UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

North American Electric Reliability Corporation	**)** **)**	**Docket No. _____**

PETITION OF THE NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION FOR APPROVAL OF PROPOSED RELIABILITY STANDARD VAR-001-5

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Pursuant to Section 215(d)(1) of the Federal Power Act[1] and Section 39.5[2] of the Federal Energy Regulatory Commission's ("FERC" or the "Commission") regulations, the North American Electric Reliability Corporation ("NERC")[3] hereby submits for Commission approval proposed Reliability Standard VAR-001-5 – Voltage and Reactive Control. NERC is proposing revisions only to the regional Western Electricity Coordinating Council ("WECC") Variance to the standard, which applies to entities in the Western Interconnection.

NERC requests that the Commission approve proposed Reliability Standard VAR-001-5 (**Exhibit A**) as just, reasonable, not unduly discriminatory or preferential, and in the public interest.[4] NERC also requests approval of the proposed effective date as described herein and in Exhibit A. Lastly, NERC requests approval of the associated Violation Severity Levels ("VSLs") and Violation Risk Factors ("VRFs"), both of which remain substantively unchanged from the currently-effective version of the standard.

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1 16 U.S.C. § 824o (2018).

2 18 C.F.R. § 39.5 (2018).

3 The Commission certified NERC as the electric reliability organization ("ERO") in accordance with Section 215 of the Federal Power Act on July 20, 2006. *N. Am. Elec. Reliability Corp.*, 116 F.E.R.C ¶ 61,062 (2006).

4 Unless otherwise designated, all capitalized terms shall have the meaning set forth in the *Glossary of Terms Used in NERC Reliability Standards*, *available at* http://www.nerc.com/files/Glossary_of_Terms.pdf.

As required by Section 39.5(a)[5] of the Commission's regulations, this petition presents the technical basis and purpose of the proposed Reliability Standard and a summary of the development proceedings (**Exhibit B**). The proposed standard continues to meet the criteria for approval identified by the Commission in Order No. 672.[6] In accordance with NERC's Rules of Procedure, the Variance revisions reflected in proposed Reliability Standard VAR-001-5 were developed through WECC's standard development process. The proposed standard was approved by the WECC Board of Directors on June 20, 2018 and by the NERC Board of Trustees on August 16, 2018.

I. EXECUTIVE SUMMARY

The purpose of VAR-001-5 is to ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in Real-time to protect equipment and the reliable operation of the Interconnection. In 2013, the Commission approved the Variance for the WECC region.[7] In 2017, WECC initiated a periodic review of the Variance and, as a result of this review, determined that certain revisions were necessary.

As explained more fully herein, WECC has revised the Variance to eliminate Requirement E.A.15 because the reliability-related task is addressed in a continent-wide Reliability Standard. Additionally, WECC has made several minor changes to the standard and associated elements, including correcting typographical and capitalization errors, updating the Measures to match NERC conventions, and replacing the term "shall" with "will." No revisions were made to the

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5 18 C.F.R. § 39.5(a).

6 The Commission specified in Order No. 672 certain general factors it would consider when assessing whether a particular Reliability Standard is just and reasonable. *See Rules Concerning Certification of the Electric Reliability Organization; and Procedures for the Establishment, Approval, and Enforcement of Electric Reliability Standards*, Order No. 672, F.E.R.C Stats. & Regs. ¶ 31,204, at P 262, 321-37, *order on reh'g*, Order No. 672-A, F.E.R.C Stats. & Regs. ¶ 31,212 (2006).

7 *N. Am. Elec. Reliability Corp.*, Docket No. RD13-6-000 (June 20, 2013) (delegated letter order approving VAR-001-3, which modified VAR-001-2 to add the WECC Variance) (hereinafter "2013 Approval Order").

continent-wide Requirements or any of the corresponding elements. The revised WECC Variance in proposed Reliability Standard VAR-001-5 continues to remain more stringent than the continent-wide Requirements it replaces and continues to provide an alternate approach to meeting the same reliability objective based on physical differences in the Western Interconnection. For these reasons, and as discussed more fully herein, NERC respectfully requests the Commission approve proposed Reliability Standard VAR-001-5 and the associated elements. The following petition presents the justification for approval and supporting documentation.

II. NOTICES AND COMMUNICATIONS

Notices and communications with respect to this filing may be addressed to the following:

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III. BACKGROUND

The following background information is provided below: (a) an explanation of the regulatory framework for NERC and Regional Reliability Standards; (b) an explanation of the WECC standards development process; and (c) the history of Project WECC-0128, VAR-001-4.1, Voltage and Reactive Control – WECC Regional Variance, Five-year Review**.**

A. Regulatory Framework

By enacting the Energy Policy Act of 2005,[8] Congress entrusted the Commission with the duties of approving and enforcing rules to ensure the reliability of the Bulk-Power System, and with the duties of certifying an ERO that would be charged with developing and enforcing mandatory Reliability Standards, subject to Commission approval. Section 215(b)(1)[9] of the Federal Power Act states that all users, owners, and operators of the Bulk-Power System in the United States will be subject to Commission-approved Reliability Standards. Section 215(d)(5)[10] of the Federal Power Act authorizes the Commission to order the ERO to submit a new or modified Reliability Standard. Section 39.5(a)[11] of the Commission's regulations requires the ERO to file with the Commission for its approval each Reliability Standard that the ERO proposes should become mandatory and enforceable in the United States, and each modification to a Reliability Standard that the ERO proposes should be made effective.

The Commission has the regulatory responsibility to approve Reliability Standards that protect the reliability of the Bulk-Power System and to ensure that such Reliability Standards are just, reasonable, not unduly discriminatory or preferential, and in the public interest. A Reliability Standard proposed by a Regional Entity must meet the same standard that NERC's Reliability Standards must meet, *i.e.*, the Regional Reliability Standard must be shown to be just, reasonable, not unduly discriminatory or preferential, and in the public interest.[12]

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8 16 U.S.C. § 824o (2018).

9 *Id.* § 824o(b)(1).

10 *Id.* § 824o(d)(5).

11 18 C.F.R. § 39.5(a).

12 16 U.S.C. § 824o(d)(2); 18 C.F.R. §39.5(a). If the regional Reliability Standard is proposed by a Regional Entity organized on an Interconnection-wide basis, to be applicable on an Interconnection-wide basis, then NERC must rebuttably presume that the standard is just, reasonable, not unduly discriminatory or preferential, and in the public interest. 16 U.S.C. § 824o(d)(3); 18 C.F.R. §39.5(b).

In Order No. 672, the Commission stated that it would accept two types of regional differences, provided that they were otherwise just, reasonable, not unduly discriminatory or preferential in the public interest. Specifically, the Commission stated it would accept regional differences that are: (1) more stringent than the continent-wide Reliability Standard, or (2) necessitated by a physical difference in the Bulk-Power System.[13] A regional difference generally takes one of two forms: (1) a regional Variance may be included in a continent-wide Reliability Standard, which achieves the reliability objective of the continent-wide standard's requirement(s) in an alternate way than specified in a given Requirement in the continent-wide standard; or (2) a separate Regional Reliability Standard may be developed, which adds one or more Requirements without altering any continent-wide Requirements that are applicable to entities in the region.

Pursuant to Section 215(d)(2) of the Federal Power Act[14] and Section 39.5(c)[15] of the Commission's regulations, the Commission will give due weight to the technical expertise of the ERO with respect to the content of a Reliability Standard and to the technical expertise of a Regional Entity organized on an Interconnection-wide basis with respect to a Reliability Standard to be applicable within that Interconnection.

B. WECC Regional Reliability Standards Development Process

The proposed Reliability Standard was developed in an open and fair manner and in accordance with the Commission-approved NERC Standard Processes Manual[16] and the WECC

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13 Order No. 672 at P 291.

14 16 U.S.C. § 824o(d)(2).

15 18 C.F.R. § 39.5(c)(1).

16 Section 9.0 of the NERC Standard Processes Manual, Appendix 3A to the NERC Rules of Procedure, provides that any Variance that is proposed to apply to entities within a Regional Entity organized on an Interconnection-wide basis shall be considered an Interconnection-wide Variance and shall be developed through that Regional Entity's standard development procedure. The NERC Standard Processes Manual is available at https://www.nerc.com/AboutNERC/Pages/Rules-of-Procedure.aspx.

Reliability Standards Development Procedures ("RSDP").[17] WECC's RSDP provides for reasonable notice and opportunity for public comment, due process, openness, and a balance of interests in developing Regional Reliability Standards and Variances and thus addresses certain of the criteria for approval. The development process is open to any person or entity that is an interested stakeholder. WECC considers the comments of all stakeholders, and a vote of stakeholders and the WECC Board of Directors is required to approve a Regional Reliability Standard or Variance. Once the standard is approved by the WECC Board of Directors, NERC posts the approved Regional Reliability Standard or Variance for an additional comment period. Then the NERC Board of Trustees must adopt the Regional Reliability Standard or Variance before it is submitted to the Commission for approval.

C. Relevant Commission Approval History

The Commission approved the first version of the VAR-001 WECC Variance in 2013, in standard version VAR-001-3.[18] The Variance removed Requirement R3 and replaced Requirement R4 of Reliability Standard VAR-001-2 for applicable entities in the Western Interconnection. The Variance was originally developed to allow Generator Operators in the Western Interconnection to better assist in controlling system voltage during steady-state and outage conditions.

The Commission approved the last substantially-revised version of the standard, Reliability Standard VAR-001-4, in 2014.[19] The Commission approved the currently-effective version of the VAR-001 standard, VAR-001-4.2, in 2017.[20] VAR-001-4.2 contains several errata changes from

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17 The currently-effective WECC RSDP was approved by the Commission on October 27, 2017 (*see N. Am. Elec. Reliability Corp.*, RR17-5-000 (Oct. 27, 2017) (delegated letter order)) and is available at http://www.nerc.com/FilingsOrders/us/Regional%20Delegation%20Agreements%20DL/WECC%20RSDP_20171027.pdf.

18 2013 Approval Order, supra n. 7.

19 *N. Am. Elec. Reliability Corp.*, Docket No. RD14-11-000 (Aug. 1, 2014) (delegated letter order).

20 *N. Am. Elec. Reliability Corp.*, Docket No. RD17-7-000 (Sep. 26, 2017) (delegated letter order).

the previous version of the standard. The intermediate versions of the VAR-001 standard did not substantively modify the WECC Variance.

D. Development of the Proposed Reliability Standard

As further described in Exhibit B hereto, proposed Reliability Standard VAR-001-5 was developed as part of a Five-year review of the WECC Variance. On May 9, 2018, the standard was approved by the WECC ballot body with 100 percent affirmative vote. The WECC Board of Directors approved the standard (specifically, the retirement of Variance Requirement E.A.15) on June 20, 2018. NERC posted proposed VAR-001-5 for a 45-day comment period concluding on August 6, 2018. Commenters agreed that WECC's process was open, inclusive, balanced, transparent, and that due process was followed, and there were no additional changes after this comment period. The NERC Board of Trustees subsequently adopted the standard on August 16, 2018.

IV. JUSTIFICATION FOR APPROVAL

The purpose of proposed Reliability Standard VAR-001-5 is to ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in Real-time to protect equipment and the reliable operation of the Interconnection. The WECC Variance allows Generator Owners in the Western Interconnection to better assist in achieving this reliability goal. The currently-effective Variance deletes in its entirety continent-wide Requirement R4, which requires Transmission Operators to specify the criteria that will exempt generators from following a voltage or Reactive Power schedule, from having its automatic voltage regulator in service or from being in control mode, or from having to make any associated notifications. The Variance also replaces continent-wide Requirement R5, which requires each Transmission Operator to specify either a voltage or Reactive Power schedule, with Variance

Requirements pertaining to voltage schedules. In proposed Reliability Standard VAR-001-5, NERC proposes revisions to this Variance to eliminate a duplicative requirement, correct errors, and match current conventions. As revised, the WECC Variance remains more stringent than its continent-wide counterpart and necessary for reliability in the Western Interconnection. It also continues to satisfy the Order No. 672 criteria for approval. The proposed changes are discussed in more detail below.

A. Elimination of Requirement E.A.15

In the WECC Variance in proposed Reliability Standard VAR-001-5, Variance Requirement E.A.15 is removed, and the subsequent Requirements have been renumbered accordingly. In the currently-effective standard, this Variance Requirement provides that each Generator Operator shall convert each voltage schedule issued to it by the Transmission Operator per Variance Requirement E.A.13 into the voltage set point for the generator excitation system. Since the original WECC Variance was approved in 2013, NERC revised the continent-wide VAR-002 standard. Reliability Standard VAR-002-4.1 - Generator Operation for Maintaining Network Voltage Schedules now addresses the same reliability-related task, which is for the Generator Operator to have a means of converting the scheduled voltage specified by the Transmission Operator to the voltage set point being monitored by the Generator Operator. Reliability Standard VAR-002-4.1 Requirement R2 Part 2.3 provides as follows:

> R2. Unless exempted by the Transmission Operator, each Generator Operator shall maintain the generator voltage or Reactive Power schedule (within each generating Facility's capabilities) provided by the Transmission Operator, or otherwise shall meet the conditions of notification for deviations from the voltage or Reactive Power schedule provided by the Transmission Operator.
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> ***
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> **2.3.** Generator Operators that do not monitor the voltage at the location specified in their voltage schedule shall have a

> methodology for converting the scheduled voltage specified by the Transmission Operator to the voltage point being monitored by the Generator Operator.[21]

As the continent-wide Requirement now addresses the same reliability task as current WECC Variance Requirement E.A.15, the WECC Variance Requirement should be removed from the Variance as redundant. As a redundant Requirement, its removal will have no adverse impact on reliability in the Western Interconnection.

B. Other Revisions

The revised WECC Variance in proposed Reliability Standard VAR-001-5 reflects additional non-substantive revisions, including updating the document format and correcting the capitalization of the term "Area" in Variance Requirement E.A.14 to lower case "area", as the term is not defined in the *Glossary of Terms Used in NERC Reliability Standards*. Additionally, and as discussed in the following section, the Variance VSL Table has been updated and the Measures moved and revised to match current conventions.

V. Enforceability of Proposed Reliability Standard VAR-001-5

The revised WECC Variance in proposed Reliability Standard VAR-001-5 includes VRFs and VSLs. The VSLs provide guidance on the way that NERC will enforce the requirements of the proposed Reliability Standard. The VRFs are one of several elements used to determine an appropriate sanction when the associated requirement is violated. The VRFs assess the impact to reliability of violating a specific requirement. The VRFs and VSLs for the proposed standard comport with NERC and Commission guidelines related to their assignment. The VRFs and VSLs for the WECC Variance remain substantively unchanged from the currently-effective version of the standard, except that the VSLs have been updated to reflect renumbering of the Variance

[21] Reliability Standard VAR-002-4.1 Requirement R2 (internal footnotes omitted).

Requirements. As no changes to the continent-wide Requirements are proposed in VAR-001-5, the VRFs and VSLs corresponding to those Requirements remain unchanged.

The proposed Reliability Standard also includes Measures that support each requirement by clearly identifying what is required and how the requirement will be enforced. These Measures help ensure that the requirements will be enforced in a clear, consistent, and non-preferential manner and without prejudice to any party.[22] In proposed VAR-001-5, the WECC Variance Measures have been updated to match current conventions, including moving each Measure to immediately below the corresponding Variance Requirement, and replacing the term "shall" with "will". No changes have been made to the Measures corresponding to the continent-wide Requirements as those Requirements remain unchanged.

VI. EFFECTIVE DATE

NERC respectfully requests that the Commission approve proposed Reliability Standard VAR-001-5 to be effective the first day of the first calendar quarter following Commission approval. The currently-effective standard version VAR-001-4.2 would be retired immediately prior to the effective date of the new standard.

[22] Order No. 672 at P 327 ("There should be a clear criterion or measure of whether an entity is in compliance with a proposed Reliability Standard. It should contain or be accompanied by an objective measure of compliance so that it can be enforced and so that enforcement can be applied in a consistent and non-preferential manner.").

VII. CONCLUSION

For the reasons set forth above, NERC respectfully requests that the Commission approve:

- the proposed Reliability Standard VAR-001-5 in **Exhibit A**;
- the other associated elements in the Reliability Standard in **Exhibit A**, including the VRFs and VSLs;
- the proposed effective date, as described herein and in **Exhibit A**; and
- the retirement of currently-effective Reliability Standard VAR-001-4.2.

Respectfully submitted,

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Date: September 6, 2018

Exhibit A

Proposed Reliability Standard VAR-001-5 – Voltage and Reactive Control

Clean Version

Proposed Reliability Standard VAR-001-5 – Voltage and Reactive Control

A. Introduction

1. **Title:** Voltage and Reactive Control

2. **Number:** VAR-001-5

3. **Purpose:** To ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in Real-time to protect equipment and the reliable operation of the Interconnection.

4. **Applicability:**

   4.1. Transmission Operators

   4.2. Generator Operators within the Western Interconnection (for the WECC Variance)

5. **Effective Date:**

   5.1. The standard shall become effective on the first day of the first calendar quarter after the date that the standard is approved by an applicable governmental authority or as otherwise provided for in a jurisdiction where approval by an applicable governmental authority is required for a standard to go into effect. Where approval by an applicable governmental authority is not required, the standard shall become effective on the first day of the first calendar quarter after the date the standard is adopted by the NERC Board of Trustees or as otherwise provided for in that jurisdiction.

B. Requirements and Measures

R1. Each Transmission Operator shall specify a system voltage schedule (which is either a range or a target value with an associated tolerance band) as part of its plan to operate within System Operating Limits and Interconnection Reliability Operating Limits. *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

1.1. Each Transmission Operator shall provide a copy of the voltage schedules (which is either a range or a target value with an associated tolerance band) to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request.

M1. The Transmission Operator shall have evidence that it specified system voltage schedules using either a range or a target value with an associated tolerance band.

For part 1.1, the Transmission Operator shall have evidence that the voltage schedules (which is either a range or a target value with an associated tolerance band) were provided to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request. Evidence may include, but is not limited to, emails, website postings, and meeting minutes.

R2. Each Transmission Operator shall schedule sufficient reactive resources to regulate voltage levels under normal and Contingency conditions. Transmission Operators can provide sufficient reactive resources through various means including, but not limited to, reactive generation scheduling, transmission line and reactive resource switching, and using controllable load. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M2. Each Transmission Operator shall have evidence of scheduling sufficient reactive resources based on their assessments of the system. For the operations planning time horizon, Transmission Operators shall have evidence of assessments used as the basis for how resources were scheduled.

R3. Each Transmission Operator shall operate or direct the Real-time operation of devices to regulate transmission voltage and reactive flow as necessary. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M3. Each Transmission Operator shall have evidence that actions were taken to operate capacitive and inductive resources as necessary in Real-time. This may include, but is not limited to, instructions to Generator Operators to: 1) provide additional voltage support; 2) bring resources on-line; or 3) make manual adjustments.

R4. Each Transmission Operator shall specify the criteria that will exempt generators: 1) from following a voltage or Reactive Power schedule, 2) from having its automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any associated notifications. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

4.1 If a Transmission Operator determines that a generator has satisfied the exemption criteria, it shall notify the associated Generator Operator.

M4. Each Transmission Operator shall have evidence of the documented criteria for generator exemptions.

For part 4.1, the Transmission Operator shall also have evidence to show that, for each generator in its area that is exempt: 1) from following a voltage or Reactive Power schedule, 2) from having its automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any notifications, the associated Generator Operator was notified of this exemption.

R5. Each Transmission Operator shall specify a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) at either the high voltage side or low voltage side of the generator step-up transformer at the Transmission Operator's discretion. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

5.1. The Transmission Operator shall provide the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the associated Generator Operator and direct the Generator Operator to comply with the schedule in automatic voltage control mode (the AVR is in service and controlling voltage).

5.2. The Transmission Operator shall provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

5.3. The Transmission Operator shall provide the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the Generator Operator within 30 days of receiving a request.

M5. The Transmission Operator shall have evidence of a documented voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

For part 5.1, the Transmission Operator shall have evidence it provided a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the applicable Generator Operators, and that the Generator Operator was directed to comply with the schedule in automatic voltage control mode, unless exempted.

For part 5.2, the Transmission Operator shall have evidence it provided notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band). For part 5.3, the Transmission Operator shall have evidence it provided the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target

value with an associated tolerance band) within 30 days of receiving a request by a Generator Operator.

R6. After consultation with the Generator Owner regarding necessary step-up transformer tap changes and the implementation schedule, the Transmission Operator shall provide documentation to the Generator Owner specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M6. The Transmission Operator shall have evidence that it provided documentation to the Generator Owner when a change was needed to a generating unit's step-up transformer tap in accordance with the requirement and that it consulted with the Generator Owner.

C. Compliance

1. Compliance Monitoring Process:

1.1. Compliance Enforcement Authority:

As defined in the NERC Rules of Procedure, "Compliance Enforcement Authority" refers to NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.

1.2. Evidence Retention:

The following evidence retention periods identify the period of time a registered entity is required to retain specific evidence to demonstrate compliance. For instances in which the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask the registered entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The Transmission Operator shall retain evidence for Measures M1 through M6 for 12 months. The Compliance Monitor shall retain any audit data for three years.

1.3. Compliance Monitoring and Assessment Processes:

"Compliance Monitoring and Assessment Processes" 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.

1.4. Additional Compliance Information:

None

Table of Compliance Elements

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	**Operations Planning**	**High**	N/A	N/A	N/A	The Transmission Operator does not specify a system voltage schedule (which is either a range or a target value with an associated tolerance band).
R2	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an SOL.	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an IROL.
R3	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an SOL.	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an IROL.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R4	**Operations Planning**	**Lower**	N/A	N/A	The Transmission Operator has exemption criteria and notified the Generator Operator, but the Transmission Operator does not have evidence of the notification to the Generator Operator.	The Transmission Operator does not have exemption criteria.
R5	**Operations Planning**	**Medium**	N/A	The Transmission Operator does not provide the criteria for voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) after 30 days of a request.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to all Generator Operators.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to any Generator Operators. Or The Transmission Operator does not provide the Generator Operator with the notification

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
						requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).
R6	**Operations Planning**	**Lower**	The Transmission Operator does not provide either the technical justification or timeframe for changing generator step-up tap settings.	N/A	N/A	The Transmission Operator does not provide the technical justification and the timeframe for changing generator step-up tap settings.

D. Regional Variances

The following Interconnection-wide variance shall be applicable in the Western Electricity Coordinating Council (WECC) and replaces, in their entirety, Requirements R4 and R5. Please note that Requirement R4 is deleted and R5 is replaced with the following requirements.

Requirements and Measures

E.A.13 Each Transmission Operator shall issue any one of the following types of voltage schedules to the Generator Operators for each of their generation resources that are on-line and part of the Bulk Electric System within the Transmission Operator Area: *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- A voltage set point with a voltage tolerance band and a specified period.
- An initial volt-ampere reactive output or initial power factor output with a voltage tolerance band for a specified period that the Generator Operator uses to establish a generator bus voltage set point.
- A voltage band for a specified period.

M.E.A.13 Each Transmission Operator will have evidence that it provided the voltage schedules to the Generator Operator, as required in E.A.13. Evidence may include, but is not limited to, dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule including set points, tolerance bands, and specified periods as required in Requirement E.A.13.

E.A.14 Each Transmission Operator shall provide one of the following voltage schedule reference points for each generation resource in its area to the Generator Operator. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- The generator terminals.
- The high side of the generator step-up transformer.
- The point of interconnection.
- A location designated by mutual agreement between the Transmission Operator and Generator Operator.

M.E.A.14 The Transmission Operator will have evidence that it provided one of the voltage schedule reference points for each generation resource in its area to the Generator Operator, as required in E.A.14. Evidence may include, but is not limited to dated letters, e-mail, or other documentation that contains notification to the Generator Operator of the voltage schedule reference point for each generation resource.

E.A.15 Each Generator Operator shall provide its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals

within 30 calendar days of request by its Transmission Operator. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.15 The Generator Operator will have evidence that within 30 calendar days of request by its Transmission Operator it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals, as required in E.A.15. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

E.A.16 Each Transmission Operator shall provide to the Generator Operator, within 30 calendar days of a request for data by the Generator Operator, its transmission equipment data and operating data that supports development of the voltage set point conversion methodology. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.16 The Transmission Operator will have evidence that within 30 calendar days of request by its Generator Operator it provided data to support development of the voltage set point conversion methodology, as required in E.A.16. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

E.A.17 Each Generator Operator shall meet the following control loop specifications if the Generator Operator uses control loops external to the automatic voltage regulators (AVR) to manage Mvar loading: *[Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]*

E.A.17.1 Each control loop's design incorporates the AVR's automatic voltage controlled response to voltage deviations during System Disturbances.

E.A.17.2. Each control loop is only used by mutual agreement between the Generator Operator and the Transmission Operator affected by the control loop.

M.E.A.17 If the Generator Operator uses outside control loops to manage Mvar loading, the Generator Operator will have evidence that it met the control loop specifications in sub-parts E.A.17.1 through E.A.17.2, as required in E.A.17 and its sub-parts. Evidence may include, but is not limited to, design specifications with identified agreed-upon control loops, system reports, or other dated documentation.

Violation Severity Levels

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.13	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to at least one generation resource but less than or equal to 5% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 5% but less than or equal to 10% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 10% but less than or equal to 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.
E.A.14	The Transmission Operator did not provide a voltage schedule reference point for at least one but less than or equal to 5% of the generation resources in the Transmission Operator area.	The Transmission Operator did not provide a voltage schedule reference point for more than 5% but less than or equal to 10% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not a voltage schedule reference point for more than 10% but less than or equal to 15% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not provide a voltage schedule reference point for more than 15% of the generation resources in the Transmission Operator Area.

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.15	The Generator Operator provided its voltage set point conversion methodology greater than 30 days but less than or equal to 60 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Transmission Operator.	The Generator Operator did not provide its voltage set point conversion methodology within 120 days of a request by the Transmission Operator.
E.A.16	The Transmission Operator provided its data to support development of the voltage set point conversion methodology than 30 days but less than or equal to 60 days of a request by the Generator Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Generator. Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Generator. Operator.	The Transmission Operator did not provide its data to support development of the voltage set point conversion methodology within 120 days of a request by the Generator Operator.
E.A.17	N/A	The Generator Operator did not meet the control loop specifications in E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in E.A.17.1 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in E.A.17.1 through E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.

E. Interpretations

None

F. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New
1	August 2, 2006	BOT Adoption	Revised
1	June 18, 2007	FERC approved Version 1 of the standard.	Revised
1	July 3, 2007	Added “Generator Owners” and “Generator Operators” to Applicability section.	Errata
1	August 23, 2007	Removed “Generator Owners” and “Generator Operators” to Applicability section.	Errata
2	August 5, 2010	Adopted by NERC Board of Trustees; Modified to address Order No. 693 Directives contained in paragraphs 1858 and 1879.	Revised
2	January 10, 2011	FERC issued letter order approving the addition of LSEs and Controllable Load to the standard.	Revised
3	May 9, 2012	Adopted by NERC Board of Trustees; Modified to add a WECC region variance	Revised
3	June 20, 2013	FERC issued order approving VAR-001-3	Revised
3	November 21, 2013	R5 and associated elements approved by FERC for retirement as part of the Paragraph 81 project (Project 2013-02)	Revised
4	February 6, 2014	Adopted by NERC Board of Trustees	Revised
4	August 1, 2014	FERC issued letter order issued approving VAR-001-4	
4.1	August 25, 2015	Added “or” to Requirement R5, 5.3 to read: schedules or Reactive Power	Errata
4.1	November 13, 2015	FERC Letter Order approved errata to VAR-001-4.1. Docket RD15-6-000	Errata
4.2	June 14, 2017	Project 2016-EPR-02 errata recommendations	Errata
4.2	August 10, 2017	Adopted by NERC Board of Trustees	Errata
4.2	September 26, 2017	FERC Letter Order issued approving VAR-001-4.2 Docket No. RD17-7-000.	
5	August 16, 2018	Adopted by NERC Board of Trustees	1) In E.A.14 “Area” was changed to

			“area.”; 2) E.A.15 and associated elements were eliminated; 3) Measures were updated and relocated matching current conventions, replacing “shall” with “will”; 4) typographical errors in VSL Table for E.A.17 were corrected; 5) format was updated.

Guidelines and Technical Basis

For technical basis for each requirement, please review the rationale provided for each requirement.

Rationale:

During development of this standard, text boxes were embedded within the standard to explain the rationale for various parts of the standard. Upon BOT approval, the text from the rationale text boxes was moved to this section.

Rationale for R1:

Paragraph 1868 of Order No. 693 requires NERC to add more "detailed and definitive requirements on “established limits” and “sufficient reactive resources”, and identify acceptable margins (i.e. voltage and/or reactive power margins)." Since Order No. 693 was issued, however, several FAC and TOP standards have become enforceable to add more requirements around voltage limits. More specifically, FAC-011 and FAC-014 require that System Operating Limits (SOLs) and reliability margins are established. The NERC Glossary definition of SOLs includes both: 1) voltage stability ratings (Applicable pre- and post-Contingency Voltage Stability) and 2*)* System Voltage Limits (Applicable pre- and post-Contingency voltage limits). Therefore, for reliability reasons Requirement R1 now requires a Transmission Operator (TOP) to set voltage or Reactive Power schedules with associated tolerance bands. Further, since neighboring areas can affect each other greatly, each TOP must also provide a copy of these schedules to its Reliability Coordinator (RC) and adjacent TOP upon request.

Rationale for R2:

Paragraph 1875 from Order No. 693 directed NERC to include requirements to run voltage stability analysis periodically, using online techniques where commercially available and offline tools when online tools are not available. This standard does not explicitly require the periodic voltage stability analysis because such analysis would be performed pursuant to the SOL methodology developed under the FAC standards. TOP standards also require the TOP to operate within SOLs and Interconnection Reliability Operating Limits (IROL). The VAR standard drafting team (SDT) and industry participants also concluded that the best models and tools are the ones that have been proven and the standard should not add a requirement for a responsible entity to purchase new online simulations tools. Thus, the VAR SDT simplified the requirements to ensuring sufficient reactive resources are online or scheduled. Controllable load is specifically included to answer FERC's directive in Order No. 693 at Paragraph 1879.

Rationale for R3:

Similar to Requirement R2, the VAR SDT determined that for reliability purposes, the TOP must ensure sufficient voltage support is provided in Real-time in order to operate within an SOL.

Rationale for R4:

The VAR SDT received significant feedback on instances when a TOP would need the flexibility for defining exemptions for generators. These exemptions can be tailored as the TOP deems necessary for the specific area's needs. The goal of this requirement is to provide a TOP the ability to exempt a Generator Operator (GOP) from: 1) a voltage or Reactive Power schedule, 2) a setting on the AVR, or 3) any VAR-002 notifications based on the TOP's criteria. Feedback from the industry detailed many system events that would require these types of exemptions which included, but are not limited to: 1) maintenance during shoulder months, 2) scenarios where two units are located within close proximity and both cannot be in voltage control mode, and 3) large system voltage swings where it would harm reliability if all GOP were to notify their respective TOP of deviations at one time. Also, in an effort to improve the requirement, the sub-requirements containing an exemption list were removed from the currently enforceable standard because this created more compliance issues with regard to how often the list would be updated and maintained.

Rationale for R5:

The new requirement provides transparency regarding the criteria used by the TOP to establish the voltage schedule. This requirement also provides a vehicle for the TOP to use appropriate granularity when setting notification requirements for deviation from the voltage or Reactive Power schedule. Additionally, this requirement provides clarity regarding a "tolerance band" as specified in the voltage schedule and the control dead-band in the generator's excitation system.

Voltage schedule tolerances are the bandwidth that accompanies the voltage target in a voltage schedule, should reflect the anticipated fluctuation in voltage at the Generation Operator's facility during normal operations, and be based on the TOP's assessment of N-1 and credible N-2 system contingencies. The voltage schedule's bandwidth should not be confused with the control dead-band that is programmed into a Generation Operator's automatic voltage regulator's control system, which should be adjusting the AVR prior to reaching either end of the voltage schedule's bandwidth.

Rationale for R6:

Although tap settings are first established prior to interconnection, this requirement could not be deleted because no other standard addresses when a tap setting must be adjusted. If the tap setting is not properly set, then the amount of VARs produced by a unit can be affected.

Redline Version

Proposed Reliability Standard VAR-001-5 – Voltage and Reactive Control

A. Introduction

1. **Title:** Voltage and Reactive Control

2. **Number:** VAR-001-~~4.2~~5

3. **Purpose:** To ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in Real-time to protect equipment and the reliable operation of the Interconnection.

4. **Applicability:**

   4.1. Transmission Operators

   4.2. Generator Operators within the Western Interconnection (for the WECC Variance)

5. **Effective Date:**

   5.1. The standard shall become effective on the first day of the first calendar quarter after the date that the standard is approved by an applicable governmental authority or as otherwise provided for in a jurisdiction where approval by an applicable governmental authority is required for a standard to go into effect. Where approval by an applicable governmental authority is not required, the standard shall become effective on the first day of the first calendar quarter after the date the standard is adopted by the NERC Board of Trustees or as otherwise provided for in that jurisdiction.

B. Requirements and Measures

R1. Each Transmission Operator shall specify a system voltage schedule (which is either a range or a target value with an associated tolerance band) as part of its plan to operate within System Operating Limits and Interconnection Reliability Operating Limits. *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

1.1. Each Transmission Operator shall provide a copy of the voltage schedules (which is either a range or a target value with an associated tolerance band) to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request.

M1. The Transmission Operator shall have evidence that it specified system voltage schedules using either a range or a target value with an associated tolerance band.

For part 1.1, the Transmission Operator shall have evidence that the voltage schedules (which is either a range or a target value with an associated tolerance band) were provided to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request. Evidence may include, but is not limited to, emails, website postings, and meeting minutes.

R2. Each Transmission Operator shall schedule sufficient reactive resources to regulate voltage levels under normal and Contingency conditions. Transmission Operators can provide sufficient reactive resources through various means including, but not limited to, reactive generation scheduling, transmission line and reactive resource switching, and using controllable load. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M2. Each Transmission Operator shall have evidence of scheduling sufficient reactive resources based on their assessments of the system. For the operations planning time horizon, Transmission Operators shall have evidence of assessments used as the basis for how resources were scheduled.

R3. Each Transmission Operator shall operate or direct the Real-time operation of devices to regulate transmission voltage and reactive flow as necessary. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M3. Each Transmission Operator shall have evidence that actions were taken to operate capacitive and inductive resources as necessary in Real-time. This may include, but is not limited to, instructions to Generator Operators to: 1) provide additional voltage support; 2) bring resources on-line; or 3) make manual adjustments.

R4. Each Transmission Operator shall specify the criteria that will exempt generators: 1) from following a voltage or Reactive Power schedule, 2) from having its automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any associated notifications. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

4.1 If a Transmission Operator determines that a generator has satisfied the exemption criteria, it shall notify the associated Generator Operator.

M4. Each Transmission Operator shall have evidence of the documented criteria for generator exemptions.

For part 4.1, the Transmission Operator shall also have evidence to show that, for each generator in its area that is exempt: 1) from following a voltage or Reactive Power schedule, 2) from having its automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any notifications, the associated Generator Operator was notified of this exemption.

R5. Each Transmission Operator shall specify a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) at either the high voltage side or low voltage side of the generator step-up transformer at the Transmission Operator's discretion. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

5.1. The Transmission Operator shall provide the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the associated Generator Operator and direct the Generator Operator to comply with the schedule in automatic voltage control mode (the AVR is in service and controlling voltage).

5.2. The Transmission Operator shall provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

5.3. The Transmission Operator shall provide the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the Generator Operator within 30 days of receiving a request.

M5. The Transmission Operator shall have evidence of a documented voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

For part 5.1, the Transmission Operator shall have evidence it provided a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the applicable Generator Operators, and that the Generator Operator was directed to comply with the schedule in automatic voltage control mode, unless exempted.

For part 5.2, the Transmission Operator shall have evidence it provided notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band). For part 5.3, the Transmission Operator shall have evidence it provided the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target

value with an associated tolerance band) within 30 days of receiving a request by a Generator Operator.

R6. After consultation with the Generator Owner regarding necessary step-up transformer tap changes and the implementation schedule, the Transmission Operator shall provide documentation to the Generator Owner specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M6. The Transmission Operator shall have evidence that it provided documentation to the Generator Owner when a change was needed to a generating unit's step-up transformer tap in accordance with the requirement and that it consulted with the Generator Owner.

C. Compliance

1. Compliance Monitoring Process:

1.1. Compliance Enforcement Authority:

As defined in the NERC Rules of Procedure, "Compliance Enforcement Authority" refers to NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.

1.2. Evidence Retention:

The following evidence retention periods identify the period of time a registered entity is required to retain specific evidence to demonstrate compliance. For instances in which the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask the registered entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The Transmission Operator shall retain evidence for Measures M1 through M6 for 12 months. The Compliance Monitor shall retain any audit data for three years.

1.3. Compliance Monitoring and Assessment Processes:

"Compliance Monitoring and Assessment Processes" 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.

1.4. Additional Compliance Information:

None

Table of Compliance Elements

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	**Operations Planning**	**High**	N/A	N/A	N/A	The Transmission Operator does not specify a system voltage schedule (which is either a range or a target value with an associated tolerance band).
R2	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an SOL.	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an IROL.
R3	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an SOL.	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an IROL.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R4	**Operations Planning**	**Lower**	N/A	N/A	The Transmission Operator has exemption criteria and notified the Generator Operator, but the Transmission Operator does not have evidence of the notification to the Generator Operator.	The Transmission Operator does not have exemption criteria.
R5	**Operations Planning**	**Medium**	N/A	The Transmission Operator does not provide the criteria for voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) after 30 days of a request.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to all Generator Operators.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to any Generator Operators. Or The Transmission Operator does not provide the Generator Operator with the notification

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
						requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).
R6	**Operations Planning**	**Lower**	The Transmission Operator does not provide either the technical justification or timeframe for changing generator step-up tap settings.	N/A	N/A	The Transmission Operator does not provide the technical justification and the timeframe for changing generator step-up tap settings.

D. Regional Variances

The following Interconnection-wide variance shall be applicable in the Western Electricity Coordinating Council (WECC) and replaces, in their entirety, Requirements R4 and R5. Please note that Requirement R4 is deleted and R5 is replaced with the following requirements.

Requirements and Measures

E.A.13 Each Transmission Operator shall issue any one of the following types of voltage schedules to the Generator Operators for each of their generation resources that are on-line and part of the Bulk Electric System within the Transmission Operator Area: *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- A voltage set point with a voltage tolerance band and a specified period.
- An initial volt-ampere reactive output or initial power factor output with a voltage tolerance band for a specified period that the Generator Operator uses to establish a generator bus voltage set point.
- A voltage band for a specified period.

M.E.A.13 Each Transmission Operator will have evidence that it provided the voltage schedules to the Generator Operator, as required in E.A.13. Evidence may include, but is not limited to, dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule including set points, tolerance bands, and specified periods as required in Requirement E.A.13.

E.A.14 Each Transmission Operator shall provide one of the following voltage schedule reference points for each generation resource in its ~~Area~~area to the Generator Operator. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- The generator terminals.
- The high side of the generator step-up transformer.
- The point of interconnection.
- A location designated by mutual agreement between the Transmission Operator and Generator Operator.

~~**E.A.15** Each Generator Operator shall convert each voltage schedule specified in Requirement E.A.13 into the voltage set point for the generator excitation system. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*~~

M.E.A.14 The Transmission Operator will have evidence that it provided one of the voltage schedule reference points for each generation resource in its area to the Generator Operator, as required in E.A.14. Evidence may include, but is not limited to dated letters, e-mail, or other documentation that contains

notification to the Generator Operator of the voltage schedule reference point for each generation resource.

~~E.A.16~~E.A.15 Each Generator Operator shall provide its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals within 30 calendar days of request by its Transmission Operator. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.15 The Generator Operator will have evidence that within 30 calendar days of request by its Transmission Operator it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals, as required in E.A.15. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

~~E.A.17~~E.A.16 Each Transmission Operator shall provide to the Generator Operator, within 30 calendar days of a request for data by the Generator Operator, its transmission equipment data and operating data that supports development of the voltage set point conversion methodology. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.16 The Transmission Operator will have evidence that within 30 calendar days of request by its Generator Operator it provided data to support development of the voltage set point conversion methodology, as required in E.A.16. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

~~E.A.18~~E.A.17 Each Generator Operator shall meet the following control loop specifications if the Generator Operator uses control loops external to the automatic voltage regulators (AVR) to manage Mvar loading: *[Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]*

E.A.17.1 Each control loop's design incorporates the AVR's automatic voltage controlled response to voltage deviations during System Disturbances.

E.A.17.2. Each control loop is only used by mutual agreement between the Generator Operator and the Transmission Operator affected by the control loop.

~~Measures~~[~~1~~]

~~M.E.A.13~~ ~~Each Transmission Operator shall have and provide upon request, evidence that it provided the voltage schedules to the Generator Operator. Dated spreadsheets, reports, voice recordings, or other documentation containing~~

[~~1~~] ~~The number for each measure corresponds with the number for each requirement, i.e. M.E.A.13 means the measure for Requirement E.A.13.~~

~~the voltage schedule including set points, tolerance bands, and specified periods as required in Requirement E.A.13 are acceptable as evidence.~~

~~**M.E.A.14** The Transmission Operator shall have and provide upon request, evidence that it provided one of the voltage schedule reference points in Requirement E.A.14 for each generation resource in its Area to the Generator Operator. Dated letters, e-mail, or other documentation that contains notification to the Generator Operator of the voltage schedule reference point for each generation resource are acceptable as evidence.~~

~~**M.E.A.15** Each Generator Operator shall have and provide upon request, evidence that it converted a voltage schedule as described in Requirement E.A.13 into a voltage set point for the AVR. Dated spreadsheets, logs, reports, or other documentation are acceptable as evidence.~~

~~**M.E.A.16** The Generator Operator shall have and provide upon request, evidence that within 30 calendar days of request by its Transmission Operator it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals. Dated reports, spreadsheets, or other documentation are acceptable as evidence.~~

~~**M.E.A.17** The Transmission Operator shall have and provide upon request, evidence that within 30 calendar days of request by its Generator Operator it provided data to support development of the voltage set point conversion methodology. Dated reports, spreadsheets, or other documentation are acceptable as evidence.~~

~~**M.E.A.18**~~**M.E.A.17** If the Generator Operator uses outside control loops to manage Mvar loading, the Generator Operator ~~shall~~will have~~ and provide upon request,~~ evidence that it met the control loop specifications in sub-parts E.A.~~18~~17.1 through E.A.~~18~~17.2~~. Design~~, as required in E.A.17 and its sub-parts. Evidence may include, but is not limited to, design specifications with identified agreed-upon control loops, system reports, or other dated documentation~~ are acceptable as evidence.~~.

Violation Severity Levels

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.13	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to at least one generation resource but less than or equal to 5% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 5% but less than or equal to 10% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 10% but less than or equal to 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.
E.A.14	The Transmission Operator did not provide a voltage schedule reference point for at least one but less than or equal to 5% of the generation resources in the Transmission Operator area.	The Transmission Operator did not provide a voltage schedule reference point for more than 5% but less than or equal to 10% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not a voltage schedule reference point for more than 10% but less than or equal to 15% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not provide a voltage schedule reference point for more than 15% of the generation resources in the Transmission Operator Area.

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
~~E.A.15~~	~~The Generator Operator failed to convert at least one voltage schedule in Requirement E.A.13 into the voltage set point for the AVR for less than 25% of the voltage schedules.~~	~~The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 25% or more but less than 50% of the voltage schedules.~~	~~The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 50% or more but less than 75% of the voltage schedules.~~	~~The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 75% or more of the voltage schedules.~~
E.A.~~16~~15	The Generator Operator provided its voltage set point conversion methodology greater than 30 days but less than or equal to 60 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Transmission Operator.	The Generator Operator did not provide its voltage set point conversion methodology within 120 days of a request by the Transmission Operator.
E.A.~~17~~16	The Transmission Operator provided its data to support development of the voltage set point conversion methodology than 30 days but less than or equal to 60 days of a request by the Generator Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Generator. Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Generator. Operator.	The Transmission Operator did not provide its data to support development of the voltage set point conversion methodology within 120 days of a request by the Generator Operator.

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.~~18~~17	N/A	The Generator Operator did not meet the control loop specifications in ~~EA18~~E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in ~~EA18~~E.A.17.1 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in ~~EA18~~E.A.17.1 through ~~EA18~~E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.

E. Interpretations

None

F. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New
1	August 2, 2006	BOT Adoption	Revised
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2	January~~,~~ 10, 2011	FERC issued letter order approving the addition of LSEs and Controllable Load to the standard.	Revised

3	May 9, 2012	Adopted by NERC Board of Trustees; Modified to add a WECC region variance	Revised
3	June 20, 2013	FERC issued order approving VAR-001-3	Revised
3	November 21, 2013	R5 and associated elements approved by FERC for retirement as part of the Paragraph 81 project (Project 2013-02)	Revised
4	February 6, 2014	Adopted by NERC Board of Trustees	Revised
4	August 1, 2014	FERC issued letter order issued approving VAR-001-4	
4.1	August 25, 2015	Added "or" to Requirement R5, 5.3 to read: schedules or Reactive Power	Errata
4.1	November 13, 2015	FERC Letter Order approved errata to VAR-001-4.1. Docket RD15-6-000	Errata
4.2	June 14, 2017	Project 2016-EPR-02 errata recommendations	Errata
4.2	August 10, 2017	Adopted by NERC Board of Trustees	Errata
4.2	September 26, 2017	FERC Letter Order issued approving VAR-001-4.2 Docket No. RD17-7-000.	
5	August 16, 2018	Adopted by NERC Board of Trustees	1) In E.A.14 "Area" was changed to "area."; 2) E.A.15 and associated elements were eliminated; 3) Measures were updated and relocated matching current conventions, replacing "shall" with "will"; 4) typographical errors in VSL Table for E.A.17 were corrected; 5) format was updated.

Guidelines and Technical Basis

For technical basis for each requirement, please review the rationale provided for each requirement.

Rationale:

During development of this standard, text boxes were embedded within the standard to explain the rationale for various parts of the standard. Upon BOT approval, the text from the rationale text boxes was moved to this section.

Rationale for R1:

Paragraph 1868 of Order No. 693 requires NERC to add more "detailed and definitive requirements on “established limits” and “sufficient reactive resources”, and identify acceptable margins (i.e. voltage and/or reactive power margins)." Since Order No. 693 was issued, however, several FAC and TOP standards have become enforceable to add more requirements around voltage limits. More specifically, FAC-011 and FAC-014 require that System Operating Limits (SOLs) and reliability margins are established. The NERC Glossary definition of SOLs includes both: 1) voltage stability ratings (Applicable pre- and post-Contingency Voltage Stability) and 2*)* System Voltage Limits (Applicable pre- and post-Contingency voltage limits). Therefore, for reliability reasons Requirement R1 now requires a Transmission Operator (TOP) to set voltage or Reactive Power schedules with associated tolerance bands. Further, since neighboring areas can affect each other greatly, each TOP must also provide a copy of these schedules to its Reliability Coordinator (RC) and adjacent TOP upon request.

Rationale for R2:

Paragraph 1875 from Order No. 693 directed NERC to include requirements to run voltage stability analysis periodically, using online techniques where commercially available and offline tools when online tools are not available. This standard does not explicitly require the periodic voltage stability analysis because such analysis would be performed pursuant to the SOL methodology developed under the FAC standards. TOP standards also require the TOP to operate within SOLs and Interconnection Reliability Operating Limits (IROL). The VAR standard drafting team (SDT) and industry participants also concluded that the best models and tools are the ones that have been proven and the standard should not add a requirement for a responsible entity to purchase new online simulations tools. Thus, the VAR SDT simplified the requirements to ensuring sufficient reactive resources are online or scheduled. Controllable load is specifically included to answer FERC's directive in Order No. 693 at Paragraph 1879.

Rationale for R3:

Similar to Requirement R2, the VAR SDT determined that for reliability purposes, the TOP must ensure sufficient voltage support is provided in Real-time in order to operate within an SOL.

Rationale for R4:

The VAR SDT received significant feedback on instances when a TOP would need the flexibility for defining exemptions for generators. These exemptions can be tailored as the TOP deems necessary for the specific area's needs. The goal of this requirement is to provide a TOP the ability to exempt a Generator Operator (GOP) from: 1) a voltage or Reactive Power schedule, 2) a setting on the AVR, or 3) any VAR-002 notifications based on the TOP's criteria. Feedback from the industry detailed many system events that would require these types of exemptions which included, but are not limited to: 1) maintenance during shoulder months, 2) scenarios where two units are located within close proximity and both cannot be in voltage control mode, and 3) large system voltage swings where it would harm reliability if all GOP were to notify their respective TOP of deviations at one time. Also, in an effort to improve the requirement, the sub-requirements containing an exemption list were removed from the currently enforceable standard because this created more compliance issues with regard to how often the list would be updated and maintained.

Rationale for R5:

The new requirement provides transparency regarding the criteria used by the TOP to establish the voltage schedule. This requirement also provides a vehicle for the TOP to use appropriate granularity when setting notification requirements for deviation from the voltage or Reactive Power schedule. Additionally, this requirement provides clarity regarding a "tolerance band" as specified in the voltage schedule and the control dead-band in the generator's excitation system.

Voltage schedule tolerances are the bandwidth that accompanies the voltage target in a voltage schedule, should reflect the anticipated fluctuation in voltage at the Generation Operator's facility during normal operations, and be based on the TOP's assessment of N-1 and credible N-2 system contingencies. The voltage schedule's bandwidth should not be confused with the control dead-band that is programmed into a Generation Operator's automatic voltage regulator's control system, which should be adjusting the AVR prior to reaching either end of the voltage schedule's bandwidth.

Rationale for R6:

Although tap settings are first established prior to interconnection, this requirement could not be deleted because no other standard addresses when a tap setting must be adjusted. If the tap setting is not properly set, then the amount of VARs produced by a unit can be affected.

Exhibit B

Summary of Development History and Complete Record of Development

Summary of Development History

Summary of Development History

Proposed Reliability Standard VAR-001-5 reflects revisions to the WECC Variance in currently-effective Reliability Standard VAR-001-4.2. In accordance with the NERC Standard Processes Manual, the proposed standard containing the revised Variance was developed in accordance with the WECC Reliability Standards Development Procedure.

The development record for proposed Reliability Standard VAR-001-5 is summarized below.

I. Overview of the Standard Drafting Team

When evaluating a proposed Reliability Standard, the Commission is expected to give "due weight" to the technical expertise of the Electric Reliability Organization ("ERO").[1] For the proposed standard, the technical expertise of the ERO is derived from the standard drafting team selected by the WECC Standards Committee to lead the project in accordance with Step 3 of the WECC Reliability Standards Development Procedures. For this project, the standard drafting team consisted of industry experts, all with a diverse set of experiences. A roster of the standard drafting team members is included in **Exhibit C**.

II. Standard Development History

A. Standard Authorization Request Development

Project WECC-0128 VAR-001- 4.1 – Voltage and Reactive Control, WECC Regional Variance Five-year Review[2] was initiated on June 8, 2017 with receipt of a proposed Standards Authorization Request ("SAR"). The WECC Standards Committee ("WSC") formally approved the SAR on July 6, 2017 and created a standard drafting team on September 5, 2017.

[1] Section 215(d)(2) of the Federal Power Act; 16 U.S.C. §824o(d)(2) (2012).

[2] The project was later known as WECC-0128 VAR-001-4.2, Voltage and Reactive Control – WECC Regional Variance, Five-year Review.

B. First Posting – Comment Period

On September 20, 2017, the standard drafting team agreed by majority vote to post proposed Reliability Standard VAR-001-5 for a 45-day public comment period.[3] Proposed Reliability Standard VAR-001-5 was posted from September 25, 2017 through November 10, 2017. WECC received comments from three entities. Based on the comments received, the standard drafting team determined to make substantive changes to the proposed standard. Therefore, the proposed standard was posted for an additional comment period.

C. Second Posting – Comment Period

Proposed Regional Reliability Standard VAR-001-5 was posted for a 30-day public comment period from December 22, 2017 to January 22, 2018.[4] WECC received comments from two entities. Based on the comments received, the standard drafting team agreed by a majority of those present to forward the project to the WSC with a request for ballot.

D. Ballot Period and Results

On March 6, 2018, the WSC approved the request for ballot. The ballot pool opened on April 2, 2018 and closed on April 16, 2018. WECC held a Standards Briefing on April 13, 2018. Thirty-three individuals joined the ballot pool. The ballot was open from April 18, 2018 through May 9, 2018. Thirty-two individuals cast votes, reaching quorum at 96.97%. The regional standard obtained thirty-two affirmative votes,[5] which was 100% of the weighted segment vote. On June 19, 2018, the WSC approved the standard for WECC Board of Directors disposition.

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[3] Notice of VAR-001-WECC-4.1 Voltage and Reactive Control Five-Year Review Posting 1 is available at https://www.wecc.biz/Administrative/WECC-0128%20Posting%201%20Notice%20of%20Posting%20for%20Comment.pdf.

[4] Notice of VAR-001-WECC-4.1 Voltage and Reactive Control Five-Year Review Posting 2 is available at https://www.wecc.biz/Administrative/WECC-0128%20Posting%202%20Notice%20of%20Posting%20for%20Comment.pdf.

[5] During the ballot period there were 32 abstentions and 1 individual did not cast a vote.

E. WECC Board of Directors Approval

On June 20, 2018, the WECC Board of Directors approved the revisions to the WECC Variance reflected in proposed Reliability Standard VAR-001-5.

F. NERC Comment Period and Board of Trustees Adoption

NERC posted proposed Reliability Standard VAR-001-5 for a 45-day public comment period from June 22, 2018 to August 6, 2018.[6] The NERC Board of Trustees adopted proposed Reliability Standard VAR-001-5 on August 16, 2018.[7]

[6] The NERC web page for Regional Reliability Standards Under Development is available at http://www.nerc.com/pa/Stand/Pages/RegionalReliabilityStandardsUnderDevelopment.aspx.

[7] NERC, *Board of Trustees Agenda Package*, Agenda Item 7e (VAR-001-5 – Voltage and Reactive Control), *available at* https://www.nerc.com/gov/bot/Agenda%20highlights%20and%20Mintues%202013/Board_Open_Meeting_Agenda_Package_August_16_2018.pdf.

Complete Record of Development

Steven Rueckert
155 North 400 West
Salt Lake City, Utah 84103

August 31, 2018

Subject: Notification of Completion
VAR-001-5[1]
Automatic Voltage Regulators (AVR)
WECC Regional Variance

To: Mr. Howard Gugel
Senior Director of Standards
North American Electric Reliability Corporation (NERC)
3353 Peachtree Rd. NE, North Tower–Suite 600
Atlanta, GA 30326

Dear Howard,

WECC is seeking approval by the NERC Board of Trustees, with subsequent disposition by the Federal Energy Regulatory Commission (FERC), to approve VAR-001-5, Voltage and Reactive Control, with modification to the WECC Regional Variance.

Per the Western Electricity Coordinating Council's (WECC) Reliability Standards Development Procedures (Procedures), the VAR-001-5 Drafting Team conducted a five-year review of VAR-001-4.2, Automatic Voltage Regulators with WECC Regional Variance, making the following proposed changes:

- In E.A.14, corrected "Area" to "area."
- E.A.15 and associated elements were eliminated because the reliability-related task required in E.A.15 is contained as a lesser included task of VAR-002-4.1 Generator Operation for Maintaining Network Voltage Schedules, Requirement R2, Part 2.3. This finding by the drafting team agrees with the recent findings of the NERC Standards Efficiency Review (SER) Team and is included in the draft SER Standards Authorization Request.
- Updated Measures and moved matching current NERC conventions, replacing "shall" with "will."
- Corrected typographical errors in VSL Table for E.A.17.
- Updated the format and numbering.

Thank you for your assistance.

Sincerely,

Steven Rueckert
Director of Standards
Western Electricity Coordinating Council

[1] Numbering is subject to NERC assignment.

Supporting Documentation
WECC-0128 VAR-001-4.2
Voltage and Reactive Control with Regional Variance
Five-year Review

For documentation support please contact W. Shannon Black, at (503) 307-5782.

WECC-0128 VAR-001-4.2
Voltage and Reactive Control with Regional Variance
Five-year Review

	QR	BOT	Gov't Auth.*
SAR–Standard Authorization Request Attachment A			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment A Standard Authorization Request			
Regional Reliability Standard(s) (Clean Existing) Attachment B			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment B Clean Existing			
Regional Reliability Standard(s) (Clean Proposed) Attachment C			
File Name: WECC-0128 VAR-001-5 Five-year Review Attachment C Clean Proposed			
Regional Reliability Standard(s) (Existing redlined to Proposed) Attachment D			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment D Existing redlined to Proposed			
Project Roadmap Attachment E			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment E Project Roadmap			
Implementation Plan Attachment F			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment F Implementation Plan			
Regional Reliability Standard Submittal Request Attachment G			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment J Regional Reliability Standard Submittal Request			
Order 672 Criteria Attachment H			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment K Order 672 Criteria			
Drafting Team Roster with Biographies Attachment I			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment L Drafting Team Roster			
Ballot Pool Members Attachment J			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment M Ballot Pool Members			

Supporting Documentation
WECC-0128 VAR-001-4.2
Voltage and Reactive Control with Regional Variance
Five-year Review

Final Ballot Results Attachment K			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment N *Final Ballot Results*			
Minority Issues Attachment L			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment P *Minority Issues*			
WECC Standards Committee Roster Attachment M			
File Name: WECC-0128 VAR-001-4.2 Five-year Review Attachment Q *WECC Standards Committee Roster*			
Responses to Comments–WECC Attachment N			
File Name: WECC-0128 VAR-001-4.2 Five-year Review *Attachment N1–Posting 1 Response to Comments* *Attachment N2–Posting 2 Response to Comments*			

Attachment A
Standard Authorization Request
WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

This Standard Authorization request (SAR) was received on June 8, 2017, and deemed complete the same day. The SAR will be vetted for approval during the June 2017 WECC Standards Committee meeting.

Introduction

This project is a five-year review of the WECC Regional Variance as required by the Reliability Standards Development Procedures (Procedures).

Requester Information

1. Provide your contact information and your alternates contact information:
   - Your First Name: W. Shannon
   - Your Last Name: Black
   - Your Email Address: sblack@wecc.biz
   - Your Phone Number: (503) 307-5782
   - Organization Name: WECC
   - Alternates First Name: Steven
   - Alternates Last Name: Rueckert
   - Alternates Email Address: steve@wecc.biz
   - Alternates Phone Number: (801) 883-6878

Type of Request

2. Specify the type of request: (select one)
   - Request for Five-year Review of a WECC Regional Variance to a NERC Standard.

Create, Modify or Retire a Document Questions

Provide the requested information for your request to create, modify, or retire the document.

3. Requested Action: (select one)
   - Request for Five-year Review of a WECC Regional Variance to a NERC Standard.
4. Document Type: (select one)
   - WECC Regional Variance to a NERC Standard.

5. Issue: Specify what industry problem this request is trying to resolve.

   In accordance with the WECC Reliability Standards Development Procedures, Maintenance of RRS and Ops Documents, "The WSC shall ensure that each RRS is reviewed at least once every five years from the effective date of the most recent version of the RRS."

   The WECC Regional Variance was: 1) developed as WECC-0046, 2) approved by the NERC Board of Trustees on May 9, 2012, and 3) FERC approved on June 20, 2013.

   Changes to language outside of the Regional Variance are not within the scope of this request.

   Proposed Remedy: Specify how this request proposes to address the issue described.

   The assigned drafting team should review the document in its entirety with specific consideration for recommendations provided by NERC in its Periodic Review Recommendations for VAR-001-4.1 - Voltage and Reactive Control, May 19, 2017.

   Those recommendations include, but are not limited to:

   - The assigned drafting team should consider whether VAR-002-WECC-2 (*Automatic Voltage Regulators (AVR)*) should be retired considering the most recent versions of VAR-001-4.1 and VAR-002-4 which require all AVRs to be in service and in voltage control mode unless exempted by the TOP based on identified criteria.
   - In VAR-001-4.1, Requirement R5 has no requirement to identify the "initial" status of the PSS. However, VAR-002-4 Requirement R3 requires the Generator Operator to notify the Transmission Operator of a power system stabilizer (PSS) status change. The initial status of the PSS should be clarified within the notification required by Requirement R5. The status of the PSS raises the question whether any of the VAR-501-WECC-2 (*Power System Stabilizer*), or any subsequent new version, PSS requirements should be established similar to AVR requirements for inclusion of the continent-wide standards. Industry comments affirm that it is not necessary to require notification of the initial state of the PSS as regional practices, interconnection agreements, and data specifications can address the initial state of the PSS.
   - The WECC variance E.A.18 is specific to external control loops to the manufacturer's AVR control loop. Due to the system configuration of the WECC, it was one of the earlier adopters of AVR and PSS controls. Due to the age of the controls or difficulty with setting reactive droop compensation on some older style controls, external loop controls were implemented from the plant control system. This can be done via DCS or SCADA. Variance E.A.18 requires that if external controls are used, that they do not affect the AVR's transient response during fault conditions. Industry comments did not reveal any reliability related need to address external control loops within the continent-wide Reliability Standard. Comments identified MOD-025 or MOD-026 as a more appropriate standard to address the

need to document and communicate the impact of external control loop actions on the AVR to the TOP.

6. Functions: Each function will be reviewed if affected.
   - Applicability 4.2.
     - Generator Operators within the Western Interconnection (for the WECC Variance)
7. Detailed Description:
   There are no specific issues identified; this is a mandated review.
8. Affected Reliability Principles: Which of the following reliability principles is MOST affected by this request? (select one)
   - **Reliability Principle 1** — *Interconnected bulk electric systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.*

Document Information

Specify the documents title, document number, and affected section regarding the request.

9. Document Title: Voltage and Reactive Control (with WECC Regional Variance)

Reference Uploads

Please reference or upload any affected Standards, Regional Business Practices, Criterion, Policies, White Papers, Technical Reports, or other relevant documents. If this request is based on a conflict of law, please include a copy of, or accessible reference to, the specific law or regulatory mandate in conflict.

10. Provide additional comments (if needed)

A. Introduction

1. Title: Voltage and Reactive Control

2. Number: VAR-001-4.2

3. Purpose: To ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in Real-time to protect equipment and the reliable operation of the Interconnection.

4. Applicability:

4.1. Transmission Operators

4.2. Generator Operators within the Western Interconnection (for the WECC Variance)

5. Effective Date:

5.1. The standard shall become effective on the first day of the first calendar quarter after the date that the standard is approved by an applicable governmental authority or as otherwise provided for in a jurisdiction where approval by an applicable governmental authority is required for a standard to go into effect. Where approval by an applicable governmental authority is not required, the standard shall become effective on the first day of the first calendar quarter after the date the standard is adopted by the NERC Board of Trustees or as otherwise provided for in that jurisdiction.

B. Requirements and Measures

R1. Each Transmission Operator shall specify a system voltage schedule (which is either a range or a target value with an associated tolerance band) as part of its plan to operate within System Operating Limits and Interconnection Reliability Operating Limits. *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

1.1. Each Transmission Operator shall provide a copy of the voltage schedules (which is either a range or a target value with an associated tolerance band) to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request.

M1. The Transmission Operator shall have evidence that it specified system voltage schedules using either a range or a target value with an associated tolerance band.

For part 1.1, the Transmission Operator shall have evidence that the voltage schedules (which is either a range or a target value with an associated tolerance band) were provided to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request. Evidence may include, but is not limited to, emails, website postings, and meeting minutes.

R2. Each Transmission Operator shall schedule sufficient reactive resources to regulate voltage levels under normal and Contingency conditions. Transmission Operators can provide sufficient reactive resources through various means including, but not limited to, reactive generation scheduling, transmission line and reactive resource switching, and using controllable load. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M2. Each Transmission Operator shall have evidence of scheduling sufficient reactive resources based on their assessments of the system. For the operations planning time horizon, Transmission Operators shall have evidence of assessments used as the basis for how resources were scheduled.

R3. Each Transmission Operator shall operate or direct the Real-time operation of devices to regulate transmission voltage and reactive flow as necessary. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M3. Each Transmission Operator shall have evidence that actions were taken to operate capacitive and inductive resources as necessary in Real-time. This may include, but is not limited to, instructions to Generator Operators to: 1) provide additional voltage support; 2) bring resources on-line; or 3) make manual adjustments.

R4. Each Transmission Operator shall specify the criteria that will exempt generators: 1) from following a voltage or Reactive Power schedule, 2) from having its automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any associated notifications. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

4.1 If a Transmission Operator determines that a generator has satisfied the exemption criteria, it shall notify the associated Generator Operator.

M4. Each Transmission Operator shall have evidence of the documented criteria for generator exemptions.

For part 4.1, the Transmission Operator shall also have evidence to show that, for each generator in its area that is exempt: 1) from following a voltage or Reactive Power schedule, 2) from having its

automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any notifications, the associated Generator Operator was notified of this exemption.

R5. Each Transmission Operator shall specify a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) at either the high voltage side or low voltage side of the generator step-up transformer at the Transmission Operator's discretion. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

5.1. The Transmission Operator shall provide the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the associated Generator Operator and direct the Generator Operator to comply with the schedule in automatic voltage control mode (the AVR is in service and controlling voltage).

5.2. The Transmission Operator shall provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

5.3. The Transmission Operator shall provide the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the Generator Operator within 30 days of receiving a request.

M5. The Transmission Operator shall have evidence of a documented voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

For part 5.1, the Transmission Operator shall have evidence it provided a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the applicable Generator Operators, and that the Generator Operator was directed to comply with the schedule in automatic voltage control mode, unless exempted.

For part 5.2, the Transmission Operator shall have evidence it provided notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band). For part 5.3, the Transmission Operator shall have evidence it provided the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) within 30 days of receiving a request by a Generator Operator.

R6. After consultation with the Generator Owner regarding necessary step-up transformer tap changes and the implementation schedule, the Transmission Operator shall provide documentation to the Generator Owner specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M6. The Transmission Operator shall have evidence that it provided documentation to the Generator Owner when a change was needed to a generating unit's step-up transformer tap in accordance with the requirement and that it consulted with the Generator Owner.

C. Compliance

1. Compliance Monitoring Process:

1.1. Compliance Enforcement Authority:

As defined in the NERC Rules of Procedure, “Compliance Enforcement Authority” refers to NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.

1.2. Evidence Retention:

The following evidence retention periods identify the period of time a registered entity is required to retain specific evidence to demonstrate compliance. For instances in which the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask the registered entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The Transmission Operator shall retain evidence for Measures M1 through M6 for 12 months. The Compliance Monitor shall retain any audit data for three years.

1.3. Compliance Monitoring and Assessment Processes:

“Compliance Monitoring and Assessment Processes” 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.

1.4. Additional Compliance Information:

None

Table of Compliance Elements

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	**Operations Planning**	**High**	N/A	N/A	N/A	The Transmission Operator does not specify a system voltage schedule (which is either a range or a target value with an associated tolerance band).
R2	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an SOL.	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an IROL.
R3	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an SOL.	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an IROL.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R4	**Operations Planning**	**Lower**	N/A	N/A	The Transmission Operator has exemption criteria and notified the Generator Operator, but the Transmission Operator does not have evidence of the notification to the Generator Operator.	The Transmission Operator does not have exemption criteria.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R5	**Operations Planning**	**Medium**	N/A	The Transmission Operator does not provide the criteria for voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) after 30 days of a request.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to all Generator Operators.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to any Generator Operators. Or The Transmission Operator does not provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R6	**Operations Planning**	**Lower**	The Transmission Operator does not provide either the technical justification or timeframe for changing generator step-up tap settings.	N/A	N/A	The Transmission Operator does not provide the technical justification and the timeframe for changing generator step-up tap settings.

D. Regional Variances

The following Interconnection-wide variance shall be applicable in the Western Electricity Coordinating Council (WECC) and replaces, in their entirety, Requirements R4 and R5. Please note that Requirement R4 is deleted and R5 is replaced with the following requirements.

Requirements

E.A.13 Each Transmission Operator shall issue any one of the following types of voltage schedules to the Generator Operators for each of their generation resources that are on-line and part of the Bulk Electric System within the Transmission Operator Area: *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- A voltage set point with a voltage tolerance band and a specified period.
- An initial volt-ampere reactive output or initial power factor output with a voltage tolerance band for a specified period that the Generator Operator uses to establish a generator bus voltage set point.
- A voltage band for a specified period.

E.A.14 Each Transmission Operator shall provide one of the following voltage schedule reference points for each generation resource in its Area to the Generator Operator. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- The generator terminals.
- The high side of the generator step-up transformer.
- The point of interconnection.
- A location designated by mutual agreement between the Transmission Operator and Generator Operator.

E.A.15 Each Generator Operator shall convert each voltage schedule specified in Requirement E.A.13 into the voltage set point for the generator excitation system. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

E.A.16 Each Generator Operator shall provide its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals within 30 calendar days of request by its Transmission Operator. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

E.A.17 Each Transmission Operator shall provide to the Generator Operator, within 30 calendar days of a request for data by the Generator Operator, its transmission equipment data and operating data that supports development of the voltage set point conversion methodology. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

E.A.18 Each Generator Operator shall meet the following control loop specifications if the Generator Operator uses control loops external to the automatic voltage regulators (AVR) to manage Mvar loading: *[Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]*

E.A.18.1. Each control loop's design incorporates the AVR's automatic voltage controlled response to voltage deviations during System Disturbances.

E.A.18.2. Each control loop is only used by mutual agreement between the Generator Operator and the Transmission Operator affected by the control loop.

Measures[1]

M.E.A.13 Each Transmission Operator shall have and provide upon request, evidence that it provided the voltage schedules to the Generator Operator. Dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule including set points, tolerance bands, and specified periods as required in Requirement E.A.13 are acceptable as evidence.

M.E.A.14 The Transmission Operator shall have and provide upon request, evidence that it provided one of the voltage schedule reference points in Requirement E.A.14 for each generation resource in its Area to the Generator Operator. Dated letters, e-mail, or other documentation that contains notification to the Generator Operator of the voltage schedule reference point for each generation resource are acceptable as evidence.

M.E.A.15 Each Generator Operator shall have and provide upon request, evidence that it converted a voltage schedule as described in Requirement E.A.13 into a voltage set point for the AVR. Dated spreadsheets, logs, reports, or other documentation are acceptable as evidence.

M.E.A.16 The Generator Operator shall have and provide upon request, evidence that within 30 calendar days of request by its Transmission Operator it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals. Dated reports, spreadsheets, or other documentation are acceptable as evidence.

M.E.A.17 The Transmission Operator shall have and provide upon request, evidence that within 30 calendar days of request by its Generator Operator it provided data to support development of the voltage set point conversion methodology. Dated reports, spreadsheets, or other documentation are acceptable as evidence.

M.E.A.18 If the Generator Operator uses outside control loops to manage Mvar loading, the Generator Operator shall have and provide upon request, evidence that it met the control loop specifications in sub-parts E.A.18.1 through E.A.18.2. Design specifications with identified agreed-upon control loops, system reports, or other dated documentation are acceptable as evidence.

[1] The number for each measure corresponds with the number for each requirement, i.e. M.E.A.13 means the measure for Requirement E.A.13.

Violation Severity Levels

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.13	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to at least one generation resource but less than or equal to 5% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 5% but less than or equal to 10% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 10% but less than or equal to 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.
E.A.14	The Transmission Operator did not provide a voltage schedule reference point for at least one but less than or equal to 5% of the generation resources in the Transmission Operator area.	The Transmission Operator did not provide a voltage schedule reference point for more than 5% but less than or equal to 10% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not a voltage schedule reference point for more than 10% but less than or equal to 15% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not provide a voltage schedule reference point for more than 15% of the generation resources in the Transmission Operator Area.
E.A.15	The Generator Operator failed to convert at least one voltage schedule in Requirement E.A.13 into the voltage set point for the AVR for less than 25% of the voltage schedules.	The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 25% or more but less than 50% of the voltage schedules.	The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 50% or more but less than 75% of the voltage schedules.	The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 75% or more of the voltage schedules.

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.16	The Generator Operator provided its voltage set point conversion methodology greater than 30 days but less than or equal to 60 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Transmission Operator.	The Generator Operator did not provide its voltage set point conversion methodology within 120 days of a request by the Transmission Operator.
E.A.17	The Transmission Operator provided its data to support development of the voltage set point conversion methodology than 30 days but less than or equal to 60 days of a request by the Generator Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Generator. Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Generator. Operator.	The Transmission Operator did not provide its data to support development of the voltage set point conversion methodology within 120 days of a request by the Generator Operator.
E.A.18	N/A	The Generator Operator did not meet the control loop specifications in EA18.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in EA18.1 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in EA18.1 through EA18.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.

E. Interpretations

None

F. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New
1	August 2, 2006	BOT Adoption	Revised
1	June 18, 2007	FERC approved Version 1 of the standard.	Revised
1	July 3, 2007	Added “Generator Owners” and “Generator Operators” to Applicability section.	Errata
1	August 23, 2007	Removed “Generator Owners” and “Generator Operators” to Applicability section.	Errata
2	August 5, 2010	Adopted by NERC Board of Trustees; Modified to address Order No. 693 Directives contained in paragraphs 1858 and 1879.	Revised
2	January, 10 2011	FERC issued letter order approving the addition of LSEs and Controllable Load to the standard.	Revised
3	May 9, 2012	Adopted by NERC Board of Trustees; Modified to add a WECC region variance	Revised
3	June 20, 2013	FERC issued order approving VAR-001-3	Revised
3	November 21, 2013	R5 and associated elements approved by FERC for retirement as part of the Paragraph 81 project (Project 2013-02)	Revised
4	February 6, 2014	Adopted by NERC Board of Trustees	Revised
4	August 1, 2014	FERC issued letter order issued approving VAR-001-4	
4.1	August 25, 2015	Added “or” to Requirement R5, 5.3 to read: schedules or Reactive Power	Errata
4.1	November 13, 2015	FERC Letter Order approved errata to VAR-001-4.1. Docket RD15-6-000	Errata
4.2	June 14, 2017	Project 2016-EPR-02 errata recommendations	Errata
4.2	August 10, 2017	Adopted by NERC Board of Trustees	Errata
4.2	September 26, 2017	FERC Letter Order issued approving VAR-001-4.2 Docket No. RD17-7-000.	

Guidelines and Technical Basis

For technical basis for each requirement, please review the rationale provided for each requirement.

Rationale:

During development of this standard, text boxes were embedded within the standard to explain the rationale for various parts of the standard. Upon BOT approval, the text from the rationale text boxes was moved to this section.

Rationale for R1:

Paragraph 1868 of Order No. 693 requires NERC to add more "detailed and definitive requirements on “established limits” and “sufficient reactive resources”, and identify acceptable margins (i.e. voltage and/or reactive power margins)." Since Order No. 693 was issued, however, several FAC and TOP standards have become enforceable to add more requirements around voltage limits. More specifically, FAC-011 and FAC-014 require that System Operating Limits (SOLs) and reliability margins are established. The NERC Glossary definition of SOLs includes both: 1) voltage stability ratings (Applicable pre- and post-Contingency Voltage Stability) and 2*)* System Voltage Limits (Applicable pre- and post-Contingency voltage limits). Therefore, for reliability reasons Requirement R1 now requires a Transmission Operator (TOP) to set voltage or Reactive Power schedules with associated tolerance bands. Further, since neighboring areas can affect each other greatly, each TOP must also provide a copy of these schedules to its Reliability Coordinator (RC) and adjacent TOP upon request.

Rationale for R2:

Paragraph 1875 from Order No. 693 directed NERC to include requirements to run voltage stability analysis periodically, using online techniques where commercially available and offline tools when online tools are not available. This standard does not explicitly require the periodic voltage stability analysis because such analysis would be performed pursuant to the SOL methodology developed under the FAC standards. TOP standards also require the TOP to operate within SOLs and Interconnection Reliability Operating Limits (IROL). The VAR standard drafting team (SDT) and industry participants also concluded that the best models and tools are the ones that have been proven and the standard should not add a requirement for a responsible entity to purchase new online simulations tools. Thus, the VAR SDT simplified the requirements to ensuring sufficient reactive resources are online or scheduled. Controllable load is specifically included to answer FERC's directive in Order No. 693 at Paragraph 1879.

Rationale for R3:

Similar to Requirement R2, the VAR SDT determined that for reliability purposes, the TOP must ensure sufficient voltage support is provided in Real-time in order to operate within an SOL.

Rationale for R4:

The VAR SDT received significant feedback on instances when a TOP would need the flexibility for defining exemptions for generators. These exemptions can be tailored as the TOP deems necessary for the specific

area's needs. The goal of this requirement is to provide a TOP the ability to exempt a Generator Operator (GOP) from: 1) a voltage or Reactive Power schedule, 2) a setting on the AVR, or 3) any VAR-002 notifications based on the TOP's criteria. Feedback from the industry detailed many system events that would require these types of exemptions which included, but are not limited to: 1) maintenance during shoulder months, 2) scenarios where two units are located within close proximity and both cannot be in voltage control mode, and 3) large system voltage swings where it would harm reliability if all GOP were to notify their respective TOP of deviations at one time. Also, in an effort to improve the requirement, the sub-requirements containing an exemption list were removed from the currently enforceable standard because this created more compliance issues with regard to how often the list would be updated and maintained.

Rationale for R5:

The new requirement provides transparency regarding the criteria used by the TOP to establish the voltage schedule. This requirement also provides a vehicle for the TOP to use appropriate granularity when setting notification requirements for deviation from the voltage or Reactive Power schedule. Additionally, this requirement provides clarity regarding a "tolerance band" as specified in the voltage schedule and the control dead-band in the generator's excitation system.

Voltage schedule tolerances are the bandwidth that accompanies the voltage target in a voltage schedule, should reflect the anticipated fluctuation in voltage at the Generation Operator's facility during normal operations, and be based on the TOP's assessment of N-1 and credible N-2 system contingencies. The voltage schedule's bandwidth should not be confused with the control dead-band that is programmed into a Generation Operator's automatic voltage regulator's control system, which should be adjusting the AVR prior to reaching either end of the voltage schedule's bandwidth.

Rationale for R6:

Although tap settings are first established prior to interconnection, this requirement could not be deleted because no other standard addresses when a tap setting must be adjusted. If the tap setting is not properly set, then the amount of VARs produced by a unit can be affected.

A. Introduction

1. Title: Voltage and Reactive Control

2. Number: VAR-001-5

3. Purpose: To ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in Real-time to protect equipment and the reliable operation of the Interconnection.

4. Applicability:

4.1. Transmission Operators

4.2. Generator Operators within the Western Interconnection (for the WECC Variance)

5. Effective Date:

5.1. The standard shall become effective on the first day of the first calendar quarter after the date that the standard is approved by an applicable governmental authority or as otherwise provided for in a jurisdiction where approval by an applicable governmental authority is required for a standard to go into effect. Where approval by an applicable governmental authority is not required, the standard shall become effective on the first day of the first calendar quarter after the date the standard is adopted by the NERC Board of Trustees or as otherwise provided for in that jurisdiction.

B. Requirements and Measures

R1. Each Transmission Operator shall specify a system voltage schedule (which is either a range or a target value with an associated tolerance band) as part of its plan to operate within System Operating Limits and Interconnection Reliability Operating Limits. *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

1.1. Each Transmission Operator shall provide a copy of the voltage schedules (which is either a range or a target value with an associated tolerance band) to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request.

M1. The Transmission Operator shall have evidence that it specified system voltage schedules using either a range or a target value with an associated tolerance band.

For part 1.1, the Transmission Operator shall have evidence that the voltage schedules (which is either a range or a target value with an associated tolerance band) were provided to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request. Evidence may include, but is not limited to, emails, website postings, and meeting minutes.

R2. Each Transmission Operator shall schedule sufficient reactive resources to regulate voltage levels under normal and Contingency conditions. Transmission Operators can provide sufficient reactive resources through various means including, but not limited to, reactive generation scheduling, transmission line and reactive resource switching, and using controllable load. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M2. Each Transmission Operator shall have evidence of scheduling sufficient reactive resources based on their assessments of the system. For the operations planning time horizon, Transmission Operators shall have evidence of assessments used as the basis for how resources were scheduled.

R3. Each Transmission Operator shall operate or direct the Real-time operation of devices to regulate transmission voltage and reactive flow as necessary. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M3. Each Transmission Operator shall have evidence that actions were taken to operate capacitive and inductive resources as necessary in Real-time. This may include, but is not limited to, instructions to Generator Operators to: 1) provide additional voltage support; 2) bring resources on-line; or 3) make manual adjustments.

R4. Each Transmission Operator shall specify the criteria that will exempt generators: 1) from following a voltage or Reactive Power schedule, 2) from having its automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any associated notifications. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

4.1 If a Transmission Operator determines that a generator has satisfied the exemption criteria, it shall notify the associated Generator Operator.

M4. Each Transmission Operator shall have evidence of the documented criteria for generator exemptions.

For part 4.1, the Transmission Operator shall also have evidence to show that, for each generator in its area that is exempt: 1) from following a voltage or Reactive Power schedule, 2) from having its

automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any notifications, the associated Generator Operator was notified of this exemption.

R5. Each Transmission Operator shall specify a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) at either the high voltage side or low voltage side of the generator step-up transformer at the Transmission Operator's discretion. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

5.1. The Transmission Operator shall provide the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the associated Generator Operator and direct the Generator Operator to comply with the schedule in automatic voltage control mode (the AVR is in service and controlling voltage).

5.2. The Transmission Operator shall provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

5.3. The Transmission Operator shall provide the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the Generator Operator within 30 days of receiving a request.

M5. The Transmission Operator shall have evidence of a documented voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

For part 5.1, the Transmission Operator shall have evidence it provided a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the applicable Generator Operators, and that the Generator Operator was directed to comply with the schedule in automatic voltage control mode, unless exempted.

For part 5.2, the Transmission Operator shall have evidence it provided notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band). For part 5.3, the Transmission Operator shall have evidence it provided the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) within 30 days of receiving a request by a Generator Operator.

R6. After consultation with the Generator Owner regarding necessary step-up transformer tap changes and the implementation schedule, the Transmission Operator shall provide documentation to the Generator Owner specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M6. The Transmission Operator shall have evidence that it provided documentation to the Generator Owner when a change was needed to a generating unit's step-up transformer tap in accordance with the requirement and that it consulted with the Generator Owner.

C. Compliance

1. Compliance Monitoring Process:

1.1. Compliance Enforcement Authority:

As defined in the NERC Rules of Procedure, “Compliance Enforcement Authority” refers to NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.

1.2. Evidence Retention:

The following evidence retention periods identify the period of time a registered entity is required to retain specific evidence to demonstrate compliance. For instances in which the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask the registered entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The Transmission Operator shall retain evidence for Measures M1 through M6 for 12 months. The Compliance Monitor shall retain any audit data for three years.

1.3. Compliance Monitoring and Assessment Processes:

“Compliance Monitoring and Assessment Processes” 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.

1.4. Additional Compliance Information:

None

Table of Compliance Elements

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	**Operations Planning**	**High**	N/A	N/A	N/A	The Transmission Operator does not specify a system voltage schedule (which is either a range or a target value with an associated tolerance band).
R2	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an SOL.	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an IROL.
R3	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an SOL.	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an IROL.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R4	**Operations Planning**	**Lower**	N/A	N/A	The Transmission Operator has exemption criteria and notified the Generator Operator, but the Transmission Operator does not have evidence of the notification to the Generator Operator.	The Transmission Operator does not have exemption criteria.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R5	**Operations Planning**	**Medium**	N/A	The Transmission Operator does not provide the criteria for voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) after 30 days of a request.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to all Generator Operators.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to any Generator Operators. Or The Transmission Operator does not provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R6	**Operations Planning**	**Lower**	The Transmission Operator does not provide either the technical justification or timeframe for changing generator step-up tap settings.	N/A	N/A	The Transmission Operator does not provide the technical justification and the timeframe for changing generator step-up tap settings.

D. Regional Variances

The following Interconnection-wide variance shall be applicable in the Western Electricity Coordinating Council (WECC) and replaces, in their entirety, Requirements R4 and R5. Please note that Requirement R4 is deleted and R5 is replaced with the following requirements.

Requirements and Measures

E.A.13 Each Transmission Operator shall issue any one of the following types of voltage schedules to the Generator Operators for each of their generation resources that are on-line and part of the Bulk Electric System within the Transmission Operator Area: *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- A voltage set point with a voltage tolerance band and a specified period.
- An initial volt-ampere reactive output or initial power factor output with a voltage tolerance band for a specified period that the Generator Operator uses to establish a generator bus voltage set point.
- A voltage band for a specified period.

M.E.A.13 Each Transmission Operator will have evidence that it provided the voltage schedules to the Generator Operator, as required in E.A.13. Evidence may include, but is not limited to, dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule, including set points, tolerance bands, and specified periods as required in Requirement E.A.13.

E.A.14 Each Transmission Operator shall provide one of the following voltage schedule reference points for each generation resource in its area to the Generator Operator. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- The generator terminals.
- The high side of the generator step-up transformer.
- The point of interconnection.
- A location designated by mutual agreement between the Transmission Operator and Generator Operator.

M.E.A.14 The Transmission Operator will have evidence that it provided one of the voltage schedule reference points for each generation resource in its area to the Generator Operator, as required in E.A.14. Evidence may include, but is not limited to, dated letters, e-mail, or other documentation that contains notification to the Generator Operator of the voltage schedule reference point for each generation resource.

E.A.15 Each Generator Operator shall provide its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals within 30 calendar days of request by its Transmission Operator. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.15 The Generator Operator will have evidence that, within 30 calendar days of a request by its Transmission Operator, it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals, as required in E.A.15. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

E.A.16 Each Transmission Operator shall provide to the Generator Operator, within 30 calendar days of a request for data by the Generator Operator, its transmission equipment data and operating data that supports development of the voltage set point conversion methodology. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.16 The Transmission Operator will have evidence that, within 30 calendar days of a request by its Generator Operator, it provided data to support development of the voltage set point conversion methodology, as required in E.A.16. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

E.A.17 Each Generator Operator shall meet the following control loop specifications if the Generator Operator uses control loops external to the automatic voltage regulators (AVR) to manage Mvar loading: *[Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]*

E.A.17.1 Each control loop's design incorporates the AVR's automatic voltage controlled response to voltage deviations during System Disturbances.

E.A.17.2. Each control loop is only used by mutual agreement between the Generator Operator and the Transmission Operator affected by the control loop.

M.E.A.17 If the Generator Operator uses outside control loops to manage Mvar loading, the Generator Operator will have evidence that it met the control loop specifications in sub-parts E.A.17.1 through E.A.17.2, as required in E.A.17 and its sub-parts. Evidence may include, but is not limited to, design specifications with identified agreed-upon control loops, system reports, or other dated documentation.

Violation Severity Levels

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.13	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to at least one generation resource but less than or equal to 5% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 5% but less than or equal to 10% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 10% but less than or equal to 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.
E.A.14	The Transmission Operator did not provide a voltage schedule reference point for at least one but less than or equal to 5% of the generation resources in the Transmission Operator area.	The Transmission Operator did not provide a voltage schedule reference point for more than 5% but less than or equal to 10% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not provide a voltage schedule reference point for more than 10% but less than or equal to 15% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not provide a voltage schedule reference point for more than 15% of the generation resources in the Transmission Operator Area.
E.A.15	The Generator Operator provided its voltage set point conversion methodology greater than 30 days but less than or equal to 60 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Transmission Operator.	The Generator Operator did not provide its voltage set point conversion methodology within 120 days of a request by the Transmission Operator.

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.16	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 30 days but less than or equal to 60 days of a request by the Generator Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Generator Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Generator Operator.	The Transmission Operator did not provide its data to support development of the voltage set point conversion methodology within 120 days of a request by the Generator Operator.
E.A.17	N/A	The Generator Operator did not meet the control loop specifications in E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in E.A.17.1 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in E.A.17.1 through E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.

E. Interpretations

None

F. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New
1	August 2, 2006	BOT Adoption	Revised
1	June 18, 2007	FERC approved Version 1 of the standard.	Revised
1	July 3, 2007	Added “Generator Owners” and “Generator Operators” to Applicability section.	Errata

1	August 23, 2007	Removed “Generator Owners” and “Generator Operators” to Applicability section.	Errata
2	August 5, 2010	Adopted by NERC Board of Trustees; Modified to address Order No. 693 Directives contained in paragraphs 1858 and 1879.	Revised
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4.1	August 25, 2015	Added “or” to Requirement R5, 5.3 to read: schedules or Reactive Power	Errata
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4.2	August 10, 2017	Adopted by NERC Board of Trustees	Errata
4.2	September 26, 2017	FERC Letter Order issued approving VAR-001-4.2 Docket No. RD17-7-000.	
5	TBD	Approved by NERC Board of Trustees	1) In E.A.14 “Area” was changed to “area.”; 2) E.A.15 and associated elements were eliminated; 3) Measures were updated and relocated matching current conventions, replacing “shall” with “will”; 4) typographical errors in VSL Table for E.A.17

			were corrected; 5) format was updated.

Guidelines and Technical Basis

For technical basis for each requirement, please review the rationale provided for each requirement.

Rationale:

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Paragraph 1868 of Order No. 693 requires NERC to add more "detailed and definitive requirements on “established limits” and “sufficient reactive resources”, and identify acceptable margins (i.e. voltage and/or reactive power margins)." Since Order No. 693 was issued, however, several FAC and TOP standards have become enforceable to add more requirements around voltage limits. More specifically, FAC-011 and FAC-014 require that System Operating Limits (SOLs) and reliability margins are established. The NERC Glossary definition of SOLs includes both: 1) voltage stability ratings (Applicable pre- and post-Contingency Voltage Stability) and 2) System Voltage Limits (Applicable pre- and post-Contingency voltage limits). Therefore, for reliability reasons Requirement R1 now requires a Transmission Operator (TOP) to set voltage or Reactive Power schedules with associated tolerance bands. Further, since neighboring areas can affect each other greatly, each TOP must also provide a copy of these schedules to its Reliability Coordinator (RC) and adjacent TOP upon request.

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Voltage schedule tolerances are the bandwidth that accompanies the voltage target in a voltage schedule, should reflect the anticipated fluctuation in voltage at the Generation Operator's facility during normal operations, and be based on the TOP's assessment of N-1 and credible N-2 system contingencies. The voltage schedule's bandwidth should not be confused with the control dead-band that is programmed into a Generation Operator's automatic voltage regulator's control system, which should be adjusting the AVR prior to reaching either end of the voltage schedule's bandwidth.

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Although tap settings are first established prior to interconnection, this requirement could not be deleted because no other standard addresses when a tap setting must be adjusted. If the tap setting is not properly set, then the amount of VARs produced by a unit can be affected.

A. Introduction

1. **Title:** Voltage and Reactive Control

2. **Number:** VAR-001-~~4.2~~5

3. **Purpose:** To ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in Real-time to protect equipment and the reliable operation of the Interconnection.

4. **Applicability:**

   4.1. Transmission Operators

   4.2. Generator Operators within the Western Interconnection (for the WECC Variance)

5. **Effective Date:**

   5.1. The standard shall become effective on the first day of the first calendar quarter after the date that the standard is approved by an applicable governmental authority or as otherwise provided for in a jurisdiction where approval by an applicable governmental authority is required for a standard to go into effect. Where approval by an applicable governmental authority is not required, the standard shall become effective on the first day of the first calendar quarter after the date the standard is adopted by the NERC Board of Trustees or as otherwise provided for in that jurisdiction.

B. Requirements and Measures

R1. Each Transmission Operator shall specify a system voltage schedule (which is either a range or a target value with an associated tolerance band) as part of its plan to operate within System Operating Limits and Interconnection Reliability Operating Limits. *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

1.1. Each Transmission Operator shall provide a copy of the voltage schedules (which is either a range or a target value with an associated tolerance band) to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request.

M1. The Transmission Operator shall have evidence that it specified system voltage schedules using either a range or a target value with an associated tolerance band.

For part 1.1, the Transmission Operator shall have evidence that the voltage schedules (which is either a range or a target value with an associated tolerance band) were provided to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request. Evidence may include, but is not limited to, emails, website postings, and meeting minutes.

R2. Each Transmission Operator shall schedule sufficient reactive resources to regulate voltage levels under normal and Contingency conditions. Transmission Operators can provide sufficient reactive resources through various means including, but not limited to, reactive generation scheduling, transmission line and reactive resource switching, and using controllable load. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M2. Each Transmission Operator shall have evidence of scheduling sufficient reactive resources based on their assessments of the system. For the operations planning time horizon, Transmission Operators shall have evidence of assessments used as the basis for how resources were scheduled.

R3. Each Transmission Operator shall operate or direct the Real-time operation of devices to regulate transmission voltage and reactive flow as necessary. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M3. Each Transmission Operator shall have evidence that actions were taken to operate capacitive and inductive resources as necessary in Real-time. This may include, but is not limited to, instructions to Generator Operators to: 1) provide additional voltage support; 2) bring resources on-line; or 3) make manual adjustments.

R4. Each Transmission Operator shall specify the criteria that will exempt generators: 1) from following a voltage or Reactive Power schedule, 2) from having its automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any associated notifications. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

4.1 If a Transmission Operator determines that a generator has satisfied the exemption criteria, it shall notify the associated Generator Operator.

M4. Each Transmission Operator shall have evidence of the documented criteria for generator exemptions.

For part 4.1, the Transmission Operator shall also have evidence to show that, for each generator in its area that is exempt: 1) from following a voltage or Reactive Power schedule, 2) from having its

automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any notifications, the associated Generator Operator was notified of this exemption.

R5. Each Transmission Operator shall specify a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) at either the high voltage side or low voltage side of the generator step-up transformer at the Transmission Operator's discretion. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

5.1. The Transmission Operator shall provide the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the associated Generator Operator and direct the Generator Operator to comply with the schedule in automatic voltage control mode (the AVR is in service and controlling voltage).

5.2. The Transmission Operator shall provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

5.3. The Transmission Operator shall provide the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the Generator Operator within 30 days of receiving a request.

M5. The Transmission Operator shall have evidence of a documented voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

For part 5.1, the Transmission Operator shall have evidence it provided a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the applicable Generator Operators, and that the Generator Operator was directed to comply with the schedule in automatic voltage control mode, unless exempted.

For part 5.2, the Transmission Operator shall have evidence it provided notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band). For part 5.3, the Transmission Operator shall have evidence it provided the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) within 30 days of receiving a request by a Generator Operator.

R6. After consultation with the Generator Owner regarding necessary step-up transformer tap changes and the implementation schedule, the Transmission Operator shall provide documentation to the Generator Owner specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M6. The Transmission Operator shall have evidence that it provided documentation to the Generator Owner when a change was needed to a generating unit's step-up transformer tap in accordance with the requirement and that it consulted with the Generator Owner.

C. Compliance

1. Compliance Monitoring Process:

1.1. Compliance Enforcement Authority:

As defined in the NERC Rules of Procedure, "Compliance Enforcement Authority" refers to NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.

1.2. Evidence Retention:

The following evidence retention periods identify the period of time a registered entity is required to retain specific evidence to demonstrate compliance. For instances in which the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask the registered entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The Transmission Operator shall retain evidence for Measures M1 through M6 for 12 months. The Compliance Monitor shall retain any audit data for three years.

1.3. Compliance Monitoring and Assessment Processes:

"Compliance Monitoring and Assessment Processes" 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.

1.4. Additional Compliance Information:

None

Table of Compliance Elements

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	**Operations Planning**	**High**	N/A	N/A	N/A	The Transmission Operator does not specify a system voltage schedule (which is either a range or a target value with an associated tolerance band).
R2	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an SOL.	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an IROL.
R3	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an SOL.	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an IROL.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R4	**Operations Planning**	**Lower**	N/A	N/A	The Transmission Operator has exemption criteria and notified the Generator Operator, but the Transmission Operator does not have evidence of the notification to the Generator Operator.	The Transmission Operator does not have exemption criteria.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R5	**Operations Planning**	**Medium**	N/A	The Transmission Operator does not provide the criteria for voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) after 30 days of a request.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to all Generator Operators.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to any Generator Operators. Or The Transmission Operator does not provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R6	**Operations Planning**	**Lower**	The Transmission Operator does not provide either the technical justification or timeframe for changing generator step-up tap settings.	N/A	N/A	The Transmission Operator does not provide the technical justification and the timeframe for changing generator step-up tap settings.

D. Regional Variances

The following Interconnection-wide variance shall be applicable in the Western Electricity Coordinating Council (WECC) and replaces, in their entirety, Requirements R4 and R5. Please note that Requirement R4 is deleted and R5 is replaced with the following requirements.

Requirements and Measures

E.A.13 Each Transmission Operator shall issue any one of the following types of voltage schedules to the Generator Operators for each of their generation resources that are on-line and part of the Bulk Electric System within the Transmission Operator Area: *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- A voltage set point with a voltage tolerance band and a specified period.
- An initial volt-ampere reactive output or initial power factor output with a voltage tolerance band for a specified period that the Generator Operator uses to establish a generator bus voltage set point.
- A voltage band for a specified period.

M.E.A.13 Each Transmission Operator will have evidence that it provided the voltage schedules to the Generator Operator, as required in E.A.13. Evidence may include, but is not limited to, dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule, including set points, tolerance bands, and specified periods as required in Requirement E.A.13.

E.A.14 Each Transmission Operator shall provide one of the following voltage schedule reference points for each generation resource in its ~~Area~~area to the Generator Operator. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- The generator terminals.
- The high side of the generator step-up transformer.
- The point of interconnection.
- A location designated by mutual agreement between the Transmission Operator and Generator Operator.

~~**E.A.15** Each Generator Operator shall convert each voltage schedule specified in Requirement E.A.13 into the voltage set point for the generator excitation system. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*~~

M.E.A.14 The Transmission Operator will have evidence that it provided one of the voltage schedule reference points for each generation resource in its area to the Generator Operator, as required in E.A.14. Evidence may include, but is not limited to, dated letters, e-mail, or other documentation that contains notification to the Generator Operator of the voltage schedule reference point for each generation resource.

~~**E.A.16**~~**E.A.15** Each Generator Operator shall provide its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals within 30 calendar days of request by its Transmission Operator. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.15 The Generator Operator will have evidence that, within 30 calendar days of a request by its Transmission Operator, it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals, as required in E.A.15. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

~~**E.A.17**~~**E.A.16** Each Transmission Operator shall provide to the Generator Operator, within 30 calendar days of a request for data by the Generator Operator, its transmission equipment data and operating data that supports development of the voltage set point conversion methodology. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.16 The Transmission Operator will have evidence that, within 30 calendar days of a request by its Generator Operator, it provided data to support development of the voltage set point conversion methodology, as required in E.A.16. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

~~**E.A.18**~~**E.A.17** Each Generator Operator shall meet the following control loop specifications if the Generator Operator uses control loops external to the automatic voltage regulators (AVR) to manage Mvar loading: *[Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]*

E.A.17.1 Each control loop's design incorporates the AVR's automatic voltage controlled response to voltage deviations during System Disturbances.

E.A.17.2. Each control loop is only used by mutual agreement between the Generator Operator and the Transmission Operator affected by the control loop.

~~**Measures**[1]~~

~~**M.E.A.13** Each Transmission Operator shall have and provide upon request, evidence that it provided the voltage schedules to the Generator Operator. Dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule including set points, tolerance bands, and specified periods as required in Requirement E.A.13 are acceptable as evidence.~~

~~**M.E.A.14** The Transmission Operator shall have and provide upon request, evidence that it provided one of the voltage schedule reference points in Requirement E.A.14 for each generation resource in its Area to the Generator Operator. Dated letters, e-mail, or other documentation that contains notification to the Generator Operator of the voltage schedule reference point for each generation resource are acceptable as evidence.~~

~~**M.E.A.15** Each Generator Operator shall have and provide upon request, evidence that it converted a voltage schedule as described in Requirement E.A.13 into a voltage set point for the AVR. Dated spreadsheets, logs, reports, or other documentation are acceptable as evidence.~~

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~~[1] The number for each measure corresponds with the number for each requirement, i.e. M.E.A.13 means the measure for Requirement E.A.13.~~

~~**M.E.A.17** The Transmission Operator shall have and provide upon request, evidence that within 30 calendar days of request by its Generator Operator it provided data to support development of the voltage set point conversion methodology. Dated reports, spreadsheets, or other documentation are acceptable as evidence.~~

~~**M.E.A.18**~~**M.E.A.17** If the Generator Operator uses outside control loops to manage Mvar loading, the Generator Operator ~~shall~~will have ~~and provide upon request,~~ evidence that it met the control loop specifications in sub-parts E.A.~~18~~17.1 through E.A.~~18~~17.2~~. Design~~, as required in E.A.17 and its sub-parts. Evidence may include, but is not limited to, design specifications with identified agreed-upon control loops, system reports, or other dated documentation ~~are acceptable as evidence.~~

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Violation Severity Levels

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.13	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to at least one generation resource but less than or equal to 5% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 5% but less than or equal to 10% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 10% but less than or equal to 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.
E.A.14	The Transmission Operator did not provide a voltage schedule reference point for at least one but less than or equal to 5% of the generation resources in the Transmission Operator area.	The Transmission Operator did not provide a voltage schedule reference point for more than 5% but less than or equal to 10% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not provide a voltage schedule reference point for more than 10% but less than or equal to 15% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not provide a voltage schedule reference point for more than 15% of the generation resources in the Transmission Operator Area.
~~**E.A.15**~~	~~The Generator Operator failed to convert at least one voltage schedule in Requirement E.A.13 into the voltage set point for the AVR for less than 25% of the voltage schedules.~~	~~The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 25% or more but less than 50% of the voltage schedules.~~	~~The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 50% or more but less than 75% of the voltage schedules.~~	~~The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 75% or more of the voltage schedules.~~

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.~~16~~15	The Generator Operator provided its voltage set point conversion methodology greater than 30 days but less than or equal to 60 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Transmission Operator.	The Generator Operator did not provide its voltage set point conversion methodology within 120 days of a request by the Transmission Operator.
E.A.~~17~~16	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 30 days but less than or equal to 60 days of a request by the Generator Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Generator~~.~~ Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Generator~~.~~ Operator.	The Transmission Operator did not provide its data to support development of the voltage set point conversion methodology within 120 days of a request by the Generator Operator.
E.A.~~18~~17	N/A	The Generator Operator did not meet the control loop specifications in ~~EA18~~E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in ~~EA18~~E.A.17.1 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in ~~EA18~~E.A.17.1 through ~~EA18~~E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.

E. Interpretations

None

F. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New
1	August 2, 2006	BOT Adoption	Revised
1	June 18, 2007	FERC approved Version 1 of the standard.	Revised
1	July 3, 2007	Added "Generator Owners" and "Generator Operators" to Applicability section.	Errata
1	August 23, 2007	Removed "Generator Owners" and "Generator Operators" to Applicability section.	Errata
2	August 5, 2010	Adopted by NERC Board of Trustees; Modified to address Order No. 693 Directives contained in paragraphs 1858 and 1879.	Revised
2	January~~,~~ 10, 2011	FERC issued letter order approving the addition of LSEs and Controllable Load to the standard.	Revised
3	May 9, 2012	Adopted by NERC Board of Trustees; Modified to add a WECC region variance	Revised
3	June 20, 2013	FERC issued order approving VAR-001-3	Revised
3	November 21, 2013	R5 and associated elements approved by FERC for retirement as part of the Paragraph 81 project (Project 2013-02)	Revised
4	February 6, 2014	Adopted by NERC Board of Trustees	Revised
4	August 1, 2014	FERC issued letter order issued approving VAR-001-4	
4.1	August 25, 2015	Added "or" to Requirement R5, 5.3 to read: schedules or Reactive Power	Errata
4.1	November 13, 2015	FERC Letter Order approved errata to VAR-001-4.1. Docket RD15-6-000	Errata
4.2	June 14, 2017	Project 2016-EPR-02 errata recommendations	Errata
4.2	August 10, 2017	Adopted by NERC Board of Trustees	Errata
4.2	September 26, 2017	FERC Letter Order issued approving VAR-001-4.2 Docket No. RD17-7-000.	

5	TBD	Approved by NERC Board of Trustees	1) In E.A.14 "Area" was changed to "area."; 2) E.A.15 and associated elements were eliminated; 3) Measures were updated and relocated matching current conventions, replacing "shall" with "will"; 4) typographical errors in VSL Table for E.A.17 were corrected; 5) format was updated.

Guidelines and Technical Basis

For technical basis for each requirement, please review the rationale provided for each requirement.

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Attachment E
Project Roadmap
WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Project Roadmap

Actions		Proposed Date
1.	SAR Filed	June 8, 2017
2.	Drafting Team solicitation	July 18, 2017
3.	WSC approved the SAR	July 6, 2017
4.	Notice of DT Solicitation–Augmented	August 21, 2017
5.	DT meeting	September 19, 2017
6.	Posting 1 Comments Open	September 25, 2017
7.	Posting 1 Comments Closed	November 10, 2017
8.	DT meeting–Subset	November 14, 2017
9.	DT meeting	December 13, 2017
10.	DT Meeting	December 20, 2017
11.	Posting 2 Comments Open	December 22, 2017
12.	Posting 2 Comments Closed	January 22, 2018
13.	DT Meeting	January 24, 2018
14.	WSC Approved for Ballot	March 6, 2018
15.	Ballot Pool Open	April 2, 2018
16.	Standard Briefing	April 13, 2018
17.	Ballot Pool Closed	April 16, 2018
18.	Ballot Open	April 18, 2018
19.	Ballot Closed	May 9, 2018
20.	WSC approves for WECC Board of Directors disposition	June 19, 2018
21.	WECC Board of Directors approval	June 20, 2018
22.	NERC Posting 45-day comment period–Open	June 22, 2018
23.	NERC Posting 45-day comment period–Closed	August 6, 2018
24.	NERC Board of Trustees approval	August 16, 2018
25.	FERC approval	TBD

Attachment F
Implementation Plan

WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Standards Authorization Request (SAR)

WECC-0128 VAR-001-4.2 SAR

Approvals Required

- WECC Board of Directors June 20, 2018
- NERC Board of Trustees August 16, 2018
- FERC Pending

Applicable Entities

4. Applicability:

4.1 Transmission Operators

4.2 Generator Operators within the Western Interconnection (for the WECC Variance)

Conforming Changes to Other Standards

This filing is the result of a five-year review mandated by the WECC Reliability Standards Development Procedures (Procedures).

Only the WECC Regional Variance (RV) E.A.15 is proposed for deletion.

No changes to other NERC Standards are required to implement the proposed deletion.

The content of the RV was originally proposed as a freestanding Regional Standard (proposed as VAR-001-WECC-1) but was "appropriately recast as a variance within the continent-wide Reliability Standard VAR-001-2 because it propose[d] to replace Requirements within the continent-wide Reliability Standard with region-specific requirements."[1] On June 20, 2013, the Federal Energy Regulatory Commission (FERC) approved the RV, thereby creating Version 3, with an effective date of January 1, 2014.[2] If approved, this filing would delete RV E.A.15 and update its nomenclature.[3]

[1] Notice of Filing of the North American Electric Reliability Corporation of Proposed Reliability Standard VAR-001-3 (Voltage and Reactive Control), March 11, 2013. See pages 5-6 for quotation. That filing contains the full historic development of the Version 3 and prior.

[2] The Project was originally developed as WECC-0046.

[3] Versions 4, 4.1, and 4.2 did not impact the RV.

Proposed Effective Date

Immediately upon receipt of applicable regulatory approval.

Justification

Because the reliability-related task required in RV E.A.15 is contained as a lesser included task of VAR-002-4.1 Generator Operation for Maintaining Network Voltage Schedules, Requirement R2, Part 2.3, immediate implementation should have no impact on reliability, operations, or administration.

Consideration of Early Compliance

The drafting team foresees no concerns with early compliance.

Required Retirements

RV E.A.15 and its associated compliance and measurement elements should be retired.

No other retirements or modifications to other standards are needed.

Regional Reliability Standard Submittal
Request Attachment G

Region:	**Western Electricity Coordinating Council**
Regional Standard Number:	**VAR-001-5**[1]
Regional Standard Title:	**Voltage and Reactive Control with Regional Variance**
Date Submitted:	**DATE SUBMITTED TO NERC**
Regional Contact Name:	**Steven Rueckert**
Regional Contact Title:	**Director of Standards**
Regional Contact Telephone Number:	**(801) 883-6878**

Request (check all that apply):

- ☐ Retirement of WECC Regional Reliability Standard
- ☐ Interpret an Existing Standard
- ☐ Approval of a new standard
- ☒ Revision of an existing standard: VAR-001-4.2
- ☐ Withdrawal of an existing standard
- ☐ Urgent Action

Has this action been approved by your Board of Directors:

- ☒ Yes
- ☐ No

(If no please indicate date standard action is expected along with the current status (e.g., third comment period with anticipated board approval on mm/dd/year)):

June 20, 2018, Board of Directors / Board Resolution

[1] Numbering is subject to NERC assignment.

Resolved, that the Western Electricity Coordinating Council (WECC) Board of Directors (Board), acting upon the recommendation of the WECC Standards Committee (WSC) at the meeting of the Board on June 20, 2018 hereby approves the retirement of WECC Regional Variance E.A.15 in VAR-001-4.2, as described and attached hereunto.
[Note: The purpose of the remaining questions is to provide NERC with the information needed to file the regional standard(s) with FERC. The information provided may to a large degree be used verbatim. It is extremely important for the entity submitting this form to provide sufficient detail that clearly delineates the scope and justification of the request.]

Concise statement of the basis and purpose (scope) of request:	In accordance with the WECC Reliability Standards Development Procedures (Procedures), the WECC Standards Committee shall ensure that each Regional Reliability Standard (RRS) is reviewed at least once every five years from the effective date of the most recent version of the RRS. This project is a result of the required five-year review. The WECC Regional Variance (RV) to VAR-001-4.2 was approved by FERC on June 13, 2013 (Docket No. RD13-6-000). The background, purpose, and stringency of the RV have not changed. Only the WECC RV was reviewed.[2]
Concise statement of the justification of the request:	The assigned drafting team reviewed the RV while considering NERC's recommendations included in the Periodic Review Recommendations for VAR-001-4.1 – Voltage and Reactive Control, May 19, 2017. After considering NERC's recommendations and comments received during two postings for comment, the drafting team made the following changes: • In E.A.14 "Area" was corrected to "area." • E.A.15 and associated elements were eliminated because the reliability-related task required in E.A.15 is contained as a lesser included task of

[2] The original Regional Variance was developed under WECC Tracking Number WECC-0046. This update was assigned WECC Tracking Number WECC-0128.

	VAR-002-4.1 Generator Operation for Maintaining Network Voltage Schedules, Requirement R2, Part 2.3. • Measures were updated and relocated matching current NERC conventions, replacing “shall” with “will.” • Typographical errors in Violation Severity Level (VSL) Table for E.A.17 were corrected. • The format and numbering were updated.

Attachment H
Order 672 Criteria
WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Not used

No revisions were made to any of the Continent-wide Requirements or the Regional Variances except the deletion of the E.A.15 Regional Variance.

E.A.15 was deleted. The Violation Severity Level (VSL) and Violation Risk Factor (VRF) were also deleted.

Only minor grammatical corrections and format changes to bring the document to the current drafting conventions.

Do not need to readdress the 672 Criteria as it was already addressed and approved when FERC approved the original WECC Regional Variances.

Attachment I
Drafting Team Roster

WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Below please find a biographical snapshot for the members of the WECC-0128 VAR-001-4.2, Voltage and Reactive Control Five-year Review Drafting Team.

Name	Background
Alex Chua Pacific Gas and Electric	• Electrical Engineer with 15 years of experience working in the transmission, distribution, and generation aspects of the company • The last four years have been focused on regulatory compliance for Generator Owner and Operators • Review and negotiate voltage schedules with transmission operators • Work with automation group on Automatic Voltage Regulator (AVR)/Power System Stabilizer (PSS) controls and generating notifications for status changes to our Transmission Operator (TOP) and Balancing Authority (BA) • Former WECC and NERC drafting team member
Shane Kronebusch L&S Electric	Mr. Kronebusch is the Lead Electrical Engineer and Subject Matter Expert for excitation systems, protection and hydro governors and unit controls for L&S Electric, Inc. He has over 27 years of experience in the utility industry. Prior to joining L&S Electric in 2010, Mr. Kronebusch's responsibilities included coordinating and preforming WECC testing of generation assets as an employee of BC Hydro Generation Engineering and Maintenance Services. He was responsible for commissioning both new and rehabilitated units ranging in size from 30MW to 500MW. Mr. Kronebusch was tasked as a subject matter expert for exciters and governors as part of the BC Hydro Equipment Health Rating program. Mr. Kronebusch first became involved with WECC testing after the July and August 1996 system disturbances that initiated the testing program. He has been a member of the WECC Control Work Group since 2006.
Mario Kiresich Southern California	Mr. Kiresich has been in the utility industry since 1997 and has held several positions: Call Center as a Customer Service Specialist, Groundman, Substation

Edison Grid Control	Electrician, Transmission Dispatcher, Procedure Administrator, Trainer, and Substation Supervisor. • 10 years in BES operations as Dispatcher, Compliance, Procedures, and Training • Transmission Operator and NERC Certified at the Reliability Coordinator (RC) level He has his Bachelor of Science in political science with a political communications emphasis and a minor in criminal justice from Chapman University. NERC Member as follows: 1) 2015-12 EOP-PRT (Observer), 2) 2017-03 FAC PRT (Member), 3) 2013-03 GMDSDT (Observer), 4) GMDTF (Member), 5) 2015-08 EOP SDT (Observer), and 6) 2015-07 COM-001 SDT (Vice Chair).
Alvin Pinkston	Mr. Pinkston has over 37 years of experience in the utility industry and has held several positions: Power Plant Manager for coal- and gas-fired power plants, Transmission / Distribution Control Center Manager, Trainer, Substation Relay Electrician, Instrument Electrician Technician. • 17 years nuclear plant operations as Work Control Supervisor, Electrical Maintenance Technician, and Supervisor • Transmission Operator and Control Center Manager and NERC Certified at the RC level • Five years as Transmission Operator Trainer • Subject Matter Expert for transmission operations and generation systems
Greg Anderson	Mr. Anderson is the Subject Matter Expert for generation and excitation systems for the Southern California Edison Company. He has over 33 years of experience in the utility industry, with responsibilities for coordinating WECC testing of generation assets. He has been a WECC participant since 1997 and a member of the Control Work Group since 2003.
Baj Agrawal Arizona Public Service Company	Mr. Agrawal has over 40 years of transmission and generation experience. He has been involved in generator excitation systems, power system stabilizers, and subsynchronous resonance. Mr. Agrawal has served on several NERC and WECC drafting teams including MOD-26, 27. He is currently serving on the NERC TPL-005-1 (Single Point of Failure)

	Drafting Team, the WECC Modeling Validation Work Group, the North American Transmission Forum, and the Modeling Practices Work Group Core team. Mr. Agrawal holds his Ph.D. in education.
James Wong	Mr. Wong joined the Bonneville Power Administration in 2009 where he serves as an operations planning engineer. He is experienced in thermal, voltage, and transient stability power system security studies for real-time and planning operations. Mr. Wong's work provides system operators real-time and planned procedures to enhance situational awareness for the dynamic conditions on the grid. As a graduate of Gonzaga University, Mr. Wong holds a Bachelor of Science in electrical engineering. Prior to working in the utility industry, Mr. Wong served his country in the United States Air Force and continues to serve in the Washington Air National Guard.[1]

[1] Although Mr. Wong participated in the drafting of the document, his assignment to the team did not take place until the November 15, 2017, WECC Standards Committee meeting.

Attachment J
Ballot Pool
WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Ballot Pool

Title	Company	Sector	Vote	Comments	Created By
WECC-0128	Arizona Public Service Company	Transmission Owners	Yes		Michelle Amarantos
WECC-0128	Arizona Public Service Company	Electricity Brokers, Aggregators, and Marketers	Yes		Jonathan Aragon
WECC-0128	Arizona Public Service Company	Load-Serving Entities (LSE)	Yes		Vivian Vo
WECC-0128	Arizona Public Service Company	Electric Generators	Yes		Kelsi Rigby
WECC-0128	Black Hills Corporation	Electricity Brokers, Aggregators, and Marketers			Chad Thies
WECC-0128	Bonneville Power Administration	Load-Serving Entities (LSE)	Yes		Rebecca Berdahl
WECC-0128	Bonneville Power Administration	Transmission Owners	Yes		Kammy Rogers-Holliday
WECC-0128	Bonneville Power Administration	Electricity Brokers, Aggregators, and Marketers	Yes		Andrew Meyers

Title	Company	Sector	Vote	Comments	Created By
WECC-0128	Bonneville Power Administration	Electric Generators	Yes		Scott Winner
WECC-0128	Idaho Power Company	Transmission Owners	Yes		Laura Nelson
WECC-0128	Idaho Power Company	Electric Generators	Yes		Laura Nelson
WECC-0128	Idaho Power Company	Load-Serving Entities (LSE)	Yes		Laura Nelson
WECC-0128	Northern California Power Agency	Electricity Brokers, Aggregators, and Marketers	Yes		Dennis Sismaet
WECC-0128	Platte River Power Authority	Transmission Owners	Yes		Jeff Landis
WECC-0128	Platte River Power Authority	Electric Generators	Yes		Tyson Archie
WECC-0128	Platte River Power Authority	Electricity Brokers, Aggregators, and Marketers	Yes		Sabrina Martz
WECC-0128	Platte River Power Authority	Load-Serving Entities (LSE)	Yes		Jeff Landis
WECC-0128	Public Service Company of Colorado (Xcel Energy)	Transmission Owners	Yes		Robert Staton

Title	Company	Sector	Vote	Comments	Created By
WECC-0128	Public Service Company of Colorado (Xcel Energy)	Electric Generators	Yes		Gerry Huitt
WECC-0128	Public Service Company of New Mexico	Electric Generators	Yes		Laurie Williams
WECC-0128	Public Service Company of New Mexico	Transmission Owners	Yes		Laurie Williams
WECC-0128	Public Service Company of New Mexico	Load-Serving Entities (LSE)	Yes		Laurie Williams
WECC-0128	Public Service Company of New Mexico	Electricity Brokers, Aggregators, and Marketers	Yes		Laurie Williams
WECC-0128	Puget Sound Energy, Inc.	Transmission Owners	Yes		Theresa Rakowsky
WECC-0128	Puget Sound Energy, Inc.	Load-Serving Entities (LSE)	Yes		Theresa Rakowsky
WECC-0128	Puget Sound Energy, Inc.	Electric Generators	Yes		Eleanor Ewry
WECC-0128	Puget Sound Energy, Inc.	Electric Generators			Theresa Rakowsky
WECC-0128	Salt River Project	Load-Serving Entities (LSE)	Yes		Robert Kondziolka

Title	Company	Sector	Vote	Comments	Created By
WECC-0128	Salt River Project	Electric Generators	Yes		Kevin Nielsen
WECC-0128	Seattle City Light	Transmission Dependent Utilities (TDU)	Yes		Hao Li
WECC-0128	Seattle City Light	Load-Serving Entities (LSE)	Yes		Charles Freeman
WECC-0128	Tacoma Power	Electric Generators	Yes		Karen Hedlund
WECC-0128	Tacoma Power	Transmission Dependent Utilities (TDU)	Yes		Chad Edinger
WECC-0128	Tacoma Power	Transmission Owners	Yes		Chad Edinger

Attachment K
Final Ballot Results
WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Ballot Name: **VAR-001-4.2 Voltage and Reactive Control – WECC Regional Variance Five-year Review**

Overview: The following changes were made to the WECC Regional Variance; no changes were made to the body of the standard:

- Existing E.A.15 and associated elements were deleted because the task is contained in VAR-002-4.1, Generator Operation for Maintaining Network Voltage Schedules, Requirement R2., Part 2.3 as a lesser included task;
- In E.A.14 "Area" was changed to "area";
- Measures were updated and relocated matching current NERC conventions, replacing "shall" with "will";
- Typographical errors in the VSL Table for existing E.A.17 were corrected;
- The format was updated.

Ballot Pool Open:	04/02/2018	Ballot Opened:	04/18/2018
Ballot Pool Closed:	04/16/2018	Ballot Closed:	05/09/2018
Total Ballot Pool:	33	Total Votes:	32
Quorum:	96.97%	Weighted Votes:	100%

Ballot Results: Pass

Voting Sectors	Total in Ballot Pool	Votes Non-Abstain	Sector Weight	Yes Votes	Weighted Segment Vote	No Votes	Abstain	Total Votes for Quorum	Didn't Vote
1–Transmission Owners	8	8	0.8	8	80%	0	0	8	0
2–RTOs ISOs	0	0	0	0	00%	0	0		0
3–LSE	8	8	0.8	8	80%	0	0	8	0
4–Trans. Dep. Util.	2	2	0.2	2	20%	0	0	0	0
5–Elec. Gen.	9	9	.9	9	90%	0	0	0	0
6–Brokers, Aggr. & Markt.	6	5	0.5	5	50%	0	0	5	1
7–Large End User	0	0	0	0	00%	0	0	0	0
8–Small End User	0	0	0	0	00%	0	0	0	0
9–Gov./Reg.	0	0	0	0	00%	0	0	0	0
10–Reg. Entity	0	0	0	0	00%	0	0	0	0
Totals	33	32	3.2	32	100%	0	0	32	1

WECC
WESTERN ELECTRICITY COORDINATING COUNCIL
155 North 400 West, Suite 200
Salt Lake City, Utah 84103-1114

Attachment L
Minority Issues
WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Following a ballot period from April 18 through May 9, 2018, the WECC Ballot Pool approved the requested changes to VAR-001-4.2 Voltage and Reactive Control–with WECC Regional Variance.

Development Phase Comments–Minority Opinion

Comment Response Forms and comments received during the development phase of this project are included with this filing as Attachment R1 and R2.

During the development phase, this project was posted twice for comment. The following minority opinions were received during the development phase:

- *There were no minority opinions. This project was approved with a 100 percent affirmative ballot.*

Ballot Phase Comments–Minority Opinion

The WECC Reliability Standards Development Procedures (Procedures) do not require a drafting team to respond to comments provided during the balloting phase of a project.

During the balloting phase, the following minority opinions were received:

- *There were no minority opinions. This project was approved with a 100 percent affirmative ballot.*

Attachment M
WECC Standards Committee Roster
WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

The following individuals are those assigned to the WECC Standards Committee as of June 19, 2018.

Sector	Name	Organization
1 Transmission Owners	Sunitha Kothapalli	Puget Sound Energy
2 Regional Transmission Organizations (RTO) and Independent System Operators (ISO)	Robert Sullivan	California Independent System Operator
3 Load Serving Entities (LSE)	Cana Cabbell	Southern California Edison Company
4 Transmission Dependent Utilities (TDU)	Marty Hostler	Northern California Power Agency
5 Electric Generators	Gary Nolan	Arizona Publics Service Company
6 Electricity Brokers, Aggregators, and Marketers (BAM)	Joseph Tarantino	Sacramento Municipal Utility District
7 Large Electricity End Users	Caitlin Liotiris	Utah Association of Energy Users
8 Small Electricity Users	Crystal Musselman	Proven Compliance Solutions, Inc
9 Federal, State, and Provincial Regulatory or Other Government Entities	Davy Zhuang	British Columbia Utilities Commission
10 Regional Entities	Steven Rueckert	Western Electricity Coordinating Council
Chair	Michael Core	WECC Board of Directors

Attachment N1
Response to Comments WECC Posting 1
WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Posting 1

The WECC-0128 VAR-001-4.2, Voltage and Reactive Control, Five-year Review Drafting Team (DT) thanks everyone who submitted comments on the proposed document. The scope of the review only includes the WECC Regional Variance (RV) appended to the NERC Standard.

Posting

The document was posted for a 45-day public comment period from September 25 through November 10, 2017.

On September 20, 2017, WECC distributed notice of the posting via the Standards Email List.

The DT asked stakeholders to provide feedback on the proposed document through a standardized electronic template. WECC received comments from three entities as shown in the following table.

Location of Comments

All comments received on the document can be viewed in their original format on the WECC-0128 project page under the "Submit and Review Comments" accordion.

Changes in Response to Comment

After consideration of comments received and further DT discussions held on December 13 and December 20, 2017, the DT concluded that only RV E.A.15 should be deleted. Deletion is appropriate because the task is contained in VAR-002-4.1, Generator Operation for Maintaining Network Voltage Schedules, Requirement R2., Part 2.3 as a lesser included task.

Rationale for Deletion

In VAR-001-4.2, Voltage and Reactive Power, the Transmission Operator issues to the Generator Operator any one of three types of voltage schedules.[1] The voltage schedule must contain any one of four reference points.[2] If the Generator Operator is not monitoring the voltage at the location specified in its voltage schedule, the Generator Operator must have a methodology for converting the voltage schedule to the voltage point being monitored by the Generator Operator.[3] The Generator Operator

[1] VAR-001-4.2, Voltage and Reactive Control, Regional Variance (RV) E.A.13
[2] RV. E.A.14
[3] VAR-002-4.1, Generator Operation for Maintaining Network Voltage Schedules, Requirement R2., Part 2.3

then converts the schedule into the voltage set point for the generator excitation system[4] and maintains the schedule, unless otherwise exempted.[5]

Restated, VAR-002-4.1 requires the Generator Operator to have a conversion methodology and VAR-001-4.2 requires the Generator Operator to use the methodology. If the Generator Operator does not have a conversion methodology as required in VAR-002-4.1, it is impossible for the Generator Operator to use that methodology as required in VAR-001-4.2. As a result, the single act of omission in VAR-002-4.1 triggers a second violation in the RV of VAR-001-4.2.

By deleting E.A.15, duplicative violation based on a single omission is avoided.

Deletion of E.A.15 would have no impact on reliability because the reliability-related task is contained in VAR-002-4.1, Requirement R2 wherein the Generator Operator is required to *operate* to the schedule. Operating to that schedule cannot take place without converting the schedule (where applicable); therefore, the conversion mandate of E.A.15 is a lesser included step implied and required in VAR-002-4.1, Requirement R2. Because it is a lesser included step, it is redundant and can be deleted from the RV without negative impact to reliability.

Other Considerations

The team opted to retain E.A.13 after concluding that although portions of the requirement could default back to Requirement R5, the operational value would be di minimus and parsing the pericope would only add ambiguity.

The team opted to retain E.A.14 noting that it adds greater granularity than Requirement R5 and enhances operation by allowing for greater flexibility.

The team opted to retain E.A.16 noting that its content is not covered elsewhere.

The team opted to retain E.A.17 noting its provision for bilateral communication is not otherwise addressed elsewhere.

The team considered deletion of E.A.18 in favor of MOD-026-1, Verification of Models and Data for Generator Excitation Control System or Plant Volt/VAR Control Functions, Requirement R2. However, the MOD Standard does not engage the same applicable entities nor provide for agreement between the affected parties.

Consideration was given to reinstatement of Requirements R4 and R5 coupled with the elimination of corresponding portions of the RV; however, the DT concluded the original intent of the document still holds.[6] If Requirements R4 and R5 were reinstated, the Transmission Operator could choose to supply

[4] RV E.A.15

[5] VAR-002-4.1, Generator Operation for Maintaining Network Voltage Schedules, Requirement R2

[6] "The Regional Variance requires conversion of a reactive support schedule provided by a Transmission Operator to an equivalent voltage schedule, thereby permitting operation of generators in voltage control mode without the additional responsibility of manually revising the voltage west-point to also maintain a required reactive schedule having an automatic

the Generator Operator with a reactive power schedule in lieu of voltage schedules. As a result, the Generator Operator would be required to perform continuous manual adjustments to maintain a reactive power schedule.

Minority View.

There was no minority view.

Effective Date and Implementation Plan

The WECC Reliability Standards Development Procedures (Procedures) require that an implementation plan be posted with at least one posting of the project. The Effective Date is proposed as immediately on receipt of regulatory approval. An immediate effective date is appropriate because the task being eliminated is already being performed in compliance with VAR-002-4.1, Generator Operation for Maintaining Network Voltage Schedules, Requirement R2., Part 2.3. The Implementation Plan will be posted with Posting 2.

Action Plan

On December 20, 2017, the WECC-0128 VAR-001-4.2, Voltage and Reactive Control, Five-year Review Drafting Team (DT) agreed by majority vote to post Posting 2 of the project for a 30-day comment period. Posting 2 will include an implementation plan.

The posting period will open December 22, 2017 and close January 22, 2018. The drafting team will meet on January 24 and 31, 2018 from 10:00 a.m. to 12:00 p.m., as needed, to discuss disposition of the project.

Comments can be submitted using the green survey buttons located on the Submit and Review Comments accordion of the WECC-0128 project page.

Contacts and Appeals

If you feel your comment has been omitted or overlooked, please contact W. Shannon Black, WECC Consultant. In addition, the WECC Reliability Standards Appeals Process can be found in the Reliability Standards Development Procedures.

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voltage regulation in service and in voltage control mode was identify using disturbance analysis as essential for the reliability of the Bulk Electric System in the WECC region die to western transmission configurations." Notice of Filing of the North American Electric Reliability Corporation of Proposed Reliability Standard VAR-001-3 (Voltage and Reactive Control), March 11, 2013. See pages 2-3 for quotation. That filing contains the full historic development of the Version 3 and prior.

Comment Report Form for WECC-0128

WECC Standards Comment Table

Commenter		Organization
1	Marty Hostler	Northern California Power Agency (NCPA)
2	William Franklin	Public Service Company of Colorado (PSCo)
3	Neil Swearingen	Salt River Project (SRP)

Comment Report Form for WECC-0128

Index to Questions, Comments, and Responses

Question

1. This project covers the WECC Variance attached to VAR-001-4.1 Voltage and Reactive Control. Currently, the variance renders WECC exempt from Requirement R4. The WECC-0128 drafting team is suggesting that Requirement R4 be reinstated and become applicable to WECC. The drafting team is suggesting reinstatement of Requirement R4 because: 1) revitalization does not take away reliability but does add flexibility, and 2) for some small generators, operation without Automatic Voltage Regulation (AVR) may be the best reliability choice. Should the exemption from Requirement R4 be deleted?

1a. If you answered no to Question 2, please explain your answer.

2. The drafting team is suggesting that Variance Requirements E.A.15 through E.A.17 be deleted because the reliability-related content is addressed in VAR-002-4, Generator Operation for Maintaining Network Voltage Schedules, Requirement R2. Should Variance requirements E.A.15 through E.A.18 be deleted?

2a. If you answered no to Questions 3, please explain your answer.

3. The drafting team is suggesting that Variance Requirements E.A.18 be deleted because the reliability-related content is addressed in MOD-026-1, Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions, Requirement R2 (see also the Purpose statement for MOD-026). Should Variance requirement E.A.18 be deleted?

3a. If you answered no to Questions 4, please explain your answer.

4. The drafting team welcomes comments on all other aspects of the Variance. Comments regarding changes to the supporting body of the standard will not be addressed.

Comment Report Form for WECC-0128

1. Response Summary

Summary Consideration:	See summary in the preamble of this document.
Commenter / Comment	**Response**
NCPA	Yes
The drafting team thanks NCPA for its continued involvement in the standards development process.	
PSCo	Yes
The drafting team thanks PSCo for its continued involvement in the standards development process.	
SRP	Yes
The drafting team thanks SRP for its continued involvement in the standards development process.	

1a. Response Summary

Summary Consideration:	See summary in the preamble of this document.
Commenter / Comment	**Response**
NCPA	No response.
PSCo	No response
SRP	No response

2. Response Summary

Summary Consideration:	See summary in the preamble of this document.
Commenter / Comment	**Response**
NCPA	Yes
The drafting team thanks NCPA for its continued involvement in the standards development process.	
PSCo	Yes
The drafting team thanks PSCo for its continued involvement in the standards development process.	
SRP	Yes
The drafting team thanks SRP for its continued involvement in the standards development process.	

2a. Response Summary

Summary Consideration:	See summary in the preamble of this document.
Commenter / Comment	**Response**
NCPA	No response
PSCo	No response
SRP	No response

3. Response Summary

Summary Consideration:	See summary in the preamble of this document.
Commenter / Comment	**Response**
NCPA	Yes
The drafting team thanks NCPA for its continued involvement in the standards development process.	
PSCo	Yes
The drafting team thanks PSCo for its continued involvement in the standards development process.	
SRP	Yes
The drafting team thanks SRP for its continued involvement in the standards development process.	

3a. Response Summary

Summary Consideration:	See summary in the preamble of this document.
Commenter / Comment	**Response**
NCPA	No response
PSCo	No response
SRP	No response

4. Response Summary

Summary Consideration:	See summary in the preamble of this document.
Commenter / Comment	**Response**
NCPA	Looks good
The drafting team thanks NCPA for its continued involvement in the standards development process.	
PSCo	No comment
The drafting team thanks PSCo for its continued involvement in the standards development process.	
SRP	SRP agrees with the proposed changes as they add flexibility to exempt generators and remove the redundancy of regional variances that are already addressed in other Standards
The drafting team thanks SRP for its continued involvement in the standards development process.	

Attachment N2
Response to Comments WECC Posting 2
WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Posting 2

The WECC-0128 VAR-001-4.2, Voltage and Reactive Control, Five-year Review Drafting Team (DT) thanks everyone who submitted comments on the proposed document. The scope of the review only includes the WECC Regional Variance (RV) appended to the NERC Standard.

Posting

The document was posted for a 30-day public comment period from December 22, 2017, through January 22, 2018.

On December 20, 2017, WECC distributed notice of the posting via the Standards Email List.

The DT asked stakeholders to give feedback on the proposed document through a standardized electronic template. WECC received comments from two entities as shown in the following table.

Location of Comments

All comments received on the document can be viewed in their original format on the WECC-0128 project page under the "Submit and Review Comments" accordion.

Changes in Response to Comment

The drafting will update the numbering and references. A second look at the project will also take place once the near-final project is presented for technical writing.

Other Considerations

None

Minority View.

There was no minority view.

Effective Date and Implementation Plan

The WECC Reliability Standards Development Procedures (Procedures) require that an implementation plan be posted with at least one posting of the project. The Effective Date is proposed as immediately on receipt of regulatory approval. An immediate effective date is appropriate because the task being eliminated is already being performed in compliance with VAR-002-4.1, Generator Operation for Maintaining Network Voltage Schedules, Requirement R2., Part 2.3. The Implementation Plan was posted with Posting 1.

Action Plan

On January 24, 2018, the WECC-0128 Drafting Team agreed by a majority of those present to forward the project to the WECC Standards Committee (WSC) with a request for ballot.

The request is targeted for the March 6, 2018, WSC agenda.

Contacts and Appeals

If you feel your comment has been omitted or overlooked, please contact W. Shannon Black, WECC Consultant. In addition, the WECC Reliability Standards Appeals Process can be found in the Reliability Standards Development Procedures.

WECC Standards Comment Table

Commenter		Organization
1	Twila Hofer	Tacoma Power
2	Michelle Amarantos on Behalf of Todd Komaromy	Arizona Publics Service Company

Index to Questions, Comments, and Responses

Question

1. The drafting team welcomes comments all aspects of the Regional Variance. The scope of the project does not allow for changes to the body of the underlying standard.

1. Response Summary

Summary Consideration:	See summary in the preamble of this document.		
Commenter / Comment			**Response**
Tacoma Power			M.E.A.17 – Revise reference to E.A.18.1 and E.A.18.2 to E.A.17.1 and E.A.17.2
The drafting team appreciates Tacoma's continued involvement in the standards development process. Corrections to the references were made.			
APS			APS is supportive of the changes being recommended by the SDT, including the deletion of the requirement E.A.15.
The drafting team appreciates APS's continued involvement in the standards development process.			

Regional Reliability Standards Under Development

Regional Reliability Standards - Under Development				
Standard No.	**Title**	**Regional Status**	**Dates**	**NERC Status**
Western Electricity Coordinating Council (WECC)				
VAR-001-5 (Revisions to WECC Variance)	Voltage and Reactive Control	Standard Under Development	6/22/18 - 8/6/18	Info **(1)** VAR-001-5 Clean **(2)** | Redline **(3)** Unofficial Comment Form (Word) **(4)** Submit Comments Comment Received **(5)** Consideration of Comments **(6)**

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Regional Reliability Standards Announcement

VAR-001-5 | WECC Variance

Comment Period Open through August 6, 2018

Now Available

Western Electricity Coordinating Council (WECC) requested that NERC post **VAR-001-5 - Voltage and Reactive Control** for industry review and comment in accordance with the NERC Rules of Procedure.

Commenting

Use the electronic form to submit comments. If you experience any difficulties in using the electronic form, contact Nasheema Santos. The form must be submitted by **8 p.m. Eastern, Monday, August 6, 2018.** An unofficial Word version of the comment form is posted on the Regional Reliability Standards Under Development page**.**

Commenting

Use the Standards Balloting and Commenting System (SBS) to submit comments. If you experience any difficulties using the electronic form, contact Nasheema Santos. The form must be submitted by **8 p.m. Eastern, Monday, August 6, 2018.** An unofficial Word version of the comment form is posted on the Regional Reliability Standards Under Development page.

Regional Reliability Standards Development Process

Section 300 of NERC's Rules of Procedures of the Electric Reliability Organization governs the regional reliability standards development process.

Background

WECC requested that NERC post **VAR-001-5 - Voltage and Reactive Control** for industry review and comment in accordance with the NERC Rules of Procedure.

The drafting team made the following changes:

- In E.A.14 "Area" was corrected to "area".
- E.A.15 and associated elements were eliminated because the reliability-related task required in E.A.15 is contained as a lesser included task of VAR-002-4.1 Generator Operation for Maintaining Network Voltage Schedules, Requirement R2, Part 2.3.
- Measures were updated and relocated matching current NERC conventions, and "shall" was replaced with "will".
- Typographical errors in VSL Table for E.A.17 were corrected.

- The format and numbering were updated.

The standard was posted for comment twice, the most recent period being from December 22, 2017 – January 22, 2018, and the comments received can be viewed here.

For more information or assistance, contact Reliability Standards Analyst, Nasheema Santos (via email) or at (404) 446-2564.

North American Electric Reliability Corporation
3353 Peachtree Rd.NE
Suite 600, North Tower
Atlanta, GA 30326
404-446-2560 | www.nerc.com

A. Introduction

1. Title: Voltage and Reactive Control

2. Number: VAR-001-5

3. Purpose: To ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in Real-time to protect equipment and the reliable operation of the Interconnection.

4. Applicability:

4.1. Transmission Operators

4.2. Generator Operators within the Western Interconnection (for the WECC Variance)

5. Effective Date:

5.1. The standard shall become effective on the first day of the first calendar quarter after the date that the standard is approved by an applicable governmental authority or as otherwise provided for in a jurisdiction where approval by an applicable governmental authority is required for a standard to go into effect. Where approval by an applicable governmental authority is not required, the standard shall become effective on the first day of the first calendar quarter after the date the standard is adopted by the NERC Board of Trustees or as otherwise provided for in that jurisdiction.

B. Requirements and Measures

R1. Each Transmission Operator shall specify a system voltage schedule (which is either a range or a target value with an associated tolerance band) as part of its plan to operate within System Operating Limits and Interconnection Reliability Operating Limits. *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

1.1. Each Transmission Operator shall provide a copy of the voltage schedules (which is either a range or a target value with an associated tolerance band) to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request.

M1. The Transmission Operator shall have evidence that it specified system voltage schedules using either a range or a target value with an associated tolerance band.

For part 1.1, the Transmission Operator shall have evidence that the voltage schedules (which is either a range or a target value with an associated tolerance band) were provided to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request. Evidence may include, but is not limited to, emails, website postings, and meeting minutes.

R2. Each Transmission Operator shall schedule sufficient reactive resources to regulate voltage levels under normal and Contingency conditions. Transmission Operators can provide sufficient reactive resources through various means including, but not limited to, reactive generation scheduling, transmission line and reactive resource switching, and using controllable load. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M2. Each Transmission Operator shall have evidence of scheduling sufficient reactive resources based on their assessments of the system. For the operations planning time horizon, Transmission Operators shall have evidence of assessments used as the basis for how resources were scheduled.

R3. Each Transmission Operator shall operate or direct the Real-time operation of devices to regulate transmission voltage and reactive flow as necessary. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M3. Each Transmission Operator shall have evidence that actions were taken to operate capacitive and inductive resources as necessary in Real-time. This may include, but is not limited to, instructions to Generator Operators to: 1) provide additional voltage support; 2) bring resources on-line; or 3) make manual adjustments.

R4. Each Transmission Operator shall specify the criteria that will exempt generators: 1) from following a voltage or Reactive Power schedule, 2) from having its automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any associated notifications. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

4.1 If a Transmission Operator determines that a generator has satisfied the exemption criteria, it shall notify the associated Generator Operator.

M4. Each Transmission Operator shall have evidence of the documented criteria for generator exemptions.

For part 4.1, the Transmission Operator shall also have evidence to show that, for each generator in its area that is exempt: 1) from following a voltage or Reactive Power schedule, 2) from having its

automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any notifications, the associated Generator Operator was notified of this exemption.

R5. Each Transmission Operator shall specify a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) at either the high voltage side or low voltage side of the generator step-up transformer at the Transmission Operator's discretion. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

5.1. The Transmission Operator shall provide the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the associated Generator Operator and direct the Generator Operator to comply with the schedule in automatic voltage control mode (the AVR is in service and controlling voltage).

5.2. The Transmission Operator shall provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

5.3. The Transmission Operator shall provide the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the Generator Operator within 30 days of receiving a request.

M5. The Transmission Operator shall have evidence of a documented voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

For part 5.1, the Transmission Operator shall have evidence it provided a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the applicable Generator Operators, and that the Generator Operator was directed to comply with the schedule in automatic voltage control mode, unless exempted.

For part 5.2, the Transmission Operator shall have evidence it provided notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band). For part 5.3, the Transmission Operator shall have evidence it provided the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) within 30 days of receiving a request by a Generator Operator.

R6. After consultation with the Generator Owner regarding necessary step-up transformer tap changes and the implementation schedule, the Transmission Operator shall provide documentation to the Generator Owner specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M6. The Transmission Operator shall have evidence that it provided documentation to the Generator Owner when a change was needed to a generating unit's step-up transformer tap in accordance with the requirement and that it consulted with the Generator Owner.

C. Compliance

1. Compliance Monitoring Process:

1.1. Compliance Enforcement Authority:

As defined in the NERC Rules of Procedure, "Compliance Enforcement Authority" refers to NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.

1.2. Evidence Retention:

The following evidence retention periods identify the period of time a registered entity is required to retain specific evidence to demonstrate compliance. For instances in which the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask the registered entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The Transmission Operator shall retain evidence for Measures M1 through M6 for 12 months. The Compliance Monitor shall retain any audit data for three years.

1.3. Compliance Monitoring and Assessment Processes:

"Compliance Monitoring and Assessment Processes" 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.

1.4. Additional Compliance Information:

None

Table of Compliance Elements

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	**Operations Planning**	**High**	N/A	N/A	N/A	The Transmission Operator does not specify a system voltage schedule (which is either a range or a target value with an associated tolerance band).
R2	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an SOL.	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an IROL.
R3	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an SOL.	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an IROL.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R4	**Operations Planning**	**Lower**	N/A	N/A	The Transmission Operator has exemption criteria and notified the Generator Operator, but the Transmission Operator does not have evidence of the notification to the Generator Operator.	The Transmission Operator does not have exemption criteria.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R5	**Operations Planning**	**Medium**	N/A	The Transmission Operator does not provide the criteria for voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) after 30 days of a request.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to all Generator Operators.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to any Generator Operators. Or The Transmission Operator does not provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R6	**Operations Planning**	**Lower**	The Transmission Operator does not provide either the technical justification or timeframe for changing generator step-up tap settings.	N/A	N/A	The Transmission Operator does not provide the technical justification and the timeframe for changing generator step-up tap settings.

D. Regional Variances

The following Interconnection-wide variance shall be applicable in the Western Electricity Coordinating Council (WECC) and replaces, in their entirety, Requirements R4 and R5. Please note that Requirement R4 is deleted and R5 is replaced with the following requirements.

Requirements and Measures

E.A.13 Each Transmission Operator shall issue any one of the following types of voltage schedules to the Generator Operators for each of their generation resources that are on-line and part of the Bulk Electric System within the Transmission Operator Area: *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- A voltage set point with a voltage tolerance band and a specified period.
- An initial volt-ampere reactive output or initial power factor output with a voltage tolerance band for a specified period that the Generator Operator uses to establish a generator bus voltage set point.
- A voltage band for a specified period.

M.E.A.13 Each Transmission Operator will have evidence that it provided the voltage schedules to the Generator Operator, as required in E.A.13. Evidence may include, but is not limited to, dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule including set points, tolerance bands, and specified periods as required in Requirement E.A.13.

E.A.14 Each Transmission Operator shall provide one of the following voltage schedule reference points for each generation resource in its area to the Generator Operator. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- The generator terminals.
- The high side of the generator step-up transformer.
- The point of interconnection.
- A location designated by mutual agreement between the Transmission Operator and Generator Operator.

M.E.A.14 The Transmission Operator will have evidence that it provided one of the voltage schedule reference points for each generation resource in its area to the Generator Operator, as required in E.A.14. Evidence may include, but is not limited to dated letters, e-mail, or other documentation that contains notification to the Generator Operator of the voltage schedule reference point for each generation resource.

E.A.15 Each Generator Operator shall provide its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals within 30 calendar days of request by its Transmission Operator. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.15 The Generator Operator will have evidence that within 30 calendar days of request by its Transmission Operator it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals, as required in E.A.15. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

E.A.16 Each Transmission Operator shall provide to the Generator Operator, within 30 calendar days of a request for data by the Generator Operator, its transmission equipment data and operating data that supports development of the voltage set point conversion methodology. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.16 The Transmission Operator will have evidence that within 30 calendar days of request by its Generator Operator it provided data to support development of the voltage set point conversion methodology, as required in E.A.16. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

E.A.17 Each Generator Operator shall meet the following control loop specifications if the Generator Operator uses control loops external to the automatic voltage regulators (AVR) to manage Mvar loading: *[Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]*

E.A.17.1 Each control loop's design incorporates the AVR's automatic voltage controlled response to voltage deviations during System Disturbances.

E.A.17.2. Each control loop is only used by mutual agreement between the Generator Operator and the Transmission Operator affected by the control loop.

M.E.A.17 If the Generator Operator uses outside control loops to manage Mvar loading, the Generator Operator will have evidence that it met the control loop specifications in sub-parts E.A.17.1 through E.A.17.2, as required in E.A.17 and its sub-parts. Evidence may include, but is not limited to, design specifications with identified agreed-upon control loops, system reports, or other dated documentation.

Violation Severity Levels

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.13	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to at least one generation resource but less than or equal to 5% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 5% but less than or equal to 10% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 10% but less than or equal to 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.
E.A.14	The Transmission Operator did not provide a voltage schedule reference point for at least one but less than or equal to 5% of the generation resources in the Transmission Operator area.	The Transmission Operator did not provide a voltage schedule reference point for more than 5% but less than or equal to 10% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not a voltage schedule reference point for more than 10% but less than or equal to 15% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not provide a voltage schedule reference point for more than 15% of the generation resources in the Transmission Operator Area.

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.15	The Generator Operator provided its voltage set point conversion methodology greater than 30 days but less than or equal to 60 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Transmission Operator.	The Generator Operator did not provide its voltage set point conversion methodology within 120 days of a request by the Transmission Operator.
E.A.16	The Transmission Operator provided its data to support development of the voltage set point conversion methodology than 30 days but less than or equal to 60 days of a request by the Generator Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Generator. Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Generator. Operator.	The Transmission Operator did not provide its data to support development of the voltage set point conversion methodology within 120 days of a request by the Generator Operator.
E.A.17	N/A	The Generator Operator did not meet the control loop specifications in E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in E.A.17.1 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in E.A.17.1 through E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.

E. Interpretations

None

F. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New
1	August 2, 2006	BOT Adoption	Revised
1	June 18, 2007	FERC approved Version 1 of the standard.	Revised
1	July 3, 2007	Added “Generator Owners” and “Generator Operators” to Applicability section.	Errata
1	August 23, 2007	Removed “Generator Owners” and “Generator Operators” to Applicability section.	Errata
2	August 5, 2010	Adopted by NERC Board of Trustees; Modified to address Order No. 693 Directives contained in paragraphs 1858 and 1879.	Revised
2	January 10, 2011	FERC issued letter order approving the addition of LSEs and Controllable Load to the standard.	Revised
3	May 9, 2012	Adopted by NERC Board of Trustees; Modified to add a WECC region variance	Revised
3	June 20, 2013	FERC issued order approving VAR-001-3	Revised
3	November 21, 2013	R5 and associated elements approved by FERC for retirement as part of the Paragraph 81 project (Project 2013-02)	Revised
4	February 6, 2014	Adopted by NERC Board of Trustees	Revised
4	August 1, 2014	FERC issued letter order issued approving VAR-001-4	
4.1	August 25, 2015	Added “or” to Requirement R5, 5.3 to read: schedules or Reactive Power	Errata
4.1	November 13, 2015	FERC Letter Order approved errata to VAR-001-4.1. Docket RD15-6-000	Errata
4.2	June 14, 2017	Project 2016-EPR-02 errata recommendations	Errata
4.2	August 10, 2017	Adopted by NERC Board of Trustees	Errata
4.2	September 26, 2017	FERC Letter Order issued approving VAR-001-4.2 Docket No. RD17-7-000.	
5	TBD	Approved by NERC Board of Trustees	1) In E.A.14 “Area” was changed to “area.”; 2) E.A.15

			and associated elements were eliminated; 3) Measures were updated and relocated matching current conventions, replacing “shall” with “will”; 4) typographical errors in VSL Table for E.A.17 were corrected; 5) format was updated.

Guidelines and Technical Basis

For technical basis for each requirement, please review the rationale provided for each requirement.

Rationale:

During development of this standard, text boxes were embedded within the standard to explain the rationale for various parts of the standard. Upon BOT approval, the text from the rationale text boxes was moved to this section.

Rationale for R1:

Paragraph 1868 of Order No. 693 requires NERC to add more "detailed and definitive requirements on “established limits” and “sufficient reactive resources”, and identify acceptable margins (i.e. voltage and/or reactive power margins)." Since Order No. 693 was issued, however, several FAC and TOP standards have become enforceable to add more requirements around voltage limits. More specifically, FAC-011 and FAC-014 require that System Operating Limits (SOLs) and reliability margins are established. The NERC Glossary definition of SOLs includes both: 1) voltage stability ratings (Applicable pre- and post-Contingency Voltage Stability) and 2*)* System Voltage Limits (Applicable pre- and post-Contingency voltage limits). Therefore, for reliability reasons Requirement R1 now requires a Transmission Operator (TOP) to set voltage or Reactive Power schedules with associated tolerance bands. Further, since neighboring areas can affect each other greatly, each TOP must also provide a copy of these schedules to its Reliability Coordinator (RC) and adjacent TOP upon request.

Rationale for R2:

Paragraph 1875 from Order No. 693 directed NERC to include requirements to run voltage stability analysis periodically, using online techniques where commercially available and offline tools when online tools are not available. This standard does not explicitly require the periodic voltage stability analysis because such analysis would be performed pursuant to the SOL methodology developed under the FAC standards. TOP standards also require the TOP to operate within SOLs and Interconnection Reliability Operating Limits (IROL). The VAR standard drafting team (SDT) and industry participants also concluded that the best models and tools are the ones that have been proven and the standard should not add a requirement for a responsible entity to purchase new online simulations tools. Thus, the VAR SDT simplified the requirements to ensuring sufficient reactive resources are online or scheduled. Controllable load is specifically included to answer FERC's directive in Order No. 693 at Paragraph 1879.

Rationale for R3:

Similar to Requirement R2, the VAR SDT determined that for reliability purposes, the TOP must ensure sufficient voltage support is provided in Real-time in order to operate within an SOL.

Rationale for R4:

The VAR SDT received significant feedback on instances when a TOP would need the flexibility for defining exemptions for generators. These exemptions can be tailored as the TOP deems necessary for the specific

area's needs. The goal of this requirement is to provide a TOP the ability to exempt a Generator Operator (GOP) from: 1) a voltage or Reactive Power schedule, 2) a setting on the AVR, or 3) any VAR-002 notifications based on the TOP's criteria. Feedback from the industry detailed many system events that would require these types of exemptions which included, but are not limited to: 1) maintenance during shoulder months, 2) scenarios where two units are located within close proximity and both cannot be in voltage control mode, and 3) large system voltage swings where it would harm reliability if all GOP were to notify their respective TOP of deviations at one time. Also, in an effort to improve the requirement, the sub-requirements containing an exemption list were removed from the currently enforceable standard because this created more compliance issues with regard to how often the list would be updated and maintained.

Rationale for R5:

The new requirement provides transparency regarding the criteria used by the TOP to establish the voltage schedule. This requirement also provides a vehicle for the TOP to use appropriate granularity when setting notification requirements for deviation from the voltage or Reactive Power schedule. Additionally, this requirement provides clarity regarding a "tolerance band" as specified in the voltage schedule and the control dead-band in the generator's excitation system.

Voltage schedule tolerances are the bandwidth that accompanies the voltage target in a voltage schedule, should reflect the anticipated fluctuation in voltage at the Generation Operator's facility during normal operations, and be based on the TOP's assessment of N-1 and credible N-2 system contingencies. The voltage schedule's bandwidth should not be confused with the control dead-band that is programmed into a Generation Operator's automatic voltage regulator's control system, which should be adjusting the AVR prior to reaching either end of the voltage schedule's bandwidth.

Rationale for R6:

Although tap settings are first established prior to interconnection, this requirement could not be deleted because no other standard addresses when a tap setting must be adjusted. If the tap setting is not properly set, then the amount of VARs produced by a unit can be affected.

A. Introduction

1. **Title:** Voltage and Reactive Control

2. **Number:** VAR-001-~~4.2~~5

3. **Purpose:** To ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in Real-time to protect equipment and the reliable operation of the Interconnection.

4. **Applicability:**

   4.1. Transmission Operators

   4.2. Generator Operators within the Western Interconnection (for the WECC Variance)

5. **Effective Date:**

   5.1. The standard shall become effective on the first day of the first calendar quarter after the date that the standard is approved by an applicable governmental authority or as otherwise provided for in a jurisdiction where approval by an applicable governmental authority is required for a standard to go into effect. Where approval by an applicable governmental authority is not required, the standard shall become effective on the first day of the first calendar quarter after the date the standard is adopted by the NERC Board of Trustees or as otherwise provided for in that jurisdiction.

B. Requirements and Measures

R1. Each Transmission Operator shall specify a system voltage schedule (which is either a range or a target value with an associated tolerance band) as part of its plan to operate within System Operating Limits and Interconnection Reliability Operating Limits. *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

1.1. Each Transmission Operator shall provide a copy of the voltage schedules (which is either a range or a target value with an associated tolerance band) to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request.

M1. The Transmission Operator shall have evidence that it specified system voltage schedules using either a range or a target value with an associated tolerance band.

For part 1.1, the Transmission Operator shall have evidence that the voltage schedules (which is either a range or a target value with an associated tolerance band) were provided to its Reliability Coordinator and adjacent Transmission Operators within 30 calendar days of a request. Evidence may include, but is not limited to, emails, website postings, and meeting minutes.

R2. Each Transmission Operator shall schedule sufficient reactive resources to regulate voltage levels under normal and Contingency conditions. Transmission Operators can provide sufficient reactive resources through various means including, but not limited to, reactive generation scheduling, transmission line and reactive resource switching, and using controllable load. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M2. Each Transmission Operator shall have evidence of scheduling sufficient reactive resources based on their assessments of the system. For the operations planning time horizon, Transmission Operators shall have evidence of assessments used as the basis for how resources were scheduled.

R3. Each Transmission Operator shall operate or direct the Real-time operation of devices to regulate transmission voltage and reactive flow as necessary. *[Violation Risk Factor: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

M3. Each Transmission Operator shall have evidence that actions were taken to operate capacitive and inductive resources as necessary in Real-time. This may include, but is not limited to, instructions to Generator Operators to: 1) provide additional voltage support; 2) bring resources on-line; or 3) make manual adjustments.

R4. Each Transmission Operator shall specify the criteria that will exempt generators: 1) from following a voltage or Reactive Power schedule, 2) from having its automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any associated notifications. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

4.1 If a Transmission Operator determines that a generator has satisfied the exemption criteria, it shall notify the associated Generator Operator.

M4. Each Transmission Operator shall have evidence of the documented criteria for generator exemptions.

For part 4.1, the Transmission Operator shall also have evidence to show that, for each generator in its area that is exempt: 1) from following a voltage or Reactive Power schedule, 2) from having its

automatic voltage regulator (AVR) in service or from being in voltage control mode, or 3) from having to make any notifications, the associated Generator Operator was notified of this exemption.

R5. Each Transmission Operator shall specify a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) at either the high voltage side or low voltage side of the generator step-up transformer at the Transmission Operator's discretion. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

5.1. The Transmission Operator shall provide the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the associated Generator Operator and direct the Generator Operator to comply with the schedule in automatic voltage control mode (the AVR is in service and controlling voltage).

5.2. The Transmission Operator shall provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

5.3. The Transmission Operator shall provide the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the Generator Operator within 30 days of receiving a request.

M5. The Transmission Operator shall have evidence of a documented voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

For part 5.1, the Transmission Operator shall have evidence it provided a voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) to the applicable Generator Operators, and that the Generator Operator was directed to comply with the schedule in automatic voltage control mode, unless exempted.

For part 5.2, the Transmission Operator shall have evidence it provided notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band). For part 5.3, the Transmission Operator shall have evidence it provided the criteria used to develop voltage schedules or Reactive Power schedule (which is either a range or a target value with an associated tolerance band) within 30 days of receiving a request by a Generator Operator.

R6. After consultation with the Generator Owner regarding necessary step-up transformer tap changes and the implementation schedule, the Transmission Operator shall provide documentation to the Generator Owner specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M6. The Transmission Operator shall have evidence that it provided documentation to the Generator Owner when a change was needed to a generating unit's step-up transformer tap in accordance with the requirement and that it consulted with the Generator Owner.

C. Compliance

1. Compliance Monitoring Process:

1.1. Compliance Enforcement Authority:

As defined in the NERC Rules of Procedure, "Compliance Enforcement Authority" refers to NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.

1.2. Evidence Retention:

The following evidence retention periods identify the period of time a registered entity is required to retain specific evidence to demonstrate compliance. For instances in which the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask the registered entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The Transmission Operator shall retain evidence for Measures M1 through M6 for 12 months. The Compliance Monitor shall retain any audit data for three years.

1.3. Compliance Monitoring and Assessment Processes:

"Compliance Monitoring and Assessment Processes" 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.

1.4. Additional Compliance Information:

None

Table of Compliance Elements

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	**Operations Planning**	**High**	N/A	N/A	N/A	The Transmission Operator does not specify a system voltage schedule (which is either a range or a target value with an associated tolerance band).
R2	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an SOL.	The Transmission Operator does not schedule sufficient reactive resources as necessary to avoid violating an IROL.
R3	**Real-time Operations, Same-day Operations, and Operations Planning**	**High**	N/A	N/A	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an SOL.	The Transmission Operator does not operate or direct any real-time operation of devices as necessary to avoid violating an IROL.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R4	**Operations Planning**	**Lower**	N/A	N/A	The Transmission Operator has exemption criteria and notified the Generator Operator, but the Transmission Operator does not have evidence of the notification to the Generator Operator.	The Transmission Operator does not have exemption criteria.

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R5	**Operations Planning**	**Medium**	N/A	The Transmission Operator does not provide the criteria for voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) after 30 days of a request.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to all Generator Operators.	The Transmission Operator does not provide voltage or Reactive Power schedules (which is either a range or a target value with an associated tolerance band) to any Generator Operators. Or The Transmission Operator does not provide the Generator Operator with the notification requirements for deviations from the voltage or Reactive Power schedule (which is either a range or a target value with an associated tolerance band).

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R6	**Operations Planning**	**Lower**	The Transmission Operator does not provide either the technical justification or timeframe for changing generator step-up tap settings.	N/A	N/A	The Transmission Operator does not provide the technical justification and the timeframe for changing generator step-up tap settings.

D. Regional Variances

The following Interconnection-wide variance shall be applicable in the Western Electricity Coordinating Council (WECC) and replaces, in their entirety, Requirements R4 and R5. Please note that Requirement R4 is deleted and R5 is replaced with the following requirements.

Requirements and Measures

E.A.13 Each Transmission Operator shall issue any one of the following types of voltage schedules to the Generator Operators for each of their generation resources that are on-line and part of the Bulk Electric System within the Transmission Operator Area: *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- A voltage set point with a voltage tolerance band and a specified period.
- An initial volt-ampere reactive output or initial power factor output with a voltage tolerance band for a specified period that the Generator Operator uses to establish a generator bus voltage set point.
- A voltage band for a specified period.

M.E.A.13 Each Transmission Operator will have evidence that it provided the voltage schedules to the Generator Operator, as required in E.A.13. Evidence may include, but is not limited to, dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule including set points, tolerance bands, and specified periods as required in Requirement E.A.13.

E.A.14 Each Transmission Operator shall provide one of the following voltage schedule reference points for each generation resource in its ~~Area~~area to the Generator Operator. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*

- The generator terminals.
- The high side of the generator step-up transformer.
- The point of interconnection.
- A location designated by mutual agreement between the Transmission Operator and Generator Operator.

~~**E.A.15** Each Generator Operator shall convert each voltage schedule specified in Requirement E.A.13 into the voltage set point for the generator excitation system. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning and Same-day Operations]*~~

M.E.A.14 The Transmission Operator will have evidence that it provided one of the voltage schedule reference points for each generation resource in its area to the Generator Operator, as required in E.A.14. Evidence may include, but is not limited to dated letters, e-mail, or other documentation that contains notification to the Generator Operator of the voltage schedule reference point for each generation resource.

~~**E.A.16**~~**E.A.15** Each Generator Operator shall provide its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals within 30 calendar days of request by its Transmission Operator. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.15 The Generator Operator will have evidence that within 30 calendar days of request by its Transmission Operator it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals, as required in E.A.15. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

~~E.A.17~~E.A.16 Each Transmission Operator shall provide to the Generator Operator, within 30 calendar days of a request for data by the Generator Operator, its transmission equipment data and operating data that supports development of the voltage set point conversion methodology. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

M.E.A.16 The Transmission Operator will have evidence that within 30 calendar days of request by its Generator Operator it provided data to support development of the voltage set point conversion methodology, as required in E.A.16. Evidence may include, but is not limited to, dated reports, spreadsheets, or other documentation.

~~E.A.18~~E.A.17 Each Generator Operator shall meet the following control loop specifications if the Generator Operator uses control loops external to the automatic voltage regulators (AVR) to manage Mvar loading: *[Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]*

E.A.17.1 Each control loop's design incorporates the AVR's automatic voltage controlled response to voltage deviations during System Disturbances.

E.A.17.2. Each control loop is only used by mutual agreement between the Generator Operator and the Transmission Operator affected by the control loop.

~~**Measures**[1]~~

~~**M.E.A.13** Each Transmission Operator shall have and provide upon request, evidence that it provided the voltage schedules to the Generator Operator. Dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule including set points, tolerance bands, and specified periods as required in Requirement E.A.13 are acceptable as evidence.~~

~~**M.E.A.14** The Transmission Operator shall have and provide upon request, evidence that it provided one of the voltage schedule reference points in Requirement E.A.14 for each generation resource in its Area to the Generator Operator. Dated letters, e-mail, or other documentation that contains notification to the Generator Operator of the voltage schedule reference point for each generation resource are acceptable as evidence.~~

~~**M.E.A.15** Each Generator Operator shall have and provide upon request, evidence that it converted a voltage schedule as described in Requirement E.A.13 into a voltage set point for the AVR. Dated spreadsheets, logs, reports, or other documentation are acceptable as evidence.~~

~~**M.E.A.16** The Generator Operator shall have and provide upon request, evidence that within 30 calendar days of request by its Transmission Operator it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals. Dated reports, spreadsheets, or other documentation are acceptable as evidence.~~

~~[1] The number for each measure corresponds with the number for each requirement, i.e. M.E.A.13 means the measure for Requirement E.A.13.~~

~~**M.E.A.17** The Transmission Operator shall have and provide upon request, evidence that within 30 calendar days of request by its Generator Operator it provided data to support development of the voltage set point conversion methodology. Dated reports, spreadsheets, or other documentation are acceptable as evidence.~~

~~**M.E.A.18**~~**M.E.A.17** If the Generator Operator uses outside control loops to manage Mvar loading, the Generator Operator ~~shall~~will have ~~and provide upon request,~~ evidence that it met the control loop specifications in sub-parts E.A.~~18~~17.1 through E.A.~~18~~17.2~~. Design~~, as required in E.A.17 and its sub-parts. Evidence may include, but is not limited to, design specifications with identified agreed-upon control loops, system reports, or other dated documentation~~. are acceptable as evidence.~~

Violation Severity Levels

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.13	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to at least one generation resource but less than or equal to 5% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 5% but less than or equal to 10% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 10% but less than or equal to 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.	For the specified period, the Transmission Operator did not issue one of the voltage schedules listed in E.A.13 to more than 15% of the generation resources that are on-line and part of the BES in the Transmission Operator Area.
E.A.14	The Transmission Operator did not provide a voltage schedule reference point for at least one but less than or equal to 5% of the generation resources in the Transmission Operator area.	The Transmission Operator did not provide a voltage schedule reference point for more than 5% but less than or equal to 10% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not a voltage schedule reference point for more than 10% but less than or equal to 15% of the generation resources in the Transmission Operator Area.	The Transmission Operator did not provide a voltage schedule reference point for more than 15% of the generation resources in the Transmission Operator Area.
~~**E.A.15**~~	~~The Generator Operator failed to convert at least one voltage schedule in Requirement E.A.13 into the voltage set point for the AVR for less than 25% of the voltage schedules.~~	~~The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 25% or more but less than 50% of the voltage schedules.~~	~~The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 50% or more but less than 75% of the voltage schedules.~~	~~The Generator Operator failed to convert the voltage schedules in Requirement E.A.13 into the voltage set point for the AVR for 75% or more of the voltage schedules.~~

E #	Lower VSL	Moderate VSL	High VSL	Severe VSL
E.A.~~16~~15	The Generator Operator provided its voltage set point conversion methodology greater than 30 days but less than or equal to 60 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Transmission Operator.	The Generator Operator provided its voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Transmission Operator.	The Generator Operator did not provide its voltage set point conversion methodology within 120 days of a request by the Transmission Operator.
E.A.~~17~~16	The Transmission Operator provided its data to support development of the voltage set point conversion methodology than 30 days but less than or equal to 60 days of a request by the Generator Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 60 days but less than or equal to 90 days of a request by the Generator. Operator.	The Transmission Operator provided its data to support development of the voltage set point conversion methodology greater than 90 days but less than or equal to 120 days of a request by the Generator. Operator.	The Transmission Operator did not provide its data to support development of the voltage set point conversion methodology within 120 days of a request by the Generator Operator.
E.A.~~18~~17	N/A	The Generator Operator did not meet the control loop specifications in ~~EA18~~E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in ~~EA18~~E.A.17.1 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.	The Generator Operator did not meet the control loop specifications in ~~EA18~~E.A.17.1 through ~~EA18~~E.A.17.2 when the Generator Operator uses control loop external to the AVR to manage Mvar loading.

E. Interpretations

None

F. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New
1	August 2, 2006	BOT Adoption	Revised
1	June 18, 2007	FERC approved Version 1 of the standard.	Revised
1	July 3, 2007	Added "Generator Owners" and "Generator Operators" to Applicability section.	Errata
1	August 23, 2007	Removed "Generator Owners" and "Generator Operators" to Applicability section.	Errata
2	August 5, 2010	Adopted by NERC Board of Trustees; Modified to address Order No. 693 Directives contained in paragraphs 1858 and 1879.	Revised
2	January~~,~~ 10, 2011	FERC issued letter order approving the addition of LSEs and Controllable Load to the standard.	Revised
3	May 9, 2012	Adopted by NERC Board of Trustees; Modified to add a WECC region variance	Revised
3	June 20, 2013	FERC issued order approving VAR-001-3	Revised
3	November 21, 2013	R5 and associated elements approved by FERC for retirement as part of the Paragraph 81 project (Project 2013-02)	Revised
4	February 6, 2014	Adopted by NERC Board of Trustees	Revised
4	August 1, 2014	FERC issued letter order issued approving VAR-001-4	
4.1	August 25, 2015	Added "or" to Requirement R5, 5.3 to read: schedules or Reactive Power	Errata
4.1	November 13, 2015	FERC Letter Order approved errata to VAR-001-4.1. Docket RD15-6-000	Errata
4.2	June 14, 2017	Project 2016-EPR-02 errata recommendations	Errata
4.2	August 10, 2017	Adopted by NERC Board of Trustees	Errata
4.2	September 26, 2017	FERC Letter Order issued approving VAR-001-4.2 Docket No. RD17-7-000.	

5	TBD	Approved by NERC Board of Trustees	1) In E.A.14 "Area" was changed to "area."; 2) E.A.15 and associated elements were eliminated; 3) Measures were updated and relocated matching current conventions, replacing "shall" with "will"; 4) typographical errors in VSL Table for E.A.17 were corrected; 5) format was updated.

Guidelines and Technical Basis

For technical basis for each requirement, please review the rationale provided for each requirement.

Rationale:

During development of this standard, text boxes were embedded within the standard to explain the rationale for various parts of the standard. Upon BOT approval, the text from the rationale text boxes was moved to this section.

Rationale for R1:

Paragraph 1868 of Order No. 693 requires NERC to add more "detailed and definitive requirements on “established limits” and “sufficient reactive resources”, and identify acceptable margins (i.e. voltage and/or reactive power margins)." Since Order No. 693 was issued, however, several FAC and TOP standards have become enforceable to add more requirements around voltage limits. More specifically, FAC-011 and FAC-014 require that System Operating Limits (SOLs) and reliability margins are established. The NERC Glossary definition of SOLs includes both: 1) voltage stability ratings (Applicable pre- and post-Contingency Voltage Stability) and 2*)* System Voltage Limits (Applicable pre- and post-Contingency voltage limits). Therefore, for reliability reasons Requirement R1 now requires a Transmission Operator (TOP) to set voltage or Reactive Power schedules with associated tolerance bands. Further, since neighboring areas can affect each other greatly, each TOP must also provide a copy of these schedules to its Reliability Coordinator (RC) and adjacent TOP upon request.

Rationale for R2:

Paragraph 1875 from Order No. 693 directed NERC to include requirements to run voltage stability analysis periodically, using online techniques where commercially available and offline tools when online tools are not available. This standard does not explicitly require the periodic voltage stability analysis because such analysis would be performed pursuant to the SOL methodology developed under the FAC standards. TOP standards also require the TOP to operate within SOLs and Interconnection Reliability Operating Limits (IROL). The VAR standard drafting team (SDT) and industry participants also concluded that the best models and tools are the ones that have been proven and the standard should not add a requirement for a responsible entity to purchase new online simulations tools. Thus, the VAR SDT simplified the requirements to ensuring sufficient reactive resources are online or scheduled. Controllable load is specifically included to answer FERC's directive in Order No. 693 at Paragraph 1879.

Rationale for R3:

Similar to Requirement R2, the VAR SDT determined that for reliability purposes, the TOP must ensure sufficient voltage support is provided in Real-time in order to operate within an SOL.

Rationale for R4:

The VAR SDT received significant feedback on instances when a TOP would need the flexibility for defining exemptions for generators. These exemptions can be tailored as the TOP deems necessary for the specific

area's needs. The goal of this requirement is to provide a TOP the ability to exempt a Generator Operator (GOP) from: 1) a voltage or Reactive Power schedule, 2) a setting on the AVR, or 3) any VAR-002 notifications based on the TOP's criteria. Feedback from the industry detailed many system events that would require these types of exemptions which included, but are not limited to: 1) maintenance during shoulder months, 2) scenarios where two units are located within close proximity and both cannot be in voltage control mode, and 3) large system voltage swings where it would harm reliability if all GOP were to notify their respective TOP of deviations at one time. Also, in an effort to improve the requirement, the sub-requirements containing an exemption list were removed from the currently enforceable standard because this created more compliance issues with regard to how often the list would be updated and maintained.

Rationale for R5:

The new requirement provides transparency regarding the criteria used by the TOP to establish the voltage schedule. This requirement also provides a vehicle for the TOP to use appropriate granularity when setting notification requirements for deviation from the voltage or Reactive Power schedule. Additionally, this requirement provides clarity regarding a "tolerance band" as specified in the voltage schedule and the control dead-band in the generator's excitation system.

Voltage schedule tolerances are the bandwidth that accompanies the voltage target in a voltage schedule, should reflect the anticipated fluctuation in voltage at the Generation Operator's facility during normal operations, and be based on the TOP's assessment of N-1 and credible N-2 system contingencies. The voltage schedule's bandwidth should not be confused with the control dead-band that is programmed into a Generation Operator's automatic voltage regulator's control system, which should be adjusting the AVR prior to reaching either end of the voltage schedule's bandwidth.

Rationale for R6:

Although tap settings are first established prior to interconnection, this requirement could not be deleted because no other standard addresses when a tap setting must be adjusted. If the tap setting is not properly set, then the amount of VARs produced by a unit can be affected.

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Unofficial Comment Form

Regional Reliability Standard
VAR-001-5 | WECC Variance

DO NOT use this form for submitting comments. Use the electronic form to submit comments on Regional Reliability Standard **VAR-001-5 Voltage and Reactive Control (WECC Variance)**. Comments must be submitted by **8 p.m. Eastern, Monday, August 6, 2018.**

The Regional Reliability Standards Under Development page contains documents and information about this project. If you have questions, contact Nasheema Santos (via email).

Background Information

Western Electricity Coordinating Council (WECC) requested that NERC post the revised WECC Variance in VAR-001-5 Voltage and Reactive Control for industry review and comment in accordance with the NERC Rules of Procedure.

The drafting team made the following changes:

- In E.A.14 "Area" was corrected to "area".
- E.A.15 and associated elements were eliminated because the reliability-related task required in E.A.15 is contained as a lesser included task of VAR-002-4.1 Generator Operation for Maintaining Network Voltage Schedules, Requirement R2, Part 2.3.
- Measures were updated and relocated matching current NERC conventions; the term "shall" was replaced with "will".
- Typographical errors in VSL Table for E.A.17 were corrected.
- The format and numbering were updated.

The standard was posted twice for comment, most recently form December 22, 2017 – January 22, 2018, and the comments received can be viewed here.

Any variance from a NERC Reliability Standard Requirement that is proposed to apply to responsible entities within a Regional Entity organized on an Interconnection-wide basis shall be considered an Interconnection-wide Variance and shall be developed through that Regional Entity's NERC-approved regional Reliability Standards development procedure. While an Interconnection-wide Variance may be developed through the associated Regional Entity standards development process, Regional Entities are encouraged to work collaboratively with existing continent-wide drafting team to reduce potential conflicts between the two efforts. An Interconnection-wide Variance from a NERC Reliability Standard that is determined by NERC to be just, reasonable, and not unduly discriminatory or preferential, and in the public interest, and consistent with other applicable standards of governmental authorities shall be

made part of the associated NERC Reliability Standard. NERC shall rebuttably presume that an Interconnection-wide Variance from a NERC Reliability Standard that is developed, in accordance with a standards development procedure approved by NERC, by a Regional Entity organized on an Interconnection-wide basis, is just, reasonable, and not unduly discriminatory or preferential, and in the public interest.

NERC is publicly noticing and requesting comment on the proposed WECC Variance. Comments shall be permitted only on the following criteria (technical aspects of the Variance are vetted through the regional standards development process):

Unfair or Closed Process – The Variance was not developed in a fair and open process that provided an opportunity for all interested parties to participate. Although a NERC-approved regional reliability standards development procedure shall be presumed to be fair and open, objections could be raised regarding the implementation of the procedure.

Adverse Reliability or Commercial Impact on Other Interconnections – The Variance would have a significant adverse impact on reliability or commerce in other interconnections.

Deficient Standard – The Variance fails to provide a level of reliability of the bulk power system such that the rVariance would be likely to cause a serious and substantial threat to public health, safety, welfare, or national security.

Adverse Impact on Competitive Markets within the Interconnection – The rVariance would create a serious and substantial burden on competitive markets within the interconnection that is not necessary for reliability.

Questions

1. **Do you agree the proposed standard/variance was developed in a fair and open process, using the associated Regional Reliability Standards Development Procedure?**

   ☐ Yes
   ☐ No
   Comments:

2. **Does the proposed standard/variance pose an adverse impact to reliability or commerce in a neighboring region or interconnection?**

   ☐ Yes
   ☐ No
   Comments:

3. **Does the proposed standard/variance pose a serious and substantial threat to public health, safety, welfare, or national security?**

   ☐ Yes
   ☐ No
   Comments:

4. **Does the proposed standard/variance pose a serious and substantial burden on competitive markets within the interconnection that is not necessary for reliability?**

   ☐ Yes
   ☐ No
   Comments:

5. **Does the proposed regional reliability standard/variance meet at least one of the following criteria?**

   - **The proposed standard/variance has more specific criteria for the same requirements covered in a continent-wide standard.**
   - **The proposed standard/variance has requirements that are not included in the corresponding continent-wide reliability standard.**
   - **The proposed regional difference is necessitated by a physical difference in the bulk power system.**

   ☐ Yes
   ☐ No
   Comments:

Comment Report

Project Name:	Regional Reliability Standard | VAR-001-5 (WECC Variance)
Comment Period Start Date:	6/22/2018
Comment Period End Date:	8/6/2018
Associated Ballots:	

There were 8 sets of responses, including comments from approximately 8 different people from approximately 7 companies representing 4 of the Industry Segments as shown in the table on the following pages.

*Note: Comment report was corrected following the posting of the Consideration of Comments.

Questions

1. Do you agree the proposed standard/variance was developed in a fair and open process, using the associated Regional Reliability Standards Development Procedure?

2. Does the proposed standard/variance pose an adverse impact to reliability or commerce in a neighboring region or interconnection?

3. Does the proposed standard/variance pose a serious and substantial threat to public health, safety, welfare, or national security?

4. Does the proposed standard/variance pose a serious and substantial burden on competitive markets within the interconnection that is not necessary for reliability?

5. Does the proposed regional reliability standard/variance meet at least one of the following criteria?

- **The proposed standard/variance has more specific criteria for the same requirements covered in a continent-wide standard.**
- **The proposed standard/variance has requirements that are not included in the corresponding continent-wide reliability standard.**
- **The proposed regional difference is necessitated by a physical difference in the bulk power system.**

Organization Name	Name	Segment(s)	Region	Group Name	Group Member Name	Group Member Organization	Group Member Segment(s)	Group Member Region

1. Do you agree the proposed standard/variance was developed in a fair and open process, using the associated Regional Reliability Standards Development Procedure?	
Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	Yes
Document Name	
Comment	
None	
Likes 0	
Dislikes 0	
Response	
Marty Hostler - Northern California Power Agency - 5,6	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	

Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	Yes
Document Name	
Comment	
Likes 0	

Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	

2. Does the proposed standard/variance pose an adverse impact to reliability or commerce in a neighboring region or interconnection?	
Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	No
Document Name	
Comment	
None	
Likes 0	
Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	
Answer	No

Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Marty Hostler - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	

Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	

3. Does the proposed standard/variance pose a serious and substantial threat to public health, safety, welfare, or national security?	
Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	No
Document Name	
Comment	
None	
Likes 0	
Dislikes 0	
Response	
Marty Hostler - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	
Answer	No

Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	

Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	

4. Does the proposed standard/variance pose a serious and substantial burden on competitive markets within the interconnection that is not necessary for reliability?	
Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	No
Document Name	
Comment	
None	
Likes 0	
Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	

Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Marty Hostler - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	

Dislikes 0	
Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	

5. Does the proposed regional reliability standard/variance meet at least one of the following criteria?

- **The proposed standard/variance has more specific criteria for the same requirements covered in a continent-wide standard.**
- **The proposed standard/variance has requirements that are not included in the corresponding continent-wide reliability standard.**
- **The proposed regional difference is necessitated by a physical difference in the bulk power system.**

Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	Yes
Document Name	
Comment	

- **The proposed standard/variance has more specific criteria for the same requirements covered in a continent-wide standard.**

Yes the variance has more specific criteria for voltage schedules and generator reference points.

- **The proposed standard/variance has requirements that are not included in the corresponding continent-wide reliability standard.**

Yes in that the variance doesn't have allowance for exemption criteria and includes transmission operator requirements for submitting data.

Likes 0	
Dislikes 0	
Response	

Marty Hostler - Northern California Power Agency - 5,6	
Answer	Yes
Document Name	
Comment	

Likes 0	
Dislikes 0	
Response	

Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	Yes
Document Name	
Comment	

Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	

Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Consideration of Comments

Project Name:	Regional Reliability Standard | VAR-001-5 (WECC Variance)
Comment Period Start Date:	6/22/2018
Comment Period End Date:	8/6/2018
Associated Ballots:	

There were 8 sets of responses, including comments from approximately 8 different people from approximately 7 companies representing 4 of the Industry Segments as shown in the table on the following pages.

All comments submitted can be reviewed in their original format on the project page.

If you feel that your comment has been overlooked, please let us know immediately. Our goal is to give every comment serious consideration in this process. If you feel there has been an error or omission, you can contact the Senior Director of Standards and Education, Howard Gugel (via email) or at (404) 446-9693.

If you have any questions regarding the WECC Reliability Standards Development Procedures or this project, please contact WECC Consultant, W. Shannon Black at (503) 307-5782.

Questions

1. Do you agree the proposed standard/variance was developed in a fair and open process, using the associated Regional Reliability Standa Development Procedure?

2. Does the proposed standard/variance pose an adverse impact to reliability or commerce in a neighboring region or interconnection?

3. Does the proposed standard/variance pose a serious and substantial threat to public health, safety, welfare, or national security?

4. Does the proposed standard/variance pose a serious and substantial burden on competitive markets within the interconnection that is not necessary for reliability?

5. Does the proposed regional reliability standard/variance meet at least one of the following criteria?

- The proposed standard/variance has more specific criteria for the same requirements covered in a continent-wide standard.
- The proposed standard/variance has requirements that are not included in the corresponding continent-wide reliability standard.
- The proposed regional difference is necessitated by a physical difference in the bulk power system.

WECC Summary Response:

The WECC-0128 VAR-001-5, Voltage and Reactive Control – WECC Regional Variance Drafting Team would like to thank everyone that participated in the standards development process. The value of each standard is enriched as the depth of participation increases.

1. Do you agree the proposed standard/variance was developed in a fair and open process, using the associated Regional Reliability Standards Development Procedure?	
Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	Yes
Document Name	
Comment	
None	
Likes 0	
Dislikes 0	
Response	
Marty Hostler - Northern California Power Agency - 5,6	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	

Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	
Answer	Yes
Document Name	
Comment	

Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	

Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	

2. Does the proposed standard/variance pose an adverse impact to reliability or commerce in a neighboring region or interconnection?	
Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	No
Document Name	
Comment	
None	
Likes 0	
Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	No

Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	

Response	
Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Marty Hostler - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	
Answer	No
Document Name	

Comment	
Likes 0	
Dislikes 0	

Response
In the absence of additional information from Black Hills, the project drafting team is unable to provide additional insights. WECC does note that the ballot passed at 100% at WECC.

3. Does the proposed standard/variance pose a serious and substantial threat to public health, safety, welfare, or national security?	
Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	No
Document Name	
Comment	
None	
Likes 0	
Dislikes 0	
Response	
Marty Hostler - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	No

Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	

Response	
Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	
Answer	No
Document Name	

Comment	
Likes 0	
Dislikes 0	

Response
In the absence of additional information from Black Hills, the project drafting team is unable to provide additional insights. WECC does note that the ballot passed at 100% at WECC.

4. Does the proposed standard/variance pose a serious and substantial burden on competitive markets within the interconnection that is not necessary for reliability?	
Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	No
Document Name	
Comment	
None	
Likes 0	
Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	No

Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	

Response	
Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Marty Hostler - Northern California Power Agency - 5,6	
Answer	No
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	
Answer	No
Document Name	

Comment	
Likes 0	
Dislikes 0	

Response
In the absence of additional information from Black Hills, the project drafting team is unable to provide additional insights. WECC does note that the ballot passed at 100% at WECC.

5. Does the proposed regional reliability standard/variance meet at least one of the following criteria?

- **The proposed standard/variance has more specific criteria for the same requirements covered in a continent-wide standard.**
- **The proposed standard/variance has requirements that are not included in the corresponding continent-wide reliability standard.**
- **The proposed regional difference is necessitated by a physical difference in the bulk power system.**

Aaron Cavanaugh - Bonneville Power Administration - 1,3,5,6 - WECC	
Answer	Yes
Document Name	
Comment	

- **The proposed standard/variance has more specific criteria for the same requirements covered in a continent-wide standard.**

Yes the variance has more specific criteria for voltage schedules and generator reference points.

- **The proposed standard/variance has requirements that are not included in the corresponding continent-wide reliability standard.**

Yes in that the variance doesn't have allowance for exemption criteria and includes transmission operator requirements for submitting data.

Likes 0	
Dislikes 0	
Response	

Marty Hostler - Northern California Power Agency - 5,6	
Answer	Yes
Document Name	
Comment	

Likes 0	
Dislikes 0	
Response	
Dennis Sismaet - Northern California Power Agency - 5,6	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Richard Jackson - U.S. Bureau of Reclamation - 1,5	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Maryanne Darling-Reich - Black Hills Corporation - 1,3,5,6 - WECC	

Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Glen Farmer - Avista - Avista Corporation - 1,3,5	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	
Kevin Salsbury - Berkshire Hathaway - NV Energy - 5	
Answer	Yes
Document Name	
Comment	
Likes 0	

Dislikes 0	
Response	
Kelsi Rigby - APS - Arizona Public Service Co. - 1,3,5,6	
Answer	Yes
Document Name	
Comment	
Likes 0	
Dislikes 0	
Response	

Exhibit C

Standard Drafting Team Roster for Project WECC-0128, VAR-001-4.1, Voltage and Reactive Control – WECC Regional Variance, Five-Year Review

Drafting Team Roster

WECC-0128
VAR-001-4.2 Voltage and Reactive Control
Regional Variance Five-year Review

Below please find a biographical snapshot for the members of the WECC-0128 VAR-001-4.2, Voltage and Reactive Control Five-year Review Drafting Team.

Name	Background
Alex Chua Pacific Gas and Electric	• Electrical Engineer with 15 years of experience working in the transmission, distribution, and generation aspects of the company • The last four years have been focused on regulatory compliance for Generator Owner and Operators • Review and negotiate voltage schedules with transmission operators • Work with automation group on Automatic Voltage Regulator (AVR)/Power System Stabilizer (PSS) controls and generating notifications for status changes to our Transmission Operator (TOP) and Balancing Authority (BA) • Former WECC and NERC drafting team member
Shane Kronebusch L&S Electric	Mr. Kronebusch is the Lead Electrical Engineer and Subject Matter Expert for excitation systems, protection and hydro governors and unit controls for L&S Electric, Inc. He has over 27 years of experience in the utility industry. Prior to joining L&S Electric in 2010, Mr. Kronebusch's responsibilities included coordinating and preforming WECC testing of generation assets as an employee of BC Hydro Generation Engineering and Maintenance Services. He was responsible for commissioning both new and rehabilitated units ranging in size from 30MW to 500MW. Mr. Kronebusch was tasked as a subject matter expert for exciters and governors as part of the BC Hydro Equipment Health Rating program. Mr. Kronebusch first became involved with WECC testing after the July and August 1996 system disturbances that initiated the testing program. He has been a member of the WECC Control Work Group since 2006.
Mario Kiresich Southern California	Mr. Kiresich has been in the utility industry since 1997 and has held several positions: Call Center as a Customer Service Specialist, Groundman, Substation

Edison Grid Control	Electrician, Transmission Dispatcher, Procedure Administrator, Trainer, and Substation Supervisor. • 10 years in BES operations as Dispatcher, Compliance, Procedures, and Training • Transmission Operator and NERC Certified at the Reliability Coordinator (RC) level He has his Bachelor of Science in political science with a political communications emphasis and a minor in criminal justice from Chapman University. NERC Member as follows: 1) 2015-12 EOP-PRT (Observer), 2) 2017-03 FAC PRT (Member), 3) 2013-03 GMDSDT (Observer), 4) GMDTF (Member), 5) 2015-08 EOP SDT (Observer), and 6) 2015-07 COM-001 SDT (Vice Chair).
Alvin Pinkston	Mr. Pinkston has over 37 years of experience in the utility industry and has held several positions: Power Plant Manager for coal- and gas-fired power plants, Transmission / Distribution Control Center Manager, Trainer, Substation Relay Electrician, Instrument Electrician Technician. • 17 years nuclear plant operations as Work Control Supervisor, Electrical Maintenance Technician, and Supervisor • Transmission Operator and Control Center Manager and NERC Certified at the RC level • Five years as Transmission Operator Trainer • Subject Matter Expert for transmission operations and generation systems
Greg Anderson	Mr. Anderson is the Subject Matter Expert for generation and excitation systems for the Southern California Edison Company. He has over 33 years of experience in the utility industry, with responsibilities for coordinating WECC testing of generation assets. He has been a WECC participant since 1997 and a member of the Control Work Group since 2003.
Baj Agrawal Arizona Public Service Company	Mr. Agrawal has over 40 years of transmission and generation experience. He has been involved in generator excitation systems, power system stabilizers, and subsynchronous resonance. Mr. Agrawal has served on several NERC and WECC drafting teams including MOD-26, 27. He is currently serving on the NERC TPL-005-1 (Single Point of Failure)

	Drafting Team, the WECC Modeling Validation Work Group, the North American Transmission Forum, and the Modeling Practices Work Group Core team. Mr. Agrawal holds his Ph.D. in education.
James Wong	Mr. Wong joined the Bonneville Power Administration in 2009 where he serves as an operations planning engineer. He is experienced in thermal, voltage, and transient stability power system security studies for real-time and planning operations. Mr. Wong's work provides system operators real-time and planned procedures to enhance situational awareness for the dynamic conditions on the grid. As a graduate of Gonzaga University, Mr. Wong holds a Bachelor of Science in electrical engineering. Prior to working in the utility industry, Mr. Wong served his country in the United States Air Force and continues to serve in the Washington Air National Guard.[1]

[1] Although Mr. Wong participated in the drafting of the document, his assignment to the team did not take place until the November 15, 2017, WECC Standards Committee meeting.