17.1 LBMP Calculation ~~Method~~

The Locational Based Marginal Prices ("LBMPs" or "prices") for Suppliers and Loads in the Real-Time Market will be based on the system marginal costs produced by either the Real-Time Dispatch ("RTD") program~~, or during intervals when it is activated, the RTD-CAM program (together "RTD"),~~ and during intervals when certain conditions exist at Proxy Generator Buses, the Real-Time Commitment ("RTC") program. LBMPs for Suppliers and Loads in the Day-Ahead Market will be based on the system marginal costs produced by the Security Constrained Unit Commitment ("SCUC"). LBMPs calculated by SCUC and RTD will incorporate the incremental dispatch costs of Resources that would be scheduled to meet an increment of Load and, to the extent that tradeoffs exist between scheduling providers to produce Energy or reduce demand, and scheduling them to provide Regulation Service or Operating Reserves, LBMPs shall reflect the effect of meeting an increment of Load at each location on the Bid Production Cost associated with those services. As such, those LBMPs may incorporate: (i) Availability Bids for Regulation Service or Operating Reserves; or (ii) shortage costs associated with the inability to meet a Regulation Service or Operating Reserves requirement under the Regulation Service Demand Curve and Operating Reserve Demand Curves set forth in Rate Schedules 3 and 4 respectively of this ISO Services Tariff.

Additionally, for the purpose of calculating Real-Time LBMPs when RTD is committing and dispatching Resources meeting Minimum Generation Levels ~~as determined by the ISO~~ and capable of starting in ten minutes pursuant to Section 4.4.3.3 of this ISO Services Tariff, RTD shall include in the incremental dispatch cost of each such Resource a start-up cost based on the Start-Up Bid of each such Resource and shall assume for each such Resource a zero downward response rate.

17.1.1 LBMP Bus Calculation Method

System marginal costs will be utilized in an *ex ante* computation to produce Day-Ahead and Real-Time LBMP bus prices using the following equations.

The LBMP at bus i can be written as:

$$\gamma_i = \lambda^R + \gamma^L_i + \gamma^C_i$$

Where:

γ_i = LBMP at bus i in \$/MWh

λ^R = the system marginal price at the Reference Bus

γ_i^L = Marginal Losses Component of the LBMP at bus i which is the marginal cost of losses at bus i relative to the Reference Bus

γ_i^C = Congestion Component of the LBMP at bus i which is the marginal cost of Congestion at bus i relative to the Reference Bus

The Marginal Losses Component of the LBMP at any bus i within the NYCA is calculated using

the equation:

$$\gamma_i^L = (DF_i - 1)\,\lambda^R$$

Where:

DF_i = delivery factor for bus i to the system Reference Bus and:

$$DF_i = \left(1 - \frac{\partial L}{\partial P_i}\right)$$

Where:

L = system losses; and

P_i = injection at bus i

The Congestion Component of the LBMP at bus i is calculated using the equation:

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$$\gamma_i^c = -\left(\sum_{k \in K}^{n} GF_{ik}\mu_k\right)$$, except as noted in Sections 17.1.2.2.1 and 17.1.2.3.1 of this Attachment B

Where:

K = the set of Constraints;

GF_{ik} = Shift Factor for bus i on Constraint k in the pre- or post-Contingency case which limits flows across that Constraint (the Shift Factor measures the incremental change in flow on Constraint k, expressed in per unit, for an increment of injection at bus i and a corresponding withdrawal at the Reference Bus); and

μ_k = the Shadow Price of Constraint k expressed in $/MWh, provided however, this Shadow Price shall not exceed the Transmission Shortage Cost.

Substituting the equations for γ_i^L and γ_i^C into the first equation yields:

$$\gamma_i = \lambda^R + (DF_i - 1)\lambda^R - \sum_{k \in K} GF_{ik}\mu_k$$

LBMPs will be calculated for the Day-Ahead and the Real-Time Markets. In the Day-Ahead Market, the three components of the LBMP at each location will be calculated from the SCUC results and posted for each of the twenty four (24) hours of the next day. The Real-Time LBMPs will be calculated and posted for each execution of RTD.

17.1.2~~1~~ Real-Time LBMP Calculation Procedures

For each RTD interval, the ISO shall use the procedures described below in Sections 17.1.~~1.1~~2.1-17.1.~~1~~2.1.5 to calculate Real-Time LBMPs~~, the Marginal Losses Component, and the Congestion Component~~ at each Load Zone and Generator bus. The LBMP bus and zonal

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calculation procedures are described in Sections 17.1.1 and 17.1.5 of this Attachment B, respectively. Procedures governing the calculation of LBMPs at Proxy Generator Buses are set forth below in Section 17.1.6 of this Attachment B. In addition, when certain conditions exist, as defined in the table below, the ISO shall employ the special scarcity pricing rules described in Sections 17.1.~~1~~2.2 and 17.1.~~1~~2.3.~~ Procedures governing the calculation of LBMPs at External locations are set forth below in Section 17.1.5.~~

SCR/EDRP NYCA Called and Needed	SCR/EDRP East Called and Needed	Scarcity Pricing Rule to be Used in the West	Scarcity Pricing Rule to be Used in the East
NO	**NO**	**NONE**	**NONE**
NO	**YES**	**NONE**	**B**
YES	**NO**	**A**	**A**
YES	**YES**	**A**	**A**

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Where:

SCR/EDRP NYCA, Called and Needed	Is "YES" if the ISO has called SCR/EDRP resources and determined that, but for the Expected Load Reduction, the Available Reserves would have been less than the NYCA requirement for total 30-Minute Reserves; or is "NO" otherwise.
SCR/EDRP East, Called and Needed	Is "YES" if the ISO has called SCR/EDRP from resources located East of Central-East and determined that, but for the Expected Load Reduction, the Available Reserves located East of Central-East would have been less than the requirement for 10-Minute Reserves located East of Central-East; or is "NO" otherwise.
Pricing Rule West	Identifies the scarcity pricing rule that will be used, if applicable, to determine the LBMP, the Congestion Component of LBMP, and the Marginal Losses Component of LBMP for all buses and Load Zones located West of Central-East, including the Reference Bus.
Pricing Rule East	Identifies the scarcity pricing rule that will be used, if applicable, to determine the LBMP, the Congestion Component of LBMP, and the Marginal Losses Component of LBMP for all buses and Load Zones located East of Central-East.

17.1.~~1~~2.1 General Procedures

17.1.~~1~~2.1.1 Overview

The ISO shall calculate Real-Time Market LBMPs using the three passes of each ~~Real-Time Dispatch~~RTD run, except as noted below in Section 17.1.1.1.3. A new ~~Real-Time Dispatch~~RTD run will ~~begin~~initialize every five minutes and each run will produce prices and schedules for five points in time (the optimization period). Only the prices and schedules determined for the first time point ~~in time of a Real-Time Dispatch run~~of the optimization period will be binding. Prices and schedules for the other four time pointsof the optimization period are ~~in time shall be~~ advisory~~ only~~.

Each ~~Real-Time Dispatch~~RTD run shall, depending on when it occurs during the hour, have a bid optimization horizon of fifty, fifty-five, or sixty minutes beyond the first, or binding, point in time that it addresses. The posting time and the first time point in each RTD run, which establishes binding prices and schedules, will be five minutes apart.~~The first and second points of time in each Real-Time Dispatch run will be five minutes apart.~~ The remaining points in time in each ~~run~~optimization period can be either five, ten, or fifteen minutes apart depending on when the run begins within the hour. The points in time in each RTD ~~run~~optimization period are arranged so that they parallel as closely as possible RTC's fifteen minute evaluations.

For example, the RTD run that posts its results at the beginning of an hour ("RTD_0") will initialize at the fifty-fifth minute of the previous hour and produce schedules and prices over a fifty-five minute optimization period. RTD_0 will produce binding prices and schedules for the RTD interval beginning when it posts its results (i.e., at the beginning of the hour) and ending at the first time point in its optimization period (i.e., five minutes after the hour). It will produce advisory prices and schedules for its second time point, which is ten minutes after the first time point in its optimization period, and advisory prices and schedules for its third, fourth and fifth time points, each of which would be fifteen minutes apart. The RTD run that posts its results at five minutes after the beginning of the hour ("RTD_5") will initialize at the beginning of the hour and produce prices over a fifty minute optimization period. RTD_5 will produce binding prices and schedules for the RTD interval beginning when it posts its results (i.e., at five minutes after the hour) and ending at the first time point in its optimization period (i.e., ten minutes after the hour.) It will produce advisory prices and schedules for its second time point (which is five minutes after the first time point), and advisory prices and schedules for its third, fourth and fifth time points, each of which would be fifteen minutes apart. The RTD run that posts its results at ten minutes after the beginning of the hour ("RTD_{10}") will initialize at five minutes after the beginning of the hour and produce prices over a sixty minute optimization period. RTD_{10} will produce binding prices and schedules for the interval beginning when it posts its results (i.e., at ten minutes after the hour) and ending at the first time point in its optimization period (i.e., fifteen minutes after the hour.) It will produce advisory prices and schedules for its second, third, fourth and fifth time points, each of which would be fifteen minutes after the preceding time point.

17.1.~~1~~2.1.2 Description of the Real-Time Dispatch Process

17.1.~~1~~2.1.2.1 The First Pass

The first ~~Real-Time Dispatch~~RTD pass consists of a least bid cost, multi-period co-optimized dispatch for Energy, Regulation Service and Operating Reserves that treats all Fixed Block Units that are committed by RTC, or are otherwise instructed to be online or remain online by the ISO as if they were blocked on at their UOL_N or UOL_E, whichever is applicable. Resources meeting Minimum Generation Levels and capable of being started in ten minutes that have not been committed by RTC are treated as flexible (i.e. able to be dispatched anywhere between zero (0) MW and their UOL_N or UOL_E, whichever is applicable). The first pass establishes "physical base points" (i.e., real-time Energy schedules) and real-time schedules for Regulation Service and Operating Reserves for the first time point of the ~~run~~optimization period. Physical base points and schedules established for the first time point shall be binding and shall remain in effect until the results of the next run are posted. Physical base points and schedules established for all subsequent time points shall be advisory. The first pass also produces information that is used to calculate the RTD Base Point Signals that the ISO sends to Suppliers.

When establishing physical base points, the ISO shall assume that each Generator will move toward the physical base point established during the first pass of the prior ~~Real-Time Dispatch~~RTD run at its specified response rate.

17.1.~~1~~2.1.2.1.1 Upper and Lower Dispatch Limits for Dispatchable Resources Other Than Intermittent Power Resources That Depend on Wind as Their Fuel

When setting physical base points for a Dispatchable Resource at the first time point, the ISO shall ensure that they do not fall outside of the bounds established by the Dispatchable Resource's lower and upper dispatch limits. A Dispatchable Resource's dispatch limits shall be determined based on whether it was feasible for it to reach the physical base point calculated by the last RTD run given its: (A) metered output level at the time that the ~~Real-Time Dispatch~~RTD run was initialized; (B) response rate; (C) minimum generation level; and (D) UOL_N or UOL_E, whichever is applicable. If it was feasible for the Dispatchable Resource to reach that base point, then its upper and lower dispatch limits shall reflect the highest and lowest output levels it could achieve over the next RTD interval, given its UOL_N or UOL_E, as applicable, and starting from its previous base point. If it was not feasible for the Dispatchable Resource to reach that base point, then its upper and lower dispatch limits shall reflect the highest and lowest output levels it could achieve over the next RTD interval, given its UOL_N or UOL_E, as applicable, but instead starting from the feasible output level closest to its previous base point.

When setting physical base points for a Dispatchable Resource at later time points, the ISO shall ensure that they do not fall outside of the bounds established by the Resource's lower and upper dispatch limits for that time point. A Resource's dispatch limits at later time points shall be based on its: (A) dispatch limits from the first time point; (B) response rate; (C) minimum generation~~, or, to the extent that the ISO's software can support demand side participation, Demand Reduction level~~; and (D) UOL_N or UOL_E, whichever is applicable.

The upper dispatch limit for a Dispatchable Resource at later time points shall be determined by increasing the upper dispatch limit from the first time point at the Resource's response rate, up to its UOL_N or UOL_E, whichever is applicable. The lower dispatch limit for a Dispatchable Resource at later time points shall be determined by decreasing the lower dispatch limit from the first time point at the Resource's response rate, down to its minimum generation level or~~, to the extent that the ISO's software can support demand side participation,~~ to a Demand Side Resource's Demand Reduction level.

The RTD Base Point Signals sent to Dispatchable Resources shall be the same as the physical base points determined above.

17.1.~~1~~2.1.2.1.2 Upper and Lower Dispatch Limits for Intermittent Power Resources That Depend on Wind as Their Fuel

~~For the first time point and later time points for Intermittent Power Resources depending on wind as their fuel~~For all time points of the optimization period, the Lower Dispatch Limit shall be zero and the Upper Dispatch Limit shall be the Wind Energy Forecast for that Resource. For Intermittent Power Resources depending on wind as their fuel in commercial operation as of

January 1, 2002 with a name plate capacity of 12 MWs or fewer, the Upper and Lower Dispatch Limits shall be the output level specified by the Wind Energy Forecast.

17.1.~~1~~2.1.2.1.3. Setting Physical Basepoints for Fixed Generators

When setting physical base points for Self-Committed Fixed Generators in any time point, the ISO shall consider the feasibility of the Resource reaching the output levels that it specified in its self-commitment request for each time point in the RTD run given: (A) its metered output at the time that the run was initialized; and (B) its response rate.

When setting physical base points for ISO-Committed Fixed Generators in any time point, the ISO shall consider the feasibility of the Resource reaching the output levels scheduled for it by RTC for each time point in the RTD run given: (A) its metered output at the time that the run was initialized; and (B) its response rate.

The RTD Base Point Signals sent to Self-Committed Fixed Generators shall follow the quarter hour operating schedules that those Generators submitted in their real-time self-commitment requests

The RTD Base Point Signals sent to ISO-Committed Fixed Generators shall follow the quarter hour operating schedules established for those Generators by RTC, regardless of their actual performance. To the extent possible, the ISO shall honor the response rates specified by such Generators when establishing RTD Base Point Signals. If a Self-Committed Fixed Generator's operating schedule is not feasible based on its real-time self-commitment requests then its RTD Base Point Signals shall be determined using a response rate consistent with the operating schedule changes.

17.1.~~1~~2.1.2.2 The Second Pass

The second ~~Real-Time Dispatch~~RTD pass consists of a least bid cost, multi-period, co-optimized dispatch for Energy, Regulation Service, and Operating Reserves that treats all Fixed Block Units that are committed by RTC, all Resources meeting Minimum Generation Levels and capable of starting in ten minutes that have not been committed by RTC and all units otherwise instructed to be online or remain online by the ISO, as flexible (i.e., able to be dispatched anywhere between zero (0) MW and their UOL_N or UOL_E, whichever is applicable), regardless of their minimum run-time status. This pass shall establish "hybrid base points" (i.e., real-time Energy schedules) that are used in the third pass to determine whether minimum run-time constrained Fixed Block Units should be blocked on at their UOL_N or UOL_E, whichever is applicable, or dispatched flexibly. The ISO will not use schedules for Energy, Regulation Service and Operating Reserves established in the second pass to dispatch Resources.

The upper and lower dispatch limits used for ISO-Committed Fixed and Self-Committed Fixed Resources shall be the same as the physical base points calculated in the first pass.

17.1.~~1~~2.1.2.2.1 Upper and Lower Dispatch Limits for Dispatchable Resources Other Than Intermittent Power Resources That Depend on Wind as Their Fuel

The upper dispatch limit for the first time point of the second pass for a Dispatchable Resource shall be the higher of: (A) its upper dispatch limit from the first pass; or (B) its "pricing base point" from the first time point of the prior RTD interval adjusted up within its Dispatchable range for any possible ramping since that pricing base point was issued less the higher of: (i) the physical base point established during the first pass of the ~~Real-Time Dispatch~~RTD immediately prior to the previous ~~Real-Time Dispatch~~RTD minus the Resource's metered output level at the time that the current ~~Real-Time Dispatch~~RTD run was initialized, or (ii) zero.

The lower dispatch limit for the first time point of the second pass for a Dispatchable Resource shall be the lower of: (A) its lower dispatch limit from the first pass; or (B) its "pricing base point" from the first time point of the prior RTD interval adjusted down within its Dispatchable range to account for any possible ramping since that pricing base point was issued plus the higher of: (i) the Resource's metered output level at the time that the current ~~Real-Time Dispatch~~RTD run was initialized minus the physical base point established during the first pass of the ~~Real-Time Dispatch~~RTD immediately prior to the previous ~~Real-Time Dispatch~~RTD; or (ii) zero.

The upper dispatch limit for the later time points of the second pass for a Dispatchable Resource shall be determined by increasing its upper dispatch limit from the first time point at the Resource's response rate, up to its UOL_N or UOL_E, whichever is applicable. The lower dispatch limit for the later time points of the second pass for such a Resource shall be determined by decreasing its lower dispatch limit from the first time point at the Resource's response rate, down to its minimum generation level.

17.1.~~1~~2.1.2.2.2 Upper and Lower Dispatch Limits for Intermittent Power Resources That Depend on Wind as Their Fuel

For the first time point and later time points for Intermittent Power Resources that depend on wind as their fuel, the Lower Dispatch Limit shall be zero and the Upper Dispatch Limit shall be the Wind Energy Forecast for that Resource. For Intermittent Power Resources depending on wind as their fuel in commercial operation as of January 1, 2002 with a name plate capacity of 12 MWs or fewer, the Upper and Lower Dispatch Limits shall be the output level specified by the Wind Energy Forecast.

17.1.~~1~~2.1.2.3 The Third Pass

The third ~~Real-Time Dispatch~~RTD pass is the same as the second pass with three variations. First, the third pass treats Fixed Block Units that are committed by RTC, or are otherwise instructed to be online or remain online by the ISO that received a non-zero physical base point in the first pass, and that received a hybrid base point of zero in the second pass, as blocked on at their UOL_N or UOL_E, whichever is applicable. Second, the third pass produces "pricing base points" instead of hybrid base points. Third, and finally, the third pass calculates real-time

Energy prices and real-time Shadow Prices for Regulation Service and Operating Reserves that the ISO shall use for settlement purposes pursuant to Article 4, Rate Schedule 15.3, and Rate Schedule 15.4 of this ISO Services Tariff respectively. The ISO shall not use schedules for Energy, Regulation Service and Operating Reserves that are established in the third pass to dispatch Resources.

17.1.~~1~~2.1.3 Variations in RTD-CAM

When the ISO activates RTD-CAM, the following variations to the rules specified above in Sections 17.1.~~1~~2.1.1 and 17.1.~~1~~2.1.2 shall apply.

First, if the ISO enters reserve pickup mode: (i) the ISO will produce prices and schedules for a single ten minute interval (not for a multi-point co-optimization period); (ii) the Regulation Service markets will be temporarily suspended as described in Rate Schedule 15.3 of this ISO Services Tariff; (iii) the ISO will have discretion to make additional Generator commitments before executing the three ~~Real-Time Dispatch~~RTD passes; and (iv) the ISO will have discretion to allow the RTD Base Point Signal of each Dispatchable Generator to be set to the higher of the Generator's physical base point or its actual generation level.

Second, if the ISO enters maximum generation pickup mode: (i) the ISO will produce prices and schedules for a single five minute interval (not for a multi-point co-optimization period); (ii) the Regulation Service markets will be temporarily suspended as described in Rate Schedule 15.3 of this ISO Services Tariff; (iii) the ISO will have discretion to make additional Generator commitments in the affected area before executing the three ~~Real-Time Dispatch~~RTD passes; and (iv) the ISO will have discretion to either move the RTD Base Point Signal of each Generator within the affected area towards its UOL_E at its emergency response rate or set it at a level equal to its physical base point.

Third, if the ISO enters basepoints ASAP – no commitments mode it will produce prices and schedules for a single five minute interval (not for a multi-point co-optimization period).

Fourth, if the ISO enters basepoints ASAP – commit as needed mode: (i) the ISO will produce price and schedules for a single five minute interval (not for a multi-point co-optimization period); and (ii) the ISO may make additional commitments of Generators that are capable of starting within ten minutes before executing the three ~~Real-Time Dispatch~~RTD passes.

Fifth, and finally, if the ISO enters re-sequencing mode it will solve for a ten-minute optimization period consisting of two five-minute time points.

~~17.1.1.1.4 Calculating the Marginal Losses and Congestion Components~~

~~The Marginal Losses Component of the price at each location shall be calculated as the product of the price at the Reference Bus and a quantity equal to the delivery factor produced by RTD for that location minus one (1).~~

~~The Congestion Component of the price at each location shall be calculated as the price at that location, minus the Marginal Losses Component of the price at that location, minus the price at the Reference Bus.~~

17.1.~~1~~2.1.~~5~~4 The Real-Time Commitment ("RTC") Process and Automated Mitigation

Attachment H ~~to the~~of this Services Tariff shall establish automated market power mitigation measures that may affect the calculation of Real-Time LBMPs. To the extent that these measures are implemented they shall be incorporated into the RTC software through the establishment of a second, parallel, commitment evaluation that will assess the impact of the mitigation measures. The first evaluation, referred to as the "RTC evaluation," will determine the schedules and prices that would result using an original set of offers and Bids before any additional mitigation measures, the necessity for which will be considered in the RTC evaluation, are applied. The second evaluation, referred to as the "RT-AMP" evaluation, will determine the schedules and prices that would result from using the original set of offers and bids as modified by any necessary mitigation measures. Both evaluations will follow the rules governing RTC's operation that are set forth in Article 4 and this Attachment B to ~~the~~this ISO Services Tariff ~~(as well as the corresponding provisions of Attachment J to the ISO OATT)~~.

In situations where Attachment H specifies that real-time automated mitigation measures be utilized, the ISO will perform the two parallel RTC evaluations in a manner that enables it to implement mitigation measures one RTC run (i.e., fifteen minutes) in the future. For example, RTC_{15} and $RT\text{-}AMP_{15}$ will perform Resource commitment evaluations simultaneously. $RT\text{-}AMP_{15}$ will then apply the mitigation "impact" test, account for reference bid levels as appropriate and determine which Resources are actually to be mitigated. This information will then be conveyed to RTC_{30} which will make Resource commitments consistent with the application of the mitigation measures (and will thus indirectly be incorporated into future RTD runs).

17.1.~~1~~2.2 Scarcity Pricing Rule "A"

The ISO shall implement the following price calculation procedures for intervals when scarcity pricing rule "A" is applicable.

17.1.~~1~~2.2.1 Except as noted in 17.1.~~1~~2.2.2 below:

- The system marginal price (λ^R , as defined in Section 17.1.1 of this Attachment B)~~The LBMP~~ at the Reference Bus shall be determined by dividing the lowest offer price at which the quantity of Special Case Resources offered is equal to $RREQ_{NYCA} – (RACT_{NYCA} – ELR_{NYCA})$, or $500/MWh if the total quantity of Special Case Resources offered is less than $RREQ_{NYCA} – (RACT_{NYCA} – ELR_{NYCA})$, by the weighted average of the delivery factors produced by RTD that the ISO uses in its calculation of prices for Load Zone J in that RTD interval,

where:

- $RACT_{NYCA}$ equals the quantity of Available Reserves in the RTD interval;
- $RREQ_{NYCA}$ equals the 30-Minute Reserve requirement set by the ISO for the NYCA; and
- ELR_{NYCA} equals the Expected Load Reduction in the NYCA from the Emergency Demand Response Program and Special Case Resources in that RTD interval.

- The Marginal Losses Component of the LBMP at each location shall be calculated as the product of the LBMP at the Reference Bus and a quantity equal to the delivery factor produced by RTD for that location minus one as defined in Section 17.1.1 of this

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Attachment~~. The LBMP at each location shall be the sum of the Marginal Losses Component of the LBMP at that location, plus the LBMP at the Reference Bus.~~

- The Congestion Component of the LBMP at each location shall be set to zero.
- The LBMP at each location shall be as defined in Section 17.1.1 of this Attachment: the sum of the Marginal Losses Component of the LBMP at that location, plus the Congestion Component of the LBMP at that location, plus the LBMP at the Reference Bus.

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17.1.1.2.2 However, the ISO shall not use this procedure to set the LBMP for any location lower than the LBMP for that Load Zone or Generator bus calculated pursuant to Section 17.1.~~1~~2.1, above. In cases in which the procedures described above would cause this rule to be violated:

- The LBMP at each location (including the Reference Bus) shall be set to the greater of the LBMP calculated for that location pursuant to Section 17.1.~~1~~2.1 of this Attachment B; or the LBMP calculated for that location using the scarcity pricing rule "A" procedures.
- The Marginal Losses Component of the LBMP at each location shall be calculated as the product of the LBMP at the Reference Bus and a quantity equal to the delivery factor produced by RTD for that location minus one.
- The Congestion Component of the LBMP at each location shall be calculated as the LBMP at that location, minus the LBMP at the Reference Bus, minus the Marginal Losses Component of the LBMP at that location.

17.1.~~1~~2.3 Scarcity Pricing Rule "B"

The ISO shall implement the following procedures in intervals when scarcity pricing rule "B" is applicable;

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17.1.~~1~~2.3.1 Except as noted in Pricing Rule 17.1.~~1~~2.3.2 below:

- The Marginal Losses Component of the LBMP at each location shall be calculated as the product of the LBMP calculated for the Reference Bus (according to Section 17.1.~~1~~2.1) and a quantity equal to the delivery factor produced by RTD for that location minus one.

- The Congestion Component of the LBMP at each location shall be equal to the lowest offer price at which the quantity of Special Case Resources offered is equal to $RREQ_{East}$ – ($RACT_{East}$ – ELR_{East}), or \$500/MWh if the total quantity of Special Case Resources offered is less than $RREQ_{East}$ – ($RACT_{East}$– ELR_{East}), minus the LBMP calculated for the Reference Bus (according to Section 17.1.~~1~~2.1), minus the Marginal Losses Component of the LBMP for Load Zone J,

  where:

- $RACT_{East}$ equals the quantity of Available Reserves located East of Central-East in that RTD interval;

- $RREQ_{East}$ equals the 10-Minute Reserve requirement set by the ISO for the portion of the NYCA located East of the Central-East interface; and

- ELR_{East} equals the Expected Load Reduction East of Central-East from the Emergency Demand Response Program and Special Case Resources in that RTD interval.

- The LBMP at each location shall be the sum of the LBMP calculated for the Reference Bus (according to Section 17.1.~~1~~2.1) and the Marginal Loss Component and the Congestion Component for that location.

17.1.~~1~~2.3.2 However, the ISO shall not use this procedure to set the LBMP for any location lower than the LBMP for that Load Zone or Generator bus calculated pursuant to Section 17.1.~~1~~2.1, above. In cases in which the procedures described above would cause this rule to be violated:

- The LBMP at each such location shall be set to the LBMP calculated for that location pursuant to Section 17.1.~~1~~2.1
- The Marginal Losses Component of the LBMP at each location shall be calculated as the product of the LBMP calculated for the Reference Bus (according to Section 17.1.~~1~~2.1) and a quantity equal to the delivery factor produced by RTD for that location minus one.
- The Congestion Component of the LBMP at each such location shall be calculated as the LBMP at that location, minus the LBMP calculated for the Reference Bus (according to Section 17.1.~~1~~2.1), minus the Marginal Losses Component of the LBMP at that location.

17.1.~~2~~3 Day-Ahead LBMP Calculation Procedures

LBMPs in the Day-Ahead Market are calculated using five passes. The first two passes are commitment and dispatch passes; the last three are dispatch only passes.

Pass 1 consists of a least cost commitment and dispatch to meet Bid Load and reliable operation of the NYS Power System that includes Day-Ahead Reliability Units.

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It consists of several steps. Step 1A is a complete Security Constrained Unit Commitment ("SCUC") to meet Bid Load. At the end of this step, committed Fixed Block Units, Imports, Exports, V~~v~~irtual S~~s~~upply, V~~v~~irtual L~~l~~oad, Demand Side Resources and non-Fixed Block Units are dispatched to meet Bid Load with Fixed Block Units treated as dispatchable on a flexible basis. For mitigation purposes, LBMPs are calculated from this dispatch. Following Step 1A, SCUC tests for automated mitigation procedure ("AMP") activation.

If AMP is activated, Step 1B tests to determine if the AMP will be triggered by mitigating offer prices subject to mitigation that exceed the conduct threshold to their respective reference prices. These mitigated offer prices together with all originally submitted offer prices not subject to automatic mitigation are then used to commit generation and dispatch energy to meet Bid Load. This step is another iteration of the ~~Security Constrained Unit Commitment~~SCUC process. At the end of Step 1B, committed Fixed Block Units, Imports, Exports, V~~v~~irtual S~~s~~upply, V~~v~~irtual L~~l~~oad, Demand Side Resources, and non-Fixed Block Units are again dispatched to meet Bid Load using the same mitigated or unmitigated Bids used to determine the commitment to meet Bid Load, with Fixed Block Units treated as dispatchable on a flexible basis. For mitigation purposes, LBMPs are again calculated from this dispatch. The LBMPs determined at the end of Step 1B are compared to the LBMPs determined at the end of Step 1A to determine the hours and zones in which the impact test is met.

In Step 1C, generation offer prices subject to mitigation that exceed the conduct threshold are mitigated for those hours and zones in which the impact test was met in Step 1B. The mitigated offer prices, together with the original unmitigated offer price of units whose offer prices were not subject to mitigation, or did not trigger the conduct or impact thresholds, are used to commit generation and dispatch energy to meet Bid Load. This step is also a complete iteration of the ~~Security Constrained Unit Commitment~~SCUC process. At the end of Step 1C, committed Fixed Block Units, Imports, Exports, virtual supply, virtual load, Demand Side Resources, and non-Fixed Block Units are again dispatched to meet Bid Load, with Fixed Block Units treated as dispatchable on a flexible basis. For mitigation purposes, LBMPs are again calculated from this dispatch.

All Demand Side Resources and non-Fixed Block Units committed in the final step of Pass 1 (which could be either step 1A, 1B, or 1C depending on activation of and the AMP) are blocked on at least to minimum load in Passes 4 through 6. The resources required to meet local system reliability are determined in Pass 1.

Pass 2 consists of a least cost commitment and dispatch of Fixed Block Units, Imports, Exports, Demand Side Resources and non-Fixed Block Units to meet forecast Load requirements in excess of Bid Load, considering the Wind Energy Forecast, that minimizes the cost of incremental Minimum Generation and Start Up Bids, given revenues for Minimum Generation Energy based on LBMPs calculated in Pass 1, and assumes all Fixed Block Units are dispatchable on a flexible basis. Incremental Import Capacity needed to meet forecast Load requirements is determined in Pass 2. Fixed Block Units committed in this pass are not included in the least cost dispatches of Passes 5 or 6. Demand Side Resources and non-Fixed Block Units committed in this step are blocked on at least to minimum Load in Passes 4 through 6. Intermittent Power Resources that depend on wind as their fuel committed in this pass as a result of the consideration of the Wind Energy Forecast are not blocked in Passes 5 or 6.

Pass 3 is reserved for future use.

Pass 4 consists of a least cost dispatch to forecast Load. It is not used to set schedules or prices. It is used for operational purposes and provides a dispatch of Fixed Block Units, Imports, Exports, Demand Side Resources and non-Fixed Block Units committed in Passes 1 or 2. Incremental Import Capacity committed in Pass 2 is re-evaluated and may be reduced if no longer required.

Pass 5 consists of a least cost dispatch of Fixed Block Units, Importss, Exports, ~~v~~Virtual ~~s~~Supply, ~~v~~Virtual ~~l~~Load, Demand Side Resources and non-Fixed Block Units committed to meet Bid Load, based where appropriate on offer prices as mitigated in Pass 1. Fixed Block Units are treated as dispatchable on a flexible basis. LBMPs used to settle the Day-Ahead Market are calculated from this dispatch. The Shadow Prices used to compute Day-Ahead Market clearing prices for Regulation Service and for Operating Reserves in Rate Schedules 3 and 4 of this ISO Services Tariff are also calculated from this dispatch. Final schedules for all Imports, Exports, ~~v~~Virtual ~~s~~Supply, ~~v~~Virtual ~~l~~Load, Demand Side Resources and non-Fixed Block Units in the Day-Ahead Market are calculated from this dispatch.

Pass 6 consists of a least cost dispatch of all Day-Ahead committed Resources, Imports, Exports, ~~v~~Virtual ~~s~~Supply, ~~v~~Virtual ~~l~~Load, based where appropriate on offer prices as mitigated in Pass 1, with the schedules of all Fixed Block Units committed in the final step of Pass 1 blocked on at maximum Capacity. Final schedules for Fixed Block Units in the Day-Ahead Market are calculated from this dispatch.

~~17.1.3 LBMP Calculation Method~~

~~System marginal costs will be utilized in an *ex ante* computation to produce Day-Ahead and Real-Time LBMP bus prices using the following equations.~~

~~The LBMP at bus i can be written as:~~

~~$\gamma_i = \lambda^R + \gamma^L_i + \gamma^C_i$~~

~~Where:~~

~~γ_i~~	~~=~~	~~LBMP at bus i in \$/MWh~~
~~λ^R~~	~~=~~	~~the system marginal price at the Reference Bus~~
~~γ^L_i~~	~~=~~	~~Marginal Losses Component of the LBMP at bus i which is the marginal cost of losses at bus i relative to the Reference Bus~~
~~γ^C_i~~	~~=~~	~~Congestion Component of the LBMP at bus i which is the marginal cost of Congestion at bus i relative to the Reference Bus~~

~~The Marginal Losses Component of the LBMP at any bus i within the NYCA is~~

~~calculated using~~

~~the equation:~~

~~$\gamma^L_i = (DF_i - 1)\,\lambda^R$~~

~~Where:~~

~~DF_i = delivery factor for bus i to the system Reference Bus and:~~

~~$DF_i = \left(1 - \frac{\partial L}{\partial P_i}\right)$~~

~~Where:~~

~~L = system losses; and~~

~~P_i = injection at bus i~~

~~The Congestion Component of the LBMP at bus i is calculated using the equation:~~

~~$\gamma^c_i = -\left(\sum_{k \in K}^{n} GF_{ik}\mu_k\right)$~~

~~Where:~~

~~K = the set of Constraints;~~

~~GF_{ik} = Shift Factor for bus i on Constraint k in the pre- or post-Contingency case which limits flows across that Constraint (the Shift Factor measures the incremental change in flow on Constraint k, expressed in per unit, for an increment of injection at bus i and a corresponding withdrawal at the Reference Bus); and~~

~~μ_k = the Shadow Price of Constraint k expressed in \$/MWh, provided however, this Shadow Price shall not exceed the Transmission Shortage Cost.~~

~~Substituting the equations for γ_i^L and γ_i^C into the first equation yields:~~

$$\cancel{\gamma_i = \lambda^R + (DF_i - 1)\lambda^R - \sum_{k \in K} GF_{ik}\,\mu_k}$$

~~LBMPs will be calculated for the Day-Ahead and the Real-Time Markets. In the Day-Ahead Market, the three components of the LBMP at each location will be calculated from the SCUC results and posted for each of the twenty four (24) hours of the next day. The Real-Time LBMPs will be calculated and posted for each execution of RTD.~~

17.1.4 Determination of Transmission Shortage Cost

The Transmission Shortage Cost represents the limit on system costs associated with efficient dispatch to meet a particular Constraint. It is the maximum Shadow Price that will be used in calculating LBMPs. The Transmission Shortage Cost is set at \$4000 / MWh.

The ISO may periodically evaluate the Transmission Shortage Cost to determine whether it is necessary to modify the Transmission Shortage Cost to avoid future operational or reliability problems. The ISO will consult with its Market Monitoring Unit after it conducts this evaluation. If the ISO determines that it is necessary to modify the Transmission Shortage Cost in order to avoid future operational or reliability problems the resolution of which would otherwise require recurring operator intervention outside normal market scheduling procedures, in order to avoid among other reliability issues, a violation of NERC Interconnection Reliability Operating Limits or System Operating Limits, it may temporarily modify it for a period of up to ninety days, provided however the NYISO shall file such change with the Commission pursuant to Section 205 of the Federal Power Act within 45 days of such modification. If circumstances reasonably allow, the ISO will consult with its Market Monitoring Unit, the Business Issues Committee, the Commission, and the PSC before implementing any such modification. In all circumstances, the ISO will consult with those entities as soon as reasonably possible after implementing a temporary modification and shall explain the reasons for the change.

The responsibilities of the ISO and the Market Monitoring Unit ~~that~~in evaluating and modifying the Transmission Shortage Cost, as necessary are addressed in ~~the above section of Attachment B to the Services Tariff are also addressed in Section 30.4.6.5.1 of the Market Monitoring Plan~~Attachment O, Section 30.4.6.8.1 of this Market Services Tariff (“Market Monitoring Plan”).

17.1.5 Zonal LBMP Calculation Method

The computation described ~~above~~in Section 17.1.1 of this Attachment B is at the bus level. An eleven (11) zone model will be used for the LBMP billing related to Loads. The LBMP for a zone will be a Load weighted average of the Load bus LBMPs in the zone. The Load weights which will sum to unity will be ~~predetermined by the ISO~~calculated from the load bus MW distribution. Each component of the LBMP for a zone will be calculated as a Load weighted average of the Load bus LBMP components in the zone. The LBMP for a zone *j* can be written as:

$$\gamma_j^Z = \lambda^R + \gamma_j^{L,Z} + \gamma_j^{C,Z}$$

where:

γ_j^Z = LBMP for zone j,

$\gamma_j^{L,Z} = \sum_{i=1}^{n} W_i \gamma_i^L$ is the Marginal Losses Component of the LBMP for zone j;

$\gamma_j^{C,Z} = \sum W_i \gamma_i^C$ is the Congestion Component of the LBMP for zone j;

n = number of Load buses in zone j for which LBMPs are calculated; and

W_i = load weighting factor for bus i.

~~The zonal LBMPs will be a weighted average of the Load bus LBMPs in the zone. The weightings will be predetermined by the ISO.~~

17.1.6 Real Time LBMP Calculation Methods for Proxy Generator Buses, Non-Competitive Proxy Generator Buses and Proxy Generator Buses Associated with Designated Scheduled Lines

17.1.6.1 General Rules

External Generators and Loads can bid into the LBMP Market or participate in Bilateral Transactions. External Generators may arrange Bilateral Transactions with Internal or External Loads and External Loads may arrange Bilateral Transactions with Internal Generators.

The Generator and Load locations for which LBMPs will be calculated will initially be limited to a pre-defined set of buses External to the NYCA. LBMPs will be calculated for each bus within this limited set. The three components of LBMP will be calculated from the results of RTD, or, except as set forth in Sections 17.1.6.2 and 17.1.6.3 below, in the case of a Proxy Generator Bus, from the results of RTC_{15} during periods in which (1) proposed economic transactions over the Interface between the NYCA and the Control Area with which that Proxy

Generator Bus is associated would exceed the Available Transfer Capability for the Proxy Generator Bus or for that Interface, (2) proposed interchange schedule changes pertaining to the NYCA as a whole would exceed any Ramp Capacity limits in place for the NYCA as a whole, or (3) proposed interchange schedule changes pertaining to the Interface between the NYCA and the Control Area with which that Proxy Generator Bus is associated would exceed any Ramp Capacity limit imposed by the ISO for the Proxy Generator Bus or for that Interface.

17.1.6.2 Rules for Non-Competitive Proxy Generator Buses

Real-Time LBMPs for a Non-Competitive Proxy Generator Bus shall be determined as follows. When (i) proposed Real-Time Market economic net Import transactions into the NYCA from the Control Area in which the Non-Competitive Proxy Generator Bus is located would exceed the Available Transfer Capability for the Interface between the NYCA and the Control Area in which the Non-Competitive Proxy Generator Bus is located or would exceed the Available Transfer Capability of the Non-Competitive Proxy Generator Bus, or (ii) proposed interchange schedule changes pertaining to increases in Real-Time Market net imports into the NYCA from the Control Area in which the Non-Competitive Proxy Generator Bus is located would exceed the Ramp Capacity limit imposed by the ISO for the Interface between the NYCA and the Control Area in which the Non-Competitive Proxy Generator Bus is located or would exceed the Ramp Capacity limit imposed by the ISO for the Non-Competitive Proxy Generator Bus, the Real-Time LBMP at the Non-Competitive Proxy Generator Bus will be the higher of (i) the RTC-determined price at that Non-Competitive Proxy Generator Bus or (ii) the lower of the LBMP determined by RTD for that Non-Competitive Proxy Generator Bus or zero.

When (i) proposed Real-Time Market economic net Export Transactions from the NYCA to the Control Area in which the Non-Competitive Proxy Generator Bus is located would exceed the Available Transfer Capability for the Interface between the NYCA and the Control Area in which the Non-Competitive Proxy Generator Bus is located or would exceed the Available Transfer Capability of the Non-Competitive Proxy Generator Bus, or (ii) proposed interchange schedule changes pertaining to increases in Real-Time Market net Exports from the NYCA to the Control Area in which the Non-Competitive Proxy Generator Bus is located would exceed the Ramp Capacity limit imposed by the ISO for the Interface between the NYCA and the Control Area in which that Non-Competitive Proxy Generator Bus is located or would exceed the Ramp Capacity limit imposed by the ISO for the Non-Competitive Proxy Generator Bus, the Real-Time LBMP at the Non-Competitive Proxy Generator Bus will be the lower of (i) the RTC-determined price at the Non-Competitive Proxy Generator Bus or (ii) the higher of the LBMP determined by RTD for the Non-Competitive Proxy Generator Bus or the Day-Ahead LBMP determined by SCUC for the Non-Competitive Proxy Generator Bus. At all other times, the Real-Time LBMP shall be calculated as specified in Section 17.1.6.1 above.

17.1.6.3 Special Pricing Rules for Scheduled Lines

Real-Time LBMPs for the Proxy Generator Buses associated with designated Scheduled Lines shall be determined as follows:

When proposed Real-Time Market economic net Import Transactions into the NYCA associated with a designated Scheduled Line would exceed the Available Transfer Capability of the designated Scheduled Line, the Real-Time LBMP at the Proxy Generator Bus associated with the designated Scheduled Line will be the higher of (i) the RTC-determined price at that Proxy Generator Bus or (ii) the lower of the LBMP determined by RTD for that Proxy Generator Bus or zero.

When proposed Real-Time Market economic net Export Transactions from the NYCA associated with a designated Scheduled Line would exceed the Available Transfer Capability of the designated Scheduled Line, the Real-Time LBMP at the Proxy Generator Bus associated with the designated Scheduled Line will be the lower of (i) the RTC-determined price at the Proxy Generator Bus or (ii) the higher of the LBMP determined by RTD for the Proxy Generator Bus or the Day-Ahead LBMP determined by SCUC for the Proxy Generator Bus. At all other times, the Real-Time LBMP shall be calculated as specified in Section 17.1.6.1 above.

The Cross-Sound Scheduled Line, the Neptune Scheduled Line, and the Linden VFT Scheduled Line are designated Scheduled Lines.

17.1.6.4 Method of Calculating Marginal Loss and Congestion Components of Real-Time LBMP at Non-Competitive Proxy Generator Buses and Proxy Generator Buses that are Subject to the Special Pricing Rule for Scheduled Lines

Under the conditions specified below, the Marginal Losses Component and the Congestion Component of the Real-Time LBMP, calculated pursuant to the preceding paragraphs in Sections 17.1.6.2 and 17.1.6.3, shall be constructed as follows:

When the Real-Time LBMP is set to zero and that zero price was not the result of using the RTD, RTC or SCUC-determined LBMP;

Marginal Losses Component of the Real-Time LBMP = $\text{Losses}_{\text{RTC PROXY GENERATOR BUS}}$; and

Congestion Component of the Real-Time LBMP = - ($\text{Energy}_{\text{RTC REF BUS}}$ + $\text{Losses}_{\text{RTC PROXY GENERATOR BUS}}$).

When the Real-Time LBMP is set to the Day-Ahead LBMP:

Marginal Losses Component of the Real-Time LBMP = $\text{Losses}_{\text{RTC PROXY GENERATOR BUS}}$; and

Congestion Component of the Real-Time LBMP = Day-Ahead LBMP $_{\text{PROXY GENERATOR BUS}}$ - (Energy $_{\text{RTC REF BUS}}$ + Losses $_{\text{RTC PROXY GENERATOR BUS}}$).

where:

Energy $_{\text{RTC REF BUS}}$ = marginal Bid cost of providing Energy at the reference Bus, as calculated by RTC_{15} for the hour;

Losses $_{\text{RTC PROXY GENERATOR BUS}}$ = Marginal Losses Component of the LBMP as calculated by RTC_{15} at the Non-Competitive Proxy Generator Bus or Proxy Generator Bus associated with a designated Scheduled Line for the hour; and

Day-Ahead LBMP $_{\text{PROXY GENERATOR BUS}}$ = Day-Ahead LBMP as calculated by SCUC for the Non-Competitive Proxy Generator Bus or Proxy Generator Bus associated with a designated Scheduled Line for the hour.

17.1.6.5 The Marginal Losses Component of LBMP at Proxy Generator Buses

The components of LBMP will be posted in the Day-Ahead and Real-Time Markets as described ~~above~~in this Section 17.1.6, except that the Marginal Losses Component of LBMP will be calculated differently for Internal locations. The Marginal Losses Component of the LBMP at each bus, as described above, includes the difference between the marginal cost of losses at that bus and the Reference Bus. If this formulation were employed for an External bus, then the Marginal Losses Component would include the difference in the cost of Marginal Losses for a section of the transmission system External to the NYCA. Since the ISO will not charge for losses incurred Externally, the formulation will exclude these loss effects. To exclude these External loss effects, the Marginal Losses Component will be calculated from points on the boundary of the NYCA to the Reference Bus.

The Marginal Losses Component of the LBMP at the External bus will be a weighted average of the Marginal Losses Components of the LBMPs at the Interconnection Points. To derive the Marginal Losses Component of the LBMP at an External location, a Transaction will be assumed to be scheduled from the External bus to the Reference Bus. The Shift Factors for this Transaction on the tie lines into these Interconnection buses, which measure the per-unit effect of flows over each of those tie lines that results from the hypothetical transaction, will provide the weights for this calculation. Since all the power from this assumed Transaction crosses the NYCA boundary, the sum of these weights is unity.

The sum of the products of these Shift Factors and the Marginal Losses Component of the LBMP at each of these Interconnection buses yields the Marginal Losses Component of the LBMP that will be used for the External bus. Therefore, the Marginal Losses Component of the LBMP at an External bus E is calculated using the equation:

$$\gamma_E^L = \sum_{b \in I} F_{Eb} (DF_b - 1)\lambda^R$$

where:

γ_E^L = Marginal Losses Component of the LBMP at an External bus E;

F_{Eb} = Shift Factor for the tie line going through bus b, computed for a hypothetical Bilateral Transaction from bus E to the Reference Bus;

$(DF_b - 1)\lambda^R$ = Marginal Losses Component of the LBMP at bus b; and

I = The set of Interconnection buses between the NYCA and adjacent Control Areas.