Simplifying Compliance: An Integrated Approach to Meeting NERC PRC-002 and PRC-005 Requirements

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Presentation Overview

- Standards overview
- Overlap in required data sets
- Example application
- Beyond compliance
• **1996** – 7.5 million impacted in North America

• **2003** – 50 million impacted in U.S. and Canada

• **2011** – 2.7 million impacted in California and Arizona

• **2012** – 8.2 million impacted in 17 states
Key NERC Dates

- **2006** – U.S. Federal Energy Regulatory Commission (FERC) certifies NERC as ERO
- **2007** – FERC issues Order No. 693, approves 83 standards
“To document and implement programs for the maintenance of all Protection Systems… affecting the reliability of the Bulk Electric System (BES) so that they are kept in working order.”
Present and Future NERC PRC-005 Standards

Subject to Enforcement

PRC-005-1.1b – Transmission and Generation Protection System Maintenance and Testing

PRC-005-2(i) – Protection System Maintenance

Subject to Future Enforcement

PRC-005-6 – Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance
1.1 Ongoing program by which protection system components are kept in working order and proper operation of malfunctioning components is restored

- Time-based (TB)
- Performance-based (PB)
- Combination
NERC PRC-002 Purpose

NERC-PRC-002-2

“To have adequate data available to facilitate analysis of Bulk Electric System (BES) Disturbances.”
<table>
<thead>
<tr>
<th>Event Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequential Events Recording (SER)</td>
<td>Breaker Position ASCII CSV Format</td>
</tr>
<tr>
<td>Fault Recording (FR)</td>
<td>High Resolution / Short Term Oscillography COMTRADE Format</td>
</tr>
<tr>
<td>Dynamic Disturbance Recording (DDR)</td>
<td>Low Resolution / Continuous Filtered Measurements COMTRADE Format</td>
</tr>
</tbody>
</table>
NERC PRC-002

SER  \[ \rightarrow \]
FR
DDR

Synchronized to within ± 2 milliseconds of UTC
Burden of Compliance
Cultivate Existing Data

PRC-002 Data Sets

PRC-005 Asset Health Indicators
Finding Overlap

PRC-002
R3 – R4
FR captures of IED control signals, status and settings

PRC-005
Table 1-3
PT and CT measurement validation

PRC-005
Table 1-1
IED measurement validation

R6 – R11
Continuous recording of 3-phase I and V

IED Control output validation
Monitor PT/CTs With DDR Data

IED1

52-1

52-2

IED2

IED3

IED4
Automate Monitoring of Asset Health

IED1

IED2

IED3

IED4

Time Alignment

PT Monitor

CT Monitor

PT Alarms

CT Alarms

Report Formatter

PT Alarms

PRC-005 Reports

PRC-002 DDR Data Sets
Real-Time Comparative Analysis of Signals

- Calculates $|A - B| > $ Threshold
- Drives a pickup timer with the result
- May track jittery assertions within the pickup time
- May log assertions to a database for subsequent analysis of time-rate-of-change of alarm assertions
- May be combined with a base-line function to help inform the difference threshold
Validate PT/CT and/or IED Measurements

CT Monitor

IED Monitor

Channel Compare

- IED1
- IED2

CT1
CT2

Channel Compare

- IED1a
- IED1b

52
CT

52
Identify Criteria for Process Enabling

Channel processing qualifiers

• Minimum signal level
• IED diagnostics
• Comms diagnostics
• Time-correlation of samples
Advanced Monitoring Using PRC-002 Data

- Circuit Breaker Interrupt Current
- Circuit Breaker Pole Scatter
- Circuit Breaker Inactivity Time
- Transformer Through-Fault Current
Evaluate Trip Coil Performance Using Its Current
Evaluate Trip Coil Performance Using Its Current

1. Current Rise
2. Armature Movement
3. Post-Armature Movement
4. Current Decay
Questions?