

DER Market Design Updates & Energy Market Bid to Bill Examples

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MIWG

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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

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Purpose of Today's Meeting

- Review new and updated material
- Satisfy Stakeholder's request for a linear presentation of all Energy Market proposal materials to date

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Agenda

- **Review market design for:**
 - Updates from previous presentations
 - Market Entry Process Overview
 - Registration
 - Interconnection
 - Metering Configurations
 - Performance Measurement
 - FERC Order No. 745
 - Settlements
 - DCEA Market Entry Example with Energy Market Bid to Settlement Calculation Numerical Examples

Previously Presented Material

- Any material which has been presented at previous working groups will be denoted with a blue star in the upper left hand corner of the slide





Purpose of the DER Roadmap Effort

- Develop a Dispatchable DER Participation Model for the NYISO-administered wholesale markets
- Create a model that supports the **NYISO Market Design Vision - *Attract and retain*** the most efficient resources *to meet NY's reliability needs.*



Dispatchable DER Participation Models

- **Aggregations may be homogenous or heterogeneous**
 - Heterogeneous aggregations will be subject to the dispatchable DER participation model rules
 - Except for dispatchable Demand Side Resources, homogenous aggregations will be subject to the rules of the particular resource type (i.e., Generator, ESR, Intermittent Power Resource)
 - Dispatchable Demand Side Resources are those resources capable of responding to real-time dispatch signals from the NYISO
 - Dispatchable Demand Side Resources will be subject to the dispatchable DER participation model rules
 - Non-dispatchable Demand Side Resources (i.e., those resources that are not capable of responding to real-time dispatch signals from the NYISO) may continue to participate in the EDRP or SCR Program
- **Aggregations cannot include units requiring commitment**

Changes From Presentation on June 19th

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Real-Time Telemetry & Settlement Data

- **The NYISO had previously proposed the following:**
 - The DCE will substitute values of zero for the load-reduction response of all load reduction DER during intervals of non-dispatch by the NYISO
 - NYISO had previously contemplated allowing negative response for load reduction (i.e., when the load consumes more than the baseline load)
 - The DCE will send any non-zero injection response of all injecting DER during intervals of non-dispatch by the NYISO
 - This will ensure that the sub-zonal load calculations are accurate
- **Change from the June 19th presentation:**
 - The DCE will apply a floor of zero to the Load reduction response of load reduction DER during the intervals DCEA is dispatched by the NYISO (i.e., the load reduction response would be set to zero when the load is consuming more than the baseline)
 - Same concept exists in DADRP
 - A load reduction asset cannot therefore have negative response
 - Values provided for telemetry shall be between 0 and their baseline

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Real-Time Telemetry & Settlement Data, con't

- **Energy Markets:**

- Allowing for negative performance (below 0) the possibility for the occurrence of excessive penalties without the ability of the DER to receive compensation or dispatch signals for compensation of the same movement
- Penalizing a Load Reduction asset in excess of its supply would allow for penalties up to its total load consumption capability which could greatly exceed its dispatch signal
- The NYISO currently does not penalize generators an “under-gen penalty” that can exceed its dispatch signal in MWs

DCEA Performance, Impact

- There is no change to the concept of allowing the DCE to balance individual DER response within the DCEA to achieve DCEA dispatch
- Injecting DER within a DCEA *may still* provide balancing within the DCEA, as an example:
 - DCEA contains one 5 MW ESR and one 4 MW generator
 - DCEA bids in and is scheduled to charge 1 MW
 - The ESR charges at 5 MW while running its generator at 4 MW
 - DCEA response = -5 MW of ESR + 4 MW of injection = - 1 MW
 - The DCEA would be responsible for wholesale energy market payments of 1 MW

DCEA Performance, Impact con't

- Load reduction asset DER within a DCEA *may still* provide balancing within the DCEA, load reduction example:
 - DCEA contains one 5 MW ESR and 4 MWs of load reduction
 - DCEA bids in and is scheduled to charge 1 MW
 - The ESR charges at 5MW while providing 4MW of load reduction
 - DCEA response = -5 MW of ESR + 4 MW of load reduction = - 1 MW
 - LBMPs are above the NBT for the month
 - The NYISO is currently evaluating what would occur when the load reduction is below the NBT

Registration

DCE Registration

- **DCEs will be required to**
 - Register as a Market Participant
 - Post collateral
 - Collateral requirements for DCE/DCEAs are forthcoming and will be covered as one of the final topics

DER/DCEA Registration

- **DCE will be required to register individual DER's parameters/unique identifying information, which will be a hybrid of existing Generator, ESR and Demand Response Parameters**
 - Matrix of required information for cumulative DCEA values will be dependent on the characteristics of each individual DER



DCEA Registration, con't

- **Maximum net-injection for an individual DER within an aggregation is 20 MW based off the facility's requested physical interconnection capability**
 - For example: a protection scheme may limit a 22 MW name plate resource to 20 MW of injection into the grid
- **There is no limit in size for Demand Side Resources to participate in an aggregation**
- **A DCE may register any number of DCEA at a transmission node**
 - Transmission nodes will be unique to a single TO's subzone A subzone may have multiple transmission nodes



DCEA Registration, con't

- **DCEA will not receive unit commitment from the NYISO and will instead be considered as only a dispatch resource, when participating in the wholesale market**
 - DCEA will not have any commitment parameters such as start up cost considered in the market evaluation
 - Dispatchable DER will likely be serving a primary function other than providing Energy and Ancillary Services to the NYISO-administered wholesale markets, and therefore will already be “committed” when used to serve that primary function. It follows, then, that those resources will not require a day-ahead or real-time commitment by the NYISO.
 - In addition, unit commitment requires knowing the off/on status of the resource. Given that a DCEA is an aggregation of DER, it is not possible to determine DCEA’s on/off status



DER Registration - Interconnection

- **DER will be evaluated on an individual basis**
 - Not in aggregate (DER not DCEA)
- **Injection resources subject to the NYISO's interconnection procedures will be evaluated for ERIS, and if requested, for CRIS**
 - This includes resources which have the ability to both inject and reduce load, either in separate or overlapping intervals
 - This would be a co-located Injection and Load Reduction entities behind the same point of interconnection/utility meter
 - CRIS obtained through the NYISO's interconnection process will be assigned to the individual resource
- **Load Reduction-only resources will not be evaluated for interconnection and will have the ability to offer capacity without CRIS**

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DER Interconnection – Injection, con't

- Any resource with the capability to inject will be evaluated under the interconnection requirements based on its injection capability
 - Less than or equal to 20 MW, follows Small Generator Interconnection Process for ERIS
 - If the resource requires non-Local System Upgrade Facilities, it must enter a Class Year Study for ERIS
 - For CRIS, the resource must complete a Class Year Deliverability Study (unless the resource is 2 MW or less) and accept its cost allocation and post security for any System Deliverability Upgrades



Offering Capacity – Load Reduction-only

- **SCR resources have the ability to offer Capacity but do not need CRIS**
 - This right only exists when enrolled
- **Distributed Energy Resources that only have the ability to perform Load Reduction would share the same market entry process and have the same opportunities presently available to SCRs**

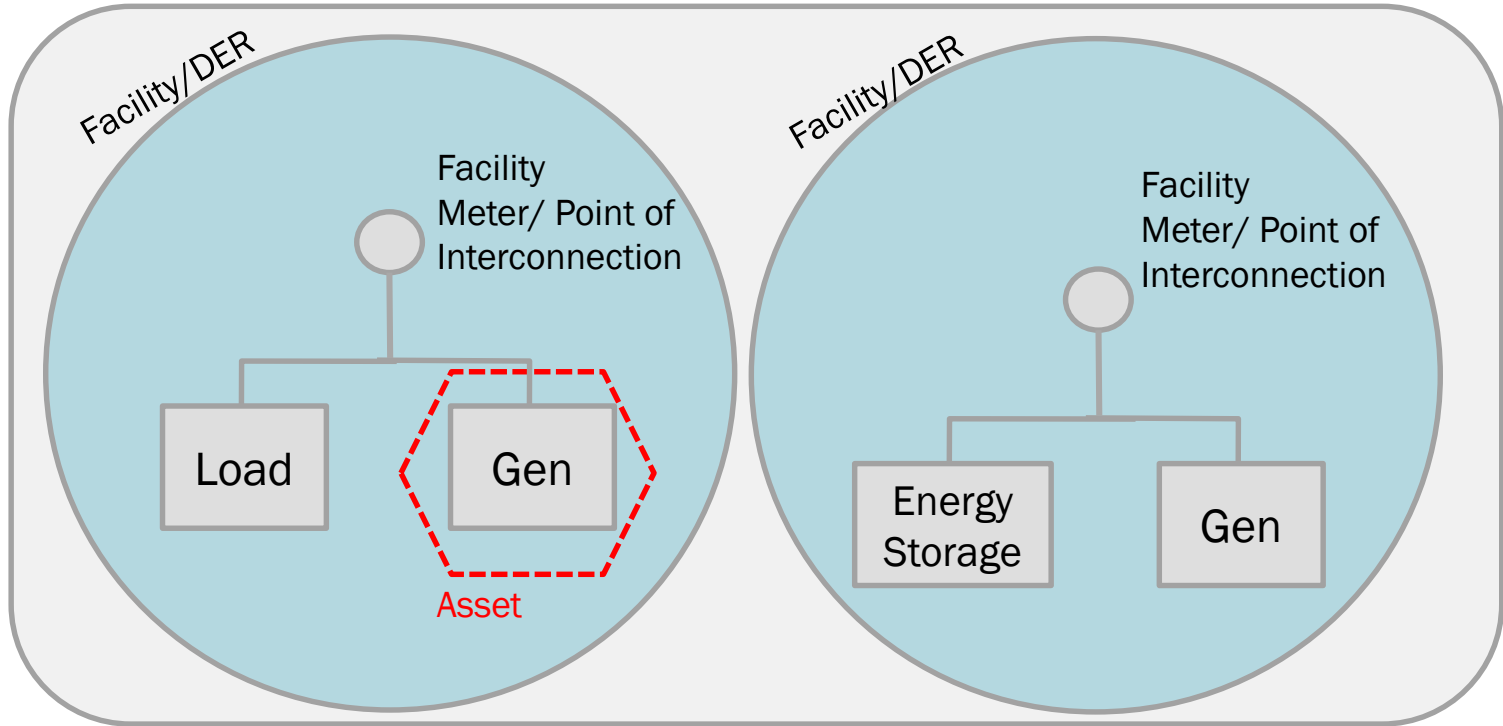
DER Metering Configurations

Terminology Overview

DCEA



Transmission Node



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Terminology, con't

- **Point of Interconnection** – Where the individual asset or facility/DER electrically interconnects to the distribution or transmission system
- **Transmission Node** – The virtual point of modeling for the entire DCEA



DER Aggregation Basics

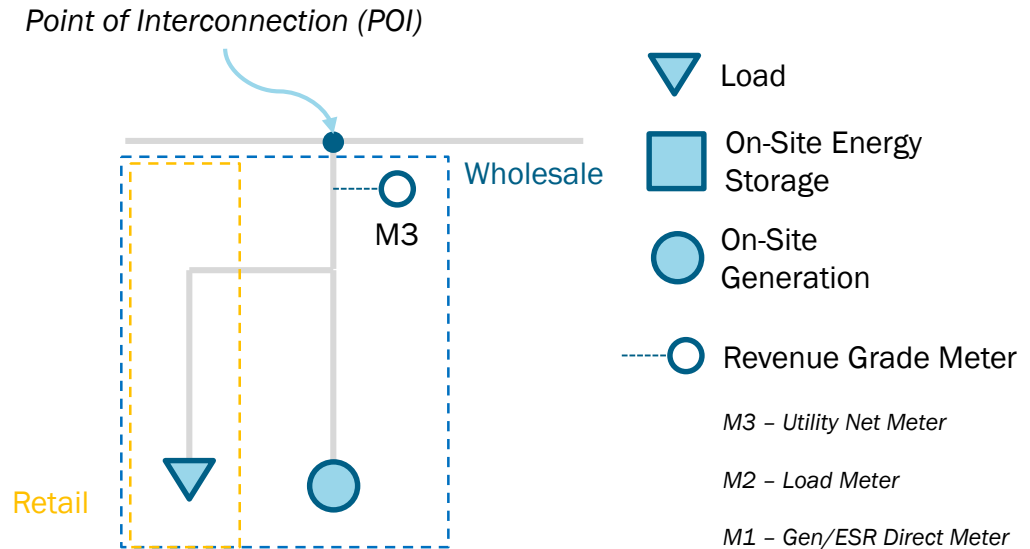
- **All resources within a DCEA will be required to be behind the same NYISO modeled Transmission Node**
 - The NYISO is working with utilities to identify the set of Transmission Nodes which will accurately reflect intra-zonal congestion
 - Methodology for Transmission Node identification for DCEA modeling will be completed as part of the 2018 Market Design process

DER and DCEA Metering Configurations

- Stakeholders have asked for depictions of the different DER metering and DCEA configurations available
- The following examples will build up from the individual DER/Facility level to the DCEA/Aggregation as a whole

1 - Net-Metered, no ESR

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

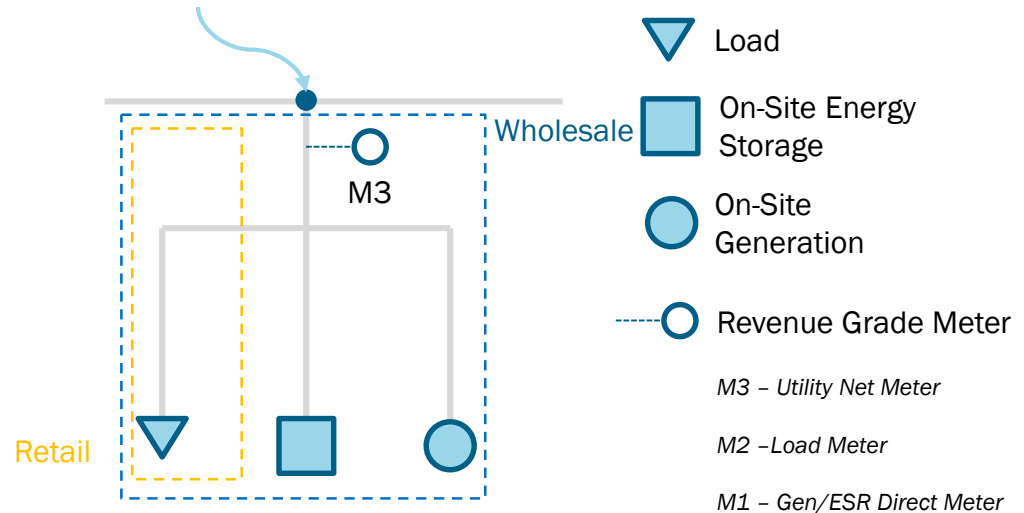


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2A – Facility/DER with no injection, ESR does not inject

- 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

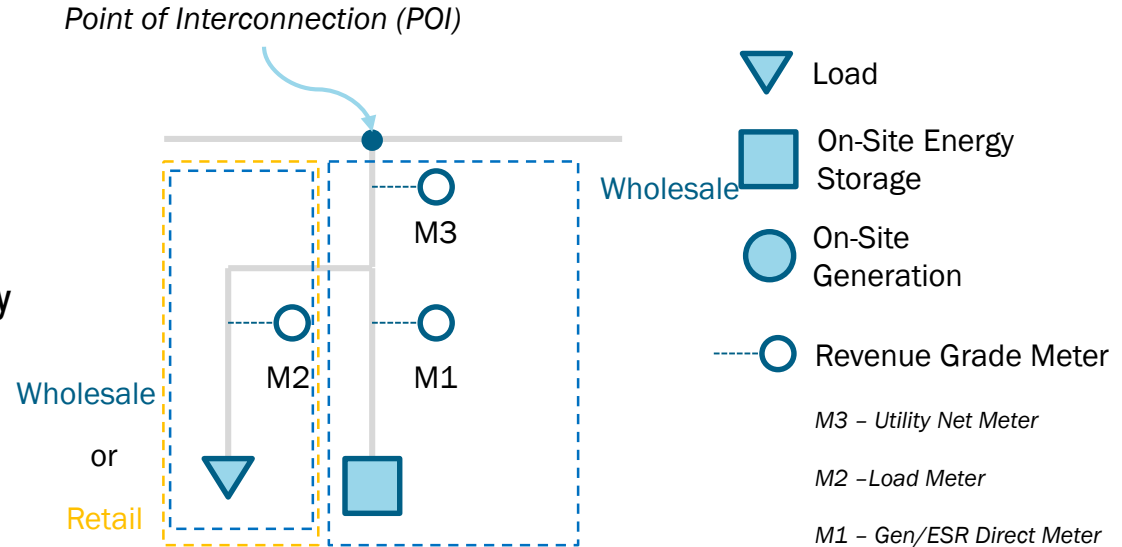
Point of Interconnection (POI)



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

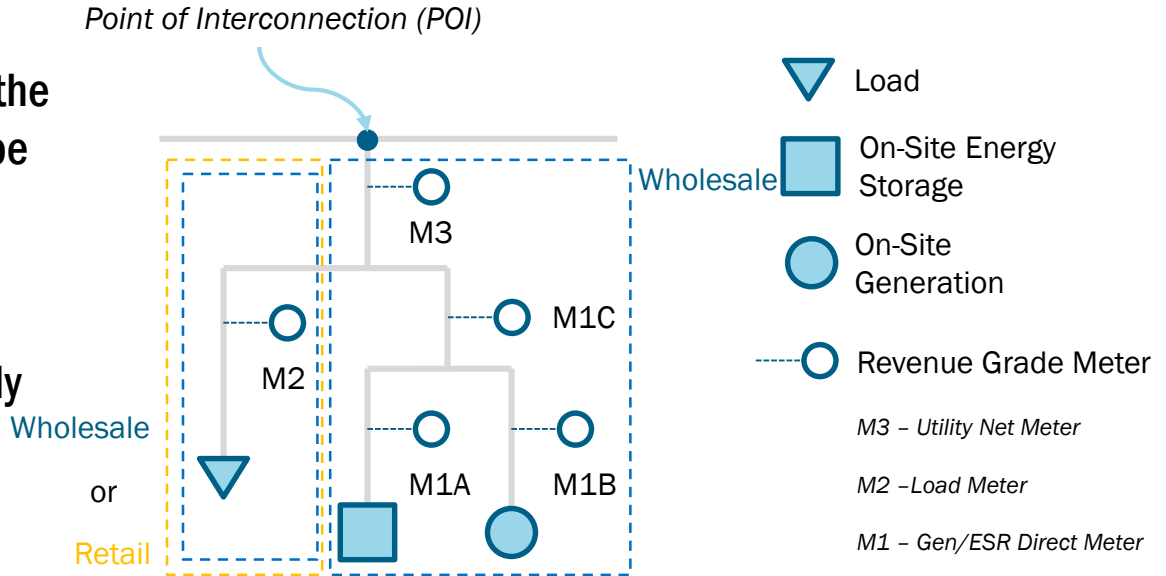
- A facility/DER with ESR will require both the ESR and the load to be metered separately
- The Load and ESR could participate as separate DER within the DCEA
- Full load at M2 must either be directly metered or calculated by the Meter Authority reported to NYISO for LSE billing purposes



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3 – Multiple generating assets with ESR

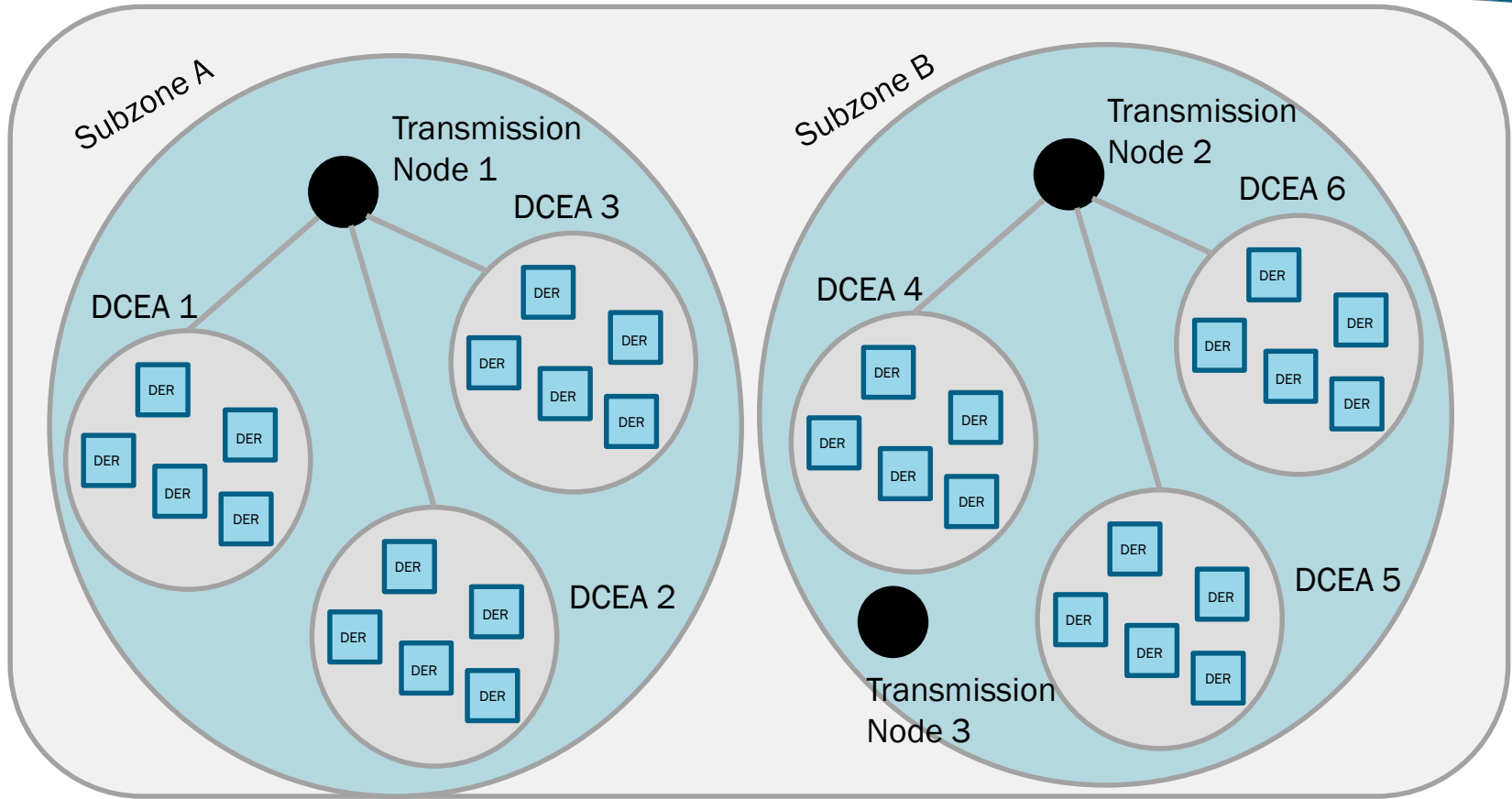
- If facility/DER has an ESR asset in addition to other generating assets, the ESR & other generating assets may be “group” or separately metered
 - M1C, or;
 - Both M1A & M1B
- Full load at M2 must either be directly metered or calculated by the Meter Authority reported to NYISO for LSE billing purposes



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Metering Configurations Overview

- 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 assets/DER
 - Regardless of physical location



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DCEA Performance, Measurement & Verification



DER Response

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



DER Response, con't

- **Telemetry and revenue/settlement data submittals for a DCEA shall be provided by the DCE, using the following calculation:**
 - For net-injection component of individual DER response:
 - Injection Response = $\max(0, \text{Net Meter Value})$ (1)
 - For net-load reduction component of individual DER response:
 - Load Reduction Response = $\max(\text{Baseline} + \min(0, \text{Net Meter Value}), 0)$ (2)
 - Total Response = (1) + (2)
 - 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



DCEA Performance

- A DCEA's performance will be measured by the DCE, across all DER in the aggregation
- DCEA allows for balancing by the DCE of individual DER performance within the aggregation
 - Over performing DER can balance the under performing DER within the DCEA

FERC Order No. 745



Existing Application of Order 745

- **The NYISO will implement its Order No. 745 tariff enhancements for the DADRP and DSASP in 2018**
 - This includes both the Net Benefits Test (NBT) Offer Floor and Cost-Allocation (CA) Methodology

Application of FERC Order No. 745 Net Benefits Test

Application/ Overview of Order 745

- **The NYISO is proposing that all Day-Ahead positions for a DCEA will automatically buy out in real time**
 - Examples on following slides
- **DER would be required to buy out of their Day-Ahead positions when their Real-Time schedule and performance differs from Day-Ahead**
 - Continued on next slide

Application/Overview of Order 745, con't

- **NYISO Day-Ahead transactions**
 - Do not guarantee dispatch in Real Time
 - Real-Time dispatch is re-evaluated with the incorporation of Real-Time bids
 - DCEAs are dispatch only and will not be considered for startup in NYISO's Security Constrained Unit Commitment (SCUC) evaluation and will not receive commitment
- **For these reasons, the NYISO proposes to conduct the after-the-fact Net Benefits Test evaluation for Real-Time load reduction MW only**
 - For the purposes of balancing obligation determination, Real-Time load 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 Load Reduction Response MW at Real-Time LBMP with consideration for the Net Benefits Test threshold

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Application/Overview of Order 745, con't

- **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 DCEA's load reduction response
- **DADRP currently disallows aggregations across multiple LSEs**
 - The NYISO is evaluating this requirement for the implementation of DER

★ Existing FERC Order No. 745 Net Benefits Test

- The NYISO's NBT Offer Floor requires Demand Side Resources submitting Energy offers to bid at or above the Offer Floor



Current Proposal, con't

- **The NYISO will apply its NBT as an after-the-fact evaluation**
 - NYISO would 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 and telemetry data during the settlements process
 - 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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Proposal Implications

- **Application of the NBT during the settlements process instead of as an Offer Floor would allow DER Coordinating Entities (DCEs) to bid in Demand Side Resource in the energy markets at any dollar value**
- **If a Demand Side Resource is scheduled and the Real-Time LBMP is below the NBT threshold value, its performance would not be compensated**
 - Numerical examples are provided in the following section, “Bidding & Settlements”

Energy Settlement Calculations

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

Proposal Calculation, Day Ahead

- 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

- Next step, the DCEA is bought out of its Day Ahead schedule and compensated for eligible Real Time performance
 - RT Energy Settlement = $(-\text{DAM Energy Schedule} * \text{RT LBMP}) + ((\text{Min}(\text{Injection Response}, \text{RT Energy Schedule})) * \text{RT LBMP})$

 $+ (\text{If}(\text{NBT} < \text{RT LBMP}, \text{Min}(\text{Load Reduction Response}, \text{RT Energy Schedule} - \text{Injection Response}) * (\text{RT LBMP}), 0))$
 - Breakdown on following slides

Proposed Calculation, con't

- **RT Settlement, Step 1**
 - Buy out of the Day Ahead Energy Schedule
 - $(-\text{DAM Energy Schedule} * \text{RT LBMP})$
- **RT Settlement, Step 2**
 - Compensate DCEA 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 Load Reduction portion of the DCEA for the remaining performance, otherwise, pay zero for Load Reduction response
 - $+ (\text{If}(\text{NBT} < \text{RT LBMP}, \text{Min}(\text{Load Reduction Response}, \text{RT Energy Schedule} - \text{Injection Response}) * (\text{RT LBMP}), 0))$

Proposed Calculation, exceptions

- **Implementation of calculation would need to 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**

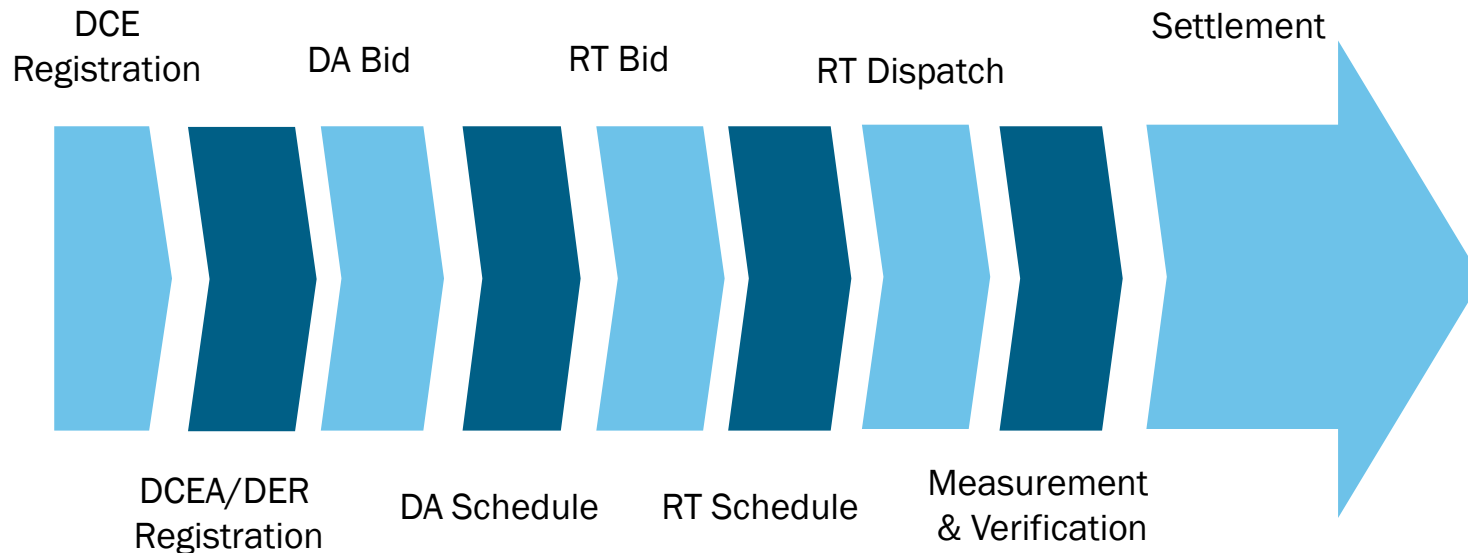
Bidding & Settlements

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Registration and Participation



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Overview of Following Slides

- The following slides are a time-step sequence of actions taken by the DCE/DCEA and the NYISO for the implementation of the Energy markets
- Each slide will denote which entity the action is attributable to

Overview of Following Slides, con't

- **There is one example on the following slides:**
 - A DCEA of mixed asset types
 - Current proposal works regardless of Heterogeneous or Homogeneous nature of the DCEA
- **For the purposes of this example, the DCEA will bid into the Day-Ahead Energy market**

Registration

- **The DCEA will be required to:**
 - Register as a Market Participant
 - Register all DER within the DCEA individually
 - Credit requirement TBD
- **Only those DER which have gone through the process of registration and/or obtaining ERIS and/or CRIS, in case of injecting DER, will be available for bidding**
 - ERIS and/or CRIS are not required for Load Reduction-only DER
- **If a DCEA meets minimum bidding requirements prior to ALL DER having been approved for the applicable NYISO markets, it may begin participating at the approved MW levels**



Bidding Overview

- **The NYISO will post the calculated NBT value prior to the beginning of the month**
 - Current filing states as of the 15th of the prior month
 - Ex: April 15th for May
- **DCE would then:**
 - Bid the DCEA in at 100kW increments, at a minimum, in the Day Ahead market
 - DCE will bid in values appropriate for each DCEA's physical characteristics (Injection/Withdrawal/Curtailment) and economic characteristics
 - No NBT offer floor limitations would be placed on bids

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Day-Ahead Market

- **For the Day-Ahead Market, the DCEA will:**
 - Enter bids appropriate for the DCEA
- **The NYISO will evaluate these bids and if accepted, provide the DCEA with a Day-Ahead schedule**
 - Schedule does not infer commitment, DCEAs are not eligible for commitment

In Day Actions

- **As part of the NYISO two part settlement system a NYISO initiated balancing transaction will have the DCEA balance its Day-Ahead position with Real-Time performance**
 - This is represented as occurring during Real-Time but the process is handled during settlements



Real Time Dispatch

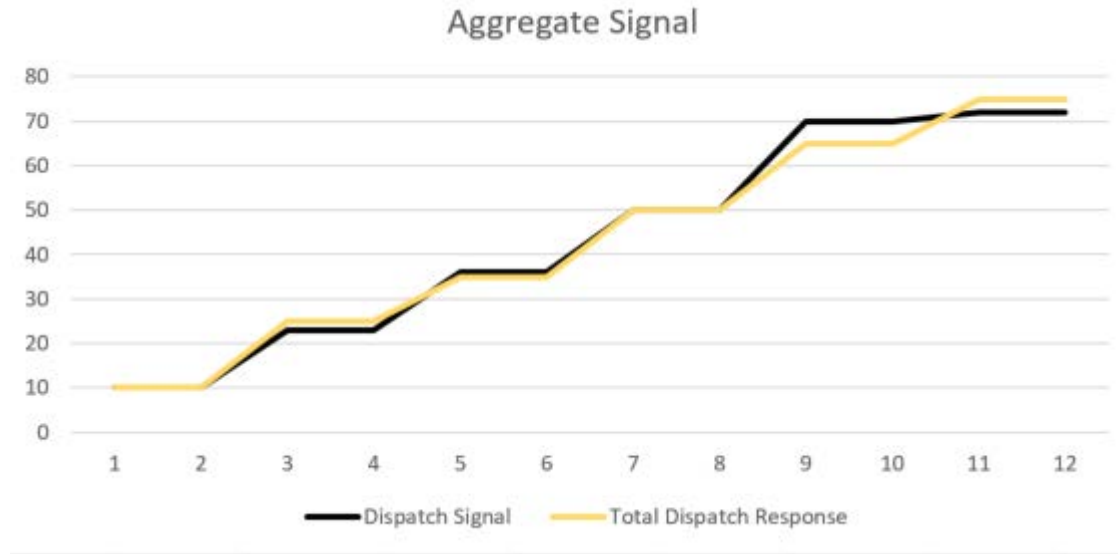
- **NYISO would then dispatch the economic DCEAs**
- **DCE would then:**
 - Respond to dispatch with a 6 sec telemetry signal, representing aggregate response of all resources within a DCEA
 - Provide additional 6 second telemetry signals for sub components
 - “Generation” telemetry signal will consist of the Injection and Negative Generation of all Injection-type and ESRs within the DCEA, regardless of utilization
 - “Load Reduction” telemetry signal will consist of the supply provided by all Load Reduction assets, regardless of utilization
 - $\text{Max}(\text{Baseline} - \text{Metered Value}, 0)$

BPCG & DAMAP

- When the calculations for BPCG and DAMAP are both finalized for ESR, the NYISO will evaluate whether these calculations also work for DCEAs
- These calculations and methodology will be brought to stakeholders at a future MIWG/ICAPWG



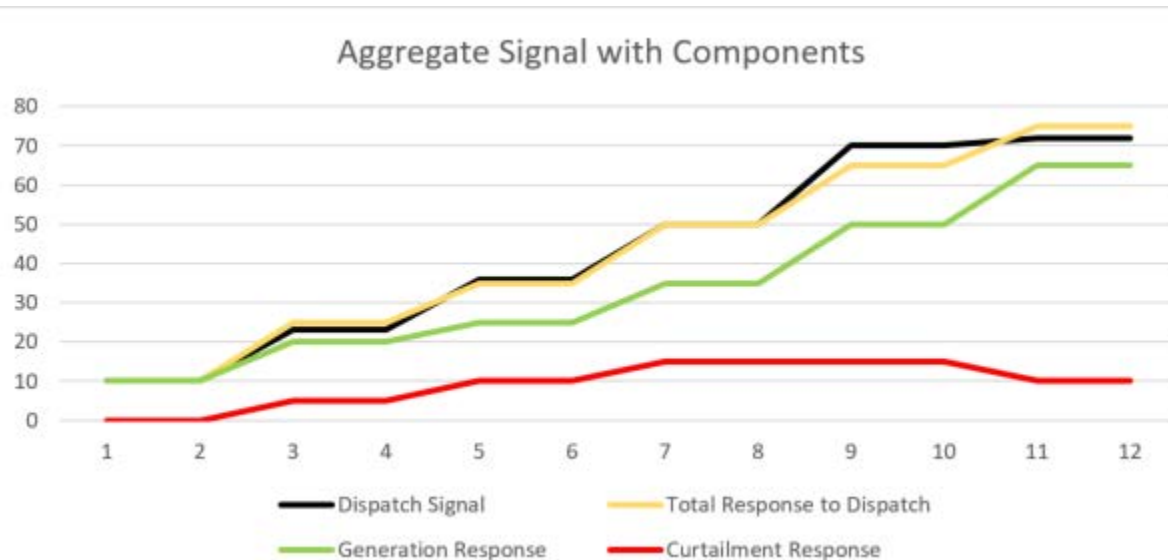
Example of Aggregate Response Signal



- This example contains the NYISO dispatch signal and the aggregate response signal



Aggregate Response Signal with Individual Components



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

Revenue Meter Data

- **By noon on the day after the Dispatch Day, the DCE will:**
 - Timing of response is the same as for Generators
 - Submit two hourly revenue meter response files
 - One for Injection and Withdrawal
 - Withdrawal is ES Charging only and represented as a negative number
 - Total value of supply provided or used (ESR charging) at the appropriate meter
 - One for Curtailment
 - Value provided is that of the supply from the resource used to meet NYISO dispatch, not the actual meter value
 - » $\text{Max}(\text{Baseline} - \text{Metered Value}, 0)$

Proposed Sequence of Events

- **NYISO would then:**
 - Pay/bill response for the injection/withdrawal dispatch signal & revenue file per current settlements process
 - Pay response within curtailment dispatch signal & revenue file per Order No. 745, if the Real Time clearing price meets or exceeds the NBT
 - Perform cost allocation for curtailment dispatch signal & revenue file per Order No. 745, if the Real Time clearing price meets or exceeds the NBT
- **These settlement processes will utilize the Day Ahead buy out calculations found in the previous section and the following numerical examples**

Numerical Example

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

Numerical Example 1 – Day Ahead

- **For this example;**
 - DCEA 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

Time Interval	Dispatch Signal	Generation Response	Curtailement 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;
 - DCEA 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 DCEA 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

- 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 Load 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(Load 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 MWs
 - RT Dispatch: 10 MWs
 - RT MW Injection Response: 10 MWs
 - RT MW Load 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(Load 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))

Numerical Example 1 – Settlements, con't

- 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

Numerical Example 1 – Settlements, con't

- 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 Load 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(Load 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

- 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

Numerical Example 2 – Day Ahead

- **For this example:**
 - DCEA 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, DECA is dispatched for MWs 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 MWs
 - RT Dispatch: 11 MWs
 - RT MW Injection Response: 11 MWs
 - RT MW Load 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(Load Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0))
 - RT Calculation For Hour 1:
 - RT Settlement = (-10 MWs * \$50) + ((Min (11 MWs, 11 MWs)) * \$50) + (If(\$35 < \$50, Min(0 MWs, 11 MWs - 11 MWs) * (\$50), 0))

Numerical Example 2 – Settlements, con't

- 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

Numerical Example 3 – Day Ahead

- **For this example;**
 - DCEA 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

- 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 Load 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(Load Reduction Response, RT Schedule - Injection Response) * (RT LBMP), 0))
 - RT Calculation For Hour 1:
 - RT Settlement = (-10 MWs * \$40) + ((Min (10 MWs, 10 MWs)) * \$40) + (If(\$35 < \$40, Min(0 MWs, 10 MWs - 10 MWs) * (\$40), 0))

Numerical Example 3 – Settlements, con't

- 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

Next Steps

- In 2018, the NYISO will develop rules for energy and capacity market offer requirements, mitigation, forecasting and interconnection
 - The NYISO will also more fully develop the market rules and tariff language to implement the 2017 MDCP
- The NYISO will evaluate the implementation of rules through the pilot program
- NYISO plans to conclude development of rules in 2018 for the eventual implementation of DER in 2021

Feedback?

- To ensure all feedback is captured please email additional feedback to: DER_Feedback@nyiso.com

Reminder – All comments received will be posted on the NYISO Distributed Energy Resources [webpage](#)

Appendix A - Acronyms

- DER – Distributed Energy Resource
- DCE – DER Coordinator Entity
- DCEA – DCE Aggregation
- DSP – Distributed System Platform
- DR – Demand Response
- RT - Real-Time
- DA – Day-Ahead
- RTC – RT Commitment
- RTD – RT Dispatch
- DAM – DA Market
- RTM – RT Market

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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Overview of DER Aggregation Basics

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Purpose of the DER Roadmap Effort

- Develop a Dispatchable DER Participation Model for the NYISO-administered wholesale markets
- Create a model that supports the **NYISO Market Design Vision - *Attract and retain*** the most efficient resources *to meet NY's reliability needs.*



DER Market Participation

- In the MDCP NYISO proposed to allow DER to utilize different participation models
- The participation model used by a DER will be determined by its capabilities and how it chooses to aggregate

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Dispatchable DER Participation Models

- **Aggregations may be homogenous or heterogeneous**
 - Heterogeneous aggregations will be subject to the dispatchable DER participation model rules
 - Except for dispatchable Demand Side Resources, homogenous aggregations will be subject to the rules of the particular resource type (i.e., Generator, ESR, Intermittent Power Resource)
 - Dispatchable Demand Side Resources are those resources capable of responding to real-time dispatch signals from the NYISO
 - Dispatchable Demand Side Resources will be subject to the dispatchable DER participation model rules
 - Non-dispatchable Demand Side Resources (i.e., those resources that are not capable of responding to real-time dispatch signals from the NYISO) may continue to participate in the EDRP or SCR Program
- **Aggregations cannot include units requiring commitment**



Participation Models Available to DER

Non-Dispatchable Resources

EDRP & SCR Program Model

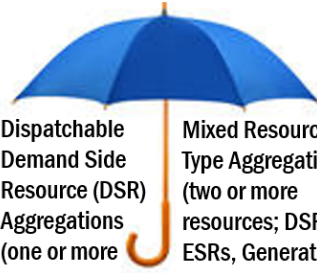


Non-Dispatchable Demand Side Resource (DSR) Aggregations (one or more resources)

- Capacity
- Energy for reliability based events

Dispatchable Resources

Dispatchable DER Participation Model



Dispatchable Demand Side Resource (DSR) Aggregations (one or more resources)

- Capacity
- Energy
- Ancillary

Mixed Resource Type Aggregations

(two or more resources; DSRs, ESRs, Generation)

- Capacity
- Energy
- Ancillary

Generator/Energy Storage Resource (ESR) Participation Model



Single Resource Type Aggregations (Generator only; ESR only)

- Capacity
- Energy
- Ancillary

Individual Generators or ESRs

- Capacity
- Energy
- Ancillary

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<p>DER Coordinating Entity Aggregation (DCEA)</p> <p>An aggregation under the responsibility of a DER Coordinating Entity (DCE) and consists of resources:</p> <ul style="list-style-type: none"> • Qualified to participate in Energy, Ancillary and Capacity market • Capable of responding in real-time to NYISO's direction 	<p>Generator Resource Model</p>	<p>Consisting of Only Generators</p> <ul style="list-style-type: none"> • Aggregation must consist of 2 or more Generator DER
	<p>Energy Storage Resource Model</p>	<p>Consisting of Only Energy Storage Resources (ESR)</p> <ul style="list-style-type: none"> • Aggregation must consist of 2 or more ESR DER
	<p>Dispatchable DER Model</p>	<p>Consisting of Only Demand Side Resources (DSR)</p> <ul style="list-style-type: none"> • Aggregation must consist of 1 or more DSR DER • No DER in the aggregation can inject into the grid, load reduction only
		<p>Mix of Generators, Energy Storage Resources, and Demand Side Resources</p> <ul style="list-style-type: none"> • Aggregation must consist of 2 or more Resource Types (i.e. Generator, ESR, DSR) • Capable of injection and/or load reduction
<p>Individual Resource</p> <ul style="list-style-type: none"> • Qualified to participate in Energy, Ancillary and Capacity market • Capable of Injection • Capable of responding in real-time to NYISO's direction 	<p>Generator Model or Energy Storage Resource Model</p>	<p>Individual Generator or Energy Storage Resource</p> <p>Individual Generator or Energy Storage Resource under the responsibility of a Market Participant</p>
<p>Non-DCEA Aggregation or Individual Demand Side Resource</p> <ul style="list-style-type: none"> • Capable of load reduction • Not capable of responding in real-time to NYISO's direction 	<p>Special Case Resource Model</p>	<p>Special Case Resources (SCR)</p> <p>Individual Demand Side Resources or Small Customer Aggregation under the responsibility of a Responsible Interface Party (RIP) and are resources:</p> <ul style="list-style-type: none"> • Qualified to participate in Capacity market
	<p>Emergency Demand Response Model</p>	<p>Emergency Demand Response Program (EDRP)</p> <p>Individual Demand Side Resources under the responsibility of a Curtailment Service Provider (CSP) and are resources:</p> <ul style="list-style-type: none"> • Qualified to provide Energy during reliability events

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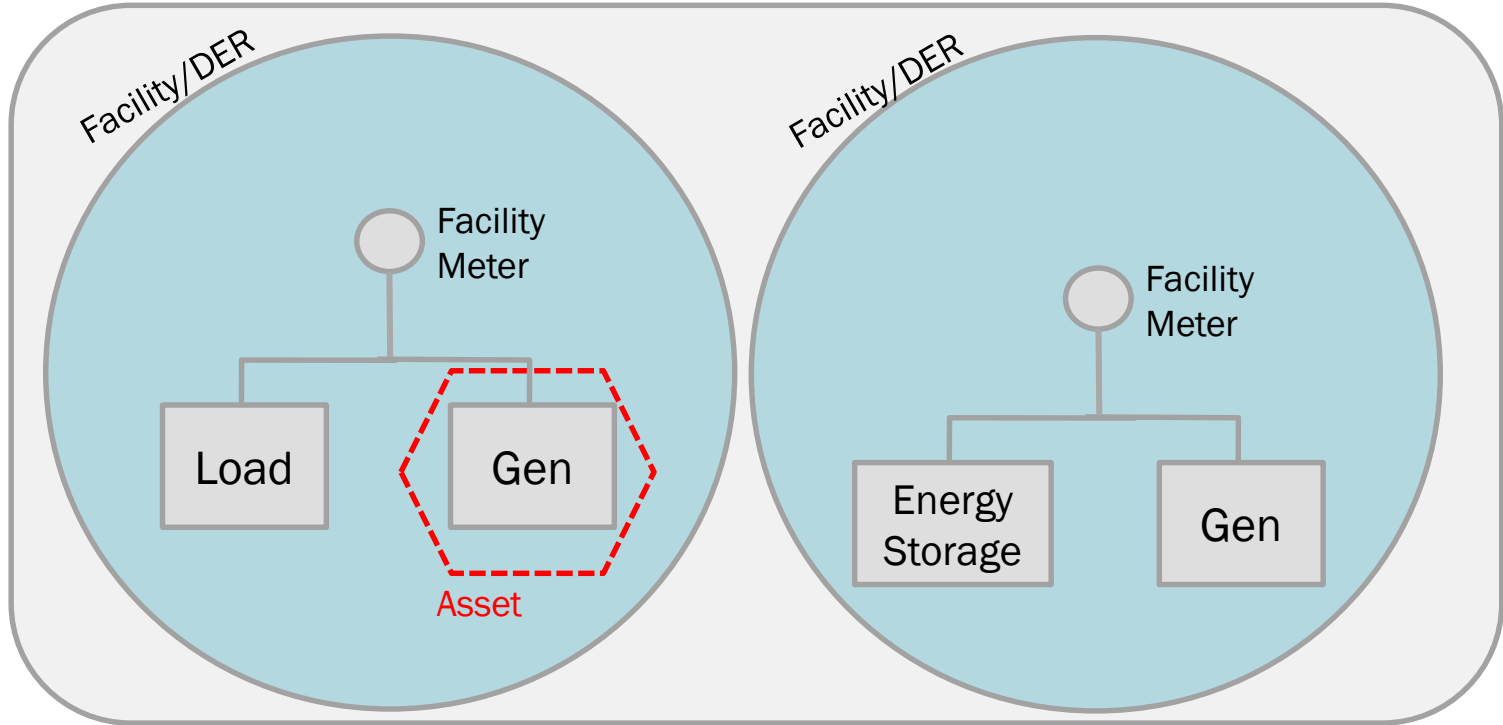
DER Aggregation Basics Recap

- DER will be permitted to aggregate to meet minimum eligibility requirements and performance obligations
- The DER Coordinating Entity (“DCE”) will be the aggregator and NYISO Market Participant
- The DER Coordinating Entity Aggregation (“DCEA”) will be a group of one or more resources participating in the NYISO Market, represented by a PTID
 - Bidding and Performance Obligations will be done and measured on a DCEA basis
 - Settlements and M&V will be done on the DCEA basis, with separate processes being used for the injection and load reduction portion



Terminology Overview

DCEA



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DER Aggregation Basics, con't

- **All resources within a DCEA will be required to be behind the same NYISO modeled Transmission Node**
 - The NYISO is working with utilities to identify the set of Transmission Nodes which will accurately reflect intra-zonal congestion
 - Methodology for Transmission Node identification for DCEA modeling will be completed as part of the 2018 Market Design process

Telemetry Signal Basics



Aggregate Response Signal for Entire DCEA

- The NYISO is proposing a telemetry signal would be sent to the NYISO during dispatch, representing the response of the entire DCEA
 - DCEAs will be comprised of either mixed technologies or solely Demand Side Resources
 - A telemetry signal for the whole DCEA will be sent to the NYISO regardless of resource types or count of resources within the DCEA
 - The NYISO will work with stakeholders on a method to aggregate all signals on the resource side, and to send this aggregate response signal to the NYISO
- Telemetry signal would be sent at 6 second intervals

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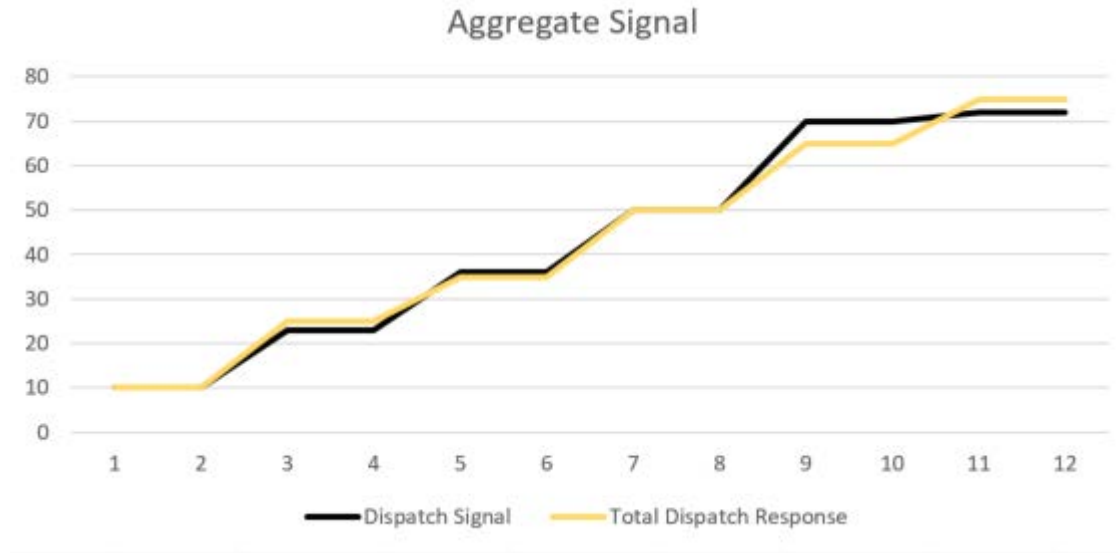


Other Response Signals, Sub-Components

- **Additional telemetry signals would also be sent to the NYISO, during dispatch**
 - By “performance type”
 - Currently theorized that there would be two separate sub-component signals
 - One showing injections and withdrawals
 - One showing only curtailment (DR)
 - NYISO is still investigating whether three signals are needed to differentiate between all three resource types
 - These Telemetry signals would also be sent at 6 second intervals
- **NYISO would be aware of signal components before revenue data was submitted to the NYISO**



Example of Aggregate Signal



- This example contains the NYISO dispatch signal and the aggregate response signal

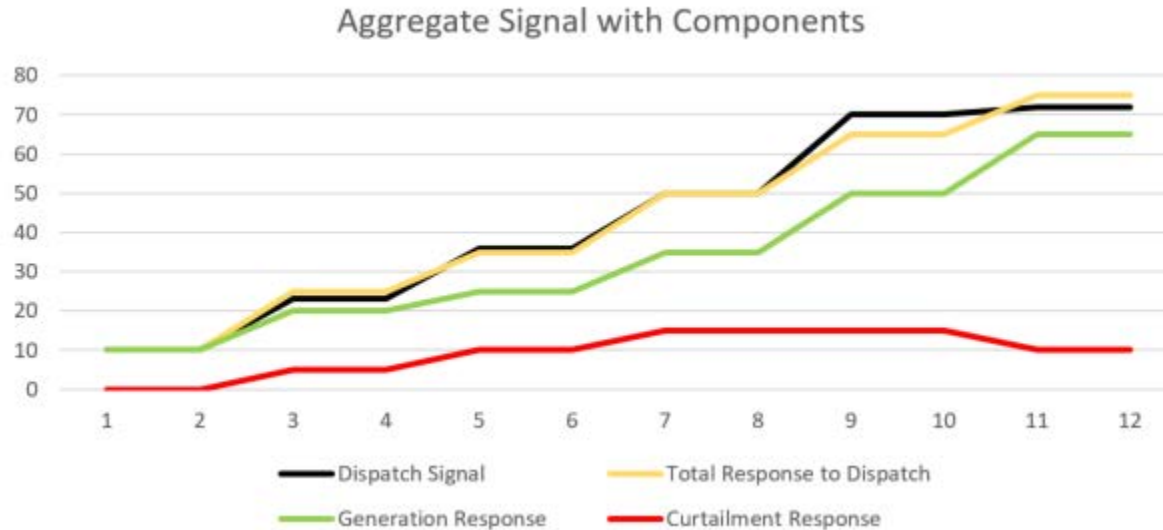


Aggregate Telemetry Signal Components

- **Aggregate telemetry signal could consist of any mix of the following:**
 - Demand Side Resources
 - Response will be sent as a positive value, similar to how DSASP works today
 - Generation
- **Telemetry signals for each individual resource or resource types within a DCEA, would not be sent to the NYISO**
- **Telemetry signals will be sent in aggregate, one for injection/withdrawal and one for curtailment**



Aggregate Signal with Components



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

Numerical Examples – Additional Examples

★ Numerical Example 1B – FERC Order No. 745

NBT Threshold not Exceeded

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	10
Hour 3	35	20	15	35	20

- For this example, the DCEA responded perfectly to dispatch, but;
 - NBT Threshold is \$50 for the month
 - Offer is \$35
 - Clearing price for each hour is \$40
 - Entire DCEA is scheduled and dispatched
- Once both revenue files are submitted;
 - Generation would get paid per current settlement rules for each of the three hours
 - No payment or cost-allocation would be performed for curtailment resources, since clearing price is not at or above the NBT threshold for the month

Numerical Example 1C – FERC Order No. 745 NBT

Threshold Exceeded: Settlements Hierarchy

Time Interval	Dispatch Signal	Generation Response	Curtailement Response	Total Response to Dispatch
Hour 1	10	20	5	25
Hour 2	15	25	5	30
Hour 3	35	35	10	45

- For this example;
 - DCEA is entirely economic
 - NBT is below the clearing price for each hour
 - The entire DCEA is scheduled and dispatched
 - The DCEA responded *far in excess* of dispatch instructions
- Generation/Injection file will have evaluation primacy for settlements
- DCEA would be compensated for satisfying the dispatch
- Therefore, in this example, Order No. 745 cost allocation would not be applied for curtailment resources, because the generation response satisfied the entire dispatch