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| NOGRR Number | [255](https://www.ercot.com/mktrules/issues/NOGRR255) | NOGRR Title | High Resolution Data Requirements |
| Date of Decision | August 3, 2023 |
| Action | Tabled |
| Timeline | Normal |
| Proposed Effective Date | To be determined |
| Priority and Rank Assigned | To be determined |
| Nodal Operating Guide Sections Requiring Revision  | 6.1, Disturbance Monitoring Requirements6.1.1, Introduction6.1.2, Fault Recording and Sequence of Events Recording Equipment6.1.2.1. Fault Recording Requirements6.1.2.2 Fault Recording and Sequence of Events Recording Equipment Location Requirements6.1.2.3, Fault Recording and Sequence of Events Recording Data Requirements6.1.2.4, Fault Recording and Sequence of Events Recording Data Retention and Reporting Requirements6.1.3, Phasor Measurement Recording Equipment Including Dynamic Disturbance Recording Equipment6.1.3.1, Dynamic Disturbance Recording Equipment Requirements (new)6.1.3.1, Recording and Triggering Requirements6.1.3.2, Location Requirements6.1.3.3, Data Recording and Redundancy Requirements6.1.3.4, Data Retention and Data Reporting Requirements6.1.3.2, Phasor Measurement Unit Requirements (new)6.1.3.2.1, Recording Requirements (new)6.1.3.2.2, Location Requirements (new)6.1.3.2.3, Data Recording and Redundancy Requirements (new)6.1.3.2.4, Data Retention and Data Reporting Requirements (new)6.1.4, Fault Recording, Sequence of Events Recording, and Phasor Measurement Unit Requirements for Inverter-Based Resources (IBRs) (new)6.1.4.1, Fault Recording and Sequence of Events Recording Equipment Requirements (new)6.1.4.1.1, Sequence of Events Recording Data Requirements (new)6.1.4.1.2, Fault Recording Data and Triggering Requirements (new)6.1.4.3, Phasor Measurement Unit Equipment Requirements (new)6.1.4.4, Data Retention and Data Reporting Requirements of Fault Recording, Sequence of Events Recording, and Phasor Measurement Unit Equipment (new)6.1.4, Maintenance and Testing Requirements6.1.5, Equipment Reporting Requirements6.1.6, Review Process |
| Related Documents Requiring Revision/Related Revision Requests | None |
| Revision Description | This Nodal Operating Guide Revision Request (NOGRR) establishes high-resolution data requirements.  |
| Reason for Revision |  Addresses current operational issues. Meets Strategic goals (tied to the [ERCOT Strategic Plan](https://www.ercot.com/files/docs/2018/12/13/ERCOT_Strategic_Plan_2019-2023.pdf) or directed by the ERCOT Board). Market efficiencies or enhancements Administrative Regulatory requirements Other: (explain)*(please select all that apply)* |
| Business Case | ERCOT has recently experienced several generation ride-through failure events and model quality issues, highlighting the need for high resolution data to perform model validation and event analysis. The resolution of Supervisory Control and Data Acquisition (SCADA) data (4-10 sec) is insufficient and, therefore, ERCOT needs high-resolution data to help ensure ERCOT System reliability. The North American Electric Reliability Corporation (NERC) 2022 Odessa Disturbance report highlighted the need for such data and ERCOT has identified several updates to the disturbance monitoring requirements in the Nodal Operating Guides to support this important work. ERCOT proposes restructuring the requirements for clarity and separating Inverter Based Resource (IBR) requirements from the requirements for other facilities.ERCOT staff have observed several issues when requesting high resolution data. There have been an unacceptable number of requests in which the Market Participant could not provide important data because recording equipment was either not properly maintained or verified as operational. Thus, ERCOT had no access to valuable data needed to troubleshoot a ride-through failure. In response, ERCOT proposes requirements for equipment maintenance and testing to ensure availability of a minimum level of data. Additionally, there have been multiple instances of Market Participants having no data due to inadequate trigger settings on recording equipment. ERCOT proposes additional clarity and consistency on trigger settings for digital fault recorders, sequence of events recording equipment, dynamic disturbance recording equipment, and phasor measurement units. ERCOT also proposes additional requirements for IBRs aligned with Table 19 in the new 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”) to have consistent specification for new and replaced recording equipment for IBRs.ERCOT proposes new disturbance monitoring requirements for Loads greater than 75 MVA and Loads or Generation Resource 20 MVA and above that experience ride-through failures, and new requirements for streaming phasor measurement unit data to ERCOT for certain locations.The proposed revisions will also help ERCOT comply with NERC Reliability Standard PRC-002-4, Disturbance Monitoring and Reporting Requirements, which goes into effect on April 1, 2024. |
| ROS Decision | On 8/3/23, ROS voted unanimously to table NOGRR255 and refer the issue to the System Protection Working Group (SPWG), the Dynamics Working Group (DWG) and the Inverter-Based Resource Working Group (IBRWG). All Market Segments participated in the vote. |
| Summary of ROS Discussion | On 8/3/23, participants discussed that ROS working groups began discussing NOGRR255 before formal assignment, that a Special SPWG meeting would be scheduled, and that NERC recently published drafts for updated standards. Participants determined to continue further discussions at fewer working groups with joint meetings to minimize strain on resources. |

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| Opinions |
| Credit Review | Not applicable |
| Independent Market Monitor Opinion | To be determined |
| ERCOT Opinion | To be determined |
| ERCOT Market Impact Statement | To be determined |

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| Market Segment | Not Applicable |

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| **Comments Received** |
| **Comment Author** | **Comment Summary** |
| None |  |

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| **Market Rules Notes** |

None

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| Proposed Guide Language Revision |

6.1 Disturbance Monitoring Requirements

(1) Disturbance monitoring equipment includes sequence of events recording equipment, fault recording equipment, dynamic disturbance recording equipment, and phasor measurement units.

(a) Sequence of events equipment includes any device capable of recording circuit breaker position (open/close) that allows analysis of the root cause of a dynamic disturbance based on the order of occurrence of events.

(b) Fault recording equipment captures data associated with an abnormal event on the system, such as phase-to-phase faults, phase-to-ground faults, etc. and includes digital fault recorders, certain protective relays, fault recording-capable meters, and dynamic disturbance recording equipment.

(c) Dynamic disturbance recording equipment captures incidents that represent behavior of the power system during dynamic events, such as low frequency oscillations, abnormal under/over frequency, voltage excursions and system-wide transients. Some dynamic disturbance recording equipment can also serve as a phasor measurement unit.

(d) Digital fault recorders, at high speed, monitor and record the transient response of the power system and equipment during and just after a system fault or transient disturbance. They are intelligent electronic devices that sample binary data (e.g., harmonics, frequency and voltage levels) during power system transients, using communications to retrieve fault, disturbance and sequence of event records and store that data in a digital format.

(e) Phasor measurement involves measuring synchronized phasors, frequency, and rate of change of frequency of the power system with accuracy in the order of one microsecond and is typically performed by a phasor measurement unit. Phasor measurement unit constantly record data and periodically overwrite data.

6.1.1 Introduction

(1) Disturbance monitoring is necessary to:

(a) Determine performance of the ERCOT System;

(b) Determine effectiveness of protective relaying systems;

(c) Verify ERCOT System models;

(d) Determine causes of ERCOT System disturbances (trips, faults, and protective relay system actions);

(e) Determine causes of Generation Resource and Energy Storage Resource (ESR) ride-through performance failures and loss of Load events; and

(e) Meet the requirements of North American Reliability Corporation (NERC) Reliability Standards.

(2) To ensure ERCOT has adequate data for these activities, ERCOT establishes the disturbance monitoring requirements and procedures in these Operating Guides for the following:

(a) Fault recording, sequence of events recording, and dynamic disturbance recording equipment owners; and

(b) Transmission Service Providers (TSPs) and Resource Entities with equipment for recording Geomagnetic Disturbance (GMD) data, including Geomagnetically-Induced Current (GIC) monitors and/or magnetometers for recording geomagnetic field data.

6.1.2 Fault Recording and Sequence of Events Recording Equipment

(1) Fault recording equipment includes digital fault recorders, certain protective relays, meters with fault recording capability, and dynamic disturbance recording equipment meeting the associated requirements in this Section.

(2) Sequence of events recording equipment includes any device capable of recording circuit breaker position (open/close) meeting the associated requirements in this Section.

(3) Required fault recording shall be time synchronized with a Global Positioning System-based clock, or ERCOT-approved alternative, with sub-cycle (1 microsecond) timing accuracy and performance of Coordinated Universal Time (UTC), with or without a local time offset for Central Prevailing Time (CPT).

(4) Required sequence of events recording equipment shall be time synchronized with a Global Positioning System-based clock, or ERCOT-approved alternative, with +/- 2 millisecond timing accuracy and performance of Coordinated Universal Time (UTC), with or without a local time offset for Central Prevailing Time (CPT).

6.1.2.1 Fault Recording Requirements

(1) Fault recording equipment shall meet the following requirements:

(a) Triggering for at least the following:

(i) Neutral (residual) overcurrent of .02 p.u. or less of rated current transformer current transformer secondary current;

(ii) Phase under-voltage below .9 p.u. for two cycles or longer;

(iii) Phase over-voltage greater than 1.1 p.u. for two cycles or longer;

(iv) Phase overcurrent of 1.5 p.u. or less of rated current transformer secondary current or protective relay tripping for all protection groups;

(v) Frequency below 59.3 Hz or above 60.6 Hz; and

(vi) Frequency rate of change for low frequency of -0.08125 Hz/sec or high frequency of 0.125 Hz/sec.

(b) Minimum recording rate of 16 samples per cycle; and

(c) A single record or multiple records that include a pre-trigger record length of at least two cycles and a total record length of at least 60 cycles for the same trigger point.

6.1.2.2 Fault Recording and Sequence of Events Recording Equipment Location Requirements

(1) The location criteria listed below apply to Transmission Facilities operated at or above 100 kV unless otherwise specified. The Facility owner shall install fault recording and sequence of events recording equipment at the following locations, at a minimum:

(a) Locations identified by the Transmission Facility owner utilizing the methodology in Section 8, Attachment M, Selecting Buses for Capturing Sequence of Events Recording and Fault Recording Data;

(b) Additional locations selected at the Transmission Facility owner’s discretion, utilizing the methodology in Section 8, Attachment M;

(c) Locations operating at or above 60 kV, as defined below.

(i) Interconnections with Control Areas outside the ERCOT Region;

(ii) Substations where electrical transfers can be made between the ERCOT Control Area and a Control Area outside the ERCOT Region;

(iii) All switchyards serving a Generation Resource or ESR connected to the ERCOT System with an aggregated gross generating capacity above 100 MVA or at the remote line terminals of each generating station switchyard.

(d) For any individual Load greater than 20 MVA that has experienced an abnormal trip or load reduction (including if caused by distribution connected resources) after a fault, ERCOT may require the installation of fault recording and sequence of events recording equipment and the Transmission Facility owner or Distribution Service Provider (DSP) shall install the fault recording and sequence of events recording equipment at an ERCOT-specified location as soon as practicable but no longer than 18 months after ERCOT notifies the Transmission Facility owner or DSP it must install the equipment; and

(e) The Transmission Facility owner shall install fault recording equipment for each new individual Load over 75 MVA aggregated at a single site placed into service after January 1, 2023.

(2) By December 31, 2024, Facility owners shall install at least 50% of the new fault recording and sequence of events recording equipment identified in paragraph (1) above and 100% of the fault recording and sequence of events recording equipment by December 31, 2025.

(3) For any Generation Resource or ESR that has experienced an abnormal trip or power reduction, ERCOT may require the installation of fault recording and sequence of events recording equipment and the Facility owner shall install the fault recording and sequence of events recording equipment at an ERCOT-specified location as soon as practicable but no longer than 18 months after ERCOT notifies the Facility owner it must install the equipment.

6.1.2.3 Fault Recording and Sequence of Events Recording Data Requirements

(1) Each Transmission Facility owner and Generation Resource owner shall have fault recording data to determine the following electrical quantities for each triggered fault recording for the Transmission Elements operated at or above 100kV it owns connected to the Facilities operated at or above 100kV identified in these requirements:

(a) Phase-to-neutral voltage for each phase of each specified bus with two sets of substation voltage measurements for breaker-and-a-half and ring bus substation configurations and one set of substation voltage measurements for each bus in other substation configurations.

(b) For transmission lines, each phase current and neutral (residual) current; and

(c) For transformers with a low-side operating voltage of 100kV or above, each phase current and the neutral (residual) current.

(2) Each Transmission Facility owner and Generation Resource owner shall have sequence of events recording data per the following requirements:

(a) Circuit breaker position (open/close) for each circuit breaker it owns connected directly to the transmission buses identified in paragraphs (1)(a) and (1)(b) of Section 6.1.2.2, Fault Recording and Sequence of Events Recording Equipment Location Requirements; and

(b) The following data as either part of the sequence of events recording data or fault recording digital status data:

(i) Circuit breaker position for each circuit breaker that it owns associated with monitored generator interconnects, transmission lines, and transformers;

(ii) Carrier transmitter control status (i.e. start, stop, keying) for associated transmission lines; and

(iii) Carrier signal receive status for associated transmission lines.

(3) Each Generation Resource owner and ESR owner shall have the following point-on-wave fault recording data for each triggered fault recording:

(a) Time stamp;

(b) Phase-to-neutral voltage for each phase on high side of the Main Power Transformer (MPT);

(c) Each phase current and the residual or neutral current on high side of the MPT;

(d) Active and reactive power on high side of the MPT;

(e) Frequency and df/dt data for at least one generator-interconnected bus measurement;

(f) If applicable, dynamic reactive device input/output such as voltage, current, and frequency; and

(g) Applicable binary status.

6.1.2.4 Fault Recording and Sequence of Events Recording Data Retention and Reporting Requirements

(1) Each Transmission Facility owner and Generation Resource owner shall, upon request, provide to the requesting Entity fault recording and sequence of events recording data for the Transmission Elements identified in these requirements as follows:

(a) Data shall be maintained and retrievable for the maximum period of time the equipment allows and shall be retrievable for, at a minimum:

(i) Thirty calendar days, including the day the data was recorded, for fault recording and sequence of events recording equipment installed on or replaced after January 1, 2024;

(ii) Ten calendar days, including the day the data was recorded, for fault recording and sequence of events recording equipment installed prior to January 1, 2024;

(b) Data subject to paragraph (1)(a) above will be provided within seven calendar days of request unless the requestor grants an extension;

(c) Sequence of events recording data will be provided in ASCII Comma Separated Value (CSV) format as follows: Date, Time, Local Time Code, Substation, Device, State;

(d) Fault recording data will be provided in electronic files formatted in conformance with Institute of Electrical and Electronic Engineers (IEEE) C37.111, IEEE Standard for Common Format for Transient Data Exchange (COMTRADE), revision C37.111-1999 or later;

(e) Data files will be named in conformance with C37.232, IEEE Standard for Common Format for Naming Time Sequence Data Files (COMNAME), revision C37.232-2011 or later; and

(f) If available, fault recording data shall be provided in electronic files in SEL ASCII event report (.EVE), compressed ASCII (.CEV), Motor Start Report (.MSR) and Sequential Events Recorder record (.SER) format.

(2) The Transmission Facility owner and Generation Resource owner providing the requested fault recording and sequence of events recording data to ERCOT, the NERC Regional Entity, or NERC shall store the data for at least three years from the date the data was created.

6.1.3 Dynamic Disturbance Recording Equipment Including Phasor Measurement Unit Equipment

(1) By December 31, 2025, all dynamic disturbance recording equipment shall function as a phasor measurement unit and meet requirements in Section 6.1.3.1.2, Location Requirements, or a Facility Owner shall install a separate phasor measurement unit in addition to the dynamic disturbance recording equipment, and the phasor measurement unit shall have identical monitoring capabilities as the dynamic disturbance recording equipment.

(2) Dynamic disturbance recording equipment shall be time synchronized with a Global Positioning System-based clock, or ERCOT-approved alternative, with sub-cycle (<1 microsecond) timing accuracy and performance.

**6.1.3.1 Dynamic Disturbance Recording Equipment Requirements**

**6.1.3.1.1 Recording and Triggering Requirements**

(1) Dynamic disturbance recording equipment shall:

(a) Have either continuous data recording or triggering for at least the following:

(i) Neutral (residual) overcurrent of 0.2 p.u. or less of rated current transformer secondary current,

(ii) Phase under-voltage below 0.9 p.u. for two cycles or longer;

(iii) Phase over-voltage greater than 1.1 p.u. for two cycles or longer;

(iv) Phase overcurrent of 1.5 p.u. or less of rated current transformer secondary current or protective relay tripping for all protection groups;

(v) Frequency below 59.3 Hz or above 60.6 Hz; and

(vi) Frequency rate of change for low frequency of -0.08125 Hz/sec or high frequency of 0.125 Hz/sec;

(b) Triggered record lengths of at least three minutes;

(c) A minimum output recording rate of 30 samples per second; and

(d) A minimum input sampling rate of 960 samples per second.

***6.1.3.1.2 Location Requirements***

(1) ERCOT shall identify and Facility owners shall install and maintain dynamic disturbance recording equipment at the following locations:

(a) Generation Resource(s) with:

(i) Gross individual nameplate rating at the Point of Interconnection (POI) greater than or equal to 500 MVA; or

(ii) Gross individual nameplate rating at the POI greater than or equal to 300 MVA if the gross plant/facility aggregate nameplate rating at the POI is greater than or equal to 1,000 MVA;

(b) Any Transmission Element part of a stability-related (angular or voltage) system operating limit;

(c) Each terminal of a high-voltage, direct current (HVDC) circuit with a nameplate rating greater than or equal to 300 MVA at the POI, on the alternating current side of a converter;

(d) One or more Transmission Elements part of an Interconnection Reliability Operating Limit (IROL); and

(e) Any one Transmission Element within a major voltage sensitive area as defined by an area with an in-service Under-Voltage Load Shedding (UVLS) program.

(2) ERCOT shall identify a minimum dynamic disturbance recording coverage, including Transmission Elements identified above, of a least:

(a) One Transmission Element; and

(b) One Transmission Element per 3,000 MW of ERCOT’s historical simultaneous peak Demand.

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***6.1.3.1.3 Data Recording and Redundancy Requirements***

(1) Recorded electrical quantities shall determine the following:

(a) For Transmission Facilities meeting the requirements in Section 6.1.3.1.2, Location Requirements:

(i) Phase-to-neutral voltage magnitude/angle data for each phase from at least two distinct transmission level element measurement points;

(ii) Single phase current magnitude/angle data for each phase from at least two distinct transmission lines; and

(iii) Frequency and df/dt data for at least two Transmission Element measurement points.

(b) For Generation Resource locations the meeting requirements in Section 6.1.3.1.2:

(i) Phase-to-neutral voltage, or phase-to-phase voltage magnitude/angle data for each phase from at least one generator-interconnected bus measurement point;

(ii) Single phase current magnitude/angle data for each phase from each interconnected generator on the high or low side of an MPT; and

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| [NOGRR227: Replace item (ii) above with the following upon system implementation of NPRR973:](ii) Single phase current magnitude/angle data for each phase from each interconnected generator on the high or low side of a Main Power Transformer (MPT); and |

(iii) Frequency and df/dt data for at least one generator-interconnected bus measurement.

6.1.3.1.4 Data Retention and Data Reporting Requirements

(1) A Market Participant required to have and maintain data regarding electrical quantities shall maintain and retain that data for the maximum period the equipment allows and, at a minimum, for:

(a) A rolling ten calendar day period for all data;

(b) At least three years for event data used for model validation in accordance with NERC Reliability Standards; and

(c) At least three years for event data provided to ERCOT, the NERC Regional Entity, or NERC via written request recorded in the context of an ERCOT-, NERC Regional Entity-, or NERC-initiated event analysis or review.

(2) Each affected Market Participant shall provide to the requesting Entity, upon request, dynamic disturbance recording data to the requesting entity, as follows:

(a) Data must be retrievable for ten calendar days, including the day the data was recorded;

(b) Data subject to paragraph (2)(a) above within seven calendar days of a request unless the requestor grants an extension;

(c) Dynamic disturbance recording data in electronic files formatted in conformance with IEEE C37.111, revision C37.111-1999 or later;

(d) Data files named in conformance with IEEE C37.232, revision C37.232-2011 or later.

**6.1.3.2 Phasor Measurement Unit Requirements**

(1) Phasor measurement unit equipment includes all dynamic disturbance recording equipment with phasor measurement recording capability meeting the requirements in Sections 6.1.3.2.1, Recording Requirements, and 6.1.3.2.3, Data Recording and Redundancy Requirements.

(2) Phasor measurement unit equipment shall be time synchronized with a Global Positioning System-based clock, or ERCOT-approved alternative, with sub-cycle (<1 microsecond) timing accuracy and performance.

***6.1.3.2.1 Recording Requirements***

(1) Recorded electrical quantities shall have continuous recording and shall:

(a) Be provided in IEEE C37.118.1-2011 or later, IEEE Standard for Synchrophasor format;

(b) Have a minimum output recording rate of 30 samples per second;

(c) Have a minimum input sampling rate of 960 samples per second; and

(d) Be transmitted to an ERCOT phasor data concentrator via a communication link or stored locally in accordance with the requirements in Section 6.1.3.2.4, Data Retention and Data Reporting Requirements*.*

***6.1.3.2.2 Location Requirements***

(1) Facility owner(s) shall install phasor measurement unit equipment at the following locations:

(a) Flexible AC transmission system devices configured to actively control steady-state voltage or power transfer capability operated at or above 100 kV and energized after July 1, 2015;

(b) A Transmission Facility deemed necessary for each published generic transmission constraint within 18 months of receiving written notice from ERCOT;

(c) New Generation Resources or ESRs over 20 MVA, connected to a Transmission Facility at or above 60 kV, aggregated at a single site placed into service after January 1, 2017;

(d) Existing Generation Resource or ESRs over 20 MVA, connected to a Transmission Facility at or above 60 kV, aggregated at a single site following any modification described in paragraph (1)(c) of Planning Guide Section 5.2.1, Applicability, with the modification’s Initial Synchronization after January 1, 2022;

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| ***[NOGRR177: Insert item (e) below upon system implementation of NPRR857 and renumber accordingly:]***(e) New Direct Current Ties (DC Ties) placed into service after January 1, 2019; |

(e) For any Generation Resource or ESR that has experienced a frequency or voltage ride-through failure, ERCOT may require installation of a phasor measurement unit and transmission of the data to an ERCOT phasor data concentrator via a communication link. The Generation Resource or ESR owner shall install the phasor measurement unit at a location specified by ERCOT as soon as practicable but no longer than 18 months after ERCOT notifies the Entity it must install the equipment, and shall transmit the data within 60 days of installing required recording equipment.

(f) ERCOT may require installation of a phasor measurement unit for Loads greater than 20 MVA that experienced abnormal trips or Load reductions (including if caused by distribution connected Resources) after a fault. ERCOT may require transmitting the data to an ERCOT phasor data concentrator via a communication link for more than one failure. The Transmission Facility owner or DSP shall install the phasor measurement unit at a location specified by ERCOT as soon as practicable but no longer than 18 months after ERCOT notifies the Transmission Facility owner or DSP it must install the recording equipment, and transmit the data within 60 days of installing the required recording equipment;

(g) The Transmission Facility owner or DSP shall install the phasor measurement unit for each individual Load with more than 20 MVA of distribution connected Resources by December 31, 2024 or within 120 days of reaching the 20 MVA threshold; and

(h) The Transmission Facility owner shall install the phasor measurement unit for each new individual Load greater than 75 MVA aggregated at a single site placed into service after January 1, 2023.

(2) By December 31, 2024, Facility owners shall install at least 50% of the new phasor measurement units identified in paragraph (1) above and 100% of the new phasor measurement units by December 31, 2025.

(3) ERCOT shall identify Transmission Elements for which data must be transmitted to an ERCOT phasor data concentrator via a communication link, including the following:

(a) Each Transmission Element part of a monitored IROL interface;

(b) Each static Volt-Ampere reactive (VAr) compensator, static synchronous compensator (STATCOM), or synchronous condenser with a lagging or leading MVAr capability of 100 MVAr or greater;

(c) Any one Transmission Element within:

(i) A voltage sensitive area as defined by an area with an in-service Under-Voltage Load Shedding (UVLS) program;

(ii) An area of the ERCOT System with 3,000 MW of ERCOT’s historical simultaneous peak Demand; and

(iii) An area with greater than 1,000 MW of Generation Resources and ESRs with identified stability risks.

(4) Each Transmission Facility owner shall install phasor measurement recording equipment for a Transmission Element identified in paragraph (2) above within 18 months after receiving written notice from ERCOT. Each Transmission Facility owner shall transmit the phasor measurement recording equipment data to an ERCOT phasor data concentrator via a communication link for each Transmission Element identified in paragraph (2) above within 120 calendar days after receiving written notice if the phasor measurement reporting equipment is already installed or within 120 calendar days of the date the phasor measurement equipment is installed, whichever is sooner.

***6.1.3.2.3 Data Recording and Redundancy Requirements***

(1) Recorded electrical quantities shall include the following:

(a) For Transmission Facility owner locations meeting the requirements in Section 6.1.3.2.2, Location Requirements:

(i) Time stamp;

(ii) Phase-to-neutral voltage magnitude/angle data for each phase from at least two distinct Transmission Element measurement points;

(iii) Single phase current magnitude/angle data for each phase from at least two distinct Transmission lines; and

(iv) Frequency and df/dt data for at least two Transmission Element measurement points.

(b) For Generator Resource or ESR owner locations meeting the requirements in Section 6.1.3.2.2:

 (i) Time stamp;

(ii) Phase-to-neutral voltage for each phase on high side of the MPT;

(iii) Each phase current and the residual or neutral current on high side of the MPT;

(iv) Active and reactive power on high side of the MPT;

(v) Frequency and df/dt data for at least one generator-interconnected bus measurement; and

(vi) If applicable, dynamic reactive device input/output such as voltage, current, and frequency.

6.1.3.2.4 Data Retention and Data Reporting Requirements

(1) A Market Participant required to have and maintain data regarding the minimum recorded electrical quantities shall maintain and retain that data for the maximum period of time the equipment allows and at a minimum for:

(a) A rolling 30 calendar day period for all data stored locally;

(b) At least three years for event data used for model validation in accordance with NERC Reliability Standards; and

(c) At least three years for event data provided to ERCOT, the NERC Regional Entity, or NERC via written request recorded in the context of an ERCOT, NERC Regional Entity, or NERC-initiated event analysis review.

(2) Each affected Market Participant shall provide to the requesting Entity, upon request, phasor measurement unit data for the buses or Transmission Elements identified in these requirements as follows:

(a) Data must be retrievable for 30 calendar days, including the day the data was recorded;

(b) Data subject to item (2)(a) above within seven calendar days of a request unless the requestor grants an extension;

(c) Data in electronic files formatted in conformance with IEEE C37.111, revision C37.111-1999 or later;

(d) Data files named in conformance with IEEE C37.232, revision C37.232-2011 or later.

6.1.4 Fault Recording, Sequence of Events Recording, and Phasor Measurement Unit Requirements for Inverter-Based Resources (IBRs)

(1) Inverter-Based Resources (IBRs) include any source of electric power connected to the ERCOT System via power electronic interface that consists of one or more IBR unit(s) capable of exporting active power from a primary energy source or energy storage system. An IBR unit is an individual inverter device or group of multiple inverters connected together at a single point of connection. An IBR unit may be an inverter, converter, wind turbine generator, or HVDC converter.

(2) All transmission connected IBR facilities at 60 kV and above with gross aggregated capacity of 20 MVA or above at a single site are subject to all requirements in this section.

(3) By December 31, 2024, Facility owners shall install at least 50% of the new fault recording and sequence of events recording equipment identified in this section, and 100% of the new fault recording and sequence of events recording equipment by December 31, 2025.

6.1.4.1 Fault Recording and Sequence of Events Recording Equipment Requirements

(1) Required fault recording equipment shall be time synchronized with a Global Positioning System-based clock, or ERCOT approved alternative, with sub-cycle (<1 microsecond) timing accuracy and performance of Coordinated Universal Time (UTC), with or without a local time offset for Central Prevailing Time (CPT).

(2) Required sequence of events recording equipment shall be time synchronized with a Global Positioning System-based clock, or ERCOT-approved alternative, with +/- 100 microseconds of Coordinated Universal Time (UTC), with or without a local time offset for Central Prevailing Time (CPT).

*6.1.4.1.1 Sequence of Events Recording Data Requirements*

(1) Generation Resource owners and ESR owners shall have sequence of events data for:

(a) All circuit breaker positions;

(b) For at least one IBR unit connected to the last 10% of each collector feeder length:

(i) All fault codes;

(ii) All Fault alarms;

(iii) Change of operating mode;

(iv) High and low voltage ride-through;

(v) High and low voltage frequency ride-through; and

(vi) Control system command values, reference values, and feedback signals.

*6.1.4.1.2 Fault Recording Data and Triggering Requirements*

(1) Generation Resource owners and ESR owners shall have fault recording data to determine the following electrical quantities for each triggered fault recording record:

 (a) Generation Resource or ESR level fault recording data:

(i) Time stamp;

(ii) Phase-to-neutral voltage for each phase on high side of the MPT;

(iii) Each phase current and the residual or neutral current on high side of the MPT;

(iv) Active and reactive power on high side of the MPT;

(v) Frequency and df/dt data for at least one generator-interconnected bus measurement; and

(vi) If applicable, dynamic reactive device input/output such as voltage, current, and frequency.

(vii) Applicable binary status.

(b) Individual IBR unit fault recording data from at least one IBR unit connected to the last 10% of each collector feeder length:

(i) Each AC phase-to-neutral or phase-to-phase voltage, as applicable, at IBR unit terminals or on high side of the IBR unit transformer;

(ii) Each AC phase current and the residual or neutral current, as applicable, on IBR unit terminals or on high side of the IBR unit transformer; and

 (iii) DC bus current and voltage.

(2) Fault recording equipment shall meet the following requirements for both Generation Resource or ESR level and individual IBR unit level as described in paragraph (1) above:

(a) Triggering for at least the following:

(i) Neutral (residual) overcurrent of 0.2 p.u. or less of rated current transformer secondary current;

(ii) Phase under-voltage below 0.9 p.u. for two cycles or longer;

(iii) Phase over-voltage greater than 1.1 p.u. for two cycles or longer;

(iv). Phase overcurrent of 1.5 p.u. or less of rated current transformer secondary current or protective relay tripping for all protection groups;

(v) Frequency below 59.3 Hz or above 60.6 Hz; and

(vi) Frequency rate of change for low frequency of -0.08125 Hz/sec or high frequency of 0.125 Hz/sec;

(b) Minimum recording rate of:

(i) 128 samples per cycle for any Fault recording equipment installed on or replaced after January 1, 2024;

(ii) 16 samples per cycle for any Fault recording equipment installed prior to January 1, 2024 but set as close to 128 samples per cycle as the equipment allows; and

(c) A single record or multiple records that include pre-trigger record length of at least two cycles and a total record length of at least 5 seconds for the same trigger point.

6.1.4.3 Phasor Measurement Unit Equipment Requirements

(1) Phasor measurement unit equipment shall be time synchronized with a Global Positioning System-based clock, or ERCOT-approved alternative, with sub-cycle (<1 microsecond) timing accuracy and performance of Coordinated Universal Time (UTC), with or without a local time offset for Central Prevailing Time (CPT).

(2) Recorded electrical quantities shall have continuous recording and be:

(a) Provided in IEEE C37.118.1-2011 or later, IEEE Standard for Synchrophasor format;

(b) A minimum output recording rate of 60 samples per second;

(c) A minimum input sampling rate of 960 samples per second; and

(d) Transmitted to an ERCOT phasor data concentrator via a communication link or stored locally per retention requirements in Section 6.1.4.4*.*

(3) Recorded electrical quantities shall include the following:

(a) Time stamp;

(b) Phase-to-neutral voltage, or phase-to-phase voltage magnitude/angle data for each phase from at least one generator-interconnected bus measurement;

(c) Single phase current magnitude/angle data for each phase on the high or low side of an MPT that represents the flow from one or multiple IBR units behind the MPT;

(d) Frequency and df/dt data for at least one generator-interconnected bus measurement; and

(e) Calculated active and reactive power output on the high or low side of the MPT that represents the flow from one or multiple IBR units behind the MPT.

6.1.4.4 Data Retention and Data Reporting Requirements for Fault Recording, Sequence of Events Recording, and Phasor Measurement Unit Equipment

(1) A Generation Resource owner or ESR owner required to have and maintain data regarding electrical quantities shall maintain and retain the data for the maximum period the equipment allows and at a minimum for:

(a) A rolling 30 calendar day period for all data;

(b) At least three years for event data used for model validation in accordance with NERC Reliability Standards; and

(c) At least three years for event data provided to ERCOT, the NERC Regional Entity, or NERC via written request recorded in the context of an ERCOT, NERC Regional Entity, or NERC-initiated event analysis or review.

(2) Each Generation Resource owner and ESR owner shall provide to the requesting Entity, upon request, fault recording, sequence of events recording, and Phasor measurement unit data locations as follows:

(a) Data for 30 calendar days, including the day the data was recorded;

(b) Data subject to item (2)(a) above within seven calendar days of a request unless the requestor grants an extension;

(c) Sequence of events data in ASCII Comma Separated Value (CSV) format as follows: Date, Time, Local Time Code, Substation, Device, State;

(d) Fault recording and phasor measurement unit data in electronic files formatted in conformance with Institute of Electrical and Electronic Engineers (IEEE) C37.111, IEEE Standard for Common Format for Transient Data Exchange (COMTRADE), revision C37.111-1999 or later;

(e) Data files named in conformance with IEEE C37.232, revision C37.232-2011 or later; and

(f) If available, fault recording data in electronic files in SEL ASCII event report (.EVE), compressed ASCII (.CEV), Motor Start Report (.MSR) and Sequential Events Recorder record (.SER) format.

6.1.5 Maintenance and Testing Requirements

(1) Each Market Participant with dynamic disturbance recording, phasor measurement recording, fault recording, or sequence of events recording equipment identified by Section 6.1.2, Section 6.1.3, and Section 6.1.4, shall maintain and test recording equipment as follows:

(a) Calibrate the recording devices at installation and when records from the equipment indicate a calibration problem;

(b) Maintain phasor measurement recording equipment to ensure a minimum availability of good data quality of at least 95% on a rolling 30 day basis if transmitted to an ERCOT phasor data concentrator via a communication link;

(c) Maintain phasor measurement recording equipment to ensure data stored locally is available upon request by verifying data availability and quality at least once every 30 calendar days, or institute an automated notification system to detect when the equipment ceases recording required data or fails to timely refresh the data.

(2) Each Market Participant with dynamic disturbance recording equipment, phasor measurement recording, fault recording, or sequence of events recording equipment identified by Section 6.1.2, Section 6.1.3, and Section 6.1.4 shall, within 30 calendar days of the discovery of a failure of the required data production, either:

(a) Restore the recording capability, or

(b) Notify and submit to ERCOT a plan and timeline for the equipment to have recording capabilities restored.

6.1.6 Equipment Reporting Requirements

(1) Each Market Participant with dynamic disturbance recording, phasor measurement recording, fault recording, or sequence of events recording equipment identified by Section 6.1.2, Section 6.1.3, and Section 6.1.4 shall:

(a) Maintain a current database summarizing disturbance monitoring equipment installations that includes installation location, type of equipment, equipment make and model, operational status, and a list of the major equipment monitored; And

(b) Have and maintain a complete list of all monitored points at each Facility and, when requested by ERCOT, the NERC Regional Entity, or NERC, provide the list within 30 days.

6.1.7 Review Process

(1) After December 31, 2025, ERCOT shall review disturbance monitoring equipment locations for adequacy when significant changes are made to the ERCOT System or at least every five years.

(2) Transmission Facility owners shall review fault recording and sequence of events recording equipment locations for compliance at least every five years.

(3) Existing Facility owners identified in the reviews shall have three years from the time of notification to install the equipment.