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| NOGRR Number | [247](https://www.ercot.com/mktrules/issues/NOGRR247) | NOGRR Title | Change UFLS Stages and Load Relief Amounts |
| Date Posted | February 15, 2023 |
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| Requested Resolution  | Normal |
| Nodal Operating Guide Sections Requiring Revision  | 2.6.1, Automatic Firm Load Shedding |
| Related Documents Requiring Revision/Related Revision Requests | None |
| Revision Description | This Nodal Operating Guide Revision Request (NOGRR) modifies the ERCOT automatic Under-Frequency Load Shed (UFLS) program by increasing the number of Load shed stages from three to five and changing the Transmission Operator (TO) Load relief amounts to uniformly increment by 5% for each stage. The NOGRR also adds a UFLS minimum time delay of six cycles (0.1 seconds). Additionally, this NOGRR revises the grey-box language from NOGRR226 in Section 2.6.1 to provide that the TO Load value used to determine the TO Load at each frequency threshold in Table 1 will be the value of TO Load at the time frequency reaches 59.5 Hz, rather than the value of TO Load at the time of reaching each successive frequency threshold, consistent with the current method for determining TO Load in Table 1. |
| Reason for Revision |  Addresses current operational issues Meets Strategic goals (tied to the [ERCOT Strategic Plan](http://www.ercot.com/content/wcm/lists/144926/ERCOT_Strategic_Plan_2019-2023.pdf) or directed by the ERCOT Board). Market efficiencies or enhancements Administrative Regulatory requirements Other: (explain)*(please select all that apply)* |
| Business Case | The current ERCOT automatic UFLS program design includes three stages of TO Load relief of approximately 5%, 10%, and 10%, respectively. It was observed on February 15, 2021 that some steam-turbine generators experienced instability when frequency rose rapidly from a low frequency to 60 Hz (and beyond) during Energy Emergency Alert (EEA) directed Load shed. Based on observations from February 15, 2021, the frequency swing induced by an automatic and directed Load shed of 10% of system Load may result in some generators experiencing instability during a Load shed event. Furthermore, ERCOT is not aware of any reliability justification for having a Load shed stage as large as 10%. Therefore, this NOGRR changes the minimum Load shed amount per UFLS stage to 5% and keeps the overall minimum Load shed amount at 25%, in alignment with NERC Reliability Standard PRC-006-5, Automatic Underfrequency Load Shedding.Also, the NOGRR also adds a minimum time delay of six cycles (0.1 seconds) to ensure that UFLS is not triggered for any localized and/or transient frequency excursions.Finally, the NOGRR revises the description of the method for determining the TO Load value in grey-boxed paragraph (1) of Section 2.6.1, as approved in NOGRR226, Addition of Supplemental UFLS Stages, because ERCOT has determined the language would not require the desired amount of Load shed at each stage.  |

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| Proposed Guide Language Revision |

2.6.1 Automatic Firm Load Shedding

(1) At least 25% of the ERCOT System Load shall be equipped at all times with provisions for automatic Under-Frequency Load Shedding (UFLS) as described in this paragraph. In the event of an under-frequency event, each Transmission Operator (TO) shall provide Load relief by shedding the required percentage of its Distribution Service Provider (DSP)-connected Load and transmission-level Customer Load using automatic under-frequency relays, as specified in Table 1, Standard UFLS Stages, below. TOs may, but are not required to, provide supplemental anti-stall under-frequency Load relief in the amounts described in Table 2, Supplemental Anti-Stall UFLS Stages, below. If the TOs provide supplemental anti-stall under-frequency Load relief, the under-frequency relays shall be set to use the frequency thresholds and time delays described in Table 2. For the purposes of this paragraph, the TO Load will be the amount of Load being served by the DSPs that the TO represents, as well as the TO’s transmission-level Customer Load, when the ERCOT frequency drops to the 59.5 Hz threshold. As such, TO Load that has already been removed from the system without restoration prior to the 59.5 Hz frequency threshold will not apply to meeting TO Load relief percentage requirements as stated in Table 1 and Table 2 below.

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| ***[NOGRR226: Replace paragraph (1) above with the following upon system implementation but no earlier than October 1, 2024:]***(1) At least 25% of the ERCOT System Load shall be equipped at all times with provisions for automatic Under-Frequency Load Shedding (UFLS) as described in this paragraph. In the event of an under-frequency event, each Transmission Operator (TO) shall provide Load relief by shedding the required percentage of its Distribution Service Provider (DSP)-connected Load and transmission-level Customer Load using automatic under-frequency relays, as specified in the tables below. For the purposes of this paragraph, the TO Load will be the amount of Load being served by the DSPs that the TO represents, as well as the TO’s transmission-level Customer Load, when the ERCOT frequency drops to the 59.5 Hz threshold. As such, TO Load that has already been removed from the system without restoration prior to the 59.5 Hz frequency threshold will not apply to meeting TO Load relief percentage requirements as stated in Table 1 and Table 2 below.  |

Table 1: Standard UFLS Stages

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| **Frequency Threshold** | **TO Load Relief** | **Delay to Trip** |
| 59.3 Hz | At least 5% of the TO Load | No more than 30 cycles |
| 59.1 Hz | A total of at least 5% of the TO Load | No more than 30 cycles |
| 58.9 Hz | A total of at least 15% of the TO Load | No more than 30 cycles |
| 58.7 Hz | A total of at least 15% of the TO Load | No more than 30 cycles |
| 58.5 Hz | A total of at least 25% of the TO Load | No more than 30 cycles |

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| ***[NOGRR247: Replace Table 1 above with the following upon system implementation but no earlier than October 1, 2024:]***

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| **Frequency Threshold** | **TO Load Relief** | **Delay to Trip** |
| 59.3 Hz | At least 5% of the TO Load | At least six cycles but no more than 30 cycles |
| 59.1 Hz | A total of at least 10% of the TO Load | At least six cycles but no more than 30 cycles |
| 58.9 Hz | A total of at least 15% of the TO Load | At least six cycles but no more than 30 cycles |
| 58.7 Hz | A total of at least 20% of the TO Load | At least six cycles but no more than 30 cycles |
| 58.5 Hz | A total of at least 25% of the TO Load | At least six cycles but no more than 30 cycles |

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Table 2: Supplemental Anti-Stall UFLS Stages

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| **Frequency Threshold** | **TO Load Relief** | **Delay to Trip** |
| 59.5 Hz | At least 1.5% of the TO Load | 90 seconds |
| 59.5 Hz | A total of at least 3.0% of the TO Load | 120 seconds |
| 59.5 Hz | A total of at least 4.5% of the TO Load | 150 seconds |

(2) ERCOT will, prior to the peak each year, survey each TO’s compliance with the automatic Load shedding requirements described in paragraph (1) above, and report its findings to the Technical Advisory Committee (TAC). For purposes of determining a TO’s compliance with this annual survey requirement, TO Load will be the total amount of Load being served by the DSPs that the TO represents, as well as the TO’s transmission-level Customer Load, at the specified time of the survey. The TO shall identify those circuits armed with under-frequency relays, the corresponding amount of Load, and identify the frequency threshold. A TO shall not equip the entirety of its Load shed obligation in any one tier, and should endeavor to shed in controlled amounts that equal the difference between the TO Load relief required for each tier. If ERCOT identifies potential reliability issues related to distribution of Load shed across the tiers, ERCOT may require the TO to redistribute Load relief closer to the minimum amount required after submitting ERCOT’s proposal to redistribute Load relief to the TO and considering any comments submitted by the TO regarding the proposal. Compliance with this annual survey does not excuse the TO from compliance with the requirements of paragraph (1) above in an actual frequency event. To assist TOs, ERCOT will provide the TO’s inventory, including substation and capacity amounts, of registered Load Resources in its area within ten Business Days of receiving a request in writing from a TO.

(3) A TO may meet the Load relief requirements of the Supplemental anti-stall UFLS stages by utilizing Load that would otherwise be utilized to meet the 58.9 Hz, 58.7 Hz, and 58.5 Hz standard UFLS stages. In this circumstance, the TO’s Load relief responsibility at the 58.9 Hz, 58.7 Hz, and 58.5 Hz standard UFLS stages is reduced by the amount of Load already shed in the supplemental anti-stall UFLS stages. A TO may not meet the Load relief requirements of the supplemental anti-stall UFLS stages by utilizing Load that the TO needs to meet the 59.3 Hz and 59.1 Hz standard UFLS stages.

(4) Additional under-frequency relays may be installed on Transmission Facilities with the approval of ERCOT provided the relays are set at 58.0 Hz or below, are not directional, and have at least 2.0 seconds time delay. A DSP may by mutual agreement arrange to have all or part of its automatic Load shedding requirement performed by another entity. ERCOT will be notified and provided with the details of any such arrangement prior to implementation.

(5) DSPs shall ensure, to the extent possible, and under the direction of ERCOT, that Loads equipped with under-frequency relays are dispersed geographically throughout the ERCOT Region to minimize the impact of Load shedding within a given geographical area. Customers equipped with under-frequency relays shall be dispersed without regard to which Load Serving Entity (LSE) serves the customer. DSPs shall ensure that Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs) are connected to circuits that are not subject to disconnection during UFLS events, except as permitted by Protocol Section 3.8.6, Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs). DSPs shall ensure that the under-frequency relays connected to each Load will operate with a fixed time delay as specified in paragraph (1) above. Total time from the time when a sustained under-frequency condition first reaches one of the values specified above to the time Load is interrupted shall be no more than the maximum fixed time delay specified in paragraph (1) above plus 10 cycles, including all relay and breaker operating times, and no less than any applicable minimum fixed time delay specified in paragraph (1) above. If the frequency drops below 58.5 Hz, ERCOT shall determine additional steps to continue operation.

(6) If a loss of Load occurs due to the operation of under-frequency relays, a DSP or its designee may rotate the physical Load interrupted to minimize the duration of interruption experienced by individual Customers or to restore the availability of under-frequency Load-shedding capability. In no event shall the initial total amount of Load without service be decreased without the approval of ERCOT. TOs, in coordination with DSPs, shall make every reasonable attempt to restore Load, either by automatic or manual means, to preserve system integrity. Restoration of any Load shed by UFLS systems, including supplemental anti-stall UFLS Load, shall be coordinated with ERCOT by the TO. In the event frequency drops below any of the frequency thresholds specified in the tables in paragraph (1) above, and a TO’s UFLS relays that previously activated as a result of reaching that same frequency threshold have not been restored since the previous excursion, the Load on the feeders controlled by those relays shall be counted toward the TO’s satisfaction of the percentages in paragraph (1) above for that subsequent frequency excursion.