging restoration standards.

Third Party Collaborators

University of Strathclyde

Nominated Contact Email Address(es)

Innovation@neso.energy

Problem Being Solved

The existing Probabilistic Restoration Model is a bespoke Excel-based tool developed and maintained by NESO over the past 15 years. The model is used for producing annual GB's Restoration Performance statement which is shared with DESNZ. The model is

also used sensitivity studies for power plant closures and their effect on system restoration and for tender assessment of generators This model creates a significant single point of failure, as no other staff member is able to operate or maintain the model if that individual is unavailable. Due to software limitations, making modifications is difficult, reducing the model's adaptability. Growing system complexity is challenging the foundations on which the model was built, further limiting its effectiveness. An audit has recommended enhancements to improve maintainability and adaptability, which cannot be achieved without developing a new model.

Method(s)

The main project deliverables will include:
- Combined design document including functional and non-functional specification and use cases.
- Combined report on current and future restoration methodologies and potential DNO/NESO dependencies.
- Proof-of-Concept model with supporting test cases and documentation.
- Revised model with documentation, test reporting, and training plan/user guide to enable NESO future scaling and integration.

This project will be delivered through the following Work Packages (WP):

WP1 will commence with desk-based research to gather existing information and insights. This will be complemented by a series of workshops aimed at collaboratively brainstorming and refining ideas. To ensure a comprehensive understanding of stakeholder needs, interviews will be conducted with key individuals, including industry experts and users. These activities will culminate in the development of detailed functional and non-functional specifications, a comprehensive list of use cases, and a consolidated design document integrating all elements. The potential cost for this WP would be £193,317.31

WP2 will focus on producing reports that outline both current and potential future restoration modelling methodologies. This will involve extensive desk-based research and structured report writing. Meetings with experts will be organised to explore the impact of DNO operator actions on NESO restoration, ensuring accurate representation of these dependencies. The potential cost for this WP would be £193,317.31

WP3 will involve a series of design and development sessions to produce detailed specifications and test cases. Collaborative tools will be used to facilitate documentation and feedback. A key output will be a proof-of-concept model developed using an appropriate modelling language, followed by a review of its computational performance. Supporting documentation will be provided to ensure clarity and usability. The potential cost for this WP would be £109231.17

WP4 will involve revising existing specifications and use cases based on workshop feedback. The objective is to refine the model for production readiness. This will include full model development, comprehensive testing, and evaluation of accuracy against test cases. Final outputs will include a report on modelling accuracy, a training plan, a user guide, and a complete codebase with all necessary documentation and test reporting, ready for handover to end-users. The potential cost for this WP would be £159,521.21

In line with the ENA's ENIP document, the risk rating is scored Low.
- TRL Steps = 1 (2 TRL Steps)
- Cost = 1 (£700k)
- Suppliers = 1 (1 supplier)
- Data Assumptions = 2 (Medium)

Total = 5 (Low)

Measurement Quality Statement

The project outcomes will be measured through comparative modelling and analysis. As there is limited real-world data available on restoration performance, the new model will be evaluated against the existing model to assess its effectiveness. Validation will be based on comparing outputs between the current and proposed approaches, with a focus on whether the new model improves analytical capability, accuracy, and representation of restoration scenarios. The main limitation of this approach is the lack of historical restoration performance data, which means validation cannot be fully based on observed real-world outcomes. As a result, there will be some uncertainty in the extent to which modelled results reflect actual system restoration behaviour.

Scope

This project aims to develop a proof of concept for a world leading and enduring probabilistic restoration performance measurement tool suitable for an increasingly decentralised renewable energy system.

Overall, the project will challenge existing methodologies and potential limitations within existing restoration performance models. Through research and appraisal of methodologies and platforms suitable for a future probabilistic model, the project will provide recommendations for future proofing any probabilistic model to ensure wider integration following a successful innovation project. By defining specific restoration use cases with NESO restoration stakeholders, the project will develop a new proof of concept model which is fit for purpose and will provide a test bed for novel approaches to restoration modelling, such as integration of AI techniques or alternative probabilistic methods. A successful PoC will enable testing of different restoration strategies and influence approaches to procurement of restoration services.

Objective(s)

Project objectives are:

- Deliver a combined design document including functional and non-functional specification and use cases.

- Deliver a combined report on current and future restoration methodologies and potential DNO/NESO dependencies.

- Deliver a Proof-of-Concept model with supporting test cases and documentation. This new model will be more suited to a low carbon electricity system with large volumes of distributed resources, ensuring NESO is better equipped to prepare for system disruption.

- Deliver a revised model with documentation, test reporting, and training plan/user guide to enable NESO future scaling and integration.

- Develop the ability to test different restoration strategies and approaches to procurement of restoration services with the potential (a) to speed up restoration in the event that it's needed, with wide societal benefits and (b) provide restoration services more cheaply. (In 2020-21, Black Start services cost NESO £66 million).

Consumer Vulnerability Impact Assessment

The new model should enhance NESO's ability to optimise investment in restoration capability across the system to minimise any disruption whilst controlling costs to consumers. The targets have been set by policy (Restoration Standard) and this model should become our means of delivering and demonstrating compliance.
It will enable faster restoration, which will limit impact on consumers, especially those in vulnerable situations/areas.

Success Criteria

Success will be determined by satisfactory delivery of a working prototype model which encompasses relevant functional improvements associated with a Net Zero system along with appropriate documentation to enable model use and productionisation after the project completion.

Key output is to deliver a working prototype model; the success criteria is:
- The model should be capable of calculating restoration time for a nationwide blackout based on the country's current generation capacity.
- The model should be capable of supporting restoration planning for partial and zonal blackout scenarios.
- The model should be adaptable to the evolving energy landscape and accurately reflect its impact on restoration modelling.
- The model should be able to incorporate new technologies introduced into the grid and assess their effect on restoration time.
- The project should provide a detailed analysis of, and insight into, the changing nature of generation within DNO networks.
- We would expect improved analysis and more accurate results, with no significant detriment to model performance.

Project Partners and External Funding

The University of Strathclyde is the project partner for this project; no external funding required.

Potential for New Learning

A clearer picture of how decarbonisation of our energy system changes our ability to restore it following a National Power Outage

(NPO), and how best to manage performance in a cost-effective way.

There are also additional opportunities for the restoration team to understand and input into the restoration model/process.

Project findings will (where permitted) be shared and tested across the industry in the UK via existing networks including the ENA and EnergyUK, and internationally via G-PST and CIGRE.

Scale of Project

The Project will take 24 months with one lead project partner, University of Strathclyde.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

This project will be conducted within GB.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

Project spent broken down by work package:

The potential cost for this WP1 would be £193,317.31
The potential cost for this WP2 would be £193,317.31

The potential cost for this WP3 would be £109231.17
The potential cost for this WP4 would be £159,521.21

Total estimated project cost £700,000

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 transition to a low-carbon energy system requires a fundamental shift in how electricity system restoration is planned and delivered. As the power system increasingly incorporates renewable generation and distributed energy resources, traditional restoration strategies are becoming inadequate in meeting future electricity demand and in complying with the forthcoming Electricity System Restoration Standard, which will take effect in 2026. This project addresses that challenge by developing adaptable modelling software capable of evaluating new restoration strategies and services.

The model will support understanding of how renewable and decentralised energy sources can be integrated and utilised during a restoration event. Enhanced functionality will provide greater certainty in identifying the most effective and least-cost restoration solutions. This will assist government and system operators in balancing the cost of restoration with the potential impact of a national power outage. In doing so, the project delivers a critical capability to ensure that system restoration evolves in step with the broader energy system transition.

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

This project aims to address limitations of the current model by enabling faster and more effective restoration. Improved restoration performance has the potential to significantly reduce the impact of a national power outage on consumers while supporting compliance with regulatory requirements.

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

Other system operators may wish to adopt similar modelling processes. Anecdotal evident suggests there is interest from some other operators, but we cannot state that this will happen at this stage.
This project is aimed at restoration across the whole of GB.

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

This will be a non-default project and therefore the model developed will not be shared with other networks for replication across GB.

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 new model should fully accommodate developments consistent with Net Zero system. The learnings will tested across the industry in the UK via existing networks including the ENA and EnergyUK, and internationally via G-PST and CIGRE. This is a non-default innovation project and, as such, detailed findings and models will not be shared externally. Only some of these learnings will be shared externally due to confidentially and security requirements.

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.

There are no other projects in the innovation space that have undertaken the development and modelling of the system restoration approach.

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

The existing model of system restoration and the probabilistic estimation of restoration times that it enables are understood to be unique in the world.
The energy system is evolving, making more use of renewable energy and distributed resources. Historic restoration strategies are unlikely to meet society's needs or to comply with the new Electricity System Restoration Standard being introduced. New strategies

and services need to be investigated, tested and procured. This requires suitable modelling capability and software. Some candidate strategies in this project would be unique in the world.

Relevant Foreground IPR

- Scenario-based model for restoration activities.
- Documentation on the operation and development of the model.

This is a non-default innovation project and, as such, detailed findings and models will not be shared externally

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), or Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

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

Details on the terms on which such data will be made available by National Energy System Operator can be found on our website: Data Sharing Approach | National Energy System Operator.

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

There is significant risk in the successful outcome of the project's activities, and novel modelling techniques will be investigated that have not been proven for this application previously.

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

Due to the high risk and investigative nature of the project, innovation funding was determined as the most suitable method of funding this project. The NIA funding approach is applicable in this case due to the potential for other network licensees to benefit from the approach and results that will form the outputs of this project.

This project has been approved by a senior member of staff

☑ Yes