

Posting #3

The WECC-0107, VAR-501-WECC-2, Power System Stabilizer Drafting Team (DT) thanks everyone who submitted comments on the proposed documents.

Posting

This document was last posted for a 30-day public comment period from December 12, 2014 through January 12, 2015. Late comments were received until January 20, 2015, 10:00 a.m. (Mountain) when the drafting team met to respond to comments. The window was extended because a closing date in the mandated notice did not match text in the posted document.

WECC distributed the notice for the posting on December 3, 2014. The DT asked stakeholders to provide feedback on the proposed document through a standardized electronic template. WECC received comments from five companies representing six of the eight Industry Segments, as shown in the table on the following page.

Location of Comments

All comments received on the document can be viewed in their original format on the project page under the “Submit and Review Comments” accordion.

Changes in Response to Comment

After consideration of comments received, the DT made the following changes:

Requirement R1

To eliminate confusion between information required under this document and that of NERC Standard MOD-026, Requirement R1 was changed to read as follows:

R1. Each Generator Operator shall provide to its Transmission Planner, within 180 days of the PSS’s Commercial Operation date or any changes to the PSS operating specifications, its written operating procedure describing those known circumstances during which its PSS will not be providing an active signal to the Automatic Voltage Regulator (AVR). *[Violation Risk Factor: Low]*
[Time Horizon: Planning Horizon]

Requirement R2

Requirement R2 was redrafted to eliminate duplicative notice requirements between the proposed document and other existing NERC Standards. The notification component of the proposed Requirement was removed. The requirement now reads:

- 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 BES Element affecting or affected by the PSS;
 - Maintenance;
 - As agreed upon by the Generator Operator and the Transmission Operator.

Requirement R3

Requirement R3, numbered section 1 was changed to synchronize the Requirement with the Guidance section, inter alia. The drafting team noted in its response that the numbers included in the proposed Requirement are not new; rather, they reflect thresholds already included in WECC Guidelines. The DT also noted its commitment from Posting 1 to review APS's concerns regarding the 30 degree threshold. The DT believes the following redraft addresses APS's Posting 1 concern as well as that presented for review by others in Posting 3. The Requirement now reads:

- R3.** Each Generator Owner shall tune its PSS to meet the following inter-area mode criteria: *[Violation Risk Factor: Medium] [Time Horizon: Operating Assessment]*
- 1) PSS shall be set to provide a compensated minimum-load V_t/V_{ref} frequency response of the excitation system and synchronous machine such that the phase angle will not exceed ± 30 degrees through the frequency range from 0.2 Hertz to 1.0 Hertz or the highest frequency at which the phase of the minimum-load V_t/V_{ref} frequency response does not exceed 90 degrees.
 - 2) PSS output limits shall be set to provide at least $\pm 5\%$ of the synchronous machine's nominal terminal voltage.
 - 3) PSS gain shall be set to between $1/3$ and $1/2$ of maximum practical gain.
 - 4) PSS washout time constant shall be no greater than 30 seconds.

Requirement R4

The drafting team did not accept a suggestion to exchange the word "replace" with "upgrade" because the term "upgrade" was too ambiguous. The team opted for "replace" as the triggering event noting that when a voltage regulator is replaced, the PSS must also be replaced or added, and must meet the specification of the proposed standard.

Requirement R5

Commenter		Organization	WECC Standards Voting Sectors							
			1	2	3	4	5	6	7	8
		(Kestrel)								
3	David Lemmons	Xcel Energy/Public Service Company of Colorado	X	X	X	X	X			
4	Sergio Banuelos	Tri-state Generation and Transmission (Tri-state)	X	X	X	X	X			
5	Joseph Wilson	Tacoma Power	X	X	X	X	X			

Index to Questions, Comments, and Responses

Question

1. The drafting team welcomes comments on all aspects of the document.

1. The drafting team welcomes comments on all aspects of the document.

Summary Consideration:		See summary in the preamble of this document.	
Commenter	Yes	No	Comment
APS			<p>To remove ambiguity, APS would like to see a fifth bullet added to R2 that addresses the condition that even when a generator is synchronized to the BES, the PSS will not be functioning when the unit is operation below the PSS threshold values. The added bullet should be closely worded to R1.5 of the current VAR-501-WECC-1.</p> <p>R2. Each Generator Operator shall have its PSS in service while synchronized, except when the Generator Operator has notified the Transmission Operator that the PSS is removed from service for any of the following circumstances: <i>[Violation Risk Factor: Medium]</i> <i>[Time Horizon: Operating Assessment]</i></p> <ul style="list-style-type: none"> • Component failure; • Testing of a BES Element affecting or affected by the PSS; • Maintenance; or, • As agreed upon by the Generator Operator and the Transmission Operator. • Unit is generating less power than the set point where PSS is designed to be turned on. <p>Or, if it is the drafting board's recommendation that GO's <u>do not</u> need to track the time when a generator is synchronized to the BES but producing less power then what is needed to run the PSS (Start up, shout down, and spinning reserve); please specifically specify that this time does not need to be tracked (PSS is available but not active).</p>
<p><u>Requirement R2, "Fifth Bullet"</u></p> <p>Requirement R2:</p> <p>The drafting team recognizes the duplication of the notification requirement in the proposed language as well as the NERC VAR-002-3, Requirement R3. The notification component of the proposed Requirement has been removed. The focus of the proposed Requirement is now on ensuring the PSS is operating as opposed to notification.</p>			

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R2.	<p>Each Generator Operator shall have its PSS in service while synchronized, except for any of the following: <i>[Violation Risk Factor: Medium] [Time Horizon: Operating Assessment]</i></p> <ul style="list-style-type: none"> • Component failure; • Testing of a BES Element affecting or affected by the PSS; • Maintenance; • As agreed upon by the Generator Operator and the Transmission Operator. <p>The DT also notes its commitment from Posting 1 to further assess the “30 degree” issue raised by APS in that posting. The DT modified the Requirement R3 (as numbered on February 10, 2015) in a manner believed to meet APS’s reliability concerns. The new Requirement R3 and APS’s Posting 1 concern appears below.</p> <p>Requirement R3: APS Posting 1 Comment:</p> <p>In reference to Requirement 2, the following comments are provided:</p> <ul style="list-style-type: none"> • R2: The ± 30 degrees criteria should be relaxed to ± 45 degrees and with a comment that it be generally within ± 30 degrees. There are many situations where ± 30 degrees is not attainable. APS Suggests a revision to the language of this requirement, which would read: "PSS shall provide a compensated frequency response of the excitation system and synchronous machine such that through the frequency range from 0.1 Hertz to 1.0 Hertz the phase will generally be within ± 30 degrees but not exceed ± 45 degrees. <p>Proposed remedial language:</p> <p>R3. Each Generator Owner shall tune its PSS to meet the following inter-area mode criteria: <i>[Violation Risk Factor: Medium] [Time Horizon: Operating Assessment]</i></p> <ol style="list-style-type: none"> 1) PSS shall be set to provide a compensated minimum-load V_t/V_{ref} frequency response of the excitation system and synchronous machine such that the phase angle will not exceed ± 30 degrees through the frequency range from 0.2 Hertz to 1.0 Hertz or the highest frequency at which the phase of the minimum-load V_t/V_{ref} frequency response does not exceed 90 degrees. 2) PSS output limits shall be set to provide at least $\pm 5\%$ of the synchronous machine’s nominal terminal voltage. 3) PSS gain shall be set to between $1/3$ and $1/2$ of maximum practical gain. 4) PSS washout time constant shall be no greater than 30 seconds. 		
Kestrel			This Draft of the Standard has clarified most of the issues/comments raised in the previous round of comments.

Summary Consideration:		See summary in the preamble of this document.	
Commenter	Yes	No	Comment
			<p>Unfortunately, it seems that a small inconsistency was introduced between the text in R3, item (1), and the associated explanation presented in the Guideline and Technical Basis.</p> <p>Requirement R3, item (1), defines the frequency range of interest from 0.1 Hz to 1.0 Hz, while the explanation in the Guideline and Technical Basis refers to 0.2 Hz as the lower end of the same frequency range.</p> <p>The Drafting Team should clarify which frequency range will be part of the actual Requirement R3.</p> <p>Our position is that the value of 0.2 Hz should be used, despite the fact that the lower value of 0.1 Hz has been used in the past. Basically, raising the lower threshold of the frequency range will have a significant positive impact on the selection of the washout time constant T_w (see item (4) of Requirement R3), allowing the selection of time constants much smaller than 30 seconds. In practice, raising the lower threshold of the frequency range of interest from 0.1 Hz to 0.2 Hz should make it relatively easy to achieve washout time constants smaller than 10 s and even smaller than 5 s in most cases.</p> <p>On the other hand, maintaining the lower threshold value of 0.1 Hz might require the use of larger values of T_w and would also make the PSS responsive at that lower frequency. This is problematic, due to the possibility of interaction of the PSS with the dynamic response of turbines, particularly hydro turbines. This interaction between the PSS and the turbine controls should be avoided, as the PSS might show unexpected response and even detrimental response to events such as a fast loading/unloading of the unit (fast ramp rates of hydro units) and even introducing relatively large variations in terminal voltage following events leading to large or sustained frequency deviations.</p> <p>A review of the literature found only one reference [1] of an oscillation frequency lower than 0.20 Hz in WECC, and that was for the system configuration prior to 1967 (prior to the energization of the Pacific Intertie) when the system operated with a very weak 230 kV interconnection. The same reference indicates that the oscillation frequency increased to 0.30 Hz after commissioning of</p>

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			<p>the Pacific Intertie. The same reference indicates the emergence of a new oscillation mode, at around 0.20 Hz, probably related to the parallel North-South path through Idaho, Utah and Arizona.</p> <p>[1] R. L. Cresap and J. F. Hauer, "Emergence of a New Swing Mode in the Western Power System", IEEE Trans. on Power Apparatus and Systems, vol. 100, no 4, April 1981, pp. 2037-2045.</p>
<p><u>Inconsistency between R3, item (1) and the associated Guideline and Technical Basis</u></p> <p>Requirement R3, item (1), defines the frequency range of interest from 0.1 Hz to 1.0 Hz, while the explanation in the Guideline and Technical Basis refers to 0.2 Hz as the lower end of the same frequency range.</p> <p>The concern has been addressed with updated text in Requirement R3, Bullet 1:</p> <p>Requirement R3:</p> <p>1) "PSS shall be set to provide a compensated minimum-load Vt/Vref frequency response of the excitation system and synchronous machine such that the phase angle will not exceed ± 30 degrees through the frequency range from 0.2 Hertz to 1.0 Hertz or the highest frequency at which the phase of the minimum-load Vt/Vref frequency response does not exceed 90 degrees."</p>			
Xcel			<p>Xcel Energy appreciates the efforts made by the WECC-0107 drafting team to improve the current PSS standard. This draft is a significant improvement over the current standard. However, Xcel Energy has some concerns related to the proposed standard, specifically related to the first three requirements.</p> <p>Concern with proposed R1</p> <p>As written, Xcel Energy is concerned that there could be some confusion related to the information needed under R1 compared to information required under MOD-026. Xcel Energy recommends revising the language in R1 to be as follows:</p> <p>Each Generator Operator shall provide to its Transmission Planner the operating conditions for the generator describing each condition during which the PSS will be non-operational, within 180</p>

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			<p>days of the PSS Commercial Operation date or any changes to the operating conditions that impact the PSS operation.</p> <p>This language provides clarity as to what information is required under this standard as compared to the information required under MOD-026.</p> <p>Concern with proposed R2</p> <p>As worded, there appears to be two parts to the requirement: the first part is to have the PSS in service; the second part is to notify the Transmission operator that the PSS is not in service. Xcel Energy is concerned that the second part of the requirement puts an entity at risk of double jeopardy.</p> <p>Under the NERC standard VAR-002-3, R3 clearly requires that the TOP be notified of a change of status for the PSS. If an entity fails to make that notification, then it is Xcel Energy's position that the entity will be found to have violated both the proposed WECC standard and the NERC standard.</p> <p>It is also unclear if the notification must be made while the PSS is out of service or if notification might be made after the PSS has been returned to service, especially for a very short duration outage. Note that under the NERC standard, outages of less than 30 minutes do not require notification to the TOP. However, as worded in the WECC proposal, it is unclear if notification must be made prior to the PSS being removed from service or if notification after the PSS goes out of service is sufficient.</p> <p>Due to the concerns of double jeopardy, Xcel believes that a regional variance to the NERC VAR-002 standard, Requirement R1, to address the need to have the PSS in service is better than a separate standard. The NERC Requirement R1 requires that the AVR be in operation but is silent on the PSS. However, Requirement R3 in the NERC standard requires that the GOP notify the TOP of a status change of either the AVR or PSS. A WECC regional variance to Requirement R1, which could easily add the PSS to the language already approved for the AVR, would address the concerns in a reasonable manner without subjecting all GOPs</p>

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			<p>operating in the WECC to double jeopardy.</p> <p>Concerns with proposed R3</p> <p>Xcel Energy has two concerns with the proposed R3. First, there does not appear to be any differentiation for current technology versus older technology. While new electronic systems can be easily tuned to these specifications, older PSSs may not be capable of modifications to address the specified setting requirements. Also there is concern that any adjustments to the older solid state equipment may lead to equipment failure with lack of replacement parts. The drafting team must address this issue before a standard can be implemented.</p> <p>Second, the proposed implementation time for this standard is not acceptable for the needed tuning/setting process for the fleet of PSSs in the WECC. There are a limited number of people/entities with the expertise to test and tune the PSS. In addition, the concerns related to older technology was confirmed by Xcel Energy's consultant used for tuning the PSS systems within the PSCo fleet. If a person is to modify the settings of these older systems, the time tune and verify is much greater than the time to adjust newer digital systems. Therefore, the proposed time frame to implement R3 is unacceptable. This standard, or at least this requirement, needs a much longer time period for implementation than the proposed 12 months.</p> <p>Concern with proposed R5</p> <p>As worded, it is unclear when the PSS must be repaired or replaced. Reading both the requirement and the measure, it appears that the PSS must be repaired/replaced within 24 months of the generating unit becoming non-operational, which does not make logical sense. Xcel Energy believes the intent is to allow for 24 months for the PSS to be repaired/replaced if the PSS quits working. If that is the case, the drafting team should not use the word unit. In the electric industry, the word "unit" typically refers to the generator, not the PSS. Therefore, Xcel Energy recommends replacing the word unit with PSS anywhere the drafting team is referring to the actual PSS instead of the generating unit itself.</p>

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Commenter	Yes	No	Comment
			Thank you for your efforts on improving the current PSS standard. Xcel Energy looks forward to working with the drafting team to address these issues.

Requirement R1

As written, Xcel Energy is concerned that there could be some confusion related to the information needed under Requirement R1 compared to information required under MOD-026. To address this concern the DT will request that WECC Compliance review the proposed Requirement along with MOD-026 to see if duplication exists. Requirement R1 has been redrafted as follows:

Requirement R1:

R1. Each Generator Operator shall provide to its Transmission Planner, within 180 days of the PSS’s Commercial Operation date or any changes to the PSS operating specifications, its written operating procedure describing those known circumstances during which its PSS will not be providing an active signal to the Automatic Voltage Regulator (AVR).

Requirement R2:

The drafting team recognizes the duplication of the notification requirement in the proposed language as well as the NERC VAR-002-3, Requirement R3. The notification component of the proposed Requirement has been removed. The focus of the proposed Requirement is now on ensuring the PSS is operating as opposed to notification.

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

- Component failure;
- Testing of a BES Element affecting or affected by the PSS;
- Maintenance;
- As agreed upon by the Generator Operator and the Transmission Operator.

Requirement R3

The drafting team appreciates your concern. The first bullet of Requirement R3 has been changed to read as follows. The proposed language is crafted to allow for performance by both older as well as newer units. To the extent an entity tuned in accordance with the now existing tuning guidelines, adherence to the Requirement as drafted should be viable by the proposed Effective Date.

“PSS shall be set to provide a compensated minimum-load VT/Vref frequency response of the

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<p>excitation system and synchronous machine such that the phase will not exceed ± 30 degrees through the frequency range from 0.2 Hertz to 1.0 Hertz or the highest frequency at which the phase angle of the minimum-load V_t/V_{ref} frequency response does not exceed 90 degrees.”</p> <p><u>Requirement R5 / Repair of PSS</u></p> <p>The drafting team has redrafted the Requirement and Measure as follows:</p> <p>R5. Each Generator Owner shall repair or replace a non-operating PSS within 24 months of that non-operating PSS becoming non-operational. <i>[Violation Risk Factor: Medium] [Time Horizon: Operational Assessment]</i></p> <p>M5. Each Generator Owner will have evidence that it repaired or replaced a non-operational PSS within 24 months of that non-operating PSS becoming non-operational. Evidence may include, but is not limited to, documentation of: 1) the date the PSS became non-operational, and 2) the date the PSS was returned to service, the span of time between the two events being within 24 months of one another.</p>			
Tri-State			<p>Tri-State Generation and Transmission (TSGT) believes that the language in R4 should be modified. TSGT suggests changing the language in the second bullet of the requirement from “The Generator Owner replaces the voltage regulator...” to “The Generator Owner upgrades the voltage regulator...” If an entity is replacing an old voltage regulator with a similar device then the entity should not be required to install PSS.</p> <p>TSGT is interested to know the information the standard drafting team has that supports the numbers in requirement R3. What has occurred that leads the standard drafting team to believe this new requirement is necessary?</p> <p>TSGT would also like to know what evidence has been found that suggests that all synchronous generators (applicable to the BES) require PSS. This requirement is a large leap from what is currently required and TSGT wonders what recent information makes this requirement necessary. There isn’t sufficient information provided in the “technical basis” section of the document to support the addition of this requirement. What fundamental data has been collected or research has been done to require PSS on every applicable facility?</p>

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Commenter	Yes	No	Comment
<p><u>Requirement R4 / Upgrade vs. Replace</u></p> <p>The drafting team has concerns with the use of the term “upgrade” as its generic application is too ambiguous. For example, if a new piece is used to repair an older piece, and the newer piece is superior to the older piece – it is unclear whether that action is an “upgrade. To remedy the ambiguity, the team opted for “replacement” as the triggering event noting that when a voltage regulator is replaced, the PSS must also be replaced or added, and must met the specifications of the standard.</p> <p><u>Requirement R3 / Numbers</u></p> <p>The drafting team notes that the substance of the requirement is not new in the sense that the requirement has been resident in WECC Guidelines for some time.</p>			
Tacoma Power			<p><u>Measure 3 (M3)</u></p> <p>The Requirement 3 (R3) task responsibility was changed from generator Operator to generator Owner. Measure 3 (M3) needs to change to generator Owner to be consistent.</p> <p><u>C. Compliance, 1.3 Evidence Retention</u></p> <p>The second paragraph should also include Generator Owner to be consistent with the change made to R3.</p> <p><u>Table of Compliance Elements</u></p> <p>Pertaining to R3, the Violation Security Levels need to change from Generator Operator to Generator Owner for consistency.</p>
<p>The drafting team appreciates Tacoma’s comments. The drafting team has been in touch with Tacoma directly and indicated that Measures and Compliance will be addressed in subsequent postings. Tacoma agreed to re-submit its comments once the drafting team has solicited comments on the Measures and Compliance sections.</p>			