10-Minute Non-synchronous Reserve Lost Opportunity Cost

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Introduction

This document describes a procedure to determine lost opportunity cost for 10-minute non-synchronous (10NS) reserve units. Lost opportunity costs apply only to units that have been selected to supply 10NS reserve and have not been selected to supply energy. Purpose of the lost opportunity cost is to insure that there is no economic penalty, indeed that there is an economic incentive, associated with bidding in the 10NS market.

Eligibility

A unit is eligible for 10NS reserve lost opportunity costs if:

1. The unit is capable of going from off-line (non-synchronous) to on-line (synchronous) and loaded condition in 10 minutes or less.
2. The unit has participated in the day-ahead energy market by submitting a bid. The entire capacity of the unit must be bid.
3. The unit has participated in the day-ahead and/or real-time 10NS reserve market by submitting a bid. The entire capacity of the unit must be bid.
4. The unit's bid in the day-ahead and/or real-time10NS market has been selected
5. The unit is not running and has not been selected to provide energy

Table of Symbols

Symbol	Description	Units
3600	Seconds per hour	-
CE_{gh}^{DA}	The average day-ahead bid for cost for energy from generating unit "g" in the hour "h" between its minimum generation limit and EH_{gi}^{RT}	$\$/MWh$
CR_{gh}^{DA}	Day-ahead bid for cost of reserve from unit "g" in the hour "h."	$\$/MW$
CR_{gi}^{RT}	Real-time bid for cost of reserve from unit "g" in the hour that contains the dispatch interval "i" in the real-time market.	$\$/MW$
$DAMPR$	Daily average minimum pick-up ratio (AKA average supply ratio)	-
EH_{gi}^{RT}	Estimate of the level of generation that the dispatch would have required from generating unit "g" in the hour that contains the dispatch interval "i" had the generating unit not been withheld for reserve in the real-time market. This is the point where real-time LBMP intersects the generating unit's day-ahead energy bid curve.	MW
INT_i	Length of dispatch interval "i", nominally 300 seconds	sec
$LBMP_{gi}^{RT}$	Real-time locational based marginal price for energy at generating unit "g" in the hour that contains the dispatch interval "i."	$\$/MWh$
LOC_{gi}	Lost opportunity cost for generating unit "g" in the hour that contains the dispatch interval "i."	$
LOC_g	Total daily lost opportunity cost for generating unit "g."	$
LOP_g	Total daily lost opportunity payment to generating unit "g."	$

$NASR_{gi}^{TOT}$	Net ancillary services scheduled revenue paid to generating unit "g" in the hour that contains the dispatch interval "i" as a result of having been scheduled in either the day-ahead or real-time markets[1].	$
R_{gh}^{DA}	Day-ahead 10NS reserve selected from generating unit "g" in the hour "h."	MW
R_{gi}^{RT}	Real-time 10NS reserve selected from generating unit "g" in the hour that contains the dispatch interval "i."	MW

Time Period of Lost Opportunity Cost Calculation

Lost opportunity costs for eligible 10NS reserve generating units shall be determined for each security-constrained dispatch ("dispatch") interval. These are nominally five-minute intervals starting on the hour. Each calculated cost shall apply to one dispatch interval. Interval lost opportunity cost shall be accumulated for each interval in a day.

Lost Opportunity Cost Calculation

Lost opportunity cost shall be calculated for each eligible generator (g) for each dispatch interval (i) according to the equation below, except that the lost opportunity cost shall never be negative. Zero shall be substituted in the event that the equation below yields a negative number.

$$LOC_{gi} = \left[\left(LBMP_{gi}^{RT} - CE_{gi}^{DA} \right) \times EH_{gi}^{RT} \times \frac{INT_i}{3600} \right]$$

Note, the lost opportunity cost calculated above is in addition to payments made to the generating unit for 10NS reserve. Payment to a generating unit for 10NS reserve for a dispatch interval is:

$$\left[\left(R_{gh}^{DA} \times CR_{gh}^{DA} \right) + \left(R_{gi}^{RT} \times CR_{gi}^{RT} \right) \right] \times \frac{INT_i}{3600}$$

Total daily lost opportunity cost for a generating unit shall be the sum of the lost opportunity costs calculated for each dispatch interval during the day.

$$LOC_g = \sum_{i \in day} LOC_{gi}$$

A dispatch interval is assigned to the day at the beginning of the interval. Normally there are 288 dispatch intervals in a day. This number may change from day to day because:

1. Any particular dispatch interval may be longer or shorter than the nominal 600 seconds;
2. Day length is 23 hours at the transition from standard- to day light savings time;
3. Day length is 25 hours at the transition from day light savings- to standard time.

Lost Opportunity Payment

The daily lost opportunity revenue due a generator shall be the daily lost opportunity cost of the generator reduced by the daily average minimum pick-up ratio[2] (AKA average supply ratio). Daily revenue to a generator shall be:

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[1] New York Independent System Operator Market Administration and Control Area Services Tariff, Attachment C.

[2] "Reserve Availability Adjustments for Non-performance," GIRT Resolution No. 99037, June 15, 1999.

$$LOP_g = DAMPR \times LOC_g$$

Daily revenue due a generator shall be accumulated for each day of the billing period and paid upon termination of the billing period.

Net Ancillary Services

Lost opportunity costs of a generator shall be counted toward the total ancillary services[3] paid to the generator. Specifically, the lost opportunity cost of a generator, LOC_g (not the lost opportunity payment LOP_g), shall be included as a term in the net ancillary services revenue, $NASR_{gi}^{TOT}$, for that generator. There shall be no change in day-ahead net ancillary services revenue, $NASR_{gi}^{DA}$, for that generator because of lost opportunity.

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[3] New York Independent System Operator Market Administration and Control Area Services Tariff, Attachment C.