



Electric Reliability and Security for the West

WECC Criterion
PRC-001-WECC-CRT-2.1

Introduction

1. **Title:** Governor Droop Setting
2. **Number:** PRC-001-WECC-CRT-2.1
3. **Purpose:** To facilitate primary frequency support in the Western Interconnection
4. **Applicability:**
 - 4.1. **Functional Entities:**
 - 4.1.1. Generator Owners
 - 4.2. **Facilities**
 - 4.2.1. Generating units that have governor function.
 - 4.2.2. Generating units having the ability to react or respond to a change in system frequency.
 - 4.2.3. Generating units being used during blackstart or islanded conditions are excluded from this document.
5. **Effective Date:** June 18, 2019

Requirements and Measures

WR1. Each Generator Owner shall set the Frequency Response droop for each generating unit to greater than or equal to 3 percent but less than or equal to 5 percent.

WM1. Each Generator Owner will have evidence that it set the Frequency Response droop for each generating unit to the parameters specified in WR1. Evidence may include, but is not limited to, dated setting sheets, generator test reports, generator logs, pictures, or other documentation.



Version History

Version	Date	Action	Change Tracking
1	October 13, 2011	Operating Committee Approved	Initial version
1	December 1, 2011	WECC Board of Directors Approved	Developed as WECC-0070. Initial version
1	September 5, 2012	WECC Board of Directors changed "CRT" to "RBP"	Designation change
1.1	January 17, 2013	Errata	Where applicable, the term "criterion" was exchanged for the generic term "document." At Section 6: Background, a footnote was added to explain the change from Criterion to Regional Business Practice. The document was conformed to the RBP template.
1.1	June 25, 2014	WECC Board of Directors changed "RBP" to "CRT"	Designation change
1.2	January 28, 2016	Errata	Sentence structure in the Effective Date was added for clarity. The information from the Background Fn 1 was removed because it is included in the Version History Table. The title "PRC-001-WECC-RBP-1.1 Regional Business Practice" was removed from Figure 1 to bring the Figure current. "PRC-001-WECC-RBP-1.1" was removed from the Rationale FAQs section to bring the document current.
1.2	April 1, 2016	No Change	Converted to new template
2	November 15, 2017	WECC Standards Committee approved for Board action	This project was developed as WECC-0125. The Purpose statement was shortened by removing the prepositional phrase. Facilities 4.2.2 was added to incorporate new technologies. The Background section was moved to the Guidance section. WR1/WM1 was updated replacing "governor" with "Frequency Response." M1 was updated to reflect current drafting conventions. The "Equipment Installation" section was added to the Guidance section. A typographical error in the April 1, 2016 row was corrected from 2.1 to 1.2.
2	December 6, 2017	WECC Board of Directors approved	The proposed Effective Date for the project was "immediately upon approval by the WECC Board of Directors (Board)." The Effective Date is December 6, 2017.
2.1	June 18, 2019	Errata	Converted to newest template.

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Attachments

Not used.



Rationale

A Rationale section is optional. If Rationale Boxes were used during the development of this project, the content of those boxes appears below.

Equipment Installation

Nothing in this document mandates installation of equipment required to meet Frequency Response.

Nothing in this document mandates installation of governor droop equipment.

This document only addresses equipment already installed or that which may be installed in the future and meets the criteria stated in the Applicability/Facilities section.

What constitutes a unit's "ability to react or respond to a change in system frequency" as described in the NERC Glossary is purposely omitted from this document to allow other regulatory forums to make that determination.

Background

The Operating Reliability Criteria Work Group (ORCWG) recommended that the WECC Minimum Operating Reliability Criteria (MORC) document be retired. As part of the ORCWG review of the MORC document, it was determined that the existing requirement for a governor droop setting was not covered by any other NERC or WECC requirement. After reviewing documents available from historical and recent professional organizations, such as IEEE, the WECC-0070 Governor Droop Setting Criterion Drafting Team has determined that WECC would be better off with a governor droop setting requirement in a small range rather than a fixed point. This permits Generator Owners more flexibility in setting governor droop to provide more frequency response when appropriate for reliability.

Requirement

WR1:

The 3-to-5 percent range provides a balance between frequency regulation and system stability. If the setting is too low, there could be system instability and negative damping of low frequency oscillations. If the setting is too high, larger frequency dips could result in under frequency load shedding.

Typically, the droop settings are at 5 percent. It is recommended that hydro units be maintained at 5 percent for stability reasons.

If blackstart or islanded conditions require governor droop settings to be modified during the event, this document would not apply.



The drafting team took the following into consideration developing the requirement:

- Are there different settings for different types of units?

The drafting team believes that all generators should provide response to frequency deviations through a setting criterion. In order to obtain participation from the maximum number of units, the drafting team decided to recommend adopting a governor droop setting requirement that permits a range of 3-to-5 percent for all governors. After reviewing industry standard recommendations for governor droop settings, the drafting team found that setting a range of 3-to-5 percent falls within the international industry recommendations for governor droop settings for different types of generators.

- Can non-rotating generating resources provide a comparable response to a governor?

The drafting team determined that it was only going to address traditional generating resources and not new technologies. The drafting team does not intend to place any obligations in the requirements for having generating equipment equivalent to a governor. In addition, the drafting team decided that requiring governors or functionally equivalent equipment was outside the scope of the Standard Authorization Request.

- Should there be a generator megawatt size limit for this criterion?

No, the drafting team believes in the interest of reliability that all generators with a functioning governor should set the governor droop to between 3 percent and 5 percent.

- As the generation mix is changing, does the Governor Droop Setting document need to be different?

No, the 3-to-5 percent governor droop setting range provides flexibility for generators with governors to respond regardless of generation mix.

Additional Considerations:

- Operational Concepts: The drafting team reviewed current practices in setting governor droop and the settings that manufacturers are recommending.
- In the drafting team's research of published data, it did not find any technical basis for the current 5 percent droop criterion.
- The drafting team reviewed results from technical studies with high loads. The results indicated that raising the droop settings above 5 percent would result in deeper frequency dips (see Figure 1.) Based on these results, the drafting team does not recommend that the governor droop settings be greater than 5 percent.

The labels in the graph for Figure 1 represent the scaling used, based on the existing base-case model; i.e., the first number shows the comparable droop setting. Droop settings were then



scaled between 3 and 17 percent to determine the effects of changing the droop settings in the Interconnection. As droop settings were increased for a double Palo Verde outage, the frequency dips were greater and response decreased. At a minimum, the drafting team wanted to maintain the current level of reliability. As a result, the drafting team chose not to permit droop settings greater than the previous criterion of 5 percent.

Lower droop settings reduce frequency dips. Currently, some manufacturers are recommending droop settings as low as 3 percent. Depending on the type of unit, droop settings below 3 percent may result in local instability. Thus, the drafting team felt that 3 percent was a good practical lower limit. Before changing a droop setting, it is recommended that manufacturers be consulted to ensure there is no adverse impact to the unit and that stability studies have been conducted.

- This document is not a system performance standard. The drafting team believes that this document should apply to the governor setting on individual generators rather than as an effective droop for an individual unit, a Balancing Authority Area, or a group of generators.
- Whereas droop and regulation are often confused, the drafting team clarifies that it considered droop as a setting in the governor while regulation reflects the measured response of the unit. This document is not intended to apply to regulation.
- Approximately half the generation will not respond to a frequency event regardless of the droop setting. In determining whether a specific unit will respond to a frequency dip depends upon factors such as generation loading, valve position, or control modes. Some gas turbines' response changes as frequency changes; e.g., output may decrease as frequency declines.
- The drafting team developed a setting criterion rather than performance criterion because it is difficult to verify governor performance criteria for generators for the following reasons:
 - 1) The ability to measure response is currently limited by existing data collection and storage systems.
 - 2) Settings do not solely determine response. Governor response is typically non-linear.
 - 3) Response is subject to a variety of operating conditions such as generator operating point, boiler and turbine operating conditions, ambient conditions, and the vintage and design of the unit; as well as by physical, regulatory, and environmental constraints.
 - 4) The response is impacted by the ramp rate, Automatic Generation Control, and other control mechanisms.
 - 5) Performing a test of the governor response is difficult because frequency events are hard to duplicate in test conditions, particularly for non-hydro units.

PRC-001-WECC-CRT-2.1—Governor Droop Setting

- 6) The frequency is constantly changing throughout a frequency event. Therefore, the response varies with time for each event. Primary response blends into secondary response. External events influence response of the unit (verification requires a steady-state condition that does not exist).



Figure 1—Governor Droop Setting

