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.

Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

NIA Project Close Down Report Document

Date of Submission

Jul 2024

Project Reference Number

NIA2_NGESO060

Project Progress

Project Title

FastOut

Project Reference Number

NIA2_NGESO060

Project Start Date

October 2023

Project Duration

0 years and 6 months

Nominated Project Contact(s)

Marian Kantor (ESO)

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.

Objectives

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)

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

Performance Compared to the Original Project Aims, Objectives and Success Criteria

Project 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 aimed 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.

The project consisted of three main work packages:

- 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.

WP1: User Research and Design

The first work package focused on engaging with NGESO users to accurately define the project's problem statement and the scope of the AI software solution. The primary aim was to determine the performance requirements and interaction preferences of end-users, including the specific metrics and visualizations needed for effective decision-making. Key stakeholders in network planning and IT were closely involved to ensure that the developed solution would integrate seamlessly into existing business-as-usual (BAU) processes. Through comprehensive user research, the project identified essential requirements, such as the types of outages to be prioritized and the rules-based constraints that should guide the decision-making process.

WP2: Data Science

The second work package involved the ingestion and analysis of relevant datasets, such as outage requests, day-ahead constraints, and wind forecasts. This phase was crucial for developing an appropriate solution design to be tested with NGESO. The team generated data for unmitigated single outages using the PowerFactory tool and assessed SORT and ENUMS data for quality. When reviewing the data, it became clear that there were several challenges around the accuracy and availability, and the team worked to develop a baseline set of data to be utilised as part of the project. The exploration of collected data helped map outages to the constraint boundaries they affect and determine the timescales for outages. The initial hypothesis tested was whether post-fault actions could be approximately modelled as a function of unmitigated outages. Despite challenges in data quality and consistency, the team developed an initial PoC model which was shared with the ESO teams for feedback and testing.

WP3: Backend Engineering

The third work package focused on backend engineering to identify and test potential deployment pipelines, ensuring the models could be successfully integrated into NGESO's infrastructure. The team developed a Python-based tool with a graphical user interface (GUI) accessible through a web browser. The GUI allowed users to input options and assumptions, with results presented as a Gantt chart. However, the PoC prototype revealed significant discrepancies between the modelled results and expected outcomes. The tool incorrectly indicated high impacts for geographically distant outages and produced non-credible cost estimates for outage requests. These issues highlighted the inconsistencies of the core functions of the tool, and challenges around the input data. It was established that more time and accurate data was needed to bring the tool up to a level that could be utilised by the ESO engineers. However, due to resource constraints and timelines, it was agreed that the ESO would park this project for the time being, potentially picking it back up later.

Project Outputs and Successes

Despite the decision not to move forward with the next phase, the FastOut project yielded several valuable insights and outputs. It improved the understanding of the relationship between outages and constraint limit loss, even though the final tool did not meet performance expectations. The project highlighted critical data quality and consistency challenges that must be addressed in future automation projects. Additionally, the engagement with key stakeholders and the development of initial models and user interfaces provided a foundation for further refinement and potential future applications.

Conclusion

The FastOut project has underscored the complexities of integrating AI-based solutions into energy system operations. While the initial objectives were not fully met, the project has provided important lessons on data management and the integration of innovative tools within existing infrastructure. The collaborative efforts and insights gained will inform future projects, driving continuous improvement in outage management and network planning for the UK Energy System.

Required Modifications to the Planned Approach During the Course of the Project

During the FastOut project, several modifications to the planned approach were necessary to address unforeseen challenges and enhance the project's feasibility. Initially, the project aimed to use historical data and existing modelling tools to rapidly assess outage impacts. However, early findings indicated significant issues with data quality and consistency across various sources, necessitating a more rigorous data validation and correction process than originally anticipated. Additionally, the hypothesis that post-fault actions could be modelled as a function of unmitigated outages required revision. The team explored alternative modelling approaches that better accounted for network topology, ultimately leading to a refined PoC model. These adjustments were crucial for ensuring the project remained aligned with its objectives and could deliver meaningful insights, even if the final tool did not fully meet expectations.

Lessons Learnt for Future Projects

The FastOut project provided several valuable lessons for future initiatives in outage management and network planning. A key lesson was the importance of ensuring high-quality and consistent data from the outset. The significant time and resources spent on data correction underscored the need for robust data management practices. Additionally, the project highlighted the challenges of modelling complex network interactions and the limitations of existing tools in capturing these dynamics accurately. Future projects should consider more flexible and adaptable modelling approaches. Engaging stakeholders early and throughout the project lifecycle proved essential for aligning project outputs with user needs and expectations. Lastly, the importance of iterative development and testing was reinforced, allowing for continuous refinement based on real-world feedback.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

The FastOut project yielded several notable outcomes despite not progressing to full deployment. The project advanced the understanding of the relationship between outages and constraint limit loss, highlighting the complexities involved in outage scheduling. The engagement with NGESO users and stakeholders facilitated a comprehensive requirements analysis, ensuring that future iterations of the tool can better meet operational needs. Furthermore, the project identified critical data management issues, providing a clear direction for improving data quality and consistency in future projects. These outcomes collectively contribute to the ongoing efforts to enhance network planning and outage management processes.

Data Access

Details on how network or consumption data arising in the course of NIA funded projects can be requested by interested parties, and the terms on which such data will be made available by National Grid can be found in our publicly available “Data sharing policy related to NIC/NIA projects” and www.nationalgrideso.com/innovation.

National Grid Electricity System Operator already publishes much of the data arising from our NIC/NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published.

The data used by the project is owned by ESO and classified as strictly confidential, hence it cannot be shared with third parties. The only exception is constraint limit data, which is publicly available on the ESO website.

Foreground IPR

- Source code and documentation has been provided by the developer
- Due to the confidential nature of the information contained in the reports, these will not be uploaded to the Smarter Networks Portal but can be shared with wider network licensees upon request.

Planned Implementation

Given the insights gained and the challenges encountered, the next steps would involve refining the PoC model and addressing the data quality issues identified. It is recommended that a comprehensive data audit be undertaken, and more rigorous data management protocols established. Additionally, exploring advanced AI and machine learning techniques that can better accommodate the complexities of network topology and post-fault actions will be crucial. A phased implementation approach is advised, starting with pilot testing in controlled environments before full-scale deployment. Continuous stakeholder engagement and feedback loops should be maintained to ensure the tool's usability and effectiveness. Developing detailed documentation and training materials will also support successful integration into NGESO's operations.

Net Benefit Statement

Despite its challenges, the FastOut project, has provided significant net benefits for the NGESO and wider network licensees. The project advanced the understanding of outage impacts on constraint limit loss, contributing valuable insights for future outage management strategies. The development of a PoC tool demonstrated the potential for rapid assessment of outage requests, offering a foundation for further innovation in this area. By highlighting critical data management issues, the project has paved the way for improved data quality and consistency, which are essential for effective network planning. The lessons learnt and recommendations from the project will inform future initiatives, ensuring that NGESO continues to enhance its capabilities in managing outages and optimising network performance. Overall, the project has contributed to the long-term resilience and efficiency of the UK's energy system.

Other Comments

The Project outcomes and results contain confidential information and intellectual property rights that cannot be disclosed in this Report due to their proprietary nature. Should the viewer of this Report (“Viewer”) require further details this may be provided on a case by case basis following consultation of all Publishers. In the event such further information is provided each and any Publisher that owns such confidential information or intellectual property rights shall be entitled to request the Viewer enter into terms that govern the sharing of such confidential information and/ or intellectual property rights including where appropriate formal licence terms or confidentiality provisions. Dependent upon the nature of such request the Publishers may be entitled to request a fee from the Viewer in respect of such confidential information or intellectual property rights.

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