

**Comparison between NERC VAR-001-1a and Alberta VAR-001-AB-1a  
Voltage and Reactive Control**

<b>Section</b>	<b>NERC VAR-001-1a</b>	<b>Alberta VAR-001-AB-1a</b>	<b>Reason for Difference<sup>1</sup></b>
<b>Purpose</b>	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 purpose of this reliability standard is to ensure that transmission voltage levels, reactive flows, and reactive power resources are monitored, controlled, and maintained within limits in real-time to protect equipment and the reliable operation of the Interconnection.	
<b>Applicability</b>	4.1. Transmission Operators. 4.2. Purchasing-Selling Entities.	This reliability standard applies to: <ul style="list-style-type: none"> <li>• TFOs</li> <li>• ISO</li> </ul>	As requested by generator owners and operators, the AESO has moved their requirements to VAR-002-AB.
<b>Effective Date</b>	Six months after BOT adoption.	Ninety calendar days after the date of approval by the Commission.	

<sup>1</sup> The following revisions have been made throughout this proposed reliability standard:

- Identified the responsible entities in Alberta.
- Applied a consistent writing style and added clarity.
- Changed passive terms such as “shall” to “must”.
- Developed measures specific to the requirements.

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<b>Requirement</b>	<b>R1.</b> Each Transmission Operator, individually and jointly with other Transmission Operators, shall ensure that formal policies and procedures are developed, maintained, and implemented for monitoring and controlling voltage levels and Mvar flows within their individual areas and with the areas of neighboring Transmission Operators.	<p><b>R1</b> The ISO must make rules for monitoring and controlling voltage levels and MVar flows within the transmission system, including consulting with TFOs and transmission operators adjacent to Alberta as appropriate in the development of such ISO rules.</p> <p><b>R2.</b> The ISO and each TFO must develop, maintain, and implement procedures, for monitoring and controlling voltage levels and MVar flows within the transmission system, including consulting with each other, neighbouring TFOs and, as appropriate, transmission operators adjacent to Alberta.</p>	Divided into two statements to accurately reflect the responsibilities outlined in the Alberta Reliability Framework.
<b>Measure</b>	<b>M1.</b> The Transmission Operator shall have evidence it provided a voltage or Reactive Power schedule as specified in Requirement 4 to each Generator Operator it requires to follow such a schedule.	<p><b>MR1</b> Evidence exists that the rules have been made or are under development pursuant to requirement R1.</p> <p><b>MR2</b> Evidence exists that procedures have been developed, maintained and implemented pursuant to requirement R2.</p>	
<b>Requirement</b>	<b>R2.</b> Each Transmission Operator shall acquire sufficient reactive resources within its area to protect the voltage levels under normal and Contingency conditions. This includes the Transmission Operator's share of the reactive requirements of interconnecting transmission	<b>R3</b> The ISO must operate with sufficient reactive power resources available within Alberta to protect the voltage levels of the transmission system under normal and contingency conditions. This includes, without limitation, consideration of the transmission	<p>The ISO assumes this responsibility in Alberta.</p> <p>Sharing of reactive requirements for transmission lines in Alberta only applies to interconnections.</p>

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	circuits.	system share of the reactive requirements of interconnections.	
<b>Measure</b>	<b>M2.</b> The Transmission Operator shall have evidence to show that, for each generating unit in its area that is exempt from following a voltage or Reactive Power schedule, the associated Generator Owner was notified of this exemption in accordance with Requirement 3.2.	<b>MR3</b> Evidence exists and shows that adequate reactive power resources are available.	
<b>Requirement</b>	<b>R3.</b> The Transmission Operator shall specify criteria that exempts generators from compliance with the requirements defined in Requirement 4, and Requirement 6.1.	<b>R4</b> The ISO may establish and publish criteria on its website that exempts generating units from compliance with any or all of the directives in requirements R5 and R6.3.	Reworded for clarity and consistency. Used passive wording to allow for the possibility that there may not be additional exemptions, other than what is stated in the Act.
<b>Measure</b>	<b>M3.</b> The Transmission Operator shall have evidence to show that it issued directives as specified in Requirement 6.1 when notified by a Generator Operator of the loss of an automatic voltage regulator control.	<b>MR4</b> A written criteria that defines exemptions exists as specified in requirement R4.	
<b>Requirement</b>	<b>R3.1.</b> Each Transmission Operator shall maintain a list of generators in its area that are exempt from following a voltage or Reactive Power schedule.	<b>R4.1</b> The ISO must maintain a list of generating units and wind aggregated generating facilities in Alberta that are exempt from following voltage level directives or reactive power requirements in the ISO rules.	Expanded the requirement to include wind power facilities.

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<b>Measure</b>		<b>MR4.1</b> An accurate and complete list of generating units and wind aggregated generating facilities that are exempt from the criteria specified in requirement R4.1 exists.	
<b>Requirement</b>	<b>R3.2.</b> For each generator that is on this exemption list, the Transmission Operator shall notify the associated Generator Owner.	<b>R4.2.</b> The ISO must inform each GFO when its generating unit(s) is included on the list referred to in requirement R4.1.	Reworded for clarity and consistency.
<b>Measure</b>		<b>MR4.2</b> Document exists that show the GFO was notified.	
<b>Requirement</b>	<b>R4.</b> Each Transmission Operator shall specify a voltage or Reactive Power schedule 1 at the interconnection between the generator facility and the Transmission Owner's facilities to be maintained by each generator. The Transmission Operator shall provide the voltage or Reactive Power schedule to the associated Generator Operator and direct the Generator Operator to comply with the schedule in automatic voltage control mode (AVR in service and controlling voltage).	<b>R5.</b> The ISO must issue directives to the operator of a generating unit that specify the following: <ul style="list-style-type: none"> <li>a) voltage level on the high voltage side of the transformer at the point of connection between each generating unit and the TFO's facilities; or</li> <li>b) the reactive power to be achieved by the generating unit.</li> </ul>	Appendix 1 (interpretation of Requirement 4) did not result in any changes to the Alberta requirements that correspond to NERC Requirement 4.

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<b>Measure</b>	<b>M4.</b> 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 Requirement 11.	<b>MR5</b> Evidence exists that shows that voltage levels or reactive power output have been specified as in requirement R5.	
<b>Requirement</b>	<b>R5.</b> Each Purchasing-Selling Entity shall arrange for (self-provide or purchase) reactive resources to satisfy its reactive requirements identified by its Transmission Service Provider.		NERC requirement R5 was deleted as NERC requires the Purchase-Selling Entity to arrange for reactive resources to satisfy the reactive requirements identified by its Transmission Service Provider. This requirement was deleted as the ISO ensures the reactive power requirements are met in Alberta.
<b>Measure</b>			
<b>Requirement</b>	<b>R6.</b> The Transmission Operator shall know the status of all transmission Reactive Power resources, including the status of voltage regulators and power system stabilizers.	<p><b>R6.</b> The ISO must know the status of all transmission reactive power resources, voltage regulators and power system stabilizers.</p> <p><b>R7</b> Each TFO must know the status of all transmission reactive power resources, voltage regulators and power system stabilizers within its service area.</p>	Split the requirement to identify ISO and TFO areas of responsibility.

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<b>Measure</b>		<p><b>MR6</b> Procedures or other evidence exist, including monitoring of resources as specified in requirement R6.</p> <p><b>MR7</b> Procedures or other evidence exist and include monitoring of resources, as specified in requirement R6.1.</p>	
<b>Requirement</b>	<b>R6.1.</b> When notified of the loss of an automatic voltage regulator control, the Transmission Operator shall direct the Generator Operator to maintain or change either its voltage schedule or its Reactive Power schedule.	<b>R8</b> The ISO, when notified by an operator of a generating unit of the loss of automatic voltage regulator control or by an operator of an aggregated generating facility of the loss of voltage regulating system control, must issue a directive to the operator to maintain or change either its voltage or reactive power.	Reworded for clarity and consistency.
<b>Measure</b>		<b>MR8</b> Electronic logs, operator logs, and/or voice recordings show that a directive was issued, as specified in requirement R6.3	
<b>Requirement</b>	<b>R7.</b> The Transmission Operator shall be able to operate or direct the operation of devices necessary to regulate transmission voltage and reactive flow.	<b>R9</b> The ISO must, when it determines it is necessary, regulate transmission voltage and reactive power flow by issuing directives to TFOs to operate the devices necessary to do so.	Reworded for clarity and consistency.

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<b>Measure</b>		<b>MR9</b> Electronic logs, operator logs, and/or voice recordings show that directives were issued in accordance with requirement 10.	
<b>Requirement</b>	<b>R8.</b> Each Transmission Operator shall operate or direct the operation of capacitive and inductive reactive resources within its area – including reactive generation scheduling; transmission line and reactive resource switching; and, if necessary, load shedding – to maintain system and Interconnection voltages within established limits.	<b>R10</b> The ISO must maintain system operating limits by issuing directives to TFOs and operators of generating units for the operation of capacitive and inductive reactive power resources with respect to, without limitation, the following: <ul style="list-style-type: none"> <li>• reactive power generation</li> <li>• voltage</li> <li>• transmission line switching</li> <li>• reactive power resource switching,</li> <li>• load shedding</li> </ul>	Reworded for clarity and consistency.
<b>Measure</b>		<b>MR10</b> Electronic logs, operator logs, and/or voice recordings show that directives were issued as specified in requirement R8.	
<b>Requirement</b>	<b>R9.</b> Each Transmission Operator shall maintain reactive resources to support its voltage under first Contingency conditions.	<b>R11</b> The ISO must make arrangements such that there are sufficient reactive power resources to support voltage under first contingency conditions.	Reworded for clarity and consistency.
<b>Measure</b>			
<b>Requirement</b>	<b>R9.1.</b> Each Transmission Operator shall disperse and locate the reactive resources so	<b>R11.1</b> The ISO must make arrangements such that reactive power resources are available in	Reworded for clarity and consistency.

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	that the resources can be applied effectively and quickly when Contingencies occur.	locations within Alberta such that the resources can be applied effectively and as soon as practical when a contingency occurs pursuant to R12.	
<b>Measure</b>		<b>MR11.1</b> Evidence exists that reactive power resources are being arranged for or are in place at locations as specified in requirement R9.1.	
<b>Requirement</b>	<b>R10.</b> Each Transmission Operator shall correct IROL or SOL violations resulting from reactive resource deficiencies (IROL violations must be corrected within 30 minutes) and complete the required IROL or SOL violation reporting.	<b>R12</b> The ISO must take action to restore system operation within interconnection reliability operating limits or system operating limits established by the ISO in the event of a violation resulting from reactive power resource deficiencies.	Deleted the reference to 30 minutes for the correction of IROL violations as this is redundant with requirements in TOP-007-WECC-AB-1.
<b>Measure</b>		<b>MR12</b> Evidence shows that actions were taken as specified in requirement R10.	
<b>Requirement</b>	<b>R11.</b> After consultation with the Generator Owner regarding necessary step-up transformer tap changes, 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.	<b>R13</b> The ISO must, after reviewing with the GFO regarding necessary step-up transformer off-load tap changes, provide documentation to the GFO specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes.	Reworded for clarity and consistency.

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<b>Measure</b>		<b>MR13</b> Evidence exists that changes were documented and communicated as specified per requirement R11.	
<b>Requirement</b>	<b>R12.</b> The Transmission Operator shall direct corrective action, including load reduction, necessary to prevent voltage collapse when reactive resources are insufficient.	<b>R14</b> The ISO must issue directives necessary to prevent voltage collapse in the event of reactive power resource deficiencies including without limitation to reduce load.	Reworded for clarity and consistency.
<b>Measure</b>		<b>MR14</b> Electronic logs, operator logs, and/or voice recordings show that directives were issued as specified in requirement R12.	
<b>Compliance</b>	To view the compliance section D of the NERC reliability standard follow this link: <a href="http://www.nerc.com/files/VAR-001-1a.pdf">http://www.nerc.com/files/VAR-001-1a.pdf</a>		There is no compliance section currently proposed in the Alberta Reliability Standards.  A compliance program is under development for Alberta Reliability Standards that recognizes the compliance monitoring and enforcement structure in Alberta.  This approach is deemed consistent with the existing ISO Rules.

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<b>Regional Differences</b>	None identified.	None identified.	Not applicable in Alberta

~~Attachments: Refer to Appendix 1 at the end of this document.~~<sup>2</sup>

**Proposed Terms for the Consolidated Authoritative Document Glossary<sup>3</sup>:**

“**aggregated generating facilities**” means an aggregation of **generating units**, including any **reactive power** resources, which are:

- (i) designated by the **ISO**; and
- (ii) situated in the same proximate location at one or more **point of connections**.

“**voltage regulating system**” means the equipment that automatically controls the **reactive power** resources to regulate the voltage level at any **collector bus**.

<sup>2</sup> Appendix 1 will be deleted in the Alberta reliability standard. The interpretation provided by NERC for requirement R4 did not require any further clarification in the corresponding Alberta requirements.

<sup>3</sup> These proposed defined terms are also being consulted on as part of the ISO rules consultation on Section G1 Definitions (Package 4).



### **Defined Terms Used in this Standard:**

(As included in the Consolidated Authoritative Document Glossary)

- automatic voltage regulator
- Commission
- contingency
- day
- directive
- generating facility
- generating facility owner
- generating unit
- interconnection
- interconnection reliability operating limits
- ISO
- MVar
- reactive power
- reliability standards
- system operating limit
- transmission system

Note: The following appendix will not be included in the Alberta reliability standard and the content of the appendix does not require changes to be made to the Alberta requirements that correspond to NERC requirement R4.

## Appendix 1

### Interpretation of Requirement 4

#### Request:

*The current wording of VAR-001-1 Requirement 4 does not impose any explicit obligations on the Transmission Operator other than to provide the Generator Operator with a voltage or reactive power output schedule and an associated tolerance band.*

1. *Is the Transmission Operator implicitly required to have a technical basis for specifying the voltage or reactive power and associated tolerance band?*
2. *Is the Transmission Operator implicitly required to issue a voltage or reactive power schedule and associated tolerance band that is reasonable and practical for the Generator Operator to maintain?*
3. *What measure should be used to determine if the Transmission Operator has issued a technically based, reasonable and practical to maintain voltage or reactive power schedule and associated tolerance band?*

#### VAR-001-1

**R4.** Each Transmission Operator shall specify a voltage or Reactive Power schedule<sup>1</sup> at the interconnection between the generator facility and the Transmission Owner's facilities to be maintained by each generator. The Transmission Operator shall provide the voltage or Reactive Power schedule to the associated Generator Operator and direct the Generator Operator to comply with the schedule in automatic voltage control mode (AVR in service and controlling voltage).

<sup>1</sup> The voltage schedule is a target voltage to be maintained within a tolerance band during a specified period.

#### Interpretation:

NERC Reliability Standard VAR-001-1 is only comprised of stated requirements and associated compliance elements. The requirements have been developed in a fair and open process, balloted and accepted by FERC for compliance review. Any “implicit” requirement would be based on subjective interpretation and viewpoint and therefore cannot be objectively measured and enforced. Any attempt at “interpreting an implicit requirement” would effectively be adding a new requirement to the standard. This can only be done through the SAR process.

Since there are no requirements in VAR-001-1 to issue a “technically based, reasonable and practical to maintain voltage or reactive power schedule and associated tolerance band”, there are no measures or associated compliance elements in the standard.

The standard only requires that “Each Transmission Operator shall specify a voltage or Reactive Power schedule ...” and that “The Transmission Operator shall provide the voltage or Reactive Power schedule to the associated Generator Operator and direct the Generator Operator to comply with the schedule....”. Also, Measure 1 and the associated compliance elements follow accordingly by stating that “The Transmission Operator shall have evidence it provided a voltage or Reactive Power schedule ...”

## **VAR-002-1 — Generator Operation for Maintaining Network Voltage Schedules**

**R2.** Unless exempted by the Transmission Operator, each Generator Operator shall maintain the generator voltage or Reactive Power output (within applicable Facility Ratings<sup>1</sup>) as directed by the Transmission Operator.

**R2.1.** When a generator's automatic voltage regulator is out of service, the Generator Operator shall 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.

**R2.2.** When directed to modify voltage, the Generator Operator shall comply or provide an explanation of why the schedule cannot be met.

<sup>1</sup> When a Generator is operating in manual control, reactive power capability may change based on stability considerations and this will lead to a change in the associated Facility Ratings.

Transmission Operator.” R2.2 goes on to state “When directed to modify voltage, the Generator Operator shall comply or provide an explanation of why the schedule cannot be met.”