TEXAS RE

Protection System Standards PRC-004-6 and PRC-027-1

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September 19, 2024

PRC-004-6 Overview

Purpose

- Identify and correct the causes of Misoperations of Protection Systems for Bulk Electric System (BES) Elements
- Prevent BES instability, separation, or a cascading sequence of failures

Applicability

- Transmission Owners
- Generator Owners
- Distribution Providers (that own Protection Systems installed to detect and isolate Faults on BES Elements)

Requirement

- Owners of BES interrupting devices shall, within 120 calendar days of the BES interrupting device operation, identify whether its Protection System component(s) caused a Misoperation (R1)
- Owners of the Protection System component(s) that caused the Misoperation shall, within 60 calendar days of first identifying a cause of the Misoperation develop a Corrective Action Plan (CAP) or explain why not



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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

Misoperation

- Failure to Trip A failure of a Composite Protection System to operate for a Fault condition for which it is designed. The failure of a Protection System component is not a Misoperation as long as the performance of the Composite Protection System is correct
- Slow Trip A Composite Protection System operation that is slower than required for a Fault condition if the duration of its operating time resulted in the operation of at least one other Element's Composite Protection System
- Unnecessary Trip An unnecessary Composite Protection System operation for a Fault condition on another Element

Corrective Action Plan (CAP)

- A list of actions and an associated timetable for implementation to remedy a specific problem
- The timetable associated with the CAP may shift depending on findings in performing the CAP or due to rescheduling outages



- Entity list of all BES interrupting device operations that have occurred during the monitoring period
- Dated evidence to demonstrate the entity identified whether its Protection System components caused a Misoperation
 - Operational analysis that includes a determination
 - Determination should be made with 120 calendar days (R1)
- Entity list of Misoperations identified
- Review Corrective Action Plan
 - List of actions and timetable for implementation to remedy
 - Evaluation of CAP applicability to other Protection Systems including other locations



Develop process

- Identify BES Protection System ownership
- Identify and track BES interrupting device operations
- Evaluate BES operations and determine Misoperation (or not)

Define and communicate timeframes

- 120 calendar days to make determination (R1)
- 60 calendar days to develop CAP (R5)
- CAP timeframe to remedy





Possible CAP actions

- Change of protection system settings
- Protection system coordination study
- Replacement of equipment
- Wiring or design change
- Update of procedure with additional training



PRC-027-1 Overview

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
- This is to ensure that the minimum portion of the BES is removed from service by the operation of the Protection System to maintain the reliability of the grid

Applicability

- Transmission Owners
- Generator Owners
- Distribution Providers (that own Protection Systems installed to detect and isolate Faults on BES Elements)

Requirement

• Applicable entities must establish and implement a process to develop new and revised Protection System settings for BES Elements



Coordination = relays/protection systems operating in the intended sequence

Collaboration = communication between entities (for the purposes of this discussion)





NSRF - Protection System Standards

- **Reliability:** A relay system must operate correctly
- Selectivity: A protection system must isolate the minor portion of the fault condition, make it more selective, limit service gaps, and ensure continuous service
- Speed of Operation: A protection system should isolate faulty areas in minimal time to reduce thermal stress
- **Simplicity:** A power system protection relay should be simple to find and correct faults quickly
- Sensitivity: A sensitive protection system detects minor fault conditions quickly; sensitivity is essential in high impedance faults



Entities should document the process when developing and implementing new and revised Protection System settings (to operate in the intended sequence during Faults)

- Include all System settings prior to implementation
- Highlight all System settings that were changed and impacted by changes
- Reduce the possibility of human error through peer review
- Automated checking programs
- Entity review procedures



NSRF - Protection System Standards

A Protection System Coordination Study (PSCS) should include Protection System functions identified in Attachment A that could operate for faults on the BES

Option 1: Perform a PSCS within a six-calendar year time interval Option 2: Compare present Fault current values to an established Fault current baseline and perform a PSCS when the comparison identifies at least a 15% deviation, all within a six-calendar year time interval

Option 3: Use a combination of the above



Protection System functions applicable to Requirement R2

- 21 Distance (if infeed or zero-sequence mutual coupling is used in determining reach)
- 50 Instantaneous overcurrent
- 51 AC inverse time overcurrent
- 67 AC directional overcurrent (if used in a non-communication-aided protection)



PRC-027-1 Protection System Coordination Study

Determine the network boundary

- Wide-area coordination or partial coordination
- Identify scenarios and configurations
- Ensure correct models are used
- Define primary and backup relay coordination pairs

Perform a coordination study

- Static, step event analysis, or combination of both
- Perform coordination study using Option 1, 2, or 3

Document all results in a report and implement processes from R1

- Update the short-circuit model with latest settings
- Collaborate with entities to resolve coordination issues



Resolution of differences

- Entities agree not to mitigate all issues based on engineering judgement
- Entities may agree to delay resolution if system modifications were not identified in the initial project scope
- Entities may agree that protection philosophy differences do not create coordination issues

Documentation of communication and acknowledgements of all entities involved is recommended





PRC-027-1 Internal Controls

Create a fully documented procedure with clearly defined steps

Review of developed settings and coordination studies

- Verify settings meet coordination requirements
- Document any deviations from the procedure

Review any work performed by third-party contractors to confirm accuracy

Establish and document clear communication protocols and procedures for collaboration with electrically joined Facilities to ensure that Protection System settings are appropriately reviewed and issues are addressed prior to implementation



PRC-027-1 Further Reading

- <u>A Systematic Approach to Meet NERC PRC-027-1 Requirements –</u> <u>Beyond Compliance (selinc.com)</u>
 - Metropolitan Water District of Southern California
 - Schweitzer Engineering Laboratories, Inc.
 - Presented at the 75th Annual Georgia Tech Protective Relaying Conference (2022)





Questions?

