

## Standard Development Timeline

*This section is maintained by the drafting team during the development of the standard and will be removed when the standard becomes effective.*

### Development Steps Completed

1. SAR posted for comment on July XX, 2013

### Description of Current Draft

This draft standard is concluding informal development and will move to formal development when authorized by the Standards Committee.

| Anticipated Actions                         | Anticipated Date |
|---|------------------|
| SAR Authorized by the Standards Committee   | July             |
| 45 Day SAR Comment and Initial Ballot Open  | July             |
| Nomination Period Opens                     | July             |
| Standard Drafting Team Appointed            | July             |
| Initial Comment and Initial Ballot Closes   | August           |
| Final Ballot Opens                          | October          |
| Final Ballot Closes                         | October          |
| BOT Adoption                                | November         |
| Filing to Applicable Regulatory Authorities | December         |

## Effective Dates

In those jurisdictions where regulatory approval is required, this standard shall become effective on the first day of the first calendar quarter after applicable regulatory approval or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities. In those jurisdictions where no regulatory approval is required, this standard shall become effective on the first day of the first calendar quarter after Board of Trustees approval.

## Version History

| Version | Date       | Action  | Change Tracking |
|---------|------------|---|-----------------|
| 1       | 5/1/2006   | Added "(R2)" to the end of levels on non-compliance 2.1.2, 2.2.2, 2.3.2, and 2.4.3.   | July 5, 2006    |
| 1a      | 12/19/2007 | Added Appendix 1 – Interpretation of R1 and R2 approved by BOT on August 1, 2007  | Revised         |
| 1a      | 1/16/2007  | In Section A.2., Added "a" to end of standard number.<br>Section F: added "1."; and added date.   | <b>Errata</b>   |
| 1.1a    | 10/29/2008 | BOT adopted errata changes; updated version number to "1.1a"  | <b>Errata</b>   |
| 1.1b    | 3/3/2009   | Added Appendix 2 – Interpretation of VAR-002-1.1a approved by BOT on February 10, 2009  | <b>Revised</b>  |
| 2b      | 4/16/2013  | Revised R1 to address an Interpretation Request. Also added previously approved VRFs, Time Horizons and VSLs. Revised R2 to address consistency issue with VAR-001-2, R4. FERC Order issued approving VAR-002-2b. | Revised         |

## **Definitions of Terms Used in the Standard**

*None.*

## Introduction

1. **Title:**           **Generator Operation for Maintaining Network Voltage Schedules**
2. **Number:**    VAR-002-3
3. **Purpose:** To ensure generators provide reactive and voltage control necessary to ensure voltage levels, reactive flows, and reactive resources are maintained within applicable Facility Ratings to protect equipment and the reliable operation of the Interconnection.
4. **Applicability:**
  - 4.1. Generator Operator
  - 4.2. Generator Owner

## Requirements and Measures

**Rationale for R1:** This requirement has been maintained due to the importance of running a unit with its automatic voltage regulator (AVR) in service and in voltage controlling mode. The measure has been updated include some of the evidence that can be used for Compliance purposes.

- R1.** The Generator Operator shall operate each generator connected to the interconnected transmission system in the automatic voltage control mode (with its automatic voltage regulator (AVR) in service and controlling voltage) unless the Generator Operator has notified the Transmission Operator of one of the following: [Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]
- That the generator is being operated in start-up<sup>1</sup> or shutdown<sup>2</sup> mode pursuant to a Real-time communication or a procedure that was previously provided to the Transmission Operator; or
  - That the generator is not being operated in the automatic voltage control mode for a reason other than start-up or shutdown.
- M1.** The Generator Operator shall have evidence to show that it notified its associated Transmission Operator any time it failed to operate a generator in the automatic voltage control mode as specified in Requirement 1. If a generator is being started up or shut down with the automatic voltage control off and no notification of the automatic voltage regulator status is made to the Transmission Operator, the Generator Operator will have evidence that it notified the Transmission Operator of its procedure for placing the unit into automatic voltage control mode. Such evidence must include, but is not limited to, dated evidence of transmittal of the procedure such as an electronic message or a transmittal letter with the procedure included or attached.

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<sup>1</sup> Start-up is deemed to have ended when the generator is ramped up to its minimum continuously sustainable load and the generator is prepared for continuous operation.

<sup>2</sup> Shutdown is deemed to begin when the generator is ramped down to its minimum continuously sustainable load and the generator is prepared to go offline.

**Rationale for R2:**

R2 details how a Generator Operator (GOP) operates the system to maintain a voltage schedule and when the GOP is expected to notify the Transmission Operator (TOP). Sub-requirement 2.1 provides guidance on a non-compliance window in the event a unit is deviating from schedule, and the GOP must notify the TOP if it is unable to return to schedule. Thus, the non-compliance window allows for notifications when a unit is unable to provide additional VAR support (e.g., when hitting an operational limit) or when the unit is too small to raise voltage. In both instances, the TOP may then provide some type of temporary exemption as outlined in VAR-001.

- R2.** Unless exempted by the Transmission Operator, each Generator Operator shall maintain the generator voltage or Reactive Power schedule<sup>3</sup> (within applicable Facility Ratings<sup>4</sup>) as directed by the Transmission Operator. [Violation Risk Factor: Medium] [Time Horizon: Real-time Operations]
- 2.1.** If a GOP drifts out of schedule, each Generator Operator shall notify its associated Transmission Operator within 15 minutes when both of the following conditions are met: 1) the GOP is operating outside of the prescribed voltage or Reactive Power schedule tolerance band<sup>5</sup> for 15 minutes; and 2) the GOP is no longer able to return to its voltage or Reactive Power schedule.
- 2.2.** When a generator's automatic voltage regulator is out-of-service, the Generator Operator shall use an alternative method to control the generator reactive output to meet the voltage or Reactive Power schedule directed by the Transmission Operator.
- 2.3.** When directed to modify voltage, the Generator Operator shall comply or provide an explanation of why the schedule cannot be met.
- M2.** Generator Operators will still make all attempts to operate within the tolerance bands provided by the TOP, but natural drifting may occur. In instances where there is an event occurring to pull a unit out of the tolerance band, the Generator Operator will not be held in non-compliance with this requirement if the sub-requirements 2.1, 2.2, and 2.3 are met. In order to identify when a unit is deviating from its schedule, GOPs will monitor voltage based on existing equipment at its facility. Therefore, GOPs have the option to operate on a voltage schedule on either the high-side or convert the high-side schedule to a low-side schedule at the GOP's discretion. For units that monitor on the low-side/terminal voltage, Generator Operators shall provide evidence of the method of conversion from the high-side schedule to low-side monitoring. For sub-requirement 2.1, most units will not be able to return to schedule due to a limiting factor. Such limiting factors may include, but are not limited to: 1) terminal voltage, 2) bus voltage, 3) equipment temperature,

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<sup>3</sup> The voltage or Reactive Power schedule is a target value communicated by the Transmission Operator to the Generator Operator establishing a tolerance band within which the target value is to be maintained during a specified period.

<sup>4</sup> When a Generator is operating in manual control, reactive power capability may change based on stability considerations and this may lead to a change in the associated Facility Ratings.

<sup>5</sup> GOPs monitor and control voltage based on their equipment limitations. GOPs will monitor their voltage or Reactive Power schedule tolerance bands either at the high-side or low-side/terminal voltage.

4) transformer, 5) auxiliary equipment, 6) Volts/Hz limits, and 7) excitation or regulator limits. GOP shall have evidence to show compliance with requirement R2 by providing 1) Communications with the TOP when the Generator Operator was operating outside of the prescribed voltage or Reactive Power schedule tolerance band for 30 minutes or less (the 30 minutes allow for 15 minutes to call and 15 minutes to be outside of the tolerance band) AND Generator Operator is no longer able to return to its voltage or Reactive Power schedule; 2) Generator Operator implemented an alternative method to control reactive output when the AVR was out-of-service or unavailable; 3) compliance with directive to modify voltage or a notification that the directive could not be met. Evidence may include, but is not limited to Generator Operator logs, SCADA data, phone logs, and any other alarming notifications that would alert the Transmission Operator that both conditions were met. Timing for Requirement R2.1 is crucial, and Generator Operators are expected to begin timing an event as soon as the unit is operating outside of the tolerance band. Further, voltage documentation during a system event maybe requested by an auditor to show measures were taken to bring the unit back into schedule.

**Rationale for R3:**

This requirement has been modified to reduce the number of violations for when an AVR goes out-of-service and then comes back in-service. Fifteen (15) minutes have been built into the requirement to allow a Generator Operator time to resolve an issue before having to notify the Transmission Operator of a status or capability change. The requirement has also been amended to remove the sub-requirement to provide an estimate for the expected duration of the status change. The 15-minute window should resolve most issues, and further trouble-shooting will probably be required if the status change is unresolved within 15 minutes.

- R3.** Each Generator Operator shall notify its associated Transmission Operator of a status or capability change on any generator Reactive Power resource, including the status of each automatic voltage regulator and power system stabilizer and the expected duration of the change in status or capability within 30 minutes of the change. If the status has been restored within the first 15 minutes of such change, then there is no need to call the TOP. [*Violation Risk Factor: Medium*] [*Time Horizon: Real-time Operations*]
- M3.** The Generator Operator shall have evidence it notified its associated Transmission Operator within 30 minutes of any of the changes identified in Requirement 3. If the status has been restored within the first 15 minutes, no call is necessary; therefore, if a status on Reactive Power resource has changed, and that change lasts greater than 15 minutes, the GOP must notify its associated TOP within 30 minutes of when the change first occurred.

**Rationale for R4:**

This requirement and corresponding measure language has been maintained due to the importance of having accurate tap settings. If the tap setting is not properly set, then the amount of VARs produced by a unit can be affected.

- R4.** The Generator Owner shall provide the following to its associated Transmission Operator and Transmission Planner within 30 calendar days of a request. *[Violation Risk Factor: Lower] [Time Horizon: Real-time Operations]*
  - 4.1.** For generator step-up transformers and auxiliary transformers with primary voltages equal to or greater than the generator terminal voltage:
    - 4.1.1.** Tap settings.
    - 4.1.2.** Available fixed tap ranges.
    - 4.1.3.** Impedance data.
- M4.** The Generator Owner shall have evidence it provided its associated Transmission Operator and Transmission Planner with information on its step-up transformers and auxiliary transformers as required in Requirements 4.1.1 through 4.1.3.

**Rationale for R5:**

This requirement and corresponding measure language has been maintained due to the importance of having accurate tap settings. If the tap setting is not properly set, then the amount of VARs produced by a unit can be affected.

- R5.** After consultation with the Transmission Operator regarding necessary step-up transformer tap changes, the Generator Owner shall ensure that transformer tap positions are changed according to the specifications provided by the Transmission Operator, unless such action would violate safety, an equipment rating, a regulatory requirement, or a statutory requirement. *[Violation Risk Factor: Lower] [Time Horizon: Real-time Operations]*.
  - 5.1.** If the Generator Operator can't comply with the Transmission Operator's specifications, the Generator Operator shall notify the Transmission Operator and shall provide the technical justification.
- M5.** The Generator Owner shall have evidence that its step-up transformer taps were modified per the Transmission Operator's documentation as identified in Requirement 5. The Generator Operator shall have evidence that it notified its associated Transmission Operator when it couldn't comply

with the Transmission Operator's step-up transformer tap specifications as identified in Requirement 5.1.

## Compliance

### 1. Compliance Monitoring Process:

#### 1.1. Compliance Enforcement Authority:

As defined in the NERC Rules of Procedure, “Compliance Enforcement Authority” means 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 an entity is required to retain specific evidence to demonstrate compliance. For instances where the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask an entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The Generator Owner shall keep its latest version of documentation on its step-up and auxiliary transformers. The Generator Operator shall maintain all other evidence for the current and previous calendar year.

The Compliance Monitor shall retain any audit data for three years.

#### 1.3. Compliance Monitoring and Assessment Processes:

As defined in the NERC Rules of Procedure, “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   |
| <b>R1</b> | <b>Real-time Operations</b> | <b>Medium</b> | N/A   | N/A  | N/A  | The responsible entity did not operate each generator in the automatic voltage control mode and failed to notify the Transmission Operator as identified in R1.  |
| <b>R2</b> | <b>Real-time Operations</b> | <b>Medium</b> | N/A   | N/A  | N/A  | The responsible entity did not perform any of the sub-requirements.  |
| <b>R3</b> | <b>Real-time Operations</b> | <b>Medium</b> | N/A   | N/A  | N/A  | The responsible entity did not make the notification within 30 minutes.  |
| <b>R4</b> | <b>Real-time Operations</b> | <b>Lower</b>  | When directed by the Transmission Operator to maintain the generator voltage or reactive power schedule the Generator Operator failed to meet the directed values for up to and including 45 minutes. | When directed by the Transmission Operator to maintain the generator voltage or reactive power schedule the Generator Operator failed to meet the directed values for more than 45 minutes up to and including 60 minutes.<br><br>OR<br>When a generator's automatic voltage regulator is out of service, the Generator Operator | When directed by the Transmission Operator to maintain the generator voltage or reactive power schedule the Generator Operator failed to meet the directed values for more than 60 minutes up to and including 75 minutes. | When directed by the Transmission Operator to maintain the generator voltage or reactive power schedule the Generator Operator failed to meet the directed values for more than 75 minutes.<br><br>OR<br>When a generator's automatic voltage regulator is out of service, the Generator Operator failed to use an alternative method to control the |

| R #       | Time Horizon                | VRF          | Violation Severity Levels |  |          |   |
|-----------|-----------------------------|--------------|---------------------------|--|----------|---|
|           |                             |              | Lower VSL                 | Moderate VSL   | High VSL | Severe VSL  |
|           |                             |              |                           | <p>failed to use an alternative method to control the generator voltage and reactive output to meet the voltage or Reactive Power schedule directed by the Transmission Operator.</p> <p>OR</p> <p>The Generator Operator failed to provide an explanation of why the voltage schedule could not be met.</p> |          | <p>generator voltage and reactive output to meet the voltage or Reactive Power schedule directed by the Transmission Operator and the Generator Operator failed to provide an explanation of why the voltage schedule could not be met.</p> |
| <b>R5</b> | <b>Real-time Operations</b> | <b>Lower</b> | N/A                       | N/A  | N/A      | <p>The GOP failed to perform the tap changes, and the GOP did not provide technical justification for why it cannot comply with the TOP directive</p>   |

**Regional Variances**

None.

**Interpretations**

None.

**Associated Documents**

None.

## **Guidelines and Technical Basis**

For technical basis for each requirement, please see the VAR White Paper for further technical information.