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 2025

Project Reference Number

NIA2_NGET0098

Project Registration

Project Title

Framework for Risk Analysis and Modelling of Events (FRAME II)

Project Reference Number

NIA2_NGET0098

Project Licensee(s)

National Grid Electricity Transmission

Project Start

August 2025

Project Duration

0 years and 4 months

Nominated Project Contact(s)

Aisha Ali

Project Budget

£680,785.00

Summary

The expanding and interconnected electricity network poses challenges for National Grid Electricity Transmission (NGET) in monitoring and assessing network resilience. Currently, tracking resilience involves multiple metrics on separate Power BI pages, making it difficult to view overall resilience and hindering timely decision-making during storms or major events. This fragmented approach can lead to suboptimal maintenance and repair decisions. To address these challenges, the proposed project aims to incorporate probabilistic risk analysis to further improve resilience assessments, enhance decision-making accuracy using risk scores, and identify weak areas in the network. Additionally, simplify monitoring through a holistic map view. Ultimately, the project seeks to improve network resilience by streamlining risk identification and establishing minimum resilience levels for substations. FRAME II will be the second phase following the Proof-of-Concept (POC) phase in NIA2_NGET0075 Framework for Risk Analysis and Modelling of Events (FRAME I) .

Preceding Projects

NIA2_NGET0075 - Framework for Risk Analysis and Modelling of Events (FRAME I)

Nominated Contact Email Address(es)

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Problem Being Solved

The expanding electricity network is becoming increasingly integrated. It is crucial to understand the spread of network resilience risk and the overall network health score in different locations. Phase 1; NIA2_NGET0075 (FRAME I) of the project aiming to address these issues has already been completed

The network resilience team at National Grid Electricity Transmission (NGET) currently monitors network performance using multiple metrics presented on separate Microsoft Power BI pages. However, the existing data collection process, which involves regular

updates from various sources and changing priorities, highlights the need for an additional analytical and visualisation platform beyond Power BI. The challenges to be addressed include:

- Lack of a holistic view making it challenging to assess network resilience status or obtain comprehensive information quickly.
- Difficulty in obtaining an overall view of the resilience of substations or zones.
- Limited ability to prioritise and make timely decisions during storms, network events, or major events like Eurovision.
- No comprehensive and streamlined approach to network resilience assessment and decision-making to enhance overall resilience and response capabilities during critical events.
- Increased likelihood of incorrect maintenance or repair decisions that do not optimise network resilience.
- Time-consuming process to understand site, zonal, and national risks.

Method(s)

This is a formal request to initiate Phase 2 of the FRAME project. Phase 1 of the project (FRAME I) successfully delivered an interactive POC web application that displays key metrics for the NGET Network Resilience Risk Tool. The following outputs were achieved in Phase 1:

- Web application that visualises substation risk scores.
- Two engine models that uses a combination of Machine Learning (ML) and rule-based resilience score weightings to derive the composite substation risk score.

The following outlines the proposed method for Phase 2.

FRAME (FRAME II) will deliver Phase 2 an application displaying key metrics for the NGET Network Resilience Risk Tool. FRAME II will build on the POC developed in Phase 1 by undertaking the following:

- Enhancing the modelling methodology by refining the current approach.
- Investigating additional features to improve technical limitation prediction accuracy and utilising new identified datasets to further enhance risk score modelling.
- Adding consequence of failure as a quantifiable metric, to be used in conjunction with technical limitation predictions.

As described in Phase 1, the product will adhere to the following standards:

Data Quality Statement (DQS): The project will be delivered under the NIA framework in line with OFGEM, ENA and NGET 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 backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS): The methodology used in this project will be subject to our 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.

The project will operate at Technology Readiness Level (TRL) 7–8 and has been structured into three Work Packages. Phase 1, which ran for 3.5 months from February to May 2025, focused on the development of a POC, and Phase 2, focused on refining the modelling approach and taking new data into account, which will run from August 2025 to December 2025.

Medium Risk

TRL Steps = 3 (7-8 TRL, 2 steps)

Cost = 3 (£614*k*)

Suppliers = 1 (1 supplier)

Data Assumption = 1 (data supplied by suppliers and NGET for analysis)

Risk Assessment Methodology

Scope

FRAME II will build on the POC developed in Phase 1, which utilised use Machine Learning (ML) to model asset and overall substation risk scores, delivering an interactive web application that's displays the modelling results as well as other key metrics. This next phase will consist of three Work Packages (WPs) and will be delivered over four months, focussing on incorporating additional datasets while refining and expanding the modelling capabilities for both assets and overall substation scoring.

Work Package 1: Enhance the modelling methodology by refining the current approach - investigating additional features to improve technical limitation prediction accuracy for the previously modelled assets, utilising datasets such as alarm, oil sampling, climate and other identified data. In addition, the scope of the modelling will include investigating expanding to other assets such as Overhead Lines and Delayed Auto Reclose (DARs).

Work Package 2: Add consequence of failure as a metric, supporting informed prioritisation of asset maintenance – use generation, demand, site sensitivity and other data to calculate the impact value for a substation, allowing them to be ranked by potential loss of supply impact.

Work Package 3: FRAME II comprehensive Methodology Statement that outlines the approach used to derive the composite substation risk score as well as detailed solution documentation, including asset and substation risk score extracts and other relevant artefacts such as the developed code for both the solution and the ML models. Handover sessions with appropriate NGET team members conducted.

Milestones:

Description

- Updated data model, incorporating new datasets
- M1: New dataset receipt, investigation and evaluation for quality, timelines covered, ability to map to relevant datasets and other features.
- Modelling iteration with additional datasets, including investigations for new asset classes.
- M2: Initial Exploratory Data Analysis of datasets completed, including examinations for outliers, patterns and feature relationships.
- M3: Iteration of modelling using weather/oil/alarm and other data.
- M4: Consequence of failure modelling initial rules defined.
- FRAME II completion
- M5: Substation Resilience Score modelling refined to include additional features focused on impact of supply loss.
- M6: Deploying and testing the model; Finalised Substation Resilience Score
- M7: NGET Risk Tool Pre environment updated with latest changes
- M8: Training sessions conducted with NGET chosen appropriate team members and handover material provided.
- M9: FRAME II Methodology Statement (Final Report) provided.

Objective(s)

The key objective of the FRAME project is to demonstrate the ability to predict asset technical limitations in the form of risk scores and have a centralised view of substation resilience risk scores to highlight network risk areas for decision making. FRAME will enhance the visualisation of network resilience by combining multiple data sources and developing a risk scoring framework along with a holistic map view. This will facilitate prompt issue identification and enable quicker decision making during live events and extreme weather conditions.

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 an overall positive impact on consumers in vulnerable situations. The assessment has identified that this project will look to reduce the costs for households, while reducing the number of disruptions to them in the home. It will aim to enhance the ability of the network to respond to issues quickly and enable swift decision making for example in a storm environment. Other considerations including the project's impact on supply, immediate health and safety in the home have been made in carrying out this assessment. The proactive monitoring of asset health and prioritisation of substation maintenance is a priority for NGET.

Success Criteria

The project will be successful if it achieves the objectives set out in this document. In particular, the following outputs are expected:

- Create a quantitative metric for consequence of failure.
- Conduct additional exploratory data analysis to identify additional features and datasets for risk score modelling.
- Second generation of risk model/s for improved technical limitations prediction accuracy.

Project Partners and External Funding

Project Partner: Baringa - Energy Consultancy will deliver all the milestones of the project.

NGET is providing all the funding for the project and is the lead project partner.

Potential for New Learning

The project aims to deliver the following new learning:

- Resilience score for every substation which is not currently possible.
- Improved trending on events and asset limitations – location, frequency, time of the year with the 'hot spots' where resilience is weak.
- The learning will be disseminated through sharing written methodology, workshops as required by NGET and the reporting via the ENA portal. Effectively in-house, but lessons learnt, and innovation tool may be transferable to other TOs/DNOs with similar business environments.

Scale of Project

The overall duration of the Network Resilience Tool project is limited to 7.5 months, with Phase 2 spanning 4 months (POC of 3.5 months completed).

The project is to enhance network detection and response capabilities, minimising downtime and optimising the allocation and management of network resources by analysing traffic patterns and predicting future needs. By automating the detection and historical data of resolution of similar network issues, the tool will reduce the need for manual oversight, lowering operational costs. Learnings from the project will help inform business decisions to what extent this risk scoring methodology can enhance the future development of the NGET Resilience Risk capabilities

Technology Readiness at Start

TRL7 Inactive Commissioning

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The project will be conducted within the licensing area of NGET, which encompasses England and Wales.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

Total budget (External/supplier costs + internal project management, indirects, annual reporting, dissemination costs) – 10% Cost in here should be 90% of the total budget The total project expenditure is expected to be approximately £1,200,766 (FRAME I and FRAME II).

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:

The project will support energy system transition by addressing network challenges like grid stability and reliability. For instance, identifying weak substations to be improved before/during customer connection works.

- Increased resilience against extreme weather events providing early warning systems and optimising infrastructure performance, improving network performance during storms or extreme weather.
- Proactive and preventative maintenance avoiding expensive unplanned repairs and optimising resource use by scheduling repairs during non-peak times, minimizing downtime and operational disruptions.
- Data-driven insights and cutting-edge algorithms within the model would empower NGET to improve climate resilience by identifying trends and their resolutions.
- Reduced likelihood of an unplanned outage which could impact demand and generators.
- Improved network resilience and reliability will reduce load, potentially increasing asset lifespan.

In summary, the Network resilience tool will enable NGET to manage the complexities of the energy system transition. It will support the security of energy supply and facilitate investment in infrastructure. By making the electricity transmission network more robust and adaptive, the resilience tool will facilitate to a cleaner, more sustainable energy future.

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

This project has been assessed as having an overall positive impact on consumers in vulnerable situations. The assessment has identified that this project will look to minimise the exposure of vulnerable customers to the risks associated with power outages and disruptions while improving their access to reliable and stable electricity. It will enhance the ability of the network to respond to issues quickly, safeguarding those who are most at risk. Other considerations including the projects impact on supply, immediate health and safety in the home have been made in carrying out this assessment.

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

FRAME is expected to deliver ~£5.78m with 4.45:1 benefit ratio directly to NGET over 10 years, by improving the network resilience and operational efficiency of multiple teams. These impacts are achieved by consolidating and visualising network resilience data and insights reports which help identify high-risk areas across geographic scale and enable faster and more accurate decision-making during network and weather events. Further benefits can be realised through alignment with the regulatory performance. Additional qualitative benefits include enabling better coordination between teams for operational efficiency (e.g., proactive maintenance), reputation with external stakeholders, reduced stress for teams operating during critical events or extreme weather and better understanding of complex relations between environment and network assets.

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

The problem addressed in this project is experienced by all electricity transmission networks and has the potential to create positive benefits for all UK TOs. At the point of registration, we have identified no barriers to replication across Great Britain. The lessons learnt and the innovation tool may be transferable to other TOs/DNOs with similar business-as-usual (BAU) environments.

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

The successful completion of Phase I of the POC establishes a strong foundation for progressing to FRAME II. The total investment for both FRAME I and FRAME II phases is approximately £1.2 million.

At this stage, the project remains in the PoC phase, and as such, a detailed cost breakdown for a full-scale rollout across Transmission and Distribution Network Operators (TOs/DNOs) is not yet applicable. The primary objective is to validate the Method's feasibility and effectiveness within a controlled environment.

However, it is anticipated that, subject to successful outcomes and alignment with business-as-usual (BAU) environments, the Method could be replicated across other TOs/DNOs—provided they possess comparable levels of data availability and IT maturity. Future cost estimates for broader deployment will be informed by learnings from the PoC and tailored to the specific operational contexts of each network operator POC paves the way for FRAME II. This tool has the potential to be replicated in other Transmission and Distribution Network Operators (TOs/DNOs) with BAU environments, provided they have the same level of data and IT maturity.

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

n/a

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

Please demonstrate how the learning from the project can be successfully disseminated to Network Licensees and other interested parties.

The final report will be shared with other licensee's and a dissemination event will take place at the end of project to share learning outcome.

Please describe how many potential constraints or costs caused, or resulting from the imposed IPR arrangements.<

Not Applicable.

Please justify why the proposed IPR arrangements provide value for money for customers.

Not Applicable.

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 are no other NIA projects looking at Network resilience tool to view Network resilience information holistically.

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

This project is innovative for the following reasons:

- The application of mathematical models and systems engineering techniques to an electrical network. NGET, nor other TO's have not applied complex systems engineering approaches to a transmission network before. We believe this would be one of the most mathematically rigorous analysis of the transmission network undertaken.
- The aggregation of asset-based risk into network and substation level risk forecasting (resilience scores), using supervised machine learning methods is novel.
- This project will identify and test a range of tools and techniques which can be used to implement new quantitative methods across network operations and incident response. NGET does not currently apply any such tools or techniques within Resilience Planning.
- This tool is designed to justify the need for asset repairs and enhance decision-making regarding defect repairs by highlighting combinations of issues that indicate when a particular asset requires urgent replacement—capabilities that are currently beyond human analysis. The project integrates data from various sources to assess the condition of sites and the network effectively.

Application of normative analysis methods which can be subsequently transferred to other network assets and processes to further reduce risk cost and exposure. (E.G Climate Resilience; Wildfire Threat Assessment). Our current analysis methods across Resilience are heuristics based.

Relevant Foreground IPR

n/a

Data Access Details

n/a

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

This project sits outside the scope of Business as Usual (BAU) as it delivers a new and complex risk modelling approach not previously used on the transmission network. It combines systems engineering and machine learning to assess substation-level risk,

representing a clear shift from current practices. This project will identify and test a range of tools and techniques which can be used to implement new quantitative methods across network operations and incident response. NGET does not currently apply any such tools or techniques within Resilience Planning. Due to the exploratory nature of the project, it falls outside BAU and will require separate funding.

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 work has not been undertaken elsewhere before and the results could have significant impact on business planning. The results will benefit other business units such as AO (planning performance managers, lead aces, operational managers), Network Resilience (Resilience and Policy Team) and TNCC (Control Room), NOI and AO management making NIA the most appropriate route.

This project has been approved by a senior member of staff

☑ Yes