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NESO reply to consultation comments

NESO acknowledged all the comments from EDF and had a follow-up meeting to clarify their questions and concerns. NESO detailed responses and discussion notes are summarised in the table. A case study on minimum inertia policy's impact on 14th March 2025 event were included in the appendix of this note.

Summary of Discussions:

- **Future System Risk Considerations**

EDF has been leading research projects involving academics and industry to identify new issues and system changes in the future power networks in 2025 and beyond. NESO manages future risks as described in the Future Energy Scenarios and Operability Strategy Report. FRCR considers existing and anticipated system risks when quantifying cost saving and benefits. NESO would like to collaborate with EDF and wider industry to tackle future system challenges and FRCR will be able to look beyond the immediate future and consider the implications of new technologies and system changes.

- **Way of engagement in future FRCR process**

NESO acknowledged EDF's feedback regarding the delayed consultation caused by the ad-hoc integrated engineering review work introduced to FRCR 2025. EDF suggested that earlier notification of such delays could help manage their workload. NESO agreed with this feedback and will consider earlier engagement and provide advance notice to the industry for future changes. EDF suggested the traditional ways of getting feedback might not be sufficient given the complexity of the FRCR analysis. The consultation and engagement process for the FRCR need to be improved. NESO explained, based on industry's feedback on FRCR future governance and the SQSS Panel's oversight role, for future FRCR, the requirement of an independent technical review or the continuous engineering assurance will be clarified with the SQSS Panel.

- **Managing SSO, regional inertia and regional stability**

EDF raised concerns about the future risks and the geographic distribution of inertia providers. NESO and EDF both agreed the importance of understanding regional inertia and its effect on system stability. We explained further discussion regarding regional inertia and regional RoCoF will be held in an upcoming industry workshop. We welcome views from industry on how to measure, monitor, and model regional inertia to derive relevant policies tackling wider operability issues.

- **Wider economic Impacts following a LFDD event**

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EDF emphasised the importance of considering wider economic impacts and system risks following a system wide event. NESO explained FRCR only considered direct cost in managing system frequency but not the wider economic impact and indirect cost following a system event. However, in the context of FRCR 2025, reducing the minimum inertia requirement will not increase the probability of LFDD event. FRCR team will forward the wider system security and economic impacts question to NESO Resilience team.

- **Wider operability scope and flexibility in FRCR assessment**

Although this was not a consultation question or FRCR technical area, EDF raised a question around how flexible FRCR is to assess and align emerging system operability risks. NESO explained the history of FRCR development and our current position of proposing lowering down the minimum inertia policy. NESO explained the balance between being flexible and transparent with industry. EDF welcomed the direction of travel proposed by current FRCR policy but suggested a wider operability view from NESO moving forward. We think this is a wider question regarding how NESO engages with industry to tackle long-term system changes and risks. We will feedback to NESO Senior management team and discuss with Ofgem as well.

No	Questions	Comments	NESO Response
7	<p>Do you agree that the FRCR 2025 has been prepared appropriately? Please elaborate...</p>	<p>We agree that this year's FRCR has been appropriately prepared. For future FRCR publications NESO should further consider the issues highlighted by us regarding increased SSO events and risks of lower inertia. This is particularly important as the electricity system continues to evolve as we progress towards clean power and more renewables and inverter-based resources are connected to the system. Based on this, it is worth NESO capturing additional asks from stakeholders to be picked up going forward.</p>	<ul style="list-style-type: none"> • EDF highlighted the fast pace of shifting to clear power and ambitious renewable energy target present significant new risks affecting the future system. EDF is leading some academic collaborations involving NESO to identify edge cases and unexpected issues in 2025 and beyond. In particular with the context of FRCR, EDF asked if NESO considered inertia distribution and the impact of inertia provision following the reduction of inertia policy. • NESO explained there is no inertia distribution / regional inertia considered in FRCR analysis. This is to be explored in the future. The reduction of inertia presents total saving and has no direct impact to the inertia provision as in operation practice. Inertia is the last-stage check after other national and regional operability requirements are met, e.g. reserve/margin and voltage requirement. • NESO acknowledge that the system changing is complex and we are unable to foresee future new challenges or risks. We have factored anticipated system changes in other publications like Future Energy Scenarios (FES) and Operability Strategy Report (OSR). We welcome and would like to contribute to EDF's collaboration in investigating future challenges. In the meantime, NESO is deploying other projects / programmes, e.g.

			<p>pathfinder, stability markets, and Grid forming technology connections to tackle new issues experienced from operation, and particularly to understand and manage regional inertia better. From FRCR point of view, we would like to unwind inertia discussion from other operability concerns, e.g. system damping and inertia, although they are technically correlating. Those operability issues can be monitored and managed separately. We welcome further discussions on other operability issues and will take concerns to the future FRCR analysis.</p>
8	<p>Do you believe there has been sufficient industry engagement in preparing FRCR 2025? Please specify further suggestions.</p>	<p>More industry engagement would have been preferred and the engagement that did take place could have been planned better. The FRCR consultation was only discussed in one Operational Transparency Forum (OTF) towards the end of January, with no early indication given that the FRCR this year would be delayed to March until later. As this is an incredibly complex modelling area, NESO must consider the extent to which any industry party can really provide effective scrutiny of the modelling, given capabilities, information asymmetry, and the consultation time period. NESO needs to consider whether this is the best way to seek feedback on proposals.</p>	<ul style="list-style-type: none"> • During the meeting, EDF asked if NESO could flag the delayed of FRCR 2025 consultation earlier, which could help manage their workload. NESO acknowledges this feedback and agrees to consider earlier engagement and heads up to the industry if any changes are anticipated in the future FRCR cycles. • NESO also acknowledged EDF's concern about the complexity of FRCR analysis hence the heavy resource requirement to engage in this topic. We explained that the SQSS Panel expressed similar concerns hence this year we introduced Accenture's engineering assurance review. Moving forward we would like to review the independent review requirement with the SQSS Panel.

9	<p>Overall, do you agree that the FRCR 2025 represents the appropriate level of development in determining the way that the NESO will balance cost and risk in maintaining frequency security while operating the system at a reduced inertia down to 102 GVA.s? Please use the boxes below for the bullet points.</p>	<p>Overall, there is a good level of development and consideration from NESO on balancing cost and risk in maintaining frequency at safe levels. However, we think some considerations of risks and costs require further attention:</p> <ul style="list-style-type: none"> • Would residual risks remain consistent/decrease at 102 GVAs when we do not fully understand how certain events on the system occur and whether they relate to lower inertia levels e.g. SSOs? • Has the cost saving been considered in the context of a wider economic cost to the economy if the system faces a country-wide shut down? • What impact, if any, will a lower inertia level have on NESO workloads? • Some considerations were already made on longer-term impacts e.g. in 2026/27 and how increased connections could decrease residual risks of low frequency events further. Could this be expanded on in future FRCR publications? 	<p>1 – Current SSO investigation identified no correlation between SSO phenomenon to national inertia level. Our operational experience post reducing the minimum inertia level from 140 GVA.s to 120 GVA.s does not indicate increasing occurrence of SSO events or any other system events. FRCR policy assures under 102 inertia level NETS frequency can be safely managed in a cost-effective way. We observe the conditions that correlate with oscillations. When these conditions materialise, we take action to increase damping. This action may result in an increase of inertia beyond 102GVAs. The FRCR recommendations do not affect this. Similar process would apply for other phenomena.</p> <p>2 – Wider economic cost for example, Value of Lost Load (VoLL) is not the cost metric in FRCR analysis. The current application of VoLL is more suited to capacity considerations, which are more predictable, and less suited to faults and any resulting transient frequency deviation, which are less predictable. VoLL is not appropriate for frequency control policy assessment as explained in Methodology v2 and v3. FRCR analysis considers balancing costs including spends in frequency response, inertia and BM actions to reduce loss size / re-position, to evaluate system security and total benefits.</p>
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			management will be assessed again in the future FRCR. The impacts from new connections to frequency control are however difficult to comment without detailed information. With more and more smaller connections and infeed / outfeed units, the loss profile could be significantly changed compared to before, where the large CCGTs and interconnectors dominate the largest securable loss. With new technologies and control systems, the generating unit risk of trip could be different to the past. We would like to collaborate with the industry to understand and better model future risks into our operability assessment.
10	Do you agree with the recommendation to reduce minimum inertia requirement down to 102 GVA.s?		
11	Do you agree with the recommendation to secure all BMU-only events (including consequential RoCoF)? If not, please explain why.		
12	Do you agree with the recommendation to procure additional DC-Low service provision by		

	200 MW ? If not, please explain why.		
13	<p>Do you have any other comments to the recommendations?</p>	<p>Our answer to the above questions will primarily focus on reducing the minimum inertia requirement.</p> <p>Despite the downward trend in system inertia over time, we do have some concerns over reducing the minimum inertia requirement. Not only was the requirement already reduced from 140 GVAs in 2023's FRCR, but our analysis using NESO's system inertia dataset has shown that NESO are increasing the number of actions it must take in the market during more settlement periods to maintain inertia at minimum levels.</p> <p>For 2023-24, our analysis showed that for market-provided inertia:</p> <ul style="list-style-type: none"> • There were 2832 settlement periods with <120 GVAs <ul style="list-style-type: none"> - Increase of 91% from the previous year • There were 870 settlement periods with <102 GVAs <ul style="list-style-type: none"> - Increase of 213% from the previous year <p>This means that 16% of settlement periods in a year were below 120 GVAs and 5% were below 102 GVAs, with both figures expected to increase as the electricity system continues to change. This suggests that there are more settlement periods below the current minimum inertia requirement that require more NESO interventions to continue operating the system safely.</p> <p>If the minimum inertia requirement is lowered to 102GVAs and we have events occurring similar to the Drax power station trip on 14th March (which was the largest trip event at 1.88GW since the power outage in August 2019), the impact of system trips will become more serious. Though the Drax event was contained within the FRCR policy limits, such events do happen beyond expectations and their occurrences may increase over time. We are keen to know how NESO will prepare for such eventualities if the minimum inertia requirement is lowered.</p> <p>Moreover, reducing the minimum inertia requirement could potentially expose the system to a geographically uneven distribution of inertia providers. This, combined with a heavily congested network, may lead to localized effects. We would appreciate NESO's views on managing the risk of this occurring and the mitigating actions being considered, if any.</p> <p>We note NESO's estimated saving of £96m for lowering inertia to 102 GVAs, which is not a trivial saving. However, any wider system issue that may lead to country-wide blackouts may incur an economic loss that will be far greater than any stated saving of lower inertia levels. This could alternatively be framed as an insurance type product rather than a wasted cost.</p> <p>We do not have immediate concerns with the other two recommendations but again, NESO should understand and consider whether these stated savings outweigh costs from potential wider system issues.</p>	<ul style="list-style-type: none"> • Inertia data: There is an ongoing effort to align inertia data between the operational tools and the NESO data portal to address potential errors. • Minimum Inertia Requirement and Cost Savings: NESO has increased its interventions to meet the minimum inertia requirement of 120 GVA.s. Reducing this requirement further could result in significant cost savings for consumers. This aligns with recommendations from FRCR 2025 and provides NESO with greater flexibility to incorporate low-carbon generation. In the meeting we explained, when introducing lower inertia policy, maintaining system security is the primary drive whilst cost saving benefit comes as the secondary consideration. Response holding from procuring DC, DR and DM present much higher cost benefit compared to increasing inertia from synchronise generating unit. • Local and Regional Inertia Considerations: Currently, NESO has not assessed regional inertia requirements but plans to explore this in future work. They intend to engage with the industry to develop a regional inertia policy. • System Performance and Risk Assessment: Analyses suggest that reducing inertia to 102

			<p>GVA.s does not significantly compromise system security, as the probability of LFDD events remains largely unchanged. Simultaneous low-frequency events are challenging to model due to limited historical data, but NESO is actively monitoring the system to address any emerging patterns. Hypothetical analysis on 14 March event is shown in the end of this note.</p> <ul style="list-style-type: none"> • Future Plans and Industry Engagement: NESO intends to continue exploring regional operability, including monitoring and modelling of regional inertia, and will invite industry participation in developing these capabilities. In the meeting, we explained in the future R&T projects that EDF is leading on and NESO is engaging, inertia and system damping should be separately considered.
14	In your view, what should the future FRCR focus on?	<p>Future FRCR work should focus on the wider impact of increased renewables and inverter-based resources being connected onto the electricity system e.g. the relationship between increased capacities of new technologies and SSOs/other new system phenomena.</p> <p>We would also welcome further analysis from NESO on securing simultaneous events. Whilst we acknowledge NESO's comments in the 2025 FRCR report that covering this would require a significant increase in Dynamic Containment (DC) capacity, we note that this volume may be available in the future DC market as battery storage buildout is expected to continue at a rapid pace throughout this year and the foreseeable future. Therefore, we would welcome NESO revisiting this topic for future reports as the GB battery development pipeline progresses and participating volumes in DC increase, as this could result in more competitive pricing and provide a feasible option to cover simultaneous events.</p>	<ul style="list-style-type: none"> • Grid Forming Technologies: Grid Forming technologies are being explored for their ability to supply short circuit current and inertia, contributing to system stability and the achievement of net zero goals. These technologies not only provide inertia but also phase jump power and damping power, making them crucial for system support. • Expert Group and Future Requirements: An expert group has been established to review industrial experiences with Grid Forming as a potential future requirement, although current

			<p>inertia requirements remain subject to market arrangements. The focus is on examining long-term aspects to manage system stability economically.</p> <ul style="list-style-type: none"> • Role of Batteries: Batteries have a natural capability for Grid Forming, but increased volumes are needed to stabilize the economics. Over time, a greater proportion of inertia might come from Grid Forming plants rather than traditional sources.
15	<p>Do you foresee any issues that may arise from moving the obligation to produce the FRCR to a NESO License Condition rather than an Annex to the NETS SQSS?</p>	<p>Whilst we do not foresee any issues with this move, we do not want this to negatively impact the level of scrutiny of the FRCR. Any proposed changes to FRCR governance and oversight are up to NESO and Ofgem and their proposals should be brought forward to industry as part of any NESO Licence Condition consultation.</p>	<p>Thanks for sharing your view. We will collate all the feedback from the industry to the SQSS Panel and Ofgem for their consideration. Any governance changes following their decision will be brought forward to the industry.</p>
16	<p>If the obligation to produce the FRCR and the governance rules surrounding that process are moved to NESO's License, do you believe that the NETS SQSS Panel should continue to provide oversight?</p>	<p>Yes, we support this continued type of oversight, as long as there is no adverse impact to this oversight when moving from the SQSS annex to NESO's licence.</p>	
17	<p>If your answer to question 16 is "Yes", to what extent should this oversight be? For example, should it include technically</p>	<p>We would want the SQSS Panel to make a clear judgement on whether NESO have followed appropriate processes, as well as an assessment on the effectiveness of NESO's proposed FRCR changes. Through this thorough review, the panel should provide recommendations to Ofgem, who should continue to make the final decision on the proposed changes given the FRCR's importance.</p>	<p>Thanks for sharing your thoughts and clarifying this in the meeting. We understand the SQSS Panel will remain the oversight role even FRCR moves into NESO's licence obligation. We will collate all the feedback from the industry for the</p>

	assessing the recommendations and approving/rejecting it, or should it be limited to confirming that the governance process has been followed correctly?		Panel and Ofgem to decide the change and the detailed arrangement including if it requires an independent assessment apart from NESO's analysis, or it is an process assurance.
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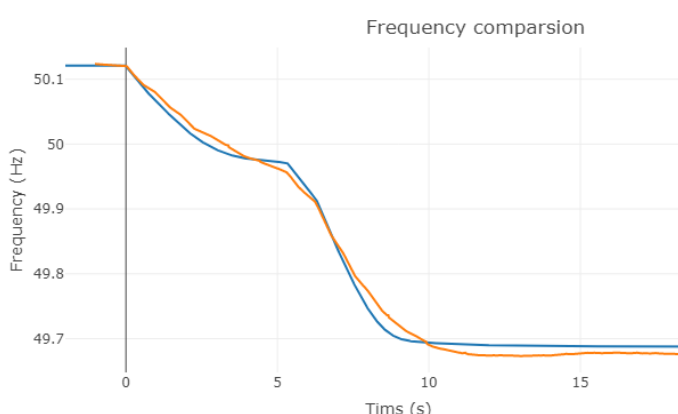
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Appendix

Case study on minimum inertia policy's impact on 14th March 2025 event.

System conditions for 14th March event is shown below where the system inertia was reported as 276.4 GVA.s at the time of the event. Based on this information, below right shows the simulated frequency vs the recorded frequency.

Date and time	Friday, 14th March 2025 at 08:51:37
National Demand	34.85GW
System frequency	50.12Hz
Inertia	276.4GVA.s
Contracted Response Services	Dynamic Containment – Low (DC-L) Dynamic Regulation – Low (DR-L): Dynamic Moderation – Low (DM-L): Static Firm Frequency Response (sFF) MFR: Primary (P): 56 MW Secondary (S): 71 MW High (H): 177 MW
Weather	No weather warnings 3.05GW transmission-connected wir 832MW estimated embedded wind 4.12GW estimated embedded solar



The minimum inertia requirement was set at 120 GVA.s. Since the total system inertia was 276.4 GVA.s, which exceeded the minimum requirement, no additional actions were necessary to increase the system inertia. We can now consider several hypothetical questions:

- **What if the minimum inertia requirements during the event was 102 GVA.s instead of 120 GVA.s?**

Since the minimum inertia requirement sets only the bottom threshold and does not intentionally reduce inertia, the total system inertia of 276.4 GVA.s satisfies both the 102 GVA.s and 120 GVA.s minimum requirements. Therefore, there would be no expected differences in this event if the minimum inertia requirement were lowered to 102 GVA.s.

However, there would be some difference if the system raw inertia is below the threshold where additional actions are needed.

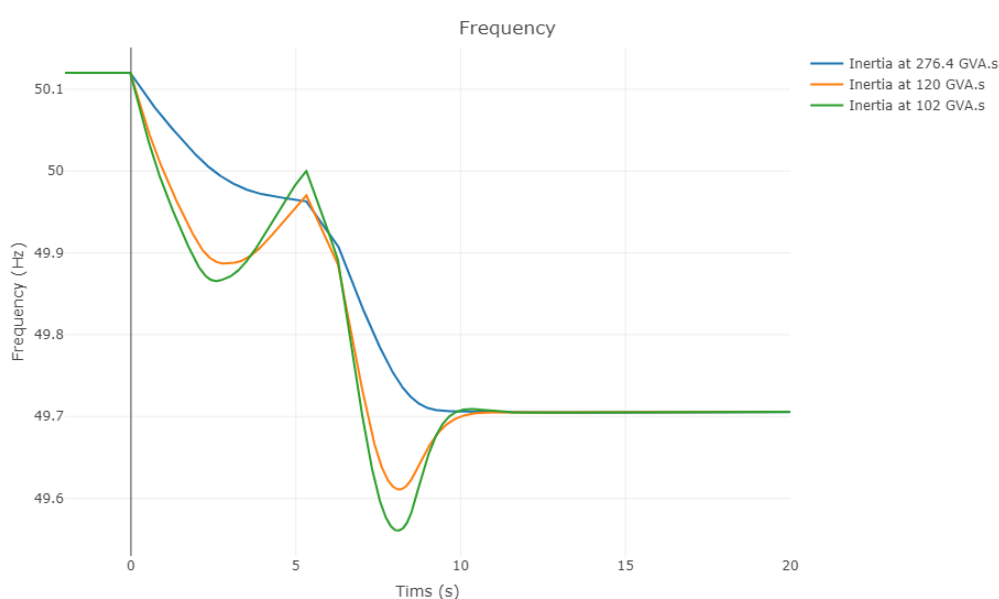
- **What if the minimum inertia requirements during the event was 102 GVA.s instead of 120 GVA.s, AND system raw inertia was below the threshold**

If the system's raw inertia falls below the threshold, additional actions would be needed to meet the minimum inertia requirements. Response holdings would be adjusted according to the inertia to ensure that the largest infeed loss can be accommodated. In

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this scenario, the Dynamic Containment holding would remain unchanged because the static Firm Frequency Response (sFFR) holding of 185 MW did not meet the requirement of 250 MW, necessitating additional Dynamic Containment to fulfil the recovery requirement.

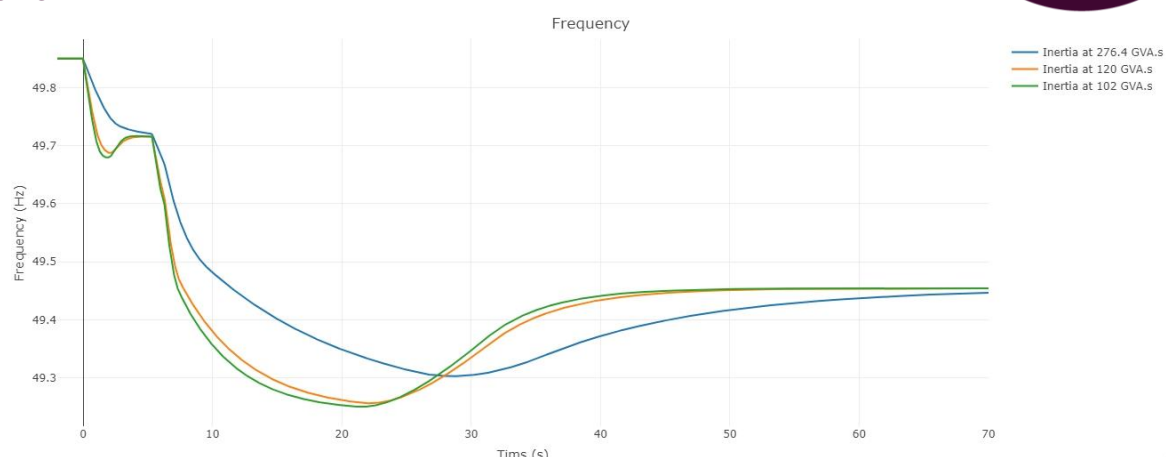
The figure below illustrates the expected frequency curves when the system inertia is either 120 GVA.s or 102 GVA.s. With lower system inertia, the frequency nadir will decrease but will still be contained within 49.5 Hz, while the stabilised frequency remains consistent.



- ***What if the minimum inertia requirements during the event was 102 GVA.s instead of 120 GVA.s, AND system raw inertia was below the threshold, AND initial frequency was 49.85 Hz instead of 50.12 Hz.***

The initial frequency of this event was 50.12 Hz which provides a certain level of buffer to this event. The worst-case scenario would be considering 49.85 Hz as the initial frequency which is implemented in the response calculation process. The figure below shows the expected frequency curves if initial frequency was 49.85 Hz.

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The frequency drop can be contained before 49.2 Hz, i.e. no LFDD risk for the worst-case scenario. However, the frequency struggles to recover within 49.5 Hz in 60 second since this event is not a secured loss. If this is the case, Control Room will need to instruct reserve products to bring frequency back within 49.5 Hz and the operational limit.

Note: LFSM-U is not included in the study, with LFSM-U the frequency deviation will be further reduced.