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NESO reply to consultation comments

NESO acknowledged all the comments from Sygensys and had a follow-up meeting to clarify their questions and concerns.

Part 1 – Key discussion points included:

- **Engagement and feedback:** Sygensys appreciated the FRCR 2025 deep dive webinar sessions but suggested that interactive discussions would be more beneficial than using SLIDO. NESO acknowledged this feedback and mentioned exploring different ways to improve future engagement.
- **Simultaneous events:** There was a detailed discussion on differentiating between simultaneous events and single BMU tripping. Sygensys suggested better definition of BMU-only event and also emphasised the importance of analysing simultaneous events to prevent system risks. NESO acknowledged the feedback and clarified the BMU-only definition. The definition will be updated in FRCR 2025 final report and other relevant documents. NESO provided insights into the ongoing investigations and classifications of simultaneous events. NESO also mentioned a new change in GC0105 report that simultaneous event is now being marked in the comment column. NESO continues our close engagement with relevant generators following any significant event via compliance route or other mechanisms. The findings and mitigations will be considered in FRCR model.
- **Fault ride-through capability:** Sygensys raised concerns about the lack of explicit requirements for vector shift fault ride-through capability. NESO acknowledged these concerns and discussed ongoing efforts to address them. NESO also clarified some of the risks should be managed outside of FRCR, i.e. via Grid Code modification and compliance route. NESO also explained that the discussion on fault ride-through requirements is included in industry engagement sessions when addressing Grid Forming Technology (GFM) and the development of its compliance requirements.
- **FRCR's forward-looking approach:** Sygensys suggested the need for FRCR to consider potential future risks, not just past events. NESO explained that while FRCR is primarily backward-looking, it does incorporate forward-looking elements to manage emerging risks, however the lack of data for new risk is challenging to be incorporated into FRCR model. It is also agreed that the new risk should be prevented through other workstreams, compliance process, as an example, instead of using FRCR to cover the risk, with more response hold.

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- **Data Transparency:** Sygensys highlighted the importance of making NESO's ongoing work, e.g. event review and updated report, GFM development, regional inertia and RoCoF monitoring, and data more visible to the industry. Particularly relevant to FRCR 2025, we explained that we have regional RoCoF monitoring and are developing systems and tools to address broader concerns that could be relevant to regional inertia and RoCoF.

Part 2 – During the meeting we also discussed some comments and questions from Sygensys in their PDF response that are directly related to FRCR. We share their questions and summarise answers in this document:

P7 – Will these worsening pre-fault trends have an impact on post fault period considered in FRCR?

⑦ Potentially conflicting message/emphasis?

- FRCR appears to present a different emphasis to the recent [control modelling](#). [Webinar - Pre-fault frequency](#)

• Recently NESO has increased Dynamic Regulation (DR) & Dynamic Moderation (DM) requirements:

	Prior to 3 Feb 2025	From 3 Feb 2025
DR	330 MW DR-Low / High	480 MW DR-Low / High
DM	170 MW DM-Low 200 MW DM-High	300 MW DM-Low / High

- We communicated the changes on [12 February 2025 OIT](#) and via [NESO Auxiliary Services Important Industry Notification](#) page.
- The increase helps NESO managing [volatile system frequency observed in recent months](#) whilst we are undertaking analysis to understand the root causes and introduce future mitigations.

- A declining frequency performance trend is observed over the past 7 years.
- This could be driven by the fast-changing system conditions including less synchronising elements, more use of natural resources, and consumer behaviour.

- Will these worsening pre-fault trends have an impact on post fault period considered in FRCR?

SYGENSYS

NESO comment: The increase of Pre-fault frequency response requirement, i.e. Dynamic Regulation and Dynamic Moderation, was communicated on the [12 February 2025 OIT](#). With more pre-fault fault response services the pre-fault frequency is less likely to deviate beyond the assumptions used in system operation and FRCR analysis, e.g. 49.85 Hz as the frequency deviation before a large loss.

P12 – Can NESO explain the underlying mechanism that results in is such a big difference?

⑫ Risk at 49.2 vs 48.8 Hz

- The very wide difference between the risk of 49.2 Hz and 48.8 Hz is very surprising and counterintuitive.
- Can NESO explain the underlying mechanism that results in is such a big difference?

6.1.1 System residual risks

Table 2 System residual risks

Scenario	140 GVA.s	120 GVA.s	110 GVA.s	102 GVA.s
49.5 Hz event	2.84 times per year	2.85 times per year	2.85 times per year	2.85 times per year
49.2 Hz event	1-in-7.40 years	1-in-7.28 years	1-in-7.25 years	1-in-7.24 years
48.8 Hz event	1-in-26.09 years	1-in-25.89 years	1-in-25.83 years	1-in-25.83 years
50.5 Hz event	1-in-78.99 years	1-in-78.99 years	1-in-78.04 years	1-in-78.06 years

SYGENSYS

NESO comment: The methodology to calculate the system residual risks is detailed in the Methodology document 8.2.3. The difference between 49.2 Hz and 48.8 Hz risk is due to the parameter of “percentage at risk”. For example,

- The upper-quantile simultaneous event is expected to occur 0.73 times per year.
- If it occurs, the percentage at risk for 49.2 Hz event is 14%, meaning the likelihood of this event to cause frequency deviate beyond 49.2 Hz is 14%.
- If it occurs, the percentage at risk for 49.8 Hz event is 0.67%, meaning the likelihood of this event to cause frequency deviate beyond 48.8 Hz is 0.67%.

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Expend it further, the difference between the residual risk for 48.8 Hz event and 49.2 Hz event are the type of risk that will cause frequency deviate beyond 49.2 Hz but won't cause LFDD. Increase DC-L will reduce the likelihood of this type of risks.

P9 – Categories do not clearly differentiate between normal single BMU events and multiple BMU, potential cascade events

- 9 Categories do not clearly differentiate between normal single BMU events and multiple BMU, potential cascade events

4.1.1 Categories of loss risks

The FRCR will cover the following categories of loss risks.

Table 2 – Events included in the FRCR assessment

BMU-only	
	<ul style="list-style-type: none"> an event that disconnects one or more BMUs, and may or may not also cause a consequential Rate of Change of Frequency (RoCoF) loss, with no Vector Shift (Vs) loss caused by a Loss of Power Infeed or Loss of Power Outfeed

<p>Slide 11 Simultaneous event Residual risks 1-in-9999 years - Does this cover loss only 2 BMU simultaneously? Last Friday shows early events show simultaneous events can impact 3 or more BMU.</p>	<p>The simultaneous event in FRCR analysis represent the additional risks that system is facing beyond single generation or transmission failure. Given the complexity of all the possible combinations of simultaneous events, FRCR analysis adopted a statistical method, in which the level of loss (MW) is determined by 2 risks for peak, upper quartile (75%) and median (50%). The 14th March event had three BMUs but the level of loss is correlated to upper quartile simultaneous events in FRCR analysis. The total loss of 14th March event will also be used in likelihood calculation in preparation for the next FRCR.</p> <p>There is nothing that rules out that simultaneous event would affect 3, 4, or more units at the same time. However, as the number increases, the probability drops and the cost required to cater for it increase significantly. Recognising that the FRCR does not require securing 3 simultaneous BMU events, it is unlikely to require securing more than 2.</p>
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[FRCR2025 Consultation Webinar Questions and Answers.xlsx](#)

SYGENSYS

NESO comment: We welcome the feedback on BMU-only event, and will update the definition statement.

P15 – 1 in 9999 years in the table below appears extraordinarily high! It is based on a statistical extrapolation from a sparse data set and making assumptions about maximum size event to derive 1 in 9999 simultaneous results. This gives a false impression of the risks from simultaneous events, probably due to the underlying FRCR assumption of max 2 BMUs tripping simultaneously.

- 15 Extrapolation from a sparse data set

- 1 in 9999 years in the table below appears extraordinarily high!
- It is based on a statistical extrapolation from a sparse data set and making assumptions about maximum size event to derive 1 in 9999 simultaneous results.
- This gives a false impression of the risks from simultaneous events, probably due to the underlying FRCR assumption of max 2 BMUs tripping simultaneously.

Table 4 Risk and cost for different risk categories at 102 GW/s

Event category	Response Control		
	Residual risk for 48.2 Hz event	Residual risk for 48.8 Hz event	Additional cost per year
BMU-only	1-in-7.24 years	1-in-25.83 years	£0
BMU+VS (outage)	1-in-7.25 years	1-in-25.84 years	£14k
BMU+VS (react)	1-in-7.26 years	1-in-25.84 years	£278k
Simultaneous event	1-in-9999 years	1-in-9999 years	£20m

*minimum inertia requirement is 102 GW/s

SYGENSYS

NESO comment: Thanks for your comments. This 1-in-9999 year risk is the residual risk after mitigating all simultaneous events, this means holds sufficient response to cover the loss up to 2.8 GW constantly. Since all risks in the FRCR analysis are being covered in this scenario, there is no residual risk. We will revise this part as follows.

- Update the residual risk to "0 times per year"
- Explain all risks are being covered in FRCR analysis.

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P24 – Massive size associated with VS. How can this uncertainty be reduced?

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VS protection and ride through

- Massive size associated with VS. How can this uncertainty be reduced?

	0.125Hz/s	0.2Hz/s	0.5Hz/s	Other RoCoF	Vector Shift (Vs)
Estimated total capacity remaining	54MW	20MW	100MW	4MW	371MW
Safety margins to cater for uncertainty	29MW	31MW	59MW	6MW	1048MW
Further capacity that has undergone enforcement but not formally reported	43MW	16MW	31MW	2MW	297MW
Total	126MW	67MW	190MW	12MW	1717MW

Still no plan to include clear VS ride through requirements as recommended ??? Years ago.

SYGENSYS

NESO comment: The large MW was due to the safety margin considered. The values shown in this table are the national volume, per each VS region the risks is less than 100MW.

P25 – 6.1 BMU failure probability

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Data

- 6.1 BMU failure probability
- "Data for the BMU outages are from an internal database and is not publicly accessible or shareable"
- Does this match data from public REMIT on Elexon Portal, if not why not?
- "Multiple breakdowns within 24 hours is treated as one failure, as the unit is likely to be struggling to return."
- Why was this applied. Each breakdown could lead to new frequency event as the unit is struggling to return to service.

SYGENSYS

NESO comment:

- Any generators smaller than 100 MW does not have REMIT obligation to submit outage data whilst FRCR assessment consider all generations including those with capacity less than 100 MW.
- The current methodology considers a unit's failure to return from a fault represents the root cause of the original fault persists hence should not affect the failure rate for a single generator.

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P26 – 6.2 Transmission fault probability

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Data

- 6.2 Transmission fault probability
- "Recorded events are from 3rd party data, e.g. from Transmission Owners (TOs) and OFTOs, hence NESO is unable to publish the raw data"
- Why would this data be different to that reported in C17 or GC0151 reports [System Performance Reports | National Energy System Operator](#)
- Should this data be made publicly available?

SYGENSYS

NESO comment:

- The Transmission Performance Report (C17 report) includes stats of NETS system planned and unplanned availability and does not present the relevant assets from individual transmission systems. NESO's licence condition also does not permit us to release the raw data from the 3rd party for other purposes other than C17 reporting purpose.
- We would agree with you that, GC0151 reports, according to the change to OC3 which requires NESO to report on fault events on the NETS, should include all the transmission faults that are considered in FRCR model. We will update this in FRCR Data Handbook.

P27 – Statistical methods and data used

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Statistical methods and data used

- CFD is not appropriate for low frequency potentially high impact simultaneous events.
- Some form of extreme value analysis would be more appropriate.
- Page 31
- Check of sample data shows some issues
 - Event 1 and 2 not shown on GC0105 report, below OC3 250 MW threshold, skews data analysis low?
 - Event 3 [GC0151 and GC0105 System Incidents Report March 2024.xlsx](#) shows loss of 945.47 MW?
 - Event 18 10/06/2023 note clear how 1332 MW loss derived from [GC0151 and GC0105 System Incidents Report June 2023 - Copy.xlsx](#)
 - Event 20 wrong date
 - 14/05/2024 missing – Coincident event increase in frequency
- GC0105 report do not tie up with data presented in table
- Possibly because it is not clear from the report if coincident tripping occurred

SYGENSYS

NESO comment:

- Regarding the utilisation of Cumulative Distribution Function (CDF) in calibrating historic simultaneous event likelihood, as we explained in the webinar, this is one of many mathematical approaches. In FRCR due to the complexity of the modelling we adopt a statistical way. In this approach as explained in our Data Handbook, the

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“weighting factor” of a large volume simultaneous event has been treated much significant compared to a small simultaneous event. Please see extraction from the table in Section 6.4 in Data Handbook for illustration.

Event number	total loss (MW)	Event date	Median CFD	Upper quantile CFD	Peak CFD
Event 8	655	05/04/2021	0.001	0	0
Event 20	1648	22/12/2023	1	0.971	0
Event 21	2000	09/08/2019	1	1	0.022

- Event 1 and 2 are included in the model and they are not shown on GC0105 report as the loss volumes were less than the reporting threshold of 250 MW as required by OC3. However it is important to note that with or without Event 1 and 2 will give the same likelihood of simultaneous events as we articulated in Section 6.4 in the Data Handbook.
- Event 3 was included in GC0151 transmission fault report for March 2024. The total loss was estimated at 300 MW.
- Event 18 was reported in GC0105 system incident report for June 2023. Further analysis when preparing FRCR data identified additional volumes of trip following the original loss of Heysham unit within 3 mins.
- Event 20 wrong date – We will update this in the final report
- 14/05/2024 missing – Coincident event increase in frequency. The simultaneous event calibrations are separated into low frequency events and high frequency events. This event is included in the FRCR 2025 analysis but not shown in the data handbook since the aggregated impact was loss of outfeed. We have included a statement in the Data Handbook to explain how we treat the historic high frequency event when modelling.

P35 – Accenture as “Critical Friend”?

35 Accenture as “Critical Friend”?

- Please can NESO FRCR team or Engineering Assurance Team or Accenture (in their phase 2 work) explain how as shown in the above extract of **FRCR Assessment Summary**, **NESO performance is at or above average in all cases**. This is particularly concerning in the review of the statistical analysis in FRCR.
- It reminded me of [How the Ofsted chief got his maths wrong on Sats | Education | theguardian.com](#) If the definition of “average” is based on some industry benchmark rather than NESO performance alone, as I suspect will be claimed, why was that not clearly stated in the report to NESO/SCSS panel?

FRCR Assessment Summary (1/2)

Part A - Governance	Assessment	Findings	Recommendations
Leadership	Strong	Good	Good
Internal Controls	Strong	Good	Good
Part B - Data Preparation	Assessment	Findings	Recommendations
Leadership	Strong	Good	Good
Data Prep	Strong	Good	Good
Program Control	Strong	Good	Good

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NESO comments: What Accenture mean is that, when comparing the work of NESO's FRCR workstreams to that undertaken by their wide portfolio of clients, the performance of a small number of workstreams against one of the three assessment criteria was average. In their recommendations, Accenture have articulated the improvements that NESO can make to drive further improvement. We welcome these recommendations, and the FRCR team have committed to deliver them ahead of FRCR 2026.

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Part 3 – In their consultation responses, Sygensys also provided further comments on the wider operability issues which are out of FRCR scope. We summarise those comments and our responses below.

Sygensys question: LFDD relay effectiveness – Some LFDD relays are very old from a higher inertia and lower RoCoF.

NESO response: The effectiveness of LFDD relay is out of FRCR scope and is included in Energy Networks Association (ENA) Technical Specification 48-6-5 Issue 1 dated 2005 “ENA Protection Assessment Functional Test Requirements – Voltage and Frequency Protection” requirement on LFDD testing to be carried out every 3 years. This is referred by GC/ECC CC.A 5.4.1.

Sygensys question: Regional RoCoF assessment.

NESO response: As indicated in FRCR 2025 forward looking, we are following system events to understand better the impact from regional inertia and regional RoCoF. We will bring the findings into future FRCR work. Additionally, we are engaging with industry to develop Grid Forming Technology (GFM) compliance requirement and market development. GFM is contributing to regional inertia and system strength to stabilise the system. Future development are to be considered in a longer term including distribution level requirement.

Sygensys question: Can NESO report in line with Ofgem NESO licence expectation statement, e.g. reporting 0.3 Hz deviation and review emerging operational risks?

NESO response: The frequency excursion reporting criteria indicated in Ofgem NESO licence expectation statement are already covered in our current reports. The information is also public available – [Link](#). NESO manages system operational risks as our BAU aligning with licence condition.

Sygensys question: Can the SQSS Panel appointed an independent review within FRCR process?

NESO response: We acknowledged the feedback and recommendations. We will collate all the response and discuss with the SQSS Panel for their indication of decision.