

ERCOT Nodal Operating Guides

Section 2: System Operations and Control Requirements

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2 SYSTEM OPERATIONS AND CONTROL REQUIREMENTS

2.1 Operational Duties

- (1) The duties of ERCOT are described in relevant sections of the Protocols and North American Electric Reliability Corporation (NERC) Reliability Standards. These Operating Guides assume that all actions taken will be on components of, or related to, the ERCOT System unless otherwise specified. The primary operational duties of ERCOT are to ensure the reliability of the ERCOT System. In doing this ERCOT shall:
- (2) Perform operational planning:
 - (a) Perform the Reliability Unit Commitment (RUC) processes in order to commit additional resources as needed to maintain reliability;
 - (b) Perform operational ERCOT Transmission Grid reliability studies, including those related to generation and load interconnection responsibilities;
 - (c) Review all Outages of Generation Resources and major transmission lines or components to identify and correct possible failure to meet credible N-1 criteria. This shall include possible failure to meet N-1 criteria not resolved through the Day-Ahead process;

[NOGRR268: Replace paragraph (c) above with the following upon system implementation of NPRR1246:]

- (c) Review all Outages of Generation Resources, Energy Storage Resources (ESRs), and major transmission lines or components to identify and correct possible failure to meet credible N-1 criteria. This shall include possible failure to meet N-1 criteria not resolved through the Day-Ahead process;

- (d) Perform load flows and security analyses of Outages submitted by Qualified Scheduling Entities (QSEs) or Transmission Service Providers (TSPs) as a basis for approval or rejection as described in Protocol Section 3.1, Outage Coordination;

[NOGRR177: Replace paragraph (d) above with the following upon system implementation of NPRR857:]

- (d) Perform load flows and security analyses of Outages submitted by Qualified Scheduling Entities (QSEs), Transmission Service Providers (TSPs), or Direct Current Tie Operators (DCTOs) as a basis for approval or rejection as described in Protocol Section 3.1, Outage Coordination;

- (e) Withdraw approval of a scheduled Outage if unable to meet credible N-1 criteria after all other reasonable options are exercised as described in Protocol Section 3.1;
 - (f) Serve as the point of contact for initiation of generation interconnection to the ERCOT Transmission Grid;
 - (g) Forecast Load and Resources for the next seven days for reliability planning; and
 - (h) Ensure that sufficient Resources in the proper location and required Ancillary Services have been committed for all expected Load on a Day-Ahead and Real-Time basis.
- (3) Operate energy and Ancillary Service markets:
- (a) Administer a Congestion Revenue Rights (CRR) market;
 - (b) Administer a Day-Ahead Market (DAM) including both energy and Ancillary Service;
 - (c) Administer the RUC processes;
 - (d) If necessary, administer a Supplemental Ancillary Service Market (SASM); and
 - (e) Administer a Real-Time energy market using Security-Constrained Economic Dispatch (SCED).

[NOGRR211: Replace paragraph (3) above with the following upon system implementation of NPRR1007:]

- (3) Operate energy and Ancillary Service markets:
- (a) Administer a Congestion Revenue Rights (CRR) market;
 - (b) Administer a Day-Ahead Market (DAM) including both energy and Ancillary Service;
 - (c) Administer the RUC processes; and
 - (d) Administer a Real-Time Market (RTM) including energy and Ancillary Services using Security-Constrained Economic Dispatch (SCED).
- (4) Supervise the ERCOT System to meet NERC Reliability Standards:
- (a) Monitor and evaluate ERCOT System conditions on a continuous basis;
 - (b) Coordinate with Transmission Operators (TOs), ERCOT System events to maintain or restore reliability;

- (c) Dispatch generation via the SCED process and deployment of Ancillary Services to control frequency and congestion;

[NOGRR268: Replace paragraph (c) above with the following upon system implementation of NPRR1246:]

- (c) Dispatch Generation Resources and ESRs via the SCED process and deployment of Ancillary Services to control frequency and congestion;
 - (d) Provide access to the ERCOT System on a nondiscriminatory basis;
 - (e) Approve schedules of interchange transactions across the Direct Current Ties (DC Ties); and
 - (f) Direct emergency operations.
- (5) Collect and Disseminate Information:
- (a) Collect, process, and disseminate market, operational and settlement information;
 - (b) Provide relevant operational information to Market Participants over the Market Information System (MIS);
 - (c) Collect and maintain operational data required by the Public Utility Commission of Texas (PUCT), NERC and Protocols;
 - (d) Receive reports from TOs and QSEs and forward them to the Department of Energy (DOE), NERC, and/or other Governmental Authority as required;
 - (e) Submit reports to DOE, NERC, and/or other Governmental Authority as required; and
 - (f) Record and report accumulated time error.

2.2 System Monitoring and Control

2.2.1 Overview

- (1) ERCOT will maintain continuous surveillance of the status of operating conditions within ERCOT and act as a central information collection and dissemination point for Market Participants.
- (2) ERCOT is designated to receive information required to continually monitor the operating conditions of the ERCOT System and to order individual Qualified Scheduling Entities (QSEs) and/or Transmission Operators (TOs) to make changes to ensure ongoing security and reliability of ERCOT.

- (3) ERCOT shall maintain, monitor, and/or direct the following in accordance with the Protocols. This includes but is not limited to:
- (a) Resources - Monitor, deploy, commit and gather data for settlement of Resources in order to maintain reliability and accurately settle energy capacity and Ancillary Service markets as described in the following Protocol Sections:
 - (i) Protocol Section 3, Management Activities for the ERCOT System;
 - (ii) Protocol Section 4, Day-Ahead Operations;
 - (iii) Protocol Section 5, Transmission Security Analysis and Reliability Unit Commitment; and
 - (iv) Protocol Section 6, Adjustment Period and Real-Time Operations.
 - (b) ERCOT Transmission Grid:
 - (i) Monitor line loading and power transfers;
 - (ii) Coordinate Planned Outages;
 - (iii) Monitor and detect Forced Outages;
 - (iv) Perform contingency analyses and direct re-dispatch to maintain reliable operations;
 - (v) Monitor and coordinate maintenance and construction schedules;
 - (vi) Monitor and control voltage levels; and
 - (vii) Monitor Reactive Power flows.
 - (c) System Operation:
 - (i) Monitor power flows with non-ERCOT systems;
 - (ii) Maintain and monitor Ancillary Services plans and delivery;
 - (iii) Maintain and document compliance with transmission security criteria;
 - (iv) Monitor performance of providers of Ancillary Services;
 - (v) Manage inadvertent energy account balances with non-ERCOT systems;
 - (vi) Direct Time Error correction;
 - (vii) Issue and direct Operating Condition Notices (OCNs), Advisories, Watches, and Emergency Notices; and

- (viii) Direct emergency and short supply operations.
- (d) Information Management:
 - (i) Monitor and coordinate information for daily planning, hourly reporting and minute-by-minute operation;
 - (ii) Validate the accuracy of the Real-Time data; and
 - (iii) Operate the Market Information System (MIS), Energy Management System (EMS) and Market Management System (MMS) to disseminate Real-Time, hourly accounting, and operations plan data between ERCOT and each QSE and TO.

2.2.2 *Security Criteria*

- (1) Technical limits established for the operation of transmission equipment shall be applied consistently in planning and engineering studies, Congestion Revenue Rights (CRRs), Day-Ahead studies, Real-Time security analyses, and operator actions.
- (2) ERCOT shall operate the system such that pre-contingency flows are within applicable Transmission Facility Ratings.
- (3) ERCOT shall operate the system such that, unless an Emergency Condition has been declared by ERCOT, the occurrence of a Credible Single Contingency will not cause any of the following conditions:
 - (a) Uncontrolled breakup of the ERCOT Transmission Grid;
 - (b) Loading of Transmission Facilities above defined Emergency Ratings that cannot be eliminated in time to prevent damage or failure following the loss through execution of a Constraint Management Plan (CMP);
 - (c) Transmission voltage levels outside system design limits that cannot be corrected through execution of a CMP before voltage instability or collapse occurs; or
 - (d) Customer Outages, except for Load that is included in a CMP, high set interruptible and radially served Loads.

2.2.3 *Response to Transient Voltage Disturbance*

- (1) Generation Resources should be designed in accordance with Section 6.2, System Protective Relaying, in order to properly respond to transient voltage disturbances.

[NOGRR268: Replace paragraph (1) above with the following upon system implementation of NPRR1246:]

- (1) Generation Resources and Energy Storage Resources (ESRs) should be designed in accordance with Section 6.2, System Protective Relaying, in order to properly respond to transient voltage disturbances.

2.2.4 Load Frequency Control

- (1) ERCOT shall operate the Load Frequency Control (LFC) system to maintain the scheduled frequency at 60 Hz (correcting periodically for time error) and to minimize the use of energy from Resources providing Regulation Service.
- (2) The ERCOT LFC system shall deploy Regulation Service energy, and release Responsive Reserve (RRS) and ERCOT Contingency Reserve Service (ECRS) capacity to Security-Constrained Economic Dispatch (SCED), as necessary, in accordance with Protocol Section 6.5.7.6, Load Frequency Control, to meet North American Electric Reliability Corporation (NERC) Reliability Standards. ERCOT shall purchase Regulation Service to provide satisfactory frequency control performance for the ERCOT Region. ERCOT shall determine the satisfactory amount of Regulation Service, required by statistical analysis of possible Resource Outages and Load forecast error, to expect operation of 95% of hours without deploying RRS.
- (3) QSEs shall use Automatic Generation Control (AGC) to direct the output of generation facilities providing Regulation.

[NOGRR211 and NOGRR268: Replace applicable portions of Section 2.2.4 above with the following upon system implementation of NPRR1007; or upon system implementation of NPRR1246, respectively:]

2.2.4 Load Frequency Control

- (1) ERCOT shall operate the Load Frequency Control (LFC) system to maintain the scheduled frequency at 60 Hz (correcting periodically for time error) and to minimize the use of energy from Resources providing Regulation Service.
- (2) The ERCOT LFC system shall deploy Regulation Service, Responsive Reserve (RRS), and ERCOT Contingency Reserve Service (ECRS) as necessary in accordance with Protocol Section 6.5.7.6.2, LFC Deployment, to meet North American Electric Reliability Corporation (NERC) Reliability Standards. ERCOT shall purchase Regulation Service to provide satisfactory frequency control performance for the ERCOT Region. ERCOT shall determine the satisfactory amount of Regulation Service, required by statistical analysis of possible Resource Outages and Load forecast error, to expect operation of 95% of hours without deploying RRS.
- (3) QSEs shall use Automatic Generation Control (AGC) to direct the output of Resources providing Regulation.

2.2.4.1 Maintenance and Verification

- (1) Each provider of Regulation Services will properly maintain AGC equipment. Performance of AGC will be verified by the results of performance metrics for Ancillary Service providers described in the Protocols. ERCOT will initiate a regulation survey to evaluate the performance of all AGC equipment in the ERCOT Region.

2.2.4.2 Regulation Provider Loss of AGC

- (1) If a QSE providing Regulation Services loses its AGC for any reason, it will notify ERCOT as soon as practicable of the reason for and estimated duration of the loss. ERCOT will assess whether additional action should be taken to maintain system frequency. Possible ERCOT actions include opening a Supplemental Ancillary Services Market (SASM) per Protocol Section 6.4.9.2, Supplemental Ancillary Services Market, for the period of anticipated loss.

[NOGRR211: Replace paragraph (1) above with the following upon system implementation of NPRR1007:]

- (1) If a QSE providing Regulation Services loses its AGC for any reason, it will notify ERCOT as soon as practicable of the reason for and estimated duration of the loss. ERCOT will assess whether additional action should be taken to maintain system frequency.

2.2.4.3 ERCOT Loss of AGC

- (1) ERCOT has back-up facilities in place for loss of control systems. In the event that these backup facilities also fail to perform, ERCOT shall direct a QSE providing regulation to implement Constant Frequency Control (CFC) for the duration of the control loss. ERCOT will direct the QSE providing CFC to enter the appropriate bias into their control system. If a QSE on CFC develops a problem with regulating room, ERCOT will order additional regulation energy from another QSE to create regulation room.
- (2) ERCOT shall conduct unannounced testing to verify a QSE's capability to operate in CFC mode. Only QSEs with at least 350 MW of spinning reserve room will be tested. QSEs shall be tested at least once every three years. At a time determined solely by ERCOT, ERCOT will direct the QSE to operate under CFC mode. Once instructed by ERCOT, the QSE will have five minutes to switch to CFC mode. The duration of this test shall be no more than 15 minutes. ERCOT shall maintain the list of QSEs that have successfully demonstrated their capability to operate in CFC mode.

2.2.5 Automatic Voltage Regulators

- (1) A Resource Entity shall immediately notify its QSE and its interconnecting TO of any change in Automatic Voltage Regulator (AVR) status (i.e., AVR unavailability due to maintenance or failure and when the AVR returns to normal operation). A QSE shall immediately notify ERCOT, via telemetry and verbal notification, of any change in AVR status and shall supply AVR status logs to ERCOT upon request per Protocol Section 6.5.5.1, Changes in Resource Status. For each Generation Resource that is On-Line but not producing real power and is not capable of providing Reactive Power, each QSE must still telemeter its AVR status to ERCOT, but is not required to provide verbal notifications of its AVR status changes to ERCOT during these operating conditions.
- (2) Resource Entities shall conduct tests for the purpose of model verification on AVRs or verify AVR performance through comparison with operational data a minimum of every ten calendar years. All new Generation Resources shall conduct an AVR test as prescribed in paragraph (4) of Protocol Section 8.1.1.2.1.4, Voltage Support Service Qualification, within five years of the initial AVR test approved as part of the commissioning process. All subsequent tests shall be conducted on a ten year cycle. Additionally, if equipment characteristics are knowingly modified, an AVR test shall be conducted within 120 days of the modification. Industry accepted testing techniques shall be used for testing, measuring and calculating the modeling parameters. The test report must list the test(s) conducted or include the operational data used to verify the modeling parameters. Any models created from the test data must be a standard Power System Simulator for Engineering (PSS/E) dynamic model or ERCOT and Transmission Service Provider (TSP) approved user written model.
 - (a) Resource Entities will provide the test data or verified dynamic models to ERCOT by submittal to the Net Dependable Capability and Reactive Capability (NDCRC) application located on the MIS Secure Area or by updating its Resource Registration information respectively.
 - (b) All devices included in the AVR control system including but not limited to synchronous condensers, static Volt-Ampere reactive (VAr) compensators, static synchronous compensators (STATCOMs), and switchable shunt reactive devices required to meet Protocol Section 3.15, Voltage Support, shall be included in the AVR test and set to regulate the transmission level voltage at the Point of Interconnection Bus (POIB).

[NOGRR204: Replace paragraph (2) above with the following upon system implementation of NPRR989:]

- (2) Resource Entities shall conduct tests for the purpose of model verification on AVRs or verify AVR performance through comparison with operational data a minimum of every ten calendar years. All new Generation Resources and Energy Storage Resources (ESRs) shall conduct an AVR test as prescribed in paragraph (4) of Protocol Section 8.1.1.2.1.4, Voltage Support Service Qualification, within five years of the initial AVR test approved as part of the commissioning process. All subsequent tests

shall be conducted on a ten year cycle. Additionally, if equipment characteristics are knowingly modified, an AVR test shall be conducted within 120 days of the modification. Industry accepted testing techniques shall be used for testing, measuring and calculating the modeling parameters. The test report must list the test(s) conducted or include the operational data used to verify the modeling parameters. Any models created from the test data must be a standard Power System Simulator for Engineering (PSS/E) dynamic model or ERCOT and Transmission Service Provider (TSP) approved user written model.

- (a) Resource Entities will provide the test data or verified dynamic models to ERCOT by submittal to the Net Dependable Capability and Reactive Capability (NDCRC) application located on the MIS Secure Area or by updating its Resource Registration information respectively.
- (b) All devices included in the AVR control system including but not limited to synchronous condensers, static Volt-Ampere reactive (VAr) compensators, static synchronous compensators (STATCOMs), and switchable shunt reactive devices required to meet Protocol Section 3.15, Voltage Support, shall be included in the AVR test and set to regulate the transmission level voltage at the Point of Interconnection Bus (POIB).

- (3) Resource Entities shall verify excitation systems model data upon initial installation, within 120 days of performance modifications, and a minimum of ten calendar years thereafter.
- (4) An exemption may be granted for the testing requirements listed in paragraphs (2) and (3) above if the Resource on which the AVR or excitation system is installed has an Annual Net Capacity Factor (ANCF) of 5% or less over the most recent three calendar years preceding the planned testing calendar year. ANCF is calculated as follows:

Annual Total Net Generation in MWhr/(Annual Hours * Average Seasonal Net Max Sustainable Rating) * 100%

Wherein:

Annual Hours = Number of hours in the calendar year being reported. Hours in mothball or retired status are not included in the hour total;

and

Average Seasonal Net Max Sustainable Rating = Average of the Seasonal Net Max Sustainable ratings submitted via the NDCRC application located on the MIS Secure Area.

- (a) At the end of this ten year timeframe, the current average three year ANCF (for years eight, nine, and ten) will be examined by ERCOT to determine if the exemption can be declared for the next ten-year period. If no longer eligible for

exemption based on the ANCF, then model verification must be completed within 365 calendar days of the date the capacity factor exemption expired. Under certain operating conditions, ERCOT may require a ten year test even if the current average three year ANCF is below the 5% threshold.

- (5) Black Start designated units are not eligible for the ANCF exemption detailed in paragraph (4) above. If a Resource that had been granted an exemption detailed in paragraph (4) above is accepted for Black Start Service (BSS), the Resource has 365 days from the start date of BSS to submit modeling information detailed in paragraph (2) above.
- (6) Generation Resource AVR modeling information required in the ERCOT planning criteria shall be determined from actual Generation Resource testing described in these Operating Guides. Within 30 days of ERCOT's request, the results of the latest test performed shall be supplied to ERCOT and the TSP.

[NOGRR204: Replace paragraph (6) above with the following upon system implementation of NPRR989:]

- (6) Generation Resource or ESR AVR modeling information required in the ERCOT planning criteria shall be determined from actual Generation Resource or ESR testing described in these Operating Guides. Within 30 days of ERCOT's request, the results of the latest test performed shall be supplied to ERCOT and the TSP.

2.2.6 Power System Stabilizers

- (1) Generation Resources with Power System Stabilizers (PSSs) shall keep their PSSs in-service ("On" or energized and performing as designed by the manufacturer) unless the PSS is installed but not in service as described in paragraph (4)(a)(ii) below. When available, the PSS shall be active and responsive at all times the generator is synchronized to the ERCOT Transmission Grid and operating at or above its Low Sustained Limit (LSL). However, if the PSS of a Generation Resource is set to be active and responsive at a point above the LSL for technical reasons, the Generation Resource may request ERCOT to allow an exception to the requirement that the PSS be active anytime the Generation Resource is at or above its LSL. In order to obtain the exception, the Generation Resource shall notify ERCOT and provide the necessary technical information to ERCOT to justify a higher activation point for the PSS.

[NOGRR268: Replace paragraph (1) above with the following upon system implementation of NPRR1246:]

- (1) Synchronously interconnected Generation Resources and synchronously interconnected ESRs with Power System Stabilizers (PSSs) shall keep their PSSs in-service ("On" or energized and performing as designed by the manufacturer) unless the PSS is installed but not in service as described in paragraph (4)(a)(ii) below. When available, the PSS

shall be active and responsive at all times the Resource is synchronized to the ERCOT Transmission Grid and operating at or above its Low Sustained Limit (LSL). However, if the PSS of a Resource is set to be active and responsive at a point above the LSL for technical reasons, the Resource may request ERCOT to allow an exception to the requirement that the PSS be active anytime the Resource is at or above its LSL. In order to obtain the exception, the Resource shall notify ERCOT and provide the necessary technical information to ERCOT to justify a higher activation point for the PSS.

- (2) Resource Entities shall notify their QSEs of any change in PSS status (e.g. PSS unavailability due to maintenance or failure and when the PSS returns to normal operation). QSEs shall notify ERCOT and the TO at the Point of Interconnection (POI) of any change in PSS status and shall supply PSS status logs to ERCOT upon request per Protocol Section 6.5.5.1, Changes in Resource Status.
- (3) Synchronous Generation Resources greater than 10 MW installed after January 1, 2008 and on or before December 1, 2010 shall install a PSS and place the PSS in service by June 1, 2011. Synchronous Generation Resources greater than 10 MW installed after December 1, 2010 shall install a PSS and place the PSS in-service prior to the Resource Commissioning Date of the Generation Resource. The Generation Resource shall establish PSS settings to dampen modes with oscillations within the range of 0.2 Hz to 2 Hz. The PSS settings shall be tested and tuned to ensure the PSS has appropriate damping characteristics. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.

[NOGRR268: Replace paragraph (3) above with the following upon system implementation of NPRR1246:]

- (3) Synchronously interconnected Generation Resources and synchronously interconnected ESRs greater than 10 MW installed after January 1, 2008 and on or before December 1, 2010 shall install a PSS and place the PSS in service by June 1, 2011. Synchronously interconnected Generation Resources and synchronously interconnected ESRs greater than 10 MW installed after December 1, 2010 shall install a PSS and place the PSS in-service prior to the Resource Commissioning Date of the Generation Resource or ESR. The Generation Resource or ESR shall establish PSS settings to dampen modes with oscillations within the range of 0.2 Hz to 2 Hz. The PSS settings shall be tested and tuned to ensure the PSS has appropriate damping characteristics. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.

- (4) Synchronous Generation Resources greater than 10 MW installed before January 1, 2008 are subject to the following requirements:
 - (a) All Generation Resources that are in this category shall notify ERCOT and the TSP:
 - (i) Whether or not a PSS has been installed; and

- (ii) Whether or not PSS settings have been determined and the PSS has been or will be placed in-service.
- (b) If a PSS was in-service prior to January 1, 2008, the PSS shall remain in-service with the established PSS settings, provided that ERCOT may direct the Generation Resource to modify the settings. The PSS settings shall be tested and tuned to ensure the PSS has appropriate damping characteristics.
- (c) If a PSS is newly installed and/or placed in-service the Generation Resource shall establish PSS settings to dampen modes with oscillations within the range of 0.2 Hz to 2 Hz. The PSS settings shall be tested and tuned to ensure the PSS has appropriate damping characteristics. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.

[NOGRR268: Replace paragraph (4) above with the following upon system implementation of NPRR1246:]

- (4) Synchronously interconnected Generation Resources and synchronously interconnected ESRs greater than 10 MW installed before January 1, 2008 are subject to the following requirements:
 - (a) All Generation Resources and ESRs that are in this category shall notify ERCOT and the TSP:
 - (i) Whether or not a PSS has been installed; and
 - (ii) Whether or not PSS settings have been determined and the PSS has been or will be placed in-service.
 - (b) If a PSS was in-service prior to January 1, 2008, the PSS shall remain in-service with the established PSS settings, provided that ERCOT may direct the Generation Resource or ESR to modify the settings. The PSS settings shall be tested and tuned to ensure the PSS has appropriate damping characteristics.
 - (c) If a PSS is newly installed and/or placed in-service the Generation Resource or ESR shall establish PSS settings to dampen modes with oscillations within the range of 0.2 Hz to 2 Hz. The PSS settings shall be tested and tuned to ensure the PSS has appropriate damping characteristics. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.
- (5) If an excitation system on a synchronous Generation Resource greater than 10 MW is modified or replaced after January 1, 2008, the Generation Resource shall install a PSS, establish PSS settings to dampen modes with oscillations within the range of 0.2 Hz to 2 Hz, and place the PSS in-service. The settings shall be tested and tuned to ensure the excitation system has appropriate damping characteristics. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.

[NOGRR268: Replace paragraph (5) above with the following upon system implementation of NPRR1246:]

- (5) If an excitation system on a synchronously interconnected Generation Resource or synchronously interconnected ESR greater than 10 MW is modified or replaced after January 1, 2008, the Resource shall install a PSS, establish PSS settings to dampen modes with oscillations within the range of 0.2 Hz to 2 Hz, and place the PSS in-service. The settings shall be tested and tuned to ensure the excitation system has appropriate damping characteristics. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.
- (6) If it is determined that a change in PSS settings or the addition of a PSS to a synchronous Generation Resource would improve overall system performance, ERCOT shall coordinate with the Generation Resource owner to determine appropriate settings. Within 180 days of determining appropriate settings, the Generation Resource owner shall revise the PSS setting and/or install the PSS. Any PSS setting established pursuant to this section shall be established to dampen modes with oscillations as directed by ERCOT and place the PSS in-service. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.

[NOGRR268: Replace paragraph (6) above with the following upon system implementation of NPRR1246:]

- (6) If it is determined that a change in PSS settings or the addition of a PSS to a synchronously interconnected Generation Resource or synchronously interconnected ESR would improve overall system performance, ERCOT shall coordinate with the Resource owner to determine appropriate settings. Within 180 days of determining appropriate settings, the Resource owner shall revise the PSS setting and/or install the PSS. Any PSS setting established pursuant to this section shall be established to dampen modes with oscillations as directed by ERCOT and place the PSS in-service. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.
- (7) At least every ten calendar years, Resource Entities shall conduct a PSS test or verify PSS performance based on operational data for the purpose of model verification on PSSs. All new Generation Resources shall conduct a PSS test within five years of the initial PSS test that was approved as part of the commissioning process. All subsequent tests shall be conducted on a ten year cycle. Additionally, if PSS equipment characteristics are modified, the Resource Entity shall conduct a performance test within 120 days of the modification. Industry accepted testing techniques shall be used for testing, measuring and calculating the modeling parameters. The test report must list the test(s) conducted and include the operational data used to verify the modeling parameters. Any models created from the test data must be a standard PSS/E dynamic model or ERCOT and TSP approved user written model. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.

[NOGRR268: Replace paragraph (7) above with the following upon system implementation of NPRR1246:]

- (7) At least every ten calendar years, Resource Entities shall conduct a PSS test or verify PSS performance based on operational data for the purpose of model verification on PSSs. All new synchronously interconnected Generation Resources and synchronously interconnected ESR shall conduct a PSS test within five years of the initial PSS test that was approved as part of the commissioning process. All subsequent tests shall be conducted on a ten year cycle. Additionally, if PSS equipment characteristics are modified, the Resource Entity shall conduct a performance test within 120 days of the modification. Industry accepted testing techniques shall be used for testing, measuring and calculating the modeling parameters. The test report must list the test(s) conducted and include the operational data used to verify the modeling parameters. Any models created from the test data must be a standard PSS/E dynamic model or ERCOT and TSP approved user written model. Final PSS settings shall be provided to ERCOT and the TSP within 30 days of the PSS in-service date.

- (a) Resource Entities will provide the test data or verified dynamic models to ERCOT by submittal to the NDCRC application located on the MIS Secure Area by updating its Resource Registration information respectively.
- (8) An exemption may be granted for the testing requirements listed above if the Resource on which the PSS is installed has a current ANCF, as calculated per paragraph (4) of Section 2.2.5, Automatic Voltage Regulators, of 5% or less over the most recent three calendar years preceding the planned testing calendar year. At the end of this ten year timeframe, the current average three year ANCF (for years eight, nine, and ten) will be examined by ERCOT to determine if the exemption can be declared for the next ten year period. If no longer eligible for the ANCF exemption, then model verification must be completed within 365 calendar days of the date the capacity factor exemption expired. Under certain operating conditions, ERCOT may require a ten year test even if the current average three year ANCF is below the 5% threshold.
- (9) The results of PSS tests or PSS performance verification shall be supplied to ERCOT and the TSP within 30 days of a request from ERCOT.

2.2.7 Turbine Speed Governors

- (1) A Governor shall be in-service whenever the Generation Resource or Energy Storage Resource (ESR) is connected to the ERCOT System, or Settlement Only Generator (SOG) is connected to the ERCOT Transmission Grid.
- (2) Generation Resources and ESRs that have not been evaluated in at least eight Frequency Measurable Events (FMEs) within 36 months shall conduct Governor performance tests within 12 months using one of the test methods or historical methods specified in Section 8, Attachment C, Turbine Governor Speed Tests. The Resource Entity shall then provide test results to ERCOT.

- (3) Generation Resources and ESRs, except steam turbines of Combined Cycle Generation Resources, Settlement Only Transmission Generators (SOTGs), and Settlement Only Transmission Self-Generators (SOTSGs) shall have Governor droop characteristics and Governor Dead-Band settings no greater than those shown below in Table 1, Maximum Governor Dead-Band Settings, and Table 2, Maximum Governor Droop Settings, as defined below:

Table 1: Maximum Governor Dead-Band Settings

Resource Type	Max. Deadband
Steam Turbines with Mechanical Governors	+/- 0.034 Hz
Hydro Turbines with Mechanical Governors	+/- 0.034 Hz
All Other Generating Units/Generating Facilities/ESRs	+/- 0.017 Hz
Controllable Load Resources (CLRs)	+/- 0.036 Hz

Table 2: Maximum Governor Droop Settings

Generator Type	Max. Droop % Setting
Combustion Turbine (Combined Cycle)	4%
All Other Generating Units/Generating Facilities/ESRs/CLRs	5%

- (4) If ERCOT determines that ERCOT System reliability would be enhanced, for a defined period of time, ERCOT may direct Wind-powered Generation Resources (WGRs) under the control of a Remedial Action Scheme (RAS) to limit power increases due to frequency if there is risk of a RAS operation due to a low frequency FME.

2.2.8 Performance/Disturbance/Compliance Analysis

- (1) Performance/Disturbance/Compliance analysis shall be performed by ERCOT for the purpose of ensuring conformance with the Protocols and Operating Guides. All Generation Resources, ESRs, SOTGs, SOTSGs, and CLRs, except nuclear-powered Resources or WGRs with a permanent exemption approved by ERCOT, must respond to frequency disturbances with a Governor droop as specified in Section 2.2.7, Turbine Speed Governors. Each Generation Resource, ESR, SOTG, SOTSG, and CLR based on participation in at least eight FMEs, shall meet a minimum 12-month rolling average initial Primary Frequency Response performance and sustained Primary Frequency Response performance of 0.75 as calculated in Section 8, Attachment J, Initial and Sustained Measurements for Primary Frequency Response. When assessing conformance with the Protocols and Operating Guides, ERCOT shall evaluate the annual rolling average and may exclude from the performance analysis Generation Resources, ESRs, SOTGs, SOTSGs, or CLRs in accordance with, but not limited to, the following conditions:
- (a) Operating within the larger of five MW or 2% of the High Sustained Limit (HSL) or the maximum capacity for low frequency disturbances;

- (b) Operating within the larger of five MW or 2% of the HSL or the maximum capacity above the LSL for high frequency disturbances;
- (c) For an ESR, while discharging, if operating within the larger of 3 MW or 2% of the Maximum Operating Discharge Power Limit for low frequency disturbances;
- (d) For an ESR, while charging, if operating within the larger of 3 MW or 2% of the Maximum Operating Charge Power Limit for high frequency disturbances;
- (e) For any Generation Resource carrying power augmentation, the maximum capacity will be computed as the HSL minus Non-Frequency Responsive Capacity (NFRC); or
- (f) Having a technical or physical limitation filed with the ERCOT client representative and approved by ERCOT.

[NOGRR263: Replace paragraph (1) above with the following upon system implementation of NPRR1244:]

- (1) Performance/Disturbance/Compliance analysis shall be performed by ERCOT for the purpose of ensuring conformance with the Protocols and Operating Guides. All Generation Resources, ESRs, CLRs that are capable of providing Primary Frequency Response, SOTGs, and SOTSGs, except nuclear-powered Resources or WGRs with a permanent exemption approved by ERCOT, must respond to frequency disturbances with a Governor droop as specified in Section 2.2.7, Turbine Speed Governors. Each Generation Resource, ESR, CLR qualified for Regulation Service and/or RRS, SOTG, and SOTSG based on participation in at least eight FMEs, shall meet a minimum 12-month rolling average initial Primary Frequency Response performance and sustained Primary Frequency Response performance of 0.75 as calculated in Section 8, Attachment J, Initial and Sustained Measurements for Primary Frequency Response. When assessing conformance with the Protocols and Operating Guides, ERCOT shall evaluate the annual rolling average and may exclude from the performance analysis Generation Resources, ESRs, CLRs qualified for Regulation Service and/or RRS, SOTGs, or SOTSGs in accordance with, but not limited to, the following conditions:
 - (a) Operating within the larger of five MW or 2% of the High Sustained Limit (HSL) or the maximum capacity for low frequency disturbances;
 - (b) Operating within the larger of five MW or 2% of the HSL or the maximum capacity above the LSL for high frequency disturbances;
 - (c) For an ESR, while discharging, if operating within the larger of 3 MW or 2% of the Maximum Operating Discharge Power Limit for low frequency disturbances;
 - (d) For an ESR, while charging, if operating within the larger of 3 MW or 2% of the Maximum Operating Charge Power Limit for high frequency disturbances;

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| <ul style="list-style-type: none"> (e) For any Generation Resource carrying power augmentation, the maximum capacity will be computed as the HSL minus Non-Frequency Responsive Capacity (NFRC); or (f) Having a technical or physical limitation filed with the ERCOT client representative and approved by ERCOT. |
|---|
- (2) Market Participants shall request an exemption from, or correction of, performance during an FME within 30 days of the MIS posting date of the “Initial and Sustained Frequency Response Unit Performance” report.
 - (3) ERCOT will, on an as needed basis, utilize the Performance, Disturbance, Compliance Working Group (PDCWG) as a technical resource in providing input for types of technical or physical limitations that may be approved by ERCOT.
 - (4) ERCOT shall make a regular report on selected system disturbances, documenting the response of individual Generation Resources, ESRs, and CLRs. In addition, Resource Entities, QSEs, and individual members of the PDCWG are encouraged to work within their respective companies to enhance the performance of individual Generation Resource’s, ESR’s, or CLR’s control systems through application of the results of the PDCWG studies.

2.2.9 Time Error and Time Synchronization

2.2.9.1 Time Error

- (1) Sustained frequency deviations from scheduled frequency result in Time Error. Time Error will be monitored and controlled in ERCOT as follows:
 - (a) Time Error Monitoring - ERCOT will monitor accumulated Time Error and initiate time corrections. The instantaneous Time Error is available to all QSEs on the ERCOT website.
 - (b) Time Error Correction - ERCOT may conduct Time Error correction at any time. However, ERCOT must promptly initiate Time Error correction if the Time Error exceeds +/- 30 seconds, unless operational circumstances require otherwise. ERCOT will initiate and terminate Time Error correction via Hotline call to QSEs representing Resources. The call initiating Time Error correction will include the frequency offset (- 0.02 Hz for fast and + 0.02 Hz for slow) and the start time. The Time Error correction may end when:
 - (i) The Time Error is within +/- 0.5 seconds of the target reference;
 - (ii) System events mandate termination;
 - (iii) The period of correction reaches five hours; or

- (iv) After any hour without at least a 0.5 second error reduction.

2.2.9.2 Time Synchronization

- (1) To promote accurate data reporting during an Energy Emergency Alert (EEA) and other system events, and to ensure transaction schedules are simultaneous, all QSEs and TOs, and ERCOT will maintain their control system time within ± 3 seconds of the National Bureau of Standards (NBS) time signal. The NBS time signal shall set the time standard for ERCOT. ERCOT, QSEs and TOs are required to employ clocks, voice and data recording systems that synchronize automatically with the NBS on at least a weekly basis.

2.2.10 Generation Resource and Energy Storage Resource Response Time Requirements

- (1) All Generation Resources and ESRs providing Voltage Support Service (VSS) as described in Protocol Section 3.15, Voltage Support, shall maintain the necessary procedures and processes plus communications, telemetry, remote control, automation, and staffing in order to normally comply with the response times listed below when a VSS Dispatch Instruction or a TO Voltage Set Point instruction, as described in Protocol Section 6.5.7.7, Voltage Support Service, is given. Compliance is based upon normal operating conditions where VSS Dispatch Instructions respect all equipment operating limits and other restrictions that are periodically placed on equipment. The response time to a VSS Dispatch Instruction or a TO Voltage Set Point instruction shall commence with the successful receipt by the QSE, Generation Resource, or ESR either through a verbal or telemetered instruction.
- (2) A Resource Entity, TO, or QSE is not required to comply with a VSS Dispatch Instruction or Voltage Set Point instruction if compliance with such an instruction is impossible due to either a Force Majeure Event or one or more of the conditions described in paragraphs (1) and (2) of Protocol Section 6.5.7.9, Compliance with Dispatch Instructions. In the event compliance with an instruction is precluded under this paragraph:
 - (a) An affected Resource Entity shall, as soon as practicable, but not longer than 15 minutes from receipt of the instruction by the Resource Entity, notify its QSE, and the Resource Entity or its QSE shall, as soon as practicable, notify the Entity issuing the instruction; and
 - (b) An affected TO shall, as soon as practicable, but not longer than 15 minutes from notification from the Resource Entity or its QSE, notify ERCOT.
- (3) The required VSS response times for Generation Resources and ESRs are:
 - (a) For automatically switchable static VAr capable devices, when voltage or reactive measurements at the POIB are outside of the Voltage Set Point tolerance band identified in paragraph (4) of Section 2.7.3.5, Resource Entity Responsibilities

and Generation Resource and Energy Storage Resource Requirements; then the response must be fully deployed in no more than five minutes. If a TO and a Resource Entity have determined that a longer response time is appropriate and have entered into a written agreement reflecting that response time, then the Generation Resource or ESR shall be required to comply with that agreed response time so long as it does not exceed ten minutes.

- (b) Response to a TO Voltage Set Point instruction shall be completed in no more than five minutes from receipt of the instruction.
 - (c) Response to a VSS Dispatch Instruction that requires a change to the real power output of the Generation Resource or ESR shall be completed as soon as practicable.
- (4) Shutting down and disconnecting Generation Resources or ESRs from the ERCOT System:
- (a) On-Line Generation Resources or ESRs must be able to commence their shutdown sequence within five minutes of receipt of a Dispatch Instruction from ERCOT. Nuclear-fueled Generation Resources shall comply with the procedural requirements of the Nuclear Regulatory Commission (NRC) when receiving Dispatch Instructions from ERCOT to disconnect the Generation Resource from the ERCOT Transmission Grid. Additionally, Distribution Generation Resources (DGRs) or Distribution Energy Storage Resources (DESRs) must be able to shut down their generators in a timeframe that meets the requirements of their Distribution Service Provider (DSP). Once disconnected from the ERCOT System, the QSE shall update the DGR or DESR's Current Operating Plan (COP) as soon as practicable of plans to reconnect to the ERCOT System.
 - (b) If the ERCOT Transmission Grid condition requires breaker or switch operations to disconnect a non-MW producing Generation Resource or ESR from the system, such operations shall be completed as soon as practicable, but no longer than 15 minutes of the receipt of a Dispatch Instruction from ERCOT. Once disconnected from the ERCOT Transmission Grid, a Generation Resource or ESR shall complete as soon as practicable, but no longer than 15 minutes, the required switching to return the system to a normal configuration except for nuclear-fueled Generation Resources, which shall comply with the procedural requirements of the NRC when receiving Dispatch Instructions from ERCOT to disconnect the Generation Resource from the ERCOT Transmission Grid.

2.3 Ancillary Services

(1) The types of Ancillary Services required by ERCOT are described below:

ANCILLARY SERVICE TYPE	DESCRIPTION	ERCOT AUTHORITY ACTION
Regulation Down Service (Reg-Down) and Regulation Up Service (Reg-Up) (for Generation Resources and Energy Storage Resources (ESRs)) <i>Reference: Protocol Section 2, Definitions and Acronyms</i>	Resource capacity provided by a Qualified Scheduling Entity (QSE) from a specific Generation Resource or ESR to control frequency within the system which is controlled second by second, normally by an Automatic Generation Control (AGC) system.	a. Reg-Down energy is a deployment to increase or decrease generation at a level below the Generation Resource's or ESR's Base Point in response to a change in system frequency. b. Reg-Up energy is a deployment to increase or decrease generation at a level above the Generation Resource's or ESR's Base Point in response to a change in system frequency.
Reg-Down and Reg-Up (for Load Resource) <i>Reference: Protocol Section 2</i>	Load Resource capacity provided by a QSE from a specific Load Resource to control frequency within the system.	a. Reg-Down is a deployment to increase or decrease Load as deployed within its Ancillary Service Schedule for Reg-Down below the Load Resource's Maximum Power Consumption (MPC) limit in response to a change in system frequency. b. Reg-Up is a deployment to increase or decrease Load as deployed within its Ancillary Service Schedule for Reg-Up above the Load Resource's Low Power Consumption (LPC) limit in response to a change in system frequency.
Responsive Reserve (RRS) <i>Reference: Protocol Section 2</i>	Operating reserves on Generation Resources, ESRs, Load Resources, and Resources capable of providing Fast Frequency Response (FFR) maintained by	RRS may only be deployed as follows: a. Through automatic Governor action or under-frequency

ANCILLARY SERVICE TYPE	DESCRIPTION	ERCOT AUTHORITY ACTION
	ERCOT to help control the frequency of the system. RRS on Generation Resources, ESRs, and Controllable Load can be used as energy during an Energy Emergency Alert (EEA) event.	<p>relay in response to frequency deviations;</p> <p>b. By electronic signal from ERCOT in response to the need; and</p> <p>c. As ordered by an ERCOT Operator during an EEA or other emergencies.</p>
<p>ERCOT Contingency Reserve Service (ECRS)</p> <p><i>Reference: Protocol Section 2</i></p>	<p>a. Off-Line Generation Resource capacity, or reserved capacity from On-Line Generation Resources, capable of being ramped to a specified output level within ten minutes, operating at a specified output for at least two consecutive hours, and are dispatchable by Security-Constrained Economic Dispatch (SCED).</p> <p>b. Controllable Load Resources dispatchable by SCED that are capable of ramping to an ERCOT-instructed consumption level within ten minutes and consuming at the ERCOT-instructed level for at least two consecutive hours.</p> <p>c. Load Resources that are not Controllable Load Resources and may or may not be controlled by under-frequency relay. Load Resources that are not Controllable Load Resources providing ECRS must be capable of reducing Load in response to an Extensible Markup Language (XML) Dispatch Instruction within ten minutes and remain</p>	<p>Deployed in response to loss-of-Resource contingencies, Load forecasting error, or other contingency events on the system. See Protocol Section 6.5.7.6.2.4, Deployment and Recall of ERCOT Contingency Reserve Service.</p>

ANCILLARY SERVICE TYPE	DESCRIPTION	ERCOT AUTHORITY ACTION
	deployed until recalled by ERCOT.	
Non-Spinning Reserve (Non-Spin) Service <i>Reference: Protocol Section 2</i>	a. Off-Line Generation Resource or ESR capacity, or reserved capacity from On-Line Generation Resources or ESRs, capable of being ramped to a specified output level within 30 minutes and operating at a specified output for at least four consecutive hours. b. Controllable Load Resources that are capable of ramping to an ERCOT-instructed consumption level within 30 minutes and consuming at the ERCOT-instructed level for at least four consecutive hours. c. Load Resources that are not Controllable Load Resources and that are not controlled by under-frequency relay. Load Resources that are not Controllable Load Resources providing Non-Spin must be capable of reducing Load in response to an XML Dispatch Instruction within 30 minutes and remain deployed until recalled by ERCOT.	Deployed in response to loss-of-Resource contingencies, Load forecasting error, or other contingency events on the system. See Protocol Section 6.5.7.6.2.3, Non-Spinning Reserve Service Deployment.
Voltage Support Service (VSS) <i>Reference: Protocol Section 3.15, Voltage Support</i>	Reactive capability of a Generation Resource or ESR that is required to maintain transmission and distribution voltages on the ERCOT Transmission Grid within acceptable limits. All Generation	Direct the scheduling of VSS by providing Voltage Profiles at the Point of Interconnection Bus (POIB). The Generation Resource or ESR is obligated to maintain the published Voltage

ANCILLARY SERVICE TYPE	DESCRIPTION	ERCOT AUTHORITY ACTION
	Resources and ESRs with a gross rating greater than 20 MVA shall provide VSS.	Profile within its Corrected Unit Reactive Limit (“CURL”).
Black Start Service (BSS) <i>Reference: Protocol Section 3.14.2, Black Start</i>	The provision of Generation Resources under a Black Start Agreement, which are capable of self-starting without support from within ERCOT in the event of a Partial Blackout or Blackout.	Provide emergency Dispatch Instructions to begin restoration to a secure operating state after a Partial Blackout or Blackout.
Reliability Must-Run (RMR) Service <i>Reference: Protocol Section 3.14.1, Reliability Must Run</i>	The provision of Generation Resource capacity and energy under an RMR Agreement.	Enter into contractual agreements to retain units required for reliable operations. Direct the operation of those units that otherwise would not operate and that are necessary to provide reliable operations.

[NOGRR211: Replace paragraph (1) above with the following upon system implementation of NPRR1007:]

(1) The types of Ancillary Services required by ERCOT are described below:

ANCILLARY SERVICE TYPE	DESCRIPTION	ERCOT AUTHORITY ACTION
Regulation Down Service (Reg-Down) and Regulation Up Service (Reg-Up) (for Generation Resources and Energy Storage Resources (ESRs)) <i>Reference: Protocol Section 2, Definitions and Acronyms</i>	Resource capacity provided by a Qualified Scheduling Entity (QSE) from a specific Generation Resource or ESR to control frequency within the system which is controlled second by second, normally by an Automatic Generation Control (AGC) system.	<p>a. Reg-Down energy is a Resource-specific deployment to increase or decrease generation at a level below the Generation Resource’s or ESR’s Base Point in response to a change in system frequency.</p> <p>b. Reg-Up energy is a Resource-specific deployment to increase or decrease generation at a level above the Generation Resource’s or ESR’s Base</p>

		Point in response to a change in system frequency.	
Reg-Down and Reg-Up (for Load Resource) <i>Reference: Protocol Section 2</i>	Load Resource capacity provided by a QSE from a specific Load Resource to control frequency within the system.	a. Reg-Down is a Resource-specific deployment to increase or decrease Load below the Load Resource's Maximum Power Consumption (MPC) limit in response to a change in system frequency. b. Reg-Up is a Resource-specific deployment to increase or decrease Load above the Load Resource's Low Power Consumption (LPC) limit in response to a change in system frequency.	
Responsive Reserve (RRS) <i>Reference: Protocol Section 2</i>	Operating reserves on Generation Resources, ESRs, Load Resources, and Resources capable of providing Fast Frequency Response (FFR) maintained by ERCOT to help control the frequency of the system. RRS on Generation Resources, ESRs, and Controllable Load can be used as energy during an Energy Emergency Alert (EEA) event.	RRS may only be deployed as follows: a. Through automatic Governor action or under-frequency relay in response to frequency deviations; b. By electronic signal from ERCOT in response to the need; and c. As ordered by an ERCOT Operator during an EEA or other emergencies.	

<p>ERCOT Contingency Reserve Service (ECRS)</p> <p><i>Reference: Protocol Section 2</i></p>	<ul style="list-style-type: none"> a. Off-Line Generation Resource or ESR capacity, or reserved capacity from On-Line Generation Resources or ESRs, capable of being ramped to a specified output level within ten minutes and operating at a specified output for at least two consecutive hours. b. Controllable Load Resources dispatchable by Security-Constrained Economic Dispatch (SCED) that are capable of ramping to an ERCOT-instructed consumption level within ten minutes and consuming at the ERCOT-instructed level for at least two consecutive hours. c. Load Resources that are not Controllable Load Resources and may or may not be controlled by under-frequency relay. Load Resources that are not Controllable Load Resources providing ECRS must be capable of reducing Load in response to an Extensible Markup Language (XML) Dispatch Instruction within ten minutes and remain deployed until recalled by ERCOT. 	<p>Deployed in response to loss-of-Resource contingencies, Load forecasting error, or other contingency events on the system. See Protocol Section 6.5.7.6.2.4, Deployment and Recall of ERCOT Contingency Reserve Service.</p>	
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<p>Non-Spinning Reserve (Non-Spin) Service</p> <p><i>Reference: Protocol Section 2</i></p>	<ul style="list-style-type: none"> a. Off-Line Generation Resource or ESR capacity, or reserved capacity from On-Line Generation Resources or ESRs, capable of being ramped to a specified output level within 30 minutes and operating at a specified output for at least four consecutive hours. b. Controllable Load Resources that are capable of ramping to an ERCOT-instructed consumption level within 30 minutes and consuming at the ERCOT-instructed level for at least four consecutive hours. c. Load Resources that are not Controllable Load Resources and that are not controlled by under-frequency relay. Load Resources that are not Controllable Load Resources providing Non-Spin must be capable of reducing Load in response to an XML Dispatch Instruction within 30 minutes and remain deployed until recalled by ERCOT. 	<p>Deployed in response to loss-of-Resource contingencies, Load forecasting error, or other contingency events on the system. See Protocol Section 6.5.7.6.2.3, Non-Spinning Reserve Service Deployment.</p>	
<p>Voltage Support Service (VSS)</p> <p><i>Reference: Protocol Section 3.15, Voltage Support</i></p>	<p>Reactive capability of a Generation Resource or ESR that is required to maintain transmission and distribution voltages on the ERCOT Transmission Grid within acceptable limits. All Generation Resources and ESRs with a gross rating greater than 20 MVA shall provide VSS.</p>	<p>Direct the scheduling of VSS by providing Voltage Profiles at the Point of Interconnection Bus (POIB). The Generation Resource or ESR is obligated to maintain the published Voltage Profile within its Corrected Unit Reactive Limit (CURL).</p>	

Black Start Service (BSS) <i>Reference: Protocol Section 3.14.2, Black Start</i>	The provision of Generation Resources under a Black Start Agreement, which are capable of self-starting without support from within ERCOT in the event of a Partial Blackout or Blackout.	Provide emergency Dispatch Instructions to begin restoration to a secure operating state after a Partial Blackout or Blackout.
Reliability Must-Run (RMR) Service <i>Reference: Protocol Section 3.14.1, Reliability Must Run</i>	The provision of Generation Resource capacity and energy under an RMR Agreement.	Enter into contractual agreements to retain units required for reliable operations. Direct the operation of those units that otherwise would not operate and that are necessary to provide reliable operations.

2.3.1 Responsive Reserve

2.3.1.1 Obligation

- (1) ERCOT operating reserve requirements are more restrictive than North American Electric Reliability Corporation (NERC) Reliability Standards. The RRS obligation is a minimum of 2300 MW. The amount of RRS procured may be adjusted as described in ERCOT Methodologies for Determining Ancillary Service Requirements or if ERCOT determines a reliability need for additional Ancillary Service Resources.

2.3.1.2 Additional Operational Details for Responsive Reserve Providers

- (1) ERCOT shall specify the minimum amount of RRS provided by Generation Resources as outlined in Section 2.3.1.2.1, Limit on Resources Providing RRS Using Primary Frequency Response. QSE's Generation Resources providing RRS must be On-Line, immediately responsive to system frequency deviations.
- (2) RRS provided by a QSE shall meet the requirements as defined in paragraph (3) of Protocol Section 3.18, Resource Limits in Providing Ancillary Service.
- (3) ERCOT shall issue a Verbal Dispatch Instruction (VDI) to QSEs of Generation Resources operating in synchronous condenser fast-response mode who provide MWs to the ERCOT System in response to a frequency event occurring at or below the frequency set point specified in paragraph (3)(b) of Protocol Section 3.18 when the energy is provided without an RRS deployment. The VDI shall be in the quantity of MWs (energy) supplied by the Generation Resource responding in synchronous condenser fast-response mode and shall relieve the QSE of its obligation for the equivalent RRS obligation quantity. If ERCOT issues an RRS deployment to the QSE responding with

Generation Resources operating in synchronous condenser fast-response mode, ERCOT shall count the responding Generation Resource(s) MWs (energy) as part of its response to the RRS deployment.

[NOGRR211: Replace paragraph (3) above with the following upon system implementation of NPRR1007:]

- (3) ERCOT shall issue Dispatch Instructions for RRS through Inter-Control Center Communications Protocol (ICCP) to a QSE representing a Generation Resource in synchronous condenser fast-response mode that is responding to a Frequency Measurable Event (FME) at or below the frequency set point specified in paragraph (3)(b) of Protocol Section 3.18, or under manual deployment when system frequency does not go below the frequency set point specified in paragraph (3)(b) of Protocol Section 3.18. Dispatch Instructions under this section shall only occur during scarcity conditions, as specified in Protocol Section 6.5.9.4.2, EEA Levels, or in an attempt to recover frequency to meet NERC Standards.
- (4) Unless ERCOT issues a recall instruction for the RRS deployed via Inter-Control Center Communications Protocol (ICCP), the QSE of the Generation Resource operating in synchronous condenser fast-response mode may contact ERCOT to determine if it is allowed to recall and reset the individual unit(s) to the synchronous condenser fast-response mode.
- (5) ERCOT, at its sole discretion, may request that the Generation Resource operating in synchronous condenser fast-response mode remain On-Line and generating after an initial deployment. The request to remain On-Line and generating after an initial deployment may not exceed 30 minutes per deployment for each frequency deviation or event nor shall such request exceed two hours per a consecutive 12-hour period in aggregate unless ERCOT has declared an EEA.
- (6) Load Resources providing RRS must be either a Controllable Load Resource qualified for SCED and capable of providing Primary Frequency Response or a Load Resource controlled by high-set under-frequency relays for automatic interruption. For eligibility to participate as a RRS provider, reference Protocol Section 8.1.1.2.1.2, Responsive Reserve Qualification. Load Resources controlled by high-set under-frequency relays shall also complete the following requirements:
 - (a) The under-frequency relay must have a delay of no more than 20 cycles (or 0.33 seconds for relays that do not count cycles). Total time from the time frequency first decays to a value low enough to initiate action of the under frequency relay(s) to the time Load is interrupted should be no more than 30 cycles, including all relay and breaker operating times;
 - (b) The initiation setting of the under-frequency relay shall not be any lower than 59.7 Hz; and

- (c) The Load Resource must be able to remain interrupted during actual event until replaced by other net dependable capability. In no case may interrupted Load be restored to service without the approval of an ERCOT operator.
- (7) To become and remain fully qualified as a provider of RRS, the Load Resource shall complete the requirements above and the following:
 - (a) Pass simulated or actual testing according to ERCOT procedures; and
 - (b) Perform verification testing as described in Section 8, Attachment G, Load Resource Tests.
- (8) Generation Resource operating in synchronous condenser fast-response mode – Modes of RRS and/or ECRS that will be counted:
 - (a) Synchronous condenser fast response mode - described in item (3)(b) or (4)(c) of Protocol Section 3.18;
 - (b) Generation MW mode - For any Generation Resource with a 5% droop setting operating as a generator, the amount of RRS provided is dependent upon the verified droop characteristics of the Resource;
 - (c) Synchronous Condenser Mode in “Manual” Dispatch Mode - Units will supply MWs based on operator action within the ten-minute Protocol requirement for supplying RRS or ECRS. Once deployed these units are frequency responsive; and
 - (d) A Real-Time signal of the MW capacity of units being operated in any of the synchronous condenser modes is telemetered to ERCOT.
- (9) Each Resource seeking RRS qualification as a Resource capable of providing FFR must be On-Line and shall also meet the following requirements:
 - (a) The total time from the time frequency first decays to a value low enough to initiate action up to the time when full Ancillary Service Resource Responsibility for RRS is delivered should be no more than 15 cycles, including all relay and breaker operating times;
 - (b) The initiation setting of the under-frequency relay or similar trigger mechanism shall not be any lower than 59.85 Hz;
 - (c) A Resource must demonstrate its ability to sustain the scheduled level of deployment for at least 15 minutes at a minimum level of 95% but not more than a maximum level of 110% of the MW capacity for which the Resource seeks qualification for FFR; and
 - (d) Resource providing FFR shall be capable of measuring and recording ERCOT Frequency (Hz) and MW output with a resolution of no less than 32 samples per second.

- (10) Each QSE providing RRS with Resources capable of providing FFR shall so indicate by appropriate entries in the relevant Resources' Ancillary Service Schedules and by setting the Ancillary Service Resource Responsibilities accordingly. Control performance during periods in which ERCOT has deployed FFR shall be based on the requirements below:
- (a) For any FFR deployment event, ERCOT will collect the following data:
 - (i) High speed event data from Resources that are not deployed via breaker action;
 - (ii) High speed event data from the recorders at ERCOT's primary and back-up facilities;
 - (iii) High speed event data from phasor measurement units available to ERCOT;
 - (iv) Telemetry data for all Resources providing FFR during the event; and
 - (v) Recording of ERCOT frequency (Hz) and MW output with a resolution of no less than 32 samples per second.
 - (b) The performance of a Load Resource providing FFR in response to an RRS Dispatch Instruction shall be determined by subtracting the Load Resource's actual Load response from the average of the telemetered net real power consumption values for the five minutes preceding the Dispatch Instruction ("meter before / meter after"). The actual Load response is the average of the real power consumption data being telemetered to ERCOT during the Settlement Interval indicated in the Dispatch Instruction.
 - (c) For an FFR deployment event triggered by an under-frequency event (frequency at or below 59.85 Hz). ERCOT will use the collected data to determine if the following requirements were met:
 - (i) The total time from the time frequency first decays to a value low enough to initiate action up to the time when full Ancillary Service Resource Responsibility for RRS is delivered should be no more than 15 cycles, including all relay and breaker operating times;
 - (ii) The Resource deployed 95% to 110% of its Ancillary Service Resource Responsibility in 15 cycles after the frequency reached 59.85 Hz;
 - (iii) The Resource sustained 95% to 110% of its Ancillary Service Resource Responsibility for the duration of the sustained response period, defined as 15 minutes or until the time of recall instruction from ERCOT, whichever occurred first;

- (iv) The Resource restored its capability to provide its Ancillary Service Resource Responsibility within 15 minutes from the end of the deployment period subject to paragraph (v) below; and
 - (v) Upon completion of deployment, ERCOT will issue a recall instruction to a Resource providing FFR. Once the recall instruction is issued to Resources providing FFR, it must ramp down to zero output level over the duration of five minutes. A Resource providing FFR may withdraw energy from the grid only after the frequency has recovered to 60 Hz and Physical Responsive Capability (PRC) is above 2,500 MW, unless ordered to do so by ERCOT.
- (d) For an FFR deployment through a VDI, in addition to the data listed in paragraph (a) above, ERCOT will collect a voice recording of the VDI to document the time of the instruction. The official start of the ramp period for the FFR deployment is the end of the ERCOT Operator's acknowledgement that the read back of the instruction was correct. ERCOT will use the collected data to determine if the following requirements were met:
- (i) The Resource deployed 95% to 110% of its Ancillary Service Resource Responsibility within ten minutes after the start of the ramp period;
 - (ii) The Resource sustained 95% to 110% of its Ancillary Service Resource Responsibility for the duration of the sustained response period, defined as 15 minutes or until the time of recall instruction from ERCOT, whichever occurred first;
 - (iii) The Resource restored its capability to provide its Ancillary Service Resource Responsibility within 15 minutes after ERCOT declares that the EEA has been cancelled; and
 - (iv) Upon completion of deployment, ERCOT will issue a recall instruction to a Resource providing FFR. A Resource providing FFR may withdraw energy from the grid only after the frequency has recovered to 60 Hz and Physical Responsive Capability (PRC) is above 2,500 MW, unless ordered to do so by ERCOT.
- (e) For a Resource providing FFR that is unable to return to its RRS Ancillary Service Resource Responsibility within 15 minutes from the end of the deployment period, its QSE may replace the quantity of deficient FFR capacity within that same 15 minutes using other Resources qualified to provide RRS but not already committed to provide RRS unless the Resource is not allowed by ERCOT to withdraw energy from the grid.

[NOGRR211: Replace paragraph (10) above with the following upon system implementation of NPRR1007:]

- (10) Control performance during periods in which ERCOT has deployed FFR shall be based on the requirements below:
- (a) For any FFR deployment event, ERCOT will collect the following data:
 - (i) High speed event data from Resources that are not deployed via breaker action;
 - (ii) High speed event data from the recorders at ERCOT's primary and back-up facilities;
 - (iii) High speed event data from phasor measurement units available to ERCOT;
 - (iv) Telemetry data for all Resources providing FFR during the event; and
 - (v) Recording of ERCOT frequency (Hz) and MW output with a resolution of no less than 32 samples per second.
 - (b) The performance of a Load Resource providing FFR in response to an RRS Dispatch Instruction shall be determined by subtracting the Load Resource's actual Load response from the average of the telemetered net real power consumption values for the five minutes preceding the Dispatch Instruction ("meter before / meter after"). The actual Load response is the average of the real power consumption data being telemetered to ERCOT during the Settlement Interval indicated in the Dispatch Instruction.
 - (c) For an FFR deployment event triggered by an under-frequency event (frequency at or below 59.85 Hz). ERCOT will use the collected data to determine if the following requirements were met:
 - (i) The total time from the time frequency first decays to a value low enough to initiate action up to the time when full Ancillary Service award for RRS is delivered should be no more than 15 cycles, including all relay and breaker operating times;
 - (ii) The Resource deployed 95% to 110% of its Ancillary Service award for RRS in 15 cycles after the frequency reached 59.85 Hz;
 - (iii) The SCED-dispatchable Resource sustained 95% to 110% of its Ancillary Service award for RRS;
 - (iv) The non-Controllable Load Resource providing FFR sustained 95% to 110% of its Ancillary Service award for RRS for the duration of the sustained response period, defined as 15 minutes or until the time of recall instruction from ERCOT, whichever occurred first;
 - (v) Upon completion of deployment, ERCOT will issue a recall instruction to a Resource providing FFR. Once the recall instruction is issued to

Resources providing FFR, the Resource shall continue following its Updated Desired Set Point (UDSP). A Load Resource that is controlled by a high-set under-frequency relay and is providing FFR may only withdraw energy from the grid after the frequency has recovered to 60 Hz and Physical Responsive Capability (PRC) is above 2,500 MW, or if instructed to do so by ERCOT.

- (d) For an FFR deployment of non-Controllable Load Resources through a VDI, in addition to the data listed in paragraph (a) above, ERCOT will collect a voice recording of the VDI to document the time of the instruction. The official start of the ramp period for the FFR deployment is the end of the ERCOT Operator's acknowledgement that the read back of the instruction was correct. ERCOT will use the collected data to determine if the following requirements were met:
 - (i) The Resource deployed 95% to 110% of its Ancillary Service award for RRS within ten minutes after the start of the ramp period;
 - (ii) The Resource sustained 95% to 110% of its Ancillary Service award for RRS for the duration of the sustained response period, defined as 15 minutes or until the time of recall instruction from ERCOT, whichever occurred first;
 - (iii) Upon completion of deployment, ERCOT will issue a recall instruction to a Resource providing FFR. A Load Resource that is controlled by a high-set under-frequency relay and is providing FFR may only withdraw energy from the grid after the frequency has recovered to 60 Hz and Physical Responsive Capability (PRC) is above 2,500 MW, or if instructed to do so by ERCOT.

- (11) If a failure occurs at the QSE or sub-QSE level, as part of any compliance review ERCOT shall identify the individual Resource(s) responsible for the failure. QSEs representing Resources providing FFR will have an opportunity to provide ERCOT with site-specific high resolution data (at least 32 samples per second) for further analysis. Regardless of the QSE's or sub-QSE level performance, ERCOT may require any individual Resource that fails to meet its FFR performance criteria to submit a corrective action plan and may suspend a Resource's qualification to provide FFR for a pattern of non-performance.

2.3.1.2.1 Limit on Resources Providing RRS Using Primary Frequency Response

- (1) ERCOT shall establish MW limits on individual Resource's ability to provide RRS using Primary Frequency Response. The MW limit shall be based on Resource performance during Frequency Measurable Events (FMEs) and actual tests.

- (2) The default maximum MW limit of Primary Frequency Response shall be set to 20% of its High Sustained Limit (HSL) for any newly qualified Resource not yet evaluated per Section 8, Attachment N, Procedure for Calculating RRS MW Limits for Individual Resources to Provide RRS Using Primary Frequency Response, for measuring actual performance.
- (3) 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.

2.3.2 *Non-Spinning Reserve Service*

2.3.2.1 Additional Operational Details for Non-Spinning Reserve Service Providers

- (1) Non-Spin Service Generation Resource providers must be capable of being synchronized and ramped to a specified output level within 30 minutes of notification of deployment and run at a specified output level for at least four consecutive hours, as specified in item (1)(a) of Protocol Section 3.17.3, Non-Spinning Reserve Service.

[NOGRR211: Replace paragraph (1) above with the following upon system implementation of NPRR1007:]

- (1) Non-Spin Service Generation Resource providers, including MW from power augmentation, must be capable of being synchronized and ramped to a specified output level within 30 minutes of notification of deployment and run at a specified output level for at least four consecutive hours, as specified in item (1)(a) of Protocol Section 3.17.3, Non-Spinning Reserve Service.
- (2) Non-Spin Controllable Load Resource providers must be capable of ramping to an ERCOT-instructed consumption level within 30 minutes and consuming at the ERCOT-instructed level for at least four consecutive hours, as specified in item (1)(b) of Protocol Section 3.17.3.
- (3) A Load Resource that is not a Controllable Load Resource providing Non-Spin must be capable of reducing Load based on an XML Dispatch Instruction issued by ERCOT within 30 minutes and maintaining that deployment until recalled.
- (4) To become provisionally qualified as a provider of Non-Spin, a Load Resource shall complete the following requirements:
 - (a) Register as a Load Resource with ERCOT;
 - (b) Complete asset registration of the Load Resource;
 - (c) Provide ERCOT the appropriate Non-Spinning Load affidavit;

- (d) Test to verify appropriate voice communications are in place for VDIs by ERCOT;
- (e) Provide telemetry through the QSE to ERCOT in accordance with all applicable requirements set forth in paragraph (5) of Protocol Section 6.5.5.2, Operational Data Requirements; and
- (f) Be able to consume at an ERCOT-instructed level during an ERCOT deployment based on the applicable duration requirements specified in Section 2.3, Ancillary Services.

[NOGRR211: Replace applicable portions of paragraph (4) above with the following upon system implementation of NPRR1007:]

- (4) To become provisionally qualified as a provider of Non-Spin, a Load Resource shall complete the following requirements:
 - (a) Register as a Load Resource with ERCOT;
 - (b) Complete asset registration of the Load Resource;
 - (c) Provide ERCOT the appropriate Non-Spinning Load affidavit;
 - (d) Test to verify appropriate voice communications are in place for VDIs by ERCOT;
 - (e) Provide telemetry through the QSE to ERCOT in accordance with all applicable requirements set forth in paragraph (5) of Protocol Section 6.5.5.2, Operational Data Requirements; and
 - (f) Be able to consume at an ERCOT-instructed level during an ERCOT deployment based on the applicable duration requirements specified in Section 2.3, Ancillary Services.

- (5) To become and remain fully qualified as a provider of Non-Spin, the Load Resource shall complete all the requirements for provisional qualification identified above and the following:
 - (a) Respond successfully to an actual ERCOT deployment or pass simulated or actual testing according to ERCOT's Procedure; and
 - (b) Perform verification testing as described in Section 8, Attachment G, Load Resource Tests.

2.3.3 *ERCOT Contingency Reserve Service*

2.3.3.1 Additional Operational Details for ERCOT Contingency Reserve Service (ECRS) Providers

- (1) Generation Resources providing ECRS must be capable of being synchronized and ramped to a specified output level within ten minutes of notification of deployment and run at a specified output level for the entire duration of its ECRS obligation.
- (2) Controllable Load Resource providing ECRS must be capable of ramping to an ERCOT-instructed consumption level within ten minutes and consuming at the ERCOT-instructed level for the entire duration of its ECRS obligation.
- (3) To become provisionally qualified as a provider of ECRS, a Controllable Load Resource shall complete the following requirements:
 - (a) Register as a Controllable Load Resource with ERCOT;
 - (b) Provide ERCOT the ECRS Load affidavit;
 - (c) Test to verify primary and alternative voice communications are in place for VDIs by ERCOT;
 - (d) Provide telemetry through the QSE to ERCOT in accordance with all applicable requirements set forth in paragraph (5) of Protocol Section 6.5.5.2, Operational Data Requirements; and
 - (e) Be able to maintain consumption at an ERCOT-instructed level during an ERCOT-instructed test for the entire duration of the test period.
- (4) To become and remain fully qualified as a provider of ECRS, the Controllable Load Resource shall complete all the requirements for provisional qualification identified above and the following:
 - (a) Respond successfully to an actual ERCOT deployment or pass actual testing according to ERCOT's Procedure; and
 - (b) Perform verification testing as described in Section 8, Attachment G, Load Resource Tests.
- (5) The total amount of ECRS that Load Resources other than Controllable Load Resources may provide shall not exceed 50% of the total ERCOT-wide ECRS requirement. A Load Resource must be loaded and capable of unloading the scheduled amount of ECRS within ten minutes of instruction by ERCOT or be interrupted by action of under-frequency relays.
 - (a) Load Resources that are providing ECRS are not required to be controlled by high-set under-frequency relays.

- (b) Load Resources controlled by high-set under-frequency relays and providing ECRS shall meet the relay setting requirement stated in paragraph (6) of Section 2.3.1.2, Additional Operational Details for Responsive Reserve Providers.
- (6) ERCOT shall deploy ECRS to meet NERC Reliability Standards and other performance criteria as specified in these Operating Guides and the Protocols by one or more of the following:
 - (a) Automatic Dispatch Instruction signal to release ECRS capacity from Generation Resources and Controllable Load Resources to SCED; and/or
 - (b) Dispatch Instruction for deployment of Load Resources energy via electronic Messaging System.
- (7) ERCOT shall release ECRS from Generation Resources and Controllable Load Resources to SCED when frequency drops below 59.91 Hz and available Reg-Up alone is not sufficient to restore frequency. ERCOT shall recall automatically deployed ECRS capacity once system frequency recovers above 59.97 Hz.

[NOGRR211: Replace Section 2.3.3.1 above with the following upon system implementation of NPRR1007:]

2.3.3.1 Additional Operational Details for ERCOT Contingency Reserve Service (ECRS) Providers

- (1) Generation Resources providing ECRS must be capable of being synchronized and ramped to a specified output level within ten minutes of notification of deployment and run at a specified output level for at least two consecutive hours.
- (2) Controllable Load Resource providing ECRS must be capable of ramping to an ERCOT-instructed consumption level within ten minutes and consuming at the ERCOT-instructed level for at least two consecutive hours.
- (3) To become provisionally qualified as a provider of ECRS, a Controllable Load Resource shall complete the following requirements:
 - (a) Register as a Controllable Load Resource with ERCOT;
 - (b) Provide ERCOT the ECRS Load affidavit;
 - (c) Test to verify primary and alternative voice communications are in place for VDIs by ERCOT;
 - (d) Provide telemetry through the QSE to ERCOT in accordance with all applicable requirements set forth in paragraph (5) of Protocol Section 6.5.5.2, Operational Data Requirements; and

- (e) Be able to maintain consumption at an ERCOT-instructed level during an ERCOT-instructed test for the entire duration of the test period.
- (4) To become and remain fully qualified as a provider of ECRS, the Controllable Load Resource shall complete all the requirements for provisional qualification identified above and the following:
 - (a) Respond successfully to an actual ERCOT deployment or pass actual testing according to ERCOT's Procedure; and
 - (b) Perform verification testing as described in Section 8, Attachment G, Load Resource Tests.
- (5) The total amount of ECRS that Load Resources other than Controllable Load Resources may provide shall not exceed 50% of the total ERCOT-wide ECRS requirement. A Load Resource must be loaded and capable of unloading the scheduled amount of ECRS within ten minutes of instruction by ERCOT or be interrupted by action of under-frequency relays.
 - (a) Load Resources that are providing ECRS are not required to be controlled by high-set under-frequency relays.
 - (b) Load Resources controlled by high-set under-frequency relays and providing ECRS shall meet the relay setting requirement stated in paragraph (6) of Section 2.3.1.2, Additional Operational Details for Responsive Reserve Providers.
- (6) ERCOT shall deploy ECRS to meet NERC Reliability Standards and other performance criteria as specified in these Operating Guides and the Protocols by Dispatch Instruction for ECRS through Inter-Control Center Communications Protocol (ICCP) to a QSE representing a Generation Resource in synchronous condenser fast-response mode that is responding to a Frequency Measurable Event (FME) at or below the frequency set point specified in paragraph (3)(b) of Protocol Section 3.18, or under manual deployment when system frequency does not go below the frequency set point specified in paragraph (3)(b) of Protocol Section 3.18. Dispatch Instructions under this section shall only occur during scarcity conditions, as specified in Protocol Section 6.5.9.4.2, EEA Levels, or in an attempt to recover frequency to meet NERC Standards; and/or Dispatch Instruction for deployment of Load Resources energy via electronic Messaging System.

2.4 Outage Coordination

- (1) For Outage coordination details, reference Protocol Section 3.1, Outage Coordination and the ERCOT Market Information System (MIS) Secure Area.

2.5 Reliability Unit Commitment

2.5.1 *Criteria for Removing Contingencies from the Reliability Unit Commitment Analyses*

- (1) ERCOT shall remove contingencies from the Reliability Unit Commitment (RUC) analysis when:
 - (a) The contingency is known to produce post-contingency results that are incorrect; or
 - (b) The contingency is known to produce a non-convergent contingency result which may cause the RUC process to fail.

2.6 Requirements for Under-Frequency and Over-Frequency Relaying

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, unless provisions specified in Section 4.5.3.3, EEA Levels, are required to meet ERCOT operating instructions for manual Load shed. 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.

[NOGRR226: Replace paragraph (1) above with the following upon system implementation but no earlier than October 1, 2026:]

- (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, unless provisions specified in Section 4.5.3.3, EEA Levels, are required to meet ERCOT operating instructions for manual Load shed. 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, and Table 2, Supplemental/Anti-Stall UFLS Stages, 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

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

[NOGRR247: Replace Table 1 above with the following upon system implementation but no earlier than October 1, 2026:]

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

Table 2: Supplemental/Anti-Stall UFLS Stages

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 59.1 Hz, 58.9 Hz, 58.7 Hz, and 58.5 Hz standard UFLS stages. In this circumstance, the TO's Load relief responsibility at the 59.1 Hz, 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 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.

[NOGRR250: Replace paragraph (5) above with the following upon system implementation of NPRR1171:]

- (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 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.

2.6.2 *Frequency Ride-Through Requirements for Generation Resources and Energy Storage Resources*

- (1) Except for Generation Resources and Energy Storage Resources (ESRs) subject to Sections 2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, or 2.6.2.2, Frequency Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs), if under-frequency relays are installed and activated to trip the Generation Resource or ESR, these relays shall perform such that the automatic removal of the Resource from the ERCOT System meets or exceeds the following requirements:

Frequency Range	Delay to Trip
Above 59.4 Hz	No automatic tripping (continuous operation)
Above 58.4 Hz up to and including 59.4 Hz	Not less than 9 minutes
Above 58.0 Hz up to and including 58.4 Hz	Not less than 30 seconds
Above 57.5 Hz up to and including 58.0 Hz	Not less than 2 seconds
57.5 Hz or below	No time delay required

- (2) Except for Generation Resources subject to Sections 2.6.2.1 or 2.6.2.2, if over-frequency relays are installed and activated to trip the Resource, the Resource shall perform such that the automatic removal of the Resource from the ERCOT System meets or exceeds the following requirements:

Frequency Range	Delay to Trip
Below 60.6 Hz down to and including 60 Hz	No automatic tripping (continuous operation)
Below 61.6 Hz down to and including 60.6 Hz	Not less than 9 minutes
Below 61.8 Hz down to and including 61.6 Hz	Not less than 30 seconds
61.8 Hz or above	No time delay required

- (3) If frequency protection schemes are installed and activated to trip a Generation Resource or ESR, they shall use filtered quantities or add sufficient time delays to prevent misoperations while providing the desired equipment protection. Protection schemes shall not trip a Generation Resource or ESR based on an instantaneous frequency measurement.
- (4) This Section shall not affect the Resource Entity's responsibility to protect Generation Resources or ESRs from damaging operating conditions. The Resource Entity for a Generation Resource or ESR subject to paragraphs (1) and (2) above that is unable to

remain reliably connected to the ERCOT System as set forth in paragraphs (1) and (2), shall immediately provide to ERCOT the reason(s) for the Resource's limitation, including available study results or manufacturer recommendations, and the Resource's frequency ride-through capability in the format shown in the tables in paragraphs (1) and (2) above.

2.6.2.1 Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs

- (1) This Section applies to all IBRs, Type 1 WGRs and Type 2 WGRs connected to the ERCOT Transmission Grid. Such Resources shall ride through the frequency conditions at the Resource's Point of Interconnection Bus (POIB) specified in the following table:

Frequency (f) in (Hz)	Minimum Ride-Through Time (seconds)
$f > 61.8$	May ride-through or trip
$61.6 < f \leq 61.8$	299
$61.2 < f \leq 61.6$	540
$58.8 \leq f \leq 61.2$	continuous
$58.4 \leq f < 58.8$	540
$57.0 \leq f < 58.4$	299
$f < 57.0$	May ride-through or trip

- (2) Nothing in paragraph (1) above shall be interpreted to require an IBR, Type 1 WGR or Type 2 WGR to trip for frequency conditions beyond those for which ride-through is required.
- (3) If protection systems (including, but not limited to protection for over-/under-frequency, rate-of-change-of-frequency, anti-islanding, and phase angle jump) are installed and activated to trip the IBR, Type 1 WGR or Type 2 WGR, they shall enable the Resource to ride through frequency conditions beyond those defined in paragraph (1) above to the maximum level the equipment allows.
- (4) An IBR, Type 1 WGR or Type 2 WGR shall inject electric current when required to ride-through frequency conditions. Except when caused by reductions associated with intermittent primary energy source availability (e.g., wind speed or solar irradiance), an IBR, Type 1 WGR or Type 2 WGR shall not reduce active current injection during frequency conditions requiring ride-through unless allowed pursuant to paragraph (4) of Section 2.9.1.1, Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), or paragraph (4) of Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, or to provide appropriate frequency response.
- (5) IBR, Type 1 WGR and Type 2 WGR plant controls, turbine controls and/or inverter controls shall not disconnect the plant or any individual inverter/turbine, or prevent

current exchange between the Resource and the ERCOT Transmission Grid during frequency conditions where ride-through is required.

- (6) The Resource Entity or Interconnecting Entity (IE) of an IBR, Type 1 WGR or Type 2 WGR, shall ensure the Resource's frequency ride-through capability is set to the maximum level the equipment allows to meet or exceed the requirements of paragraphs (1) through (5) above as soon as practicable but no later than December 31, 2025 or at the time of its synchronization with the ERCOT Transmission Grid for new IBRs synchronizing after December 31, 2025. The Resource Entity must inform ERCOT (in a manner prescribed by ERCOT) of the date on which the IBR, Type 1 WGR or Type 2 WGR has fully maximized its ride-through capability to equipment limits. To establish ride-through capabilities to the maximum extent the equipment allows as used throughout Section 2.6.2, Frequency Ride-Through Requirements for Generation Resources and Energy Storage Resources, means making software, settings, firmware, and parameterization changes, which includes any memory upgrades to accommodate such changes that do not involve modifying other Resource equipment or components, to maximize the frequency ride-through capabilities of the Resource in accordance with Good Utility Practice.
- (7) If an IBR, Type 1 WGR or Type 2 WGR with a Standard Generation Interconnection Agreement (SGIA) executed prior to August 1, 2024 cannot comply with paragraphs (1) through (6) above by December 31, 2025, the Resource Entity or IE shall, by April 1, 2025, submit an Initial Frequency Ride-Through Capability Report ("IFRTCR") pursuant to Section 2.11.1, Initial Frequency Ride-Through Capability Documentation and Reporting Requirements, and submit an extension request or notice of intent to request an exemption pursuant to Section 2.12.1, Exemptions and Extensions Process. The Resource must comply with the frequency ride-through requirements in effect on May 1, 2024 until the Resource maximizes its frequency ride-through capability as set forth in paragraph (6) above.
- (8) If an IBR, Type 1 WGR or Type 2 WGR fails to perform in accordance with the applicable frequency ride-through requirements, the Resource Entity shall take the actions described in Section 2.13, Actions Following a Transmission-Connected Inverter-Based Resource (IBR), Type 1 Wind-powered Generation Resource (WGR) or Type 2 WGR Apparent Failure to Ride-Through.

2.6.2.1.1 Temporary Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs

- (1) This Section applies to IBRs, Type 1 WGRs and Type 2 WGRs with an SGIA executed prior to August 1, 2024 that have not implemented modifications to satisfy paragraphs (1) through (5) of Section 2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs.

- (2) Such Resources shall ride through the frequency conditions at the POIB specified in the following table:

Frequency Range	Delay to Trip
61.8 Hz or above	No time delay required
Below 61.8 Hz down to and including 61.6 Hz	Not less than 30 seconds
Below 61.6 Hz down to and including 60.6 Hz	Not less than 9 minutes
Above 59.4 Hz up to 60.6 Hz	No automatic tripping (continuous operation)
Above 58.4 Hz up to and including 59.4 Hz	Not less than 9 minutes
Above 58.0 Hz up to and including 58.4 Hz	Not less than 30 seconds
Above 57.5 Hz up to and including 58.0 Hz	Not less than 2 seconds
57.5 Hz or below	No time delay required

- (3) This Section shall not affect the Resource Entity's responsibility to protect equipment from damaging operating conditions. The Resource Entity for an IBR, Type 1 WGR or Type 2 WGR subject to paragraph (2) above that is unable to remain reliably connected to the ERCOT Transmission Grid as set forth in paragraph (2), shall provide to ERCOT the information required in Section 2.11, Ride-Through Reporting Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs.

2.6.2.2 Frequency Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs)

- (1) For any short-circuit fault or open-phase condition that occurs on the circuit to which the DGR or DESR is connected, the DGR or DESR will cease to energize and trip offline, and this will take priority over the frequency ride-through function.
- (2) DGRs and DESRs must have over-/under-frequency relays set to ride through frequency conditions as specified in the following table:

Frequency (Hz)	Ride-Through Mode	Minimum Ride-through Time (seconds)
$f > 61.8$	No ride-through requirements	
$61.2 < f \leq 61.8$	Mandatory Operation	299
$58.8 \leq f \leq 61.2$	Continuous Operation	continuous
$57.0 \leq f < 58.8$	Mandatory Operation	299
$f < 57.0$	No ride-through requirements	

- (3) Any Resource Entity with a DGR or DESR utilizing inverter-based generation that achieved Initial Synchronization before April 1, 2020 that is not capable of complying with the requirements of paragraph (2) above may request an exemption from those requirements. Such a request shall be submitted by November 2, 2020 and shall include documentation that demonstrates the DGR's or DESR's frequency ride-through capability to ERCOT's satisfaction. If, after reviewing the request and documentation, ERCOT determines the DGR or DESR is not capable of complying with the requirements of paragraph (2), then the DGR or DESR shall be exempt from those requirements, but shall be required to comply with those requirements to the greatest degree possible within its capability, as determined in writing by ERCOT. Upon replacement or retirement of the inverter, the DGR or DESR shall no longer be exempt and shall at that time be required to comply with the requirements of paragraph (2) or other applicable requirement.
- (4) Section 2.12, Procedures for Frequency and Voltage Ride-Through Exemptions and Extensions for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, does not apply to exemptions to frequency ride-through requirements for DGRs and DESRs.

2.6.3 *Frequency Ride-Through Requirements for Direct Current Ties (DC Ties)*

- (1) The following Direct Current Ties (DC Ties) are subject to the frequency ride-through requirements specified in this Section:
- (a) Any DC Tie with an initial energization date after January 1, 2021.
 - (b) Any DC Tie that is modified by increasing the physical capacity of the DC Tie by 20 MW or more or by changing the power converter associated with the DC Tie, unless the replacement is in-kind.
- (2) The owner of a DC Tie meeting the applicability requirements of paragraph (1) above shall ensure the DC Tie rides through the frequency conditions specified in the following table:

Frequency (Hz)	Minimum Ride-Through Time (seconds)
$f > 61.8$	No ride-through requirements
$61.2 < f \leq 61.8$	299
$58.8 \leq f \leq 61.2$	continuous
$57.0 \leq f < 58.8$	299
$f < 57.0$	No ride-through requirements

- (3) Nothing in paragraph (2) above shall be interpreted to require a DC Tie to trip for frequency conditions beyond those for which ride-through is required.

- (4) The owner of a DC Tie meeting the applicability requirements of paragraph (1) above shall ensure any protective over- or under-frequency relay for the DC Tie is set to enable the DC Tie to ride through any frequency condition beyond those defined in paragraph (2) above to the maximum extent possible within the DC Tie's capability.

2.7 System Voltage Profile and Operational Voltage Control

2.7.1 Introduction

- (1) The system Voltage Profile is the set of normally desired Voltage Set Points for those Generation Resources and Energy Storage Resources (ESRs) required to provide Voltage Support Service (VSS).
- (2) ERCOT coordinates and conducts studies with the Transmission Service Providers (TSPs) to determine and establish the Voltage Profile.
- (3) ERCOT and/or the Transmission Operators (TOs) adjust Voltage Set Points to maintain system voltages within established limits.

2.7.2 Maintaining Voltage Profile

- (1) ERCOT has the responsibility for monitoring and controlling the Voltage Profile and should use the following:
 - (a) Operations Engineering
 - (i) All voltage limits must be based on sound engineering studies that use the appropriate Network Operations Model. TSP study results should be made available to ERCOT; and
 - (ii) Transfer limits shall reflect voltage and/or reactive restrictions.
 - (b) Coordination
 - (i) Entities must coordinate high voltage limits in order to guarantee that the maximum continuous over-voltage of equipment is not exceeded. TOs shall notify ERCOT of normal operating voltage limits and post-contingency voltage limits for each bus;
 - (ii) Low voltage limits must be coordinated in order to prevent one Entity from being a burden to another;
 - (iii) Voltage limits shall not be violated during all normal and Credible Single Contingency conditions; and

- (iv) The operation of all Reactive Power devices under the control of a TO or a Qualified Scheduling Entity (QSE) will be coordinated under the direction of ERCOT to maintain transmission voltage levels within normal limits and post-contingency voltages within post contingency limits. Static reactive devices will be managed to ensure that adequate dynamic reactive reserves are maintained at all times.

[NOGRR234: Replace item (iv) above with the following upon system implementation of NPRR1098:]

- (iv) The operation of all Reactive Power devices under the control of a TO, Direct Current Tie Operator (DCTO), or a Qualified Scheduling Entity (QSE) will be coordinated under the direction of ERCOT to maintain transmission voltage levels within normal limits and post-contingency voltages within post contingency limits. Static reactive devices will be managed to ensure that adequate dynamic reactive reserves are maintained at all times.

(c) Notification

- (i) Generation Resources or ESRs with voltage problems shall notify the TO to whom they are directly connected. TOs shall notify other affected TOs and ERCOT; and
- (ii) ERCOT will monitor events and may direct actions to solve the problem.

(d) Response

- (i) When the voltage levels deviate from established limits, ERCOT or the TO shall take immediate steps to relieve the condition using all available reactive resources.

(e) Monitoring

- (i) TOs shall provide telemetry to ERCOT on all major transmission bus voltages.

(f) Controls

- (i) ERCOT must be aware of the location of and availability of reactive capability;
- (ii) ERCOT shall maintain displays to monitor Voltage Profiles and reactive flows; and
- (iii) Controls to maintain Voltage Profiles may include but are not limited to capacitor switching, reactor switching, auto-transformer tap changing,

Generation Resource and ESR reactive dispatch, transmission line switching, and Load shedding.

[NOGRR234: Replace item (f) above upon system implementation of NPRR1098:]

(f) Controls

- (i) ERCOT must be aware of the location of and availability of reactive capability;
- (ii) ERCOT shall maintain displays to monitor Voltage Profiles and reactive flows; and
- (iii) Controls to maintain Voltage Profiles may include but are not limited to capacitor switching; reactor switching; auto-transformer tap changing; Generation Resource, ESR, and Direct Current Tie (DC Tie) reactive dispatch; transmission line switching; and Load shedding.

(g) Documentation

- (i) Each TO must maintain a voltage/reactive plan for normal and Emergency Conditions and will provide this plan to adjacent TOs as well as ERCOT upon request.

(h) Emergency or Abnormal Conditions

- (i) Transmission systems shall be designed so that effective reactive reserves shall be available without de-energizing other Facilities or shedding Load under normal conditions;
- (ii) Major transmission lines shall be kept in service during light Load as much as possible. Lines should only be removed after all applicable reactive controls are implemented and studies show that reliability will not be degraded; and
- (iii) Voltage reduction should not be done on the transmission system unless coordinated with adjacent TOs.

2.7.3 Real-Time Operational Voltage Control

2.7.3.1 Operational Guidelines

- (1) The following guidelines describe ideal system operational characteristics and do not establish requirements for any particular Entity:
 - (a) General operational voltage limits are:

Nominal Voltage	Normal Operating Limits	Emergency Operating Limits
345	327.75 – 362.25	310.5 – 379.5
230	218.5 – 241.5	207 – 253
138	131.1 – 144.9	124.2 – 151.8
115	109.25 – 120.75	103.5 – 126.5
69	65.55 – 72.45	62.1 – 75.9

- (b) Except for Transmission Facilities that are designed to operate outside of normal operating limits, transmission voltage should not exceed 105% nor fall below 95% of the nominal voltage during normal operation of the system.
- (c) Transmission voltage during emergencies (including contingency events) should not exceed equipment over-excitation ratings.
- (d) Transmission voltage during emergencies (including contingency events) should not result in customer voltage exceeding or falling below prescribed limits at distribution substations on the transmission system.
- (e) Transmission voltage post contingency should not exceed 110% nor fall below 90% of the per-unit voltage, unless more restrictive limits have been specified by the TSP for their system, then those limits shall not be exceeded.
- (f) Transmission voltage post contingency should not fall below any Under-Voltage Load Shedding (UVLS) set point during normal operations.
- (g) The accuracy of any transmission voltage that appears to exceed normal or emergency limits should be verified prior to taking further actions.
- (h) Major transmission lines should be kept in service during light Load as much as possible. Lines should only be removed after all applicable reactive controls are implemented and the practicality of additional generation Dispatch has been considered. Time permitting, studies should be conducted to verify that reliability will not be degraded by removing any major transmission line from service.
- (i) Generally speaking, static reactive devices should be brought On-Line before predicted daily maximum Load or before dynamic reactive Resources reach operating limits. Static reactive devices will be taken Off-Line during daily Load decline and before dynamic reactive Resources reach operating limits.

2.7.3.2 ERCOT Responsibilities

- (1) ERCOT shall be responsible for ordering necessary Generation Resources or ESRs On-Line to regulate transmission voltage and reactive flow.
- (2) When voltage levels deviate from normal operating limits in the pre-contingency (base case) condition or from emergency operating limits in the post-contingency condition,

ERCOT shall take immediate steps to restore voltage levels within the applicable operating limits using all available reactive resources. ERCOT may allow additional time for a TO to correct the voltage levels to within limits on sub-100kV facilities prior to ERCOT taking further steps to restore voltage levels. The steps ERCOT may take include, but are not limited to:

- (a) Evaluating TO actions taken to correct voltage levels;
 - (b) Directing additional Generation Resources or ESRs On-Line;
 - (c) Re-dispatching Generation Resources or ESRs;
 - (d) Deploying additional Resources;
 - (e) Directing static Reactive Power resources to be put in service;
 - (f) Utilizing temporary changes to limits of Resources or Transmission Facilities;
 - (g) Developing a Constraint Management Plan (CMP);
 - (h) Adjusting a Voltage Set Point; and
 - (i) Shedding firm Load.
- (3) ERCOT shall issue a VSS Dispatch Instruction to the designated QSE for adjustments that would require a Generation Resource or ESR to operate outside its Unit Reactive Limit (URL).
 - (4) For multi-generator buses, ERCOT may not instruct any single Generation Resource or ESR to operate beyond its Corrected Unit Reactive Limit (CURL) or URL until all Generation Resources and/or ESRs On-Line and interconnected at the same transmission bus are operating at their respective CURLs or URLs.
 - (5) ERCOT shall coordinate Automatic Voltage Regulator (AVR), dynamic and static reactive device Outages to ensure adequate reactive reserves are maintained.
 - (6) ERCOT shall maintain a performance log of QSE acknowledgements of VSS Dispatch Instructions.
 - (7) ERCOT shall be aware of the location of and availability of reactive power resources, including AVRs and Power System Stabilizers (PSSs), and shall monitor their statuses.
 - (8) ERCOT shall maintain displays to monitor Voltage Profiles and reactive flows.
 - (9) ERCOT shall, for each Generation Resource and ESR providing VSS, telemeter the Real-Time desired Voltage Set Point and the TSP-designated Point of Interconnection Bus (POIB) kV measurement via Inter-Control Center Communications Protocol (ICCP) to the QSE representing that Generation Resource or ESR.

- (10) ERCOT shall instruct the TO to make Voltage Set Point adjustments, as necessary, within the Generation Resource's or ESR's URL provided to ERCOT.

2.7.3.3 TO/TSP Responsibilities

- (1) Each TO shall be responsible for directing Voltage Set Points for each Generation Resource and ESR required to provide VSS interconnected to its TSP's Facilities. Each TO will adjust the Voltage Set Point by communicating directly with the Resource Entity or QSE responsible for the operation of the Generation Resource or ESR. Normal communication is to request voltage or Reactive Power be raised or lowered at a specified bus by a stated number of kV or MVar (e.g., +1 kV, +20 MVar, or -1 kV, -20 MVar).
- (2) Each TO shall monitor system voltages and shall operate voltage control equipment, including, but not limited to, static Reactive Power resources such as capacitors, reactors and transformer tap changers to maintain system voltages within limits.
- (3) Each TO shall operate static Reactive Power resources within its operating area as required by its criteria while maintaining dynamic reactive reserves, both leading and lagging, provided by Generation Resources and ESRs. Except as reasonably necessary to ensure reliability or operational efficiency, TOs should utilize available static reactive devices prior to requesting a Voltage Set Point change from a Generation Resource.
- (4) Each TO shall telemeter to ERCOT via ICCP the Real-Time desired Voltage Set Point and actual voltage at the POIB for each Generation Resource or ESR interconnected to its system required to provide VSS. Each TO shall modify the telemetered Voltage Set Point as soon as practicable in order to match any verbal Voltage Set Point instruction issued.
- (5) Each TO shall know the status of static transmission Reactive Power resources in its operating area and shall provide such information to ERCOT.
- (6) When voltage levels deviate from established limits, the affected TO shall take immediate steps to relieve the condition using available reactive resources under its control.
- (7) Each TSP shall, as soon as practicable, notify ERCOT of any temporary transmission voltage limit changes and shall coordinate with ERCOT to update the Network Operations Model with any permanent or long-term changes to voltage limits that deviate from those identified in Section 2.7.3.1, Operational Guidelines.

[NOGRR177 and NOGRR234: Replace applicable portions of Section 2.7.3.3 above with the following upon system implementation of NPRR857 or NPRR1098, respectively:]

2.7.3.3 TO/TSP Responsibilities

- (1) Each TO shall be responsible for directing Voltage Set Points for each Generation Resource and ESR required to provide VSS interconnected to its TSP's Facilities. Each TO will adjust the Voltage Set Point by communicating directly with the Resource Entity or QSE responsible for the operation of the Generation Resource or ESR. Normal communication is to request voltage or Reactive Power be raised or lowered at a specified bus by a stated number of kV or MVar (e.g., +1 kV, +20 MVar, or -1 kV, -20 MVar).
- (2) Each TO shall monitor system voltages and shall operate voltage control equipment, including, but not limited to, static Reactive Power resources such as capacitors, reactors and transformer tap changers to maintain system voltages within limits.
- (3) Each TO shall operate static Reactive Power resources within its operating area as required by its criteria while maintaining dynamic reactive reserves, both leading and lagging provided by Generation Resources and ESRs. Except as reasonably necessary to ensure reliability or operational efficiency, TOs should utilize available static reactive devices prior to requesting a Voltage Set Point change from a Generation Resource or ESR.
- (4) Each TO shall telemeter to ERCOT via ICCP the Real-Time desired Voltage Set Point and actual voltage at the POIB for each Generation Resource and ESR interconnected to its system required to provide VSS. Each TO shall modify the telemetered Voltage Set Point as soon as practicable in order to match any verbal Voltage Set Point instruction issued.
- (5) Each TO shall know the status of static transmission Reactive Power resources in its operating area and shall provide such information to ERCOT.
- (6) When voltage levels deviate from established limits, the affected TO shall take immediate steps to relieve the condition using available reactive resources under its control.
- (7) Each TSP shall, as soon as practicable, notify ERCOT of any temporary transmission voltage limit changes and shall coordinate with ERCOT to update the Network Operations Model with any permanent or long-term changes to voltage limits that deviate from those identified in Section 2.7.3.1, Operational Guidelines.
- (8) Each TO designated by a DCTO operating a DC Tie meeting the applicability requirements of paragraph (1) of Protocol Section 3.15.4, Direct Current Tie Owner and Direct Current Tie Operator (DCTO) Responsibilities Related to Voltage Support, shall be responsible for directing the operation of reactive power resources operated by that DCTO. Each TO shall telemeter to ERCOT via ICCP and to the DCTO via telemetry, the Real-Time desired target voltage at the DC Tie's Point of Interconnection Bus

(POIB) and the actual voltage at the POIB. Each TO shall modify the telemetered target voltage to match any verbal target voltage instruction issued as soon as practicable.

- (9) Each TO designated by a DCTO operating a DC Tie meeting the applicability requirements of paragraph (1) of Protocol Section 3.15.4 shall for each such DC Tie provide to ERCOT, via ICCP, the status of the DC Tie Facility's voltage control system. An "On" status will indicate that the control system is on and set to regulate the voltage at the DC Tie's POIB in automatic voltage control mode, and an "Off" status will indicate that the control system is off or in manual mode.
- (10) Each TO designated by a DCTO operating a DC Tie meeting the applicability requirements of paragraph (1) of Protocol Section 3.15.4 shall, as soon as practicable, notify ERCOT when a DC Tie Facility experiences a change that affects its reactive capability, including any change to the operation mode of the DC Tie Facility's voltage control system or any temporary transmission voltage limit changes.

2.7.3.4 QSE Responsibilities

- (1) Each QSE shall ensure that any Generation Resource or ESR that it represents and that is required to provide VSS responds to any VSS Dispatch Instruction including VSS Dispatch Instruction to exceed its CURL or URL or TO Voltage Set Point instruction within the time requirements specified in paragraph (3)(b) of Section 2.2.10, Generation Resource and Energy Storage Resource Response Time Requirements, even if the new Voltage Set Point is within the tolerance band identified in paragraph (4) of Section 2.7.3.5, Resource Entity Responsibilities and Generation Resource and Energy Storage Resource Requirements. If the Resource Entity notifies the QSE that a Generation Resource or an ESR cannot comply with the VSS Dispatch Instruction or TO Voltage Set Point instruction, either the Resource Entity or its QSE shall, as soon as practicable, notify the Entity that issued the instruction. The Resource Entity or its QSE shall provide the reason for not being able to comply and an estimated time for resolution, when known.
- (2) Each QSE representing a Generation Resource or ESR shall provide in Real-Time the desired Voltage Set Point and the associated POIB kV measurement to the Generation Resource or ESR.
- (3) Each QSE will continuously monitor the status of its Resources' AVRs and PSSs.
- (4) Each QSE must, as soon as practicable, notify ERCOT, via telemetry and verbal notifications, when a Generation Resource or ESR experiences a change that affects its reactive capability, including any change to the operation mode of the Generation Resource's or ESR's AVR. For each Generation Resource that is On-Line but not producing real power and is not capable of providing Reactive Power, each QSE must still telemeter its AVR status to ERCOT, but is not required to provide verbal notifications of its AVR status changes to ERCOT during these operating conditions.

2.7.3.5 Resource Entity Responsibilities and Generation Resource and Energy Storage Resource Requirements

- (1) Each Resource Entity shall ensure that its Generation Resource(s) and ESR(s) responds to all VSS Dispatch Instruction or a TO Voltage Set Point instruction from its QSE or interconnecting TO within the time requirements specified in paragraph (3)(b) of Section 2.2.10, Generation Resource and Energy Storage Resource Response Time Requirements, even if the new Voltage Set Point is within the tolerance band identified in paragraph (4) below.
- (2) Generation Resources or ESRs with high reactive loading resulting from abnormal conditions shall not reduce their reactive loading without the consent of ERCOT unless equipment damage is imminent based on the sole and reasonable judgment of the Resource Entity. In that case the Resource Entity will notify its QSE and its TO as soon as practicable of its action.
- (3) Each Resource Entity shall monitor Real-Time provided Voltage Set Point instructions it receives. The Resource Entity shall inform its QSE and either the Resource Entity or its QSE shall notify the Resource Entity's TO, as soon as practicable, but not longer than 15 minutes from receipt of the instruction by the Resource Entity, if it cannot comply with TO Voltage Set Point instructions, or not longer than 30 minutes from being outside of the tolerance band if it cannot maintain the POIB voltage within the tolerance band identified in paragraph (4) below. If a Resource Entity cannot comply with a VSS Dispatch Instruction, the Resource Entity shall inform its QSE and its QSE shall notify ERCOT as soon as practicable but not longer than 15 minutes from the receipt of the instruction by the Resource Entity.
- (4) A Resource Entity required to provide VSS shall maintain the Resource's voltage or Reactive Power schedule to maintain voltage at the POIB to be within a tolerance band of the Voltage Set Point while operating at less than or equal to the maximum reactive capability of the Generation Resource or ESR. A Generation Resource's or ESR's POIB voltage may be out of the tolerance band if it has exhausted all of its reactive capability. The tolerance bands are as follows:

Nominal Voltage	Tolerance Band kV
345	+/- 4kV
230	+/- 3kV
138	+/- 2kV
115	+/- 2kV
69	+/- 1kV

- (5) Required reactive capability must be maintained at all times that the Generation Resource or ESR is On-Line. When a Generation Resource or ESR experiences a change that affects its reactive capability, the associated Resource Entity shall notify its QSE and TO, as soon as practicable but not longer than 30 minutes from becoming aware of the change in reactive capability.

- (6) Each Resource Entity shall communicate any Resource Entity-owned transmission voltage limits that deviate from those identified in Section 2.7.3.1, Operational Guidelines, to ERCOT and to its QSE.

[NOGRR234: Insert Section 2.7.3.6 below upon system implementation of NPRR1098:]

2.7.3.6 DCTO Responsibilities and DC Tie Requirements

- (1) Each DCTO operating a DC Tie subject to Protocol Section 3.15.4, Direct Current Tie Owner and Direct Current Tie Operator Responsibilities Related to Voltage Support, shall comply with any instruction from its designated TO with respect to the DC Tie's Reactive Power capability, including any instruction to maintain a specific voltage at the POIB, subject to the DC Tie's operating characteristic limits and voltage limits, and within the tolerances identified in paragraph (2) below, and subject to any superseding Dispatch Instruction from ERCOT.
- (2) A DCTO operating a DC Tie subject to Protocol Section 3.15.4 shall maintain the voltage at the POIB within the tolerance band below while operating at less than or equal to the maximum reactive capability of the DC Tie. A DC Tie's POIB voltage may be out of the tolerance band if all of its reactive capability has been exhausted. The tolerance bands are as follows:

Nominal Voltage	Tolerance Band kV
345	+/- 4kV
230	+/- 3kV
138	+/- 2kV
115	+/- 2kV
69	+/- 1kV

- (3) Required reactive capability must be maintained at all times that the DC Tie is not experiencing an Outage. When a DC Tie experiences a change that affects its reactive capability, the associated DCTO shall notify its TO as soon as practicable, but not longer than 30 minutes, from becoming aware of the change in reactive capability.
- (4) Each DCTO shall, as soon as practicable, notify its TO of any temporary transmission voltage limit changes. The DC Tie owner shall coordinate with its DCTO on necessary changes to the Network Operations Model. The DCTO will coordinate with ERCOT to update the Network Operations Model with any permanent or long-term changes to voltage limits that deviate from those identified in Section 2.7.3.1, Operational Guidelines.
- (5) Each DCTO shall provide to its TO, via telemetry, the status of the voltage control system for any DC Tie meeting the applicability requirements of paragraph (1) of Protocol Section 3.15.4. An "On" status will indicate that the control system is on and

set to regulate the voltage at the DC Tie's POIB in automatic voltage control mode, and an "Off" status will indicate that the control system is off or in manual mode.

2.7.4 *Special Consideration for Nuclear Power Plants*

- (1) In all planning studies and Real-Time operations, ERCOT and TOs shall maintain the switchyard voltage at each nuclear power plant at a value that does not violate its licensing basis with the Nuclear Regulatory Commission (NRC). ERCOT shall notify the QSE representing a nuclear power plant of the result of any studies where the voltage at the plant switchyard cannot be adequately maintained. ERCOT and the TO shall monitor the voltage in Real-Time. ERCOT shall provide notice to the QSE representing the nuclear power plant of any voltage inadequacy at the plant switchyard that cannot be corrected within 30 minutes. High and low limits on switchyard voltage at each nuclear power plant necessary to meet these requirements shall be specified in ERCOT Procedures.

2.7.5 *Parameters for Standard Reactor and Capacitor Switching Plan*

- (1) TOs shall provide switching plans for automatically controlled reactors, capacitors, and other reactive controlled sources to ERCOT. For manually switched reactive devices, the TO shall provide its guidelines for the operation of these devices. These plans and guidelines shall be posted on the Market Information System (MIS) Secure Area and must be provided in accordance with the NOMCR or other ERCOT prescribed process. The parameters to be provided in the standard reactor and capacitor switching plan as required by Protocol Section 3.10.7.1.5, Reactors, Capacitors, and other Reactive Controlled Sources, are as follows:

Device Attributes

- (a) Transmission Element name per Protocol Section 3.10.7.1, Modeling of Transmission Elements and Parameters;
- (b) Substation name; and
- (c) Schedules of device:
 - (i) Time-based;
 - (ii) Voltage-based;
 - (iii) Load-based;
 - (iv) Contingency-based;
 - (v) Normal Operation;

- (vi) Emergency Operation;
- (vii) Seasonal; and
- (viii) Others as required by technology.

2.7.6 Unit Dispatch Beyond the Corrected Unit Reactive Limit or Unit Reactive Limit

- (1) Each Generation Resource shall respond to ERCOT instructed voltage control, including exceeding its CURL or URL. For multi-generator buses, ERCOT shall not instruct any single Generation Resource to operate beyond its CURL or URL until all Generation Resources On-Line and interconnected at the same transmission bus, have been instructed to their respective CURLs or URLs.

[NOGRR268: Replace paragraph (1) above with the following upon system implementation of NPRR1246:]

- (1) Each Generation Resource and Energy Storage Resource (ESR) shall respond to ERCOT-instructed voltage control, including exceeding its CURL or URL. For multi-generator buses, ERCOT shall not instruct any single Generation Resource or ESR to operate beyond its CURL or URL until all Generation Resources and ESRs On-Line and interconnected at the same transmission bus, have been instructed to their respective CURLs or URLs.

2.8 Operation of Direct Current Ties

- (1) ERCOT will confirm interconnected non-ERCOT balancing authority schedule profiles with the Direct Current Tie (DC Tie) operator, who will control the tie to the schedules agreed to by both the designated security coordinator for the interconnected non-ERCOT balancing authority and ERCOT.
- (2) Any changes in the DC Tie schedules due to a de-rating of the DC Tie or transmission/generation capabilities in the non-ERCOT balancing authority will be communicated to ERCOT by the DC Tie Operator or designated security coordinator for the interconnected non-ERCOT balancing authority.
- (3) ERCOT will coordinate operation of the DC Tie(s) with the DC Tie operator such that the Inadvertent Energy Account as defined in Protocol Section 6.5.4, Inadvertent Energy Account, is maintained as close to zero as practicable.

[NOGRR177: Replace Section 2.8 above with the following upon system implementation of NPRR857:]

2.8 Operation of Direct Current Ties

- (1) ERCOT will confirm interconnected non-ERCOT balancing authority schedule profiles with the Direct Current Tie Operator (DCTO), who will control the tie to the schedules agreed to by both the designated security coordinator for the interconnected non-ERCOT balancing authority and ERCOT.
- (2) Any changes in the DC Tie schedules due to a de-rating of the DC Tie or transmission/generation capabilities in the non-ERCOT balancing authority will be communicated to ERCOT by the DCTO or designated security coordinator for the interconnected non-ERCOT balancing authority.
- (3) ERCOT will coordinate operation of the Direct Current Tie(s) (DC Tie(s)) with the DCTO such that the Inadvertent Energy Account as defined in Protocol Section 6.5.4, Inadvertent Energy Account, is maintained as close to zero as practicable.

2.8.1 Inadvertent Energy Management

- (1) The only inadvertent energy will be between ERCOT and the Southwest Power Pool (SPP) and/or Comision Federal de Electricidad (CFE). ERCOT shall track any differences between the net of scheduled energy across each DC Tie and the actual metered value at that DC Tie in an Inadvertent Energy Account between ERCOT and each interconnected non-ERCOT balancing authority as per Protocol Section 6.5.4, Inadvertent Energy Account. All inadvertent energy is placed in an inadvertent payback account to be paid back in kind.

[NOGRR177: Replace Section 2.8.1 above with the following upon system implementation of NPRR857:]

2.8.1 Inadvertent Energy Management

- (1) The only inadvertent energy will be between ERCOT and non-ERCOT Control Areas. ERCOT shall track any differences between the net of scheduled energy across each DC Tie and the actual metered value at that DC Tie in an Inadvertent Energy Account between ERCOT and each interconnected non-ERCOT balancing authority as per Protocol Section 6.5.4, Inadvertent Energy Account. All inadvertent energy is placed in an inadvertent payback account to be paid back in kind.

2.9 Voltage Ride-Through Requirements for Generation Resources and Energy Storage Resources

- (1) Except for Generation Resources and Energy Storage Resources (ESRs) subject to Sections 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected

Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs and Type 3 WGRs, or 2.9.2, Voltage Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs), each Generation Resource or ESR must remain reliably connected to the ERCOT Transmission Grid during the following:

- (a) Generator or inverter terminal voltages are within 5% of the rated design voltage and volts per hertz are less than 105% of generator rated design voltage and frequency;
 - (b) Generator or inverter terminal voltage deviations exceed 5% but are within 10% of the rated design voltage and persist for less than ten seconds;
 - (c) Generator or inverter volts per hertz conditions are less than 116% of rated design voltage and frequency and last for less than 1.5 seconds; and
 - (d) A transmission system fault (three-phase, single-phase or phase-to-phase), but not a unit bus fault, is cleared by the protection scheme coordinated between the Resource Entity and the Transmission Service Provider (TSP) on any line connected to the Resource's Point of Interconnection (POI), provided such lines are not connected to induction generators described in paragraph (12) of Protocol Section 3.15, Voltage Support.
- (2) In the case of a unit bus fault or a primary transmission system relay failure, the unit protective relaying may clear the unit independent of the operation of any transmission protective relaying.
 - (3) During operating conditions listed in paragraph (1) above, each Generation Resource and ESR subject to paragraph (1) shall not, during and following a transient voltage disturbance, cease providing real or reactive current except to the extent needed to provide frequency support or aid in voltage recovery. Each ESR, if consuming active power from the ERCOT System when operating in the charging mode, shall reduce or cease power consumption as necessary to aid in voltage recovery during and following transient voltage disturbances.
 - (4) Synchronous Generation Resources required to provide Voltage Support Service (VSS) shall have and maintain the following capability:
 - (a) Over-excitation limiters shall be provided and coordinated with the thermal capability of the generator field winding and protective relays in order to permit short-term reactive capability that allows at least 80% of the unit design standard (ANSI C50.13-1989), as follows:

Time (seconds)	10	30	60	120
Field Voltage %	208	146	125	112

After allowing temporary field current overload, the limiter shall operate through the automatic AC voltage regulator to reduce field current to the continuous

rating. Return to normal AC voltage regulation after current reduction shall be automatic. The over-excitation limiter shall be coordinated with the over-excitation protection so over-excitation protection operates only for failure of the voltage regulator/limiter.

- (b) Under-excitation limiters shall be provided and coordinated with loss-of-field protection to eliminate unnecessary generating unit disconnection as a result of operator error or equipment malfunction.
- (5) Generation Resources and ESRs shall have protective relaying necessary to protect equipment from abnormal conditions and be consistent with protective relaying criteria described in Section 6.2.6.3.4, Generator and Energy Storage Resource Protection and Relay Requirements.
- (6) The voltage ride-through requirements, including Section 2.9.1, do not apply to faults at or behind the POI, when clearing the fault effectively disconnects the Generation Resource from the ERCOT System.
- (7) A Generation Resource or ESR may be tripped Off-Line or curtailed after the fault clearing period if part of an approved Remedial Action Scheme (RAS).
- (8) The Resource Entity of each Generation Resource or ESR shall provide to ERCOT technical documentation of voltage ride-through capability upon request.

2.9.1 *Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs and Type 3 WGRs*

- (1) All Inverter-Based Resources (IBRs) and Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs interconnected to the ERCOT Transmission Grid shall comply with voltage ride-through requirements as follows:
 - (a) Section 2.9.1.1, Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), shall apply to:
 - (i) An IBR with a Standard Generation Interconnection Agreement (SGIA) executed on or after August 1, 2024; and
 - (ii) An IBR that implements any modification, as described in paragraph (1)(c) of Planning Guide Section 5.2.1, Applicability, for which upgrades or facilities under a Generator Interconnection or Modification (GIM) was initiated on or after August 1, 2024, unless the modification was fully implemented prior to January 1, 2028.
 - (b) Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, shall apply to IBRs not subject to Section 2.9.1.1, and Type 1 WGRs and Type 2 WGRs.

- (2) An IBR with an SGIA executed on or after August 1, 2024 or that implements a modification, as described in paragraph (1)(c) of Planning Guide Section 5.2.1 for which a GIM was initiated on or after August 1, 2024, shall meet or exceed the capability and performance requirements in the following sections of Institute of Electrical and Electronics Engineers (IEEE) 2800-2022, Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems (“IEEE 2800-2022 standard”), including any intra-standard cross references or definitions, unless otherwise clarified, modified, or exempted in the Protocols, these Operating Guides, or the Planning Guide:
 - (a) Section 5, Reactive power-voltage control requirements within the continuous operation region;
 - (b) Section 7, Response to TS abnormal conditions; and
 - (c) Section 9, Protection.
- (3) All IBR plant requirements and IBR unit requirements described in the IEEE 2800-2022 standard apply at the Point of Interconnection Bus (POIB) and the individual IBR unit terminal, as appropriate, unless otherwise clarified, modified, or exempted in the Protocols, these Operating Guides, or the Planning Guide.
- (4) An IBR, Type 1 WGR or Type 2 WGR with an original SGIA executed before August 1, 2024, that implements modifications complying with Section 2.9.1.2 prior to January 1, 2028, is not required to meet or exceed the capability and performance requirements in sections 5, 7 and 9 of the IEEE 2800-2022 standard. Any IBR modifications implemented on or after January 1, 2028 do not qualify for this exception.
- (5) If a Type 3 WGR with an original SGIA executed before August 1, 2024, cannot fully meet the requirements in Table 11 of the IEEE 2800-2022 standard and implements a modification as described in paragraph (1)(c) of Planning Guide Section 5.2.1, for which upgrades to equipment or facilities under a GIM are completed prior to January 1, 2028, the Resource Entity may submit a notice of intent to request an exemption from meeting the voltage ride-through requirements in Table 11 of the IEEE 2800-2022 standard pursuant to Section 2.12, Procedures for Frequency and Voltage Ride-Through Exemptions and Extensions for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs.
- (6) If an IBR with an SGIA executed on or after August 1, 2024, cannot meet or exceed the capability and performance requirements in sections 5, 7 and 9 of the IEEE 2800-2022 standard by its synchronization date, the Resource Entity or Interconnecting Entity (IE) may request a temporary extension to meet those requirements by submitting an extension request pursuant to Section 2.12. Any temporary extensions shall be minimized and not extend beyond December 31, 2028 or 24 months after the Commercial Operations Date, whichever is earlier.
- (7) Type 1 and Type 2 WGRs are not required to meet or exceed the capability and performance requirements in sections 5, 7 and 9 of the IEEE 2800-2022 standard but

must meet or exceed the capability and performance requirements in Section 2.9.1.2 unless an extension or exemption applies under this Section or Section 2.12.

- (8) The Resource Entity or IE for each IBR shall maximize the performance of its protection systems, controls, and other plant equipment (within equipment limitations) to meet and, if possible, exceed the capability and performance set forth in sections 5, 7 and 9 of the IEEE 2800-2022 standard. If an IBR with an SGIA executed prior to August 1, 2024 cannot fully meet the requirements of sections 5, 7, and 9 of the IEEE 2800-2022 standard, the Resource Entity shall maximize the performance of its protection systems, controls, and other plant equipment (within equipment limitations) to achieve, as close as reasonably possible, the capability and performance set forth in sections 5, 7 and 9 of the IEEE 2800-2022 standard as soon as practicable but no later than December 31, 2025 or by its Commercial Operations Date, whichever is later. The Resource Entity must inform ERCOT (in a manner prescribed by ERCOT) of the date on which the IBR, Type 1 WGR, Type 2 WGR or Type 3 WGR has fully maximized its capability with respect to the specified IEEE 2800-2022 requirements. To establish capabilities to the maximum extent the equipment allows as used throughout this Section means the Resource Entity must make software, settings, firmware, and parameterization changes, which includes any memory upgrades to accommodate such changes that do not involve modifying other Resource equipment or components, to maximize capabilities of the Resource with respect to the specified IEEE 2800-2022 requirements in accordance with Good Utility Practice.
- (9) The addition of co-located Load as a modification, as described in paragraph (1)(c) of Planning Guide Section 5.2.1, for which a GIM was initiated, shall not trigger a change in ride-through requirements so long as the IBR, Type 1 WGR or Type 2 WGR has an original SGIA executed prior to August 1, 2024 unless the converters, inverters, supplemental dynamic reactive devices, or any other equipment that alters frequency or voltage ride-through capability are materially modified or replaced to meet any reliability requirements because of the co-located Load, in which case the Resource Entity shall continue to be subject to Section 2.9.1.2.

2.9.1.1 Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs)

- (1) All IBRs subject to this Section shall ride through the root-mean-square voltage conditions in Table A: Applicable to WGR IBRs, or Table B: Applicable to PhotoVoltaic Generation Resources (PVGRs) and ESR IBRs, below, as applicable, as measured at the IBR's POIB:

Table A: Applicable to WGR IBRs

Root-Mean-Square Voltage (p.u. of nominal)	Minimum Ride-Through Time (seconds)
$V > 1.20$	May ride-through or trip
$1.10 < V \leq 1.20$	1.0

$0.90 \leq V \leq 1.10$	continuous
$0.70 \leq V < 0.90$	3.0
$0.50 \leq V < 0.70$	2.5
$0.25 \leq V < 0.50$	1.2
$0.005625 \leq V < 0.25$	$(V+0.084375)/0.5625$
$V < 0.005625$	0.16

Table B: Applicable to PhotoVoltaic Generation Resources (PVGRs) and ESR IBRs

Root-Mean-Square Voltage (p.u. of nominal)	Minimum Ride-Through Time (seconds)
$V > 1.20$	May ride-through or trip
$1.10 < V \leq 1.20$	1.0
$0.90 \leq V \leq 1.10$	continuous
$0.70 \leq V < 0.90$	6.0
$0.50 \leq V < 0.70$	3.0
$0.25 \leq V < 0.50$	1.2
$0.095625 \leq V < 0.25$	$(V+0.084375)/0.5625$
$V < 0.095625$	0.32

The minimum ride-through time in Tables A and B for voltage below the continuous operating range is inclusive of any amount of time the POIB voltage is below the specified voltage range. In the event of multiple excursions, the minimum ride-through time in Tables A or B is a cumulative time over a ten-second time window. For voltage between 0.005625 p.u. and 0.25 p.u. in Table A above and 0.095625 p.u. and 0.25 p.u. in Table B above, the minimum ride-through time is defined by a straight-line mathematical function where the duration is 0.15 seconds at zero voltage and 1.75 seconds at 0.9 p.u. voltage.

- (2) Nothing in paragraph (1) above shall be interpreted to require an IBR to trip for voltage conditions beyond those for which ride-through is required.
- (3) If protection systems (including, but not limited to protection for over-/under-voltage, rate-of-change-of-frequency, anti-islanding, and phase angle jump) are installed and activated to trip the IBR, they shall enable the IBR to ride through voltage conditions beyond those defined in paragraph (1) above to the maximum level the equipment allows.
- (4) An IBR shall inject electric current when required to ride-through voltage conditions. Except when caused by reductions associated with intermittent primary energy source availability (e.g., wind speed or solar irradiance), an IBR shall not reduce active current injection during voltage conditions requiring ride-through unless allowed in this paragraph or to provide appropriate frequency response. When the POIB voltage is outside the continuous operating voltage range, an IBR shall continue to deliver pre-disturbance active current unless reduction is needed to allow for voltage support or otherwise specified by ERCOT or the interconnecting TSP. Any necessary reductions in active current to prioritize reactive current shall be relative to the voltage change at the

POIB. Typically, more aggressive reductions in active current to allow for additional reactive current (if needed to stay within its current limitations) will occur at lower voltages (e.g., 0.4 p.u. or lower) but settings should be made based on the local needs of the ERCOT System where the IBR interconnects and ensures sufficient active current is available for protection system sensing. An IBR shall return to its pre-disturbance level of real power injection as soon as possible but no more than one second after POIB voltage recovers to normal operating range. ERCOT, in its reasonable discretion, may allow slower real power injection recovery rates if necessary for reliability as determined by the impacted TSP or ERCOT.

- (5) IBR plant controls, turbine controls and/or inverter controls shall not disconnect the plant, or any individual inverter/turbine, or prevent current exchange between the IBR and the ERCOT Transmission Grid during voltage conditions where ride-through is required.
- (6) If instantaneous over-current or over-voltage protection systems are installed and activated to trip the IBR, they shall use filtered quantities or time delays to prevent misoperation while providing the desired equipment protection. Any alternating current instantaneous over-voltage protection that could disrupt IBR power output shall use a measurement window of at least one cycle of fundamental frequency.
- (7) An IBR shall not use phase angle jump or rate-of-change-of-frequency measurement quantities as a basis for reducing power output or tripping offline during fault conditions and subsequent recovery to a steady-state operating point within the ride-through profiles specified in paragraph (1) above.
- (8) The Resource Entity or IE for each IBR shall maximize the performance of its protection systems, controls, and other plant equipment (within equipment limitations) to meet and, if possible, exceed the requirements of paragraphs (1) through (7) above by December 31, 2025. A Resource Entity or IE may request an extension for upgrades or retrofits to confirm capability specified in paragraph (7) above by following the extension process set forth in Section 2.12, Procedures for Frequency and Voltage Ride-Through Exemptions and Extensions for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs. Any temporary extensions under this paragraph shall be minimized and not extend beyond December 31, 2028.
- (9) A Resource Entity of a Type 3 WGR may seek an extension for completing modifications to meet the voltage ride-through performance Table A in paragraph (1) above by following the extension process set forth in Section 2.12. During any extension, the Resource Entity shall ensure the WGR's voltage ride-through capability is set to the maximum level the equipment allows as soon as practicable.
- (10) Any temporary extensions for IBRs with SGAs on or after August 1, 2024 shall be minimized and not extend beyond December 31, 2028. Temporary extensions for performance that do not meet the voltage ride-through performance in Table A in paragraph (1) of Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, are not allowed.

- (11) If an IBR fails to perform in accordance with the applicable voltage ride-through requirements, the Resource Entity for the IBR shall take the actions described in Section 2.13, Actions Following a Transmission-Connected Inverter-Based Resource (IBR), Type 1 Wind-powered Generation Resource (WGR) or Type 2 WGR Apparent Failure to Ride-Through.

2.9.1.2 Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs

- (1) All IBRs, Type 1 WGRs and Type 2 WGRs subject to this Section in accordance with paragraph (1) of Section 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs, and Type 3 WGRs, shall ride through the root-mean-square voltage conditions in Table A below as measured at the Resource's POIB:

Table A

Root-Mean-Square Voltage (p.u. of nominal)	Minimum Ride-Through Time (seconds)
$V > 1.20$	May ride-through or may trip
$1.175 < V \leq 1.2$	0.2
$1.15 < V \leq 1.175$	0.5
$1.10 < V \leq 1.15$	1.0
$0.90 \leq V \leq 1.10$	continuous
$0.0 < V < 0.90$	$(V+0.084375)/0.5625$
$V = 0.0$	0.15

For voltage between zero and 0.9 p.u. the minimum ride-through time in Table A above is defined by a straight line mathematical function where the duration is 0.15 seconds at zero voltage and 1.75 seconds at 0.9 p.u. voltage.

- (2) Nothing in paragraph (1) above shall be interpreted to require an IBR, Type 1 WGR or Type 2 WGR to trip for voltage conditions beyond those for which ride-through is required.
- (3) If protection systems (including, but not limited to protection for over-/under-voltage, rate-of-change-of-frequency, anti-islanding, and phase angle jump) are installed and activated to trip the IBR, Type 1 WGR or Type 2 WGR, they shall enable the IBR, Type 1 WGR or Type 2 WGR to ride through voltage conditions beyond those defined in paragraph (1) above to the maximum level the equipment allows.
- (4) An IBR, Type 1 WGR or Type 2 WGR shall inject electric current when required to ride-through voltage conditions. Except when caused by reductions associated with intermittent primary energy source availability (e.g., wind speed or solar irradiance), an IBR, Type 1 WGR or Type 2 WGR shall not reduce active current injection during voltage conditions requiring ride-through unless allowed in this paragraph or to provide

appropriate frequency response. When the POIB voltage is outside the continuous operating voltage range, an IBR shall continue to deliver pre-disturbance active current unless reduction is needed for voltage support or otherwise specified by ERCOT or the interconnecting TSP. Any necessary reductions in active current to prioritize reactive current shall be relative to the voltage change at the POIB. Typically, more aggressive reductions in active current to allow for additional reactive current (if needed to stay within its current limitations) will occur at lower voltages (e.g., 0.4 p.u. or lower) but settings shall be based on the local needs of the area of the ERCOT System to which the IBR interconnects and ensure sufficient active current is available for protection system sensing. An IBR, Type 1 WGR or Type 2 WGR shall return to its pre-disturbance level of real power injection as soon as possible but no more than one second after POIB voltage recovers to normal operating range. Slower real power injection recovery rates may be allowed if necessary for reliability as documented by the impacted TSP or ERCOT.

- (5) IBR, Type 1 WGR and Type 2 WGR plant controls, turbine controls, and/or inverter controls shall not disconnect the plant or any individual inverter/turbine, or prevent current exchange between the Resource and the ERCOT Transmission Grid during voltage conditions where ride-through is required.
- (6) If instantaneous over-current or over-voltage protection systems are installed and activated to trip the IBR, Type 1 WGR or Type 2 WGR, they shall use filtered quantities or sufficient time delays to prevent misoperation while providing the desired equipment protection. Any alternating current instantaneous over-voltage protection that could disrupt power output shall use a measurement period of at least one cycle (of fundamental frequency).
- (7) An IBR, Type 1 WGR or Type 2 WGR shall not use phase angle jump or rate-of-change-of-frequency measurement quantities as a basis for reducing power output or tripping offline during fault conditions and subsequent recovery to a steady-state operating point within the ride-through profiles specified in paragraph (1) above.
- (8) The Resource Entity for each IBR, Type 1 WGR or Type 2 WGR shall maximize the performance of its protection systems, controls, and other plant equipment (within equipment limitations) to meet and, if possible, exceed the performance requirements in paragraphs (1) through (7) above as soon as practicable but no later than December 31, 2025 or by its Commercial Operations Date, whichever is later.
- (9) If an IBR, Type 1 WGR or Type 2 WGR with an SGIA executed prior to August 1, 2024 cannot comply with paragraphs (1) through (7) above by December 31, 2025 after maximizing the performance of its protection systems, controls, and other plant equipment (within equipment limitations), the Resource Entity shall, by April 1, 2025, submit an Initial Voltage Ride-Through Capability Report (“IVRTCR”) pursuant to Section 2.11.2, Initial Voltage Ride-Through Capability Documentation and Reporting Requirements, and request an extension to comply pursuant to Section 2.12, Procedures for Frequency and Voltage Ride-Through Exemptions and Extensions for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs. If the Resource Entity submits an IVRTCR and

cannot comply with paragraphs (1) through (7) above with an extension, it must submit a notice of intent to request an exemption pursuant to Section 2.12. The Resource Entity must comply with the voltage ride-through requirements in effect on May 1, 2024 until it maximizes its voltage ride-through capability.

- (10) If an IBR, Type 1 WGR or Type 2 WGR fails to perform in accordance with the applicable voltage ride-through requirements, the Resource Entity shall take the actions described in Section 2.13, Actions Following a Transmission-Connected Inverter-Based Resource (IBR), Type 1 Wind-powered Generation Resource (WGR) or Type 2 WGR Apparent Failure to Ride-Through.

2.9.2 *Voltage Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs)*

- (1) For any short-circuit fault or open-phase condition that occurs on the distribution circuit to which the DGR or DESR is connected, the DGR or DESR will cease to energize and trip offline, and will take priority over the voltage ride-through function.
- (2) DGRs utilizing synchronous generation must have over-/under-voltage relays set to ride through the following operating conditions:

Voltage (p.u. of nominal)	Minimum Ride-Through Time (seconds)
$0.88 \leq V \leq 1.10$	continuous
$0.70 \leq V < 0.88$	Linear slope of 4 s/1 p.u. voltage starting at 0.7 s @ 0.7 p.u.

- (3) DGRs and DESRs utilizing inverter-based generation must be designed and relays must be set to ride through the following operating conditions:

Voltage (p.u. of nominal)	Ride-Through Mode	Minimum Ride-Through Time (seconds)
$1.10 < V \leq 1.20$	Momentary Cessation	12
$0.88 \leq V \leq 1.10$	Continuous Operation	continuous
$0.70 \leq V < 0.88$	Mandatory Operation	20
$0.50 \leq V < 0.70$	Mandatory Operation	10
$V < 0.50$	Momentary Cessation	1

- (4) Any Resource Entity with a DGR or DESR utilizing inverter-based generation that achieved Initial Synchronization before August 1, 2020 that is not capable of complying with the requirements of paragraph (3) above may request an exemption from those requirements. Such a request shall be submitted by November 2, 2020 and shall include documentation that demonstrates the DGR's or DESR's voltage ride-through capability to ERCOT's satisfaction. If, after reviewing the request and documentation, ERCOT determines the DGR or DESR is not capable of complying with the requirements of paragraph (3), then the DGR or DESR shall be exempt from those requirements, but shall be required to comply with those requirements to the greatest degree possible within its

capability, as determined in writing by ERCOT. Upon replacement or retirement of the inverter, the DGR or DESR shall no longer be exempt and shall at that time be required to comply with the requirements of paragraph (3) or other applicable requirement.

2.10 Voltage Ride-Through Requirements for DC Ties

- (1) The following Direct Current Ties (DC Ties) are subject to the voltage ride-through requirements specified in this Section:
 - (a) Any DC Tie with an initial energization date after January 1, 2021.
 - (b) Any DC Tie that is modified by increasing the physical capacity of the DC Tie by 20 MW or more or by changing the power converter associated with the DC Tie, unless the replacement is in-kind.
- (2) The owner of a DC Tie meeting the applicability requirements of paragraph (1) above shall ensure the DC Tie rides through the root-mean-square voltage conditions specified in Table A and the instantaneous phase voltage conditions specified in Table B, as measured at the DC Tie's Point of Interconnection Bus (POIB):

Table A

Root-Mean-Square Voltage (p.u. of nominal)	Minimum Ride-Through Time (seconds)
$V > 1.20$	No ride-through requirements
$1.10 < V \leq 1.20$	1.0
$0.90 \leq V \leq 1.10$	continuous
$0.70 \leq V < 0.90$	6.0
$0.50 \leq V < 0.70$	3.0
$0.25 \leq V < 0.50$	1.2
$V < 0.25$	0.16

Table B

Instantaneous Phase Voltage (p.u. of nominal)	Minimum Ride-Through Time (milliseconds)
$V > 1.80$	No ride-through requirements
$1.70 < V \leq 1.80$	0.2
$1.60 < V \leq 1.70$	1.0
$1.40 < V \leq 1.60$	3.0
$1.20 < V \leq 1.40$	15.0

- (3) Nothing in paragraph (2) above shall be interpreted to require a DC Tie to trip for voltage conditions beyond those for which ride-through is required.

- (4) The owner of a DC Tie meeting the applicability requirements of paragraph (1) above shall ensure any protective over- or under-voltage relay for the DC Tie is set to enable the DC Tie to ride through any voltage condition beyond those defined in paragraph (2) above to the maximum extent possible within the DC Tie's capability.
- (5) A DC Tie shall not cease injecting electric current during any period in which ride-through is required pursuant to paragraph (2) and paragraph (4) above. A DC Tie shall return to the pre-disturbance level of real power transfer within 1 second of POIB voltage recovery to normal operating range.

2.11 Ride-Through Reporting Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs

- (1) If the Resource Entity for an Inverter-Based Resource (IBR), Type 1 Wind-powered Generation Resource (WGR) or Type 2 WGR believes one or more of its Resources (i) has already maximized its ride-through capabilities to meet or exceed the applicable ride-through performance requirements, or (ii) will maximize its ride-through capabilities with available software, firmware, settings and parameterization changes to meet or exceed the applicable ride-through performance requirements before December 31, 2025, the Resource Entity must submit to ERCOT accurate models reflecting the field settings of the IBR, Type 1 WGR or Type 2 WGR consistent with applicable requirements for model updates in these Protocols and Other Binding Documents.
- (2) Until an IBR, Type 1 WGR or Type 2 WGR completes the work to maximize ride-through capability as required in Sections 2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs and Type 3 WGRs, 2.9.1.1, Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), and 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, the Resource must comply with the ride-through requirements in effect on May 1, 2024.
- (3) Upon completing the work to maximize ride-through capability as required in Sections 2.6.2.1, 2.9.1, 2.9.1.1, and 2.9.1.2, the Resource Entity shall inform ERCOT (in a manner prescribed by ERCOT) it has completed the work to maximize ride-through capability for each Resource.

2.11.1 Initial Frequency Ride-Through Capability Documentation and Reporting Requirements

- (1) The Resource Entity of an IBR, Type 1 WGR or Type 2 WGR with a Standard Generation Interconnection Agreement (SGIA) executed prior to August 1, 2024 that

cannot comply with paragraphs (1) through (6) of Section 2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, by December 31, 2025 shall, by April 1, 2025, submit to ERCOT via the Resource Integration and Ongoing Operations (RIOO) system, or as otherwise directed by ERCOT, an Initial Frequency Ride-Through Capability Report (“IFRTCR”) containing the following:

- (a) The Resource Entity Data Universal Numbering System (DUNS) Number;
- (b) IBR/WGR Site Name;
- (c) IBR/WGR Unit Name(s);
- (d) Nodal Operating Guide Section(s) with which the Resource cannot comply;
- (e) Current frequency ride-through capability in a format similar to the table in paragraph (1) of Section 2.6.2.1;
- (f) Known frequency ride-through limitations of the IBR, Type 1 WGR or Type 2 WGR as compared to the requirements in paragraphs (1) through (5) of Section 2.6.2.1;
- (g) A detailed description of the technical limitation preventing the Resource from meeting the ride-through requirement(s), including a letter signed by an officer or executive of the original equipment manufacturer (or subsequent support company if the original equipment manufacturer is no longer in business) or an engineering consulting firm verifying the limitations:
 - (i) If a Resource Entity cannot address the entire plant design with a letter required in paragraph (1)(g) above, the Resource Entity must supplement a letter from the original equipment manufacturer for its equipment (or subsequent support company if the original equipment manufacturer is no longer in business) or an engineering consulting firm by providing a notarized attestation sworn to by the Resource Entity’s highest-ranking representative, official, or officer with binding authority over the entity attesting to: the efforts made to obtain the letter, why those efforts failed, and which parts of the plant design is attested to. The attestation shall also include a detailed description of the technical limitation(s) preventing the Resource from meeting the ride-through requirement, including any information on technical limitations on all or part of the Resource which the Resource Entity is able to obtain from original equipment manufacturers or an engineering consulting firm under paragraph (1)(g) above;
- (h) Available software, firmware, settings or parameterization modifications the Resource Entity will implement to maximize the frequency ride-through capability of the IBR, Type 1 WGR or Type 2 WGR within known equipment limitations, to the greatest extent possible;

- (i) To the extent the Resource Entity chooses to implement changes to existing equipment other than software, firmware, settings or parameterization modifications that increase the frequency ride-through capability, identification of any such equipment modifications;
 - (j) Expected post-modification Resource capability in a format similar to the table in paragraph (1) of Section 2.6.2.1 and documentation of any expected remaining limitation(s) following implementation of such modifications;
 - (k) A schedule for implementing the modification(s);
 - (l) A model accurately representing expected performance reflecting all technical limitations, or a statement that there are no new models available other than what is currently submitted to ERCOT that already reflect all technical limitations in frequency ride-through capability; and
 - (m) A description of any limitation that cannot be accurately represented in a model.
- (2) If a Resource Entity does not timely provide to ERCOT an IFRTCR by April 1, 2025, the Resource will not be eligible for an exemption or extension to comply with the ride-through requirements. If a Resource Entity timely provides an IFRTCR by April 1, 2025 and ERCOT requests additional information, it will not render the Resource ineligible for an exemption.

2.11.2 Initial Voltage Ride-Through Capability Documentation and Reporting Requirements

- (1) The Resource Entity of an IBR, Type 1 WGR or Type 2 WGR with an SGIA executed prior to August 1, 2024, that cannot comply with paragraphs (1) through (7) of Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, by December 31, 2025 shall, by April 1, 2025, submit to ERCOT via the RIOO system, or as otherwise directed by ERCOT, an Initial Voltage Ride-Through Capability Report (“IVRTCR”) containing the following:
- (a) The Resource Entity DUNS Number;
 - (b) IBR/WGR Site Name;
 - (c) IBR/WGR Unit Name(s);
 - (d) Nodal Operating Guide Section(s) with which the Resource cannot comply;
 - (e) Current voltage ride-through capability in a format similar to the table in paragraph (1) of Section 2.9.1.2;
 - (f) Known voltage ride-through limitations of the IBR, Type 1 WGR or Type 2 WGR as compared to the requirements in paragraphs (1) through (7) of Section 2.9.1.2;

- (g) A detailed description of the technical limitation preventing the Resource from meeting the ride-through requirement(s), including a letter signed by an officer or executive of the original equipment manufacturer (or subsequent support company if the original equipment manufacturer is no longer in business) or an engineering consulting firm verifying the limitations:
 - (i) If a Resource Entity cannot address the entire plant design with a letter required in paragraph (1)(g) above, the Resource Entity must supplement a letter from the original equipment manufacturer for its equipment (or subsequent support company if the original equipment manufacturer is no longer in business) and an engineering consulting firm by providing a notarized attestation sworn to by the Resource Entity's highest-ranking representative, official, or officer with binding authority over the entity attesting to: the efforts made to obtain the letter, why those efforts failed, and which parts of the plant design is attested to. The attestation shall also include a detailed description of the technical limitation(s) preventing the Resource from meeting the ride-through requirement, including any information on technical limitations on all or part of the Resource which the Resource Entity is able to obtain from original equipment manufacturers or an engineering consulting firm under paragraph (1)(g) above;
 - (h) Available software, firmware, settings, or parameterization modifications the Resource Entity will implement to maximize the voltage ride-through capability of the IBR, Type 1 WGR or Type 2 WGR to approach or meet the voltage ride-through requirements in paragraphs (1) through (7) of Section 2.9.1.2 within known equipment limitations, to the greatest extent possible;
 - (i) To the extent the Resource Entity chooses to implement changes to existing equipment other than software, firmware, settings or parameterization modifications that increase the voltage ride-through capability, identification of any such equipment modifications;
 - (j) Expected post-modification Resource capability in a format similar to the table in paragraph (1) of Section 2.9.1.2 and documentation of any expected remaining limitation(s) following implementation of such modifications;
 - (k) A schedule for implementing the modification(s);
 - (l) A model accurately representing expected performance reflecting all technical limitations, or a statement that there are no new models available other than what is currently submitted to ERCOT that already reflect all technical limitations in voltage ride-through capability; and
 - (m) A description of any limitation that cannot be accurately represented in a model.
- (2) If a Resource Entity does not timely provide to ERCOT an IVRTPCR by April 1, 2025, the Resource will not be eligible for an exemption or extension to comply with the ride-

through requirements. If a Resource Entity timely provides an IVRTCR by April 1, 2025 and ERCOT requests additional information, it will not render the Resource ineligible for an exemption.

2.12 Procedures for Frequency and Voltage Ride-Through Exemptions and Extensions for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs

2.12.1 Exemptions and Extensions Process

- (1) If an Inverter-Based Resource (IBR), Type 1 Wind-powered Generation Resource (WGR) or Type 2 WGR has a technical limitation preventing it from fully meeting the frequency ride-through requirements in paragraphs (1) through (5) of Section 2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, or the voltage ride-through requirements in paragraphs (1) through (7) of Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, or as otherwise specified in paragraph (5) through (7) of Section 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs and Type 3 WGRs, or certain voltage ride-through requirements in accordance with paragraph (9) of Section 2.9.1.1, Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), the Resource Entity or Interconnecting Entity (IE) (“Requesting Entity”) must submit to ERCOT, by April 1, 2025: (i) a request for an extension to meet such requirements and/or (ii) a notice of intent to request an exemption based on standards established in a subsequent Nodal Operating Guide Revision Request (NOGRR).
- (2) For any IBR, Type 1 WGR or Type 2 WGR with a Standard Generation Interconnection Agreement (SGIA) dated before August 1, 2024, a notice of intent to request an exemption must be submitted to ERCOT on or before April 1, 2025 as part of the Initial Frequency Ride-Through Capability Report (“IFRTCR”) and Initial Voltage Ride-Through Capability Report (“IVRTCR”) as applicable. No new notices of intent to request an exemption beyond April 1, 2025, detailing additional technical limitations of ride-through requirements are allowed. A Resource Entity may only request an exemption based upon the technical limitations identified in its April 1, 2025 IFRTCR and/or IVRTCR. An exemption request and the ability to provide supplemental information, including updated models reflecting improved ride-through capability, will be established under processes in a subsequent NOGRR.
- (3) ERCOT, in its sole and reasonable discretion, will grant an extension if all of the following conditions exist:
 - (a) Circumstances beyond the Requesting Entity’s reasonable control prevented it from meeting the deadline;

- (b) The extension request demonstrates the Requesting Entity's good faith efforts to minimize the extension's duration;
 - (c) The Requesting Entity has provided accurate models that include all limitations and describes all limitations the Requesting Entity cannot model and represents to ERCOT the model is accurate;
 - (d) The date for the requested extension for a Resource with an SGIA before August 1, 2024 does not exceed December 31, 2027; and
 - (e) The date for the requested extension for a Resource with an SGIA after August 1, 2024 does not exceed December 31, 2028.
- (4) For any IBR, Type 1 WGR or Type 2 WGR with an approved exemption or extension, the documented maximum capabilities will become the new performance requirements until the exemption or extension has ended.
 - (5) Exemptions and extensions take effect immediately upon approval by ERCOT and apply only to the extent approved by ERCOT.
 - (6) Exemptions continue until:
 - (a) The IBR, Type 1 WGR or Type 2 WGR fully implements a modification as described in paragraph (1)(c) of Planning Guide Section 5.2.1, Applicability, that is synchronized after January 1, 2028; or
 - (b) The IBR, Type 1 WGR or Type 2 WGR fully implements a modification that eliminates the need for the exemption.
 - (7) If ERCOT or the Resource Entity becomes aware of a newly available software, firmware, settings or parameterization modification for a Resource with an exemption, the Resource Entity shall: (i) submit an implementation plan to ERCOT for approval within 90 days, and (ii) if ERCOT approves the plan, implement the plan within 180 days, unless ERCOT approves a longer timeline.
 - (8) Extensions shall end in accordance with Section 2.12.1.2, Submission of Extension Requests.
 - (9) The deadlines in Section 2.12.1.2 may be modified by mutual written agreement of ERCOT and the Requesting Entity.
 - (10) Until the consideration of an exemption, extension, or appeal process is finalized, the IBR, Type 1 WGR or Type 2 WGR with an SGIA prior to August 1, 2024 that has submitted an extension request or notice of intent to request an exemption and any required documentation by April 1, 2025 must meet the greater of: (i) its documented maximum ride-through capability, or (ii) its performance requirements in effect on May 1, 2024 until there is a non-appealable Public Utility Commission of Texas (PUCT) final order.

- (11) ERCOT shall not use a Resource Entity's IFRTCR, IVRTCR, or notice of intent to request an exemption as a basis for referral to the Reliability Monitor so long as the Resource meets the applicable ride-through requirements set forth in paragraph (10) above.
- (12) All information submitted under Sections 2.11, Ride-Through Reporting Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, and 2.12, Procedures for Frequency and Voltage Ride-Through Exemptions and Extensions for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, shall be considered Protected Information.

2.12.1.1 Submission of Exemption Requests

- (1) A Requesting Entity may seek an exemption for an IBR, Type 1 WGR or Type 2 WGR as follows:
 - (a) A Requesting Entity for an IBR, Type 1 WGR or Type 2 WGR with an SGIA executed prior to August 1, 2024 may seek exemptions from ride-through requirements in paragraphs (1) through (5) of Section 2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, or Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs.
 - (b) A Requesting Entity for a Type 3 WGR with an original SGIA executed prior to August 1, 2024, that meets the criteria in paragraph (5) of Section 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs and Type 3 WGRs, may seek an exemption as described in that Section.
- (2) The Resource Entity intending to request an exemption for an IBR, Type 1 WGR, Type 2 WGR must, by April 1, 2025, submit an IFRTCR or IVRTCR with a notice of intent to request an exemption describing the need for the exemption consistent with Sections 2.11.1, Initial Frequency Ride-Through Capability Documentation and Reporting Requirements, or 2.11.2, Initial Voltage Ride-Through Capability Documentation and Reporting Requirements.

2.12.1.2 Submission of Extension Requests

- (1) Unless otherwise approved by ERCOT, extension requests must be submitted by April 1, 2025. A Requesting Entity may seek an extension for an IBR, Type 1 WGR or Type 2 WGR as follows:
 - (a) A Requesting Entity for an IBR, Type 1 WGR or Type 2 WGR with an SGIA executed prior to August 1, 2024, may seek extensions for ride-through

requirements in paragraphs (1) through (5) of Section 2.6.2.1, Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, or Section 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs.

- (b) A Requesting Entity for an IBR with an SGIA executed on or after August 1, 2024 may seek extensions as contemplated in paragraph (6) of Section 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs and Type 3 WGRs, or paragraphs (9) or (10) of Section 2.9.1.1, Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs).
- (2) A Requesting Entity, through its Authorized Representative, may initiate a request for an extension under this Section by submitting written notice of the request to ERCOT through the Resource Integration and Ongoing Operations (RIOO) system (or as otherwise specified by ERCOT), with the following information:
- (a) Requesting Entity Name;
 - (b) Requesting Entity DUNS Number;
 - (c) IBR/WGR Site Name;
 - (d) IBR/WGR Unit Name(s);
 - (e) Nodal Operating Guide Section(s) under which the extension is requested;
 - (f) A detailed description of the grounds for the extension and the basis for each request;
 - (g) Documentation from the equipment manufacturer describing any known limitations associated with the extension request, a description of proposed modifications, and a schedule for implementing modifications; and
 - (h) Other information specified in this Section.
- (3) The Requesting Entity for an IBR with an SGIA executed on or after August 1, 2024, seeking an extension contemplated in paragraph (6) of Section 2.9.1, or paragraph (10) of Section 2.9.1.1 shall, at a minimum, submit the following information to ERCOT:
- (a) Documentation describing the justification for granting the extension;
 - (b) A model accurately representing all technical limitations and expected performance;
 - (c) A description of any limitation that cannot be accurately represented in a model;

- (d) Data and information identified in paragraphs (5) through (7) below, as applicable; and
 - (e) Any other data or information ERCOT reasonably deems necessary to evaluate granting the extension.
- (4) If a Requesting Entity submits a request for an extension to meet the performance requirements in sections 5, 7, and 9 of the Institute of Electrical and Electronics Engineers (IEEE) 2800-2022, Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems (“IEEE 2800-2022 standard”) as described in paragraph (6) of Section 2.9.1, it must provide to ERCOT:
- (a) Evidence from its original equipment manufacturer (or subsequent inverter/turbine vendor support company if the original equipment manufacturer is no longer in business) of technical infeasibility to comply with any of the performance requirements in sections 5, 7, and 9 of the IEEE 2800-2022 standard by its synchronization date;
 - (b) A description of proposed modifications; and
 - (c) The schedule for implementing those modifications. Any temporary extension shall be minimized and not extend beyond December 31, 2028 or 24 months after the Resource’s Commercial Operations Date, whichever is earlier.
- (5) If a Requesting Entity submits a request for an extension to meeting the performance requirements in Table A in paragraph (1) as contemplated in paragraph (10) of Section 2.9.1.1, it must provide to ERCOT:
- (a) Documented evidence from its equipment manufacturer of technical infeasibility to comply with the performance requirements in paragraph (1) of Section 2.9.1.1 by the IBR’s/WGR’s synchronization date;
 - (b) A description of proposed modifications; and
 - (c) The schedule for implementing those modifications. Any extensions under this paragraph shall be minimized and not extend beyond December 31, 2028. ERCOT will not grant any temporary extensions for performance that do not meet the voltage ride-through performance requirements in Table A in paragraph (1) of Section 2.9.1.2.
- (6) Extensions will terminate according to their terms at the time granted or at another date approved by ERCOT in writing.

2.12.1.3 Timeline for Submission and Determination of Extension Requests

- (1) As soon as practicable after receiving a request for an extension, ERCOT shall provide the Requesting Entity with written confirmation of receipt and notification that either:

- (a) The submission was complete and ERCOT is reviewing the request; or
- (b) The submission was incomplete. For incomplete submissions, ERCOT will:
 - (i) Identify the missing information; and
 - (ii) Provide instructions for the Requesting Entity to submit the missing information (e.g., to ERCOT Legal at MPRegistration@ercot.com or through the RIOO system).
- (2) Unless otherwise agreed by ERCOT, not later than ten Business Days of receiving a notice of an incomplete submission, the Requesting Entity shall submit the missing information to ERCOT through the RIOO system or as otherwise directed by ERCOT or request additional time to provide the additional information with an explanation for the delay.
- (3) Within seven days after ERCOT acknowledges receiving a complete request for extension, ERCOT shall designate an ERCOT senior representative with decision-making authority to participate in discussions with the Requesting Entity regarding the extension request.
- (4) During the time ERCOT considers an extension request, ERCOT and the Requesting Entity will cooperate in requesting and providing relevant information to develop a complete record to allow an effective and efficient review process.
- (5) ERCOT shall make reasonable efforts to complete or extension request process within 180 days after receiving a complete request for an extension. If ERCOT cannot complete its review of the request within that time period, ERCOT shall provide the Requesting Entity an estimate of the additional time needed to complete its review. ERCOT shall provide the Requesting Entity with written notification that ERCOT has completed its review and ERCOT's determination that the extension is:
 - (a) Approved;
 - (b) Approved in part, along with details of the approved part of the extension, and a detailed explanation for denying part of the extension request; or
 - (c) Rejected, along with details explaining the grounds upon which ERCOT rejected the extension request.
- (6) Upon issuance of ERCOT's decision on an extension request, the Requesting Entity adversely affected may appeal ERCOT's decision to the Public Utility Commission of Texas (PUCT) pursuant to P.U.C. PROC. R. 22.251, Review of Electric Reliability Council of Texas (ERCOT) Conduct. For such an appeal, the Requesting Entity is not required to comply with Protocol Section 20, Alternative Dispute Resolution Procedure and Procedure for Return of Settlement Funds.

- (7) A Requesting Entity that does not submit a notice of appeal to ERCOT within the required time period after receiving ERCOT's notice rejecting the extension request is deemed to have accepted ERCOT's decision.

2.13 Actions Following a Transmission-Connected Inverter-Based Resource (IBR), Type 1 Wind-powered Generation Resource (WGR) or Type 2 WGR Apparent Failure to Ride-Through

- (1) The required ride-through performance criteria ("Required Criteria") are defined in Section 2.6.2.1, Frequency Ride-through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, and Section 2.9.1, Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs and Type 3 WGRs. For any Inverter-Based Resource (IBR), Type 1 Wind-powered Generation Resource (WGR) or Type 2 WGR with an approved exemption or extension for the ride-through requirements, the Resource's documented maximum ride-through capabilities are the ride-through performance requirements for compliance purposes for the duration of the exemption or extension unless otherwise indicated by Governmental Authority rules or regulations. All IBRs, Type 1 WGRs and Type 2 WGRs shall strive to meet or exceed the Required Criteria to the fullest extent their equipment allows.
- (2) For any IBR, Type 1 WGR or Type 2 WGR with an approved exemption or extension for the ride-through requirements, the Resource's documented maximum ride-through capabilities are the ride-through performance requirements for compliance purposes for the duration of the exemption or extension unless otherwise indicated by Governmental Authority rules or regulations. Any IBR with documented maximized ride-through capabilities that exceed the applicable Required Criteria and fails to ride-through a disturbance within the IBR's documented maximized capabilities is also subject to this Section.
- (3) If an IBR, Type 1 WGR or Type 2 WGR does not ride-through in accordance with the applicable ride-through performance requirements, including its maximized capabilities (an "Apparent Performance Failure"), the Resource Entity shall, as soon as practicable:
 - (a) Investigate the Apparent Performance Failure;
 - (b) Report to ERCOT the cause of the Apparent Performance Failure; and
 - (c) Perform model validation and report the results to ERCOT.
- (4) Following an Apparent Performance Failure, Transmission Service Providers (TSPs) directly impacted by the Apparent Performance Failure shall provide available information to ERCOT to assist with event analysis.
- (5) The Resource Entity for an IBR, Type 1 WGR, or Type 2 WGR that experiences an Apparent Performance Failure shall:

- (a) Develop a plan to ensure the IBR, Type 1 WGR, or Type 2 WGR meets the applicable ride-through performance requirements (whether documented maximized capability or Required Criteria, whichever applies);
 - (b) Submit the plan to ERCOT for approval within 90 days; and
 - (c) If ERCOT approves the plan, implement the plan within 180 days, unless ERCOT approves a longer timeline.
- (6) To encourage all Resources to maximize all equipment frequency and voltage ride-through parameters to the maximum level the equipment allows and all new Resources to also design the plant to the utilize the inverter or converter capabilities to the fullest extent, any Apparent Performance Failure where system conditions at the Point of Interconnection Bus (POIB) exceeded the Required Criteria but remained below documented maximized frequency or voltage ride-through capabilities exceeding the applicable requirements in Sections 2.6.2, Frequency Ride-Through Requirements for Generation Resources and Energy Storage Resources, 2.9.1, 2.9.1.1, Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), or 2.9.1.2, Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs, shall be reported to the Reliability Monitor only if the Resource Entity does not fully meet the requirements in paragraphs (3) and (5) above.