

Projects 2007-06 & -06.2

System Protection Coordination
Requirement revisions to PRC-001-1.1(ii)

Industry Webinar
August 25 and 26, 2015

RELIABILITY | ACCOUNTABILITY



- Presenters
 - Project 2007-06
 - SDT Chair, Bill Middaugh, Tri-State Generation & Transmission Association
 - NERC Staff, Al McMeekin, Standards Developer
 - Project 2007-06.2
 - SDT Chair, Mark Peterson, Great River Energy
 - SDT Vice Chair, Michael Cruz-Montes, CenterPoint Energy
 - NERC Staff, Scott Barfield-McGinnis, Standards Developer
- Administrative Items
- Project 2007-06 (PRC-027-1)
- Project 2007-06.2 (TOP-009-1)
- Closing Remarks
- Questions and Answers (Moderated and Chat)



Administrative Items

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- **For the official record**
 - Conference presentation is not a part of the official project record
 - Comments must be submitted via the project page during posting

Acronym	Term
BA	Balancing Authority
BES	Bulk Electric System
FERC	Federal Energy Regulatory Commission
GOP	Generator Operator
IRO	Interconnection Reliability Operations (standard family)
NERC	North American Electric Reliability Corporation
OER	Office of Electric Reliability (FERC)
OPA	Operational Planning Analysis
PC	Planning Coordinator (entity)
PER	Personnel (standard family)
PRC	Protection and Control (standard family)

Acronym	Term
RAS	Remedial Action Scheme
RC	Reliability Coordinator (entity)
RTA	Real-time Assessment
RTM	Real-time monitoring
SDT	Standard Drafting Team
SPS	Special Protection System (being replaced by RAS)
TOP	Transmission Operator (entity)
TOP	Transmission Operation (standard family)
TP	Transmission Planning (entity)
VRF	Violation Risk Factor
VSL	Violation Severity Level



Project 2007-06 (PRC-027-1)

PRC-027-1 Standard Drafting Team

Member	Entity
Bill Middaugh, Chair	Tri-State Generation & Transmission Association
Forrest Brock	Western Farmers Electric Cooperative
Sam Francis	Oncor Electric Delivery
Jeff Iler	American Electric Power
Kevin Wempe	Kansas City Power and Light
Phil Winston	Southern Company

- **R3.** A Generator Operator or Transmission Operator shall coordinate new protective systems and changes as follows:
 - **R3.1.** Each Generator Operator shall coordinate all new protective systems and all protective system changes with its Transmission Operator and Host Balancing Authority.
 - Requirement R3.1 is not applicable to the individual generating units of dispersed power producing resources identified through Inclusion I4 of the Bulk Electric System definition.
 - **R3.2.** Each Transmission Operator shall coordinate all new protective systems and all protective system changes with neighboring Transmission Operators and Balancing Authorities.
- **Being retired by PRC-027-1**

- **R4.** Each Transmission Operator shall coordinate Protection Systems on major transmission lines and interconnections with neighboring Generator Operators, Transmission Operators, and Balancing Authorities.
- Being retired by PRC-027-1

- Protection System Coordination Study (PSCS)
 - An analysis to determine whether Protection Systems operate in the intended sequence during Faults.

- Purpose
 - To maintain the coordination of Protection Systems installed to detect and isolate Faults on Bulk Electric System (BES) Elements, such that those Protection Systems operate in the intended sequence during Faults
- Functional Entities
 - Transmission Owner
 - Generator Owner
 - Distribution Provider (that own Protection Systems identified in the Facilities)
- Facilities
 - Protection Systems installed to detect and isolate Faults on BES Elements

- **R1.** Each Transmission Owner, Generator Owner, and Distribution Provider shall establish a process for developing new and revised Protection System settings for BES Elements, such that the Protection Systems operate in the intended sequence during Faults. The process shall include:
 - **1.1.** A review and update of short-circuit models for the BES Elements under study.
 - **1.2.** A review of the developed Protection System settings.
 - **1.3.** For Protection System settings applied on BES Elements that electrically join Facilities owned by separate functional entities (Transmission Owners, Generator Owners, and Distribution Providers), provisions to:
 - **1.3.1.** Provide the proposed Protection System settings to the owner(s) of the electrically-joined Facilities

- **1.3.2.** Respond to any owner(s) that provided its proposed Protection System settings pursuant to Requirement R1, Part 1.3.1 by identifying any coordination issue(s) or affirming that no coordination issue(s) were identified.
- **1.3.3.** Verify that identified coordination issue(s) associated with the proposed Protection System settings for the associated BES Elements are addressed prior to implementation.
- **1.3.4.** Communicate with the other owner(s) of the electrically-joined Facilities regarding revised Protection System settings resulting from unforeseen circumstances that arise during:
 - **1.3.4.1.** Implementation or commissioning.
 - **1.3.4.2.** Misoperation investigations.
 - **1.3.4.3.** Maintenance activities.
 - **1.3.4.4.** Emergency replacements required as a result of Protection System component failure.

- **M1.** Acceptable evidence may include, but is not limited to, dated electronic or hard copy documentation to demonstrate that the responsible entity established a process to develop settings for its Protection Systems, in accordance with Requirement R1.

- **R2.** Each Transmission Owner, Generator Owner, and Distribution Provider shall, for each BES Element with Protection System functions identified in Attachment A:
 - Option 1: Perform a Protection System Coordination Study in a time interval not to exceed six calendar years; or
 - Option 2: Compare present Fault current values to an established Fault current baseline and perform a Protection System Coordination Study when the comparison identifies a 15 percent or greater deviation in Fault current values (either three phase or phase to ground) at a bus to which the Element is connected, all in a time interval not to exceed six calendar years;¹ or,
 - Option 3: A combination of the above.

¹ See next slide

- The initial Fault current baseline(s) shall be established by the effective date of this Reliability Standard and updated each time a Protection System Coordination Study is performed. If an initial baseline was not established by the effective date of this Reliability Standard because of the previous use of an alternate option or the installation of a new Element, the entity may establish the baseline by performing a Protection System Coordination Study.
- Key point
 - If Option 2 is initially used, the Fault current baseline must be established prior to the Effective Date (12 months after regulatory approval)
 - Once a PSCS is performed, the entity may reset or establish a Fault current baseline

- **M2.** Acceptable evidence may include, but is not limited to, dated electronic or hard copy documentation to demonstrate that the responsible entity performed Protection System Coordination Study(ies) and/or Fault current comparisons in accordance with Requirement R2.

- The following Protection System functions are applicable to Requirement R2 if available Fault current levels are used to develop the settings for those Protection System functions:
- 21 – Distance if:
 - infeed is used in determining reach (phase and ground distance), or
 - zero-sequence mutual coupling is used in determining reach (ground distance).
- 50 – Instantaneous overcurrent
- 51 – AC inverse time overcurrent
- 67 – AC directional overcurrent if used in a non-communication-aided protection scheme

- **R3.** Each Transmission Owner, Generator Owner, and Distribution Provider shall utilize its process established in Requirement R1 to develop new and revised Protection System settings for BES Elements.

- **M3.** Acceptable evidence may include, but is not limited to, dated electronic or hard copy documentation to demonstrate that the responsible entity utilized its settings development process established in Requirement R1, as specified in Requirement R3.

- Implementation Plan
 - Effective date is the first day of the first calendar quarter that is twelve (12) months after the date that the standard is approved by an applicable governmental authority...
 - Commensurate with Phase 2 (TOP-009-1) implementation
 - Required for complete retirement of PRC-001-1.1(ii)
- Required on effective date:
 - R1 – documented process
 - R2 – a Fault current baseline (if using Option 2)
 - R3 – utilize the process



Project 2007-06.2 (TOP-009-1)

TOP-009-1 Standard Drafting Team

Member	Entity
Mark Peterson, chair	Great River Energy
Michael Cruz-Montes, vice-chair	CenterPoint Energy Houston Electric, LLC
Po Bun Ear	Hydro-Québec TransÉnergie
Scott Hayes	Pacific Gas & Electric
Mark Kuras	PJM Interconnection, LLC
Sam Mannan	Los Angeles Dept. of Water and Power (LADWP)
Yubaraj Sharma	Luminant Generation Company, LLC
Rui Da Shu	Northeast Power Coordinating Council
Scott Watts	Duke Energy Carolinas

- Address Federal Energy Regulatory Commission directives
- Consider applicable entities are appropriate
 - E.g., NERC Functional Model
- Requirements
 - Meet the reliability objectives
 - Eliminate ambiguity and duplicity
 - Improve measurability
 - What family should reliability objectives be placed
- IRO and TOP standards referenced are NERC Board adopted, filed, and pending approval by FERC

- PRC-001 presentation will be by requirement to explain how the reliability objectives are maintained
 - R6 – monitoring and notification of SPS (expected to become RAS)
 - R5 – notification of system changes “in advance” that impact protection
 - R2 – notification of relay and equipment failures and corrective actions as soon as possible
 - R1 – knowledge of Protection Systems (TOP-009-1)

- Proposed for **retirement**
 - BA and TOP is required to monitor the status of each SPS (being replaced by RAS) and notify affected entities of each change in status
- Reliability objectives are addressed by:
 - Addressed by TOP-001-3, R10 (Monitoring – TOP)
 - Addressed by TOP-001-3, R11 (Monitoring – BA)
 - Addressed by IRO-008-2, R4 (Monitoring – RC)
 - Real-time Assessment is done once every 30 minutes
 - Implied RC must be notified of RAS status to be able to perform RTA
 - Addressed by IRO-010-2, R1 (Notification – RC)
 - Addressed by TOP-003-3, R1 and R2 (Notification – BA & TOP)

- Proposed for **retirement**
 - GOP and TOP are required to notify neighboring entities “in advance” of changes in generation, transmission, load, or operating conditions that could require changes in Protection Systems
- Reliability objectives are addressed by:
 - TOP-002-4, R1 and R2 (in advance – BA and TOP)
 - IRO-005-4, R1 (RC communication to BA and TOP)
 - IRO-008-2, R1 and R2 (in advance – RC)
 - IRO-017-1, R1, R2, R3, and R4 (in advance – RC)
 - TPL-001-4, R4 (in advance – PC and TP)
- Reliability objective for the GOP is also addressed by these standards, details in mapping document

- Proposed for **retirement**
 - GOP and TOP are required to notify entities of relay/equipment failures and take corrective action as soon as possible
- Reliability objectives are addressed by:
 - TOP-003-3, R1 and R2 (Notification – BA and TOP)
 - TOP-001-3, R1, R2, R13, and R14 (Corrective Action via Operating Instructions, i.e., as soon as possible – BA & TOP)
 - IRO-001-4, R1 (Corrective Action via Operating Instructions, i.e., as soon as possible – RC)
 - IRO-008-2, R4 (As soon as possible – RC)
 - IRO-010-2, R1 (Notification – RC)
- Reliability objective for the GOP is also addressed by these standards, details in mapping document

- Proposed to be incorporated into new TOP-009-1
 - Entities must be familiar with the purpose and limitations of Protection System schemes applied in its area
- NERC staff and the SDT met with FERC OER staff on June 16, 2015 to discuss the development of the standard
 - SDT discussions with FERC OER staff communicated the reliability objective of R1 is intended to ensure operating entities know how Composite Protection Systems will respond to BES conditions and their effects on the operation of the BES
- Should Requirement R1 go in a PER, PRC, or a TOP standard
 - SDT considered FERC OER staff and industry feedback and determined R1 is best suited for a new “TOP” Reliability Standard

- TOP-009-1 (*Knowledge of Composite Protection Systems and Remedial Action Schemes and Their Effects*)
- Purpose
 - To ensure operating entities have the requisite knowledge of Composite Protection Systems and Remedial Action Schemes (RAS), and their effects, in order to operate and maintain the reliability of the Bulk Electric System (BES)
- Applicability
 - Transmission Operator
 - Balancing Authority
 - Generator Operator
- Clarifies which Composite Protection Systems are important
- Addresses the operational functionality and effects

- NERC Glossary term “Composite Protection System”
 - “The total complement of Protection System(s) that function collectively to protect an Element. Backup protection provided by a different Element’s Protection System(s) is excluded.”
 - Individual Protection System functionality is not intended in TOP-009-1
- Knowledge of Composite Protection System
 - May be demonstrated through training (including the effects on the BES), operating guides, manuals, procedures, output of operational tools (e.g., databases or analysis programs), or outcomes of analyses, monitoring, and assessments that identify the impacts on the BES
- SDT determined that knowledge should also extend to “Remedial Action Scheme” (RAS)
 - Ensures full coverage

- Each TOP shall ensure its personnel responsible for Reliable Operation of its TOP Area have knowledge of operational functionality and effects of Composite Protection Systems and RAS that are necessary to perform its Operational Planning Analysis, Real-time monitoring, and Real-time assessments
- Personnel must have knowledge of those protective systems that are used as inputs to its OPA, RTM, and RTA. For example:
 - Systems defined by TOP-003, R1 (i.e., operational data)
 - Systems logged into operational tools or using other methods
 - Systems that are in an abnormal or temporary state due to some issue

- Each TOP shall have evidence that demonstrates the knowledge according to Requirement R1. Evidence may include, but is not limited to, the following: training (including the effects on the BES), operating guides, manuals, procedures, output of operational tools (e.g., databases or analysis programs), or outcomes of analyses, monitoring, and assessments that identify the impacts on the BES.

- Each BA shall ensure its personnel responsible for Reliable Operation of its BA Area have knowledge of operational functionality and effects of Composite Protection Systems and RAS that are necessary to perform its Real-time monitoring (RTM) in order to maintain generation-Load-Interchange balance
- Personnel must have knowledge of those protective systems that are used as inputs to its RTM. For example:
 - Systems defined by TOP-003, R2 (i.e., operational data)
 - Systems logged into operational tools or using other methods
 - Systems that are in an abnormal or temporary state due to some issue

- Each BA shall have evidence that demonstrates the knowledge according to Requirement R2. Evidence may include, but is not limited to, the following: training (including the effects on the BES), operating guides, manuals, procedures, output of operational tools (e.g., databases or analysis programs), or outcomes of Real-time monitoring that identify the impacts on the BES.

- Each GOP shall ensure its personnel responsible for Reliable Operation of its generating Facilities have knowledge of operational functionality and effects of Composite Protection Systems and Remedial Action Schemes (RAS) that impact its generating Facilities.
- Personnel must have knowledge of those protective systems that impact its generating Facilities. For example:
 - RAS operation resulting in a generating unit trip or runback that effects the BES

- Each GOP shall have evidence that demonstrates the knowledge according to Requirement R3. Evidence may include, but is not limited to, the following: training (including the effects on the generating Facilities), operating guides, manuals, procedures, interconnection agreements or studies, or access to third-party documentation.

- Implementation Plan
 - Effective date is the first day of the first calendar quarter that is twelve (12) months after the date that the standard is approved by an applicable governmental authority...
 - Commensurate with Phase 1 (PRC-027-1) implementation
 - Required for complete retirement of PRC-001-1.1(ii)
- Required on effective date:
 - To have knowledge of operational functionality and effects of Protection Systems and RAS:
 - R1 – TOP used as inputs into its OPA, RTM, and RTA to maintain reliability of the BES
 - R2 – BA used as inputs into its RTM to maintain generation-Load-Interchange balance
 - R3 – GOP necessary to operate its generating Facilities in order to maintain BES reliability



Closing Remarks

- The purpose of PRC-027-1 is to maintain the coordination of Protection Systems installed to detect and isolate Faults on BES Elements, such that those Protection Systems operate in the intended sequence during Faults
- Requirement R1 mandates that an entity establish a process to develop settings for its BES Protection Systems to operate in the intended sequence during Faults; and stipulates certain attributes that must be included in the process
- Utilizing the process (Requirement R3) will promote consistency in developing Protection System settings and will minimize the introduction of errors

- Requiring entities to periodically assess (Requirement R2) the state of their BES Protection Systems minimizes the risk that incremental changes in Fault current have accumulated enough to impact coordination
- Requirement R2 requires a PSCS to be performed if:
 - (1) Entity desires a time-based approach (every 6 years), or
 - (2) Fault current comparisons (present-day to baseline) identify a deviation of 15 percent or more
- Baselines
 - If Option 2 is initially used, the Fault current baseline must be established prior to the Effective Date (12 months)
 - A baseline may be established anytime a PSCS is performed

- Attachment A lists the Protection System functions (21, 50, 51, and 67) that are applicable to Requirement R2 if available Fault current levels are used to develop the settings for those Protection System functions
- The above Protection System functions are susceptible to changes in the magnitude of available short-circuit Fault current. These functions utilize current in their measurement to initiate tripping of circuit breakers. The functions listed above are included in a Protection System Coordination Study because they require coordination with other Protection Systems

- Aligns the reliability activity in the proper family of Reliability Standards
- Meets the reliability objectives of PRC-001-1.1(ii), R1
- Eliminates duplicity (R2, R5, and R6) by retiring the Requirements
- Eliminates ambiguous phrases
 - As soon as possible
 - Reduces system reliability
 - Operating conditions that could require changes in other's Protection Systems
- Improves measurability
 - Functionality and effects
 - Which Protection Systems and RAS

- The complete retirement of PRC-001-1.1(ii) is contingent upon the approval of both proposed Reliability Standards PRC-027-1 and TOP-009-1
- Project Mapping Documents
 - Project 2007-06 shows how proposed PRC-027-1 addresses Requirements R3 and R4 of PRC-001-1.1(ii)
 - Project 2007-06.2 shows:
 - How Requirement R1 is incorporated into a new proposed TOP-009-1
 - How the reliability objective of Requirements R2, R5, and R6 of PRC-001-1.1(ii) are addressed by yet to be approved TOP/IRO standards

- PRC-027-1 is posted for formal comment and ballot
 - Comment period: July 29 – September 11, 2015
 - Additional ballot: September 2-11, 2015
- Draft RSAW to be posted for feedback
 - August 12 – September 11, 2015
- SDT in-person meeting to respond to comments
 - Week of September 21, 2015
- Final ballot
 - October 2015
- Anticipated NERC Board of Trustees adoption
 - November 2015

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- Encourage working through forums or trades
 - To become aware of industry direction on topics
 - Develop consolidated comments informally or during postings
- NERC Standards Developer
 - Project 2007-06, Al.McMeekin@nerc.net, 404-446-9675
 - Project 2007-06.2, Scott.Barfield@nerc.net, 404-446-9689
- SDT members and NERC staff are available to address other groups (e.g., Regional working groups, trades, etc.)
 - Contact the Standards Developer to arrange



Q&A for Project 2007-06 & -06.2