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. Draft 1 of SAR posted for comment August 17 – September 17, 2009.
2. Draft 2 of SAR posted for comment February 24 – March 26, 2010.
3. SC authorized moving the SAR forward to standard development May 13, 2010.
4. SC appoints SDT July 14, 2010.

Description of Current Draft

The VRPC SDT is requesting comments on the draft standard under a 30-day informal comment period.

Anticipated Actions	Anticipated Date
30-day Formal Comment Period	June 2011
45-day Formal Comment Period with Parallel Initial Ballot	
30-day Formal Comment Period with Parallel Successive Ballot	
Recirculation ballot	
BOT adoption	

Effective Dates

Version History

Version	Date	Action	Change Tracking

Definitions of Terms Used in Standard

This section includes all newly defined or revised terms used in the proposed standard. Terms already defined in the Reliability Standards Glossary of Terms are not repeated here. New or revised definitions listed below become approved when the proposed standard is approved. When the standard becomes effective, these defined terms will be removed from the individual standard and added to the Glossary.

Term: definition

When this standard has received ballot approval, the text boxes will be moved to the Application Guidelines Section of the Standard.

A. Introduction

1. Title: Generator Operation for Maintaining Network Voltage Requirements

2. Number: VAR-002-2

3. Purpose:

4. Applicability:

4.1. Functional Entities:

4.1.1 Generator Operator

4.1.2 Generator Owner

4.2. Facilities:

4.2.1 This Standard is applicable to all generators that are part of the BES whenever they are synchronized to the BES, stable, and ready for load.

5. Background:

In August 2008 the Transmission Issues Subcommittee formed the Reactive Support/Control Subteam (RSCS) to develop a report to address the fundamental issues of Standards Committee Project 2008-01. The report *Reactive Support & Control Whitepaper* dated 05/18/2009 identifies what technical requirements are needed to determine the reactive resources required under different system. The report provides the reliability concepts and foundation for the Standards Authorization Request (SAR) and subsequent work by the Standards Drafting Team (SDT) and includes the directives contained in FERC Order 693. In August of 2008 NERC established a SAR Team to investigate revisions to VAR Reliability Standards and address directives in FERC order 693. Review and modifications to the existing VAR standards considered the Transmission Issues Subcommittee's "Reactive Support & Control Whitepaper" dated 05/18/2009. The review addressed the technical requirements needed to determine the reactive resources required under each system state. The Voltage and Reactive Planning and Control (VRPC) SDT also relied on the *Electric Reliability Organization Compliance Analysis Report Reliability Standard VAR-002, August 2010*, which characterized compliance issues with the existing standards and listed recommendations addressing the violations.

The VRPC SDT determined that controllable load would be addressed in VAR-003. In addition the standard recognizes the control of static VAR resources is a function of the TOP and would be addressed in VAR-001. This standard is limited to dynamic VAR resources which are controlled by the GOP. The VRPC SDT recognized the transient nature equipment status that may be encountered in the operation of voltage regulators and made allowances for those conditions without impact to the reliability of the Bulk Electric System.

The requirements in this standard are based on the concept that the voltage level needed to ensure stable bulk electric system operation was determined through planning studies. These results are provided to the TOP. The TOP utilizes the results to operate static reactive resources under its control and to develop a voltage requirement for use by the GOP. **The documented voltage *requirement* provided by the TOP for each facility shall include the ~~desired operating mode,~~ type of schedule (voltage, reactive output, or power factor), voltage, reactive output, or power factor set point, ~~voltage, reactive or power factor~~the setpoint tolerance band, and duration. The voltage *requirement* generally encompasses either long term instructions or short term operational changes to the long term instructions. ~~[Concern about compliance evidence.]~~** The voltage *requirement* is used by the GOP in its control of the generation resources. The GOP provides information to the TOP concerning the capability of its equipment to control voltage through the modeling standards (MOD-010 and MOD-012). The TOP uses the information to develop a voltage *requirement* for the GOP. The function of the GOP is to ensure that the requirement provided by the TOP can be implemented and to convey information if it cannot. The GOP also monitors the function of its facilities to ensure that the facility is operating in accordance with the requirement. If there is deviation in the function of the equipment, the GOP is provided a set amount of time to resolve the function before notifying the TOP. The GOP notifies the TOP of changes in the operating condition of equipment used in support of the voltage requirement. This standard encourages interaction between the GOP and TOP to ensure situational awareness of voltage support.

The VRPC SDT developed a framework for the requirements based on the new results based standard development process. The VRPC SDT developed a Need statement and Goals that supported the Need. This was followed by the development of objectives of how to implement the goal. The requirements in the standard were developed from this outline which is listed below.

Summary of Concepts

Need: To maintain system voltage

- Goal: Awareness of established voltage requirements
  - Objective: Voltage Requirement defined at the control point for each facility
- Goal: Define method to meet the requirement
  - Objective: Operate equipment within limits to meet voltage requirements
- Goal: Monitor performance of equipment for deviations
  - Objective: Awareness of performance to requirements
  - Objective: Awareness of status of equipment operating mode
  - Objective: Awareness of equipment limits
  - Objective: Awareness of equipment availability
- Goal: Develop response process to performance deviations
  - Objective: Report status of any changes to equipment capability and availability
  - Objective: Action plan in response to changes

B. Requirements and Measures

R1. Each Generator Operator shall develop documentation of its voltage control equipment, ~~and~~ methodology, and existing transformer tap settings at its facilities. *[Violation Risk Factor:] [Time Horizon:]*

1.1. Each Generator Operator shall provide the above documentation to the TOP, TP, or PC within 30 days upon receipt of a request.

1.2. Each Generator Operator shall provide the above documentation to the TOP, TP, or PC within 30 days after any changes become operational.

M1. Each Generator Operator will have a dated document with elements specified in R1.

M1.1 Each Generator Operator will have documentation, such as dated paper or electronic notice showing transmittal of the specified document to the TOP, TP, or PC within 30 days of receipt of the request.

M1.2 Each Generator Operator will have documentation, such as dated paper or electronic notice showing transmittal of the specified document to the TOP, TP, or PC within 30 days of change becoming operational.

Rationale for R1: This requirement is for the GOP to define how it is going to ~~dooperate~~ accomplish voltage control at its facility. This information will later be passed to the TOP, TP, or PC so they know how the GOP will perform and can factor that into the design or plan for voltage *requirements.* This requirement is for the formal documentation of the existing equipment, methodology and status of voltage control at the facility. The real time notification of changes is covered in R~~6~~7. MOD-012 modeling and simulation data may not cover the specific information between the voltage control point and

R2. Each Generator Operator shall have a process to implement~~convert~~ the TOP provided target (voltage or reactive) ~~voltage *requirement* provided by the TOP to the voltage~~ at the AVR voltage control point for each generating unit. ~~facility~~. *[Violation Risk Factor:] [Time Horizon:]*

Rationale for R2: The GOP converts the voltage requirement from the point of interconnection to the point where the voltage control occurs. In some cases the voltage requirement is given at the generator operator's control point, then no conversion is needed. Voltage control is accomplished through the use of equipment such as Automatic Voltage Regulators, external control loops, and automatic load tap changers. The GOP has the ability to control voltage at a reference point within the GOP's facility and not necessarily at the point the voltage *requirement* is given to the GOP. The voltage *requirement* provided by the TOP will include the desired operating mode, type of schedule, voltage, reactive output, or power factor set point, voltage, reactive or power factor tolerance band, and duration. The voltage *requirement* can be provided by either an established document or a dispatch instruction. This process may be how the GOP coordinates with the TOP in determining the voltage at the voltage control point.

M2. Each Generator Operator will have documentation of its process to convert the voltage *requirement* in an electronic or hard copy format. The documentation may include calculations, screen shots, operating procedure excerpts or logbook entries.

R4. The Generator Operator shall notify the TOP of any ~~equipment~~ limitations in meeting the established, documented voltage *requirement* within 30 days from receipt. *[Violation Risk Factor:] [Time Horizon:]*

M4. Each Generator Operator will have dated and time stamped documentation of its notification to the TOP of any limitation in meeting the established, documented voltage *requirement* in an electronic or hard copy format. The documentation may include voice recordings, email records, or logbook entries.

Rationale for R4: The GOP looks to see if the established, documented voltage *requirement* can be implemented within the equipment limits and operating parameters in the generation facility. Smaller generators need to determine if they can support the voltage *requirement* without hitting their equipment limits. All generators need to determine if the established voltage *requirement* received from the TOP is reasonable and attainable within the capability of its facilities. This requirement relies on the conversion process used in R2.

R5. The Generator Operator shall notify the TOP of any ~~equipment~~ limitations in meeting any R~~r~~eal-~~-~~time adjustments to the voltage requirement issued by the TOP within 30 minutes of identifying the limitation. *[Violation Risk Factor:] [Time Horizon:]*

Rationale for R5: The GOP looks to see if the real time adjustment voltage *requirement* (such as a dispatch instruction) can be implemented within the equipment limits and operating parameters in the generation facility. Smaller generators need to determine if they can support the real time adjustment to the voltage *requirement* without hitting their equipment limits. All generators need to determine if the adjustments received from the TOP are reasonable and attainable within the capability of its facilities.

M5. Each Generator Operator will have dated and time stamped documentation of its notification to the TOP of any limitation in meeting the real time adjustments to the voltage *requirement* in an electronic or hard copy format. The documentation may include voice recordings, email records, or logbook entries.

R6. Each Generator Operator shall operate each generating unit to meet the voltage *requirement* such that *[Violation Risk Factor:] [Time Horizon:]*:

6.1 The 30 minute clock average of the *requirement* is within the required tolerance band

6.2 Each generator is operated with the automatic voltage control in service and controlling voltage unless the GOP has notified the TOP within 15 minutes of identifying any change lasting longer than 15 minutes in the operating mode of the voltage control equipment, unit reactive capability and availability of its equipment or unless otherwise instructed by the TOP.

6.3 Each generator is operated within equipment limits.

R7. Each GOP shall operate each generator with the power system stabilizer in service unless the GOP has notified~~y~~ the TOP within 15 minutes of identifying any status change in power system stabilizer operation lasting longer than 15 minutes.

~~**R6.** Each Generator Operator shall operate its equipmenteach generating unit or connected to the Bulk Electric System to meet the voltage *requirement* such that: as instructed by the TOP, to meet the voltage *requirement* within equipment limits at the generator terminals using monitoring equipment at locations agreed to between the GOP and TOP. *[Violation Risk Factor:] [Time Horizon:]*~~

~~**6.1** Generator is operated with the automatic voltage controlregulator in service and controlling voltage, or as instructed by the TOP~~

~~**6.2** Generator is operated within equipment limits~~

~~**6.3** Voltage is monitored at locations agreed to between the GOP and TOP.~~

Rationale for R6: The voltage *requirement* includes the operating mode, the voltage, reactive power or power factor set point, and tolerance band. The equipment limits cannot be exceeded by the voltage *requirement.* Generator control is accomplished at the generator terminals. Monitoring of the actual voltage may be accomplished at a location agreed to between the GOP and TOP.

M6. Each Generator Operator will provide data at the monitoring point agreed to between the GOP and TOP using an hourly integration monitoring period for any event with operation outside the voltage *requirements* including date, time, duration, and details of how far outside the voltage *requirements*.

R7. Each Generator Operator shall notify the TOP within 15 minutes of identifying

Rationale for R6 and R7: The 30 minutes is based on the contingency analysis needs and EOP performance requirements. The longest that the TOP would not know of a change would be 30 minutes. The revision is also to eliminate short duration operating mode changes. These changes do not include outages coordinated with the TOP. The term "voltage control equipment" was used to include automatic voltage regulators and external control loops. Status of the power system stabilizer does not include that time when the Power System Stabilizer automatically switches between bypass and normal due to generator operating parameters. Those conditions are defined in MOD-12 and validated in MOD-10.

any change lasting longer than 15 minutes in the operating mode of the voltage control equipment, status of the power system stabilizer, unit reactive capability and availability of its equipment. *[Violation Risk Factor:] [Time Horizon:-]*

M7. Each Generator Operator will have documentation of its notification to the TOP of any change lasting longer than 15 minutes in the operating mode of the voltage control equipment, status of the power system stabilizer, unit reactive capability and availability of its equipment. The documentation may include voice recordings, email records, or logbook entries.

R8. 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:] [Time Horizon:-]*

Rationale for R8: The GO will implement tap change settings within equipment limitations per the TOP's instructions.

M8. The Generator Owner will have evidence that its transformer taps were modified per the TOP's specifications. The GO~~/GOP~~ will have evidence that it notified the TOP when it couldn't comply with the TOP's step up transformer specifications. The documentation may include voice recordings, email records, or logbook entries.

C. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

Regional Entity

1.2. Evidence Retention

Text

1.3. Compliance Monitoring and Assessment Processes:

Compliance Audits

Self-Certifications

Spot Checking

Compliance Violation Investigations

Self-Reporting

Complaints Text

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						
R2						
R3						

D. Regional Variances

None.

E. Interpretations

None.

F. Associated Documents

None.

Guidelines and Technical Basis

The basis used to define the requirements in this draft standard came from the original Goals and Reliability Objectives established by the SDT, as well as consideration of the recommendations in the ~~Develop and include text referencing the~~ ERO Compliance Analysis Report for VAR-002 dated August 2010~~, specifically how recommendations in the report along with Goals and Reliability Objectives established by the SDT were used to define requirements~~.

Requirements R1, R2, and R3 are Competency Based Requirements; the over-arching outcome to be achieved by these requirements is to set forth a clear and concise process for coordination between the GOP and TOP in order to develop voltage requirements that are consistent with the actual operating conditions at the generation site and therefore attainable by the generation. The reliability objective to be met by these requirements is to ensure dynamic reactive resources are operated in support of system voltage requirements.

Rationale for R1: This requirement is for the GOP to define how it is going to ~~dooperate~~accomplish voltage control at its facility. This information will later be passed to the TOP, TP, or PC so they know how the GOP will perform and can factor that into the design or plan for voltage *requirements*. This requirement is for the formal documentation of the existing equipment, methodology and status of voltage control at the facility. The real time notification of changes is covered in R~~6~~7. MOD-012 modeling and simulation data may not cover the specific information between the voltage control point and generator terminals.

Rationale for R2: The GOP converts the voltage requirement from the point of interconnection to the point where the voltage control occurs. In some cases the voltage requirement is given at the generator operator's control point, then no conversion is needed. Voltage control is accomplished through the use of equipment such as Automatic Voltage Regulators, external control loops, and automatic load tap changers. The GOP has the ability to control voltage at a reference point within the GOP's facility and not necessarily at the point the voltage *requirement* is given to the GOP. The voltage *requirement* provided by the TOP will include the desired operating mode, type of schedule, voltage, reactive output, or power factor set point, voltage, reactive or power factor tolerance band, and duration. The voltage *requirement* can be provided by either an established document or a dispatch instruction. This process may be how the GOP coordinates with the TOP in determining the voltage at the voltage control point.

Rationale for R3: The GOP looks to see if the voltage *requirement* can be implemented within the equipment limits and operating parameters in the generation facility. Smaller generators need to determine if they can support the voltage *requirement* without hitting their equipment limits. All generators need to determine if the voltage *requirement* received from the TOP is reasonable and within the capability of its facilities.

Requirements R4 and R5 are Risk Based Requirements, in the event that a facility is unable to reach a requested voltage level, the requirements will ensure the TOP has timely information to aid in decisions to take other actions to support system voltage.

Rationale for R4: The GOP looks to see if the established, documented voltage *requirement* can be implemented within the equipment limits and operating parameters in the generation facility. Smaller generators need to determine if they can support the voltage *requirement* without hitting their equipment limits. All generators need to determine if the established voltage *requirement* received from the TOP is reasonable and attainable within the capability of its facilities. This requirement relies on the conversion process used in R2.

Rationale for R5: The GOP looks to see if the real time adjustment voltage *requirement* (such as a dispatch instruction) can be implemented within the equipment limits and operating parameters in the generation facility. Smaller generators need to determine if they can support the real time adjustment to the voltage *requirement* without hitting their equipment limits. All generators need to determine if the adjustments received from the TOP are reasonable and attainable within the capability of its facilities.

Requirement R6 is a Performance Based Requirement; the reliability objective to be met by this requirement is the Generator Operator must operate their equipment in accordance with agreed upon requirements. Implicit in the requirement is the need for the Generator Operator to monitor its performance to ensure it is meeting the requirements. This can be accomplished through increased situational awareness using well defined alarming, and control room displays. The requirement also states that the GOP and TOP have communicated and coordinated a set of parameters that identifies the location of voltage measurement that is applicable, and the measure sets forth a reference time period over which the voltage measurement will be taken in order to determine that voltage requirements have been met.

Rationale for R6: The voltage requirement includes the operating mode, the voltage, reactive power or power factor set point, and tolerance band. The equipment limits cannot be exceeded by the voltage *requirement.* Generator control is accomplished at the generator terminals. Monitoring of the actual voltage may be accomplished at a location agreed to between the GOP and TOP.

Requirement R7 is a Risk Based Requirement. The requirement ensures the TOP has timely information associated with the status of voltage control equipment at a generation facility. The reliability objective to be met is to develop a process to report status of equipment capability and availability changes, within a specific time period.

Rationale for R7: The 30 minutes is based on the contingency analysis needs and EOP performance requirements. The longest that the TOP would not know of a change would be 30 minutes. The revision is also to eliminate short duration operating mode changes. These changes do not include outages coordinated with the TOP. The term "voltage control equipment" was used to include automatic voltage regulators and external control loops. Status of the power system stabilizer does not include that time when the Power System Stabilizer automatically switches between bypass and normal due to generator operating parameters. Those conditions are defined in MOD-12 and validated in MOD-10.

Requirement R8 is a Performance Based Requirement, the reliability objective to be met by this requirement is the Generator Operator must meet tap position specifications in accordance with the TOP requirements.

Rationale for R8: The GO will implement tap change settings within equipment limitations per the TOP's instructions.