

## 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~~second draft of the proposed standard being posted for a formal 45-day comment period and additional ballot.

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

Anticipated Actions	Date
45-day formal or informal comment period with additional ballot	<del>February</del> – April – <del>June</del> 2023
10-day final ballot	<del>May</del> <u>July</u> 2023
Board adoption	August <del>or December</del> 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 **Individual synchronous condenser greater than 20 MVA (gross nameplate rating) directly connected to the BES.**
    - ~~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, greater than 75 MVA (gross nameplate rating)** 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);<sup>1</sup>

<sup>1</sup> 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.

4.2.4.5 Generator step-up (GSU) transformer(s);<sup>2</sup>

4.2.5 Any Blackstart Resource.

**4.2.6 Facilities meeting an exclusion of the BES definition are exempt as an applicable Facility.**

5. **Effective Date:** See the Implementation Plan for PRC-019-3.

## B. Requirements and Measures

**R1.** ~~At a maximum of every six calendar years, each~~**Each** Generator Owner and Transmission Owner with applicable Facilities shall coordinate<sup>3</sup> the voltage regulating system controls, with the applicable equipment capabilities and settings of the applicable ~~protective~~**Protection System devices and** functions.<sup>4</sup> 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 functions<sup>54</sup> 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<sup>5</sup> is enabled in the power plant controller and/or IBR unit(s)<sup>6</sup> 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

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<sup>2</sup> 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.

<sup>3</sup> ~~As-left~~**Protection System as-left** settings shall be utilized in **compliance evidence for** a protection and control coordination study.

<sup>4</sup> ~~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.~~

<sup>54</sup> Limiter functions that are installed and activated on the generator or synchronous condenser.

<sup>5</sup> **For an IBR generating Facility without a voltage control mode capability, coordination should be performed assuming the normal operation control mode, and R1.2.1. and R1.2.2. would not apply.**

<sup>6</sup> IBR unit ~~includes the inverter, converter, or wind turbine generator~~**as defined by IEEE Std. 2800.**

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 **the** 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 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~~**will** 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.~~ **Associated** coordination documentation **shall be updated** 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~~**IBR generating Facility 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~~**will** 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.	<del>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.</del>	<del>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.</del>	<del>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.</del>	<del>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.</del> 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 <del>151</del> <b>181</b> calendar days after return to in-service date. OR The Generator Owner or Transmission Owner failed to

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R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
				coordinate equipment capabilities, limiters, and protection specified in Requirement R1 prior to <del>the</del> 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”

**“IEEE Std 2800-2022 IEEE Standard for Interconnection and Interoperability of Invert-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems”**

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## 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 and associated control function;
  - Transformer undervoltage protective function and associated control function;
  - Transformer volts per hertz capability ~~and~~ protective function and associated control function;
  - Collector bus overvoltage protective function and associated control function;
  - Collector bus undervoltage protective function and associated control function;
  - Reactive compensating devices voltage control functions and associated control function;
  - Reactive compensating devices voltage protective function and associated control function;
  - Collector feeder phase overvoltage protective function and associated control function;
  - Collector feeder phase undervoltage protective function and associated control function;
  - Collector feeder overcurrent limiter;
  - ~~and associated IBR unit phase lock loop~~ protective function;

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- IBR unit overcurrent limiter and associated protective function;
- IBR unit momentary cessation (cease current injection) protective function;
- IBR unit phase overvoltage protective function and associated control function;
- IBR unit phase undervoltage protective function and associated control function; and
- IBR unit phase overcurrent protective function and associated control function.

<b>Summary report:</b>	
<b>Litera Compare for Word 11.3.1.3 Document comparison done on 4/20/2023 7:05:12 PM</b>	
<b>Style name:</b> NERC Standards	
<b>Intelligent Table Comparison:</b> Active	
<b>Original filename:</b> PRC-019-3 Draft 1.0.docx	
<b>Modified filename:</b> PRC-019-3 Draft 2.0.docx	
<b>Changes:</b>	
<b>Add</b>	58
<b>Delete</b>	44
<b>Move From</b>	0
<b>Move To</b>	0
<b>Table Insert</b>	1
<b>Table Delete</b>	1
<b>Table moves to</b>	0
<b>Table moves from</b>	0
Embedded Graphics (Visio, ChemDraw, Images etc.)	0
Embedded Excel	0
Format changes	0
<b>Total Changes:</b>	<b>104</b>