

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Protection Systems

Protection and Control (PRC) Standards

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RELIABILITY | ACCOUNTABILITY



Order No. 754 Status

PRC Standards with upcoming Enforcement Dates

- PRC-006-1 — Automatic Underfrequency Load Shedding (10/1/2013)

PRC Standards filed or pending filing with FERC

- PRC-005-2 — Protection System Maintenance (2/26/2013)
- PRC-019-1 — Coordination of Generating Unit or Plant Capabilities, Voltage Reg. Controls, and Protection (BOT Approved 2/7/2013)

PRC Standards under Development

- PRC-001-3 — System Protection Coordination (Project 2007-06)
- PRC-002-2 — Disturbance Monitoring and Reporting Requirements (Project 2007-11)
- PRC-004-3 — Protection System Misoperation Identification and Correction (Project 2010-05.1)
- PRC-024-1 — Generator Frequency and Voltage Protective Relay Settings (Project 2007-09)
- PRC-001-3 — System Protection Coordination (Project 2007-06)
- PRC-025-1 — Generator Relay Loadability (Project 2007-06)
- PRC-027-1 — Protection System Coordination for Performance During Faults (Project 2007-06)

SPI – Based on EA Risk Assessments

- Events Analyzed
- Top 10 Risk Assessment Elements

- Initiated in April 2007
- Six areas of focus – each has led to a standard project
 - Relay Loadability – Standard PRC-023
 - Protection System Redundancy – Standards Project 2009-07 Reliability of Protection Systems
 - Protection System Coordination – PRC-001 & PRC-027
 - Generator Frequency and Voltage Protective Relay Coordination – PRC-019 and PRC-024
 - Transmission and Generation Protection System Misoperations – PRC-004-3
 - Protection System Maintenance – PRC-005

Event Analyses 2005 - 2010

- 12 Major Event Analyses
- 133 Events analyzed – Top 10 Elements
 1. 56 Protection System Misoperations
 - 12 - Gen. vs trans. protection miscoordination
 - 7 - Protection equipment failures
 - 6 - Wiring errors
 - 5 - Lack of Redundancy, Human Error, Relay Settings, Relay loadability
 - 4 - Design Errors / Misapplications
 - 2 - Logic Errors, Communications Failure, Other

- 133 Events analyzed – Top 10 Elements (cont.)
 2. Unexpected Gen. Turbine Control Action (35)
 3. Transmission equipment failures (24) (most initiating)
 4. Human Error (17)
 5. Voltage sensitivity of gen. aux. power systems (13)
 6. Near-term load forecasting error (6)
 7. Wiring errors (incidental) (6)
 8. Loss of station observability (5)
 9. Disturbances during abnormal configurations (5)
 10. Inter-area oscillations (5)

- Protection system component failures may render a protection system inoperative, potentially causing:
 - Longer fault clearing times
 - Operation of protection systems on adjacent elements
 - N-1 transmission system contingencies evolving into more severe or extreme events
- Single point of failure is the subject of:
 - FERC Order No. 754 – September 15, 2011
 - NERC Industry Advisory – March 30, 2009
 - Project 2009-07: Reliability of Protection Systems

- FERC Technical Conference held October 24-25, 2011
- Discussions included open exchange among FERC staff, NERC staff, and industry stakeholders
- Consensus Points
 - Performance based issue, not full redundancy issue
 - Existing approved standards address requirements to assess single point of failure
 - Assessments of single point of failure of non-redundant primary protection (including backup) systems need to be sufficiently comprehensive
 - Lack of sufficiently comprehensive assessments of non-redundant primary protection systems is a reliability concern
- Three potential approaches identified

- The data request seeks information with sufficient detail to allow NERC to:
 - Assess whether a reliability gap exists that needs to be addressed and, if so, to
 - Develop appropriate measures tailored to address the concern
- Collecting data for selected buses 100 kV and above
 - Tiered approach by voltage levels
 - Identify buses where a single point of failure may lead to severe consequences for system performance
 - Assess the extent to which single points of failure exist at these locations
 - Protective relays, communication systems, ac current and voltage inputs, and dc control circuitry
 - Station dc supplies and associated monitoring evaluated separately

Reporting Deadline	Activity
October 5, 2012	Transmission Planners must acknowledge the request for data
March 4, 2013	Transmission Planners must submit a status report stating percent of work complete
October 2, 2013	Transmission Planners must report data for buses operated at 300 kV or higher
March 3, 2014	Transmission Planners must report data for buses operated at 200 kV or higher and below 300 kV
September 30, 2014	Transmission Planners must report data for buses operated at 100 kV or higher and below 200 kV

- NERC is nearing the final development stages for the data submittal web portal
- A webinar will be held to familiarize entities with the web portal

- Interpretation of TPL-003-0a and TPL-004-0 adopted by the NERC Board of Trustees and Pending Regulatory Filing
- Addresses the extent to which these planning standards require assessment of protection system single point of failure
 1. Option of evaluating stuck breaker or protection system failure
 - Entities must evaluate the situation that produces the more severe system results or impacts due to a delayed clearing condition regardless of whether the condition resulted from a stuck breaker or protection system failure
 2. Modeling protection system component single point of failure
 - A protection system component failure that impacts one or more protection systems and increases the total fault clearing time requires entities to simulate the full impact (clearing time and facilities removed) on the Bulk Electric System performance
 - The evaluation would include addressing all protection systems affected by the selected component

- Status: Under Consideration for Development
- Standards Committee has submitted a request for research to the Planning Committee
- Recommendation for future activity dependent on results of the data request

- Available at the NERC Order 754 Project web page:
http://www.nerc.com/filez/standards/order_754.html
 - This page includes links for Transmission Planners to provide information per the project schedule
- NERC will periodically communicate information for various activities, reporting, and deadlines throughout the data request period
 - Requests for clarifications and responses posted periodically
- Please submit any questions to DataRequest754@nerc.net

PRC-001-3 & PRC-027-1

- [PRC-001](#) was from an era of voluntary compliance.
- Both FERC & SPCTF identified shortcomings in PRC-001.
- New standards now coordinate among all related entities.
- Requirements to be retired: R2, R5, & R6 are addressed in proposed [TOP-003-2](#). R3 & R4 are addressed by [PRC-001-3](#) and PRC-027-1
- [PRC-027-1](#) was created specifically to address fault clearing.
 - Accounts for 2003 Blackout Report Rec. 21 C on “appropriate use of time delays in relays.”
- Eventual plan is to retire PRC-001 as replaced by other Requirements

PRC-002-2 — Disturbance Monitoring and Reporting Requirements

- To establish requirements for installation of Disturbance Monitoring Equipment (DME) and reporting of disturbance data to facilitate analyses of events and verify system models.
- Brought back to formal development - January, 2013
- Will absorb PRC-018 dealing with DME Installation and Data
- Next Steps:
 - Workshop – June 5-6, 2013
 - Webinar – TBD; but prior to 45-day comment period
 - Review and finalization of comments, standard, and other documents in preparation for the next comment period.

PRC-004-3 — Protection System Misoperation Identification and Correction

- Establishes a continent-wide procedure.
- Retires PRC-003 (not approved by FERC) and PRC-004-2a.
- Industry agreed reporting should be standardized
 - ERO-RAPA and SPCS developed presently used quarterly reporting form.
 - Expanded to collect # of operations **per** quarter **by** voltage level.
- The drafting team has deliberated on requirement to collect misoperations report data.
 - Drafting Team believes reporting should be addressed outside the standard.

PRC-005-2 — Protection System Maintenance

- Consolidates [PRC-005](#), -008 (UFLS), -011 (UVLS), & -017 (SPS) maintenance and testing standards.
- Sets maximum time intervals for maintenance and testing.
- Provides clarification for Unresolved Maintenance Issues
- Clarifies what maintenance activities are required for Protection System Components
- Order No. 758 Developments
 - PRC-005-3 to address reclosing relays (79) – Project 2007-17.2 - Phase 2
 - PRC-005-4 expected to address sudden pressure relays (63) and other relays (e.g., thermal) that use non-electrical quantities (Order No. 758) – Targeted for a 2014 development project

PRC-006-1 — Automatic Underfrequency Load Shedding (UFLS)

- Enforceable on October 1, 2013
- Provides standardized performance requirements
- Standard is not overly prescriptive - Planning Coordinators (PCs) can achieve UFLS program goal(s).
- Significant effort made to coordinate load based underfrequency devices with underfrequency operating capabilities of generators
- Requires planning for formation of Bulk Electric System (BES) islands
- Includes Requirement for automatic switching of Reactive Resources if included in UFLS program.

PRC-019-1 — Coordination of Generating Unit or Plant Capabilities, Voltage Reg. Controls, and Protection

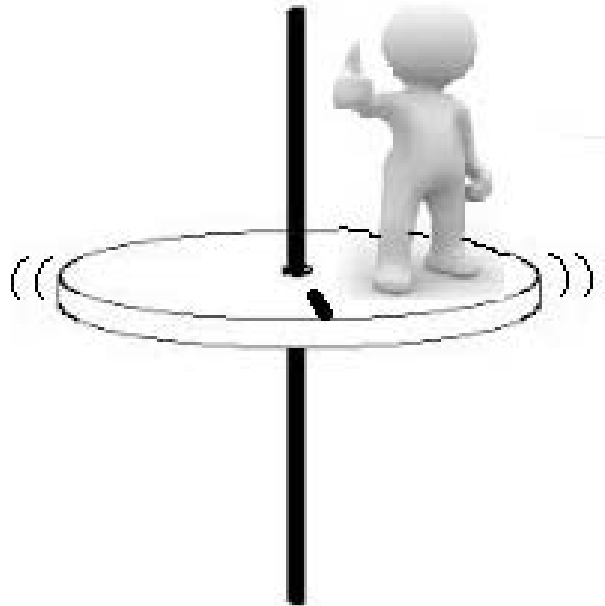
- Ensures generators will not trip off-line due to improper coordination between generator protective relays and generator voltage regulator controls and limit functions (includes generating unit's capabilities).
- Part of [Project 2007-09 Generator Verification](#)
- Should be performed prior to MOD-025-2 Reactive Power capability testing.

PRC-024-1 — Generator Frequency and Voltage Protective Relay Settings

- To ensure that generators will not trip off-line during specified voltage and frequency excursions
- Part of Project 2007-09 Generator Verification
- Sets standardized performance requirements
- Addresses Order Nos. 661 and 661-A directives associated with low voltage ride-through capability
- Coordinated with PRC-006-1 (UFLS)

PRC-025-1 — Generator Relay Loadability

- Creates Requirements to address generator relay loadability directives in Order No. 733
- Requires setting protective relays to avoid unnecessary generating unit trips during system disturbances that are not damaging to the generator.
- Drafting Team is working to avoid:
 - Duplicative Requirements between PRC-023 and PRC-025
 - Gaps in reliability (e.g., GSU ownership issues, remote line relays owned by Generator Owners)





Questions and Answers