DER Energy Market Design: Part 2

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Agenda

- Overview & Purpose
- Bidding, Scheduling & Pricing
- Real Time Response of An Aggregation
- Settlements Application of FERC Order No. 745 Net Benefits Threshold
- DER/Facility Meter Configurations
- Mitigation
- BPCG & DAMAP Eligibility

- Appendix
  - Appendix A – DER Energy Baselines
  - Appendix B – Aggregation M&V
  - Appendix C – Settlements Example

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

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- 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;**
- Identify the Market Administration and Control Area Services Tariff (Services Tariff) sections affected by the topic discussed for draft Tariff that has been posted
  - There are ministerial edits throughout the tariff to add in, "and Aggregations" where appropriate
  - Sections of tariff have been removed throughout for language pertaining specifically to DADRP and DSASP
- This presentation does not cover the following topics which will be discussed in future presentations:
  - Interconnections/ERIS/CRIS (expected 2/6)
  - Capacity (expected 2/6)
  - Dual Participation (expected 2/15)

DER Definition for the Market Design

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- DER: A Generator, Energy Storage Resource, Intermittent Power Resource, Energy Limited Resource, or Capacity Limited Resource participating in an Aggregation whose maximum physical injection is 20 MW or less and Demand Side Resources (including facilities that can reduce Load and inject Energy) that respond to the ISO's instructions.
- Dispatchable DER are a subset of DER that are capable of responding in real-time to NYISO dispatch instructions.

Part II

Bidding con't
§ 4.2.1

Energy Withdrawals by Aggregations

- **An Aggregation that contains a Withdrawal-Eligible Generator may Bid to withdraw Energy for a market interval**
  - The points in the Aggregation's Bids may reflect the entire operating range of the Aggregation for that interval
  - Example: Aggregation contains 3 – 1MW small generators and 1 ESR with a -2MW to +2MW range
    - Aggregation operating range reflected in the Bid could be -2 to +5

Aggregation Bids to Withdraw Energy

- **Bids to withdraw Energy will only be permitted when an Aggregation contains a Withdrawal-Eligible Generator, and the Aggregator must notify the ISO if the Withdrawal-Eligible Generator is no longer in an Aggregation**
  - This Withdrawal-Eligibility will be set with each new DER enrolled in or removed from an Aggregation
  - Aggregations containing at least one Withdrawal-Eligible Generator will have access to a sub-component of ESR bid parameters

Determination of Real-Time Response of an Aggregation

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Real-Time Response of an Aggregation, con't

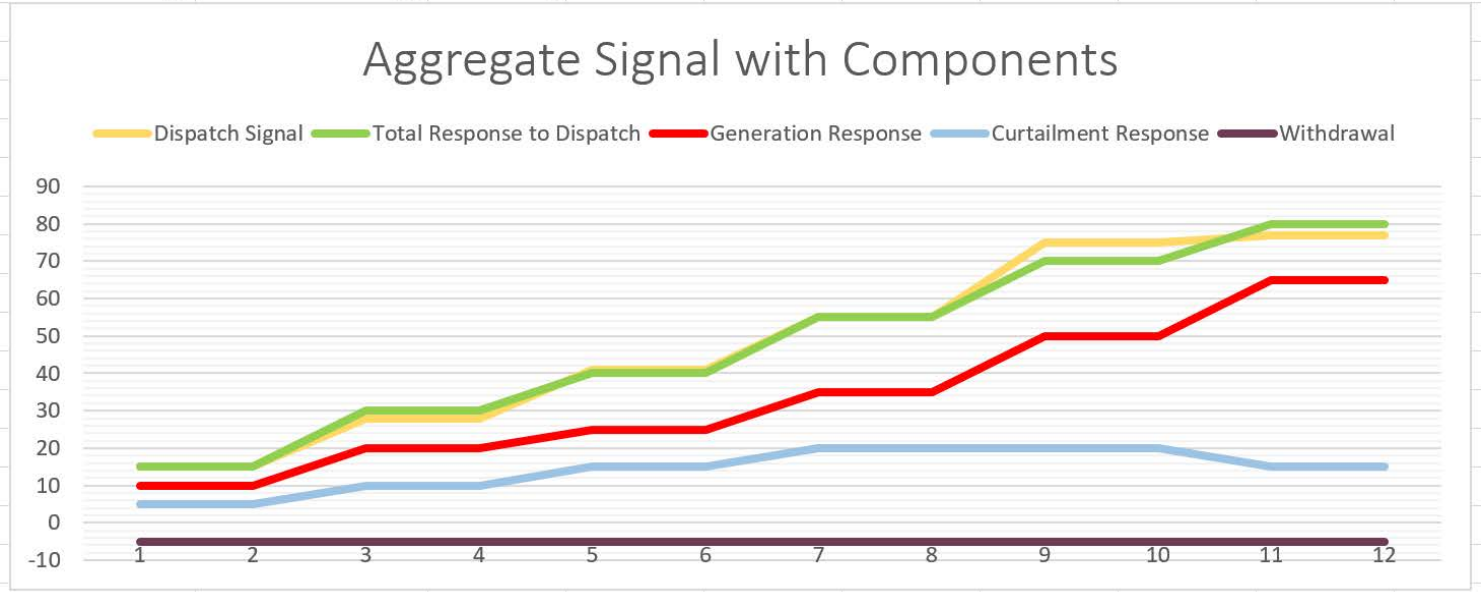
- The Aggregator is responsible for aligning the time intervals of Injection, withdrawals, and Demand Reduction response for each DER within the Aggregation for the purposes of real-time telemetry to the NYISO
- Regardless of if the Aggregation has been dispatched by the NYISO, the Aggregator is to include the DER's calculated/actual response into the Aggregation's signal, regardless of whether the Aggregator has dispatched the individual resource
- The aggregator is required to provide within its aggregated telemetry signal the MW portion that (1) represents the Aggregation's Demand Reduction response, (2) represents the Aggregation's Injection response, and (3) represents the Aggregation's Energy withdrawal response
  - The aggregator must provide the response of the Aggregation in its entirety when it is dispatched by the NYISO
  - The aggregator must provide the response of the Injection type DER in the Aggregation, in its entirety, even when the Aggregation is *not* being dispatched by the NYISO
  - If the Aggregation has not been dispatched by the NYISO, the aggregator is to indicate a zero MW response of the Demand Reduction aspect of the Aggregation
  - The Aggregation Demand Reduction response will be the sum of the resource-level response of Demand Reduction resources
    - Response for each Demand Reduction resource will be determined by the aggregator using energy baseline methodologies* prescribed by the NYISO

*See Appendix A for more details

Real-Time Response of an Aggregation, con't

- Additionally, the Aggregator will be required to provide the Aggregation's total Energy withdrawal by Withdrawal-Eligible Generators as a separate signal
- If the telemetry between the aggregator and DER has been lost, the Aggregator must consider that DER as unavailable, and if necessary, report a de-rate if the Aggregation cannot meet its schedule without that DER

Aggregate Response Signal with Individual Components



- This example contains the NYISO dispatch signal, the aggregate response signal and the sub-component signals for settlements

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Settlements and Application of FERC Order No. 745 Net Benefits Threshold (§ 4.5.9)

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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

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- **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 ~~an Aggregation's bids~~ LBMPs and telemetry data during the settlements process
  - Application of the NBT during the settlements process instead of as an Offer ~~Threshold~~ 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.

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Application/Overview of Order 745

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- DER will be required to buy out of their Day-Ahead positions when their Real-Time schedule and performance differs from Day-Ahead subject to the Net Benefits Threshold
- NYISO Day-Ahead transactions
  - Does not guarantee dispatch in Real-Time
    - Real-Time dispatch is re-evaluated with the incorporation of Real-Time bids
    - Aggregations are dispatch only and will not be considered for startup in NYISO's Security Constrained Unit Commitment (SCUC) evaluation and will not receive commitment

Application/Overview of Order 745, con't

- **For these reasons, the NYISO will conduct the after-the-fact Net Benefits Test evaluation for Real-Time demand reduction MW only**
  - For the purposes of balancing obligation determination, Real-Time demand reduction MW would only be considered if the Real-Time LBMP is greater than or equal to the Net Benefits Test Threshold
  - This presentation describes this calculation in three steps:
    - A buy-out of the Day-Ahead scheduled MW at Real-Time LBMP
    - Payments to the Real-Time Injection MW at Real-Time LBMP
    - Payments to the Real-time Demand Reduction Response MW at Real-Time LBMP with consideration for the Net Benefits Test Threshold

Application/Overview of Order 745, con't

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- **The NYISO is not proposing a change to the application of the Cost-Allocation Methodology**
  - Order No. 745 cost-allocation methodology will be applied for Aggregation's demand reduction response
- **DADRP currently disallows Aggregations across multiple LSEs**
  - The NYISO has determined that this requirement is not necessary for the implementation of DER

DER/Facility Meter Configurations

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Metering Configurations

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- The following examples will build up from the individual DER/Facility level to the Aggregation as a whole

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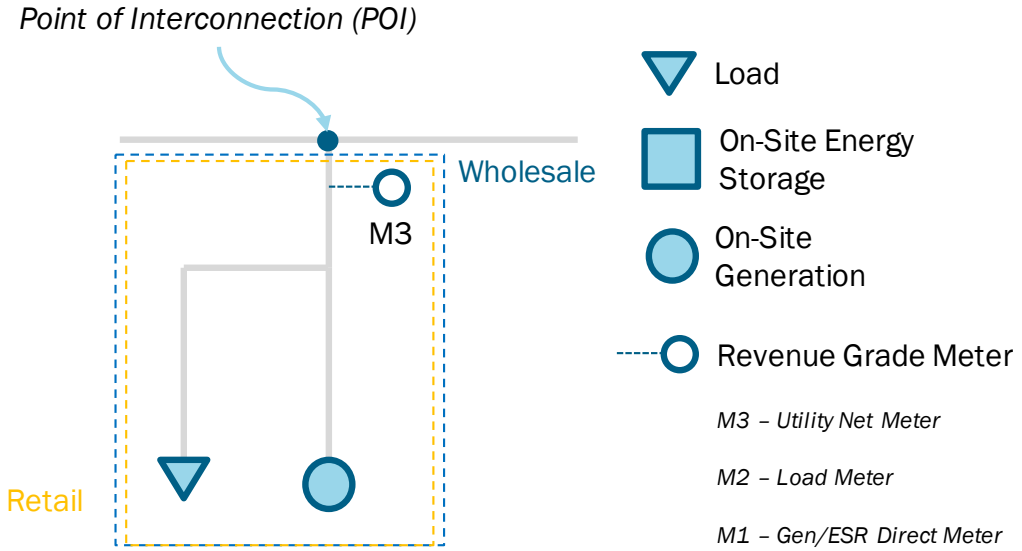
1 - Net-Metered, no ESR

- A net-metered facility/DER without ESR may participate as an injection, demand reduction or both type resource



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2A – Facility/DER with no injection, ESR does not inject

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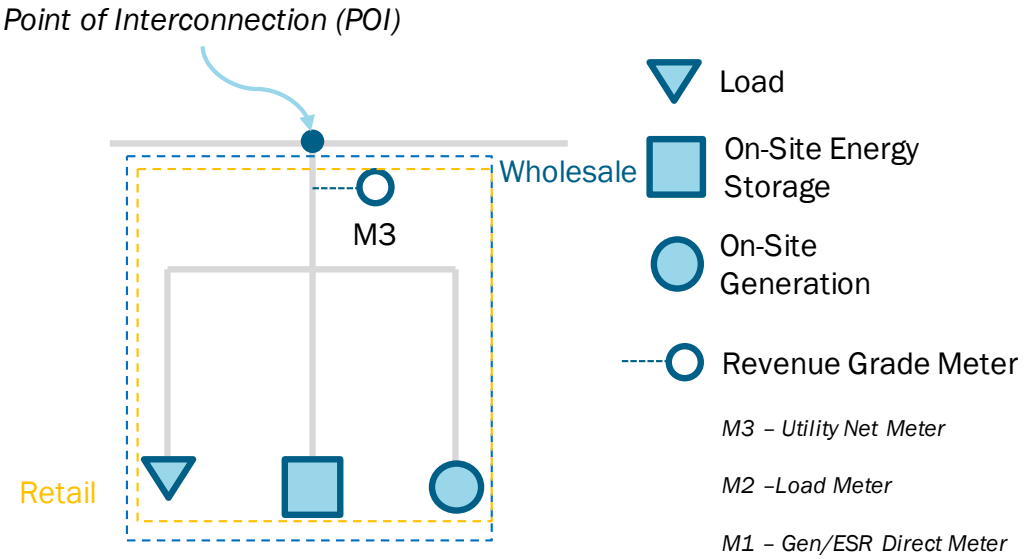
- If facility/DER has an ESR asset which does not inject into the grid, it will be considered a load-reduction asset and be net-metered



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2B – Injecting Facility/DER , with Load and Wholesale ESR

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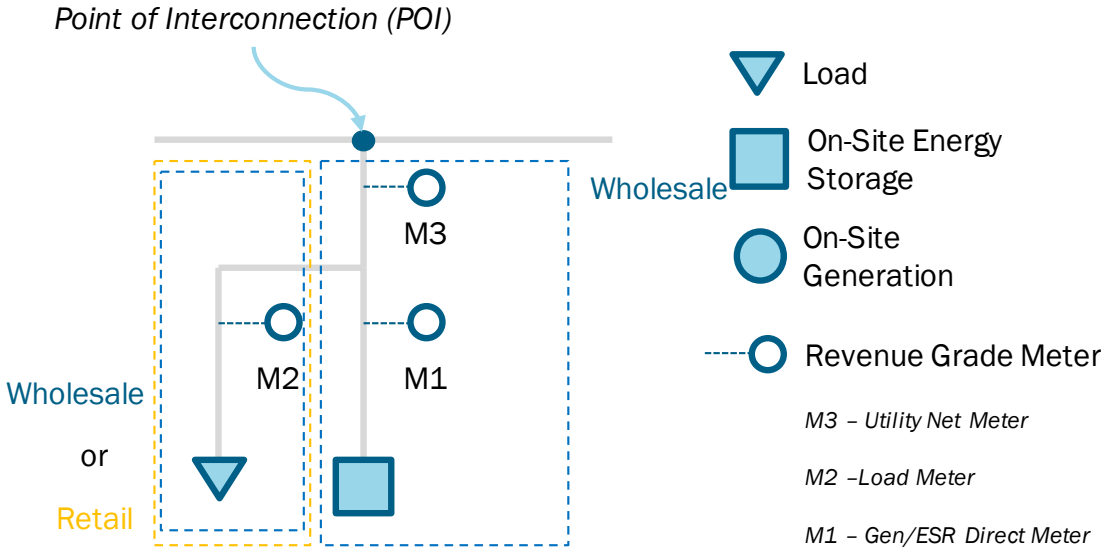
- A facility/DER with ESR will require both the ESR and the load to be metered separately
- The Load and ESR could participate as separate DER within the Aggregation
- Full load at M2 must either be directly metered or calculated by the Meter Authority reported to NYISO for LSE billing purposes



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3 – Multiple generating assets with ESR

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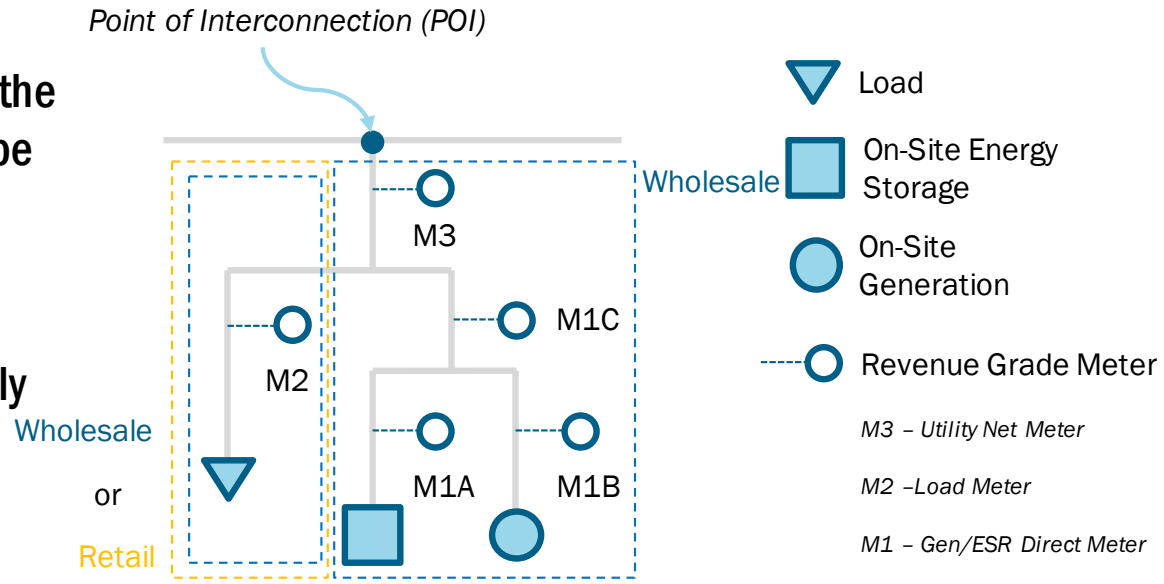
- If facility/DER has an ESR asset in addition to other generating assets, the ESR & other generating assets may be "group" or separately metered
  - M1C, or;
  - Both M1A & M1B
- Full load at M2 must either be directly metered or calculated by the Meter Authority reported to NYISO for LSE billing purposes



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Metering Configurations Overview

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- Only facilities/DER with wholesale ESR assets which are looking to inject, are required to utilize separate metering configurations
- If assets are separately metered with approved metering devices at the same location, they will be regarded as separate and distinct Facilities/DER
  - Regardless of physical location

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Mitigation

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DER Mitigation – Energy

- **The NYISO has not identified the need for any additional market mitigation measures specifically for the DER participation model at this time**
  - Individual DER, aggregators and Market Participant portfolios containing DER will be subject to existing mitigation measures

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BPCG & DAMAP Eligibility

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DER – BPCG & DAMAP

- **Review of BPCG & DAMAP Market Design for DER will be covered at a future ICAPWG/MIWG later this month**
  - Will be brought with applicable edits to calculations
  - MST 18 & 25

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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 A: Energy Baselines and Real-Time Response for Demand Reduction in an Aggregation

Use of Baselines for Demand Reduction within an Aggregation

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- As a reminder, the DER market design intends to allow an Aggregation to provide offers for energy, operating reserves, regulation service or combination of such if capable and qualified to do so
- As a result a Demand Reduction resource within an Aggregation may be contributing to an aggregated dispatch instruction of the Aggregation for energy, reserves and/or regulation service
  - Calculation methodologies for a Demand Reduction resource need to account for the ability to provide (1) energy and reserves, and (2) regulation

Proposed Energy Baseline Methodology for Demand Reduction within an Aggregation

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- To minimize the data exchange between the NYISO and the aggregator, the energy baseline will be calculated by the aggregator to support real-time operation and settlement purposes, and will not be reported to the NYISO in real-time
  - The energy baseline of each resource will be used by the aggregator to determine the energy response by each resource providing Demand Reduction within a Aggregation
  - Only the Demand Reduction response of the Aggregation as a whole is communicated to the NYISO in real-time via telemetry
- The NYISO intends to include the calculation methodology to determine the energy baselines to be used by the aggregator in its Tariffs, similar to EDRP, DADRP and SCR
- The aggregator will be required to retain these calculation results and make them available to NYISO upon request

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Proposed Energy Baseline Methodology for Demand Reduction within an Aggregation, cont'd

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- The NYISO is proposing that the aggregator use an adjusted 5-minute ECBL for calculating the Demand Reduction of a resource when the Aggregation is providing energy
- This proposal is akin to the DADRP ECBL methodology with a few key differences:
  - Calculation of the baseline will be at a 5-minute time granularity instead of hourly
    - Hourly ECBL was intended for DADRP, which is an hourly granular market (i.e., day-ahead)
    - Dispatchable DER are intended to be dispatched in real-time for energy and ancillary services, making a 5-minute granular baseline more applicable when capturing load variability and resource capability

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Proposed Energy Baseline Methodology for Demand Reduction within an Aggregation, cont'd

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- **Other key differences to the DADRP methodology include:**
  - The 5-minute ECBL will have an in-day adjustment applied on the resource's unadjusted 5-minute ECBL during the entire dispatch period of the Aggregation based on the resource's load during the three 5-minute intervals, starting 60 minutes prior to operating hour and ending 45 minutes prior to operating hour of the Aggregation
    - To better determine the real-time capability of a resource, NYISO is proposing a baseline adjustment to be calculated during the Operating Day for the purposes of real-time telemetry
    - The in-day adjustment will be capped at ±20%
    - DNV GL has concluded with similar finding that real-time adjustments perform better when the look-back window proximity is closer and its duration is shorter compared to the dispatch time, and when the adjustment is calculated throughout the Operating Day[1]
  - The in-day adjustment is to be recalculated when there is sufficient post dispatch load data available that is not affected by a wholesale market instruction to reduce load

[1] ISO New England, Inc., Oct. 31, 2014 Filing, Docket No. ER15-257-000, Testimony of Henry Yoshimura at 49

Example Unadjusted 5-minute ECBL Calculation

4/26 MIWG

- Calculation of Unadjusted 5-minute ECBL for 11:05 interval on March 2, 2018 (weekday)

Day	Load at 11:05 interval
March 1	1.1 MW
February 28	1.0 MW
February 27	1.0 MW
February 26	3.1 MW
February 23 **Dispatch Day**	2.8 MW + 0.5 MW (add-back) = 3.3 MW
February 22	2.4 MW
February 21	2.5 MW
February 20	1.2 MW
February 19 **Dispatch Day**	1.3 MW + 0.5 MW (add-back) = 1.8 MW
February 16	1.2 MW

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Example Unadjusted 5-minute ECBL Calculation

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- **Calculation of Unadjusted 5-minute ECBL for 11:05 on March 2, 2018 (weekday)**
  - Sorted highest to lowest
  - Unadjusted 5-minute ECBL = average of 5th and 6th values from descending list
  - Unadjusted 5-minute ECBL @ 11:05 March 2, 2018 = average (1.8, 1.2) = **1.5 MW**

Day	Load at 11:05 interval
February 23 **Dispatch Day**	2.8 MW + 0.5 MW (add-back) = 3.3 MW
February 26	3.1 MW
February 21	2.5 MW
February 22	2.4 MW
February 19 **Dispatch Day**	1.3 MW + 0.5 MW (add-back) = 1.8 MW
February 20	1.2 MW
February 16	1.2 MW
March 1	1.1 MW
February 28	1.0 MW
February 27	1.0 MW

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Example Timeline when Applying the In-Day Adjustment

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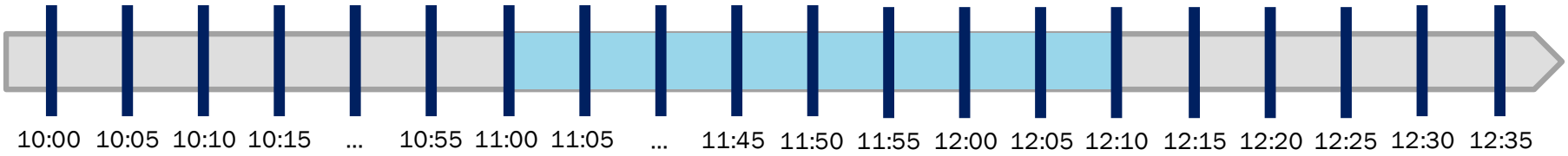
$Adj_{10:00,10:05,10:10}$ = (Average of Actual Metered Load Data) – (Average of Unadjusted 5-minute ECBL) for 5-min time intervals: 10:00, 10:05, 10:10

Start of Aggregation Dispatch

End of Aggregation Dispatch



Adjusted 5-minute $ECBL_{11:00}$ = Unadjusted 5-minute $ECBL_{11:00}$ + $Adj_{10:00,10:05,10:10}$

Adjusted 5-minute $ECBL_{11:05}$ = Unadjusted 5-minute $ECBL_{11:05}$ + $Adj_{10:00,10:05,10:10}$

and so on during dispatch period …

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Review of NYISO Ancillary Service Baseline for DSASP

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- Today the real-time response of a Demand Side Ancillary Service Program (DSASP) resource is calculated by taking its baseload prior to a dispatch event minus its actual metered load
- DSASP resources can provide 10-minute or 30-minute operating reserves and regulation service
- The baseload value is carried throughout the entire duration of the dispatch
- NYISO proposes to use the same methodology from DSASP to determine the response of a Demand Reduction resource contributing to a regulation dispatch of an Aggregation
  - The methodology used in DSASP adequately captures the response information needed by the NYISO for a resource providing regulation movement

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Response Calculation Methodology of Curtailment Resources within a Aggregation

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- **The NYISO proposes to use the aforementioned baselines to prescribe how an aggregator is to calculate the Demand Reduction response of a resource such that it can be incorporated into the Aggregation's total Demand Reduction response:**
  - When an Aggregation is dispatched for energy and reserves, the aggregator is to calculate any Demand Reduction response by taking the difference (MW) of (1) its Adjusted 5-minute ECBL and (2) its current 6-second resource load,
  - When an Aggregation is dispatched for regulation, the aggregator is to calculate any Demand Reduction response by taking the difference (MW) of (1) its baseload prior to start of dispatch for regulation service and (2) its current 6-second resource load, akin to the methodology used for existing DSASP resources
    - If the Aggregation was dispatched for energy only prior to being dispatched for regulation, the aggregator is to use a Demand Reduction resource's 6-second resource load during the time interval prior to dispatch plus its calculated response for the same time interval to calculate its "baseload prior to start of dispatch for ancillary regulation"

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Response Calculation Methodology of Demand Reduction Resources within an Aggregation – Energy Only Example

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	10:59:42	10:59:48	10:59:54	11:00:00	11:00:06	11:00:06
Agg Scheduled for Energy	Y	Y	Y	N	N	N
Agg Scheduled for Regulation	N	N	N	N	N	N
Resource Load	1.00	1.05	1.05	1.60	1.70	1.75
Unadjusted 5-min ECBL	2.00	2.00	2.00	1.50	1.50	1.50
In-Day Adjustment	-0.30	-0.30	-0.30	0.25	0.25	0.25
Adjusted 5-min ECBL	1.70	1.70	1.70	1.75	1.75	1.75
Demand Reduction Response	0.70	**0.65**	0.65	0	0	0

Demand Reduction Response at 10:59:48

= Unadjusted 5-minute ECBL @ 10:59:48 + In-Day Adjustment @ 10:59:48 – Resource Load @ 10:59:48

= 2.00 MW + (-0.30 MW) – 1.05 MW

= 0.65 MW

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Response Calculation Methodology of Demand Reduction Resources within an Aggregation – Regulation Only Example

	10:59:42	10:59:48	10:59:54	11:00:00	11:00:06	11:00:06
Agg Scheduled for Energy	N	N	N	N	N	N
Agg Scheduled for Regulation	N	N	N	Y	Y	Y
Resource Load	1.75	1.85	1.70	1.60	1.70	1.55
Baseload Prior Regulation Dispatch				1.70	1.70	1.70
Unadjusted 5-min ECBL	2.00	2.00	2.00	1.50	1.50	1.50
In-Day Adjustment	-0.30	-0.30	-0.30	0.25	0.25	0.25
Adjusted 5-min ECBL	1.70	1.70	1.70	1.75	1.75	1.75
Demand Reduction Response	0	0	0	**0.10**	0	-0.15

<u>Demand Reduction Response at 11:00:00</u>

= Baseload Prior to Regulation Dispatch – Resource Load @ 11:00:00

= (Resource Load @ 10:59:54 + Demand Reduction Response @ 10:59:54) - Resource Load @ 11:00:00

= (1.70 MW + 0 MW) – 1.60 MW

= 0.10 MW

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Response Calculation Methodology of Demand Reduction

Resources within an Aggregation – Energy and Regulation

Example

4/26 MIWG

	10:59:42	10:59:48	10:59:54	11:00:00	11:00:06	11:00:06
Agg Scheduled for Energy	Y	Y	Y	Y	Y	Y
Agg Scheduled for Regulation	N	N	N	Y	Y	Y
Resource Load	1.00	1.05	1.05	1.60	1.70	1.55
Baseload Prior Regulation Dispatch				1.70	1.70	1.70
Unadjusted 5-min ECBL	2.00	2.00	2.00	1.50	1.50	1.50
In-Day Adjustment	-0.30	-0.30	-0.30	0.25	0.25	0.25
Adjusted 5-min ECBL	1.70	1.70	1.70	1.75	1.75	1.75
Demand Reduction Response	0.70	**0.65**	0.65	0.10	0	-0.15

Demand Reduction Response at 10:59:48

= Unadjusted 5-minute ECBL @ 10:59:48 + In-Day Adjustment @ 10:59:48 – Resource Load @ 10:59:48

= 2.00 MW + (-0.30 MW) – 1.05 MW

= 0.65 MW

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Response Calculation Methodology of Demand Reduction Resources within an Aggregation – Energy and Regulation Example, cont'd

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	10:59:42	10:59:48	10:59:54	11:00:00	11:00:06	11:00:06
Agg Scheduled for Energy	Y	Y	Y	Y	Y	Y
Agg Scheduled for Regulation	N	N	N	Y	Y	Y
Resource Load	1.00	1.05	1.05	1.60	1.70	1.55
Baseload Prior Regulation Dispatch				1.70	1.70	1.70
Unadjusted 5-min ECBL	2.00	2.00	2.00	1.50	1.50	1.50
In-Day Adjustment	-0.30	-0.30	-0.30	0.25	0.25	0.25
Adjusted 5-min ECBL	1.70	1.70	1.70	1.75	1.75	1.75
Demand Reduction Response	0.70	0.65	0.65	**0.10**	0	-0.15

Demand Reduction Response at 11:00:00

= Baseload Prior to Regulation Dispatch – Resource Load @ 11:00:00

= (Resource Load @ 10:59:54 + Demand Reduction Response @ 10:59:54) - Resource Load @ 11:00:00

= (1.05 MW + 0.65 MW) – 1.60 MW

= 0.10 MW

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Appendix B: Aggregation Measurement & Verification

DER Response

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- **DER within an Aggregation can provide injection response and demand reduction response in the same 5-minute LBMP interval**
  - Load with on-site generation may perform both Demand reduction (either through curtailing the Load or shifting the Load to on-site generation) and injection into the grid at the same interval

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DER Response, con't

- **Telemetry and revenue/settlement data submittals for an Aggregation shall be provided by the aggregator, using the following calculation:**
  - (1) For net-injection component of individual DER response:
    - Injection Response = max(0, Net Meter Value)
  - (2) For net-withdrawal component of individual DER response of directly metered Withdrawal-Eligible Generator:
    - Withdrawal Response = min(0, Net Meter Value)
  - (3) For net-demand reduction component of individual DER response:
    - Demand Reduction Response = max(0, Baseline + min(0, Net Meter Value))
  - Total Response= (1) + (2) + (3)
    - Coincident injection and reduction response for the same resource shall be measured separately, telemetered separately and submitted in the separate and applicable meter files for settlements
- **Sign convention used for DER response calculation:**
  - 'Baseline' is always non-negative
  - 'Net Meter Value' is negative when DER is net-withdrawing from the grid, and positive when DER is net-injecting into the grid as measured at the net facility meter

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Injection and Demand Reduction-No Dispatch

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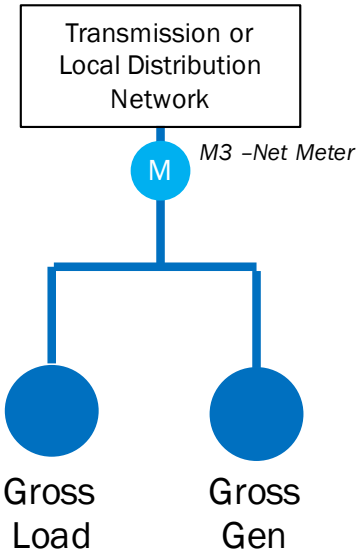
- **DER has host load 2 MW based on M3 meter data for a specific 5-minute interval, also has a dispatchable 4 MW generator, and is the only DER in the Aggregation**
- **At the start of that 5-minute interval:**
  - The Aggregation is not dispatched by the NYISO
  - The facility baseline load is 2 MW
  - The generator outputs 0 MW
- **Injection component:**
  - At the point of interconnection (i.e. M3) there is 2 MW of Load
  - Injection Response = max(0, Net Meter Value)
  - Injection Response = max(0, -2)
  - Injection Response = 0, Therefore the Injection response of the DER is 0 MW
- **Demand Reduction component:**
  - The baseline of the facility is 2 MW
  - At the point of interconnection the M3 meter reads -2 MW
  - Demand Reduction Response = max(0, Baseline + min(0, Net Meter Value))
  - Demand Reduction Response = max(0, 2 + min(0,-2))
  - Demand Reduction Response = 0, Therefore, Demand Reduction response of the DER is 0 MW



Total Response=
Injection + Demand Reduction
Total Response = 0 MW

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Injection & Demand Reduction Response-Only Demand Reduction

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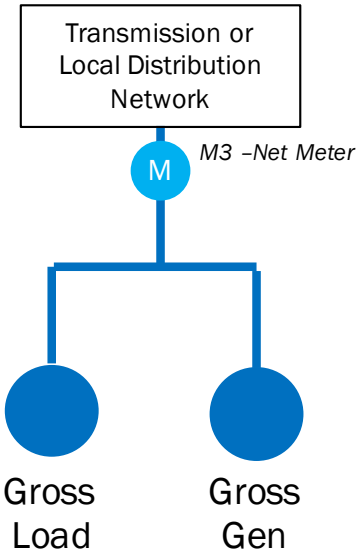
- DER has host load 2 MW based on M3 meter data for a specific 5-minute interval, also has a dispatchable 4 MW generator, and is the only DER in the Aggregation
- At the start of that 5-minute interval:
  - The Aggregation is dispatched for 2 MW by the NYISO
  - The facility baseline load is 2 MW
  - The generator outputs 2 MW
- Injection component:
  - At the point of interconnection (i.e. M3) there is 0 MW of Injection
  - Injection Response = max(0, Net Meter Value)
  - Injection Response = max(0, 0)
  - Injection Response = 0, Therefore the Injection response of the DER is 0 MW
- Demand Reduction component:
  - The baseline of the facility is 2 MW
  - At the point of interconnection the M3 meter reads 0 MW
  - Demand Reduction Response = max(0, Baseline + min(0, Net Meter Value))
  - Demand Reduction Response = max(0, 2 + min(0,0))
  - Demand Reduction Response = 2, Therefore, Demand Reduction response of the DER is 2 MW



Total Response=
Injection + Demand Reduction
Total Response = 2 MW

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Injection and Demand Reduction Response-Injection and Demand Reduction – Example 1

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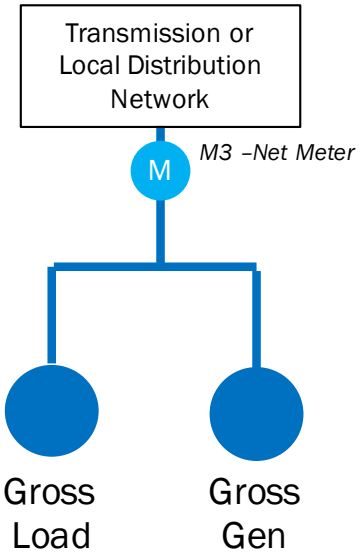
- DER has host load 2 MW based on M3 meter data for a specific 5-minute interval, also has a dispatchable 4 MW generator, and is the only DER in the Aggregation
- At the start of that 5-minute interval:
  - The Aggregation is dispatched for 4 MW by the NYISO
  - The facility baseline load is 2 MW
  - The generator outputs 4 MW
- Injection component:
  - At the point of interconnection (i.e. M3) there is 2 MW of Injection
  - Injection Response = max(0, Net Meter Value)
  - Injection Response = max(0, 2)
  - Injection Response = 2, Therefore the Injection response of the DER is 2 MW
- Demand Reduction component:
  - The baseline of the facility is 2 MW
  - At the point of interconnection the M3 meter reads 2 MW, a net injection
  - Demand Reduction Response = max(0, Baseline + min(0, Net Meter Value))
  - Demand Reduction Response = max(0, 2 + min(0,2))
  - Demand Reduction Response = 2, Therefore, Demand Reduction response of the DER is 2 MW



Total Response=
Injection + Demand Reduction
Total Response = 4 MW

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Injection and Demand Reduction Response-Injection and Demand Reduction – Example 2

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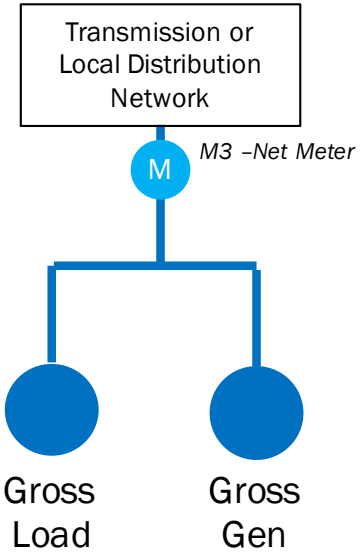
- DER has host load 2 MW based on M3 meter data for a specific 5-minute interval, also has a dispatchable 4 MW generator, and is the only DER in the Aggregation
- At the start of that 5-minute interval:
  - The Aggregation is dispatched for 4 MW by the NYISO
  - The facility baseline load is 2 MW
  - The facility load curtails 2 MW, the generator outputs 2 MW
- Injection component:
  - At the point of interconnection (i.e. M3) there is 2 MW of Injection
  - Injection Response = max(0, Net Meter Value)
  - Injection Response = max(0, 2)
  - Injection Response = 2, Therefore the Injection response of the DER is 2 MW
- Demand Reduction component:
  - The baseline of the facility is 2 MW
  - At the point of interconnection the M3 meter reads 2 MW, a net injection
  - Demand Reduction Response = max(0, Baseline + min(0, Net Meter Value))
  - Demand Reduction Response = max(0, 2 + min(0,2))
  - Demand Reduction Response = 2, Therefore, Demand Reduction response of the DER is 2 MW



Total Response=
Injection + Demand Reduction
Total Response = 4 MW

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Appendix C: 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

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*

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 = (-DAM Energy Schedule * RT LBMP)

  *+ ((Min (Injection Response, RT Energy Schedule)) * RT LBMP)*

  *+ (If(NBT<RT LBMP, Min(Demand Reduction Response, RT Energy Schedule – Injection Response) * (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
    - (-DAM Energy Schedule * RT LBMP)
- **RT Settlement, Step 2**
  - Compensate Aggregation for the max of the amount of Injection or the RT Energy schedule
    - + ((Min (Injection Response, RT Energy Schedule)) * 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
    - + (If(NBT<RT LBMP, Min(Demand Reduction Response, RT Energy Schedule – Injection Response) * (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

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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- **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

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Numerical Example 1 – Settlements

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- **During Settlements the following would occur for Hour 1:**
  - Inputs:
    - DAM Price: $45
    - DAM MW: 10 MWs
    - RT Dispatch: 10 MWs
    - RT MW Injection Response: 10 MWs
    - RT MW Demand Reduction Response: 0 MWs
    - 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)

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Numerical Example 1 – Settlements, con't

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

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Numerical Example 1 – Settlements, con't

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

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Numerical Example 1 – Settlements, con't

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

Numerical Example 1 – Settlements, con't

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

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Numerical Example 2 – Day Ahead

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- **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 MWs 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 MWs
    - RT Dispatch: 11 MWs
    - RT MW Injection Response: 11 MWs
    - RT MW Demand Reduction Response: 0 MWs
    - RT Price: $50
    - NBT: $35
  - DAM Calculation For Hour 1:
    - DAM Settlement = (DAM Schedule * DAM LBMP)
  - DAM Calculation For Hour 1:
    - DAM Settlement = (10 MWs* $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 MWs * $50) + ((Min (11 MWs, 11MWs)) * $50) + (If($35 < $50, Min(0 MWs, 11MWs – 11 MWs) * ($50), 0)

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Numerical Example 2 – Settlements, con't

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

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Numerical Example 3 – Day Ahead

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- **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***

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Numerical Example 3 – Settlements, con't

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

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Numerical Example 3 – Settlements, con't

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

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- 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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