

Alberta Reliability Standard

Voltage and Reactive Control

VAR-001-AB-5

A. Introduction

1. Title: Voltage and Reactive Control
2. Number: VAR-001-AB-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:
 - 4.0. Functional Entities:
 - 4.0.1. the **operator** of a **transmission facility**;
 - 4.0.2. the **operator** of a **generating unit**, the **operator** of an **aggregated facility**, and the **operator** of an **energy storage resource** directly connected to the **transmission system**, or to **transmission facilities** in the City of Medicine Hat, with a **maximum authorized real power** rating greater than or equal to 5 MW; and
 - 4.0.3. the **ISO**.
5. Effective Date: The later of (i) July 1, 2029, and (ii) the first **day** of the first calendar quarter following **Commission** approval

B. Requirements and Measures

- R1. The **ISO** must 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**. *[Alberta Risk Rating: High] [Time Horizon: Operations Planning]*
 - 1.1. The **ISO** must provide a copy of the voltage schedules (which is either a range or a target value with an associated tolerance band) to an **interconnected transmission operator** within 30 **days** of a request.
- M1. The **ISO** must 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 **ISO** must have evidence that the voltage schedules (which is either a range or a target value with an associated tolerance band) were provided to **interconnected transmission operators** within 30 **days** of a request. Evidence may include emails, website postings, and meeting minutes, or other equivalent evidence.
- R2. The **ISO** must schedule sufficient reactive resources to regulate voltage levels under normal and **contingency** conditions. *[Alberta Risk Rating: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

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M2. The **ISO** must have evidence of scheduling sufficient reactive resources based on their assessments of the system. For the operations planning time horizon, the **ISO** must have evidence of assessments used as the basis for how resources were scheduled.

R3. The **ISO** must direct the real-time operation of devices to regulate transmission voltage and reactive flow as necessary. *[Alberta Risk Rating: High] [Time Horizon: Real-time Operations, Same-day Operations, and Operations Planning]*

3.1. Each **operator** of a **transmission facility** must operate the real-time operation of devices to regulate transmission voltage and reactive flow as necessary.

M3. The **ISO** must have evidence that directions were given to operate capacitive and inductive resources as necessary in real-time. Evidence may include instructions to **operators** of a **generating unit**, **operators** of an **aggregated facility**, and **operators of an energy storage resource** to: 1) provide additional voltage support; 2) bring resources on-line; or 3) make manual adjustments.

3.1. Each **operator** of a **transmission facility** must have evidence that it operated capacitive and inductive resources as necessary in real-time.

R4. [Intentionally left blank.]

4.1. [Intentionally left blank.]

M4. [Intentionally left blank.]

R5. [Intentionally left blank.]

5.1. [Intentionally left blank.]

5.2. [Intentionally left blank.]

5.3. [Intentionally left blank.]

M5. [Intentionally left blank.]

E.A.13 The **ISO** must issue any one of the following types of voltage schedules to the **operator** of a **generating unit**, **operator** of an **aggregated facility**, and **operator of an energy storage resource** for each of their **generating units**, **aggregated facilities**, and **energy storage resources** that are on-line within the **ISO's** area: *[Alberta Risk Rating: 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 **operator** of a **generating unit**, **operator** of an **aggregated facility**, or **operator** of an **energy storage resource** uses to establish a voltage set point at the point of control; or
- A voltage band for a specified period.

M.E.A.13 The **ISO** must have evidence that it provided the voltage schedules to the **operator** of a **generating unit**, **operator** of an **aggregated facility**, and **operator** of an **energy storage resource**, as required in E.A.13. Evidence may include dated spreadsheets, reports, voice recordings, or other documentation containing the voltage schedule including set points,

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tolerance bands, and specified periods as required in Requirement E.A.13, or other equivalent evidence.

- E.A.14** The **ISO** must provide one of the following voltage schedule reference points for each **generating unit, aggregated facility, and energy storage resource** in its area to the **operator of a generating unit, operator of an aggregated facility, and operator of an energy storage resource**. *[Alberta Risk Rating: Medium] [Time Horizon: Operations Planning and Same-day Operations]*
- The stator winding terminals or **collector bus**;
 - The high side of the step-up transformer;
 - The **point of connection**; or
 - A location designated by mutual agreement between the **ISO** and the **operator of a generating unit, operator of an aggregated facility, or operator of an energy storage resource**.
- M.E.A.14** The **ISO** must have evidence that it provided one of the voltage schedule reference points for each **generating unit, aggregated facility, and energy storage resource** in its area to the **operator of a generating unit, operator of an aggregated facility, and operator of an energy storage resource**, as required in E.A.14. Evidence may include dated letters, e-mail, or other documentation that contains notification to the **operator of a generating unit, operator of an aggregated facility, and operator of an energy storage resource** of the voltage schedule reference point for each generation resource, or other equivalent evidence.
- E.A.15** Each **operator of a generating unit, operator of an aggregated facility, and operator of an energy storage resource** must provide its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals or **collector bus** within **30 days** of request by the **ISO**. *[Alberta Risk Rating: Lower] [Time Horizon: Operations Planning]*
- M.E.A.15** The **operator of a generating unit, operator of an aggregated facility, and operator of an energy storage resource** must have evidence that within **30 days** of request by the **ISO** it provided its voltage set point conversion methodology from the point in Requirement E.A.14 to the generator terminals or **collector bus**, as required in E.A.15. Evidence may include dated reports, spreadsheets, or other documentation.
- E.A.16** The **ISO** must provide to the **operator of a generating unit, operator of an aggregated facility, or operator of an energy storage resource** within **30 days** of a request for data by the **operator of a generating unit, operator of an aggregated facility, or operator of an energy storage resource**, transmission equipment data and operating data that supports development of the voltage set point conversion methodology. *[Alberta Risk Rating: Lower] [Time Horizon: Operations Planning]*
- M.E.A.16** The **ISO** must have evidence that within **30 days** of request by the **operator of a generating unit, operator of an aggregated facility, or operator of an energy storage resource** it provided data to support development of the voltage set point conversion methodology, as required in E.A.16. Evidence may include dated reports, spreadsheets, or other documentation.
- E.A.17** Each **operator of a generating unit, operator of an aggregated facility, and operator of an energy storage resource** must meet the following control loop specifications if the **operator of the generating unit, operator of an aggregated facility, or operator of an energy storage resource**

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storage resource uses control loops external to the **automatic voltage regulators** to manage Mvar loading: *[Alberta Risk Rating: Medium] [Time Horizon: Real-time Operations]*

E.A.17.1 Each control loop's design incorporates the **voltage regulating system** or **automatic voltage regulator's** automatic voltage-controlled response to voltage deviations during system **disturbances**; and

E.A.17.2 Each control loop is only used by mutual agreement between the **operator** of a **generating unit**, **operator** of an **aggregated facility**, or **operator** of an **energy storage resource**, and the **ISO**.

M.E.A.17 If the **operator** of a **generating unit**, **operator** of an **aggregated facility**, or **operator** of an **energy storage resource** uses outside control loops to manage Mvar loading, the **operator** of a **generating unit**, **operator** of an **aggregated facility**, or **operator** of an **energy storage resource** must 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 design specifications with identified agreed-upon control loops, system reports, or other dated documentation.

R6. After review with the **legal owner** of a **generating unit**, **legal owner** of an **aggregated facility**, or **legal owner** of an **energy storage resource** regarding necessary step-up transformer tap changes and the implementation schedule, the **ISO** must provide documentation to the **legal owner** of a **generating unit**, **legal owner** of an **aggregated facility**, or **legal owner** of an **energy storage resource** specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. *[Alberta Risk Rating: Lower] [Time Horizon: Operations Planning]*

M6. The **ISO** must have evidence that it provided documentation to the **legal owner** of a **generating unit**, **legal owner** of an **aggregated facility**, or **legal owner** of an **energy storage resource** when a change was needed to a **generating unit**, **aggregated facility**, or **energy storage resource's** step-up transformer tap in accordance with the requirement and that it reviewed with the **legal owner**.

C. Compliance

[Intentionally left blank.]

D. Regional Variances

Requirement R4 has been deleted and Requirement R5 has been replaced, in its entirety, by an **interconnection**-wide variance applicable in the **western interconnection**.

E. Interpretations

None.

F. Associated Documents

AESO Information Document #2010-007RS, *General Operating Practices – Voltage Control* and any amendments made thereto from time to time

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Version History

Version	Effective Date	Description of Changes
AB-5	The later of (i) July 1, 2029, and (ii) the first day of the first calendar quarter following Commission approval	Revised based on NERC VAR-001-5, approved by FERC in Docket No. RD18-8-000. The revisions to VAR-001-AB-5 include expanding the applicability of the standard to the operator of a transmission facility , operator of a generating unit , operator of an energy storage resource , and operator of an aggregated facility , retiring Requirement R4, and adopting the WECC variances that replace Requirement R5.
AB-4	2019-12-01	Unbolded “real time”.
AB-4	2016-04-01	Revised to align with NERC version 4.
AB-1a	2012-10-01	Initial Release.

Guidelines and Technical Basis

[Intentionally left blank.]