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

Nov 2023

Project Reference Number

NIA2_NGESO060

Project Registration

Project Title

FastOut

Project Reference Number

NIA2_NGESO060

Project Licensee(s)

National Energy System Operator

Project Start

October 2023

Project Duration

0 years and 6 months

Nominated Project Contact(s)

Marian Kantor (ESO)

Project Budget

£500,000.00

Summary

Outage requests from asset owners are ideally scheduled when their effect on constraint limit loss is minimal. Currently, the network planning team model the effect of each outage on constraint limits using PowerFactory models. Although this process can account for the complexities of the network, it can be slow and contributes to a backlog of outage requests from asset owners, which can lead to costly emergency or short-notice outages from unresolved outage requests and results in penalties (Fail to Fly) from Ofgem.

This project aims to explore the relationship between outages and constraint limit losses by examining historical outage and post-fault action data and developing an AI. model that can perform a rapid first pass assessment of outage requests reducing the search-space for time consuming PowerFactory modelling.

Third Party Collaborators

Faculty Science Ltd

Nominated Contact Email Address(es)

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Problem Being Solved

Any asset carrying electrical power has a maximum tolerance (upper bound in MW) above which it will overheat leading to damage

and possible destruction to the asset. When the number of assets or the maximum tolerance of each asset connecting two parts of the UK (e.g. Scotland and England) is low, this creates a constraint boundary - power can only flow from one side of those assets to the other up to the sum of the maximum tolerance of each parallel asset (as an example the Scottish border where excess wind generation cannot be exported to England because there aren't enough cables to transmit the electricity.)

If an asset on a constraint boundary is taken out of service, we would expect the limit on the constraint boundary to drop by the tolerance of that asset. In reality, a series of post-fault actions mitigate the loss.
The effect of post-fault actions is not linear, therefore understanding when to schedule an asset outage (e.g. for maintenance) is complex.

Refusal to grant outage requests can result in expensive emergency/unplanned maintenance where each MW lost on a constraint boundary has a fixed price that the ESO has to pay.

Currently, the effect of an asset outage is modelled by simulation in the PowerFactory tool where the time taken to run simulations for each outage has resulted in a severe backlog of requests.

Method(s)

The Project will be broadly delivered through 3 work packages (WPs):

- WP1: User research and design - Engage with ESO users to define the project problem statement and scope of the AI software solution, in particular, how the outcome of this project can provide outage advice to planning engineers.
- WP2: Data Science – ingestion and analysis of relevant datasets (for example, outage requests, day-ahead constraints, wind forecasts) to determine an appropriate solution design to be tested with ESO. The project will continue to build a Proof-of-Concept (PoC) solution, which represents the core output of this phase.
- WP 3: Backend engineering – actively identify and test potential deployment pipelines, such that models described above can be successfully integrated into ESO infrastructure within subsequently Beta/Live Phases.

Using a combination of PowerFactory derived data for single circuit outages, historical outage versus constraint limit data and data on intact limits for each constraint boundary, Faculty will develop an AI tool that can assess a single outage at a given time against existing scheduled outages. Due to the nature of the data utilised in the project it will restrict how the data can be handled and shared; we have put mitigations in place with our security teams to ensure that the data used for the project follows a strict governance process with our supplier, and information that is deemed confidential will be redacted from the final reports and outputs to ensure we comply with our obligations.

At the end of this project, we expect to have the following:

- Improved understanding of the relationship between outages and constraint limit loss.
- Proof of Concept tool for delivering a rapid assessment of the scale of cost of a planned outage.
- Agreed plan for how the tool will be deployed for regular use by end users, developed in close collaboration with ESO's IT team.
- Established infrastructure for tool deployment as tested with a skeleton solution.

The success of the project will be based on the following criteria:

- Benchmarking of the operability and estimated cost of an outage request provided by the tool relative to the operability and costs determined by engineers by running simulations in PowerFactory and calculating the costs of the outputs from the model outputs.
- Outage advice provided by a PoC solution, validated through acceptance testing with planning engineers in the NAP team and a wider ESO Steering Group.

In line with the ENA's ENIP document, the risk rating is scored Low.
TRL Steps = 1 (3 TRL steps)
Cost = 1 (£500k)
Suppliers = 1 (1 supplier)
Data Assumptions = 2
Total = 5 (Low)

Scope

Currently, most outage requests received by engineers in Network Access Planning (NAP) have to be assessed in PowerFactory to determine the likely impact on the network (PowerFactory is a custom power systems model of the electricity transmission network). The PowerFactory modelling is an interactive process and can take considerable time and requires significant expertise.

The project would seek to better understand the relationship between outages and constraint limit losses. The relationship between outages, limit losses and other factors will be codified into a model that can calculate a cost indication (cheap vs. expensive) for scheduling an outage.

This model will be the engine of a PoC tool to allow engineers to triage outage requests before decided whether to pursue more complex time-consuming analysis with PowerFactory.

The project will also involve interviewing key stakeholders to determine, what 'good enough' looks like and how the output from the modelling is best presented to users. These insights will be used to create a user-interface that is intuitive and fit-for-purpose.

The overall solution has the potential to deliver substantial time-savings for planning engineers and other users as well as improve their understanding of the impact of outages on the network.

Objective(s)

This project aims to deliver a PoC AI solution to provide rapid outage request triaging. The PoC will be trained and tested on historical data but will not be deployable on ESO infrastructure. The specific objectives of the project are to develop:

- A PoC model that estimates the impact of an outage request on the network in terms of the operability of the request and the cost to the system if the request is approved and goes ahead. The estimate will be based on PowerFactory derived data for single circuit outages, historical constraint limit data and other features deemed to be relevant (e.g. wind forecasts).
- The project deliverables will include initial designs of a front-end user interface to represent how the bespoke software would be integrated into decision-making
- Based on engineering discovery activities combined with user research, a plan for full deployment during a prospective Beta Phase (deployment out of scope of this phase)

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The ESO does not have a direct connection to consumers, and therefore is unable to differentiate the impact on consumers and those in vulnerable situations. Benefits to all consumers are detailed below.

Success Criteria

- Outage advice provided by a PoC solution, validated through acceptance testing with planning engineers in the NAP team and a wider ESO Steering Group.
- Benchmarking of the operability and estimated cost of an outage request provided by the tool relative to the operability and costs determined by engineers by running simulations in PowerFactory and calculating the costs of the outputs from the model outputs.
- An approved front-end interface facilitating buy-in from end users.
- Clear plan for deployment

Project Partners and External Funding

Faculty.ai will be carrying out the work. No external funding required.

Potential for New Learning

There are multiple channels for new learning through this project, including:

- Provide NAP with improved understanding of the relationship between outages and constraint limit losses.
- Ability of customers (network owners and DNOs) to understand the impact of their outage requests in real time to improve their decision-making processes.
- Learnings regarding the adoption of AI solutions across the business, both for application within these projects but also more widely as to opportunities for AI adoption across the organisation.
- Data quality – this project will provide learnings for ESO how best to share, process and maintain data for analysis in a consistent, secure and efficient manner, providing learnings for use not only by this project but future AI use cases.
- Learning will be shared internally through regular briefings, user research, solution documentation and presentation of key findings, with the ultimate objective to hand over any tools produced to the ESO in future phases. All appropriate documentation will be published on the ENA Smarter Networks Portal (and other forums).

Scale of Project

The project spans six months with one project partner. The project consists of desk-based research, tool development and workshops with the relevant ESO teams (including network and wider teams).

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL6 Large Scale

Geographical Area

Based upon the GB ESO area of operations.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£500,000

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:

Provision of outage advice through FastOut will enable planning engineers to quickly triage outage requests and in many instances remove the need for complex PowerFactory modelling. This will increase the speed at which outage requests can be prioritised and processed, reducing the backlog of unresolved requests which can result in the need for expensive emergency/unplanned maintenance.

As more intermittent renewable generation is connected to the system, the costs of balancing will increase. Furthermore, the electricity network will have to be upgraded and extended to ensure that low carbon generation from areas like the North Sea reach the high demand regions onshore.

It is difficult for planning engineers today to manage and prioritise the large volumes of outage requests and decisions are based on ever-changing assumptions (wind generation forecasts). The energy transition will only make this process more challenging and expensive and therefore tools like FastOut will be critical to support the coordination and stability of the energy system as it accommodates greater renewable generation.

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 (RIIO-1 projects only)

N/A

Please provide a calculation of the expected benefits the Solution

The expected benefits are:

- Better prioritisation of outage requests so that the NAP team can focus on critical outages
- Lower system costs for thermal constraints as a result of more timely decision making and avoidance of emergency outages
- Significant time efficiencies for planning engineers in assessing outage requests.

Baseline Cost: Outturn thermal constraint costs over the last two years have been significantly higher than previously:

- 2019-2020: £264m
- 2020-2021: £433m
- 2021-2022: £960m
- 2022-2023: £808m

Over these four years the average annual cost has been £493m.

Method Cost: FastOut can enable planning engineers to schedule outage requests more efficiently and avoid last-minute emergency requests that carry cost premiums. This will have a positive impact on the outturn thermal constraint costs.

If we assume that FastOut could deliver a 0.5% efficiency saving on outturn thermal constraint costs this would deliver savings of £2.5m per annum (nominal). Should such efficiencies be delivered, cost of rolling out the solution would be recovered within the first year of implementation.

Source:
https://data.nationalgrideso.com/constraint-management/thermal-constraint-costs

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

The method will be applied across all of the regions in which ESO approves outage requests i.e. the full GB transmission network.

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

Following conclusion of this phase, a further Beta/Live Phase would be required to finalise model development (from PoC to deployable product) and integrate the solution into ESO systems. It is estimated that the cost of this next phase would cost between £0.5-1m – these costs will be developed further within the scope of this project.

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 NIA project will deliver a PoC AI solution to provide outage request triage advice, namely, a solution that has been trained and tested on historical data but is not yet deployed on ESO infrastructure.
As such, this project will deliver an initial PoC for direct use and testing with ESO end-users (NAP engineers). User feedback will be fully incorporated into future deployment. ESO staff will own and operate the solution developed within this project, so will directly benefit from the learnings of the project within day-to-day operations.

There is the potential to roll out the tool to ESO customers to enable them to triage their outage requests e.g. prior to submitting on the electricity Network Access Management System (eNAMS), so the user community could well be extended beyond ESO.

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.

This is the first attempt to provide outage assessment support using AI techniques. The ESO use a customised version of PowerFactory, a leading power system analysis software application for use in analysing generation, transmission, distribution and industrial systems. PowerFactory is a physics-based network modelling tool that considers network topology, constraint boundaries and geographic dispersion of assets. The physics based and customised nature of PowerFactory means that AI and ML approaches are not part of the feature set.

While the application of AI solutions is being pursued both by the ESO and other stakeholders within the energy system, this is a specific use case for which there is no publicly available precedent.

Outage planning of the transmission network is a unique activity carried out only by the ESO and this is the first attempt by the ESO to explore other approaches to assessing outage requests and therefore there is no risk of 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

The project will investigate a new approach to providing constraint outage assessment and support using a machine learning approach that has not been tried before. Existing tools (namely PowerFactory) seek to use physics-based models of the power system and whilst computationally time-consuming provide a very high degree of accuracy.

The advancement of high-performance computing power coupled with the increase in data available is making alternative methods such as those applied to the FastOut project feasible. The risk in their deployment is that the performance of the models is often dependent on having sufficiently large volumes of good quality data for training and testing purposes and as a consequence their outputs may not always be actionable.

Relevant Foreground IPR

The following foreground IPR is expected to be generated in the course of the project:

- Proof of Concept tool
- Established infrastructure for tool deployment as tested with a skeleton solution

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:

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 Grid ESO 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.nationalgrideso.com/future-energy/innovation
3. Via our managed mailbox innovation@nationalgrideso.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 https://www.nationalgrideso.com/document/168191/download.

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

Due to the inherently risky nature of the project, given that it is trialling new approaches to providing voltage support using new, innovative AI techniques, it does not fall into current business as usual (BAU).

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 project attempts to use AI to provide rapid outage request triaging, a complex area of the business, and the overall TRL is low. Innovation funding is therefore more suitable for exploring the project’s potential and increasing TRL before transferring into BAU if proof of value can be delivered. This is a project that otherwise would not be pursued without the assistance of innovation funding.

This is a novel application of AI methods both for this use case and across the ESO – this brings an inherent risk that workable advice cannot be provided, a risk that is not suited for BAU funding.

Standard ESO processes and procedures relating to data capture, storage, processing and sharing may need to be adapted to fully integrate the solution into ESO architecture and run the solution at the frequency required (daily, hourly).

This project has been approved by a senior member of staff

- [x] Yes