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| NPRR Number | [1257](https://www.ercot.com/mktrules/issues/NPRR1257) | NPRR Title | Limit on Amount of RRS a Resource can Provide Using Primary Frequency Response |
| Date of Decision | | March 13, 2025 | |
| Action | | Approved | |
| Timeline | | Normal | |
| Estimated Impacts | | Cost/Budgetary: Less than $10K Operations & Maintenance (O&M)  Project Duration: No project required | |
| Effective Date | | April 1, 2025 | |
| Priority and Rank Assigned | | Not applicable | |
| Nodal Protocol Sections Requiring Revision | | 3.16, Standards for Determining Ancillary Service Quantities  3.18, Resource Limits in Providing Ancillary Service | |
| Related Documents Requiring Revision/Related Revision Requests | | Nodal Operating Guide Revision Request (NOGRR) 271, Related to NPRR1257, Limit on Amount of RRS a Resource can Provide Using Primary Frequency Response  ERCOT Methodologies for Determining Minimum Ancillary Service Requirements | |
| Revision Description | | This Nodal Protocol Revision Request (NPRR) establishes a maximum limit on the amount of Responsive Reserve (RRS) that a Resource can provide using Primary Frequency Response (“PFR”). An initial static limit of 157 megawatts (MW) is proposed, and this limit is intended to be reevaluated annually as part of the Ancillary Services Methodology review and approval process. | |
| Reason for Revision | | [Strategic Plan](https://www.ercot.com/files/docs/2023/08/25/ERCOT-Strategic-Plan-2024-2028.pdf) Objective 1 – Be an industry leader for grid reliability and resilience  [Strategic Plan](https://www.ercot.com/files/docs/2023/08/25/ERCOT-Strategic-Plan-2024-2028.pdf) Objective 2 - Enhance the ERCOT region’s economic competitiveness with respect to trends in wholesale power rates and retail electricity prices to consumers  [Strategic Plan](https://www.ercot.com/files/docs/2023/08/25/ERCOT-Strategic-Plan-2024-2028.pdf) Objective 3 - Advance ERCOT, Inc. as an independent leading industry expert and an employer of choice by fostering innovation, investing in our people, and emphasizing the importance of our mission  General system and/or process improvement(s)  Regulatory requirements  ERCOT Board/PUCT Directive  *(please select ONLY ONE – if more than one apply, please select the ONE that is most relevant)* | |
| Justification of Reason for Revision and Market Impacts | | This NPRR focuses on addressing the risk of common mode failure, i.e., the risk of too much RRS-PFR being provided from a single Resource and that Resource failing to respond as expected.  For context, ERCOT commissioned GE Vernova (f/k/a GE Energy Consulting) in December 2021, to conduct an evaluation to identify reliability concerns that could indicate the need to limit the provision of RRS from Primary Frequency Response in certain circumstances. GE Vernova completed this evaluation and presented its results to ERCOT stakeholders in the [RRS-PFR Limits Study Workshop](https://www.ercot.com/calendar/04062023-RRS_PFR-Limits-Study-Workshop) held on April 6, 2023. GE Vernova’s complete report from this work is posted on ERCOT’s webpage ([report link](https://www.ercot.com/files/docs/2024/03/20/02_GE-ERCOT_StakeholderPresentation_R6_new.pdf)).  RRS is procured to ensure sufficient response is available to meet ERCOT’s frequency response requirements under North American Electric Reliability Corporation (NERC) Reliability Standard BAL-003, Frequency Response and Frequency Bias Setting, specifically, to ensure that enough capacity is available such that Under-Frequency Load Shed (UFLS) is not triggered in the event of the loss of the two largest Resources in the ERCOT Region, totaling 2,805 MW. Failure of a Resource that is carrying an RRS obligation to respond during a frequency event will degrade system frequency response and could increase the risk of triggering UFLS that might not otherwise occur. In its report, GE Vernova recommends that to address the risk related to common mode failures, the maximum amount of RRS-PFR that any individual Resource can provide should be determined using studies that assess the impact of common mode failure on frequency nadir degradation for loss of 2,805 MW of supply during a variety of grid inertia conditions.  GE Venova’s proposed approach creates a maximum limit on provision or procurement of RRS-PFR that will vary dynamically with grid inertia conditions. However under the current paradigm, complex systems changes would be needed to implement a concept like this. Implementing this dynamic RRS-PFR limit concept is expected to be simpler after Real-Time Co-optimization (RTC) is implemented and Resources receive binding RRS-PFR awards in Real-Time.  To address the immediate reliability concern without necessitating complex system changes before RTC implementation, this NPRR establishes a static limit on the maximum RRS-PFR that a single Resource can provide. To further limit systems impacts, this NPRR incorporates the limit in the procedure used to calculate RRS MW Limit under Nodal Operating Guide Section 8, Attachment N, Procedure for Calculating RRS Limits for Individual Resources.  ERCOT recommends 157 MW as the initial static limit for the maximum amount of RRS-PFR that a single Resource can provide. Based on the complementary studies that ERCOT has conducted, with a static RRS-PFR limit of 157 MW, frequency degradation due to failure to perform from a single RRS-PFR Resource is expected to stay below 50 megahertz (MHz) under a variety of historic inertia conditions, while maintaining an approximately 100 MHz margin for other issues that may occur in Real-Time. This proposed limit is higher than the maximum RRS-PFR Ancillary Service Resource Responsibility that any single Resource provided in Real-Time in 2023. ERCOT has analyzed provision of RRS-PFR in 2024 between January 1 and September 30, in approximately 2.78% of Security-Constrained Economic Dispatch (SCED) intervals, nine different Resources carried more than 157 MW of RRS-PFR, in any interval at a maximum two Resources simultaneously carried more than 157 MW of RRS-PFR. ERCOT will revisit the studies used to determine the static RRS-PFR limit during the annual Ancillary Services Methodology review process to identify if any changes in the static limit are necessary. Further, ERCOT proposes to revisit the dynamic RRS-PFR limit concept after RTC is implemented.  GE Vernova’s report also noted that the studies conducted did not identify a compelling reliability reason to limit the provision or procurement of RRS-PFR in a manner to ensure geographic or locational diversity, such as incorporating proximity checks. Every Resource providing RRS-PFR is expected to have separate/independent control systems for providing frequency response. Equipment failure contributing to performance issues should have no, or low, common mode failure risk because such equipment is expected to be exclusive to the Resource, meaning that any such failure impacts only that single Resource. Accordingly, GE Vernova found that the proposed limit for any single Resource is sufficient and additional safeguards, either at a station level or a the ERCOT Region level, are not necessary at this time. ERCOT agrees with GE Vernova’s assessment but will continue to monitor frequency performance in this context and can make adjustments in the future if it becomes necessary. | |
| PRS Decision | | On 11/14/24, PRS voted unanimously to table NPRR1257 and refer the issue to ROS. All Market Segments participated in the vote.  On 12/12/24, PRS voted unanimously to recommend approval of NPRR1257 as submitted. All Market Segments participated in the vote.  On 1/15/25, PRS voted unanimously to endorse and forward to TAC the 12/12/24 PRS Report and 10/21/24 Impact Analysis for NPRR1257. All Market Segments participated in the vote. | |
| Summary of PRS Discussion | | On 11/14/24, ERCOT Staff provided an overview of NPRR1257.  On 12/12/24, participants noted the ROS endorsement of NPRR1257 as submitted.  On 1/15/25, there was no discussion. | |
| TAC Decision | | On 1/22/25, TAC voted unanimously to recommend approval of NPRR1257 as recommended by PRS in the 1/15/25 PRS Report. All Market Segments participated in the vote. | |
| Summary of TAC Discussion | | On 1/22/25, there was no additional discussion beyond TAC review of the items below. | |
| TAC Review/Justification of Recommendation | | Revision Request ties to Reason for Revision as explained in Justification  Impact Analysis reviewed and impacts are justified as explained in Justification  Opinions were reviewed and discussed  Comments were reviewed and discussed (if applicable)  Other: (explain) | |
| ERCOT Board Decision | | On 2/4/25, the ERCOT Board voted unanimously to recommend approval of NPRR1257 as recommended by TAC in the 1/22/25 TAC Report. | |
| PUCT Decision | | On 3/13/25, the PUCT approved NPRR1257 and accompanying ERCOT Market Impact Statement as presented in Project No. 54445, Review of Protocols Adopted by the Independent Organization. | |

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| **Opinions** | |
| Credit Review | ERCOT Credit Staff and the Credit Finance Sub Group (CFSG) have reviewed NPRR1257 and do not believe that it requires changes to credit monitoring activity or the calculation of liability. |
| Independent Market Monitor Opinion | IMM has no opinion on NPRR1257. |
| ERCOT Opinion | ERCOT supports approval of NPRR1257. |
| ERCOT Market Impact Statement | ERCOT Staff has reviewed NPRR1257 and believes the market impact for NPRR1257 applies a reasonable limit on the amount of RRS from Primary Frequency Response that is provided by an individual Resource to address the risk of common mode failure, in line with recommendations from GE Vernova. |

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| Market Segment | Not applicable |

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| **Comments Received** | |
| Comment Author | **Comment Summary** |
| ROS 110824 | Requested PRS table NPRR1257 for further review by the Performance, Disturbance, Compliance Working Group (PDCWG) |
| ROS 120524 | Endorsed NPRR1257 as submitted |

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| **Market Rules Notes** |

Please note that the baseline Protocol language in the following sections has been updated to reflect the incorporation of the following NPRR(s) into the Protocols:

* NPRR1183, ECEII Definition Clarification and Updates to Posting Rules for Certain Documents without ECEII (unboxed 12/12/24)
  + Section 3.16

Please note that the following NPRR(s) also propose revisions to the following section(s):

* NPRR1235, Dispatchable Reliability Reserve Service as a Stand-Alone Ancillary Service
  + Section 3.18
* NPRR1246, Energy Storage Resource Terminology Alignment for the Single-Model Era
  + Section 3.18

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| Proposed Protocol Language Revision |

**3.16** **Standards for Determining Ancillary Service Quantities**

(1) ERCOT shall comply with the requirements for determining Ancillary Service quantities as specified in these Protocols and the ERCOT Operating Guides.

(2) ERCOT shall, at least annually, determine with supporting data, the methodology for determining the quantity requirements for each Ancillary Service needed for reliability, including:

(a) The percentage or MW limit of ERCOT Contingency Reserve Service (ECRS) allowed from Load Resources providing ECRS;

(b) The maximum amount (MW) of Responsive Reserve (RRS) that can be provided by Resources capable of Fast Frequency Response (FFR);

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| ***[NPRR1128: Replace item (b) above with the following upon system implementation:]***  (b) The maximum amount (MW) of Responsive Reserve (RRS) that can be provided by Resources capable of Fast Frequency Response (FFR) and specify the Operating Hours where prioritizing procurement of FFR up to the maximum FFR amount is beneficial in improving reliability; |

(c) The maximum amount (MW) of Regulation Up Service (Reg-Up) that can be provided by Resources providing Fast Responding Regulation Up Service (FRRS-Up); and

(d) The maximum amount (MW) of Regulation Down Service (Reg-Down) that can be provided by Resources providing Fast Responding Regulation Down Service (FRRS-Down).

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| ***[NPRR1007: Delete items (c) and (d) above upon system implementation of the Real-Time Co-Optimization (RTC) project and renumber accordingly.]*** |

(e) The minimum capacity required from Resources providing RRS using Primary Frequency Response shall not be less than 1,150 MW.

(3) The ERCOT Board shall review and recommend approval of ERCOT's methodology for determining the minimum Ancillary Service requirements, any minimum capacity required from Security-Constrained Economic Dispatch (SCED) dispatchable Resources to provide Non-Spinning Reserve (Non-Spin), the minimum capacity required from Resources providing Primary Frequency Response to provide RRS, the maximum amount of RRS that can be provided by Resources capable of FFR, the maximum amount of RRS that an individual Resource can provide using Primary Frequency Response, and the maximum amount of Reg-Up and Reg-Down that can be provided by Resources providing FRRS-Up and FRRS-Down. ERCOT shall post on the ERCOT website the ERCOT Methodologies for Determining Minimum Ancillary Service Requirements approved by the ERCOT Board. Any such recommendations require approval by the Public Utility Commission of Texas (PUCT) prior to implementation.

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| ***[NPRR1007, NPRR1128, NPRR1171, and NPRR1213: Replace applicable portions of paragraph (3) above with the following upon system implementation of the Real-Time Co-Optimization (RTC) project for NPRR1007; or upon system implementation for NPRR1128, or NPRR1171; or upon system implementation and upon system implementation of NPRR1171 for NPRR1213:]***  (3) The ERCOT Board shall review and recommend approval of ERCOT's methodology for determining the minimum Ancillary Service requirements, any minimum capacity required from Security-Constrained Economic Dispatch (SCED) dispatchable Resources to provide Non-Spinning Reserve (Non-Spin), the maximum amount of Non-Spin that can be provided by Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs) that are interconnected to a distribution circuit that is subject to Load shed, the maximum amount of ECRS that can be provided by DGRs and DESRs that are interconnected to a distribution circuit that is subject to Load shed, the minimum capacity required from Resources providing Primary Frequency Response to provide RRS, the maximum amount of RRS that can be provided by Resources capable of FFR, the maximum amount of RRS that an individual Resource can provide using Primary Frequency Response, and the Operating Hours where prioritizing procurement of FFR up to the maximum FFR amount is beneficial in improving reliability. ERCOT shall post on the ERCOT website the ERCOT Methodologies for Determining Minimum Ancillary Service Requirements approved by the ERCOT Board. Any such recommendations require approval by the Public Utility Commission of Texas (PUCT) prior to implementation. |

(4) If ERCOT determines a need for additional Ancillary Service Resources under these Protocols or the ERCOT Operating Guides, after an Ancillary Service Plan for a specified day has been posted, ERCOT shall inform the market by posting notice on the ERCOT website, of ERCOT’s intent to procure additional Ancillary Service Resources under Section 6.4.9.2, Supplemental Ancillary Services Market. ERCOT shall post the reliability reason for the increase in service requirements.

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| ***[NPRR1007: Delete paragraph (4) above upon system implementation of the Real-Time Co-Optimization (RTC) project and renumber accordingly.]*** |

(5) Monthly, ERCOT shall determine and post on the ERCOT website a minimum capacity required from Resources providing RRS using Primary Frequency Response. The remaining capacity required for RRS may be supplied by all Resources qualified to provide RRS, provided that RRS from Load Resources on high-set under-frequency relays and Resources providing FFR shall be limited to 60% of the total ERCOT RRS requirement. ERCOT may increase the minimum capacity required from Resources providing RRS using Primary Frequency Response if it believes that the current posted quantity will have a negative impact on reliability or if it would require additional Regulation Service to be deployed.

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| ***[NPRR1128: Replace paragraph (5) above with the following upon system implementation:]***  (5) Monthly, ERCOT shall determine and post on the ERCOT website a minimum capacity required from Resources providing RRS using Primary Frequency Response. The remaining capacity required for RRS may be supplied by all Resources qualified to provide RRS, provided that RRS from Load Resources on high-set under-frequency relays and Resources providing FFR shall be limited to 60% of the total ERCOT RRS requirement. ERCOT may increase the minimum capacity required from Resources providing RRS using Primary Frequency Response if it believes that the current posted quantity will have a negative impact on reliability or if it would require additional Regulation Service to be deployed. ERCOT may add more Operating Hours where prioritizing procurement of FFR up to the maximum FFR amount is beneficial in improving reliability if it believes that these additional hours are vulnerable to low system inertia. ERCOT will issue an operations notice when such a change is made. |

(6) The amount of RRS that a Qualified Scheduling Entity (QSE) can self-arrange using a Load Resource excluding Controllable Load Resources (CLRs) and Resources providing FFR is limited to its Load Ratio Share (LRS) of the capacity allowed to be provided by Resources not providing RRS using Primary Frequency Response established in paragraph (5) above, provided that RRS from these Resources shall be limited to 60% of the total ERCOT RRS requirement.

(7) However, a QSE may offer more of the Load Resource above the percentage limit established by ERCOT for sale of RRS to other Market Participants. The total amount of RRS using the Load Resource procured by ERCOT is also limited to the capacity established in paragraph (5) above, up to the lesser of the 60% limit or the limit established by ERCOT in paragraph (5) above.

(8) Monthly, ERCOT shall determine and post on the ERCOT website a minimum capacity required from Resources providing ECRS. The amount of Load Resources excluding CLRs that may or may not be on high-set under-frequency relays providing ECRS is limited to 50% of the total ERCOT ECRS requirement.

(9) The amount of ECRS that a QSE can self-arrange using a Load Resource excluding CLRs is limited to the lower of:

(a) 50% of its ECRS Ancillary Service Obligation; or

(b) A reduced percentage of its ECRS Ancillary Service Obligation based on the limit established by ERCOT in paragraph (8) above.

(10) A QSE may offer more of the Load Resource above the percentage limit established by ERCOT for sale of ECRS to other Market Participants. The total amount of ECRS using the Load Resource excluding CLRs procured by ERCOT is also limited to the lesser of the 50% limit or the limit established by ERCOT in paragraph (9) above.

(11) The maximum MW amount of capacity from Resources providing FRRS-Up is limited to 65 MW. ERCOT may reduce this limit if it believes that this amount will have a negative impact on reliability or if this limit would require additional Regulation Service to be deployed.

(12) The maximum MW amount of capacity from Resources providing FRRS-Down is limited to 35 MW. ERCOT may reduce this limit if it believes that this amount will have a negative impact on reliability or if this limit would require additional Regulation Service to be deployed.

(13) Resources can only provide FRRS-Up or FRRS-Down if awarded Regulation Service in the Day-Ahead Market (DAM) for that particular Resource, up to the awarded quantity.

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| ***[NPRR1007: Delete paragraphs (11)-(13) above upon system implementation of the Real-Time Co-Optimization (RTC) project.]*** |

3.18 Resource Limits in Providing Ancillary Service

(1) For both Generation Resources and Load Resources the High Sustained Limit (HSL) must be greater than or equal to the Low Sustained Limit (LSL) and the sum of the Resource-specific designation of capacity to provide Responsive Reserve (RRS), ERCOT Contingency Reserve Service (ECRS), Regulation Up Service (Reg-Up), Regulation Down Service (Reg-Down), and Non-Spinning Reserve (Non-Spin).

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| ***[NPRR1007: Replace paragraph (1) above with the following upon system implementation of the Real-Time Co-Optimization (RTC) project:]***  (1) For both Generation Resources and Load Resources the High Sustained Limit (HSL) must be greater than or equal to the Low Sustained Limit (LSL) and the sum of the Resource-specific awards for Responsive Reserve (RRS), ERCOT Contingency Reserve Service (ECRS), Regulation Up Service (Reg-Up), Regulation Down Service (Reg-Down), and Non-Spinning Reserve (Non-Spin). |

(2) For Non-Spin, the amount of Non-Spin provided must be less than or equal to the HSL for Off-Line Generation Resources.

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| ***[NPRR1007: Replace paragraph (2) above with the following upon system implementation of the Real-Time Co-Optimization (RTC) project:]***  (2) For Non-Spin, the amount of Non-Spin awarded must be less than or equal to the HSL for Off-Line Generation Resources. |

(3) For RRS:

(a) The full amount of RRS using Primary Frequency Response awarded to or self-arranged from an On-Line Resource is dependent upon the verified droop characteristics of the Resource. ERCOT shall calculate and update, using the methodology described in Nodal Operating Guide Section 8, Attachment N, Procedure for Calculating RRS MW Limits for Individual Resources to Provide RRS Using Primary Frequency Response, a maximum MW amount of RRS using Primary Frequency Response for each Resource subject to verified droop performance. The default value for any newly qualified Resource not yet evaluated per Nodal Operating Guide Section 8, Attachment N shall be 20% of its HSL. A Private Use Network with a registered Resource may use the gross HSL for qualification and establishing a limit on the amount of RRS capacity that the Resource within the Private Use Network can provide;

(b) Generation Resources operating in the synchronous condenser fast-response mode may provide RRS up to the Generation Resource’s proven 20-second response capability (which may be 100% of the HSL). The initiation setting of the automatic under-frequency relay setting shall not be lower than 59.80 Hz. Once deployed, a Resource telemetering a Resource Status of ONRR shall telemeter an RRS Ancillary Service Schedule of zero, and when recalled by ERCOT after frequency recovers above 59.98 Hz, such Resource shall telemeter an RRS Ancillary Service Schedule that shall be a non-zero value equal to its RRS Ancillary Service Responsibility;

(c) The initiation setting of the automatic under-frequency relay setting for Load Resources providing RRS shall not be lower than 59.70 Hz; and

(d) The amount of RRS provided from a Resource capable of providing Fast Frequency Response (FFR) must be less than or equal to its 15-minute rated capacity. The initiation setting of the automatic self-deployment of the Resource providing RRS as FFR must be no lower than 59.85 Hz. A Resource providing RRS as FFR that is deployed shall not recall its capacity until system frequency is greater than 59.98 Hz. Once deployed, a Resource telemetering a Resource Status of ONFFRRRS or ONFFRRRSL shall telemeter an RRS Ancillary Service Schedule of zero, and when recalled, such Resource shall telemeter an RRS Ancillary Service Schedule that shall be a non-zero value equal to its RRS Ancillary Service Responsibility. Once recalled, a Resource providing RRS as FFR must restore its full RRS Ancillary Service Resource Responsibility within 15 minutes after cessation of deployment or as otherwise directed by ERCOT.

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| ***[NPRR1007: Replace paragraph (3) above with the following upon system implementation of the Real-Time Co-Optimization (RTC) project:]***  (3) For RRS:  (a) The full amount of RRS using Primary Frequency Response that can be provided by an On-Line Resource is dependent upon the verified droop characteristics of the Resource. ERCOT shall calculate and update, using the methodology described in Nodal Operating Guide Section 8, Attachment N, Procedure for Calculating RRS MW Limits for Individual Resources to Provide RRS Using Primary Frequency Response, a maximum MW amount of RRS using Primary Frequency Response for each Resource subject to verified droop performance. The default value for any newly qualified Resource not yet evaluated per Nodal Operating Guide Section 8, Attachment N shall be 20% of its HSL. A Private Use Network with a registered Resource may use the gross HSL for qualification and establishing a limit on the amount of RRS capacity that the Resource within the Private Use Network can provide;  (b) Generation Resources operating in the synchronous condenser fast-response mode may be awarded RRS up to the Generation Resource’s proven 20-second response capability (which may be 100% of the HSL). The initiation setting of the automatic under-frequency relay setting shall not be lower than 59.80 Hz;  (c) The initiation setting of the automatic under-frequency relay setting for Load Resources providing RRS shall not be lower than 59.70 Hz; and  (d) The amount of RRS awarded to a Resource capable of providing Fast Frequency Response (FFR) must be less than or equal to its 15-minute rated capacity. The initiation setting of the automatic self-deployment of the Resource providing RRS as FFR must be no lower than 59.85 Hz. |

(4) For ECRS:

(a) The full amount of ECRS provided from an On-Line Generation Resource must be less than or equal to ten times the Emergency Ramp Rate;

(b) The full amount of ECRS provided by a Quick Start Generation Resource (QSGR) must be less than or equal to its proven ten-minute capability as demonstrated pursuant to paragraph (16) of Section 8.1.1.2, General Capacity Testing Requirements;

(c) Generation Resources operating in the synchronous condenser fast-response mode may provide ECRS up to the Generation Resource’s proven 20-second response capability (which may be 100% of the HSL). The initiation setting of the automatic under-frequency relay setting shall not be lower than 59.80 Hz; and

(d) For any Load Resources controlled by under-frequency relay and providing ECRS, the initiation setting of the automatic under-frequency relay setting shall not be lower than 59.70 Hz. To provide ECRS, Load Resources are not required to be controlled by under-frequency relays.

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| ***[NPRR1007: Replace applicable portions of paragraph (4) above with the following upon system implementation of the Real-Time Co-Optimization (RTC) project:]***  (4) For ECRS:  (a) The full amount of ECRS that can be awarded to an On-Line Generation Resource must be less than or equal to ten times the Emergency Ramp Rate;  (b) The full amount of ECRS that can be awarded to a Quick Start Generation Resource (QSGR) must be less than or equal to its proven ten-minute capability as demonstrated pursuant to paragraph (16) of Section 8.1.1.2, General Capacity Testing Requirements;  (c) Generation Resources operating in the synchronous condenser fast-response mode may be awarded ECRS up to the Generation Resource’s proven 20-second response capability (which may be 100% of the HSL). The initiation setting of the automatic under-frequency relay setting shall not be lower than 59.80 Hz; and  (d) For any Load Resources controlled by under-frequency relay and awarded ECRS, the initiation setting of the automatic under-frequency relay setting shall not be lower than 59.70 Hz. To provide ECRS, Load Resources are not required to be controlled by under-frequency relays. |