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| NOGRR Number | [255](https://www.ercot.com/mktrules/issues/NOGRR255) | NOGRR Title | High Resolution Data Requirements |
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| **Date** | | December 4, 2023 | |
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| **Submitter’s Information** | | | |
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| Cell Number | | 202-270-5758 | |
| Market Segment | | Independent Generator | |

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| Comments |

As an equipment manufacturer and a software company, Tesla continuously logs telemetry from its products to its servers to support service needs and research and development.  Tesla’s data retention policy also generally exceeds the requirements proposed in Nodal Operating Guide Revision Request (NOGGRR) 255. While Tesla has been leveraging this data to meet its own equipment guarantees and needs, we acknowledge that a number of our existing (and future) customers may not have access to this kind of telemetry pipeline and troubleshooting tools. Therefore, Tesla would like to leverage this functionality and allow its customers to comply with certain requirements proposed in NOGGR255 by relying on the original equipment manufacturer for the required data. Other generator owners may have contracted with third parties using similar approaches of storing data in the cloud for Operations and Maintenance (O&M) and analytics purposes, and could benefit from the ability to request data from a third party to comply with ERCOT’s proposed requirements.

Requiring the installation of additional equipment comes with a cost for generator owners: outage time onsite and missed market revenues, new equipment, field labor for installation and commissioning. Tesla is continuously improving the quality and performance of its products by performing, with customer’s approval, software and firmware updates. These updates allow Tesla to address existing issues without requiring onsite labor and require limited outage time compared to hardware retrofits. Tesla would like to highlight that the Inverter-Based Resource (IBR) unit (and adjacent cabinet-level hardware and software) itself can be used to record data in lieu of a distinct fault or sequence of events recorder. As such, some of the requirements in NOGGR255, such as inverter unit-level sequence of event recording, can be met with additional firmware developments and updates, rather than a physical equipment installation. Other requirements, such as the time synchronization accuracy for sequence of events and fault records, and the sampling rate and duration of fault records, will necessitate product improvements inside of the IBR unit with hardware changes. Tesla recommends lowering requirements for IBR unit-level time synchronization and fault record data (sample rate and duration) for resources installed prior to January 1, 2026, to avoid equipment retrofits leading to additional cost and downtime or impact to ongoing or planned deployments within ERCOT.

In addition, Tesla has the following comments or questions:

1. In paragraph (1)(a)(i) of Section 6.1.2.1, Fault Recording Requirements, there is no neutral on a Tesla Megapack, so we add “when applicable.”
2. In Section 6.1.4.1, Fault Recording and Sequence of Events Recording Equipment Requirements, we suggest a new paragraph (3) to allow the IBR unit itself (i.e., an individual Megapack) to meet these requirements. We suggest a different timing 100 microseconds instead of 1. We would welcome a lower requirement for existing resources and recommend lowering the time synchronization accuracy requirement to +/-1ms.
3. In paragraph (1) of Section 6.1.4.1.1, Sequence of Events Recording Data Requirements, we add “ability to obtain” to reflect how Tesla as an original equipment manufacturer provides this service on behalf of its customers. We also add “alarm or status” to reflect our understanding of items (iv) and (v) in paragraph (1)(b) of Section 6.4.1.1.1 but would welcome ERCOT providing more specificity around its expectations.
4. We add “ability to obtain” to paragraph (1) of Section 6.1.4.1.2, Fault Recording Data and Triggering Requirements. We also add “when applicable” to paragraph (1)(b)(iii) of Section 6.1.4.1.2. Tesla’s architecture does not have a single DC bus, instead current Megapacks have 24 separate modules, so therefore could not provide a single measurement per unit. In paragraph (2)(a)(i) of Section 6.1.4.1.2 we add “when applicable” to reflect that there is no neutral in the Megapack design.
5. For paragraph (2)(b) of Section 6.1.4.1.2, we add “for AC-side data” for clarity (see above) and change the applicable date to January 1, 2026 to allow for the necessary hardware changes to take place. We add “-capable” to fault recording equipment to reflect the fact this can apply to the IBR unit. We would welcome a lower requirement for existing resources and recommend lowering either the sampling rate (1 sample per cycle for 5s) or lowering the duration (16 samples per cycle for 0.3 s).
6. For paragraph (2)(d) of Section 6.1.4.4, Data Retention and Data Reporting Requirements for Fault Recording, Sequence of Events Recording, and Phasor Measurement Unit Equipment, we suggest an additional data format: Comma Separated Value (CSV)..

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| **Revised Cover Page Language** |

None

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| Revised Proposed Guide Language |

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 some 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) Phasor measurement involves measuring time 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 digital relay, fault recording equipment or dedicated phasor measurement unit.

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

(f) 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, phasor measurement, 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 (+/-2 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 0.2 p.u. or less of rated current transformer current transformer secondary current when applicable;

(ii) Phase under-voltage below 0.85 p.u. for two cycles or longer; or;

(iii) Phase overcurrent above the equipment’s maximum emergency current rating; or

(iv) Protective relay tripping for all protection groups;

(v) Any other trigger criterion (including deviations to the above triggers) based on local conditions as reviewed and approved by ERCOT.

(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 owned by 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 Load consisting of one or more Facilities at a single site with an aggregate peak Demand greater than or equal to 20 MW that has experienced an abnormal trip or load reduction (including if caused by a DGR, DESR, or SODG) after a fault:

(i) ERCOT may require the installation of fault recording and sequence of events recording equipment;

(ii) The interconnecting Transmission Service Provider (TSP) or Distribution Service Provider (DSP) shall install the recording equipment’

(iii) A suitable location for the recording equipment will be coordinated between ERCOT and the interconnecting TSP or DSP;

(iv) The recording equipment will be installed as soon as practicable, but no longer than 18 months after ERCOT notifies the TSP or DSP it must install the equipment, unless ERCOT provides an extension;

(v) If the TSP or DSP determines that the recording equipment installation is infeasible due to engineering, technical or operational reasons, it will provide such rationale to ERCOT for consideration.

(e) For any Load consisting of one or more Facilities at a single site with an aggregate peak Demand greater than or equal to 75 MW behind one or more common Points of Interconnection (POIs) or Service Delivery Points:

(i) ERCOT may require the installation of fault recording and sequence of events recording equipment;

(ii) The interconnecting TSP or DSP shall install the recording equipment;

(iii) A suitable location for the recording equipment will be coordinated between ERCOT and the interconnecting TSP or DSP;

(iv) The recording equipment will be installed as soon as practicable, but no longer than 18 months after ERCOT notifies the TSP or DSP it must install the equipment, unless ERCOT provides an extension; and

(v) If the TSP or DSP determines that the recording equipment installation is infeasible due to engineering, technical or operational reasons, it will provide such rationale in writing to ERCOT for consideration.

(2) Facility owners shall install the fault recording and sequence of events recording equipment identified in paragraph (1) above as soon as practicable.

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| ***[NOGRR255: Replace paragraph (2) above with the following no earlier than <Insert Date at least 18 months after PUCT approval> and renumber accordingly:]***  (2) Facility owners shall have at least 50% of the new fault recording and sequence of events recording equipment identified in paragraph (1) above installed. |

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| ***[NOGRR255: Delete paragraph (2) no earlier than <Insert Date at least 36 months after PUCT approval> and renumber accordingly:]*** |

(3) For any Generation Resource or ESR that has experienced an abnormal trip or power reduction after a fault, ERCOT may require the installation of fault recording and sequence of events recording equipment and the Resource 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 locations specified in Section 6.1.2.2, Fault Recording and Sequence of Events Recording Equipment Location 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 ERCOT 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 reasonably 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 may be provided in electronic files in SEL ASCII event report (.EVE), compressed ASCII (.CEV), or Motor Start Report (.MSR) in both raw and filtered format in addition to the data required above.

(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) Phase under-voltage below 0.85 p.u. for two cycles or longer;

(ii) Phase under-voltage that would trigger Under-Voltage Load Shed (UVLS);

(iii) Phase over-voltage greater than 1.15 p.u. for two cycles or longer;

(iv) Frequency below 59.5 Hz or above 60.5 Hz; and

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

(vi) Any other trigger criterion (including deviations to the above triggers) based on local conditions as reviewed and approved by ERCOT.

(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 provide notification to Facility owners who shall install and maintain dynamic disturbance recording equipment at the following locations:

(a) A Generation Resource(s) that is not an IBR with:

(i) Gross individual nameplate rating greater than or equal to 500 MVA; or

(ii) Gross individual nameplate rating greater than or equal to 300 MVA if the gross plant/facility aggregate nameplate rating 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 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.



***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 owner locations meeting the 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 reasonably 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 ERCOT, 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 compliant with 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) 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) Each Transmission Element part of a monitored IROL interface;

(g) For any synchronous condensers used to support the transmission system

(h) Any one Transmission Element within:

(i) A voltage sensitive area as defined by an area with an in-service 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.

(i) For any Load consisting of one or more Facilities at a single site with an aggregate peak demand greater than or equal to 20 MW that experienced abnormal trips or Load reductions (including if caused by a DGR, DESR, or SODG) after a fault:

1. ERCOT may require the installation of phasor measurement recording equipment;
2. The interconnecting Transmission Service Provider (TSP) or Distribution Service Provider (DSP) shall install the recording equipment;
3. A suitable location for the recording equipment will be coordinated between ERCOT and the interconnecting TSP or DSP;
4. The recording equipment will be installed as soon as practicable, but no longer than 18 months after ERCOT notifies the TSP or DSP it must install the equipment, unless the requestor provides an extension;
5. If the TSP or DSP determines that the recording equipment installation is infeasible due to engineering, technical or operational reasons, it will provide such rationale in writing to ERCOT.

(j) For any Load consisting of one or more Facilities at a single site with an aggregate peak Demand greater than or equal to 75 MW behind one or more common Points of Interconnection (POIs) or Service Delivery Points:

1. ERCOT may require the installation of phasor measurement recording equipment;
2. The interconnecting Transmission Service Provider (TSP) or Distribution Service Provider (DSP) shall install the recording equipment;
3. A suitable location for the recording equipment will be coordinated between ERCOT and the interconnecting TSP or DSP;
4. The recording equipment will be installed as soon as practicable, but no longer than 18 months after ERCOT notifies the TSP or DSP it must install the equipment, unless the requestor provides an extension;
5. If the TSP or DSP determines that the recording equipment installation is infeasible due to engineering, technical or operational reasons, it will provide such rationale in writing to ERCOT for consideration.

(2) Facility owners shall install the new phasor measurement units identified in paragraph (1) above as soon as practicable.

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| ***[NOGRR255: Replace paragraph (2) above with the following no earlier than <Insert Date at least 18 months after PUCT approval>:]***  (2) Facility owners shall have at least 50% of the new phasor measurement units identified in paragraph (1) above installed. |

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| ***[NOGRR255: Delete paragraph (2) no earlier than <Insert Date at least 36 months after PUCT approval>.]*** |

***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 reasonably 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) Facility owners shall install the new fault recording and sequence of events recording equipment identified in this section as soon as practicable.

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| ***[NOGRR255: Replace paragraph (3) above with the following no earlier than <Insert Date at least 18 months after PUCT approval>:]***  (2) Facility owners shall have at least 50% of the new phasor measurement units identified in paragraph (1) above installed. |

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| ***[NOGRR255: Delete paragraph (3) no earlier than <Insert Date at least 36 months after PUCT approval>.]*** |

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).

(3) In the case of IBR unit-level sequence of event or fault recording, the IBR unit itself may perform the sequence of event or fault recording. The IBR unit shall be time synchronized with a Global Positioning System-based clock, or ERCOT approved alternative, with sub-cycle (+/- 100 microseconds) timing accuracy and performance 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 the ability to obtain 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 alarm or status;

(v) High and low voltage frequency ride-through alarm or status; 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 the ability to obtain 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 when applicable.

(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 when applicable;

(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 59.5 Hz or above 60.5 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, for AC-side data, of:

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

(ii) 16 samples per cycle for any fault recording-capable equipment installed prior to January 1, 2026 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, or for IBR unit-level data, in Comma Separated Value (CSV);

(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 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.