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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 203.1 of the ISO rules, *Offers and Bids for Energy* ("Section 203.1")

The purpose of this Information Document is to clarify requirements for a pool participant that submits an offer while participating in the energy market.

2   Background

Subsection 6 of Section 203.1 outlines the requirements related to the submission of a ramp rate and ramp table for a generating source asset or a load sink asset.

The ramp rate for a pool asset is a single value representing the current rate at which the pool asset is able to change its level of production or consumption in response to a dispatch or directive. The AESO uses the ramp rate to evaluate ramping compliance under subsection 4(1) of Section 203.4 of the ISO rules, *Delivery Requirements for Energy* ("Section 203.4").

The AESO uses the ramp table to inform dispatch decisions by system controllers. The provision of a ramp table does not replace the ramp rate, or change the obligation of pool participants under Section 203.4. The AESO will continue to use the single submitted ramp rate for compliance purposes.

3   Ramp Table Requirements

The ramp table for an asset represents a detailed breakdown of achievable ramp rates over operating intervals between distinct breakpoints. The breakpoints that define these operating intervals vary based on the asset type: the breakpoint for a generating source asset represents its generation level; the breakpoint for a load sink asset represents its load level.

The ramp rates tabulated in the ramp table also depend on the asset type. The ramp-up ramp rate for a generating source asset represents the rate at which the asset is expected to increase generation in response to a dispatch; conversely, the ramp-down ramp rate represents the rate at which generation is expected to decrease. The ramp-down ramp rate for a load sink asset represents the rate at which the asset is expected to decrease consumption in response to a dispatch; the ramp-up ramp rate represents the rate at which load is expected to increase.

Regardless of asset type, breakpoints share a number of common requirements, including:

- ramp tables for ramp-up ramp rates and ramp-down ramp rates are tabulated separately;
- each breakpoint in a ramp table is expressed as a whole number;
- each breakpoint is unique: ramp tables do not include duplicate values of breakpoints; and
- the total number of intervals between breakpoints does not exceed 10.

The above features apply equally to ramp tables for both generating source assets and load sink assets.

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[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.

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4   Ramp Table for Generating Source Assets

A system controller may issue a dispatch for a generating source asset to deliver power to the energy market. The amount of energy included in a dispatch will range in size between zero MW and the available capability of the asset. The following example shows sample ramp tables for ramp-up ramp rates and ramp-down ramp rates for a generating source asset with a maximum capability of 450 MW.

A generating source asset for which the AESO issues a dispatch up must increase its generation level. The ramp-up ramp rate represents the rate at which the asset is able to increase its generation in response to a dispatch. The ramp table for the ramp-up ramp rate tabulates achievable ramp-up ramp rates between generation levels. Note that system controller will use the ramp table for forecasting purposes to assist in dispatch decision.

Subsection 6(1)(b) of Section 203.1 allows the AESO to specify the manner in which the ramp table is to be provided. Accordingly, the AESO requires each ramp table for ramp-up ramp rates for a generating source asset to list (1) each generation level, expressed in MW, from zero to its maximum capability and sorted from least to greatest; and, (2) the time required to increase generation from the previous generation level (i.e. the ramp-up time). From this information the AESO will calculate the applicable ramp rate in MW/min.

Table 1: Example ramp table for ramp-up ramp rates for a generating source asset

Generation Interval i	(1) Generation Level (MW)	(2) Ramp-Up Time (min)	Ramp-Up Ramp Rate (MW/min)
0	0		
1	11	10	+1.100
2	78	30	+2.233
3	79	440	+0.002
4	160	60	+1.350
5	161	60	+0.017
6	220	40	+1.475
7	445	130	+1.731

From this information, the AESO will calculate the ramp-up ramp rates using the following formula:

$$Ramp\text{-}Up\ Ramp\ Rate_i = \frac{Generation\ Level_i - Generation\ Level_{i-1}}{Ramp\text{-}Up\ Time_i}$$

The ramp-down ramp rate represents the rate at which the asset can decrease its generation. The ramp table for ramp-down ramp rates tabulates achievable ramp-down ramp rates between generation levels.

Each ramp table for ramp-down ramp rates for a generating source asset is required to list (1) each generation level, expressed in MW, from its maximum capability to zero and sorted from greatest to least; and, (2) the time required to decrease source power to each generation level from the previous generation level (i.e. the ramp-down time).

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Table 2: Example ramp table for ramp-down ramp rates for a generating source asset

Generation Interval i	(1) Generation Level (MW)	(2) Ramp-Down Time (min)	Ramp-Down Ramp Rate (MW/min)
0	445		
1	200	60	-4.083
2	60	30	-4.667
3	0	15	-4.000

From this information, the AESO will calculate the ramp-down ramp rates using the following formula:

$$Ramp\text{-}Down\ Ramp\ Rate_i = \frac{Generation\ Level_i - Generation\ Level_{i-1}}{Ramp\text{-}Down\ Time_i}$$

5   Ramp Table for Load Sink Assets Providing Guaranteed Load Reduction

A system controller may issue a dispatch for a load sink asset providing guaranteed load reduction to reduce its load by a specified amount. The amount of load reduction specified in the dispatch will range in size between 0 MW and the available capability of the load sink asset. The following example shows sample ramp-up and ramp-down ramp rates for a load sink asset providing 50 MW of guaranteed load reduction.

The ramp-down ramp rate represents the rate at which a load sink asset providing guaranteed load reduction can decrease its load (i.e. increase its load reduction) in response to a dispatch. The ramp table for ramp-down ramp rates tabulates the achievable ramp-down ramp rates between reduction levels.

For a load sink asset providing guaranteed load reduction, each ramp table for ramp-down ramp rate is required to list: (1) each reduction level, expressed in MW, from zero to its maximum capability and sorted from least to greatest; and (2) the time required to decrease load from the previous breakpoint (i.e. the ramp-down time).

**Figure 3: Example ramp table for ramp-down ramp rates
for load asset providing guaranteed load reduction**

Reduction Interval i	(1) Reduction Level (MW)	(2) Ramp-Down Time (min)	Ramp-Down Ramp Rate (MW/min)
0	0		
1	40	4	+10.000
2	50	2	+5.000

From this information, the AESO will calculate the ramp-down ramp rates using the following formula:

$$Ramp\text{-}Down\ Ramp\ Rate_i = \frac{Reduction\ Level_i - Reduction\ Level_{i-1}}{Ramp\text{-}Down\ Time_i}$$

A load sink asset providing guaranteed load reduction will, when the AESO issues a dispatch to zero MW, increase its load to a minimum of its available capability. The ramp-up ramp rate represents the rate at which a load sink asset providing guaranteed load reduction can increase its load (i.e. decrease its load reduction). The ramp table for ramp-up ramp rates tabulates achievable ramp-up ramp rates between reduction levels.

For a load sink asset providing guaranteed load reduction, each ramp table for ramp-up ramp rates must list: (1) each reduction level, expressed in MW, from its maximum capability to zero and sorted from greatest to least; and (2) the time required to increase load from the previous breakpoint (i.e. the ramp-up time).

Figure 4: Example ramp table for ramp-up ramp rates
for load asset providing guaranteed load reduction

Reduction Interval i	(1) Reduction Level (MW)	(2) Ramp-Up Time (min)	Ramp-Up Ramp Rate (MW/min)
0	50		
1	0	5	-10.000

From this information, the AESO will calculate the ramp-up ramp rates using the following formula:

$$Ramp\text{-}Up\ Ramp\ Rate_i = \frac{Reduction\ Level_i - Reduction\ Level_{i-1}}{Ramp\text{-}Up\ Time_i}$$

6   Ramp Table for Load Sink Assets Providing Firm Consumption Level

A system controller may issue a dispatch for a load sink asset providing firm consumption level to reduce its consumption in the energy market to a specified maximum level.

The ramp-down ramp rate represents the rate at which a load sink asset providing firm consumption level can decrease its consumption. There is no corresponding ramp table for ramp-up ramp rates: a dispatch issued to a load sink asset providing firm consumption level does not require the load sink asset to increase its consumption.

Each ramp table for ramp-down ramp rates for a load sink asset providing firm consumption level is required to list: (1) each load level, expressed in MW, from its maximum load to its contracted firm consumption level, and sorted from greatest to least; and (2) the time required to reduce consumption to each load level from the previous load level.

Figure 5: Example ramp table for ramp-down ramp rates
for load asset providing firm consumption level

Load Interval i	(1) Load Level (MW)	(2) Ramp-Down Time (min)	Ramp-Down Ramp Rate (MW/min)
0	200		
1	100	10	-10.000
2	80	4	-5.000
3	FCL=20	4	-15.000

From this information, the AESO will calculate the ramp-down ramp rates using the following formula:

$$Ramp\text{-}Down\ Ramp\ Rate_i = \frac{Load\ Level_i - Load\ Level_{i-1}}{Ramp\text{-}Down\ Time_i}$$

Note that a load sink asset providing firm consumption level may reach a higher load level than the maximum load level specified in the ramp table for ramp-down ramp rates. In this case, the AESO will apply ramp-down ramp rate$_1$ (i.e. the ramp rate calculated between load intervals 0 and 1).

Revision History

Posting Date	Description of Changes
	Initial release