



OPERATING RESERVES

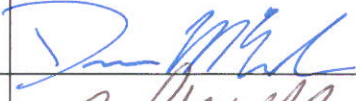


Technical Requirements

**Technical Requirements for Provision of Regulating
Reserves**

Version 2.0

Change History

Date	Version	Detail	Changes By
Dec. 10, 2004	2.0	Re-release under AESO heading. No change to content.	Darren McCrank

	Name	Signature	Date
Prepared:	Darren McCrank, P.Eng.		23 Dec 04
Reviewed:	John Kehler		23 Dec 04
Approved:	Fred Ritter, P.Eng		23-12-04

APEGGA Permit to Practice P-08200

TABLE OF CONTENTS

CHANGE HISTORY	2
TABLE OF CONTENTS	3
1.0 INTRODUCTION	4
2.0 TECHNICAL REQUIREMENTS	4
2.1 Regulation range , Ramp rate and Maneuverability requirements	4
2.2 Regulating Reserve Resource response to frequency deviation.....	6
2.3 Telemetry and communications	7
3.0 OPERATIONAL REQUIREMENTS	8
4.0 DUE DILIGENCE REVIEW.....	9
4.1 Test Description	10

1.0 INTRODUCTION

A party offering Regulating Reserve Resources (RRR) to the Alberta Electric System Operator (AESO) must satisfy the technical requirements outlined in the sections below. A party offering RRR (hereinafter referred to as a RRP) must be provided from a Generating Resource within the Alberta Control Area and be connected to the Alberta Interconnected Electric System (AIES).

For the definition of the meanings of capitalized words in this document please refer to the Glossary of Terms for Technical Requirements for Ancillary Services.

2.0 TECHNICAL REQUIREMENTS

2.1 REGULATION RANGE, RAMP RATE AND MANEUVERABILITY REQUIREMENTS

1. Regulating Reserve Resources must be equipped with operating speed governors, set to a droop as established by the WECC Minimum Operating Criteria.
2. The RRP must provide the AESO with a copy of the Test Report for Synchronous Generator Testing for the Regulating Reserve Resource being offered. (WECC Synchronous Generator Testing Program).
3. The RRP must submit a completed form to the AESO (see *Technical Specification and Contact Information* in the Due Diligence section).
4. The Regulating Reserve Resource must be able to provide a minimum of 15 MWs of Regulation Range.
5. The Regulating Reserve Resource must at minimum, provide a ramp rate (MW/Minute) of 1/10 times the maximum Regulation range the Resource is qualified by the AESO to provide to be eligible.
6. The RRP must declare to the AESO the maximum amount of Regulation range being offered in MW.
7. The Regulation range offered must be within the maximum Real Power and minimum Real Power of the Regulating Reserve declared in the *Technical Specification and Contact Information* form.
8. Upon receipt of an AS Dispatch from the System Controller to provide Regulating Reserve, the RRP shall, within fifteen (15) minutes, Position the Regulating Reserve Resource within the offered Regulation range and be able to accept control signals from the AGC master controller.
9. The Regulating Reserve Resource shall be able to produce any Real Power within the Regulation range without manual intervention by the Generation Unit operator at the plant.
10. A Regulating Reserve Resource shall be capable of operating continuously at either the high limit or the low limit of the Regulation range for sixty (60) minutes while providing Regulating Reserve service.

11. The RRP must declare to the AESO the high limit and the low limit associated with each Regulation range offered. These limits bound the Regulation range and shall be telemetered to the Energy Management System (EMS) operated by the System Controller.
12. The Regulating Reserve Resource must be able to ramp between the high and low limits of the Regulation range at its declared ramp rate.
13. The Regulating Reserve Resource shall be capable of following and shall follow the control signals issued by the AGC master controller. During normal AGC operation such control signals consist of raise and lower signals. A raise signal may follow a previous raise signal, and similarly, a lower signal may follow a previous lower signal. Control signals may also include reversals, where a raise follows a lower or, vice versa, a lower follows a raise. Such control signals, consisting of short movements of the Generation Unit up or down are called “short ramps”, for the purposes of this document and the qualification requirements. The AGC master controller may issue reversals as often as every four (4) seconds. The RRP shall declare the minimum time between reversals that the Regulating Reserve Resource can accept. The Regulating Reserve Resource shall remain stable when following such control signals. The maximum acceptable delay time when responding to short ramp control signals is forty (40) seconds.
14. The Regulating Reserve Resource offering Regulating Reserve must be able to respond to control signals from the AGC master controller. The Real Power of the Regulating Reserve Resource shall respond to the AGC control signals with a time delay no longer than twenty-eight (28) seconds.
15. The RRP must declare to the AESO the response rate (MW/minute) of the Regulating Reserve Resource. The minimum (slowest) response rate that is acceptable for Regulation Reserve service is a continuous rate of 10% of the offered range per minute. There is no limit to the maximum (fastest) response rate that may be offered.
16. The Regulating Reserve Resource offered must be “stable” at any dispatch level within the Regulation range when not receiving control signals. Being stable means that the Regulating Reserve Resource must be able to hold the level of Real Power set by the last control signals +/- a Real Power deadband amount. The deadband is +/-5% of the maximum Regulation range that the Regulating Reserve Resource is capable of or +/- 1 MW (whichever is greater).
17. Regulating Reserve Resources that participate in Remedial Action Schemes (RAS) may be ineligible to provide Regulating Reserves while the RAS is in effect. The AESO will advise the RRP when a Regulating Reserve Resource is ineligible to provide Regulating Reserves because of RAS.
18. A Regulating Reserve Resource may receive an Energy Market Dispatch while it is providing Regulating Reserve. In this case the RRP continues to be responsible for being able to deliver the Regulating range that was dispatched before the Energy Market Dispatch was received. Figure 1 below illustrates a situation where the RRP has received an Energy Market dispatch in the direction to increase the energy delivered by the Generation Unit. The Figure shows how the responsibility for continuing to deliver the Regulating range follows the Energy Market Dispatch.

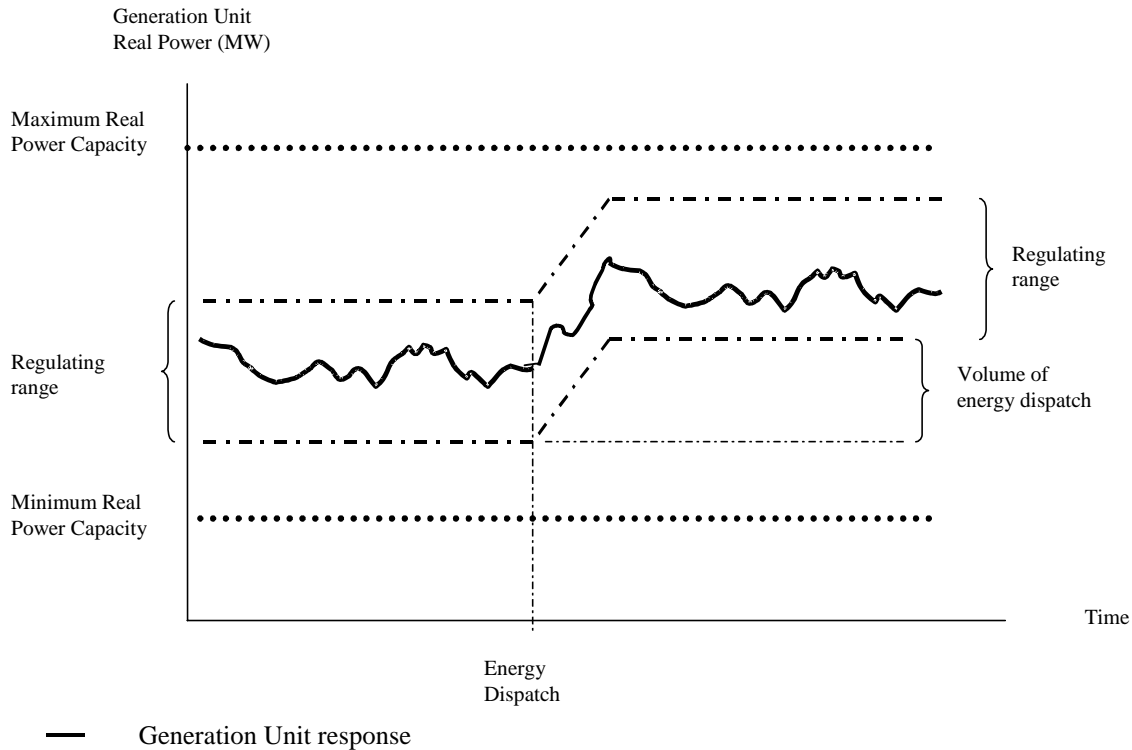


Figure 1 Response of a Generation Unit receiving an Energy Market dispatch while providing Regulating Reserve.

2.2 REGULATING RESERVE RESOURCE RESPONSE TO FREQUENCY DEVIATION

The requirement for response to frequency deviations overrides the requirements for “stability” described in section 2.1, item 16 above.

1. The Real Power of the Regulating Reserve Resources must respond to deviations in the power system frequency without assistance by the Generation Unit operator and AGC control signals. The Real Power shall increase when frequency decreases below 60 Hz and the Real Power shall decrease when system frequency increases above 60 Hz.
2. The Regulating Reserve Resource governor deadband shall not be more than 0.036 Hz.
3. The Regulating Reserve Resource must be capable of Real Power response to AGC signals during frequency deviation events between 61 Hz and 58.9 Hz.
4. The Regulating Reserve Resource governor control action and Automatic Generation Control action shall not oppose each other. For example, the Real Power of a Regulating Reserve Resource may exceed the high limit of the Regulation range, due to governor response to a frequency deviation event. In such a case, the Real Power of the Regulating Reserve Resource shall not be forced by any automatic mechanism to return within the high limit of the Regulation range, for a time of twenty (20) minutes, unless the frequency deviation is aided by this response. The Real Power of the Regulating Reserve Resource shall also not be changed in a direction that opposes recovery from the frequency deviation due to operator

intervention, unless the Regulating Reserve Resource is at risk of malfunction, in the operator's judgement.

5. The Regulating Reserve Resource shall not be operated with a governor load limiter that prevents the contracted volume of Regulating Reserve to be delivered when dispatched.
6. The Regulating Reserve Resource shall not be operated with a governor load limiter that prevents Real Power response to power system frequency deviations.

2.3 TELEMETRY AND COMMUNICATIONS

1. The Regulating Reserve Resource must have telemetry of the quantities listed below to the EMS operated by the System Controller. The telemetry provided must have the update rate indicated for each quantity:
 - b) Regulating Reserve Resource Gross Real-Power (MW) (2 second refresh rate);
 - c) Regulating Reserve Resource high limit of the Regulation range (MW) (updated within 10 seconds any time it is changed by the Generation Unit operator);
 - d) Regulating Reserve Resource low limit of the Regulation range (MW) (updated within 10 seconds any time it is changed by the Generation Unit operator);
 - e) Regulating Reserve Resource Regulating control enable switch status (updated within 10 seconds of a change in status); and
 - f) Regulating Reserve Resource breaker status. Such status may be actually made up of more than one physical breaker. In the latter case, the status of all breakers that must be closed / opened for the Regulating Reserve Resource to be connected / removed from AIES must be available (updated within 2 seconds of a change in status).
2. The accuracy of the analog telemetry must be at least +/- 2% of the actual value.
3. The resolution of the analog telemetry must be 0.5 % or better.
4. The availability of the telemetry system must be 99.8% or better.
5. The RRP shall maintain a "control centre" for the Regulating Reserve Resource being offered that is staffed 24 hours a day, 7 days a week.
6. Both primary and backup voice communications between the control centre of the System Controller and the control centre of the RRP must be provided by the RRP.
7. The RRP shall communicate with the System Controller using voice or electronic means, as set out in the AESO Operating Policies and Procedures (OPP's).

3.0 OPERATIONAL REQUIREMENTS

1. The RRP must follow all applicable AESO OPP's published by the AESO with respect to the operation of Regulating Reserve.
2. The RRP must accept control signals from the System Controller's EMS (or its designate) by the electronic means used for this purpose by the System Controller (or its designate).

4.1 TEST DESCRIPTION

In order to conduct a test, as described in the contract for supply of Ancillary Services, the RRR shall be tested to demonstrate an ability to ramp in response to AGC master controller signals. A test sequence is described below and shown in Figure 2. The following data is shown in Figure 2:

- measured data of the Regulation Reserve Resource;
- Regulation high and low limits; and
- Real Power and AGC signals.

The test will be conducted as follows:

1. The Regulation range for Regulating Reserve Resource is set at the maximum the Generation Unit is capable of;
2. The Regulating Reserve Resource shall be ramped to approximately the mid-point of the Regulation range;
3. The AGC master controller (or intermediate controller) shall cause control signals to be sent to the Regulating Reserve Resource according to the test sequence shown in the Figure 2 below; and
4. The response of the Regulating Reserve Resource shall be recorded and the following characteristics shall be observed:
 - a) Delay to start response of the Regulating Reserve Resource as measured from the start of a ramp sequence;
 - b) Overshoot or undershoot of the Regulating Reserve Resource upon termination of a control sequence, as measured from the expected target point;
 - c) Ability of the Regulating Reserve Resource to meet the minimum ramp rate; and
 - d) Stability of the Regulating Reserve Resource at the end of each test ramp and at the conclusion of the test, measured as the drift from the desired target point.

Throughout this test the Regulating Reserve Resource shall be able to operate within the Regulation range without manual intervention of the Regulating Reserve Resource operator at the plant. The test sequence shown in the figure below contains the following elements:

1. The Real Power of the Regulating Reserve Resource is manually set to a mid-position between the Regulation range;
2. Ramp the Real Power of the Regulating Reserve Resource to the high limit of the Regulation range, using the AGC control signals;
3. Ramp the Real Power of the Regulating Reserve Resource from the high limit down to the low limit of the Regulation range at the lower ramp rate, using the AGC control signals;

4. Ramp the Real Power of the Regulating Reserve Resource from the low limit back up to the high limit of the Regulation range at the raise ramp rate, using the AGC control signals;
5. Ramp the Real Power of the Regulating Reserve Resource down to about mid point of its Regulation range at the lower ramp rate, using the AGC control signals;
6. Ramp the Real Power of the Regulating Reserve Resource at the raise ramp rate for a Real Power value of approximately 1/10th of the Regulation range, using the AGC control signals. Without delay, ramp using the AGC control signals, the Real Power of the Regulating Reserve Resource at the lower ramp rate for a Real Power value of approximately 1/10th of the Regulation range; and
7. Record the Real Power of the Regulating Reserve Resource at the last target position for five (5) minutes and observe any drift.

The typical Generation Unit response shown in the curve shows different types of response at the indicated points. It is assumed that there are no Energy Market Dispatches during the test time period.

A - represents the Real Power instability of the Regulating Reserve Resource prior to the beginning of the test.

B – represents a delay of the Real Power in responding to the AGC control signal. This delay should not exceed twenty-eight (28) seconds.

C – is a “settling out period” of no more than five (5) minutes. This is a manual delay.

D – represents a condition of the Regulating Reserve Resource Real Power not following the AGC control signals. This would represent a case where the Generation Unit falls behind with respect to the AGC control signals.

E – is a delay of up to forty (40) seconds, provided by the AGC master controller, between ramps.

F – represents a situation of overshoot of the Regulating Reserve Resource Real Power exceeds the AGC control signals.

G – represents a situation of Real Power instability some time after AGC control signals have stopped being received by the Generation Unit.

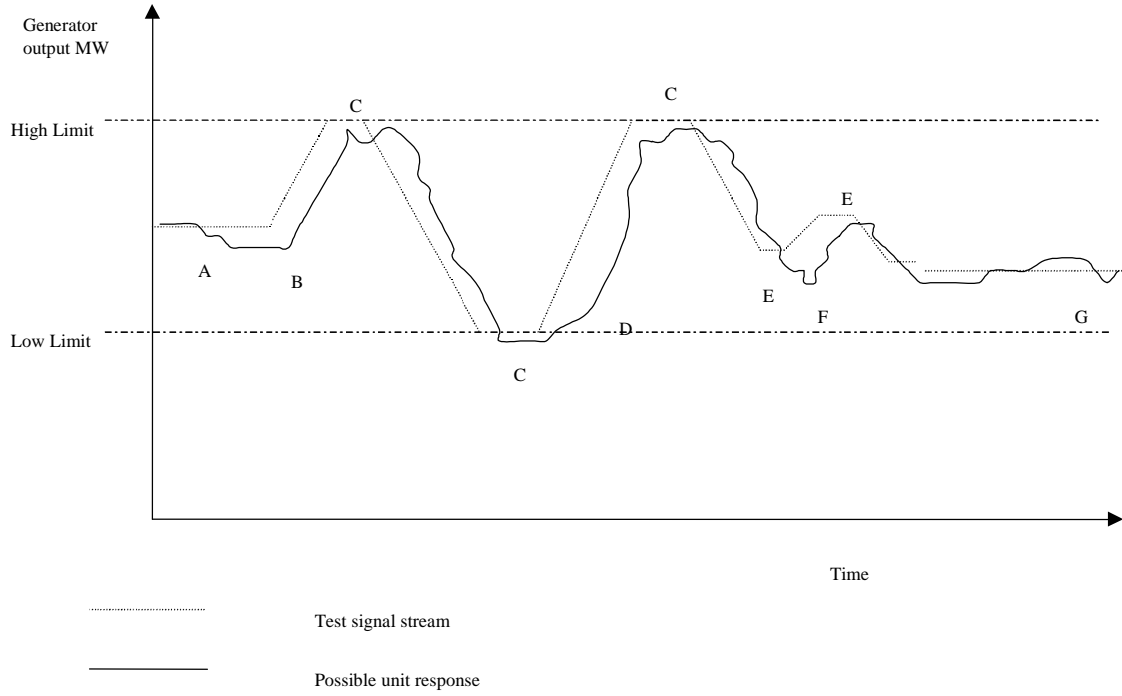


Figure 2 Test Sequence for Regulating Reserve