Balancing Intermittency: Locational Distribution and ORDCs

Amanda Myott
Senior Market Design Specialist
Energy Market Design

Vijay Kaki
Market Design Specialist
Energy Market Design

Mark Buffaline
Senior Settlements Analyst
Customer Settlements

ICAPWG/MIWG
September 18, 2023

Previous Presentations

Date	Working Group	Discussion Points and Links to Materials
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
02-21-2023	ICAPWG/MIWG	Project Kickoff: https://www.nyiso.com/documents/20142/36339783/Balancing%20Intermittency_MIWG_022123_FINAL%20(002).pdf/5ff99fc1-1eb2-8bec-d385-b4983568802a

New York ISO

Updated Definitions

- DAM : Day-Ahead Market
- DAM Net Load Forecast : Day-Ahead gross load forecast – Day-Ahead behind-the-meter (BTM) solar forecast
- Net Load Actual : Observed real-time actual load, which captures the effect of BTM Solar
- DAM Net Load Forecast Error : Net Load Actual– DAM Net Load Forecast
- Reserve Notification Time : The lead time that a reserve product is scheduled for (e.g., 10-minute reserves, 30-minute reserves, etc.)
- Reserve Sustainability : The duration (number of hours) that reserve providers can sustain energy output upon conversion from reserves to energy. The current reserve sustainability requirement in the NYISO markets is 1 hour.
- MHFE : Multi-Hour Forecast Error
- Uncertainty Reserves: Reserves to address forecast error.

Background

- **Leveraging the findings in the 2022 Grid in Transition Study, the Balancing Intermittency effort is evaluating whether new market products are necessary to continue reliably maintaining system balance, given a future grid characterized by large quantities of intermittent renewable resources, ESR, and DER.**
  - Update regulation requirements [Completed]
  - Determine if there is a need for additional ancillary services to balance intermittency [Completed]
  - Determine the uncertainty reserve requirement calculation methodology [Completed]
  - Examine locational distribution and ORDCs for the uncertainty reserves [Review in this presentation]
  - New Uncertainty Reserve Product Evaluation [Sept/Oct]
  - Reserve Sustainability Evaluation [Oct]
- **The 2023 project deliverable is a Market Design Concept Proposed [Mid-Late Nov].**

New York ISO

Objective of Today's Discussion

- Today's presentation will propose the locational distribution of the uncertainty reserve requirement components and discuss the need for an appropriate ORDC for these reserves.

Review of 7/19 MIWG And 9/5 MIWG

Recap from 07/19 MIWG

- **Analysis conducted by the NYISO indicates that the basis of the current reserve procurements is likely inadequate to sustain reliability in the grid of the future.**
  - Analysis supports that reserve requirements need to consider forecast error in addition to the single largest contingency.
- **NYISO proposed to procure reserves to make sufficient energy available in RT to manage forecast error**

Uncertainty Reserve Requirement Methodology Proposal

- **The NYISO proposed an uncertainty requirement-setting methodology that incorporates the following:**
  - An annual historical error metric to comprise 80% of the uncertainty reserve requirement, combined with a 2-month rolling historical error metric to comprise 20% of the uncertainty reserve requirement.
    - The 80% / 20% division in the requirement represents a balance between long-term data (*e.g.*, good characterization of overall error distribution) and short-term data (*e.g.*, capturing recent forecast errors).
      - The annual component of the formula will update once per year.
      - The 2-month rolling average component of the formula will update once per month. Exact process timing TBD.
    - This approach yields similar performance results between the 7-day, 30-day, 90-day, like-month, and annual methods.
  - This method will be applied to DAM and RT separately to establish DA and RT reserve requirements, and these will differ due to the reduction in uncertainty as we approach RT. See the Appendix for additional information.
  - The requirement will be assigned to products (*e.g.*, 30min, 10min) based on which products can satisfy the need.
    - That is, the fraction of day-ahead uncertainty that is resolved within 60 minutes of the RT interval by a 30-minute reserve provider.
      - The fraction of day-ahead uncertainty that is resolved 30 minutes from the RT interval cannot be satisfied by a 30min reserve provider and will thus be assigned to a 10 min requirement.

New York ISO

Scalability

The Uncertainty Reserve Requirement is Scalable

- **NYISO received feedback inquiring whether the uncertainty reserve requirement is scalable**
  - The design as proposed is scalable for load, BTM Solar, FTM Solar, and land-based wind.
  - The DA forecast quantity for each component of the uncertainty reserve requirement scales with load and the penetration of intermittent resources, maintaining alignment between uncertainty reserves and potential forecast error.
  - Observed error is a rolling value, updated every month using the blended formula proposed, incorporating changes in forecast error into the uncertainty reserve requirement on a timely basis.
- **The NYISO's 9/5 proposal did not address how to accommodate new technologies which do not have the necessary operating data to calculate the observed historical forecast error. Offshore wind is currently one such technology.**
  - For the first year in which such new technologies are present, NYISO will weight the 2-month rolling forecast error data at 100% (instead of 80% annual / 20% 2-month).
  - Thereafter, the NYISO will weight annual error at 80% and 2-month error at 20%.

New York ISO

Updated Uncertainty Reserve Requirement Proposal

- **Today**
  - Contingency Reserves
    - 2620 MW (NYCA 30-min)

- **Proposal**
  - Contingency Reserves
    - 2620 MW (NYCA 30-min) (Unchanged)
  - Uncertainty Reserves
    - Net Load (Load with BTM Solar Impacts) Uncertainty Reserve Requirement MW
      - FTM Solar would be included here as deployed
    - Land-based Wind Uncertainty Reserve Requirement MW
    - Offshore Wind Uncertainty Reserve Requirement MW

New York ISO

Locational Distribution of Uncertainty Reserves

Locational Distribution of Uncertainty Reserves

- Locational distribution of uncertainty reserves is necessary to allow the scheduled uncertainty reserves to address localized forecast error needs.
- Setting this requirement on a NYCA-wide basis could result in reserves being scheduled on resources that are unable to address forecast error in other regions due to transmission constraints.
  - For example, if the uncertainty reserves were scheduled upstate and forecast error occurs in N.Y.C., these reserves could be unable to address the forecast error in N.Y.C. due to transmission constraints.
  - Other ISO/RTOs have faced this issue where the reserves scheduled to address forecast error were unable to be utilized due to deliverability issues and are revising their market design to incorporate deliverability.

New York ISO

Locational Distribution: General Approach

- **Forecast error results in RT energy needs on dispatchable resources exceeding DAM scheduled energy**
- **NYISO proposes to set reserve requirements that align with where forecast errors are likely to occur**
  - Uncertainty reserve requirements will be assigned to NYCA and Locational Reserve Requirements in proportion to the underlying causal variable
    - Uncertainty Reserves for Net Load Forecast Error will be assigned in proportion to forecast Load in each Locational Reserve region
    - Uncertainty Reserves for land-based Wind and Off-shore Wind will be assigned in proportion to forecast Energy output in each Locational Reserve region
- **The following slides provide examples**

New York ISO

Locational Distribution of Uncertainty Reserves – Net Load

- The Net Load Uncertainty Reserve Requirement will be pro rata based on the location of net load.
- The Net Load Uncertainty Reserve Requirement percentage, calculated using the methodology presented to stakeholders at the 9/5/23 MIWG, will be multiplied with the Net Load Forecast MW for each reserve region to determine regional Net Load Uncertainty Reserve Requirements.
- Locational uncertainty reserve requirements will be nested just as contingency reserves are.

Uncertainty Reserve Requirement Calculation (NYCA and Reserve Region Specific)

- **NYCA Uncertainty Reserve Requirement MW =**
  80% x (Prior Year Static Net Load Forecast Error x NYCA Net Load Forecast (Zones A-K)) +
  20% x (Previous 2-month Rolling Net Load Forecast Error x NYCA Net Load Forecast (Zones A-K))
- **East Uncertainty Reserve Requirement MW =**
  80% x (Prior Year Static Net Load Forecast Error x East Net Load Forecast (Zones F-K) +
  20% x (Previous 2-month Rolling Net Load Forecast Error x East Net Load Forecast (Zones F-K)
- **SENY Uncertainty Reserve Requirement MW =**
  80% x (Prior Year Static Net Load Forecast Error x SENY Net Load Forecast (Zones G-K) +
  20% x (Previous 2-month Rolling Net Load Forecast Error x SENY Net Load Forecast (Zones G-K)
- **N.Y.C. Uncertainty Reserve Requirement MW =**
  80% x (Prior Year Static Net Load Forecast Error x N.Y.C. Net Load Forecast (Zone J) +
  20% x (Previous 2-month Rolling Net Load Forecast Error x N.Y.C. Net Load Forecast (Zone J)
- **Long Island Uncertainty Reserve Requirement MW =**
  80% x (Prior Year Static Net Load Forecast Error x Long Island Net Load Forecast (Zone K) +
  20% x (Previous 2-month Rolling Net Load Forecast Error x Long Island Net Load Forecast (Zone K)

Net Load Uncertainty Reserve Requirement Calculation (NYCA and Reserve Region Specific): Example

Annual Uncertainty Reserve Requirement % = 2%, 2-month Uncertainty Reserve Requirement % = 1%

Reserve Region	Net Load Forecast MW (A)	Uncertainty Reserve Requirement % (B)	Uncertainty Reserve Requirement MW (A x B)	Uncertainty Reserve Requirement (MW)
NYCA	20,000	(80% x 2%) + (20% x 1%) = 1.8%	1.8% x 20,000	360 MW
EAST	13,500	(80% x 2%) + (20% x 1%) = 1.8%	1.8% x 13,500	243 MW
SENY	11,000	(80% x 2%) + (20% x 1%) = 1.8%	1.8% x 11,000	198 MW
N.Y.C.	7,000	(80% x 2%) + (20% x 1%) = 1.8%	1.8% x 7,000	126 MW
Long Island	2,500	(80% x 2%) + (20% x 1%) = 1.8%	1.8% x 2,500	45 MW

New York ISO

Locational Distribution of Uncertainty Reserves – Land-based Wind

- The Land-based Wind uncertainty reserve requirement will be pro rata based on the location of land-based wind resources.
- Currently, Land-based Wind resources are only present in Zones A-E
  - Therefore, at this point of time, the land-based wind component of the Uncertainty Reserve Requirement will be NYCA-wide.
- The Wind Uncertainty Reserve Requirement percentage calculated using the methodology presented in the last presentation will be multiplied with the NYCA-wide Wind Forecast MW values to determine the NYCA wide Wind Uncertainty Reserve Requirement.
- NYCA Wind Uncertainty Reserve Requirement =

  80% x (Prior Year Static Land-based Wind Forecast Error x NYCA Land-based Wind Forecast) +
  20% x (Previous 2-month Rolling Land-based Wind Forecast Error x NYCA Land-based Wind Forecast)
- In the future, the wind component of the Uncertainty Reserve requirement will be tailored to reserve regions based on the regions in which wind resources are installed, similar to the net load share ratio methodology proposed in the previous slide, but rather using the land-based wind share ratio.
- Locational land-based wind uncertainty reserve requirements will be nested just as contingency reserves are.

New York ISO

Locational Distribution of Uncertainty Reserves – Offshore Wind

- The Offshore Wind uncertainty reserve requirement will be pro rata based on the location of offshore wind resources.
- At the time of uncertainty reserve deployment, Offshore Wind resources would likely only be connected to Zone K
  - Therefore, at that time, the offshore wind component of the Uncertainty Reserve Requirement will be calculated for Long Island alone.
- The Wind Uncertainty Reserve Requirement percentage calculated using the methodology presented in the last presentation will be multiplied with the Long Island Offshore Wind Forecast MW values to determine the Long Island Wind Uncertainty Reserve Requirement.
- Long Island Wind Uncertainty Reserve Requirement =

  80% x (Prior Year Static Offshore Wind Forecast Error x Long Island Offshore Wind Forecast) +
  20% x (Previous 2-month Rolling Offshore Wind Forecast Error x Long Island Offshore Wind Forecast)
- In the future, the offshore wind component of the Uncertainty Reserve requirement will be tailored to reserve regions based on the regions to which the offshore wind resources are connected, similar to the net load share ratio methodology proposed in the previous slide, but rather using the offshore wind share ratio.
- Locational offshore wind uncertainty reserve requirements will be nested just as contingency reserves are.

New York ISO

ORDCs for Uncertainty Reserves

ORDCs for Uncertainty Reserves

- Operating Reserve Demand Curves ("ORDCs") are employed to efficiently price energy and operating reserves when market conditions are tight.
- These curves establish a price above which the optimization will choose to be deficient of certain products/services rather than procure resources at costs that exceed established values.
- NYISO proposes to add an additional step to the applicable Operating Reserve Demand Curves ("ORDCs"), with a MW value equal to the Uncertainty Reserve requirement.
- Since the uncertainty reserve requirement can vary from interval to interval based on the forecast values, the MW value associated with the step would change from interval to interval.
- NYISO will determine the necessary Uncertainty Reserve requirement price step for each reserve product and location as part of the Market Design Complete phase next year.

New York ISO

Uncertainty Reserve Requirement Proposal Summary

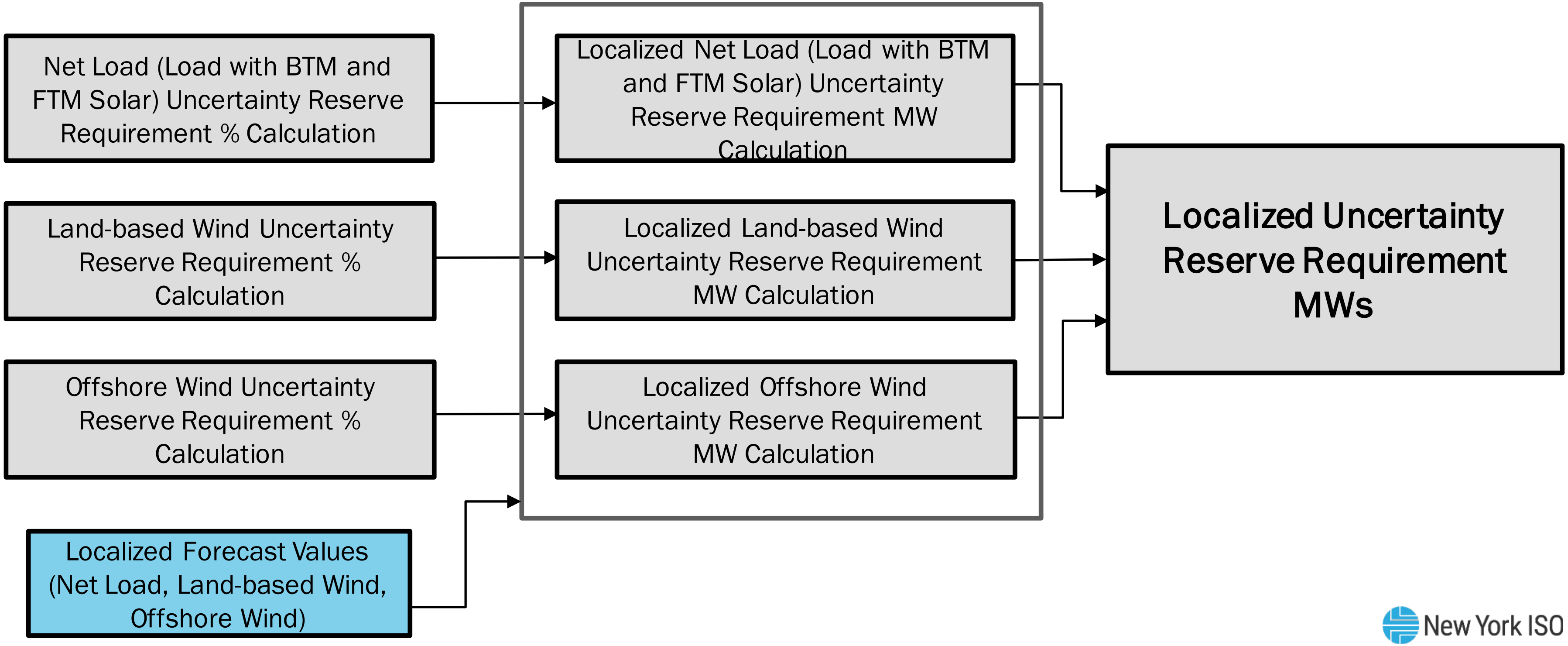
Uncertainty Reserve Requirement Proposal Summary

- The Uncertainty Reserve Requirement percentages will be calculated using NYCA wide data for the following components by using the 80/20 blending method as mentioned in the previous presentation:
  - Net Load [Load net of BTM Solar (and FTM Solar in the future)]
  - Land-based Wind
- The Uncertainty Reserve Requirement percentage will be calculated by using NYCA wide data for new technology such as Offshore wind in their first year by using the 2-month rolling historical error data.
  - Thereafter, the 80/20 blending method will be employed to calculate the uncertainty reserve requirement percentage.
- The Uncertainty Reserve Requirement MWs will be calculated for reserve regions for each component based on the respective net load/land-based wind/offshore wind share ratio.
- An additional price step will be added to the applicable Operating Reserve Demand Curves with a MW value equal to the calculated Uncertainty Reserve Requirement MW which will change interval to interval.

New York ISO

DRAFT – FOR DISCUSSION PURPOSES ONLY

Uncertainty Reserve Requirement Proposal Summary



New York ISO

DRAFT – FOR DISCUSSION PURPOSES ONLY

Next Steps

Next Steps

- **September/October 2023**
  - Discuss further reserve market enhancements to balance intermittency.
- **2023 Project Milestone: Q4 Market Design Concept Proposed**

New York ISO

Appendix

Existing ORDCs for Contingency Reserves

Reserve Region	Reserve Product	Reserve Reqt.	Current	Rationale behind the steps
NYCA	30-minute	2,620 MW	200 MW at $40/MWh	Allow a portion of the 30 minute total reserves to be forgone against price volatility
			125 MW at $100/MWh	Facilitate reduction of unnecessary price volatility by further graduation of the NYCA 30-minute reserve demand curve
			55 MW at $175/MWh	Consistent with cost of operator actions to maintain 30-minute reserves (GT OOMs)
			55 MW at $225/MWh	Consistent with cost of operator actions to maintain 30-minute reserves (SREs)
			55 MW at $300/MWh	Facilitate reduction of unnecessary price volatility by further graduation of the NYCA 30-minute reserve demand curve
			55 MW at $375/MWh	Represents a value aligned with the average cost of 99% of the resource costs observed for historic SRE and OOM commitments
			55 MW at $500/MWh	Consistent with cost of activating SCR/EDRP resources to maintain reserves
			55 MW at $625/MWh	Facilitate reduction of unnecessary price volatility by further graduation of the NYCA 30-minute reserve demand curve
			1,965 MW at $750/MWh	Consistent with cost of operator actions to replenish by converting 30 min GTs to energy
NYCA	10 minute total	1,310 MW	$750/MWh	Consistent with cost of operator actions to replenish by converting 30 min GTs to energy
NYCA	10 minute spin	655 MW	$775/MWh	Provide scheduling priority to NYCA 10-minute total and NYCA 30-minute reserves
EAST	30-minute	1,200 MW	$40/MWh	Facilitates distribution of reserves throughout NYCA
EAST	10 minute total	1,200 MW	$775/MWh	Recognizes equal importance with NYCA 10-min spinning reserves
EAST	10 minute spin	330 MW	$40/MWh	Facilitates distribution of reserves throughout NYCA

New York ISO

Existing ORDCs for Contingency Reserves

Reserve Region	Reserve Product	Reserve Reqt.	Current	Rationale
SENY	30-minute	1,550 MW or 1,800 MW	250 MW or 500 MW at $40/MWh (only if SENY incremental reserves proposal is approved by stakeholders)	Additional reserves to facilitate returning transmission assets to Normal Transfer Criteria following a contingency (see Reserves for Resource Flexibility project)
			1,300 MW at $500/MWh	Consistent with cost of activating SCR/EDRP resources to maintain reserves
NYC	30-minute	1,000 MW	$25/MWh	Facilitates distribution of reserves throughout NYCA
NYC	10-minute total	500 MW	$25/MWh	Facilitates distribution of reserves throughout NYCA
LI	30-minute	270-540 MW	$25/MWh	Facilitates distribution of reserves throughout NYCA
LI	10-minute total	120 MW	$25/MWh	Facilitates distribution of reserves throughout NYCA

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

DRAFT – FOR DISCUSSION PURPOSES ONLY