

Standard Development Timeline

This section is maintained by the drafting team during the development of the standard and will be removed when the standard is adopted by the NERC Board of Trustees (Board).

Description of Current Draft

Completed Actions	Date
Standards Committee approved Standard Authorization Request (SAR) for posting	01/20/2021
SAR posted for comment	06/14/2021 – 07/13/2021
Standards Committee approved revised Standard Authorization Request (SAR) for creating a new Standard	4/19/2023

Anticipated Actions	Date
45-day formal comment period with ballot	08/01/2023 – 09/15/2023
45-day formal or informal comment period with additional ballot	11/01/2023 – 12/15/2023
10-day final ballot	TBD
Board adoption	TBD

New or Modified Term(s) Used in NERC Reliability Standards

This section includes all new or modified terms used in the proposed standard that will be included in the *Glossary of Terms Used in NERC Reliability Standards* upon applicable regulatory approval. Terms used in the proposed standard that are already defined and are not being modified can be found in the *Glossary of Terms Used in NERC Reliability Standards*. The new or revised terms listed below will be presented for approval with the proposed standard. Upon Board adoption, this section will be removed.

Term(s):

N/A.

A. Introduction

1. **Title:** Disturbance Monitoring and Reporting Requirements for Inverter-Based Resources
2. **Number:** PRC-028-1
3. **Purpose:** To have adequate data available from inverter-based resources (IBR) to facilitate analysis of Bulk Electric System (BES) Disturbances.
4. **Applicability:**
 - 4.1. **Functional Entities:**
 - 4.1.1. Transmission Owner that owns equipment as identified in section 4.2
 - 4.1.2. Generator Owner that owns equipment as identified in section 4.2
 - 4.2. **Facilities:** The following Elements associated with BES generating plants (inverter-based portion of generating plant/Facility meeting the criteria set by Inclusion I2, Part (b) or Inclusion I4 of the BES definition):
 - 4.2.1. Circuit breaker(s).
 - 4.2.2. Main power transformer(s)¹.
 - 4.2.3. Collector bus.
 - 4.2.4. Shunt static or dynamic reactive device(s).
 - 4.2.5. At least one IBR unit² connected to last 10% of each collector feeder length (i.e., furthest from the collector bus).
5. **Effective Date:** See Implementation Plan

B. Requirements and Measures

- R1. Each Transmission Owner and Generator Owner shall have sequence of event recording (SER) data for the following Elements that it owns: [*Violation Risk Factor: Lower*] [*Time Horizon: Long-term Planning*]
 - 1.1. Circuit breaker position (open/close) for circuit breakers associated with the Elements identified in section 4.2.
 - 1.2. At least one IBR unit connected to last 10% of each collector feeder length. IBR units installed prior to the effective date of this standard and are not capable of recording this data are excluded.
 - 1.2.1. All fault codes.

¹ For the purpose of this standard, the main power transformer is the power transformer that steps up voltage from the collection system voltage to the nominal transmission/interconnecting system voltage for dispersed power producing resources.

² IBR unit includes the inverter, converter, wind turbine generator, or high voltage direct current converter connecting generating resource to alternating current Transmission network.

- 1.2.2. All fault alarms.
 - 1.2.3. Change of operating mode.
 - 1.2.4. High and low voltage ride-through.
 - 1.2.5. High and low frequency ride-through.
 - 1.2.6. Control system command values, reference values, and feedback signals.
- M1.** The Transmission Owner or Generator Owner has evidence (electronic or hard copy) of data, as applicable, as specified in Requirement R1. Evidence may include, but is not limited to: (1) actual data recordings; or (2) documents describing the device interconnections and configurations which may include a single design standard as representative for common installations; or (3) station or equipment drawings.
- R2.** Each Transmission Owner and Generator Owner shall have triggered fault recording (FR) data to determine the following electrical quantities for Elements that it owns: *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*
- 2.1. High-side of the main power transformer FR data:
 - 2.1.1. Phase-to-neutral voltage for each phase.
 - 2.1.2. Each phase current and the residual or neutral current.
 - 2.1.3. Real and Reactive Power.
 - 2.2. IBR unit FR data from at least one IBR unit connected to last 10% of each collector feeder length:
 - 2.2.1. 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.
 - 2.2.2. 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.
 - 2.2.3. DC bus current and voltage. IBR units installed prior to the effective date of this standard and are not capable of recording this data are excluded.
 - 2.3. Dynamic reactive device
 - 2.3.1. Phase-to-neutral voltage for each phase.
 - 2.3.2. Each phase current and the residual or neutral current.
 - 2.3.3. Real and Reactive Power output.
- M2.** The Transmission Owner or Generator Owner has evidence (electronic or hard copy) of FR data that is sufficient to determine electrical quantities as specified in Requirement R2. Evidence may include, but is not limited to: (1) actual data recordings or derivations; or (2) documents describing the device specifications and configurations which may include a single design standard as representative for common installations; or (3) station or equipment drawings.

- R3.** Each Transmission Owner and Generator Owner shall have FR data as specified in Requirement R2 that meets the following: *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*
- 3.1.** High-side of the main power transformer FR data
 - 3.1.1.** 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 2.0 seconds for the same trigger point.
 - 3.1.2.** A minimum recording rate of 128 samples per cycle.
 - 3.1.3.** Trigger settings for at least the following:
 - 3.1.3.1.** Neutral (residual) overcurrent.
 - 3.1.3.2.** AC phase overvoltage and undervoltage.
 - 3.2.** IBR unit level data
 - 3.2.1.** 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 2 seconds for the same trigger point.
 - 3.2.2.** A minimum recording rate of 128 samples per cycle.
 - 3.2.3.** Trigger settings for at least the following:
 - 3.2.3.1.** AC Phase overvoltage and undervoltage.
 - 3.2.3.2.** DC overvoltage, DC overcurrent, and DC reverse current.
 - 3.2.3.3.** Overfrequency and underfrequency.
 - 3.3.** Dynamic reactive device FR data
 - 3.3.1.** 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 2.0 seconds for the same trigger point.
 - 3.3.2.** A minimum recording rate of 128 samples per cycle.
 - 3.3.3.** Trigger settings for at least the following:
 - 3.3.3.1.** Neutral (residual) overcurrent.
 - 3.3.3.2.** AC phase overvoltage and undervoltage.
- M3.** The Transmission Owner or Generator Owner has evidence (electronic or hard copy) that FR data meets Requirement R3. Evidence may include, but is not limited to: (1) actual data recordings or derivations, or (2) documents describing the device specification and device configuration or settings.
- R4.** Each Generator Owner and Transmission Owner shall have continuous dynamic Disturbance recording (DDR) data and storage to determine the following electrical

quantities for each main power transformer(s) it owns: *[Violation Risk Factor: Lower]*
[Time Horizon: Long-term Planning]

- 4.1.** One phase-to-neutral or positive sequence voltage on high-side of the main power transformer(s).
 - 4.2.** The phase current for the same phase at the same voltage corresponding to the voltage in Requirement R4, Part 4.1, or the positive sequence current.
 - 4.3.** Real Power and Reactive Power flows expressed on a three-phase basis corresponding to each main power transformer(s) where current measurements are required.
 - 4.4.** Frequency of any one of the voltage(s) in Requirement R4, Part 4.1.
- M4.** The Generator Owner or Transmission Owner has evidence (electronic or hard copy) of continuous DDR data recording and storage to determine electrical quantities as specified in Requirement R4. Evidence may include, but is not limited to: (1) actual data recordings or derivations; or (2) documents describing the device specifications and configurations, which may include a single design standard as representative for common installations; or (3) station drawings.
- R5.** Each Transmission Owner and Generator Owner responsible for DDR data for the electrical quantities identified in Requirement R4 shall meet the following: *[Violation Risk Factor: Lower]* *[Time Horizon: Long-term Planning]*
- 5.1.** Input sampling rate of at least 960 samples per second.
 - 5.2.** Output recording rate of electrical quantities of at least 60 times per second.
- M5.** The Transmission Owner or Generator Owner has evidence (electronic or hard copy) that DDR data meets Requirement R5. Evidence may include, but is not limited to: (1) documents describing the device specification, device configuration, or settings (R5, Part 5.1; R5, Part 5.2); or (2) actual data recordings (R5, Part 5.2).
- R6.** Each Transmission Owner and Generator Owner shall time synchronize all SER, FR, and DDR data to meet the following: *[Violation Risk Factor: Lower]* *[Time Horizon: Long-term Planning]*
- 6.1.** Synchronization to Coordinated Universal Time (UTC) with or without a local time offset.
 - 6.2.** Synchronized device clock accuracy within ± 100 microseconds of UTC.
- M6.** The Transmission Owner or Generator Owner has evidence (electronic or hard copy) of time synchronization described in Requirement R6. Evidence may include, but is not limited to: (1) documents describing the device specification, configuration, or setting; (2) time synchronization indication or status; or (3) station drawings.
- R7.** Each Transmission Owner and Generator Owner shall provide, upon request, all SER, FR, and DDR data to its Reliability Coordinator, Regional Entity, or NERC in accordance with the following: *[Violation Risk Factor: Lower]* *[Time Horizon: Long-term Planning]*

- 7.1. Data shall be retrievable for the period of 30 calendar days, inclusive of the day the data was recorded.
 - 7.2. Data subject to Part 7.1 shall be provided within 30 calendar days of a request unless an extension is granted by the requestor.
 - 7.3. SER data shall be provided in ASCII³ Comma Separated Value (CSV) format following Attachment 1.
 - 7.4. FR and DDR data shall be provided in electronic files that are formatted in conformance with C37.111, (IEEE Standard Common Format for Transient Data Exchange (COMTRADE)), revision C37.111-1999 or later.
 - 7.5. Data files shall 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.
- M7.** The Transmission Owner or Generator Owner has evidence (electronic or hard copy) that data was submitted upon request in accordance with Requirement R7. Evidence may include, but is not limited to: (1) actual data recordings; (2) dated transmittals to the requesting entity with formatted records; or (3) documents describing data storage capability, device specification, configuration, or settings.
- R8.** Each Transmission Owner and Generator Owner shall, within 90 calendar days of the discovery of a failure of the recording capability for the SER, FR, or DDR data, either: *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*
- Restore the recording capability, or
 - Submit a Corrective Action Plan (CAP) to the Regional Entity and implement it.
- M8.** The Transmission Owner or Generator Owner has dated evidence (electronic or hard copy) that meets Requirement R8. Evidence may include, but is not limited to: (1) dated reports of the discovery of a failure, (2) documentation noting the date the data recording was restored, (3) SCADA records, or (4) dated Corrective Action Plan transmittals to the Regional Entity and evidence of Corrective Action Plan implementation.

C. Compliance

1. Compliance Monitoring Process

- 1.1. Compliance Enforcement Authority:** “Compliance Enforcement Authority” (CEA) means NERC or the Regional Entity, or any entity as otherwise designated by an Applicable Governmental Authority, in their respective roles of monitoring and/or enforcing compliance with mandatory and enforceable Reliability Standards in their respective jurisdictions.

³ American Standard Code for Information Exchange.

1.2. Evidence Retention: The following evidence retention period(s) identify the period of time an entity is required to retain specific evidence to demonstrate compliance. For instances where the evidence retention period specified below is shorter than the time since the last audit, the CEA may ask an entity to provide other evidence to show that it was compliant for the full-time period since the last audit.

The applicable entity shall keep data or evidence to show compliance as identified below unless directed by its CEA to retain specific evidence for a longer period of time as part of an investigation.

The Transmission Owner and Generator Owner shall retain evidence, as per Requirements R1 through R8, for three calendar years.

If a Transmission Owner or Generator Owner is found non-compliant, it shall keep information related to the non-compliance until mitigation is completed and approved or for the time specified above, whichever is longer.

The Compliance Enforcement Authority shall keep the last audit records, and all requested and submitted subsequent audit records.

1.3. Compliance Monitoring and Enforcement Program:

- Compliance Audit
- Self-Certification
- Spot Checking
- Compliance Violation Investigation
- Self-Reporting
- Complaints

1.4. Additional Compliance Information

None.

Violation Severity Levels

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	Long-term Planning	Lower	Each Transmission Owner or Generator Owner as directed by Requirement R1 to have the required SER data had more than 80 percent, but less than 100 percent of the Elements (circuit breaker(s) or IBR units) identified in Section 4.2 Facilities.	Each Transmission Owner or Generator Owner as directed by Requirement R1 to have the required SER data had more than 70 percent, but less than or equal to 80 percent of the Elements (circuit breaker(s) or IBR units) identified in Section 4.2 Facilities.	Each Transmission Owner or Generator Owner as directed by Requirement R1 to have the required SER data had more than 60 percent, but less than or equal to 70 percent of the Elements (circuit breaker(s) or IBR units) identified in Section 4.2 Facilities.	Each Transmission Owner or Generator Owner as directed by Requirement R1 to have the required SER data had less than or equal to 60 percent of the Elements (circuit breaker(s) or IBR units) identified in Section 4.2 Facilities.
R2	Long-term Planning	Lower	The Transmission Owner or Generator Owner had FR data as directed by Requirement R2, Parts 2.1 and 2.2 that covers more than 80 percent, but less than 100 percent of the total required electrical quantities, which is the product of the total number of monitored Elements and the number of specified electrical	The Transmission Owner or Generator Owner had FR data as directed by Requirement R2, Parts 2.1 and 2.2 that covers more than 70 percent, but less than or equal to 80 percent of the total required electrical quantities, which is the product of the total number of monitored Elements and the number of specified electrical	The Transmission Owner or Generator Owner had FR data as directed by Requirement R2, Parts 2.1 and 2.2 that covers more than 60 percent, but less than or equal to 70 percent of the total required electrical quantities, which is the product of the total number of monitored Elements and the number of specified electrical	The Transmission Owner or Generator Owner had FR data as directed by Requirement R2, Parts 2.1 and 2.2 that covers less than or equal to 60 percent of the total required electrical quantities, which is the product of the total number of monitored Elements and the number of specified electrical

			quantities for each Element.	quantities for each Element.	quantities for each Element.	quantities for each Element.
R3	Long-term Planning	Lower	The Transmission Owner or Generator Owner had FR data that meets more than 80 percent, but less than 100 percent of the total recording parameters as specified in Requirement R3.	The Transmission Owner or Generator Owner had FR data that meets more than 70 percent, but less than or equal to 80 percent of the total recording parameters as specified in Requirement R3.	The Transmission Owner or Generator Owner had FR data that meets more than 60 percent, but less than or equal to 70 percent of the total recording parameters as specified in Requirement R3.	The Transmission Owner or Generator Owner had FR data that meets less than or equal to 60 percent of the total recording parameters as specified in Requirement R3.
R4	Long-term Planning	Lower	The Transmission Owner or Generator Owner had DDR data as directed by Requirement R4, Parts 4.1 through 4.4 that covered more than 80 percent, but less than 100 percent of the total required electrical quantities, which is the product of the total number of monitored Elements and the number of specified electrical quantities for each Element.	The Transmission Owner or Generator Owner had DDR data as directed by Requirement R4, Parts 4.1 through 4.4 for more than 70 percent, but less than or equal to 80 percent of the total required electrical quantities, which is the product of the total number of monitored Elements and the number of specified electrical quantities for each Element.	The Transmission Owner or Generator Owner had DDR data as directed by Requirement R4, Parts 4.1 through 4.4 for more than 60 percent, but less than or equal to 70 percent of the total required electrical quantities, which is the product of the total number of monitored Elements and the number of specified electrical quantities for each Element.	The Transmission Owner or Generator Owner had DDR data as directed by Requirement R4, Parts 4.1 through 4.4 for less than or equal to 60 percent of the total required electrical quantities, which is the product of the total number of monitored Elements and the number of specified electrical quantities for each Element.

R5	Long-term Planning	Lower	The Transmission Owner or Generator Owner had DDR data that meets more than 80 percent, but less than 100 percent of the total recording parameters as specified in Requirement R5.	The Transmission Owner or Generator Owner had DDR data that meets more than 70 percent, but less than or equal to 80 percent of the total recording properties as specified in Requirement R5.	The Transmission Owner or Generator Owner had DDR data that meets more than 60 percent, but less than or equal to 70 percent of the total recording properties as specified in Requirement R5.	The Transmission Owner or Generator Owner had DDR data that meets less than or equal to 60 percent of the total recording properties as specified in Requirement R5.
R6	Long-term Planning	Lower	The Transmission Owner or Generator Owner had time synchronized SER, FR, or DDR data per Requirement R6, Parts 6.1 and 6.2 for more than 90 percent, but less than 100 percent of the Elements.	The Transmission Owner or Generator Owner had time synchronized SER, FR, or DDR data per Requirement R6, Parts 6.1 and 6.2 for more than 80 percent, but less than or equal to 90 percent of the Elements.	The Transmission Owner or Generator Owner had time synchronized SER, FR, or DDR data per Requirement R6, Parts 6.1 and 6.2 for more than 70 percent, but less than or equal to 80 percent of the Elements.	The Transmission Owner or Generator Owner failed to have time synchronized SER, FR, or DDR data per Requirement R6, Parts 6.1 and 6.2 for less than or equal to 70 percent of the Elements.
R7	Long-term Planning	Lower	<p>The Transmission Owner or Generator Owner as directed by Requirement R7 provided more than 90 percent, but less than 100 percent of the requested data.</p> <p>OR</p> <p>The Transmission Owner or Generator Owner as</p>	<p>The Transmission Owner or Generator Owner as directed by Requirement R7 provided more than 80 percent, but less than or equal to 90 percent of the requested data.</p> <p>OR</p> <p>The Transmission Owner or Generator Owner as</p>	<p>The Transmission Owner or Generator Owner as directed by Requirement R7 provided more than 70 percent, but less than or equal to 80 percent of the requested data.</p> <p>OR</p> <p>The Transmission Owner or Generator Owner as</p>	<p>The Transmission Owner or Generator Owner as directed by Requirement R7 failed to provide less than or equal to 70 percent of the requested data.</p> <p>OR</p> <p>The Transmission Owner or Generator Owner as</p>

			<p>directed by Requirement R7, Part 7.2 provided the requested data more than 30 calendar days, but less than or equal to 40 calendar days after the request, unless an extension was granted by the requestor.</p> <p>OR</p> <p>The Transmission Owner or Generator Owner as directed by Requirement R7, Parts 7.3 through 7.5 provided more than 90 percent of the data, but less than 100 percent of the data in the proper data format.</p>	<p>directed by Requirement R7, Part 7.2 provided the requested data more than 40 calendar days, but less than or equal to 50 calendar days after the request, unless an extension was granted by the requestor.</p> <p>OR</p> <p>The Transmission Owner or Generator Owner as directed by Requirement R7, Parts 7.3 through 7.5 provided more than 80 percent of the data, but less than or equal to 90 percent of the data in the proper data format.</p>	<p>directed by Requirement R7, Part 7.2 provided the requested data more than 50 calendar days, but less than or equal to 60 calendar days after the request, unless an extension was granted by the requestor.</p> <p>OR</p> <p>The Transmission Owner or Generator Owner as directed by Requirement R7, Parts 7.3 through 7.5 provided more than 70 percent of the data, but less than or equal to 80 percent of the data in the proper data format.</p>	<p>directed by Requirement R7, Part 7.2 failed to provide the requested data more than 60 calendar days after the request, unless an extension was granted by the requestor.</p> <p>OR</p> <p>The Transmission Owner or Generator Owner as directed by Requirement R7, Parts 7.3 through 7.5 provided less than or equal to 70 percent of the data in the proper data format.</p>
R8	Long-term Planning	Lower	<p>The Transmission Owner or Generator Owner as directed by Requirement R8 was unable to restore recording capability within 90 calendar days and provided a Corrective Action Plan to the Regional Entity more than 90 calendar days, but less than or equal to 100</p>	<p>The Transmission Owner or Generator Owner as directed by Requirement R8 was unable to restore recording capability within 90 calendar days and provided a Corrective Action Plan to the Regional Entity more than 100 calendar days, but less than or equal to 110 calendar</p>	<p>The Transmission Owner or Generator Owner as directed by Requirement R8 was unable to restore recording capability within 90 calendar days and provided a Corrective Action Plan to the Regional Entity more than 110 calendar days, but less than or equal to 120</p>	<p>The Transmission Owner or Generator Owner as directed by Requirement R8 was unable to restore recording capability within 90 calendar days and failed to provide a Corrective Action Plan to the Regional Entity more than 120</p>

			calendar days after discovery of the failure.	days after discovery of the failure.	calendar days after discovery of the failure. OR The Transmission Owner or Generator Owner as directed by Requirement R8 submitted a Corrective Action Plan to the Regional Entity but failed to implement it.	calendar days after discovery of the failure. OR Transmission Owner or Generator Owner as directed by Requirement R8 failed to restore the recording capability within 90 calendar days and failed to submit a Corrective Action Plan to the Regional Entity.
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D. Regional Variances

None.

E. Interpretations

None.

F. Associated Documents

NERC Reliability Standard PRC-028-1: Implementation Plan.

G. References

IEEE C37.111: Common format for transient data exchange (COMTRADE) for power Systems.

IEEE C37.232-2011: IEEE Standard for Common Format for Naming Time Sequence Data Files (COMNAME). Standard published 11/09/2011 by IEEE.

IEEE Std 2800-2022: IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems.

Multiple Solar PV Disturbances in CAISO, Joint NERC and WECC Staff Report, April 2022.

NERC Reliability Standard PRC-002-5.

Odessa Disturbance, Texas Events: May 9, 2021 and June 26, 2021, Joint NERC and Texas RE Event Report, September 2021.

Odessa Disturbance, Texas Event: June 4, 2022, Joint NERC and Texas RE Event Report, December 2022.

Version History

Version	Date	Action	Change Tracking
0	TBD	Adopted by NERC Board of Trustees	New

Attachment 1

Sequence of Events Recording (SER) Data Format (Requirement R7, Part 7.3)

Date, Time, Local Time Code, Plant Name, Device⁴, State⁵

08/27/23, 23:58:57.110, -5, Plant name 1, Breaker 1, Close

08/27/23, 23:58:57.082, -5, Plant name 2, Breaker 2, Close

08/27/23, 23:58:47.217, -5, Plant name 1, IBR unit 1, Open

08/27/23, 23:58:47.214, -5, Plant name 2, IBR unit 2, Open

08/27/23, 23:58:47.217, -5, Plant name 1, IBR unit 1, undervoltage ride-through mode

08/27/23, 23:58:47.214, -5, Plant name 2, IBR unit 2, dc overcurrent trip

⁴ Device name may include specific names of breakers or IBR units as appropriate.

⁵ Breaker status and any other terminology such as TRIP, TRIP TO LOCKOUT, RECLOSE, etc. is acceptable. For IBR unit level data, fault codes, alarms, change in operating mode etc. are also acceptable.