

DER Energy Market Design: Settlements & Other Updates

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March 28th, 2019, Krey Corporate Center

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Agenda

- **Overview & Purpose**
- **Review of DER Aggregation Energy Settlements Proposal**
- **Methodology for FERC Order No. 745 Monthly Net Benefit Test Implementation**
- **Additional Updates**
 - **Persistent Undergeneration and Compensable Overgeneration evaluation**
 - **Withdrawals by DER Aggregations**
 - **Order 745 Cost Allocation**
 - **Energy Bilaterals**
 - **DAMAP/BPCG Eligibility**
 - **Regulation Capacity**
 - **Regulation Service**
 - **RRAC & RRAP**
 - **Operating Reserves**
- **ICAP Mitigation Traceability**
- **Appendix**
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 - **Appendix A – Previous Settlements Example**
 - **Appendix B – Settlements Example With Modified Calculation**

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Background

Date	Working Group	Discussion points and links to materials
03-06-18	Market Issues Working Group (MIWG)	DER Market Design: Aggregations
04-26-18	Market Issues Working Group (MIWG)	DER Market Design: Measurement & Configuration
06-01-18	Market Issues Working Group (MIWG)	DER Market Design: Updates
06-19-18	Market Issues Working Group (MIWG)	DER Market Design: Updates
07-26-18	Market Issues Working Group (MIWG)	DER Market Design Updates: Energy Market Bid to Bill Examples
10-09-18	Market Issues Working Group (MIWG)	DER Market Design Update: Wholesale Obligations for Dual Participation
10-10-18	Market Issues Working Group (MIWG)	DER Market Design Update
11-05-18	Market Issues Working Group (MIWG)	DER Market Design Updates
12-18-18	Market Issues Working Group (MIWG)	DER Overall Energy Market Design Review
02-04-19	Market Issues Working Group (MIWG)	DER Overall Energy Market Design Review Part I

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Overview & Purpose

Purpose of the DER Roadmap Effort

- Develop and enhance participation opportunities for DER in the NYISO-administered wholesale markets by creating:
 - A Dispatchable DER Participation Model; and
 - Dispatchable Homogenous Aggregations of DER
- Create a model that supports the **NYISO Market Design Vision - *Attract and retain*** the most efficient resources *to meet NY's reliability needs.*

Purpose of this Presentation

- Review previous topics discussed with stakeholders to enable and enhance the participation of DER in the NYISO Wholesale Energy & Ancillary Services Market **only**;
- Review updates to the settlements calculations presented in July and December of 2018 and more recently as part of the Appendix for the presentation on February 6th
- The modification to the settlements calculations represented in this presentation are a change to the implementation aspect of the same proposal mentioned above
 - The proposal has not changed
 - The calculations supporting both presentations are mathematically equivalent
 - Examples proving the mathematical equivalency can be found in the appendix
 - The previous presentations can be found in the hyperlinks embedded on Slide 4

Methodology for FERC Order No. 745 Monthly Net Benefit Test Implementation

Methodology

- The Order No. 745 Net Benefits Test implementation methodology described in the July and December 2018 presentations described the NYISO's proposal to terminate the application of the Day-Ahead Market offer floor because the FERC Order No. 745 Monthly Net Benefit Test (NBT) does not need to be applied to bids submitted in the Day-Ahead Market because bids are re-evaluated in real-time to determine the real-time schedules
- As part of the NYISO's existing two settlement system, the determination of final dispatch only occurs in real-time
- The NYISO is not suggesting a change to the NBT application in real-time as part of this presentation and believes that this decision supports the following:
 1. Works with the existing settlements system
 2. Keeps payment evaluation for Energy between Generators and Aggregations otherwise (NBT) equivalent
 3. Appropriately addresses the impacts of the Billing Unit Effect of dispatching demand response

Additional Updates

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Persistent Undergeneration

- Persistent Undergeneration charges (Services Tariff 15.3A) will be evaluated based on total Supply provided in response to dispatch
- Actual Energy Injections + Actual Energy Withdrawals + actual Demand Reductions = total response

Compensable Overgeneration

- **Compensable Overgeneration will be evaluated based on total response to dispatch**
- **Actual Energy Injections + Actual Energy Withdrawals + actual Demand Reductions = total response**

Energy Withdrawals by Withdrawal-Eligible Generators in DER Aggregations

- DER Aggregations containing at least one Withdrawal-Eligible Generator may submit Bids to withdraw Energy
- Aggregations will be subject to Persistent Over-Withdrawal Charges pursuant to Services Tariff Sec. 15.3A.1.2
 - This will be applied in the same manner as Persistent Over-Withdrawal Charges for ESR

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Order 745 Cost Allocation

- The costs of demand response will be allocated in accordance with the methodology developed in compliance with FERC Order No. 745
- All make whole payments (DAMAP/BPCG) to DER Aggregations will be treated as uplift and *not* follow the FERC Order No. 745 Cost Allocation methodology

Energy Bilaterals

- Bilaterals can only be satisfied by Aggregations entirely populated by Injection type resources
- Demand Reduction assets will not be a party of an Energy Bilateral as a provider of Energy (source)
- **Allowing Demand Side Resources to be a source would leave the impacted LSE either short on supply or double paying for the MW quantity of that bilateral, dependent on how the reduction quantity of MW is accounted for in the forecast**
 - NYISO is not proposing to change methodology or software for Energy Bilaterals
 - Demand Reduction resources would still be eligible to be a party to Capacity Bilaterals according to existing tariff rules

DAMAP/BPCG Eligibility

- The proposal for DAMAP & BPCG eligibility has not changed since the December presentation
- DER Aggregations will be eligible for DAMAP and BPCG only when operating OOM or as part of an SRE
 - DAMAP and BPCG for DER Aggregations will be determined using the same formulas as currently used for generators

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Regulation Capacity

- **Regulation Capacity payments will be based on the Regulation Capacity scheduled**
 - Monthly NBT Threshold does not apply to Regulation Capacity payments
 - This is not an Energy payment
 - Monthly NBT Threshold pertains to economic Energy and not Regulation Capacity

Regulation Service

- **Aggregations containing Demand Side Resources providing Regulation Service will be eligible for Energy payments if the real-time LBMPs for a given interval meet or exceed the applicable Monthly NBT Threshold**
 - Regulation Service performance for DER Aggregations will be determined using the same formulas as currently used for generators

RRAC & RRAP

- **The proposal for RRAC & RRAP eligibility is that an Aggregation should be revenue neutral in relation to the RTD basepoint regardless of NBT when dispatched for Regulation:**
 - RRAC and RRAP will be evaluated for both payments and charges based on total response
 - Actual Energy Injections + Actual Energy Withdrawals + actual Demand Reductions = total response

Operating Reserves

- **Operating Reserves payments will be based on the Operating Reserves scheduled**
 - NBT Threshold does not apply to Operating Reserve payments
- **The Demand Reduction component of Aggregations containing Demand Side Resources whose Operating Reserves have been converted to Energy will be eligible for Energy payments if the real-time LBMPs for a given interval meet or exceed the NBT Threshold for that month**

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ICAP Mitigation Traceability

ICAP Market Power Mitigation Rules

--The following table is based on the current market design proposal and is subject to revision based on the final design and defined terms

	Location:		MCZ (presently, G-J and NYC)					
	NYCA locations other than MCZs (presently, ROS (A-F) and Long Island)		DER Aggregation	Resource		DER Aggregation	Resource	
				Generator	DER Demand Reduction		Generator	DER Demand Reduction
Buyer Side Mitigation							X	
Pivotal Supplier Must Offer					X		X*	X*
Identify Affiliated Entities					X		X*	X*
Going Forward Cost Request							X*	X*
Physical Withholding Rules in MST 23.4.5.6; note, however, all resources are subject to FERC's market manipulation rules							X	
Generator Deactivation Obligation			X				X	

*Provided the Resource is not part of an Aggregation



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Next Steps

- Review Topics and Tariff Edits Not Discussed Today

Feedback?

- Email additional feedback to:
DER_Feedback@nyiso.com



Don't forget the underscore

Appendix Overview

Concept Review

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Settlements Approach

- **Settlements will need to account for the following aspects of each DER Aggregation when evaluating performance:**
 - Energy Injection from Generation units
 - Demand Reduction provided as Supply from Demand Side Resources
 - To account for the FERC Order No. 745
 - Energy Withdrawal from Withdrawal-Eligible Generators
- **This will be implemented by separating the Telemetry signals and the Revenue Meter files into distinct data sets for Settlements processing**

Time of Application of Order 745

2/6
MIWG

- **The NYISO will apply its NBT as an after-the-fact evaluation**
 - NYISO will continue to calculate a monthly NBT value applicable to Curtailment resources participating in the DER participation model
 - NYISO will perform an evaluation of LBMPs and telemetry data during the settlements process
 - Application of the NBT during the settlements process instead of as an Offer Floor will allow aggregators to bid in Demand Side Resource in the energy markets at any dollar value
 - If the clearing price for energy is greater than the monthly NBT value, Curtailment resources would be eligible for payment
 - If the clearing price for energy is less than the monthly NBT value, Curtailment resources would not be paid (notwithstanding its contribution to the Aggregation's response to the dispatch signal)
 - Curtailment resource performance will be included in the evaluation of whether an Aggregation meets its basepoint signal, regardless of whether those resources are eligible for payment.

Previously Presented Settlements Implementation

- **Day-Ahead Market (DAM) Energy Settlement is the Day Ahead Schedule * the Day Ahead LBMP**
 - $\text{DAM Energy Settlement} = \text{DAM Schedule} * \text{DAM LBMP}$
- **RT Settlement, Step 1**
 - Buy out of the Day Ahead Energy Schedule
 - $(-\text{DAM Energy Schedule} * \text{RT LBMP})$
- **RT Settlement, Step 2**
 - Compensate Aggregation for the max of the amount of Injection or the RT Energy schedule
 - $+ ((\text{Min}(\text{Injection Response}, \text{RT Energy Schedule})) * \text{RT LBMP})$
- **RT Settlement, Step 3**
 - If the NBT is passed, compensate the Demand Reduction portion of the Aggregation for the remaining performance, otherwise, pay zero for Demand Reduction response
 - $+ (\text{If}(\text{NBT} < \text{RT LBMP}, \text{Min}(\text{Demand Reduction Response}, \text{RT Energy Schedule} - \text{Injection Response}) * (\text{RT LBMP}), 0))$

Modification to Settlement Calculation

Update

- While formulating approaches for implementation of this methodology, the NYISO found a way to improve this process by mathematically combining RT settlement step 1 and RT settlement step 2 calculations (next slide)
 - There are no other changes to the settlement calculations
 - There is no net impact to the net revenue stream of the Aggregation by combining these two steps

Modification Process

■ Process

- Portion of previous calculation being modified:
 - RT Settlement, Step 1
 - Buy out of the Day Ahead Energy Schedule
 - » $(-DAM \text{ Energy Schedule} * RT \text{ LBMP})$
 - RT Settlement, Step 2
 - Compensate Aggregation for the max of the amount of Injection or the RT Energy schedule
 - » $+ ((\text{Min}(\text{Injection Response}, RT \text{ Energy Schedule})) * RT \text{ LBMP})$
- Modification:
 - $(\text{Min}(\text{Injection Response}, RT \text{ Energy Schedule}) - DAM \text{ Energy Schedule}) * RT \text{ LBMP}$

■ Result

- These two calculations are mathematically equivalent

Remaining Slides

- Appendix A is the originally presentation and scenarios as presented on July 26th, 2018
- Appendix B is the same set of scenarios and variables utilizing the modified calculation
- The equivalent scenarios in both Appendix A & Appendix B demonstrate same results

Appendix A: Previous Settlements Example

Energy Settlement Calculations

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- To facilitate this implementation, new settlement calculations will be developed for Aggregations, which bid in the Day-Ahead market
- The following slides cover these Energy settlement calculations

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Day Ahead

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- **Day-Ahead Market (DAM) Energy Settlement is the Day Ahead Schedule * the Day Ahead LBMP**
 - *DAM Energy Settlement = DAM Schedule * DAM LBMP*

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Proposed Calculation, Real Time

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- Next step, the Aggregation is bought out of its Day Ahead schedule and compensated for eligible Real Time performance
 - RT Energy Settlement = $(-\text{DAM Energy Schedule} * \text{RT LBMP}) + ((\text{Min}(\text{Injection Response}, \text{RT Energy Schedule})) * \text{RT LBMP})$
 - + $(\text{If}(\text{NBT} < \text{RT LBMP}, \text{Min}(\text{Demand Reduction Response}, \text{RT Energy Schedule} - \text{Injection Response}) * (\text{RT LBMP}), 0))$
 - Breakdown on following slides

Proposed Calculation, con't

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- **RT Settlement, Step 1**
 - Buy out of the Day Ahead Energy Schedule
 - $(-\text{DAM Energy Schedule} * \text{RT LBMP})$

- **RT Settlement, Step 2**
 - Compensate Aggregation for the max of the amount of Injection or the RT Energy schedule
 - $+ ((\text{Min}(\text{Injection Response}, \text{RT Energy Schedule})) * \text{RT LBMP})$

- **RT Settlement, Step 3**
 - If the NBT is passed, compensate the Demand Reduction portion of the Aggregation for the remaining performance, otherwise, pay zero for Demand Reduction response
 - $+ (\text{If}(\text{NBT} < \text{RT LBMP}, \text{Min}(\text{Demand Reduction Response}, \text{RT Energy Schedule} - \text{Injection Response}) * (\text{RT LBMP}), 0))$

Proposed Calculation, exceptions

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- **Implementation of calculation will additionally accommodate:**
 - Charging/Negative Generation from ESRs
 - Allowance for Compensable Over Generation
 - 3%
- **Regardless of these accommodations, the principles of the calculation remain the same**
- **Numerical examples follow this slide**

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Numerical Example

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- **For the Numerical Example, assume the following;**
 - Aggregation comprises of both injection and curtailment
 - Order No. 745 NBT Offer Threshold is not applied at time bid is accepted
 - The aggregator can bid all technologies, including DR, at any price
 - DR within the Aggregation could be dispatched below it's applicable NBT Offer Threshold value (calculated monthly)
 - If final Real Time clearing price is below the existing NBT Offer Threshold \$ value, the result would be:
 - Entire Aggregation is dispatched, but;
 - DR portion is not paid

Numerical Example 1 – Day Ahead

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MIWG

- **For this example;**
 - Aggregation bids in entire Aggregation at \$40
 - Monthly NBT threshold value is \$35 (no evaluation in Day Ahead)
 - Day Ahead clearing price for each hour is \$45
 - Real Time dispatch and performance is 1:1 with Day Ahead offer and schedule

Numerical Example 1 – Real Time

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Time Interval	Dispatch Signal	Generation Response	Curtailment Response	Total Response to Dispatch	MWs Compensated
Hour 1	10	10	0	10	10
Hour 2	15	10	5	15	15
Hour 3	35	20	15	35	35

- For this example;
 - Economics;
 - Aggregation bids in entire Aggregation at \$40
 - Monthly NBT threshold value is \$35
 - Real Time clearing price for each hour is \$50
 - The NBT is lower than the offer price & clearing price
 - The Aggregation responded perfectly to dispatch
- Generation would get paid per current settlement rules for each of the three hours
- Order No. 745 cost allocation would be applied to the curtailment response for Hours 2 & 3

Numerical Example 1 – Settlements

7/26
MIWG

- During Settlements the following would occur for Hour 1:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 10 MW
 - RT Dispatch: 10 MW
 - RT MW Injection Response: 10 MW
 - RT MW Demand Reduction Response: 0 MW
 - RT Price: \$50
 - NBT: \$35
 - DAM Calculation For Hour 1:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - RT Calculation For Hour 1:
 - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0)

Numerical Example 1 – Settlements, con't

7/26
MIWG

- During Settlements the following would occur for Hour 1:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 10 MW
 - RT Dispatch: 10 MW
 - RT MW Injection Response: 10 MW
 - RT MW Demand Reduction Response: 0 MW
 - RT Price: \$50
 - NBT: \$35
 - DAM Calculation For Hour 1:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
 - RT Calculation For Hour 1:
 - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0)
 - RT Calculation For Hour 1:
 - RT Settlement = (-10 MW * \$50) + ((Min (10 MW, 10MW)) * \$50) + (If(\$35 < \$50, Min(0 MW, 10MW - 10 MW) * (\$50), 0)

Numerical Example 1 – Settlements, con't

7/26
MIWG

- DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
- RT Calculation For Hour 1:
 - RT Settlement = (-10 MW * \$50) + ((Min (10 MW, 10MW)) * \$50) + (If(\$35 < \$50, Min(0 MW, 10MW - 10 MW) * (\$50), 0)
- RT Calculation For Hour 1:
 - RT Settlement = (-\$500) + (\$500) + (0) = \$0

Numerical Example 1 – Settlements, con't

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MIWG

- During Settlements the following would occur for Hour 2:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 15 MW
 - RT Dispatch: 15 MW
 - RT MW Injection Response: 10 MW
 - RT MW Demand Reduction Response: 5 MW
 - RT Price: \$50
 - NBT: \$35
 - DAM Calculation For Hour 2:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - DAM Calculation For Hour 2:
 - DAM Settlement = (15 MW * \$45) = \$675
 - RT Calculation For Hour 2:
 - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0)
 - RT Calculation For Hour 2:
 - RT Settlement = (-15 MW * \$50) + ((Min (10 MW, 15MW)) * \$50) + (If(\$35 < \$50, Min(5 MW, 15MW - 10 MW) * (\$50), 0)

Numerical Example 1 – Settlements, con't

7/26
MIWG

- DAM Calculation For Hour 2:
 - DAM Settlement = (15 MW * \$45) = \$675
- RT Calculation For Hour 2:
 - RT Settlement = (-15 MW * \$50) + ((Min (10 MW, 15MW)) * \$50) + (If(\$35 < \$50, Min(5 MW, 15MW - 10 MW) * (\$50), 0)
- RT Calculation For Hour 2:
 - RT Settlement = (-\$750) + (\$500) + (\$250) = \$0

Numerical Example 2 – Day Ahead

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MIWG

- **For this example:**
 - Aggregation bids in entire Aggregation at \$40
 - Monthly NBT threshold value is \$35 (no evaluation in Day Ahead)
 - Day Ahead clearing price for each hour is \$45
 - *In Real-time, Aggregation is dispatched for MW above its Day Ahead schedule in Hour 1*

Numerical Example 2 – Settlements, con't

7/26
MIWG

- During Settlements the following would occur for Hour 1:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 10 MW
 - RT Dispatch: 11 MW
 - RT MW Injection Response: 11 MW
 - RT MW Demand Reduction Response: 0 MW
 - RT Price: \$50
 - NBT: \$35
 - DAM Calculation For Hour 1:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
 - RT Calculation For Hour 1:
 - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0)
 - RT Calculation For Hour 1:
 - RT Settlement = (-10 MW * \$50) + ((Min (11 MW, 11MW)) * \$50) + (If(\$35 < \$50, Min(0 MW, 11MW - 11 MW) * (\$50), 0)

Numerical Example 2 – Settlements, con't

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- DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
- RT Calculation For Hour 1:
 - RT Settlement = (-10 MW * \$50) + ((Min (11 MW, 11MW)) * \$50) + (If(\$35 < \$50, Min(0 MW, 11MW - 11 MW) * (\$50), 0)
- RT Calculation For Hour 1:
 - RT Settlement = (-\$500) + (\$550) + (0) = \$50

Numerical Example 3 – Day Ahead

7/26
MIWG

- **For this example;**
 - Aggregation bids in entire Aggregation at \$40
 - Monthly NBT threshold value is \$35 (no evaluation in Day Ahead)
 - Day Ahead clearing price for each hour is \$45
 - *Real Time prices are lower than Day Ahead prices*

Numerical Example 3 – Settlements, con't

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MIWG

- During Settlements the following would occur for Hour 1:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 10 MW
 - RT Dispatch: 10 MW
 - RT MW Injection Response: 10 MW
 - RT MW Demand Reduction Response: 0 MW
 - RT Price: \$40
 - NBT: \$35
 - DAM Calculation For Hour 1:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
 - RT Calculation For Hour 1:
 - RT Settlement = (-DAM Schedule * RT LBMP) + ((Min (Injection Response, RT Schedule)) * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0))
 - RT Calculation For Hour 1:
 - RT Settlement = (-10 MW * \$40) + ((Min (10 MW, 10MW)) * \$40) + (If(\$35 < \$40, Min(0 MW, 10MW - 10 MW) * (\$40), 0))

Numerical Example 3 – Settlements, con't

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MIWG

- DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
- RT Calculation For Hour 1:
 - RT Settlement = (-10 MW * \$40) + ((Min(10 MW, 10MW)) * \$40) + (If(\$35 < \$50, Min(0 MW, 10MW - 10 MW) * (\$40), 0)
- RT Calculation For Hour 1:
 - RT Settlement = (-\$400) + (\$400) + (0) = \$0

Appendix B: Settlements Example with Modification

Energy Settlement Calculations

- **This section covers the Energy settlement calculations for the new proposal**
 - The settlement calculation examples presented at the July 26, 2018 MIWG are in Appendix A
- **For each step in the following examples, changes from the previous proposal will be noted**

Day-Ahead Market Energy Settlement

- Day-Ahead Market (DAM) Energy Settlement is the Day-Ahead Schedule * the Day-Ahead LBMP
 - *DAM Energy Settlement = DAM Schedule * DAM LBMP*
- This step is the same in both proposals

Real-Time Settlement

- **Step 1: Aggregation's real-time schedule or Actual Energy Injections are balanced against its Day-Ahead schedule**
 - $(RT \text{ Injection MW} - DAM \text{ Energy Schedule}) * RT \text{ LBMP}$
- **Step 2: Determine actual DR MW**
- **Step 3: Evaluate real-time LBMP against Monthly Net-Benefit Test Threshold; if real-time LBMP is greater than or equal to the Monthly Net-Benefit Test Threshold, actual DR MW response is paid real-time LBMP**
 - $(If(NBT < RT \text{ LBMP}, Min(Demand \text{ Reduction Response}, RT \text{ Energy Schedule} - Injection \text{ Response}) * (RT \text{ LBMP}), 0))$
 - Because the Energy balancing described in Step 1 is at real-time LBMP, when an Aggregation meets its full the DAM obligation in RT, and the real-time LBMP is greater than or equal to the Monthly Net Benefits Threshold, these balancing buy-out and RT payment should net \$0
- **The Aggregation's net revenue will be equal to the DAM Scheduled MW * DAM LBMPs**
 - $Total \text{ RT Energy Balancing Settlement} = ((RT \text{ Injection MW} - DAM \text{ Energy Schedule}) * RT \text{ LBMP}) + (If(NBT < RT \text{ LBMP}, Min(Demand \text{ Reduction Response}, RT \text{ Energy Schedule} - Injection \text{ Response}) * (RT \text{ LBMP}), 0))$
- **This differs from the previous proposal where the Aggregation was buying out of the entire DA schedule, irrespective of response type**

Proposed Calculation, con't

■ RT Settlement, Step 1

- Buy out of the difference between the RT Injection Response and the Day Ahead Energy Schedule
 - $(\text{RT Injection Response} - \text{DAM Energy Schedule}) * \text{RT LBMP}$

■ RT Settlement, Step 2

- If the NBT is passed, compensate the Demand Reduction portion of the Aggregation for the remaining performance, otherwise, pay zero for Demand Reduction response
 - $+ (\text{If}(\text{NBT} < \text{RT LBMP}, \text{Min}(\text{Demand Reduction Response}, \text{RT Energy Schedule} - \text{Injection Response}) * (\text{RT LBMP}), 0))$

Numerical Example

- **Review:**
 - Net Benefit Test Threshold is not applied as an Offer Floor; it is an after-the-fact evaluation
 - Aggregator can bid entire Aggregation at a price not to exceed the bid cap
 - NYISO will dispatch some or all of the Aggregation, including Demand Reductions, economically based on the Aggregation's Bids
 - If the real-time LBMP is below the Monthly Net Benefit Threshold, the Aggregation will not be paid for Demand Reductions
- **Assume for the Numerical Examples that the Aggregation comprises both injection and Demand Reduction**

Numerical Example 1 – Day-Ahead

- **Assumptions for this example:**
 - Aggregation bids in entire Aggregation at \$40
 - Monthly NBT threshold value is \$35
 - Day-Ahead LBMP for each hour is \$45, and DAM Bid fully clears
 - There is no change to the Day-Ahead schedule in real-time
 - The Aggregation met its Day-Ahead offer and schedule

Numerical Example 1 – Real-Time

Time Interval	Dispatch Signal	Generation Response	Curtailment Response	Total Response to Dispatch	MWs Compensated
Hour 1	10	10	0	10	10
Hour 2	15	10	5	15	15
Hour 3	35	20	15	35	35

- For this example;
 - Economics;
 - Aggregation bids in entire Aggregation at \$40
 - Monthly NBT threshold value is \$35
 - Real-time LBMP for each hour is \$50
 - The NBT is lower than the LBMP
 - The Aggregation responded perfectly to dispatch
- Generation would get paid the Day-Ahead LBMP per current settlement rules for each of the three hours
- Demand Reductions would be paid the real-time LBMP for hours 2 and 3
 - Costs of Demand Response would be allocated pursuant to applicable Order No. 745 cost allocation rules

Numerical Example 1 – Settlements

- During Settlements the following would occur for Hour 1:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 10 MW
 - RT Dispatch: 10 MW
 - RT MW Injection Response: 10 MW
 - RT MW Demand Reduction Response: 0 MW
 - RT Price: \$50
 - NBT: \$35
 - DAM Calculation For Hour 1:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - RT Calculation For Hour 1:
 - RT Settlement = (Injection Response - DAM Schedule * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0)

Numerical Example 1 – Settlements, con't

- During Settlements the following would occur for Hour 1:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 10 MW
 - RT Dispatch: 10 MW
 - RT MW Injection Response: 10 MW
 - RT MW Demand Reduction Response: 0 MW
 - RT Price: \$50
 - NBT: \$35
 - DAM Calculation For Hour 1:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
 - RT Calculation For Hour 1:
 - RT Settlement = (Injection Response - DAM Schedule * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0)
 - RT Calculation For Hour 1:
 - RT Settlement = (10 MW - 10 MW * \$50) + (If(\$35 < \$50, Min(0 MW, 10 MW - 10 MW) * (\$50), 0)

Numerical Example 1 – Settlements, con't

- DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
- RT Calculation For Hour 1:
 - RT Settlement = (10 MW - 10 MW * \$50) + (If(\$35 < \$50, Min(0 MW, 10MW - 10 MW) * (\$50), 0)
- RT Calculation For Hour 1:
 - RT Settlement = (-\$0) + (\$0) = \$0

Numerical Example 1 – Settlements, con't

- During Settlements the following would occur for Hour 2:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 15 MW
 - RT Dispatch: 15 MW
 - RT MW Injection Response: 10 MW
 - RT MW Demand Reduction Response: 5 MW
 - RT Price: \$50
 - NBT: \$35
 - DAM Calculation For Hour 2:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - DAM Calculation For Hour 2:
 - DAM Settlement = (15 MW * \$45) = \$675
 - RT Calculation For Hour 2:
 - RT Settlement = (Injection Response - DAM Schedule * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0)
 - RT Calculation For Hour 2:
 - RT Settlement = (10 MW - 15 MW * \$50) + (If(\$35 < \$50, Min(5 MW, 15 MW - 10 MW) * (\$50), 0)

Numerical Example 1 – Settlements, con't

- DAM Calculation For Hour 2:
 - DAM Settlement = (15 MW * \$45) = \$675
- RT Calculation For Hour 2:
 - RT Settlement = (10 MW - 15 MW * \$50) + (If(\$35 < \$50, Min(5 MW, 15MW - 10 MW) * (\$50), 0)
- RT Calculation For Hour 2:
 - RT Settlement = (-\$250) + (\$250) = \$0

Numerical Example 2 – Day-Ahead

- **Assumptions for this example:**
 - Aggregation bids in entire Aggregation at \$40
 - Monthly NBT threshold value is \$35
 - Day-Ahead LBMP for each hour is \$45, and DAM Bid fully clears
 - *In Real-time, Aggregation is dispatched for MW above its Day Ahead schedule in Hour 1*

Numerical Example 2 – Settlements, con't

- During Settlements the following would occur for Hour 1:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 10 MW
 - RT Dispatch: 11 MW
 - RT MW Injection Response: 11 MW
 - RT MW Demand Reduction Response: 0 MW
 - RT Price: \$50
 - NBT: \$35
 - DAM Calculation For Hour 1:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
 - RT Calculation For Hour 1:
 - RT Settlement = (Injection Response - DAM Schedule * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0)
 - RT Calculation For Hour 1:
 - RT Settlement = (11 MW - 10 MW * \$50) + (If(\$35 < \$50, Min(0 MW, 11 MW - 11 MW) * (\$50), 0)

Numerical Example 2 – Settlements, con't

- DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
- RT Calculation For Hour 1:
 - RT Settlement = (11 MW - 10 MW * \$50) + (If(\$35 < \$50, Min(0 MW, 11MW - 11 MW) * (\$50), 0)
- RT Calculation For Hour 1:
 - RT Settlement = (+\$50) + (\$0) = \$50

Numerical Example 3 – Day-Ahead

- **Assumptions for this example:**
 - Aggregation bids in entire Aggregation at \$40
 - Monthly NBT threshold value is \$35
 - Day-Ahead LBMP for each hour is \$45
 - *Real-time LBMPs are lower than Day-Ahead LBMPs*

Numerical Example 3 – Settlements, con't

- During Settlements the following would occur for Hour 1:
 - Inputs:
 - DAM Price: \$45
 - DAM MW: 10 MW
 - RT Dispatch: 10 MW
 - RT MW Injection Response: 10 MW
 - RT MW Demand Reduction Response: 0 MW
 - RT Price: \$40
 - NBT: \$35
 - DAM Calculation For Hour 1:
 - DAM Settlement = (DAM Schedule * DAM LBMP)
 - DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
 - RT Calculation For Hour 1:
 - RT Settlement = (Injection Response - DAM Schedule * RT LBMP) + (If(NBT < LBMP, Min(Demand Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0)
 - RT Calculation For Hour 1:
 - RT Settlement = (10 MW - 10 MW * \$40) + (If(\$35 < \$40, Min(0 MW, 10 MW - 10 MW) * (\$40), 0)

Numerical Example 3 – Settlements, con't

- DAM Calculation For Hour 1:
 - DAM Settlement = (10 MW * \$45) = \$450
- RT Calculation For Hour 1:
 - RT Settlement = (10 MW - 10 MW * \$40) + (If(\$35 < \$50, Min(0 MW, 10MW - 10 MW) * (\$40), 0)
- RT Calculation For Hour 1:
 - RT Settlement = (\$0) + (\$0) = \$0

The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system



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