Frequency Risk and Control Report (FRCR) 2025

Webinar – 1: Framework and Methodology

27 November 2024

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National Energy System Operator

Agenda

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- Open & Housekeeping

- Introduction & Timeline
- Documents Structure
- What is Frequency Risk and Control Report (FRCR)?
- How do we structure the model?
- General Policy & Specific Policy

- Survey Open
- Q&A
- Further Information and Close

Housekeeping

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- You have been joined in listen only mode with your camera turned off.
- To ask your questions live please go to Sli.do **event code #FRCR**. Ask your questions as early as possible. Slido page remains open until this webinar closes and will re-open when Webinar-2 starts.
- Please provide your full name and organisation. Questions from unidentified parties will not be answered.
- Questions will be answered in the upvoted order whenever possible. We endeavour to answer as many as possible during the session. We may need to take some questions away.
- **Questions on detailed model and data will be taken away and addressed in Webinar – 2 as advanced questions.**
- **Out of scope questions will not be managed in FRCR webinars** and will be forwarded to the appropriate NESO team for response.
- Slides will be published after the webinar. A full Q&A document will be published by Friday 20 December that includes all Q&As from FRCR Webinar-1 and 2.
- Please contact **box.sqss@nationalenergyso.com** for feedbacks and other comments.

Introduction

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- NESO is obliged to produce a **Frequency Risk and Control Report (FRCR)** aiming to set out our general policy for managing frequency on the GB electricity system.
- Recommendations from FRCR runs an industrial consultation. FRCR is submitted to SQSS Panel for review and recommendation before it is submitted to Ofgem for approval by 1st April every year.
- Past Editions:
    - **FRCR 2021** established the baseline for evaluating the cost vs. risk in frequency management.
    - **FRCR 2022** evaluated the benefits of securing simultaneous events.
    - **FRCR 2023** assessed the benefits of reducing the minimum inertia requirement.
    - **FRCR 2024** assessed the minimum inertia requirement and benefits of holding additional response.
- **FRCR 2025 Policy will:**
    - Explore system risks and cost benefits from reducing minimum inertia from **120 GVA.s to 102 GVA.s.**
    - Benefits of securing the additional BMU+VS and simultaneous events.
    - Continue covering timeline of 2025 – 2026 and 2026 – 2027 as requested by Ofgem in 2023.

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Timeline

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FRCR 2025 Engagement Plan		
Content	**Date**	**Way of Comms**
OTF Presentation: FRCR 2025 Scope and Engagement Plan	20 - Nov	OTF
FRCR 2025 Webinar – 1: Framework and Methodology	27 - Nov	**Webinar**
FRCR 2025 Webinar – 2: Model and Data	11 – Dec	**Webinar**
Methodology and Guidance Document Publication	End of January	OTF Signpost & Publication
FRCR 2025 Consultation	February	OTF Signpost
FRCR 2025 Webinar – 3: Results and Recommendation	Mid of February (TBD)	Webinar (Signup TBD)
Post Consultation Engagement	March	Individual Meetings
Engaging with SQSS Panel & Sign off	March	SQSS Panel Meeting
Submission to Ofgem	**31 – March**	**Email**

We are here

- **This webinar focuses on framework, methodology and high-level assumptions used in FRCR analysis.**
- We welcome questions related to those topics.
- Questions on detailed model and data will be addressed in Webinar – 2.

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Documents Structure

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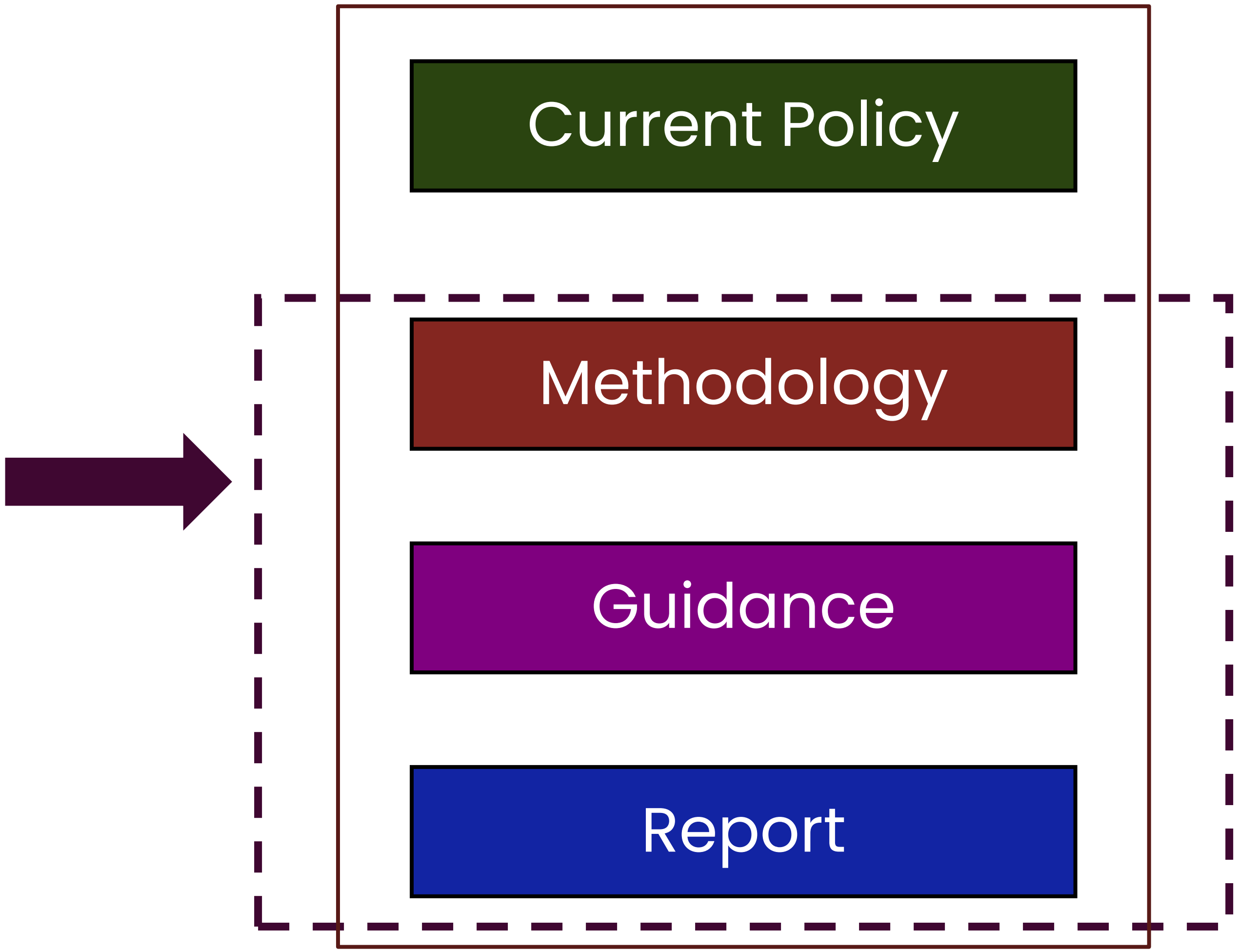
FRCR 2025
Suite of Documents



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Documents Structure

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Current Policy

Methodology

Guidance

Report

- FRCR 2024 Policy that recommends:
  - Maintain the minimum inertia requirement at 120 GVA.s.
  - Secure all BMU-only risks as baseline.
  - Consider additional DC-Low requirement to further reduce residual risks.
- It states current NESO policy for frequency risks and controls, and provides a baseline for FRCR 2025 edition.

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Documents Structure

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- Current Policy
- **Methodology**
- Guidance
- Report

- Updated methodology document (v3) that explains:
  - What will be assessed in FRCR,
  - How it will be assessed, and
  - Format of the outputs.
- It also clarifies definitions and assumptions used in FRCR assessment.
- Methodology is covered in this webinar.

Documents Structure

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Current Policy

Methodology

Guidance

Report

- Supporting document that includes:
  - General assumptions,
  - Flow charts to explain steps of assessment, and
  - Data used in FRCR model
- Models and Data are covered in next technical webinar.

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Documents Structure

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Current Policy

Methodology

Guidance

Report

- FRCR 2025 Report:
  - Will explore system risks and cost benefits from reducing minimum inertia from 120 GVA.s to 102 GVA.s., and
  - Benefits of securing the additional BMU+VS and simultaneous events.
- Report will focus on analysis results and policy recommendations.

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High level context reminder

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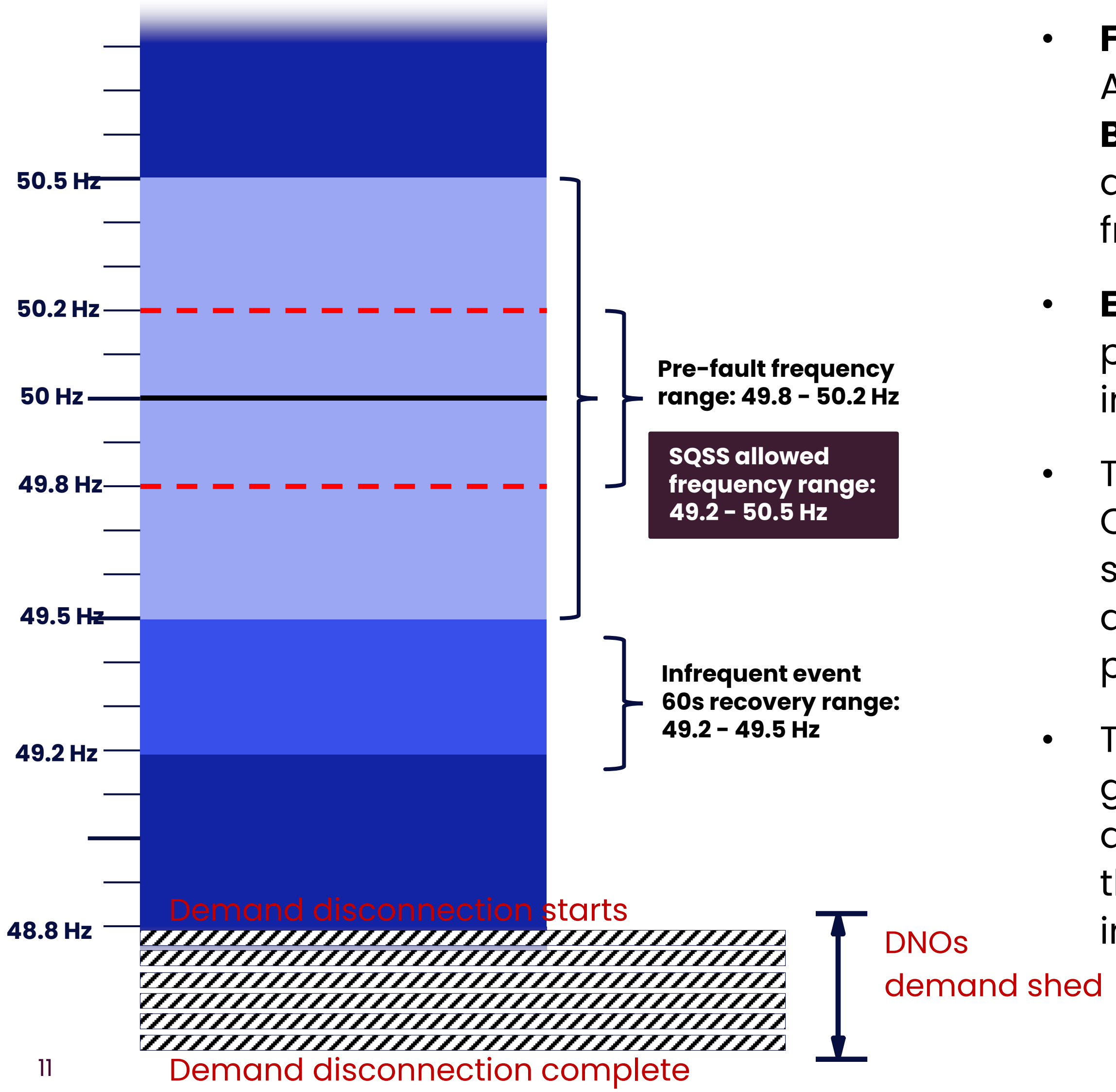

- **Frequency** is the rate at which the current is oscillating in an Alternating Current (AC system). **The nominal target for this in Great Britain is 50Hz.** If there is an imbalance between supply and demand, then putting more energy into the system increases the frequency and vice versa.
- **Events** such as trips or volatilities on the system cause a sudden power imbalance on the system resulting the frequency to drop or increase.
- To mitigate this, we procure **Response** services (e.g. Dynamic Containment) which rapidly increase their output automatically to stop the imbalance and protect the frequency. We can manually dispatch **Reserve** services following an observed system event or proactively in anticipation of a system need.
- The frequency also corresponds to how fast conventional turbine generators are spinning. The energy it takes to speed up or slow down how fast these units are spinning is called **Inertia.** The more of these units there are, the slower the frequency changes for a given imbalance.

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What is FRCR?

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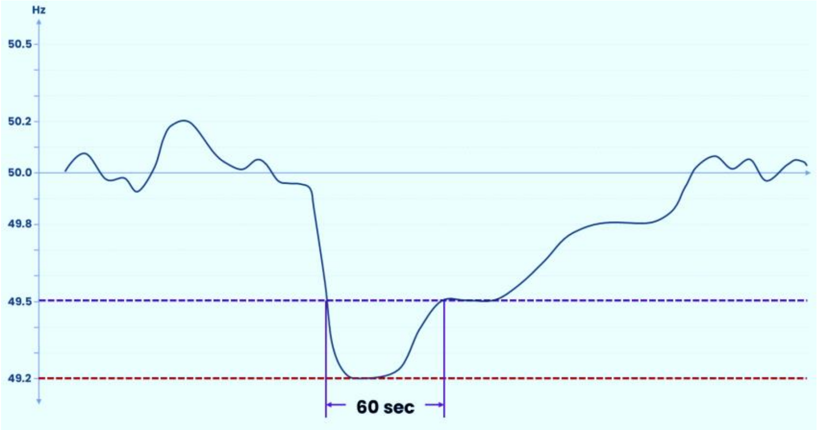
System Risks



- How secure or reliable is the system against SQSS / current FRCR policy?
- How likely do the system expect to see a 49.5Hz, 49.2Hz, low frequency demand disconnection (LFDD) event and a 50.5Hz event?

Cost

- To operate the system under a certain level of risks, what controls do we implement?
- How much do we need to spend by implementing those controls?

- **A reliable supply of electricity**
- **At an affordable cost**

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Questions we are answering:

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For all the **Events**, under different system conditions, including:

- pre-fault response holding,
- demand,
- system inertia
- system topology
- transmission system failure probability
- estimated Loss of Main (LoM) volumes

With different **Control** approaches,

Question – 1: What are the system **Impacts** following each **Event**? So for all the **Events** what are system residual **risks** / reliability, e.g. 1 out of X years to see a LFDD event?

Question – 2: **Cost –** To achieve above reliability, how much does NESO need to spend per annum?

Question – 3: Is it worth spending more to further mitigate residual risks?

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What results will we get?

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System Risk

What happens when Events occur, and how often?

Cost

How much will we spend securing the system?

Balance

- Do we achieve the right balance between risks and cost?
- What will be the best balance of cost and risk?

Policy Recommendation

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Key Definitions

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Impact of frequency deviations

Events

Controls and Control Scenarios

Costs

Cost vs. Risk Metrics

- The impact of a transient frequency deviation depends on its duration, size and the conditions under which it occurs.
- NESO applies a number of frequency limits to manage the frequency risk.

#	Deviation	Duration	Relevance
H1	50.5 < f	Any	Beyond current SQSS implementation Plant performance prescribed in detail by Grid Code, but not often tested in real-life conditions
L1	49.2 ≤ f < 49.5	60 seconds	Current SQSS implementation Infrequent occurrence, but reasonable certainty over plant performance
L2	48.8 < f < 49.2	Any	Beyond current SQSS implementation, but without triggering LFDD Plant performance prescribed in detail by Grid Code, but not often tested in real-life conditions
L3	47.75 < f ≤ 48.8	Any	First stage of LFDD

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Key Definitions

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- Impact of frequency deviations
- **Events and Loss Risks**
- Controls and Control Scenarios
- Costs
- Cost vs. Risk Metrics

- Events on the transmission system may cause consequential loss of Distributed Energy Resources through:
  - Rate of Change of Frequency (RoCoF) and
  - Vector Shift (VS)
- Assessment covers the following three categories of events / loss risks:

BMU-only	• An event that disconnects one or more BMUs, and may or may not also cause a consequential RoCoF loss (no VS loss) • Caused by a Loss of Infeed or Loss of Outfeed
BMU + VS (outage or intact)	• An event that disconnects one or more BMUs and causes a consequential VS loss, and may or may not also cause a consequential RoCoF loss • Caused by fault outages of primary transmission equipment on the National Electricity Transmission System (NETS) (i.e. a single transmission circuit, a busbar or mesh corner, or a double circuit overhead line)
Simultaneous Event	• An event that disconnects two BMUs at the same instance and may or may not also cause a consequential RoCoF loss.

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Key Definitions

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- Impact of frequency deviations
- Events and Loss Risks
- **Controls and Control Scenarios**
- Costs
- Cost vs. Risk Metrics

- There are four main controls for mitigating transient frequency deviations:
  - holding frequency response
  - reducing BMU loss size
  - increasing inertia
  - reducing Loss of Mains (LoM) loss size
- Different combinations of these controls are referred to as "Control scenarios".

Holding Response	• Dynamic Containment (DC) • system-wide controls.
Reducing BMU loss size	• Applying Bid / Offer Acceptance (BOA) controls to BMU-only and BMU+VS events. • Individual loss risk control
Increasing Inertia	• The effect of increasing the minimum-inertia limit. • system-wide controls.
Reducing LoM loss size	• Reduction of LoM volumes (RoCoF and VS) as Accelerate Loss of Main Changing Programme (ALoMCP) completed. • system-wide controls.

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Key Definitions

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- Impact of frequency deviations
- Events and Loss Risks
- Controls and Control Scenarios
- **Costs**
- Cost vs. Risk Metrics

Costs align with **Controls** that NESO uses to manage frequency deviations. They are balancing costs.

- System-Wide Cost: All frequency response and inertia costs as they affect all events and loss risks.
- Individual Control Cost: BM Control to adjust relevant BMU(s)' output(s) so that they become securable. The cost involves the Bid Offer Acceptances (BOA) price to reduce the loss size as well as the re-positioning price for other BMU's to compensate.
- Overall Cost = System-Wide Cost + Individual Control Cost

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Key Definitions

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Impact of frequency deviations

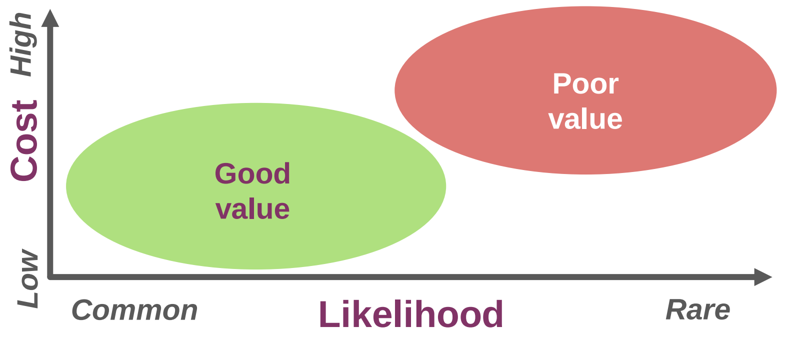
Events and Loss Risks

Controls and Control Scenarios

Costs

Cost vs. Risk Metrics

- General principle:
  - good-value risks are likely to be those which are lower cost to mitigate or contain, have a high likelihood, or which have a large impact.
  - poor-value risks are likely to be those which are higher cost to mitigate or contain, have a low likelihood, or which have a small impact.



- There is a whole spectrum of costs and likelihoods across each of the events, meaning a clear-cut judgement of the balance between reliability and cost can be difficult to reach for one event in isolation.

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How do we model?

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General Assumptions

1. Historic vs. Forecast

Analysis uses historic dataset (inertia, demand, generator positions etc.) adjusted for known or expected changes, e.g. new connections, new commissioning / decommissioning NETS in the coming 12-24 months.

2. Granularity and Time Period

Analysis of single snapshot of one point in time, for example winter peak or summer minimum, would not capture the intricacies and interactions or give a true picture of risks exposure. Analysis is performed as a time series (at Settlement Period granularity) for the 2025-26 and 2026-27 periods.

3. Baseline System Conditions

We unwind balancing actions from the historic data sets to get a representation of the "market position" for these baseline system conditions.

4. Cost of Mitigations

Costs are benchmarked against the typical prices for each control.

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How do we model?

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High-level principle of FRCR methodology

Baseline Policy	Test Policy
Apply system-wide controls	Apply system-wide controls
Apply individual loss risk controls	Apply individual loss risk controls
Determine overall cost / Determine residual risks	Determine overall cost / Determine residual risks

Comparison and Recommendations

System-wide controls refers to actions benefits the whole system, i.e**. increase inertia** and **holding response**

Individual loss risk controls refers to the actions only mitigate one individual risk, i.e. **reducing loss size**

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How do we model?

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Model environment preparation

1. System conditions

Update system conditions including, pre-fault response holdings, inertia, demand, generation profiles, system topology, LoM volumes.

2. Event and loss risks

Update events and loss risks including, generation failure rate, transmission failure rate, simultaneous/ cascading event rate, transmission outage period, new connections and new loss groups,.

3. Costs for control

Update typical costs for controls including costs for procure frequency response services, cost for reducing loss size through BOA and cost to increase inertia.

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How do we model?

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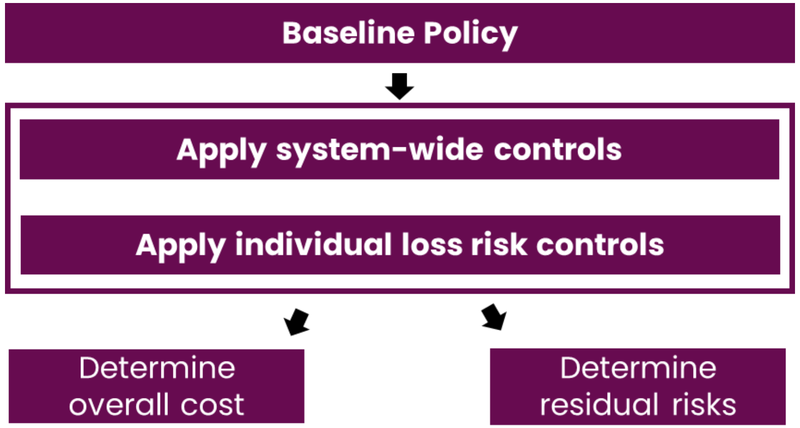
Assessment for Baseline policy



Baseline policy

- Maintain the minimum inertia requirement at 120 GVA.s.
- Secure all BMU-only events to keep resulting frequency deviations within 49.2 Hz and 50.5 Hz.
- Do not apply additional controls to secure all BMU+VS and simultaneous events.

Apply controls

System-wide Controls

- Synchronise sufficient unit to make system **inertia no smaller than 120 GVA.s**
- Procure sufficient Dynamic Containment to secure the largest BMU-only risks.

Individual loss risk Controls

- Do not apply additional controls to secure all BMU+VS and simultaneous events by reducing its loss size

How do we model?

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Assessment for Baseline policy

Baseline Policy

Apply system-wide controls

Apply individual loss risk controls

Determine overall cost

Determine residual risks

Bassline policy

Apply controls

Determine overall cost

Total cost (£) = cost for **system-wide control** + cost for **individual control**

- Cost to meet 120 GVA.s min inertia
- Cost to procure Dynamic Containment
- (Other costs, i.e. DR, DM, Stability Pathfinder)

Determine Residual risks

#	Deviation	Likelihood
H1	50.5 < f	1 in _ years
L1	49.2 ≤ f < 49.5	1 in _ years
L2	48.8 < f < 49.2	1 in _ years
L3	47.75 < f ≤ 48.8	1 in _ years

How do we model?

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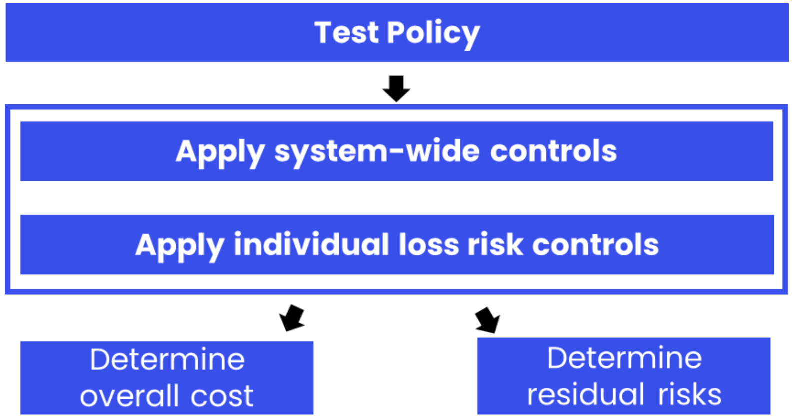
Assessment for Test policy 1



Test policy – min inertia at 102 GVA.s

- **Maintain the minimum inertia requirement at 102 GVA.s.**
- Secure all BMU-only events to keep resulting frequency deviations within 49.2 Hz and 50.5 Hz.
- Do not apply additional controls to secure all BMU+VS and simultaneous events.

Apply controls

System-wide Controls
- Synchronise sufficient units to make system **inertia no smaller than 102 GVA.s**
- Procure sufficient Dynamic Containment to secure all BMU-only risks.

Individual loss risk Controls
- Do not apply additional controls to secure all BMU+VS and simultaneous events by reducing its loss size

Determine overall cost

Determine residual risks

How do we model?

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Assessment for Test policy 2

Test Policy

Apply system-wide controls

Apply individual loss risk controls

Determine overall cost

Determine residual risks

Tested policy – secure BMU+VS risks

- Maintain the minimum inertia requirement at 120 GVA.s.
- Secure all BMU-only events to keep resulting frequency deviations within 49.2 Hz and 50.5 Hz.
- Secure all BMU+VS events to keep resulting frequency deviations within 49.2 Hz and 50.5 Hz.
- Do not apply additional controls to secure all simultaneous events.

Apply controls

System-wide Controls

- Synchronise sufficient unit to make system inertia no smaller than 120 GVA.s
- Procure sufficient Dynamic Containment to secure all BMU-only risks.
- **Procure sufficient Dynamic Containment to secure all BMU+VS risks.**

Individual loss risk Controls

- Do not apply additional controls to secure all simultaneous events

Determine overall cost

Determine residual risks

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How do we model?

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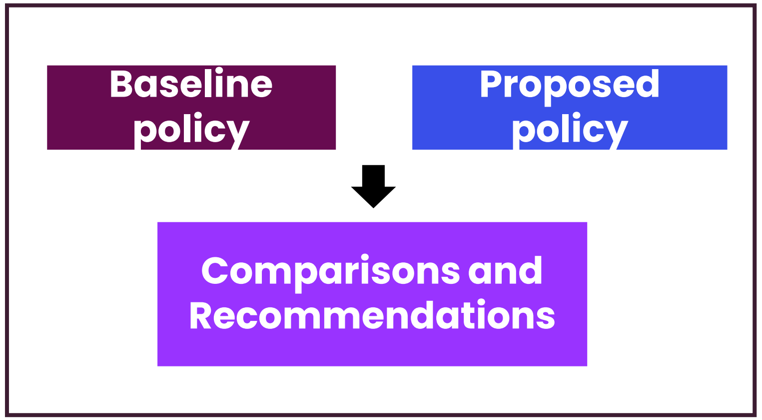
Comparison



Recommendation

- Recommendation can be made, on which set of controls represents the best balance between reliability and cost for the coming Report period.

Example from FRCR 2024 –

Reduction minimum inertia to 120 GVA.s

- **Expected Total Cost Comparison**

Scenario	140 GVA.s	120 GVA.s	110 GVA.s	102 GVA.s
Cost for system-wide controls	**£374m**	**£242m**	**£209m**	**£193m**
Cost to meet minimum inertia (this element is included in system-wide cost)	£194m	£62m	£29m	£13m
Cost for Dynamic Containment (this element is included in system-wide cost)	£51.83m	£51.98m	£52.06m	£52.12m
Incremental saving		**£132m**	£33m	£16m

- **Expected Levels of Reliability**

Scenario	140 GVA.s	120 GVA.s	110 GVA.s	102 GVA.s
49.2 Hz event	1-in-27 years	1-in-27 years	1-in-27 years	1-in-27 years
48.8 Hz event	1-in-30 years	1-in-30 years	1-in-30 years	1-in-30 years

General Policy

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- FRCR policy is developed and updated based on the assessment and recommendations. It details how NESO applies the four main controls for mitigating transient frequency deviations.
- NESO's role is to analyse the impact on reliability and cost, thus present a recommendation to achieve the appropriate balance.
- Consultation and ongoing engagement with industry stakeholders is key to achieving this in an open and transparent way. This enables Ofgem to make an informed decision on the right balance between reliability of electricity supplies and cost to end consumers.
- Following the approval NESO can then update our Operational Policy and procurement of controls to implement the policy.

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Specific Policy

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- There are specific, limited variations to the **General Policy** based on technical, probabilistic and economic grounds. This includes additional actions where appropriate during times of increased system risk, such as during severe weather, and exceptions where risks cannot feasibly occur.
- The FRCR is an assessment of all events across past years, made using assumptions as to the likelihood and impact to system security based on the controls NESO expects to have available. If there are circumstances whereby a specific event would lead to overall system risk being significantly different to the expected case, NESO reserves the right to take actions to ensure that system risk remains in line with the risk appetite outlined in the FRCR.
- If and when this occurs, NESO will inform Ofgem and industry of such actions and report relevant details in the following FRCR process.

Public

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End of the Content

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Thank you for attending

- Further reference: FRCR Methodology 2021
- Please sign up
  FRCR 2025 Technical Webinar – 2: Model and Data
  (13:30-14:30 Wednesday 11 December 2024)
- Please contact box.sqss@nationalenergyso.com for feedbacks and other questions

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