

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Project 2007-11 - Disturbance Monitoring PRC-002-2 Industry Webinar

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to ensure
the reliability of the
bulk power system

- Introduction – Stephanie Monzon
- Background – Navin Bhatt
- Proposed Disturbance Monitoring Standard PRC-002-2 – Jeff Pond
- Technical Aspects of PRC-002-2 – Chuck Jensen
- Implementation Plan – Navin Bhatt
- Questions

Disturbance Monitoring Standard Drafting Team (DMSDT) Roster:

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New Proposed Standard PRC-002-2

- **PURPOSE:** To ensure that Facility Owners collect the data needed to facilitate analyses of Disturbances on the Bulk Electric System (BES)
- PRC-002-2 to replace 2 existing standards
 1. PRC-002-1 (NERC approved)
 2. PRC-018-1 (FERC approved)

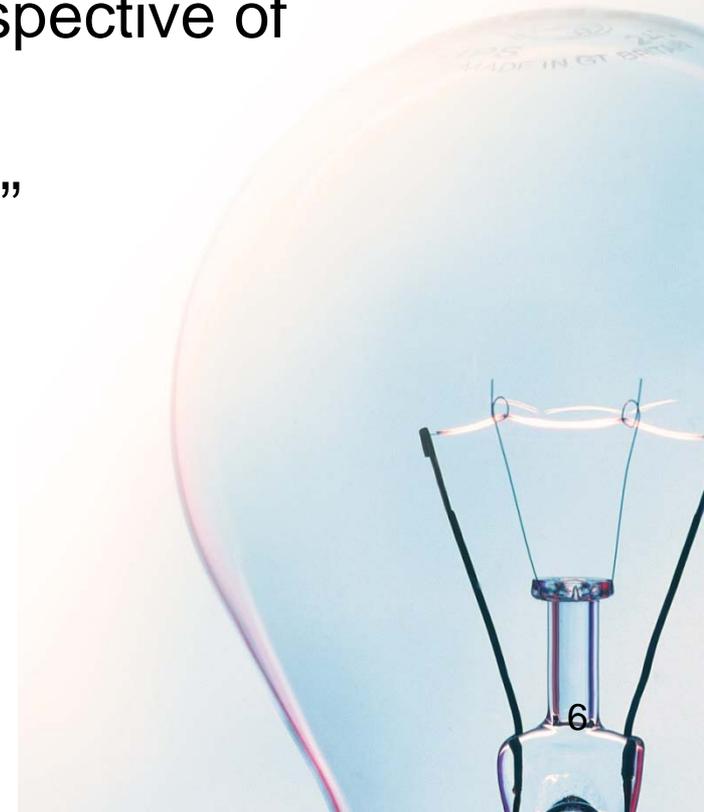


- Why Replace PRC-002-1?
 - To eliminate “fill-in-the-blank” requirements
 - To develop continent-wide requirements
 - Applicability: Not RROs, but Facility Owners

- Why Replace PRC-018-1?
 - PRC-018-1 Applicability: Facility Owners
 - All PRC-018-1 requirements are now incorporated in new PRC-002-2
 - Exception: Requirements related to maintenance & testing



- Overall Approach
 - Focus on data, NOT on equipment
 - Requirements developed for functionality of Disturbance data recording, irrespective of equipment used
 - Focus on “what” & NOT on “how”
 - Not prescriptive





- Equipment Maintenance & Testing Requirements of PRC-018-1
 - Excluded from PRC-002-2
 - Reason: Focus on data & NOT on equipment
 - Flexibility for Facility Owners to use any appropriate equipment (e.g. relays, digital fault recorders, phasor measurement units, swing recorders)
 - DMSDT does not have the expertise on a multitude of equipment that can be used



- **Definition of Substation**
 - IEEE Definition of Substation - An enclosed assemblage of equipment, e.g. switches, circuit breakers, buses and transformers, under control of qualified persons, through which electric energy is passed for the purpose of switching or modifying its characteristics.
 - Example: If at a given location, there are three (3) 500 kV lines and four (4) 230 kV lines along with a 500-230 kV transformer, this is one substation with 7 lines and 8 elements above 200 kV.

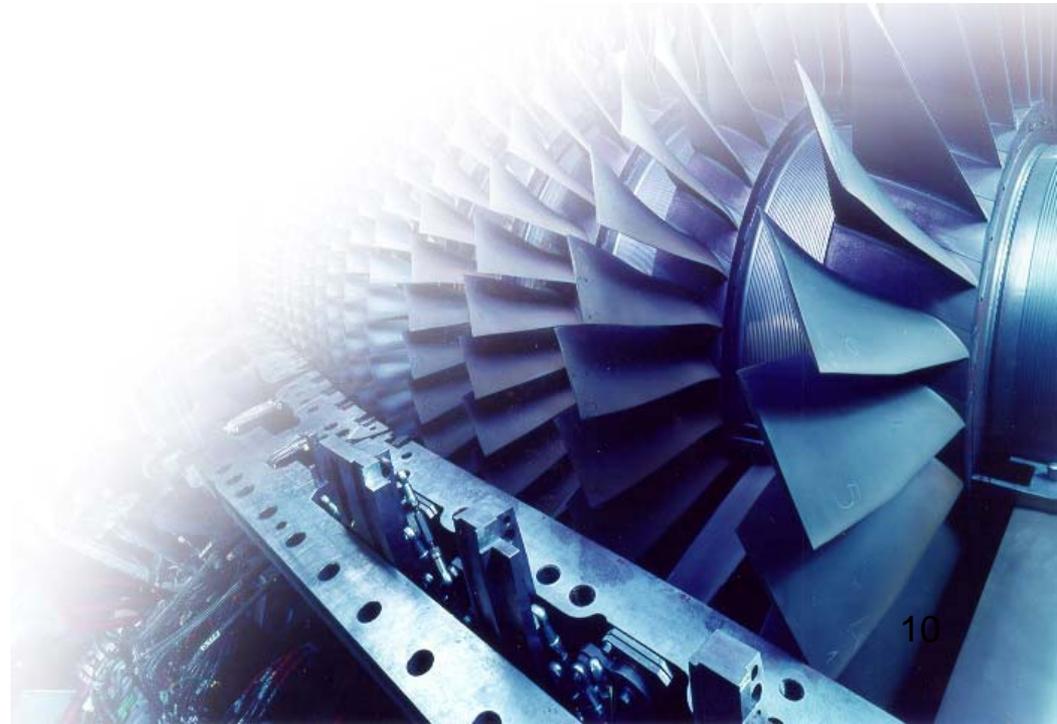


- NERC Procedure to Review Standards Every 5 Years
 - This DMSDT effort satisfies the above NERC procedure



Standard Overview – Purpose

- To ensure that Facility Owners collect the data needed to facilitate analyses of Disturbances on the Bulk Electric System (BES)



Standard Overview – Applicability

- Transmission Owners (TO) with Substations having Facilities rated at 200kV or above
- Generation Owners (GO) with any one of the following connected at 200kv or above:
 - Generating units having a single generating unit of 500 MVA or higher nameplate rating
 - Generating plants with an aggregate plant total nameplate capacity of 1500 MVA or higher

- Requirements for
 - Sequence of Events (SOE) data
 - Fault Recording (FR) data
 - Dynamic Disturbance Recording (DDR) data
- Time Synchronization of SOE, FR and DDR functions within ± 2 ms of Universal Coordinated Time (UTC)
- SOE, FR, and DDR data shall be available, locally or remotely, for 10 calendar days following a Disturbance

Standard Overview – Locations

- SOE and FR
 - Substations with three or more elements consisting of any combination of lines and transformers
 - Substations connected through Generator Step-up Transformers (GSUs)

- DDR
 - Substations having a total of seven or more lines, unless a DDR is available no more than two substations away.

- TOs and GOs shall record, or have a process in place to derive, the changes in circuit breaker position
- The time stamp shall be recorded to within 4ms of input received of a change in circuit breaker position

Standard Overview – Fault Recording

- TOs shall record or have a process in place to derive:
 - Three phase to neutral voltages for each monitored line or bus
 - Three phase currents and residual or neutral current of each monitored line and transformer

Standard Overview – Fault Recording

- GOs shall record or have a process in place to derive:
 - Three phase-to-neutral or phase-to-phase voltages for each Generator Step-up Transformer (GSU)
 - Three phase-to-neutral Voltage for each Monitored line or bus
 - Three phase currents of GSU or generator bus
 - Neutral current of Wye connected GSU High-voltage winding
 - Three phase current and residual or neutral current of each monitored line or transformer

Standard Overview – Fault Records

- Single or multiple recording including:
 - At least 2-cycles of pre-trigger
 - At least 50-cycle of post-trigger
- Or:
 - At least 2-cycles of pre-trigger
 - First 3-cycles of an event
 - The final cycle of an event
- Minimum sampling rate of 16 samples/cycle

Standard Overview – Dynamic Disturbance Recording

- TO shall record, or have a process in place to derive:
 - At least one phase to neutral voltage
 - Frequency
 - At least one phase current at same level as monitored voltage
 - Three phase Power and Reactive Power for each line at 200kv and above

Standard Overview – Dynamic Disturbance Recording

- GO shall record, or have a process in place to derive:
 - At least one phase to neutral voltage or phase-to-phase voltage of GSU or Generator Bus
 - Frequency
 - At least one phase current at same level as monitored voltage or two phase currents if phase-to-phase voltage is monitored
 - Three phase Power and Reactive Power for each line at 200kv and above

Standard Overview – Dynamic Disturbance Recording

- Each TO and GO shall manage DDR data to the following technical specifications:
 - Record same phase for voltage and current
 - Collect at least 960 sample/sec for calculation of RMS quantities
 - Store calculated RMS values at rate of at least 6 samples/sec

Standard Overview – Dynamic Disturbance Recording

- DDRs installed after January 1, 2011 shall be capable of continuous recording
- If continuous recording is not available the DDR shall be required to trigger for:
 - Rate-of-change of frequency
 - Oscillations in the 0.1 to 4 Hz range
- DDR record length shall be a minimum of three-minutes

Main Technical Elements

Time Synchronization

- Time Synchronization of SOE, FR and DDR functions within ± 2 ms of Universal Coordinated Time (UTC)
- Aligns with NERC 12a & 12b recommendations from August 14, 2003 blackout.
- Local GPS satellite clocks are the only known method to provide this accuracy.

Voltage Level Selection: 200kV

kV Level	Total # of Buses	Top Low Impedance Buses > 10,000 MVA short circuit
>= 500 kV	109	75
>= 345 kV	195	96
>= 200 kV	1418	334
>= 100 kV	3327	11

200 kV covers 97.8% off all buses with short circuit levels >= 10,000 MVA

Data provided from multiple regions across the continent.

Availability of Disturbance Data

- SOE, FR, and DDR data shall be available, locally or remotely, for 10 calendar days following a Disturbance.
- Limit of 10 days related to equipment recording limitations.
- Facility Owners should be cautioned that timely data collection of Disturbance data is needed due to the limits of recording memory.

Implementation Plan

- Team reviewed the implementation plans of PRC-002-01 and PRC-018-1.
- Made PRC-002-2 implementation plan consistent with above
- Implementation Plan in 2 Parts:
 - Part 1: Related to Requirements R12 and R13; For Consistency with FERC-Approved PRC-018-1
 - Part 2: Related to Remaining Requirements (i.e. R1 through R11); For Consistency with NERC-Approved PRC-002-1

Implementation Plan

- Implementation Plan for R12 and R13:
 - Eighteen months after regulatory approval

- Implementation Plan for R1 through R11:
 - Within 2 years of Regulatory Approval,
 - The Facility Owners shall be at least 50% compliant on monitored equipment
 - Within 4 years of Regulatory Approval,
 - The Facility Owners shall be at least 100% compliant on monitored equipment



Thank you

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