ESRS - Modelling and Restoration Tool WG Report

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1 Introduction

The Electricity System Restoration Standard (ESRS) will require the Electricity Industry to collectively have sufficient capability and arrangements in place to restore 60% of regional[1] demand within 24hrs of a supply disruption, and 100% of Great Britain's electricity demand within 5 days. Historically, industry guidelines planned to achieve sufficient national restoration to satisfy strategic and essential welfare demand requirements, (commonly proxied to 60% of national demand) within 24 hours but with a 36-hour regional minimum.

The ESRS accounts for a total electricity system black-out, which is the most onerous credible condition since any partial supply disruptions should resolve within shorter timescales. Achieving and maintaining the new ESRS will require investment and changes to operational practices across industry parties.

Since overall widespread measurement of restoration performance cannot be undertaken in real world circumstances, a computational representation of the system must be used to provide insight and understanding about compliance.

The complexity and uncertainty of restoration procedures means that the outcome is a function of many parameters and chance events. For the current network modelling, we use a probabilistic tool which was developed by the ESO on behalf of wider industry owing to our central role and access to relevant sensitive information. The results have been determined through Monte-Carlo simulation techniques to explore the range of possible outcomes for a set of central circumstances.

The ESO will require enhanced ability to model the restoration capability to provide the appropriate level of confidence to industry parties that the outcomes of the model are a fair representation of the restoration times in GB.

[1] There are currently six restoration Regions of Great Britain covering England, Scotland and Wales, commonly referred to as Zones

2 Benefits and Limitation of Models

2.1 Benefits and Limitations of Probabilistic Model

The model is built in Excel and utilises a software add-in called @Risk to provide the probabilistic Monte-Carlo statistical functionality. These models have been built using Windows Excel365 and @Risk 7.6.0.

The probabilistic tool provides a wider holistic understanding of risk and performance because it can account for uncertainty and chance within the chain of restoration activities and consequential effect. This is particularly important in complex systems where no absolute guarantee can be given due to the vast spectrum of eventualities and sequence of events. It can also map the extremes of outcome giving insight into the 'best' and 'worst' credible outcome along with 'mean' or 'most likely' outcome. These are important metrics when considering the scale of resources that can be efficiently deployed by society to address the risk of a major supply disruption.

The model benefits from a relatively high degree of sophistication and complexity, reflecting the system represented. This should lead to better results, but the downside is that it does not provide a continuous result feed. It is therefore necessary to run the model over longer timeframes to gain a holistic view of performance. Consequently, the model has been designed to sample across a whole year to gain insight across a wider time period. Annual assessments provide a means of tracking performance and identify where weaknesses occur. Each annual assessment assumes the services contracted over that period, along with the most recent or appropriate operational data.

Whilst this model has gained general acceptance, it is prudent to review its functionality and suitability before the ESRS obligation commences from late 2026. This has been undertaken by 3rd party specialists.

The recommendations of the audit and suggested improvements are shown in Figure 1. This was presented and discussed with Working Group members and the outline implications for each recommendation are captured.

Modelling Development Shopping List March 2022	Estimated resource	Risk(s)	Priority?
Establish Standard confidence level(s) with BEIS	1 or 2 month - through regular BEIS meetings?	Low, the model functionality already exists	1
Align 6 x BS zones to DNO licence areas*	3 or 4 months rebuild	Medium	2
Data assumptions review	2 or 3 months to undertake systematic analysis of all major assumptions	Low or medium	3
Embedded demand and generation improvements	6 to 8 months (if data available?)	med or high	4
Future proofing model - new developments such as DER/Skeleton networks, offshore wind, contract changes etc.	1 month annual update, strategic changes (DER etc) significant time required.	Annual process low risk, new developments medium risk	5
Data verification process for any new assumptions/data	1 month - some data available through BSTG work	Low	6
Model documentation - technical specification	3 months?	Low	7
Review software platform evaluate risk/benefit of alternatives	Estimate 6 - 12 months, delivery unknown 2 years?	High or very high	8
Totals	***23 to 63 months***	***2 to 5 years effort***	
**** Item 2 - Not raised by Auditors but now considered necessary by ESO***			

Figure 1- February 2022 Audit recommendations summary

In terms of model development there are four key areas that are regarded as priorities. These are potentially complex to implement and so a table of pros and cons has been developed as shown in Figure 2. Whilst complete and accurate representation of all relevant features is always the ambition, it must be recognised that a trade-off between practicality and perfection must be made. The full implications of these recommendations will become apparent once outline design work has been completed. It might be necessary to aggregate some fine details to a more manageable level for software purposes.

Item	Modelling Development Shopping List March 2022	Pros	Cons
1	**Align 6 x BS zones to DNO licence areas**	A Licence area based model would provide clearer functional DNO operational contraint alignment and corresponding restoration plan deployment representation.	Conceptually messy because we would still need to calculate the 6 Black Start zones restoration to measure compliance. Model development overheads and delivery risk.
2	**Embedded demand and generation improvements**	Better representation of embedded should improve accuracy through better setting of National demand curves and embedded generation behaviour.	Data not readily available. Monitoring and metering not visible although some aggregated values exist for wind and solar. Probably need to apply some broad zonal assumptions?
3	**Future proofing model - new developments such as DER/Skeleton networks, offshore wind, contract changes etc.**	General model upkeep to reflect evolving generation portfolio and services contracted. Would be required irrespective of any other considerations.	Precise definition of service/capability could be fairly complex, some assumptions inevitable. Model development overheads and some delivey risk possible.
4	**Review software platform evaluate risk/benefit of alternatives**	Could lead to model integration into wider ESO software suite with established development procedures and controls. Longer term BAU sustainable and could remove existing critical paths.	Unclear what platform could be adopted and whether this would improve model funtionality at all. Large/unknown overheads and cost, slower response high delivery risk.

Figure 2 – Outline pros and cons

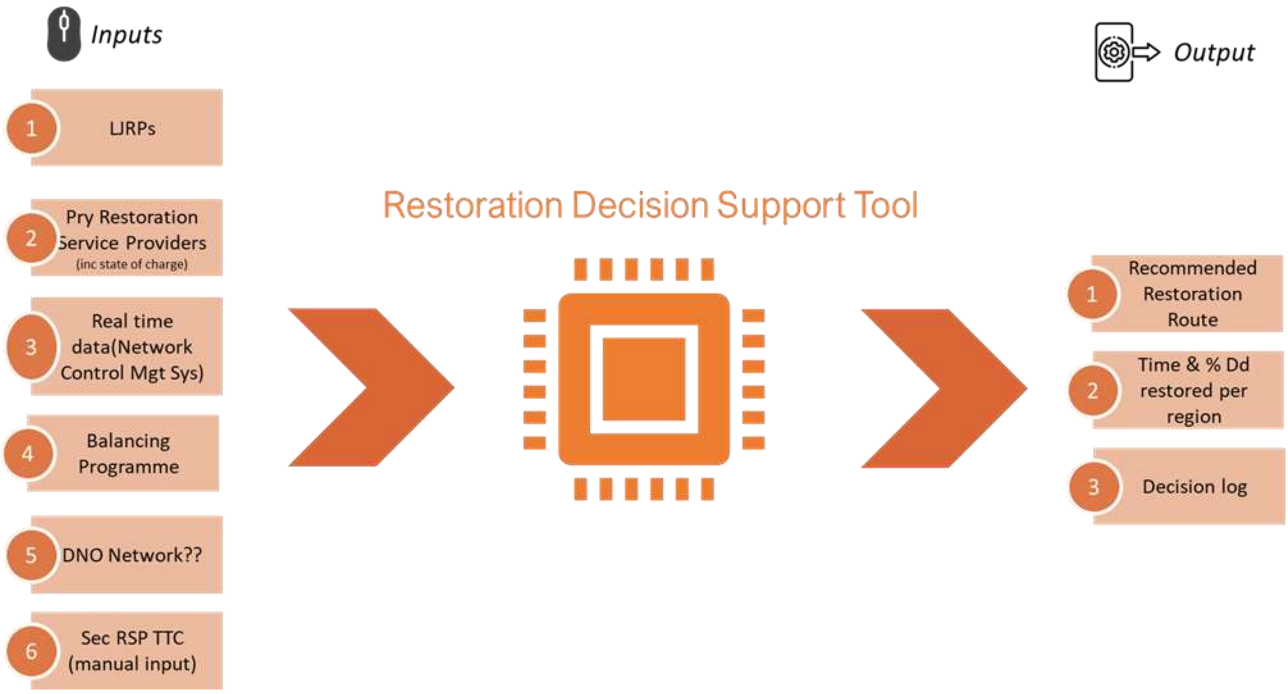
The ESO plans to work through these recommendations in priority order such that by 2026 we have a model which satisfies the requirement. It should be noted that software limitations, data restrictions or excessively complex structures could mean some approximations will be required. Some outline ideas have already been considered by the Working Group and helpful feedback accounting for wider industry provided.

Given that the probabilistic model does not lend itself to continuous capability monitoring, the Working Group has given outline consideration to the development of a simpler deterministic method based on a series of data inputs and calculations that might provide a continuous capability indicator. These details are given in the following section.

2.2 Benefits and Limitations of Deterministic Model

The deterministic Restoration Decision Support tool will be designed to provide recommendations to the Control Engineer on what the most effective restoration route would be based on real time data. This approach would support

- Increased speed around decision making for the Control Engineers
- Decrease restoration time hence a higher chance of meeting the new Licence Condition.
- Potential to capture decisions log based on a chosen cause of action, which would support audits.
- Accuracy in restoration strategy due to the use of some automated Realtime data and processing


Inputs
1 LJRPs
2 Pry Restoration Service Providers
(inc state of charge)
3 Real time data(Network Control Mgt Sys)
4 Balancing Programme
5 DNO Network??
6 Sec RSP TTC (manual input)
Restoration Decision Support Tool
Output
1 Recommended Restoration Route
2 Time & % Dd restored per region
3 Decision log

nationalgridESO

3 Technical and Non-Technical Parameters for Future Deterministic Tool

Please see attached document – Appendix A Modelling and Restoration ES Restoration Tool Strawman

4 Implementation Plan of the Deterministic Tool

High-level Implementation Plan

- Stakeholder Engagement – Nov 21 to Mar 22
- Recruit Modelling Engineer – Apr 22
- Define scope Restoration Tool with IT– Jun 22
- Identify Tool / software – Sep 22
- Tool Development - 2024
- Integration to NCMS - 2024
- Testing / Training - 2025
- Go Live – 2025
- Continuous Improvement - 2026

5 Risks & Mitigations

5.1 Table of Risks

Risk Number	Description of Risk	Cause of Risk	Consequence of Risk	Risk Likelihood (0-4)	Consequence Severity (0-4)	Risk Mitigation	Mitigated Likelihood (0-4)
1	Delay with tool development	Lack of resources Lack of clarity on scope	Impact on BP and potentially the ESRS standard	2	3	Ongoing recruitment Regular engagement to clarify requirements	3
2	Integration issues	General IT Failure	Impact on BP	2	3		

6 Impact on Industry

6.1 Impact on Industry Codes

NGESO have raised Grid Code Modification GC0156 to implement the necessary changes to the Grid Code. It is proposed this is a joint Grid Code / Distribution Code Workgroup which will also develop Distribution Code Changes. There will however need to be separate workgroup under the auspices of the other industry code panels (eg STC, SQSS, CUSC and BSC) to implement the full suite of measures required. It has been proposed that the combined Grid Code / Distribution Code should be the first formal Code modification established and the other industry code changes will then follow with the Grid Code taking the lead.

7 Conclusion

The requirement for the development of a Restoration Decision Support Tool is a Business Plan requirement therefore no further solution is expected from the GC0156 with the exception of an obligation on the DNO and TO to support the ESO in developing and maintaining and up to date model.