Dynamic Reserves

Ashley Ferrer

Market Design Specialist, Energy Market Design

ICAP/MIWG

March 20, 2024

DRAFT – FOR DISCUSSION PURPOSES ONLY

Contents

New York ISO

Background

Background

- NYISO has worked with stakeholders since 2019 to develop Dynamic Reserves, culminating in a presentation to BIC[1] in December 2023
- During the 2023 discussions, Potomac Economics discussed five elements of the NYISO proposal and provided alternate design options[2,3]
  - Potomac found that the "core elements of [the] Dynamic Reserves design are excellent" but expressed concern over five elements and encouraged further evaluation and discussion
  - The five items identified by Potomac are as follows:
    - Calculation of DAM Congestion Rent: "An error in the calculation of DAM Congestion Rent"
    - Allocation of the Forecast Reserve Charge: "Allocation of the Forecast Reserve Charge"
    - Treatment of Bid Load: "Local 30-min reserve constraints based on "Bid Load""
    - Energy Imports: "Treatment of DAM imports"
    - Large Generator Charges: "Settlements with largest and second largest contingencies"
- An additional element that will be discussed in 2024 is the interaction with Transmission Congestion Contracts (TCCs)

1: https://www.nyiso.com/documents/20142/41671891/UPDATED%20-%2020231213%20BIC%20-%20Dynamic%20Reserves%20REPOSTED.pdf/0bc8d5df-6773-8db1-9f99-d91fd1fd0676

2:https://www.nyiso.com/documents/20142/41393553/MMU%20Comments%20re%20Dynamic%20Reserves%20Proposal_11-27-2023.pdf/6b8c9fce-5e44-233e-1545-059f07747025e

3:https://www.nyiso.com/documents/20142/41570800/MMU%20Comments%20re%20Dynamic%20Reserves%20Proposal_12-04-2023.pdf/41ef7ba4-6d04-9bae-af42-95fa023659ac

Discussion of Outstanding Elements

DAM Congestion Rent and Operating Reserve Cost Recovery

Operating Reserve Cost Recovery

- **During the 2023 design, NYISO proposed to recover locational reserve costs through OATT Rate Schedule 5**
  - Locational reserve costs will be recovered from load through OATT Rate Schedule 5
  - Congestion rent (less congestion rent paid to energy suppliers) will be returned to load via the TCC market
- **Two alternate proposals were made, which would recover locational reserve costs through (1) DAM Congestion Rent and (2) a charge specifically to locational load**
  - Given stakeholder interest in this topic, NYISO will include in the 2025 project prioritization process a project titled "Review Operating Reserve Supplier Cost Recovery"
- **NYISO affirms its proposal that locational reserve cost recovery will occur through Rate Schedule 5 and in response to stakeholder feedback received following the 2/20 MIWG, the NYISO will develop and offer a project for the 2025 Project Prioritization process to "Review Operating Reserve Supplier Cost Recovery"**

Allocation of the Forecast Reserve Charge

Allocation of the Forecast Reserve Charge

- **In 2023, the NYISO proposed a new settlement construct, a Forecast Reserve Charge (FRC)**
  - The FRC will charge the Forecast Reserve price to Real-Time Loads that do not schedule in the Day-Ahead Market in order to ensure the appropriate incentive to schedule load Day-Ahead and recover the cost of scheduling reserves up to Forecast Load
  - The revenues from this charge would offset the total reserve charges to LSEs (i.e., offset Rate Schedule 5)
- **Potomac recommended changes to how the revenues from the FRC are applied. Potomac proposed that revenues from the FRC are added to the DAM Congestion Rent**
  - Potomac states that this FRC recommendation is necessary to ensure sufficient congestion rent is available to pay Operating Reserve suppliers when Operating Reserve Suppliers are compensated from DAM Congestion Rent, i.e., is related to the cost recovery element discussed above.
  - Further, Potomac proposed a change to the formulation of the FRC to LSEs. Potomac proposed that the FRC should be allowed to go negative as a credit to LSEs when their RTM schedule < DAM schedule
  - This recommendation would not affect prices, schedules, total cost to NYCA load, or total payments to suppliers
- **Given the related nature of the OR cost recovery mechanism and how the FRC revenues are applied, NYISO proposes the application of FRC revenues is also discussed during the 2025 "Review Operating Reserve Supplier Cost Recovery" project.**
- **NYISO affirms its proposal to use FRC revenues to offset total reserve charges to LSEs (i.e., offset Rate Schedule 5) and commits to exploring this element as part of the proposed "Review Operating Reserve Supplier Cost Recovery" project.**

Treatment of Bid Load

Treatment of Bid Load

- **In 2023, the NYISO proposed that 30-Minute locational reserve constraints will secure to the higher of Scheduled (Bid) Load and Forecast Load**
- **Potomac proposed that 30-Minute locational reserve constraints should only consider Forecast Load**
  - Potomac references that when the risk of real-time price spikes increase, more load may be scheduled in the DAM, which would lead to excess reserves being scheduled. An example of this is the potential overscheduling of load on days with Thunderstorm Alerts (TSAs)
- **Scheduled Load represents the foundation of the NYISO energy market**
  - Scheduled Load is a direct reflection of Market Participant expectations and positions
    - Scheduled load represents Market Participants willingness to schedule (and pay for) load in the DAM
  - Scheduled Load is the basis for DAM generation schedules, imports and exports, and TCC payments. Forecast Load represents NYISO's estimate of load and is used to support reliable operations in cases where Forecast Load is above Scheduled Load
    - Under today's rules, NYISO establishes energy schedules based on Scheduled Load even when it exceeds Forecast Load
    - If Forecast Load exceeds Scheduled Load, the quantity of resources committed may increase; however, when Forecast Load is less than Scheduled Load, resources will not be uncommitted

New York ISO

Treatment of Bid Load (continued)

- **It is appropriate to consider Scheduled Load when formulating reserve constraints**
  - Modeling reserve constraints for both Scheduled Load and Forecast Load is transparent. Market participants can adjust their behaviors to align their desired outcomes with these rules
- **NYISO affirms its proposal that 30-Minute locational reserve constraints will secure to the higher of Scheduled (Bid) Load and Forecast Load**
  - The NYISO commits to working collaboratively with the MMU and stakeholders to ensure reserve requirements reflect reliability needs

New York ISO

Energy Imports

Energy Imports

- **In 2023, the NYISO proposed treating imports the same as internal generation when solving Dynamic Reserves constraints based on Forecast Load**
  - The NYISO proposed that imports that do not materialize in the RTM (i.e., Actual Imports < DAM Scheduled Imports) will be charged the Forecast Reserve Charge
- **Potomac proposed that imports should be categorized as Firm or Non-Firm, and only Firm imports should be used to solve Dynamic Reserves constraints based on Forecast Load**
  - Potomac Economics recommended creating a firm and non-firm energy import market design and then only allowing firm energy imports to satisfy forecast load reserve constraints, arguing NYISOs design (1) will require SREs and (2) will encourage more non-firm imports. Each of these points is discussed in the following slides
- **NYISO's 2023 proposal used the existing energy market treatment of imports as an input into reserve constraints**
  - Imports satisfy resource requirements in the NYISO's DAM SCUC Forecast Load Pass, and therefore imports satisfy resource requirements in the forecast reserve constraints
- **Potomac argues this design will encourage more non-firm imports**
  - In the 2023 market design, the NYISO proposed that imports that do not materialize in the RTM (i.e., Actual Imports < DAM Scheduled Imports) will be charged the Forecast Reserve Charge when Forecast Load > Scheduled Load.
  - Potomac acknowledges this resolves the problem for purely virtual imports but not non-firm imports

Energy Imports (continued)

- An energy market structure that differentiates firm and non-firm energy market imports is a pre-requisite to differentiating firm and non-firm energy imports in the dynamic reserves forecast load reserve constraints. This energy market structure does not exist today
- NYISO affirms its proposal treating imports the same as internal generation when solving Dynamic Reserves constraints based on Forecast Load
  - This is consistent with FERC's recent acceptance of ISO-NE's Energy Imbalance Reserves product that allows imports to satisfy the requirement
  - Further, the NYISO supports exploring market designs that enhance market signals for needed resources and can help establish market solutions that avoid the need for SREs. This could include an energy market design that differentiates firm and non-firm imports. Such an effort should be considered within the project prioritization process.

Large Generator Charges

Large Generator Charges

- The NYISO proposed that the constraint for the 30-Minute NYCA-wide reserve requirement will be equal to the output of the largest contingency + second largest contingency + max(0,(Forecast Load – Scheduled Load))
  - Contingency being defined as the supplier or single import line with largest (and second largest) energy plus reserves schedule
  - NYISO did not propose any charges for suppliers, and all NYCA Operating Reserve costs will be recovered through Rate Schedule 5
- Potomac proposed the development of a charge for the largest and second largest contingency to reflect their contribution to the NYCA 10-Minute and 30-Minute contingency reserve requirement

New York ISO

Large Generator Charges

- NYISO's proposal minimizes production costs and is efficient, assuming suppliers offer consistent with their marginal costs
- Potomac agrees that SCUC/RTC/RTD minimize production costs presented in the model, but believes the NYISO design will not actually minimize overall costs because the design is not incentive compatible given that suppliers will not have an incentive to offer at marginal cost
- The resources subject to such charges are likely to be low emitting and/or policy resources, which could create incentives inconsistent with State laws.
- NYISO affirms its proposal that all NYCA Operating Reserve costs are recovered through Rate Schedule 5, but is open to exploring this question as part of the proposed "Review Operating Reserve Supplier Cost Recovery" project.

New York ISO

TCCs

Transmission Congestion Contracts (TCCs)

- **TCCs provide MPs the Day-Ahead Market (DAM) congestion rent value for the specific path associated with a TCC, which can serve as a mechanism to hedge against DAM congestion costs**
- **TCCs are primarily obtained through an auction process**
  - TCCs are awarded on a MW basis between a specified Point of Injection and Point of Withdrawal
  - For each TCC awarded, an MP will collect/pay DAM congestion rents
- **The amount of TCCs available in an auction is determined by the physical configuration of the transmission system**
  - The awards are based on an optimal power flow analysis, which utilizes system representations, transmission and interface limits, flow assumptions, and other factors to evaluate if the set of TCCs awarded (the amount of MWs) violates DAM security constraints
  - If the set of TCCs awarded does not violate security constraints in the auction model, then it ensures that the adequate congestion rents are collected in the DAM to fully fund all required payments to TCC holders
  - Congestion Rent shortfalls and surpluses occur when factors in the DAM modify internal transfer capability to levels which differ from what had been assumed in the TCC auctions. These shortfalls and surpluses are currently settled with the transmission owners subject to Attachment N of the OATT and serve as an adjustment to the transmission charges of such entities

New York ISO

Transmission Congestion Contracts (TCCs) (continued)

- **The TCC market has existing mechanisms for identifying if shortfalls or surpluses can be attributed to specific Transmission Owners due to DAM transmission facility outages, returns-to-service, uprates, and derates of transmission facilities**
  - If a shortfall or surplus (or portion thereof) can be attributed to a specific Transmission Owner that is subject to Attachment N of the OATT (TO), then that TO is responsible for those costs
  - Shortfalls or surpluses that aren’t attributed to a specific TO would be allocated across all TOs subject to Attachment N of the OATT

New York ISO

Dynamic Reserves and TCCs

- **Dynamic Reserves will allow the optimization to more precisely calculate the tradeoffs between energy and reserves, as well as to more accurately calculate the amount of MW needed to relieve post-contingency flows**
  - The formulations allow energy to flow above post-contingency limits if there are sufficient reserves to back flows down to applicable limits following a contingency, when allowed per applicable reliability rules
  - Similarly, the optimization may schedule zero reserves if energy flows will not exceed applicable limits post contingency or if the cost of reserves exceeds the production cost savings of increasing energy flows
  - Therefore, energy flows may decrease, relative to today, to manage post-contingency transmission flows associated with Dynamic Reserves constraints
- **In circumstances where a transmission element is fully utilized in the TCC auctions, congestion rent shortfalls could occur**
  - These shortfalls would be realized due to decreasing energy flows on a transmission line in the DAM which would reduce the collection of energy congestion charges, relative to today
  - This would occur under Dynamic Reserves since the constraints are not currently a part of the TCC auction model

Dynamic Reserve and TCCs: Example

- At the November 17, 2023 MIWG, the NYISO presented a series of examples to demonstrate congestion rent allocation and settlements
  - Please refer to the Appendix for a review of the example inputs
- Example 3 of that presentation demonstrated how the optimal outcome (i.e., minimized production cost) may be able to respect transmission constraints through energy scheduling and not schedule reserves
  - In this scheduling paradigm, energy would be scheduled such that post-contingency energy flows would not exceed LTE limits
  - This would occur in circumstances where scheduling reserves would be a more expensive solution

New York ISO

Dynamic Reserves and TCCs: Example (continued)

- **Example 1 is the "Base Case Example" with no dynamic reserves constraints**
  - Post-Contingency Energy flows on each line are 1049 MW
- **Example 2 is a "Cheap Operating Reserves Example" with dynamic reserves constraints and a low offer for operating reserves**
  - Post-Contingency Energy flows on each line are 1049 MW
- **Example 3 is an "Expensive Operating Reserves Example" with dynamic reserves constraints and a high offer for operating reserves**
  - Post-Contingency Energy flows on each line are 999 MW
- **In this example, we will evaluate 1) difference in energy flows using Dynamic Reserves constraints with low and high reserves offers and 2) potential congestion rent shortfalls in Example 3**
  - This example assumes that the TCC market clearing price from the TCC auction is equal to the DAM congestion value of the TCC
  - This example also assumes that TCCs are sold up to the MTE limit of the line, similar to energy scheduling constraints in NYC

New York ISO

Dynamic Reserves Scheduling: Difference in Energy Flows with Cheap and Expensive Operating Reserves

The clearing price of reserves increases from $2 to $45. At $45, no reserves are scheduled because the reserve offer is $47.

Congestion Rent Allocation and Settlements

		Example 2 - Cheap OR	Example 3 - Expensive OR
ROS Energy Offer	($/MWh)	5	5
Locality Energy Offer	($/MWh)	50	50
ROS Reserves Offer	($/MWh)	1	1
Locality Reserves Offer	($/MWh)	2	47
ROS LMP	($/MWh)	$ 5	$ 5
Locality LMP	($/MWh)	$ 50	$ 50
ROS OR Price	($/MWh)	$ -	$ -
Locality OR Price	($/MWh)	$ 2	$ 45
ROS Energy Sched	(MW)	3147	2997
Locality Energy Sched	(MW)	353	503
ROS OR Sched	(MW)	0	0
Locality OR Sched	(MW)	150	0

In Example 3, the reserve offer in the locality is increased from $2 to $47.

Due to the high reserve offers, energy flows are decreased by 150 MW, and internal generation scheduled is increased by 150 MW. The reserve requirement is reduced to 0 MW from 150 MW.

New York ISO

DRAFT – FOR DISCUSSION PURPOSES ONLY

Dynamic Reserves and TCCs: Calculation of Shortfalls

		Example 1 TODAY	Example 2 DR- Cheap OR	Example 3 DR - Expensive OR
Transmission DAM Congestion R	[A] = [E] * [F]	$ 141,615	$ 141,615	$ 134,865
Assumed TCC Sale Quantity	[B], assumed	1049	1049	1049
Assumed TCC Price	[C], assumed	$ (135)	$ (135)	$ (135)
TCC Auction Revenue	[D] = [B] * -[C]	$ 141,615	$ 141,615	$ 141,615
Post Contingency DAM Flow	[E], optimization output	1049	1049	999
Actual DAM Congestion Price	[F], optimization output	$ (135)	$ (135)	$ (135)
DAM Congestion Residual (DCR)	[G] = ([E] - [B]) * -[F]	$ -	$ (0)	$ (6,750)
TO Net of TCC Revenue and DCR	[H] = [D] + [G]	$ 141,615	$ 141,615	$ 134,865

- **Congestion rent shortfalls would be realized under Example 3 due to the decrease in energy flows across the transmission lines**

New York ISO

Next Steps

- The project description for: Review Operating Reserve Supplier Cost Recovery will be brought to the BPWG process.
- Present at a subsequent MIWG a more in-depth discussion about the proposed treatment of TCC's under Dynamic Reserves.

New York ISO

Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

New York ISO

Questions?

Appendix

Previous Presentations

Title/Topic	Link
March 7, 2023 MIWG	https://www.nyiso.com/documents/20142/36639552/Dynamic%20Reserves%20-%2020230307%20MIWG_final.pdf/a29ccf5d-4c26-5cbf-0103-5bece7edb276
March 31, 2023 MIWG	https://www.nyiso.com/documents/20142/36828420/MIWG%20March%2031%20Dynamic%20Reserves%20Postings%20and%20LMP.pdf/81c35384-2438-1e03-e021-6e7ecc18f9d7
September 5, 2023 MIWG	https://www.nyiso.com/documents/20142/39768278/2%2020230905%20MIWG%20-%20Dynamic%20Reserves.pdf/d58e28ab-de87-7a86-4296-a8c21f7c764f
September 14, 2023 MIWG	https://www.nyiso.com/documents/20142/40004830/20230914%20MIWG%20-%20Dynamic%20Reserves.pdf/a1c6d806-5b67-a8fc-9d04-a1669a926f54
September 18, 2023 MIWG	https://www.nyiso.com/documents/20142/40044890/5%2020230918%20MIWG%20-%20Dynamic%20Reserves.pdf/0b1b7e63-737d-5bee-4abc-be65c234aa3b
September 26, 2023 MIWG	https://www.nyiso.com/documents/20142/40204141/4%2020230926%20MIWG%20-%20Dynamic%20Reserves.pdf/90e8c0b2-aeaf-0935-5c4e-bd260c948f3c
October 3, 2023 MIWG	https://www.nyiso.com/documents/20142/40342797/20231003%20MIWG%20-%20Dynamic%20Reserves.pdf/51657652-ac7e-c9e2-ed5f-85b52e7e49f7
October 12, 2023 MIWG	https://www.nyiso.com/documents/20142/40559142/Dynamic%20Reserves.pdf/a17ba0a7-8e59-53b9-e028-4942f595c2f1

Previous Presentations

Title/Topic	Link
October 19, 2023 MIWG	https://www.nyiso.com/documents/20142/40696384/20231019%20MIWG%20-%20Dynamic%20Reserves.pdf/ef4371c2-5bff-7adb-5871-1d77d6fa98eb
November 8, 2023 MIWG	https://www.nyiso.com/documents/20142/41049783/20231108%20MIWG%20-%20Dynamic%20Reserves.pdf/e38b6d72-aa3f-69f3-b43f-8b3591b0e314
November 17, 2023 MIWG	https://www.nyiso.com/documents/20142/41273741/20231117%20MIWG%20-%20Dynamic%20Reserves_final.pdf/d18195bc-c940-1a1f-51c1-3220a02c23bd
November 27, 2023 MIWG	https://www.nyiso.com/documents/20142/41393553/20231127%20MIWG%20-%20Dynamic%20Reserves.pdf/ec047167-4bcb-2610-4e15-2a57565d9d18
December 4, 2023 MIWG	https://www.nyiso.com/documents/20142/41570800/20231204%20MIWG%20-%20Dynamic%20Reserves.pdf/44492075-1cfb-2446-99eb-3427b28a23c7
December 6, 2023 MIWG	https://www.nyiso.com/documents/20142/41611225/20231206%20MIWG%20-%20Dynamic%20Reserves.pdf/65df622a-9fd6-7772-287e-b56575fc23e4
December 13, 2023 BIC	https://www.nyiso.com/documents/20142/41671891/UPDATED%20-%2020231213%20BIC%20-%20Dynamic%20Reserves%20REPOSTED.pdf/0bc8d5df-6773-8db1-9f99-d91fd1fd0676
January 25, 2024 MIWG	https://www.nyiso.com/documents/20142/42590322/20240125%20Dynamic%20Reserves%20MIWG%20v2.pdf/305719ad-74a3-c57b-30c2-e3ccd229fc54
February 20, 2024 MIWG	https://www.nyiso.com/documents/20142/43038997/5%2020240220%20Dynamic%20Reserves%20MIWG.pdf/5be7321e-c694-e5ad-f029-d648ea6cc806

Assumptions: Example 1 Base Case

- The base case example demonstrates a static reserve requirement, as would be seen today
- The transmission constraints are base case energy scheduling constraints for NYC: energy flows can't exceed Normal limits or N-1 MTE limits. The example assumes four transmission elements with the following Normal/LTE/MTE ratings:
  - Line A: 798/998/1048
  - Line B: 799/999/1049
  - Line C: 800/1000/1050
  - Line D: 801/1001/1051
- The example utilizes the following shift factors:
  - Load = pre-contingency: 0.25, post-contingency: 0.33
  - Generators = pre-contingency: -0.25, post-contingency: -0.33

	Rest-of-state (ROS)	Load Pocket (NYC)
Load (MW)	0	3500
Reserve requirement (MW)	0	150
Energy Offer ($/MW)	5	50
Reserve Offer ($/MW)	1	2

New York ISO

Results: Example 1 Base Case

- **The results from the base case are:**
  - Energy Schedules:
    - ROS Generators: 3147 MW
    - Load pocket generators: 353 MW
  - Reserve Schedules:
    - ROS Generators: 0 MW
    - Load pocket generators: 150 MW
  - System Lambda = $5
  - Load pocket Operating Reserve clearing price = $2
  - Shadow price for energy scheduling transmission constraint = $135

Assumptions: Example 2 Dynamic Reserves Case

- **Example 2 introduces a dynamic reserve requirement to solve for N-1 post-contingency transmission flows into the load pocket**
  - There are no 30M reserve constraints or Forecast Load in this example
  - There is no static requirement
- **Example 2 utilizes the same assumptions as Example 1 for:**
  - Load
  - Energy and reserve offers
  - Energy scheduling constraints
  - Pre/post-contingency shift factors

New York ISO

Results: Example 2 Dynamic Reserves

- **The results from the dynamic reserves case are:**
  - Energy Schedules:
    - ROS Generators: 3147 MW
    - Load pocket generators: 353 MW
  - Reserve Schedules:
    - ROS Generators: 0 MW
    - Load pocket generators: 150 MW
  - System Lambda = $5
  - Load pocket generator Operating Reserve price = $2
  - Total shadow price for transmission constraint = $135
    - Shadow price for binding N-1 dynamic reserve constraint = $6, plus
    - Shadow price for energy scheduling transmission constraint = $129

New York ISO

Assumptions: Example 3 Dynamic Reserves Case with Expensive Operating Reserves

- **Example 3 increases the cost of locational Operating Reserves**
  - There are no 30M reserve constraints or Forecast Load in this example
  - There is no static requirement
- **Example 3 utilizes the same assumptions as Example 1 and 2 for:**
  - Load
  - Energy
  - Energy scheduling constraints
  - Pre/post-contingency shift factors
- **The OR offer for locational reserves is increased from $2 to $47**

New York ISO

Results: Example 3 Dynamic Reserves

- **The results from the dynamic reserves case are:**
  - Energy Schedules:
    - ROS Generators: 2997 MW
    - Load pocket generators: 503 MW
  - Reserve Schedules:
    - ROS Generators: 0 MW
    - Load pocket generators: 0 MW
  - System Lambda = $5
  - Load pocket generator Operating Reserve price = $45
  - Total shadow price for transmission constraint = $135
    - Shadow price for binding N-1 dynamic reserve constraint = $135, plus
    - Shadow price for energy scheduling transmission constraint = $0

New York ISO