Information Document
Regulating Reserve
ID #2013-006R

Information Documents are not authoritative. Information Documents are for information purposes only and are intended to provide guidance. In the event of any discrepancy between an Information Document and any Authoritative Document(s)[1] in effect, the Authoritative Document(s) governs.

1 Purpose

This Information Document relates to the following Authoritative Document:

- Section 205.4 of the ISO rules, *Regulating Reserve Technical Requirements and Performance Standards* ("Section 205.4").

The purpose of this Information Document is to assist pool participants in understanding regulating reserve. This Information Document is likely of most interest to market participants who currently provide or may in the future provide regulating reserve.

2 What is Regulating Reserve?

Regulating reserve is used to provide a balance between generation and load within the AESO's balancing authority area, while maintaining the interchange schedule on the interconnections with British Columbia and Montana at a frequency of 60 Hz.

Regulating reserve is provided by partially loaded, synchronized regulating reserve resources that are able to immediately respond to automatic generation control signals from the AESO system coordination centre, and that have governor systems such that the resources are frequency responsive. A regulating reserve resource is controlled by an automatic generation control system that adjusts output levels within an established regulating reserve range to compensate for the moment-to-moment changes in load and generation on the Alberta interconnected electric system.

3 Eligibility to Provide Regulating Reserve

Regulating reserve may be provided by a pool asset with one or more regulating reserve resources. A regulating reserve resource may be a single resource that individually meets the eligibility criteria in subsection 3(1) of Section 205.4, or an aggregate of resources controlled by a single governor or governor system that collectively meet the eligibility criteria in subsection 3(1) of Section 205.4. The pool asset must be qualified by the AESO to provide regulating reserve in accordance with subsection 4(1) of Section 205.4.

Regulating reserve resources require a governor system that dynamically responds to a change in frequency to provide an automatic response. Under section 3(1)(b)(iii) of Section 205.4, in the case of synchronous generators, the maximum operating range of a regulating reserve resource is usually the difference of the maximum authorized real power (MARP) value and the minimum stable generation (MSG) value of the resource. In the case of a battery storage system, the maximum operating range of a regulating reserve resource is the difference of (maximum authorize charging power plus maximum authorized real power) and (maximum authorized charging power or maximum authorized real power).

Market participants can apply to the AESO to provide regulating reserve by completing and submitting the application form on the AESO's website. In accordance with subsection 2(2) of Section 205.4, the AESO must receive a completed application before it can make any determination on resource eligibility and pool asset qualification.

[1] "Authoritative Documents" is the general name given by the AESO to categories of documents made by the AESO under the authority of the *Electric Utilities Act* and associated regulations, and that contain binding legal requirements for either market participants or the AESO, or both. AESO Authoritative Documents include: the ISO rules, the Alberta reliability standards, and the ISO tariff.

4 Procurement

The AESO procures regulating reserve based on regulating reserve levels identified in the *7 Day Forecast of Operating Reserves Volumes* report located on the AESO's website. The AESO normally procures regulating reserve from the Alberta Watt-Ex Exchange, operated by Watt-Ex, but may use other means under certain circumstances. The AESO may adjust the volume of regulating reserve in real-time based on actual system conditions. Refer to ID #2013-005R, *Operating Reserve* for more information on procurement.

5 Dispatches

When regulating reserve is dispatched, the operator of a pool asset with a regulating reserve resource that supplies regulating reserve provides the AESO with the high regulating reserve limit, the low regulating reserve limit and the control status through Supervisory Control and Data Acquisition (SCADA). The low regulating reserve limit equals the energy dispatch or transmission must run output, whichever is greater, plus the amount of contingency reserve directed by the AESO for that asset. The high regulating reserve limit equals the low regulating reserve limit plus the amount of regulating reserve dispatched by the AESO for that asset. The difference between the high and low limits is the regulating reserve range.

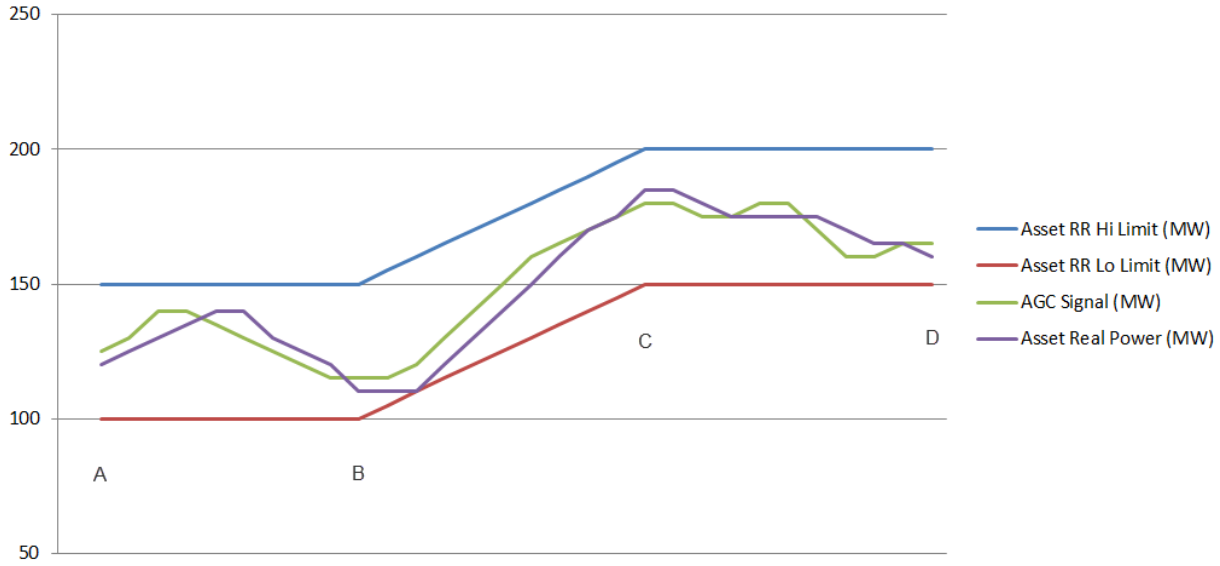
The regulating reserve range consists of the total amount of real power (MW) made available for automatic generation control operation between the upper and lower regulating limits of each regulating reserve resource. Automatic generation control performance is monitored using the NERC control performance standards as defined in Alberta Reliability Standard BAL-001-AB-0a, *Real Power Balancing Control Performance*.

The AESO then sends a signal through automatic generation control to a pool asset that establishes the pool asset's output level within its regulating reserve range.

If the pool asset has more than one regulating reserve resource, the pool participant may use an aggregate of those regulating reserve resources to produce the required response to the dispatch.

5.1 Concurrent Regulating Reserve and Energy Dispatches

If a pool participant receives an energy dispatch while providing regulating reserve, it must continue to fully provide the regulating reserve in accordance with Section 205.4. While the pool asset is ramping up or down to the new energy dispatch level, the pool asset should also continue to fully provide the regulating reserve; the high regulating reserve limit and the low regulating reserve limit move up and down accordingly while maintaining the regulating reserve range. The diagram below provides an example of expected behaviour.



A – Pool asset at initial energy dispatch (100MW) & RR dispatch (50MW).

B – Pool asset receives new energy dispatch (150MW).

B to C – Pool asset ramps up to new energy dispatch (150MW), full RR range provided while ramping, RR provided in accordance with Section 205.4 while ramping.

C – Pool asset at new energy dispatch (150MW) & RR dispatch (50MW).

6 Technical Requirements and Performance Standards

During normal automatic generation control operation, the AESO master controller issues MW set point signals that are representative of the real power level that the asset is required to ramp to. A set point signal to increase the real power level may follow a previous set point signal to increase the real power level, and similarly, a set point signal to reduce the real power level may follow a previous set point signal to reduce the real power level. MW set point signals may also include reversals, where a set point signal to increase the real power level follows a set point signal to reduce the real power level, or a set point signal to decrease the real power level follows a set point signal to increase real power level. The automatic generation control master controller may issue reversals as often as every four (4) seconds.

Section 205.4 sets out the requirements for a minimum ramp rate. There is no limit to the maximum ramp rate.

The coordinated response expectation stated in subsection 6(1)(c) of Section 205.4 mean that plants participating in automatic generation control must be designed such that governor control to off-frequency conditions is coordinated with any other controls at the plant (e.g., unit load controllers, plant load controllers, etc). The coordination is such that:

- non-governor control loops do not alter the natural MW response of the resource's governor;
- non-governor control loops can be adjusted by a change in the automatic generation control signal;
- the resource output will change due to the change in automatic generation control signal and still include the natural MW response of the resource's governor; and
- “actual” pool asset output equals automatic generation control signal + frequency response of the resource(s).

NERC's Reliability Guideline: Primary Frequency Control document outlines how this coordinated response can be achieved. The document can be found here:

http://www.nerc.com/comm/OC_Reliability_Guidelines_DL/Primary_Frequency_Control_final.pdf

A pool asset that is under dispatch to provide regulating reserve is required to maintain its output within a tolerance of the latest automatic generation control signal in accordance with subsection 5(7) of Section 205.4. This tolerance is applied at the pool asset level. For example, when multiple regulating reserve resources within the same pool asset are providing regulating reserve at the same time, the tolerance applies to the pool asset as a whole and not to each resource individually.

7 Test Description

The pool asset providing regulating reserve is tested, in accordance with subsection 10 of Section 205.4, to determine whether it demonstrates an ability to ramp in response to automatic generation control master controller set point signals. The pool asset providing regulating reserve is made available to the system controller according to a pre-arranged schedule for at least an eight (8)-hour period. A general guideline for testing is set out in the regulating reserve test description below, and illustrated in Appendix 1. The regulating reserve test may be adjusted in real time as deemed necessary by the AESO based on system conditions and/or observed responses from the pool asset undergoing the test.

The regulating reserve test is conducted as follows:

(a) the regulating reserve range for a pool asset providing regulating reserve is set at the maximum regulating reserve range the pool asset is capable of;

(b) the pool asset providing regulating reserve is ramped to approximately the mid-point of the regulating reserve range and then the following tests are carried out;

  (i) ramp the real power of the pool asset providing regulating reserve to the high limit of the regulating reserve range, using automatic generation control signals;

  (ii) ramp the real power of the pool asset providing regulating reserve from the high limit down to the low limit of the regulating reserve range at the lower ramp rate, using automatic generation control signals;

  (iii) ramp the real power of the pool asset providing regulating reserve from the low limit back up to the high limit of the regulating reserve range at the raise ramp rate, using automatic generation control signals;

  (iv) ramp the real power of the pool asset providing regulating reserve down to about mid-point of its regulating reserve range at the lower ramp rate, using automatic generation control signals;

  (v) ramp up the real power of the pool asset providing regulating reserve by a real power value of approximately 1/10th of the regulating reserve range, using automatic generation control signals. Without delay, using automatic generation control signals, ramp down the real power of the pool asset providing regulating reserve by a real power value of approximately 1/10th of the regulating reserve range; and

  (vi) record the real power of the pool asset providing regulating reserve at the last target position for five (5) minutes and observe any drift.

(c) the response of the pool asset providing regulating reserve is recorded and the following characteristics are observed:

  (i) delay to start response of the pool asset providing regulating reserve as measured from the start of a ramp sequence;

  (ii) overshoot or undershoot of the pool asset providing regulating reserve upon termination of a control sequence, as measured from the expected target point;

(iii) ability of the pool asset providing regulating reserve to meet the minimum ramp rate; and

(iv) stability of the pool asset providing regulating reserve at the end of each test ramp and at the conclusion of the test, measured as the drift from the desired target point.

If, throughout this test, the pool asset providing regulating reserve is able to operate within the regulating reserve range without manual intervention of the operator with respect to the pool asset providing regulating reserve, the pool asset has met the requirements of this test.

8 Appendices

Appendix 1 – *Test Sequence for Regulating Reserve*

Revision History

Posting Date	Description of Changes
2024-04-05	Administrative amendments to align with Energy Storage ISO rule amendments and new definitions.
2018-02-01	Revisions to align with amended Operating Reserve rules in effect as of February 1, 2018
2016-09-28	Administrative amendments
2014-12-23	Initial Release

Appendix 1
Test Sequence for Regulating Reserve

The typical generating unit response, as shown in the curve below, demonstrates a different type of response at each of the indicated points. It is assumed that there are no energy market dispatches to the generating unit during the test time period.

A – represents the real power instability of the pool asset providing regulating reserve prior to the beginning of the test.

B – represents a delay of the real power in responding to the automatic generation control signal. This delay should not exceed twenty-eight seconds.

C – is a “settling out period” of no more than five minutes. This is a manual delay.

D – represents a situation in which the pool asset providing regulating reserve real power is not following automatic generation control signals. This would represent a case where the generating unit falls behind with respect to the automatic generation control signals.

E – is a delay of up to forty seconds, provided by the automatic generation control master controller, between ramps.

F – represents a situation of overshoot of the pool asset providing regulating reserve where real power exceeds the automatic generation control signals.

G – represents a situation of real power instability sometime after automatic generation control signals have stopped being received by the generating unit.