

Standard Development Timeline

This section is maintained by the drafting team during the development of the standard and will be removed when the standard is adopted by the NERC Board of Trustees (Board).

Description of Current Draft

This is the first draft of the proposed standard for a formal 45-day comment period.

| Completed Actions | Date |
|---|-------------------------|
| Standards Committee approved Standard Authorization Request (SAR) for posting | January 20, 2021 |
| SAR posted for comment | March 4 – April 2, 2021 |

| Anticipated Actions | Date |
|---|---------------------------|
| 45-day formal or informal comment period with ballot | September – November 2022 |
| 45-day formal or informal comment period with additional ballot | February – April 2023 |
| 10-day final ballot | May 2023 |
| Board adoption | August 2023 |

New or Modified Term(s) Used in NERC Reliability Standards

This section includes all new or modified terms used in the proposed standard that will be included in the *Glossary of Terms Used in NERC Reliability Standards* upon applicable regulatory approval. Terms used in the proposed standard that are already defined and are not being modified can be found in the *Glossary of Terms Used in NERC Reliability Standards*. The new or revised terms listed below will be presented for approval with the proposed standard. Upon Board adoption, this section will be removed.

Term(s):

None.

A. Introduction

1. **Title:** Coordination of Generating Unit or Plant Capabilities, Voltage Regulating Controls, and Protection
2. **Number:** PRC-019-3
3. **Purpose:** To verify coordination of generating unit or Facility voltage regulating controls, limit functions, equipment capabilities, and protective functions.
4. **Applicability:**
 - 4.1. **Functional Entities**
 - 4.1.1 Generator Owner
 - 4.1.2 Transmission Owner
 - 4.2. **Facilities:** For the purpose of this standard, the term, “applicable Facility” or “Facility” shall mean any one of the following:
 - 4.2.1 Individual generating resource identified through Inclusion I2 of the BES definition.
 - 4.2.2 Generating plant/Facility identified through Inclusion I2 of the BES definition.
 - 4.2.3 Dynamic reactive resources identified through Inclusion I5 of the BES definition with a gross (individual or aggregate) nameplate rating greater than 20 MVA including:
 - 4.2.3.1 Synchronous condenser.
 - 4.2.4 Inverter-based resource (IBR) generating plant/Facility identified through Inclusion I4 of the BES definition, including:
 - 4.2.4.1 Individual IBR units;
 - 4.2.4.2 Collector bus(es) and collector feeder(s);
 - 4.2.4.3 Static or dynamic reactive compensating devices;
 - 4.2.4.4 Main power transformer (MPT);¹
 - 4.2.4.5 Generator step-up (GSU) transformer(s);²
 - 4.2.5 Any Blackstart Resource.
5. **Effective Date:** See the Implementation Plan for PRC-019-3.

¹ For the purpose of this standard, the MPT is the power transformer that steps up voltage from the collection system voltage to the nominal transmission/interconnecting system voltage for dispersed power producing resources.

² For the purpose of this standard, the GSU is the power transformer that steps up voltage from the individual IBR unit to the nominal collection system voltage for dispersed power producing resources.

B. Requirements and Measures

- R1.** At a maximum of every six calendar years, each Generator Owner and Transmission Owner with applicable Facilities shall coordinate³ the voltage regulating system controls, with the applicable equipment capabilities and settings of the applicable protective functions.⁴ Equipment capabilities, control functions, and protective functions for the applicable Facilities include, but are not limited to those listed in Attachment 1. *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
- 1.1.** For synchronous generators or synchronous condensers, assuming the normal automatic voltage regulator control loop and steady-state system operating conditions, verify the following coordination items:
- 1.1.1.** The in-service limiter functions⁵ are set to operate before the protective functions of the applicable Facility in order to avoid disconnecting the generator unnecessarily.
- 1.1.2.** The applicable in-service protective functions are set to operate to isolate or de-energize equipment in order to limit the extent of damage when operating conditions exceed equipment capabilities.
- 1.2.** For IBR generating Facilities, assuming the voltage control mode is enabled in the power plant controller and/or IBR unit(s)⁶ and steady-state system operating conditions, verify the following coordination items:
- 1.2.1.** The in-service control functions of the power plant controller are set to operate before the protective functions of the applicable Facilities in order to avoid disconnecting any of the Facilities listed under Section 4.2.4 unnecessarily.
- 1.2.2.** The in-service control functions of IBR unit(s) are set to operate before protective functions of the applicable Facilities in order to avoid disconnecting any of Facilities listed under Section 4.2.4 unnecessarily.
- 1.2.3.** The applicable in-service protective functions are set to operate to isolate or de-energize equipment in order to limit the extent of damage when operating conditions exceed equipment capabilities.
- M1.** Each Generator Owner and Transmission Owner with applicable Facilities will have evidence such as a graphical representation(s) of coordination including a P-Q Diagram, R-X

³ As-left settings shall be utilized in a protection and control coordination study.

⁴ A protective function includes an action performed by a Protection System device or an action performed by a control system that replicates the behavior of a Protection System device in order to mitigate the consequences of an event that exceeds equipment design basis.

⁵ Limiter functions that are installed and activated on the generator or synchronous condenser.

⁶ IBR unit includes the inverter, converter, or wind turbine generator.

Diagram, Inverse Time Diagram, equivalent tables, steady-state calculations, dynamic simulation studies, or other evidence that it performed a coordination study as specified in Requirement R1. This evidence should include dated documentation that demonstrates the coordination was performed.

R2. Each Generator Owner and Transmission Owner shall perform the coordination described in Requirement R1 prior to implementation of systems, equipment, or settings changes that will affect the coordination described in Requirement R1; and update associated coordination documentation within 90 calendar days after the return to in-service date. These possible systems, equipment or settings changes include, but are not limited to, the following: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

- Voltage regulating settings or equipment changes;
- Protective function settings or component changes;
- IBR unit, synchronous generator or synchronous condenser equipment capability changes;
- IBR unit, synchronous generator or synchronous condenser step-up transformer changes;
- IBR unit control system firmware or settings changes; or
- Power plant controller firmware or settings changes.

M2. Each Generator Owner and Transmission Owner with applicable Facilities will have evidence of the coordination study required by the events listed in Requirement R2. This evidence should include dated documentation that demonstrates Requirement R2 has been met.

C. Compliance

1. Compliance Monitoring Process

- 1.1. Compliance Enforcement Authority:** “Compliance Enforcement Authority” means NERC or the Regional Entity, or any entity as otherwise designated by an Applicable Governmental Authority, in their respective roles of monitoring and/or enforcing compliance with mandatory and enforceable Reliability Standards in their respective jurisdictions.
- 1.2. Evidence Retention:** The following evidence retention period(s) identify the period of time an entity is required to retain specific evidence to demonstrate compliance. For instances where the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask an entity to provide other evidence to show that it was compliant for the full-time period since the last audit.

The applicable entity shall keep data or evidence to show compliance as identified below unless directed by its Compliance Enforcement Authority to retain specific evidence for a longer period of time as part of an investigation.

- The Generator Owner and Transmission owner shall keep data or evidence of Requirement R1 of the most recent coordination study.
 - The Generator Owner and Transmission Owner shall keep data or evidence of Requirement R2 of the most recent coordination study.
- 1.3. Compliance Monitoring and Enforcement Program:** As defined in the NERC Rules of Procedure, “Compliance Monitoring and Enforcement Program” refers to the identification of the processes that will be used to evaluate data or information for the purpose of assessing performance or outcomes with the associated Reliability Standard.

Violation Severity Levels

| R # | Violation Severity Levels | | | |
|-----|--|---|---|---|
| | Lower VSL | Moderate VSL | High VSL | Severe VSL |
| R1. | The Generator Owner or Transmission Owner coordinated equipment capabilities, control functions, and protection specified in Requirement R1 between 6 years (72 months) and 76 months after the previous coordination. | The Generator Owner or Transmission Owner coordinated equipment capabilities, control functions, and protection specified in Requirement R1 between 77 and 81 months after the previous coordination. | The Generator Owner or Transmission Owner coordinated equipment capabilities, control functions, and protection specified in Requirement R1 between 82 and 86 months after the previous coordination. | The Generator Owner or Transmission Owner coordinated equipment capabilities, control functions, and protection specified in Requirement R1 more than 86 months after the previous coordination. OR The Generator Owner or Transmission Owner failed to coordinate equipment capabilities, limiters, and protection as specified in Requirement R1. |
| R2. | The Generator Owner or Transmission Owner updated associated coordination documentation as specified in Requirement R2 between 91 and 120 calendar days after return to in-service date. | The Generator Owner or Transmission Owner updated associated coordination documentation as specified in Requirement R2 between 121 and 150 calendar days after return to in-service date. | The Generator Owner or Transmission Owner updated associated coordination documentation as specified in Requirement R2 between 151 and 180 calendar days after return to in-service date. | The Generator Owner or Transmission Owner failed to update associated coordination documentation as specified in Requirement R2 within 151 calendar days after return to in-service date. OR The Generator Owner or Transmission Owner failed to |

| R # | Violation Severity Levels | | | |
|-----|---------------------------|--------------|----------|---|
| | Lower VSL | Moderate VSL | High VSL | Severe VSL |
| | | | | coordinate equipment capabilities, limiters, and protection specified in Requirement R1 prior to the implementing a change in equipment or settings that affected the coordination. |

D. Regional Variances

None.

E. Associated Documents

“Underexcited Operation of Turbo Generators”, AIEE Proceedings T Section 881, Volume 67, 1948, Appendix 1, C. G. Adams and J. B. McClure.

“Protective Relaying For Power Generation Systems”, Boca Raton, FL, Taylor & Francis, 2006, Reimert, Donald

“Coordination of Generator Protection with Generator Excitation Control and Generator Capability”, a report of Working Group J5 of the IEEE PSRC Rotating Machinery Subcommittee

“IEEE C37.102-2006 IEEE Guide for AC Generator Protection”

“IEEE C50.13-2005 IEEE Standard for Cylindrical-Rotor 50 Hz and 60 Hz Synchronous Generators Rated 10 MVA and Above”

“IEEE C37.106 IEEE Guide for Abnormal Frequency Protection for Power Generating Plants”

Version History

| Version | Date | Action | Change Tracking |
|---------|-------------------|---|---|
| 1 | February 7, 2013 | Adopted by NERC Board of Trustees | New |
| 1 | March 20, 2014 | FERC Order issued approving PRC-019-1. (Order becomes effective on 7/1/16.) | |
| 2 | February 12, 2015 | Adopted by NERC Board of Trustees | Standard revised in Project 2014-01: Applicability revised to clarify application of requirements to BES dispersed power producing resources |
| 2 | May 29, 2015 | FERC Letter Order in Docket No. RD15-3-000 approving PRC-019-2 | Modifications to adjust the applicability to owners of dispersed generation resources. |
| 3 | TBD | Adopted by NERC Board of Trustees | Standard revised in Project 2021-01 |

Attachment 1: Equipment Capabilities, Types of Limiters, and Protective Functions

NOTE: This standard does not require the installation or activation of any of the limiter or protection functions for synchronous generation or IBR.

A. Synchronous generation equipment capabilities, control functions, and protective functions, which shall be coordinated if enabled, include but are not limited to:

- Synchronous generator/condenser reactive capabilities;
- Field over-excitation limiter and associated protective function;
- Field under-excitation limiter and associated protective function;
- Volts per hertz limiter and associated protective function;
- Stator over-voltage protection system settings;
- Synchronous generator/condenser and transformer volts per hertz capability;
- Time vs. field current or time vs. stator current; and
- Distributed control system (DCS) voltage/VAR limit settings.

B. IBR generating Facility equipment capabilities, control functions, and protective functions, which shall be coordinated if enabled, include but are not limited to:

- Transformer overvoltage protective function;
- Transformer undervoltage protective function;
- Transformer volts per hertz capability and protective function;
- Collector bus overvoltage protective function;
- Collector bus undervoltage protective function;
- Reactive compensating devices voltage control functions;
- Reactive compensating devices voltage protective function;
- Collector feeder phase overvoltage protective function;
- Collector feeder phase undervoltage protective function;
- Collector feeder overcurrent limiter;
- IBR unit phase lock loop protective function;
- IBR unit overcurrent limiter;
- IBR unit momentary cessation (cease current injection) protective function;
- IBR unit phase overvoltage protective function;
- IBR unit phase undervoltage protective function; and
- IBR unit phase overcurrent protective function.