

Reliability Standards – Disturbance Monitoring Webinar

PRC-002-2 Disturbance Monitoring and Reporting Requirements

RELIABILITY | ACCOUNTABILITY



- Introductions
 - NERC Antitrust Guidelines
- Draft PRC-002-2
- Comment Periods and Ballot
 - PRC-002-2
 - Cost Effective Analysis Process (CEAP)
- Closing, Next Steps
- Questions

- NERC Antitrust Compliance Guidelines
 - It is NERC's policy and practice to obey the antitrust laws and to avoid all conduct that unreasonably restrains competition. This policy requires the avoidance of any conduct that violates, or that might appear to violate, the antitrust laws. Among other things, the antitrust laws forbid any agreement between or among competitors regarding prices, availability of service, product design, terms of sale, division of markets, allocation of customers or any other activity that unreasonably restrains competition. It is the responsibility of every NERC participant and employee who may in any way affect NERC's compliance with the antitrust laws to carry out this commitment.

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- Frank Ashrafi
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- Steve Myers
- Ryan Quint
- Jack Soehren
- Vladimir Stanisic
- Barb Nutter

Registered Entity

- Northeast Power Coordinating Council
- Southern California Edison
- Florida Power & Light Co.
- NRG Energy
- PSEG Fossil LLC
- ERCOT
- Bonneville Power Administration
- ITC Holdings Corp.
- AESI Inc.
- NERC Standard Developer

- Lee Pedowicz, Northeast Power Coordinating Council, Chair
- Chuck Jensen, Seminole Electric Cooperative
- Jack Soehren, ITC Holdings
- Ryan Quint, Bonneville Power Administration
- Tim Kucey, PSEG Fossil LLC
- Barb Nutter, NERC Standard Developer

- Two-hour webinar
- Drafting Team (DT) presentation followed by
- Informal Question and Answer session
 - Submitted via the chat feature
 - Please reference slide number, etc.
 - Presenters will attempt to address each question
 - Session is intended to provide better understanding

- Revised standard
 - PRC-002-2
 - Disturbance Monitoring and Reporting Requirements
- Will replace
 - PRC-002-1
 - Define Regional Disturbance Monitoring and Reporting Requirements
 - Not FERC approved
- Will retire
 - PRC-018-1
 - Disturbance Monitoring Equipment Installation and Data Reporting
 - FERC approved

- To have adequate data available to facilitate event analysis of Bulk Electric System (BES) disturbances.

The emphasis of Draft PRC-002-2 is on 'what' BES Disturbance Monitoring data is captured not on 'how' BES Disturbance Monitoring data is captured. Draft PRC-002-2 does not specify equipment.

Functional Entities:

4.1. The Responsible Entity is:

4.1.1. Eastern Interconnection – Planning Coordinator

4.1.2. ERCOT – Planning Coordinator or Reliability Coordinator

4.1.3. Western Interconnection – Reliability Coordinator

4.2. Transmission Owner

4.3. Generator Owner

- **Dynamic Disturbance Recording (DDR)**
The **recording** of time sequenced data for dynamic power system characteristics such as power swings, frequency variations, and abnormal voltage problems.
- **Fault Recording (FR)**
The **recording** of time sequenced waveform data for short circuits or failure of Elements resulting in abnormal voltage(s) and /or current(s).
- **Sequence of Events Recording (SOER)**
The **recording** of time sequenced data for change in status of Elements, which may include protection and control devices.

Requirements R1 through R5

Requirement	Entity	Identify Bus Locations	Notification	SOER	FR	5 Year Assessment
R1	TO	X		X	X	X
R2	TO		X	X	X	
R3	TO GO			X		
R4	TO GO				X	
R5	TO GO				X	

R1. Each Transmission Owner shall identify BES bus locations for Sequence of Events Recording (SOER) and Fault Recording (FR).

Parts 1.1 and 1.2 on next slide.

- 1.1. Bus locations shall be identified using *PRC-002-2 Attachment 1 – Sequence of Events Recording (SOER) and Fault Recording (FR) Locations Selection Methodology*.

- 1.2. Bus locations shall be assessed at least every five calendar years.

Highlights of TO's process:

- Determines a complete list of BES bus locations that it owns
- Eliminates any pseudo or fictitious BES buses from its list
- Sorts buses by highest to lowest three-phase short circuit MVA
- Eliminate buses:
 - below 1500 MVA or
 - below 20% of the Median (6th value down) from the top of the ordered list, by selecting the larger of the two values
- The selected BES bus listing:
 - Top 10% require FR and SOER,
 - Distributed 10% require FR and SOER
 - Overall total of 20% required
- Median Method Workbook provided to assist bus location selection

R2. Each **Transmission Owner** that identifies BES Elements at the locations established in Requirement R1 shall notify the owners of those Elements, within 90 calendar days of determination, that the Elements require Sequence of Events Recording (SOER) and Fault Recording (FR).

R3. Each **Transmission Owner** and **Generator Owner** shall have Sequence of Events Recording (SOER) for circuit breaker position (open/close) for each circuit breaker they own connected to the bus locations as per Requirement R2.

R4. Each **Transmission Owner** and **Generator Owner** shall have Fault Recording (FR) to determine the following electrical quantities at the bus locations as per Requirement R2:

Parts 4.1 and 4.2 on next slide

- 4.1. Phase-to-neutral voltages for each phase of either each line or bus.
- 4.2. Each phase current and the residual or neutral current for the following BES Elements:
 - 4.2.1. Transformers that have a low side operating voltage of 100kV or above.
 - 4.2.2. Transmission lines.

R5. Each **Transmission Owner** and **Generator Owner** shall have Fault Recording (FR) as specified in Requirement R4 that meets the following:

Parts 5.1 to 5.3 on next slide

- 5.1. A single record or multiple records that include:
 - A pre-trigger record length of at least two cycles and a post-trigger record length of at least 50 cycles for the same trigger point.
 - At least two cycles of the pre-trigger data, the first three cycles of the fault, and the final cycle of the fault.
- 5.2. A minimum recording rate of 16 samples per cycle.
- 5.3. Trigger settings for at least the following:
 - 5.3.1. Neutral (residual) overcurrent.
 - 5.3.2. Phase undervoltage.

Requirements R6 through R11

Requirement	Entity	Identify BES Elements	Notification	DDR	5 Year Assessment
R6	RE (PC RC)	X		X	X
R7	RE (PC RC)		X	X	
R8	TO			X	
R9	GO			X	
R10	TO GO			X	
R11	TO GO			X	

- R6. Each **Responsible Entity (Planning Coordinator or Reliability Coordinator, as applicable)** shall identify BES Elements for which Dynamic Disturbance Recording (DDR) is required.

Parts 6.1 and 6.2 on next three slides

6.1. The Elements shall include the following:

- 6.1.1. A minimum of one DDR location per 3,000 MW of the Responsible Entity's historical peak system Demand, inclusive of Requirement R6, Part 6.1, Sub-parts 6.1.2. – 6.1.7.
- 6.1.2. At least one DDR location in each Responsible Entity's footprint.

Parts 6.1 and 6.2 continue on next two slides

6.1.3. Generating resource(s) with:

6.1.3.1. Gross individual nameplate rating greater than or equal to 500 MVA.

6.1.3.2. Gross individual nameplate rating greater than or equal to 300 MVA where the gross plant/facility aggregate nameplate rating is greater than or equal to 1000 MVA.

6.1.4. Locations necessary to monitor all Elements of:

- Eastern Interconnection - all permanent Flowgates.
- ERCOT Interconnection - major transmission interfaces.
- Hydro-Quebec Interconnection - major transmission interfaces.
- Western Interconnection - all major transfer paths as defined by the Regional Entity.

Parts 6.1 and 6.2 continue on next slide

- 6.1.5. Both ends of high-voltage direct current (HVDC) terminals (back-to-back or each terminal of a DC circuit) on the alternating current (AC) portion of the converter.
 - 6.1.6. Locations necessary to monitor all Elements associated with Interconnection Reliability Operating Limits.
 - 6.1.7. Any one Element within a major voltage sensitive area as defined by an in-service UVLS program.
- 6.2. The Elements shall be assessed at least every five calendar years.

- R7. Each **Responsible Entity (Planning Coordinator or Reliability Coordinator, as applicable)** shall notify, within 90 calendar days of determination, each Transmission Owner and Generator Owner of the locations and Elements they own for which Dynamic Disturbance Recording (DDR) is required as established in Requirement R6.

R8. Each **Transmission Owner** shall have Dynamic Disturbance Recording (DDR), for each Element they own as per Requirement R7, to determine the following electrical quantities:

Parts 8.1 to 8.4 on next slide

- 8.1. One phase-to-neutral or positive sequence voltage.
- 8.2. The phase current on the same phase at the same voltage corresponding to the voltage in Requirement R8, Part 8.1, or the positive sequence current.
- 8.3. Real Power and Reactive Power flows expressed on a three-phase basis corresponding to all circuits where current measurements are required.
- 8.4. Frequency of any one of the voltage(s) in Requirement R8, Part 8.1.

R9. Each **Generator Owner** shall have Dynamic Disturbance Recording (DDR), for each Element they own as per Requirement R7, to determine the following electrical quantities:

Parts 9.1 to 9.4 on next slide

- 9.1. One phase-to-neutral, phase-to-phase, or positive sequence voltage at either the generator step up units (GSU) transformer high-side or low-side voltage level.
- 9.2. The phase current on the same phase at the same voltage in Requirement R9, Part 9.1, phase current(s) for any phase-to-phase voltages, or positive sequence current.
- 9.3. Real Power and Reactive Power flows expressed on a three-phase basis corresponding to all circuits where current measurements are required.
- 9.4. Frequency of at least one of the voltages in Requirement R9, Part 9.1.

R10. Each **Transmission Owner** and **Generator Owner** that is responsible for Dynamic Disturbance Recording (DDR) as per Requirement R7 shall have continuous data recording and storage. If the equipment was installed prior to the effective date of this Standard and is not capable of continuous recording, triggered records must meet the following:

Parts 10.1 and 10.2 on next two slides

- 10.1. Triggered record lengths of at least three minutes.
- 10.2. At least one of the following three triggers:

10.2 subparts on next slide

- Off nominal frequency trigger set at:

	Low	High
o Eastern Interconnection	<59.75 Hz	>61.0 Hz
o Western Interconnection	<59.55 Hz	>61.0 Hz
o ERCOT Interconnection	<59.35 Hz	>61.0 Hz
o Hydro-Quebec Interconnection	<58.55 Hz	>61.5 Hz

- Rate of change of frequency trigger set at:

o Eastern Interconnection	< -0.03125 Hz/sec	> 0.125 Hz/sec
o Western Interconnection	< -0.05625 Hz/sec	> 0.125 Hz/sec
o ERCOT Interconnection	< -0.08125 Hz/sec	> 0.125 Hz/sec
o Hydro-Quebec Interconnection	< -0.18125 Hz/sec	> 0.1875 Hz/sec

- Undervoltage trigger set at:

- o No lower than 85% of normal operating voltage for a duration of 5 seconds

R11. Each **Transmission Owner** and **Generator Owner** shall have Dynamic Disturbance Recording (DDR), for the Elements as per Requirement R7, which conform to the following technical specifications:

Parts 11.1 and 11.2 on next slide

- 11.1. Input sampling rate of at least 960 samples per second.
- 11.2. Output recording rate of electrical quantities of at least 30 times per second.

Requirements R12 through R14

Requirement	Entity	Time Synchronization	Provide SOER, FR, DDR Data	SOER, FR, DDR Availability
R12	TO GO	X		
R13	TO GO		X	
R14	TO GO			X

R12. Each **Transmission Owner** and **Generator Owner** shall time synchronize all Sequence of Events Recording (SOER), Fault Recording (FR), and Dynamic Disturbance Recording (DDR) data for the bus locations as per Requirement R2 and Elements as per Requirement R7 to within +/- 2 milliseconds of Coordinated Universal Time (UTC), time stamped with or without a local time offset.

R13. Each Transmission Owner and Generator Owner shall provide Sequence of Events Recording (SOER), Fault Recording (FR), and Dynamic Disturbance Recording (DDR) data for the bus locations as per Requirement R2 and Elements as per Requirement R7 to the Reliability Coordinator, Regional Entity, or NERC upon request:

Parts 13.1 to 13.5 on next two slides

- 13.1. The recorded data will be provided within 30 calendar days of a request.

- 13.2. The recorded data will be retrievable for the period of 10 calendar days preceding a request.

Parts 13.3 to 13.5 on next slide

- 13.3. Sequence of Events Recording data will be provided in Comma Separated Value (.CSV) format following Attachment 2.
- 13.4. Fault Recording and Dynamic Disturbance Recording data will be provided in electronic C37.111, IEEE Standard for Common Format for Transient Data Exchange (COMTRADE), formatted files.
- 13.5. Data files will be named in conformance with C37.232, IEEE Standard for Common Format for Naming Time Sequence Data Files (COMNAME).

Date	Time	Local Time Offset from UTC	Substation	Device	State ¹
08/27/13	23:58:57.110	EST	Sub 1	Breaker 1	Close
08/27/13	23:58:57.082	EST	Sub 2	Breaker 2	Close
08/27/13	23:58:47.217	EST	Sub 1	Breaker 1	Open
08/27/13	23:58:47.214	EST	Sub 2	Breaker 2	Open

¹Acceptable states are either OPEN or CLOSE

R14. Each **Transmission Owner** and **Generator Owner**, within 90 calendar days of the discovery of a failure of the Sequence of Events Recording (SOER), Fault Recording (FR), or Dynamic Disturbance Recording (DDR) at the bus locations as per Requirement R2 and Elements as per Requirement R7, shall:

Bullets on next slide

- Restore the recording ability.
- Report the inability to record data to the Regional Entity along with a Corrective Action Plan (CAP) to restore the recording ability.

- Important takeaways
 - Emphasis is on **WHAT** Bulk Electric System data is captured; not on **how** DM data is captured
 - Need for consistency of data recording across continent
 - Data capture locations for FR and SOER determined from three-phase short circuit MVA calculations
 - DDR requirements for transmission system and generators based on strategic studies and analyses
 - PRC-002-2 recognizes that existing equipment is in place to capture the required data
 - Retirement of PRC-018-1
 - Cost Effective Analysis Process (CEAP)

- [Project 2007-11](#) - 45 day comment period & ballot
 - November 1 through December 2 - Ballot Pool Forming (First 30 days of comment period)
 - November 1 through December 16 - Comment Period
 - Draft PRC-002-2
 - Median Method Workbook
 - Implementation Plan
 - December 6 through December 16 – Ballot (Last 10 days of comment period)
 - [Cost Effective Analysis Process](#) (CEAP) — 30 day comment period
 - November 1 through December 2

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 - To receive project announcements and updates
 - Request to be added to DMSDT_Plus
- Next Steps
 - Review comments



Questions and Answers