

## A. Introduction

1. **Title:** Power System Stabilizer (PSS)
2. **Number:** VAR-501-WECC-3.1
3. **Purpose:** To ensure the Western Interconnection is operated in a coordinated manner under normal and abnormal conditions by establishing the performance criteria for WECC power system stabilizers.
4. **Applicability:**
  - 4.1 Generator Operator
  - 4.2 Generator Owner
5. **Facilities:** This standard applies to synchronous generators, connected to the Bulk Electric System, that meet the definition of Commercial Operation.
6. **Effective Date:** The first day of the first quarter following regulatory approval, except for Requirement R3.

For units placed in first-time service after regulatory approval, Requirement R3 is effective the first day of the first quarter following final regulatory approval.

For units placed in service prior to final regulatory approval, Requirement R3 is effective the first day of the first quarter that is five years after regulatory approval.

## B. Requirements and Measures

- R1. Each Generator Owner shall provide to its Transmission Operator, the Generator Owner's written Operating Procedure or other document(s) describing those known circumstances during which the Generator Owner's PSS will not be providing an active signal to the Automatic Voltage Regulator (AVR), within 180 days of any of the following events: [*Violation Risk Factor: Low*] [*Time Horizon: Planning Horizon*]
  - The effective date of this standard;
  - The PSS's Commercial Operation date; or
  - Any changes to the PSS operating specifications.

- M1. Each Generator Owner will have documented evidence that it provided to its Transmission Operator, within the time allotted as described in the procedures required under Requirement R1, written Operating Procedures or other document(s) describing those known circumstances during which the Generator Owner's PSS will not be providing an active signal to the AVR.

For auditing purposes, because Requirement R1 conditions are intended to be unchanged unless the Transmission Operator is otherwise notified, the Generator Owner only needs to provide the documentation to the Transmission Operator one time, or whenever the operating specifications change.

For auditing purposes, if a PSS is in service but is not providing an active signal to the AVR as described in Requirement R1, the disabled period does not count against the Requirement R2 mandate to be in service except as otherwise allowed.

- R2.** Each Generator Operator shall have its PSS in service while synchronized, except during any of the following: *[Violation Risk Factor: Medium] [Time Horizon: Operating Assessment]*

- Component failure
- Testing of a Bulk Electric System Element affecting or affected by the PSS
- Maintenance
- As agreed upon by the Generator Operator and the Transmission Operator

A PSS that is out of service for less than 30 minutes does not create a violation of this Requirement, regardless of cause.

- M2.** Each Generator Operator will have documentation of each claimed exception specified in Requirement R2. Documentation may include, but is not limited to:

- A written explanation covering the bulleted exception that describes the circumstances of the exception as allowed in Requirement R2.
- Documented evidence that the Generator Operator and the Transmission Operator agreed the PSS would not be operating during a specified set of circumstances, where the exception is claimed under the last bullet of Requirement R2.

For auditing purposes, the presumption is that the PSS was in service unless otherwise exempted in Requirement R2. Evidence need only be provided to prove the circumstances during which the PSS was not in service for periods in excess of 30 minutes.

- R3.** Each Generator Owner shall tune its PSS to meet the following inter-area mode criteria, except as specified in Requirement R3, Part 3.5 below: *[Violation Risk Factor: Medium] [Time Horizon: Operating Assessment]*

**3.1.** PSS shall be set to provide the measured, simulated, or calculated compensated  $V_t/V_{ref}$  frequency response of the excitation system and synchronous machine such that the phase angle will not exceed  $\pm 30$  degrees through the frequency range from 0.2 Hertz to the lesser of 1.0 Hertz or the highest frequency at which the phase of the  $V_t/V_{ref}$  frequency response does not exceed 90 degrees.

**3.2.** PSS output limits shall be set to provide at least  $\pm 5\%$  of the synchronous machine's nominal terminal voltage.

**3.3.** PSS gain shall be set to between  $1/3$  and  $1/2$  of maximum practical gain.

**3.4.** PSS washout time constant shall be no greater than 30 seconds.

**3.5.** Units that have an excitation system or PSS that is incapable of meeting the tuning requirements of Requirement R3 are exempt from Requirement R3 until the voltage regulator is either replaced or retrofitted such that the PSS becomes capable of meeting the tuning requirements.

**M3.** Each Generator Owner will have documented evidence that its PSS was tuned to meet the specifications of Requirement R3.

If the exception under Requirement R3, Part 3.5, is claimed, the Generator Owner will have documented evidence describing: 1) the conditions that render the PSS incapable of meeting the tuning requirements, and 2) the date the voltage regulator was last replaced or retrofitted.

**R4.** Each Generator Owner shall install and complete start-up testing of a PSS on its generator within 180 days of either of the following events: *[Violation Risk Factor: Medium] [Time Horizon: Operational Assessment]*

- The Generator Owner connects a generator to the BES, after achieving Commercial Operation, and after the Effective Date of this standard.
- The Generator Owner replaces the voltage regulator on its existing excitation system, after achieving Commercial Operation for its generator that is connected to the BES, and after the Effective Date of this standard.

**M4.** Each Generator Owner will have evidence that it installed and completed start-up testing of a PSS on its generator within 180 days of either of the conditions described in Requirement R4, and when those conditions occur after the Effective Date of this standard.

For auditing purposes of Requirement R4, bullet one only applies to equipment on its initial (first energization) connection to the BES.

**R5.** Each Generator Owner shall repair or replace a PSS within 24 months of that PSS becoming incapable of meeting the tuning specifications stated in Requirement R3. *[Violation Risk Factor: Medium] [Time Horizon: Operational Assessment]*

**M5.** Each Generator Owner will have evidence that it repaired or replaced its PSS within 24 months of that PSS becoming incapable of meeting the tuning specifications of Requirement R3. Evidence may include, but is not limited to, documentation of the date the PSS became incapable of meeting the Requirement R3 tuning specifications, and the date the PSS was returned to service, demonstrating that the span of time between the two events was less than 24 months.

## **C. Compliance**

### **1. Compliance Monitoring Process**

#### **1.1 Compliance Enforcement Authority**

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 Compliance Monitoring and Assessment Processes**

- Compliance Audits
- Self-Certifications
- Spot Checking
- Compliance Investigations
- Self-Reporting
- Complaints

#### **1.3 Evidence Retention**

The following evidence retention periods 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.

Each Generator Operator shall keep evidence for all Requirements of the document for a period of three years plus calendar current.

#### **1.4 Additional Compliance Information**

None

## **D. Regional Differences**

None

Table of Compliance Elements

R	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	Planning Horizon	Low	NA	NA	NA	The Generator Owner failed to provide its PSS operating specifications to the Transmission Operator as required in Requirement R1.
R2	Operations Assessment	Medium	Each Generator Operator not having its PSS in service while synchronized in accordance with Requirement R2, for more than 30 minutes but less than 60 minutes.	Each Generator Operator not having its PSS in service while synchronized in accordance with Requirement R2, for more than 60 minutes but less than 120 minutes.	Each Generator Operator not having its PSS in service while synchronized in accordance with Requirement R2, for more than 120 minutes but less than 180 minutes.	Each Generator Operator not having its PSS in service while synchronized in accordance with Requirement R2, for more than 180 minutes.
R3	Operations Assessment	Medium	The Generator Owner's PSS failed to meet any of the required performances in Requirement R3, two times or fewer during the audit period.	The Generator Owner's PSS failed to meet any of the required performances in Requirement R3, three times during the audit period.	The Generator Owner's PSS failed to meet any of the required performances in Requirement R3, four times during the audit period.	The Generator Owner's PSS failed to meet any of the required performances in Requirement R3, five times or more during the audit period.

R	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
<b>R4</b>	Operational Assessment	Medium	NA	NA	NA	The Generator Owner failed to install on its generator a PSS, as required in Requirement R4.
<b>R5</b>	Operational Assessment	Medium	NA	NA	NA	The Generator Owner failed to repair or replace a non-operational PSS as required in Requirement R5.

## Version History

Version	Date	Action	Change Tracking
1	April 16, 2008	Permanent Replacement Standard for VAR-STD-002b-1	
1	October 28, 2008	Adopted by NERC Board of Trustees	
1	April 21, 2011	FERC Order issued approving VAR-501-WECC-1 (FERC approval effective June 27, 2011; Effective Date July 1, 2011)	
2	November 13, 2014	Adopted by NERC Board of Trustees	
2	March 3, 2015	FERC letter order approved VAR-501-WECC-2	
3	February 9, 2017	Adopted by NERC Board of Trustees	
3	April 28, 2017	FERC letter order approved VAR-501-WECC-3	
3.1	August 10, 2017	Adopted by the NERC Board of Trustees	Errata
3.1	September 26, 2017	FERC letter order issued approving VAR-501-WECC-3.1	
3.1	April 20,2020	The Guidelines and Technical Basis (including the Technical Rationale) section of the standard was removed and placed into a separate document. Because no changes were made to the mandatory and enforceable elements of the standard, the version number remains unchanged.	Technical Rationale Initiative

**\* FOR INFORMATIONAL PURPOSES ONLY \***

**Enforcement Dates: Standard VAR-501-WECC-3 — Power System Stabilizer**

**United States**

<b>Standard</b>	<b>Requirement</b>	<b>Enforcement Date</b>	<b>Inactive Date</b>
VAR-501-WECC-3	TBD	TBD	