New York ISO
Independent System Operator

Balancing Intermittency: Locational Examples and Initial Tariff Revisions

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Agenda

- Background
- Locational Examples for the Uncertainty Reserve Requirement Calculation
- Tariff Revisions and Definitions Set 1
- Next Steps

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Background

Previous Presentations

Date	Working Group	Discussion Points and Links to Materials
06-25-2024	ICAPWG/MIWG	Balancing Intermittency: Market Design Update https://www.nyiso.com/documents/20142/45442995/Balancing%20Intermittency_MIWG_06252024_final.pdf/dad8a46e-1713-bb43-9151-f136147745ff
03-04-2024	ICAPWG/MIWG	Balancing Intermittency: Percentiles and Shortage Pricing Curves https://www.nyiso.com/documents/20142/43315080/BI%202024%20MIWG_03042024_final.pdf/bbd5e0a7-3205-89b7-ed25-3672358fa761
01-25-2024	ICAPWG/MIWG	Balancing Intermittency 2024 Kick-off: https://www.nyiso.com/documents/20142/42590322/BI%202024%20MIWG%20Kick%20Off_final.pdf/ac2f0112-f542-f4da-3c9c-f43d0309868f
11-10-2023	ICAPWG/MIWG	Market Design Concept Proposed: https://www.nyiso.com/documents/20142/41130653/Balancing%20Intermittency_MDCP%20Presentation_final.pdf/ab912240-d021-0e7a-a02a-987a94928bf7
10-12-2023	ICAPWG/MIWG	1hr notification/4hr sustainability Reserves Product: https://www.nyiso.com/documents/20142/40342797/Balancing%20Intermittency_100323%20ICAPWG_MIWG_final.pdf/71269f5b-1e84-4bda-3219-b36a71a9be24
10-03-2023	ICAPWG/MIWG	Introductory Analysis regarding Uncertainty Reserve product : https://www.nyiso.com/documents/20142/40342797/Balancing%20Intermittency_100323%20ICAPWG_MIWG_final.pdf/71269f5b-1e84-4bda-3219-b36a71a9be24
09-18-2023	ICAPWG/MIWG	Analysis and proposal regarding Uncertainty Reserve requirement locational distribution: https://www.nyiso.com/documents/20142/40044890/3%20Balancing%20Intermittency_09182023%20ICAPWG_MIWG.pdf/0d0e82b7-1d3a-7af0-fef7-237dbf5c1b77
09-05-2023	ICAPWG/MIWG	Analysis and proposal regarding Uncertainty Reserve requirement calculation methodology: https://www.nyiso.com/documents/20142/39768278/6%20Balancing%20Intermittency_ICAPWG_MIWG_090523.pdf/23391d26-0559-5757-1289-d043e833e16c
07-19-2023	ICAPWG/MIWG	Initial analysis regarding the need to address net load uncertainty: https://www.nyiso.com/documents/20142/38852999/Balancing%20Intermittency%20Initial%20Analyses_ICAPWG_MIWG_071923_Final.pdf/c4adb509-3c09-0361-7f52-b52cae880997

2023 Market Design Concept Proposal Summary

- **Phase 1: Uncertainty Reserve Requirement (URR) on existing 10- and 30-minute reserve products**
  - The NYISO proposes to establish locational Uncertainty Reserve requirements using percentages calculated from historical data, which will be individually applied to net load, land-based wind, and offshore wind forecasts.

- **Phase 2: New 60-minute, 4-hour reserve product**
  - The features of the proposed new reserve product include a longer Notification Time and a longer Duration Availability Requirement, which aim to address needs driven by uncertainty that arises further in advance.

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Stakeholder Feedback from June 25 MIWG

- **A request for examples to show the calculation of Locational Uncertainty Reserve Requirements**
  - The following slides provide numerical examples
- **A request for more information on the consumer impact of the Phase 1 design**
  - NYISO's Consumer Impact Analysis will provide additional information on consumer impacts
  - The CIA will provide information regarding the URR at both the 90th and 95th percentiles
- **A request to understand how system flexibility needs will evolve over time and how the URR design fits within that framework**
  - NYISO studies identify system flexibility and dispatchability as key attributes to manage both today's system and our future low emission grid characterized by high penetrations of intermittent resources
  - The URR design establishes formulaic reserve requirements to facilitate efficient energy and reserve schedules to ensure sufficient energy is available to serve real-time load
  - The proposed formulaic URR design scales requirements based on system conditions such that requirements increase as system uncertainty and needed flexibility and dispatchability increase. Likewise, requirements will decrease if system uncertainty and needed flexibility and dispatchability decrease.

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Calculation of the Uncertainty Reserve Requirement

- NYISO proposes to use the 95th percentile to determine the uncertainty reserve requirement.
- NYISO observes that the 95th percentile would help facilitate DA schedules that frequently satisfy RT energy needs. Historic data indicates procuring uncertainty reserves beyond the 95th percentile shows strongly decreasing utilization. As with all risk-based decisions, there is a tradeoff between procurement magnitude (e.g., 90th percentile, 95th percentile) and utilization (and cost)
- The next slide shows the DAM forecast error with the DAM Uncertainty Reserve Requirements for the dates of 6/17/2024 – 6/21/2024 when NY experienced a recent heat wave.
  - The 95th Percentile Uncertainty Reserve Requirements for these dates are calculated for NYCA using the Net Load 2022 (due to the lack of 2023 historical forecast error metrics at the time of analysis), Land Based Wind 2023, Solar 2023 historical forecast error metrics and 2024 DAM Forecast data.
- It can be observed that there are still instances where the DAM forecast error exceeds the 95th percentile uncertainty reserve requirement (a theoretically correct outcome).
  - This reflects the need to balance the reliability and market benefits uncertainty reserve procurements and costs

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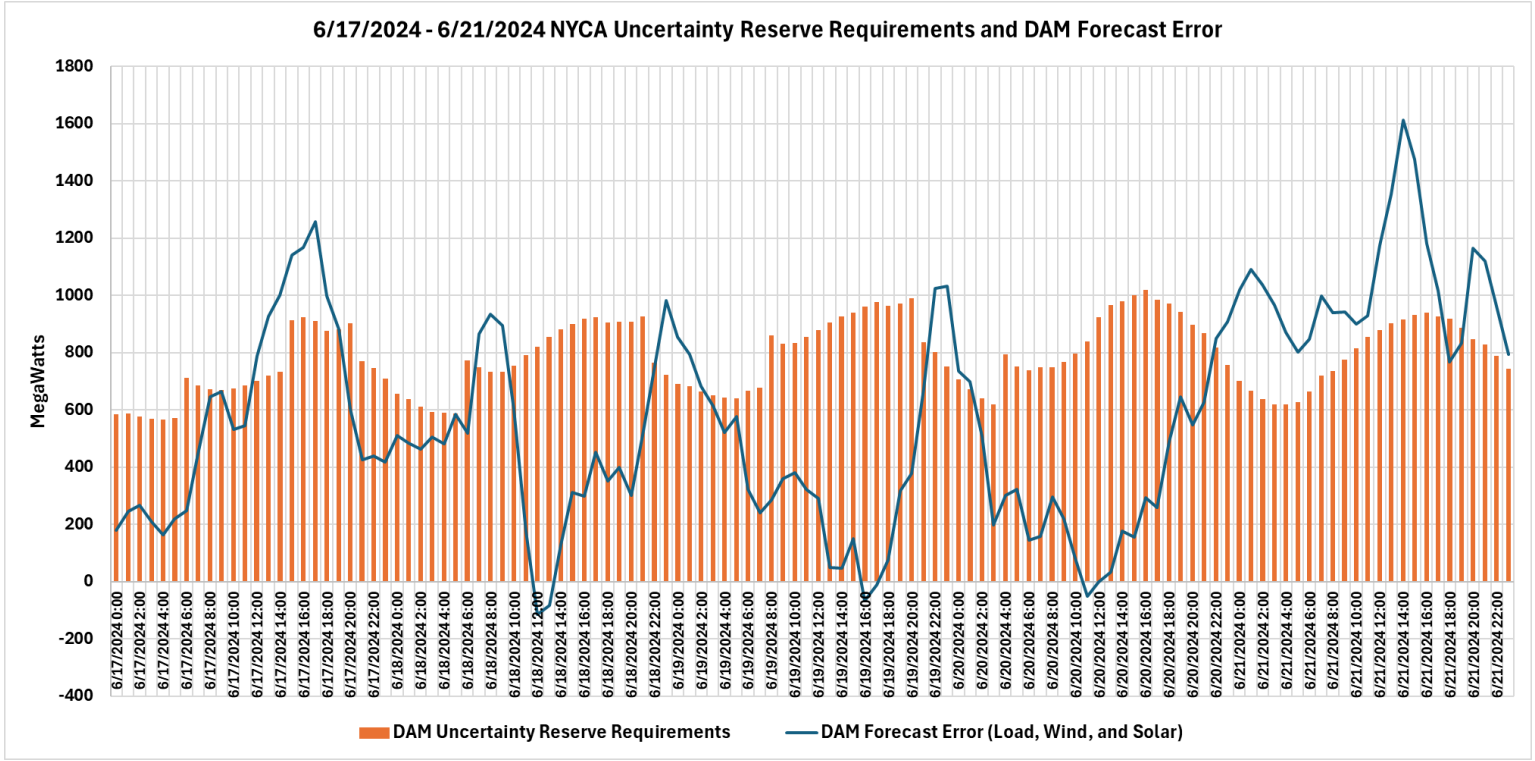
NYISO's 95th Percentile Uncertainty Reserve Requirement Setting Example



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Calculation of the Uncertainty Reserve Requirement

- NYISO's proposed URR design reflects a growing trend across organized markets, i.e., procuring market-based reserves to manage forecast uncertainty*
  - Other markets procure between 97.5 and 99th percentile
- Based on historical forecast error and formula inputs, the 95th percentile URR requirement for 2023 was 644 MW on average, or 136 MW larger than the 90th percentile URR.
- These Operating Reserves will create incremental DA schedules for resources (above those that exist under today's market rules) to help facilitate reliability. These schedules correlate with unforecast RT energy needs (e.g., these OR schedules will help satisfy RT energy needs and avoid RT reserve shortages, see [September 5 MIWG examples from 2023]
- This is NYISO's first step in this space of creating a product to manage forecast uncertainty of load and intermittent resources which is recognized as a growing necessity.
- Future market design projects are available for prioritization which may:
  - Improve NYISO and market visibility into load and intermittent uncertainty
  - Evaluate and/or enhance the design of the URR
  - Evaluate the market pricing outcomes under shortage conditions, considering the URR
- These, and potentially other, projects provide an opportunity to evaluate the effectiveness of the URR and ensure the URR is appropriately procuring reserves to manage uncertainty

*https://stakeholdercenter.caiso.com/initiativedocuments/revisedfinalproposal-day-aheadmarketenhancements.pdf

*https://www.spp.org/documents/69542/integrated%20marketplace%20ramp%20and%20uncertainty%20product%20calculation%20guide.docx

*Ramp Capability Product Development (misoenergy.org)

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Locational Example for Uncertainty Reserve Requirement Calculation

Composite DAM Uncertainty Reserve Requirement Calculation

$$\begin{aligned}\textbf{Composite DAM Uncertainty Reserve Req.} = {} & (\mu_{NL\ DA} \times \textbf{Net Load DAM Forecast MW}) \\ & + (\mu_{LBW\ DA} \times \textbf{Land Based Wind DAM Forecast MW}) \\ & + (\mu_{OSW\ DA} \times \textbf{Offshore Wind DAM Forecast MW}) \\ & + (\mu_{FTMS\ DA} \times \textbf{FTM Solar DAM Forecast MW}) \\ & + \textbf{z-score} \times \sqrt{\begin{array}{c}((\sigma_{NL\ DA})^2 \times (\textbf{Net Load DAM Forecast MW})^2) + \\ ((\sigma_{LBW\ DA})^2 \times (\textbf{Land Based Wind DAM Forecast MW})^2) + \\ ((\sigma_{OSW\ DA})^2 \times (\textbf{Offshore Wind DAM Forecast MW})^2) + ((\sigma_{FTMS\ DA})^2 \times (\textbf{FTM Solar DAM Forecast MW})^2)\end{array}}\end{aligned}$$

where,

$\mu_{NL\ DA}$ is the Mean of the Historical DAM Net Load (Load net of BTM Solar) forecast error percentages,

$\mu_{LBW\ DA}$ is the Mean of the corresponding Bin's Historical DAM Land Based Wind Forecast Error percentages,

$\mu_{OSW\ DA}$ is the Mean of the corresponding Bin's Historical DAM Offshore Wind Forecast Error percentages,

$\mu_{FTMS\ DA}$ is the Mean of the corresponding Bin's Historical DAM FTM Solar Forecast Error percentages,

$\sigma_{NL\ DA}$ is the Standard Deviation obtained from the Historical DAM Net Load (Load net of BTM Solar) Forecast Error percentages

$\sigma_{LBW\ DA}$ is the Standard Deviation of the corresponding Bin's Historical DAM Land Based Wind Forecast Error percentages,

$\sigma_{OSW\ DA}$ is the Standard Deviation of the corresponding Bin's Historical DAM Offshore Wind Forecast Error percentages,

$\sigma_{FTMS\ DA}$ is the Standard Deviation of the corresponding Bin's Historical DAM FTM Solar Forecast Error percentages.

z-score is the z-score pertaining to the chosen percentile.

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Locational Example

- Let's assume that an offshore wind plant of 200 MW has been connected to Long Island.
- This addition would impact the uncertainty reserve requirement calculations of Long Island, SENY (Zones G-K), EAST (Zones F-K), and NYCA.
  - This addition will not impact the uncertainty reserve requirement calculation of N.Y.C.
- Let's assume the following load, land-based wind, offshore wind, and FTM solar DAM forecast values for all the reserve regions for a certain interval:

	N.Y.C.	LONGIL	SENY	EAST	NYCA
Load	4000	2000	9000	10000	15000
LBW	0	0	0	0	400
OSW	0	100	100	100	100
FTM Solar	0	0	0	0	80

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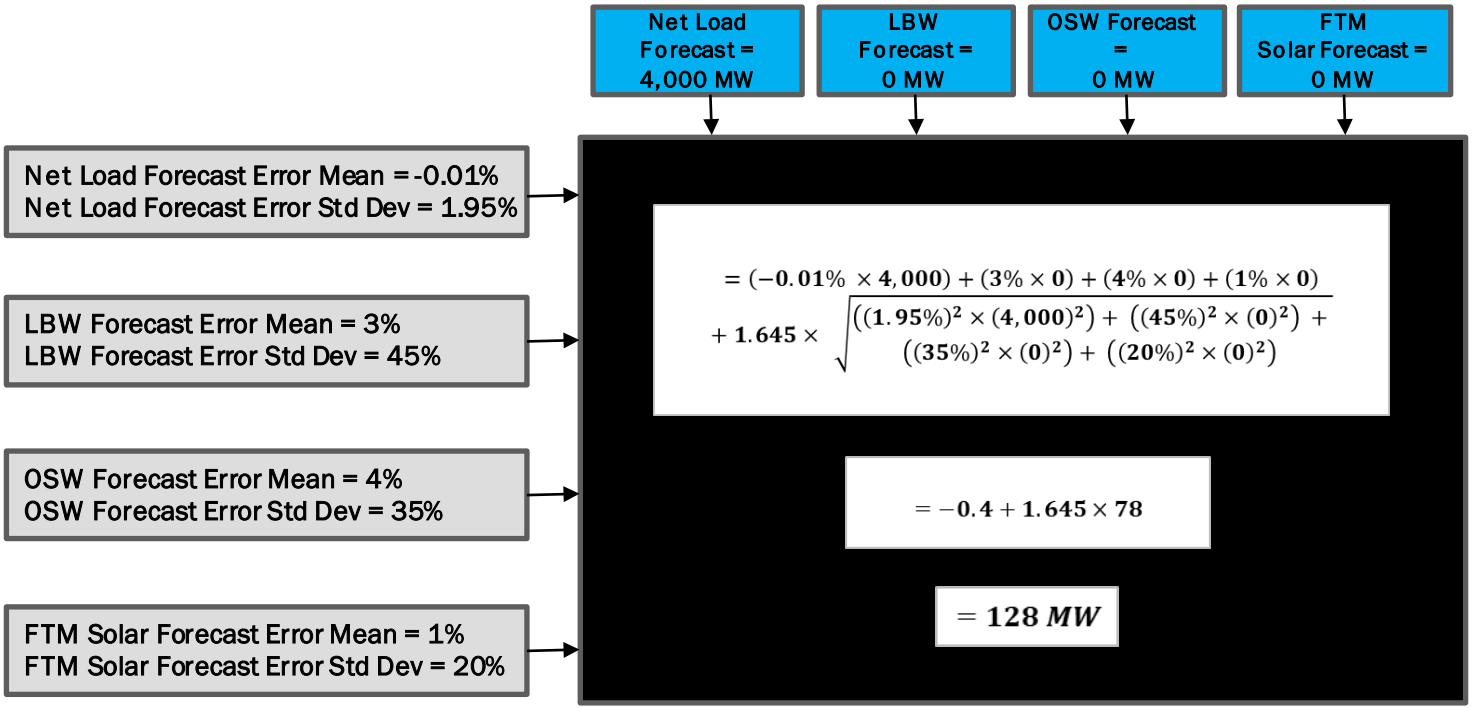
DAM N.Y.C. URR Example



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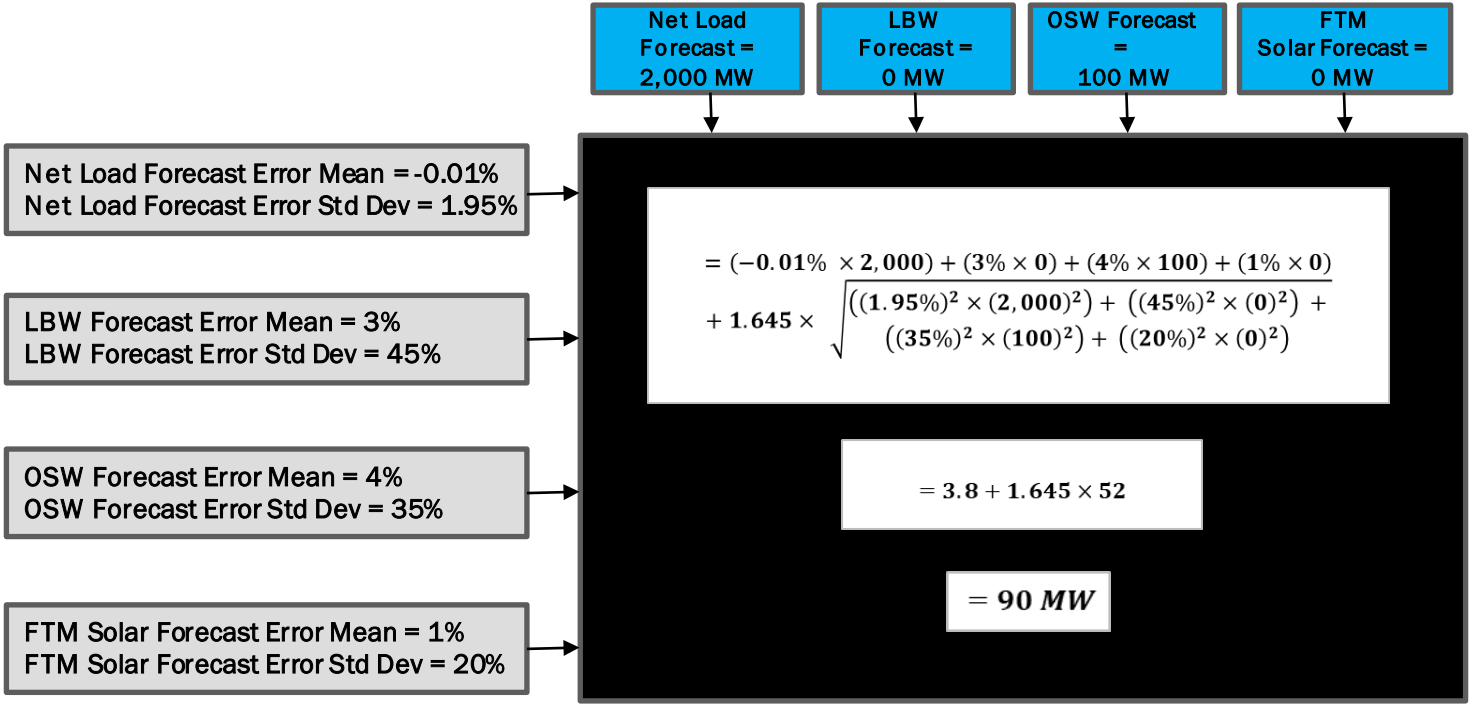
DAM Long Island URR Example



NYCA Annual Metrics

Hourly Data for each Market Day

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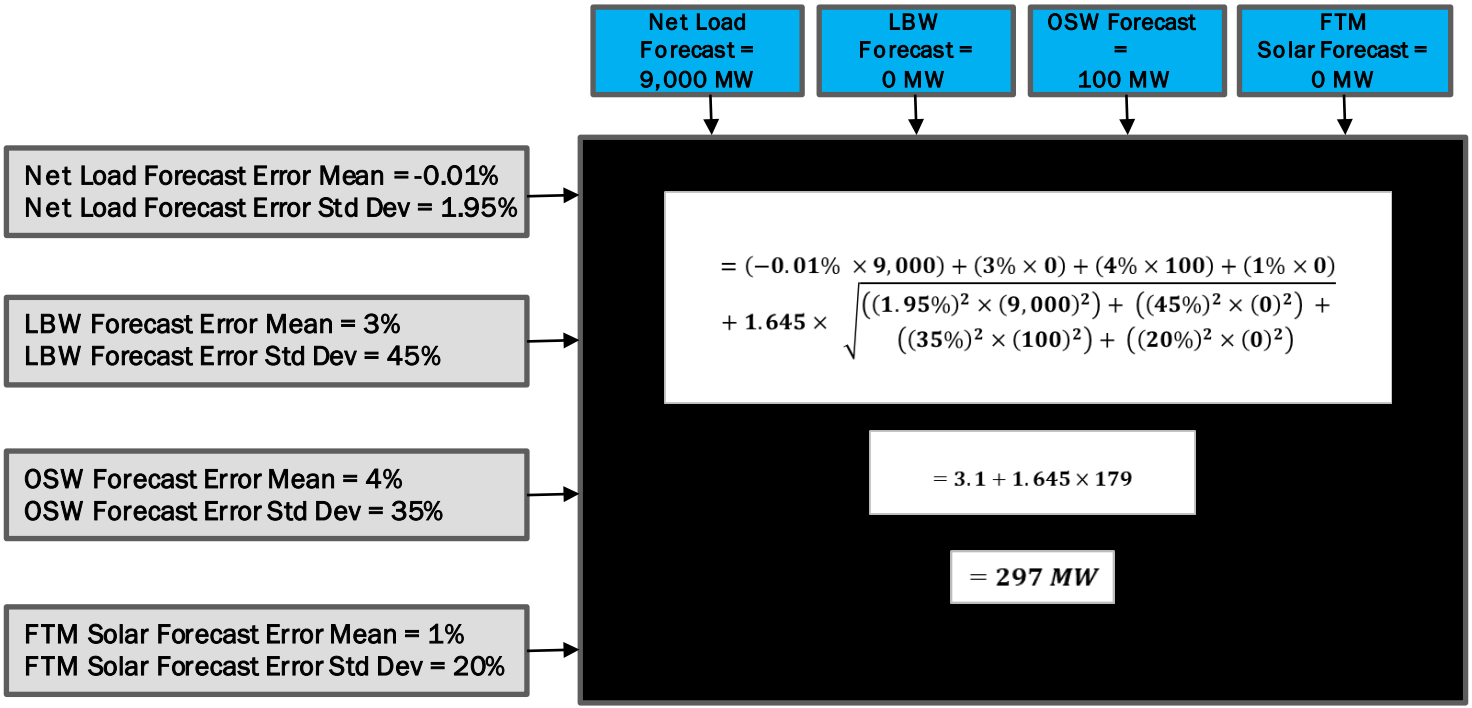
DAM SENY URR Example



Annual Metrics Hourly Data for each Market Day

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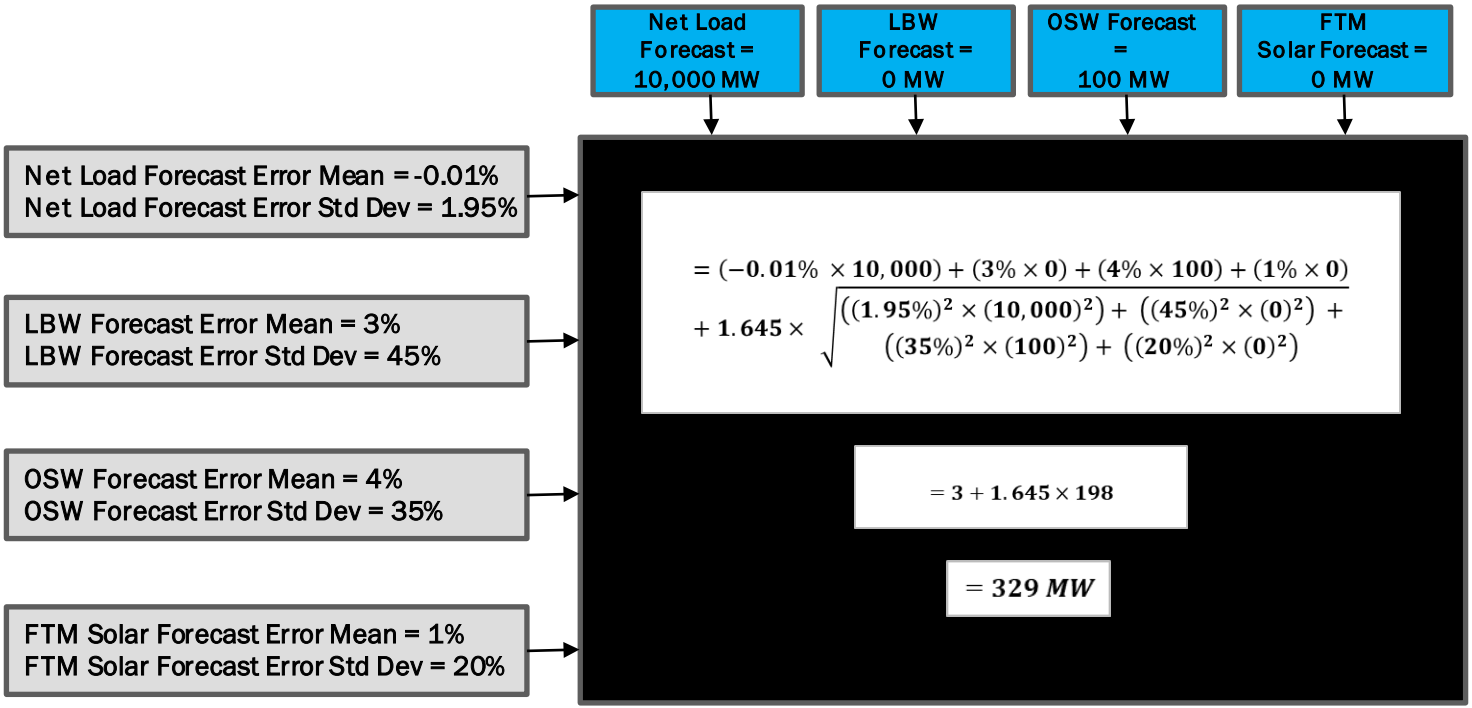
DAM EAST URR Example



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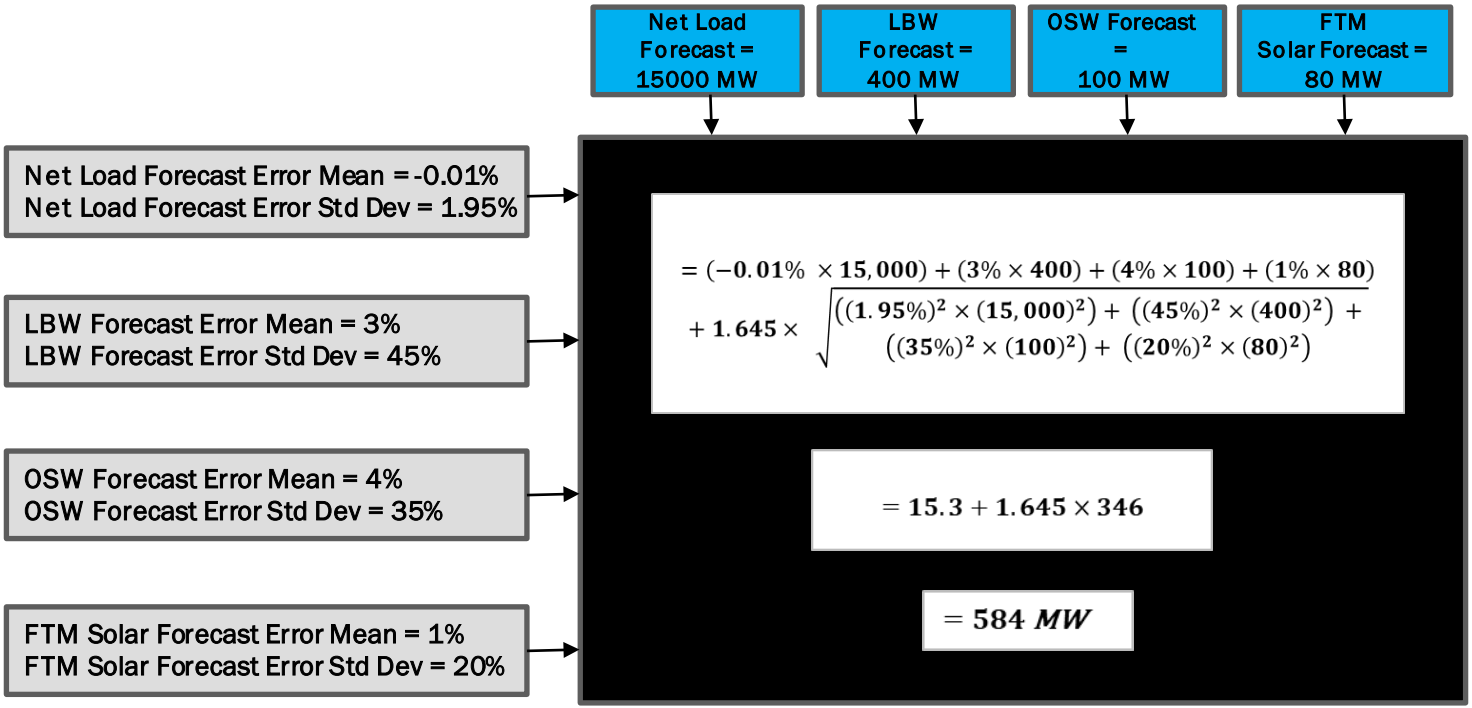
DAM NYCA URR Example



Annual Metrics Hourly Data for each Market Day

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Locational DAM Uncertainty Reserve Requirements

	N.Y.C.	LONGIL	SENY	EAST	NYCA
URR	128	90	297	329	584

Tariff Revisions and Definitions Set 1

Definitions

- **Uncertainty Reserve Requirements –** A component of the Operating Reserves requirements in the Day-Ahead and Real-Time Markets to address the uncertainties of Load forecasts and the Wind and Solar Energy Forecasts. The Uncertainty Reserve Requirements will be calculated each day before the Day-Ahead Market close and will apply to the 24-hours of the Day-Ahead Market day and the corresponding Real-Time Market day. Uncertainty Reserve Requirements will be calculated pursuant to ISO Procedures using historical forecast error metrics and Day-Ahead Market forecast information.

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Proposed Tariff Section Revisions

- MST 15.4.1.1 – ISO Responsibilities
- MST 15.4.7 – Operating Reserve Demand Curves

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Next Steps

Next Steps (Phase 1)

- Q3
  - Continue tariff revisions
    - Uncertainty Reserve Requirement Calculation
    - Scarcity Pricing and Uncertainty Reserves
  - Consumer Impact Analysis Results
  - Final Tariff Revisions
  - BIC/MC Vote
- Q4
  - Filing date TBD pending tariff/BIC/MC/NYISO Board of Directors

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Appendix

Overview of Proposed Enhancements

Reserve Region	Reserve Product	Current Reserve Reqt.	Proposed Reserve Reqt.	Demand curve ($/MWh)	
				Current	Proposed
NYCA	30-minute	2,620 MW	**2,620 MW + NYCA 30-min UR MW**	-	**NYCA 30-min UR MW at $20/MWh**
				200 MW at $40/MWh	200 MW at $40/MWh
				125 MW at $100/MWh	125 MW at $100/MWh
				55 MW at $175/MWh	55 MW at $175/MWh
				55 MW at $225/MWh	55 MW at $225/MWh
				55 MW at $300/MWh	55 MW at $300/MWh
				55 MW at $375/MWh	55 MW at $375/MWh
				55 MW at $500/MWh	55 MW at $500/MWh
				55 MW at $625/MWh	55 MW at $625/MWh
				1,965 MW at $750/MWh	1,965 MW at $750/MWh

UR – Uncertainty Reserves

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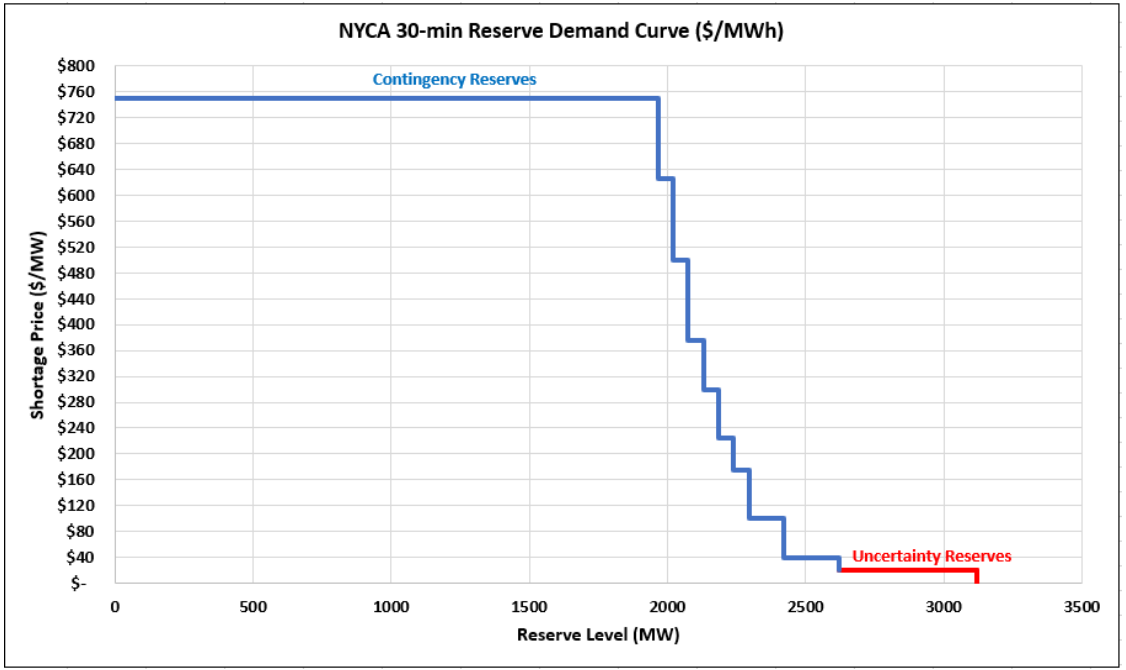
Example: NYCA 30-min Reserve Demand Curve



Assuming 500 MW of NYCA 30-min Uncertainty Reserves at $20/MWh

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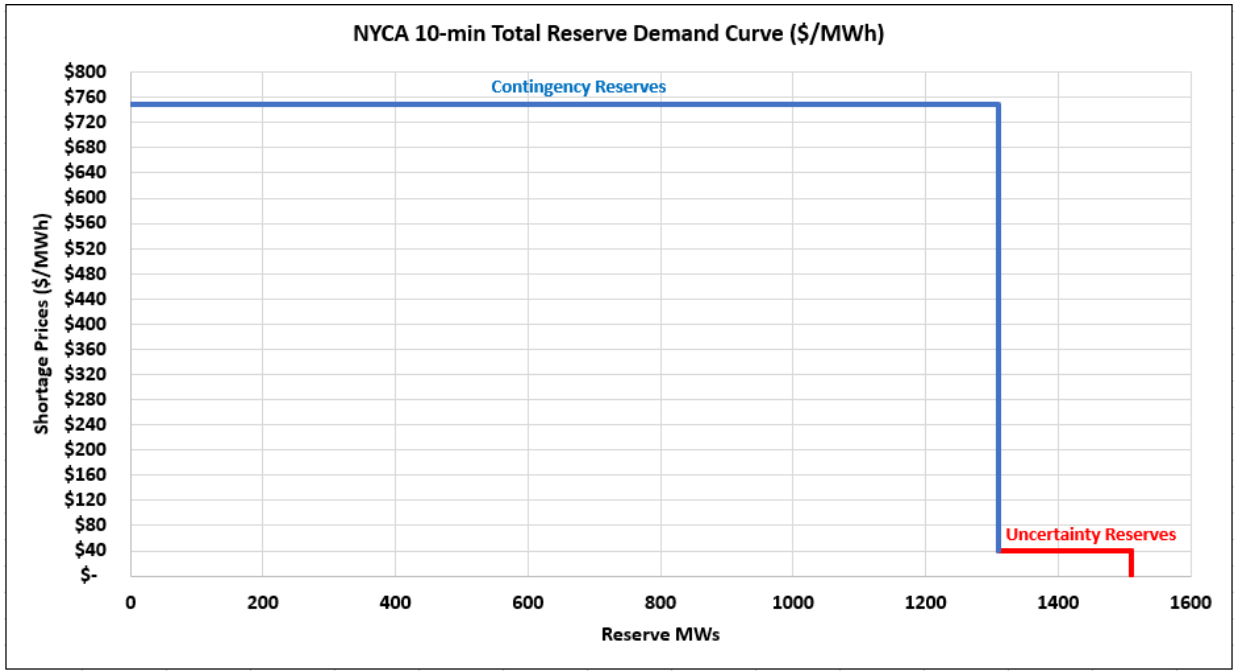
Overview of Proposed Enhancements

Reserve Region	Reserve Product	Current Reserve Reqt.	Proposed Reserve Reqt.	Demand curve ($/MWh)	
				Current	Proposed
NYCA	10-minute total	1,310 MW	**1,310 MW + NYCA 10-min UR MW**	-	**NYCA 10-min UR MW at $40/MWh**
				$750/MWh	$750/MWh
NYCA	10-minute spin	655 MW	655 MW	$775/MWh	$775/MWh
EAST	30-minute	1,200 MW	**1,200 MW + EAST 30-min UR MW**	-	**EAST 30-min UR MW at $20/MWh**
				$40/MWh	$40/MWh
EAST	10-minute total	1,200 MW	**1,200 MW + EAST 10-min UR MW**	-	**EAST 10-min UR MW at $40/MWh**
				$775/MWh	$775/MWh
EAST	10-minute spin	330 MW	330 MW	$40/MWh	$40/MWh
SENY	30-minute	1,300, 1,550 MW or 1,800 MW	**1,300, 1,550 MW or 1,800 MW + SENY 30-min UR MW**	-	**SENY 30-min UR MW at $20/MWh**
				500 MW at $40/MWh	500 MW at $40/MWh
				800 MW, 1,050 MW, or 1,300 at $500/MWh	800 MW, 1,050 MW, or 1300 MW at $500/MWh

UR – Uncertainty Reserves

Example: NYCA 10-min Total Reserve Demand Curve



Assuming 200 MW of NYCA 10-min total Uncertainty Reserves at $40/MWh

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Overview of Proposed Enhancements

Reserve Region	Reserve Product	Current Reserve Reqt.	Proposed Reserve Reqt.	Demand curve ($/MWh)	
				Current	Addition to the Step/Reqt
NYC	30-minute	1,000 MW	**1,000 MW + NYC 30-min UR MW**	-	**NYC 30-min UR MW at $20/MWh**
				$25/MWh	$25/MWh
NYC	10-minute total	500 MW	**500 MW + NYC 10-min UR MW**	-	**NYC 10-min UR MW at $20/MWh**
				$25/MWh	$25/MWh
LI	30-minute	270-540 MW	**270-540 MW + LI 30-min UR MW**	-	**LI 30-min UR MW at $20/MWh**
				$25/MWh	$25/MWh
LI	10-minute total	120 MW	**120 MW + LI 10-min UR MW**	-	**LI 10-min UR MW at $20/MWh**
				$25/MWh	$25/MWh

UR – Uncertainty Reserves

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Questions?

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

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