Reserves for Resource Flexibility

Market Design Concept Proposal

Ethan D. Avallone

TECHNICAL SPECIALIST – ENERGY MARKET DESIGN

Market Issues Working Group

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Rensselaer NY

Agenda

- Background
- Procuring Additional Reserves for Uncertainty
- Operational Metrics
- Proposed SENY Reserve Enhancements
- Next Steps
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- Appendix II: Uncertainty Analysis Results
- Appendix III: Operating Reserves Overview

Background

Background- A Grid in Transition

- **Environmentally focused public policies in New York are driving a transition to increased reliance on weather-dependent resources.[1]**
- **The variability and unpredictability of wind and solar generation resources and the potentially large quantities of each present a challenge for future grid operations.**
  - The grid will need responsive and flexible resources to address changes in net load, as well as support reliable operations.

[1] For further discussion, please see the report "Reliability and Market Considerations for a Grid in Transition" at the following link:
https://www.nyiso.com/documents/20142/6785167/Grid%20in%20Transition%20DRAFT%20FOR%20POSTING.pdf/74eb0b20-6f4c-bdb2-1a23-7d939789ed8c

Background- A Grid in Transition

- **Effective pricing of energy and ancillary services products to reflect system conditions and operational needs is crucial.**
  - Reserve prices fall when and where this grid reliability service is not needed or when there is ample supply.
    - In this way, and by fostering competition, prices help to maintain grid reliability at the lowest cost.

Reserves for Resource Flexibility: Overview

- **Today, the NYISO procures the amount of operating reserves required to meet the minimum reliability standards established by NERC, NPCC, and NYSRC.**
  - Operating reserves procured in the NYISO markets are an example of achieving reliability through markets.
    - Increasing reserve requirements when and where appropriate will incent the right resources in the right locations to help the NYISO operate the grid of the future reliably.
- **Procuring additional reserves may be appropriate for managing power balance issues due to uncertainty in the level of load, wind, solar and other factors.**

Reserves for Resource Flexibility: Overview

- **This initiative includes two components, as discussed on this and the following slide.**

1. **Additional reserves are proposed for returning transmission elements to Normal Transfer Criteria following a contingency ("Normal Transfer Criteria").**
   - Certain of the current reserve procurements are designed to facilitate returning transmission assets to Emergency Transfer Criteria after suffering a contingency.
   - Procurement of additional 30-minute reserves in select locational reserve regions would be necessary to ensure sufficient reserve capability to return assets to Normal Transfer Criteria without the potential need for out of market action.
   - This component does not propose to increase the total quantity of reserves procured statewide beyond the current level of 2,620 MW.

Reserves for Resource Flexibility: Overview

2. Additional reserves may need to be procured as the amount of weather-dependent generation on the grid increases ("Uncertainty Analysis").

- This may lead to commitment and dispatch instructions not meeting New York's power balance requirements.
- The NYISO evaluated changes in net load uncertainty that result from increasing reliance on wind and solar generation.
- This presentation includes additional metrics that are appropriate to consider when evaluating whether additional reserve procurements may be warranted.

Procuring Additional Reserves for Uncertainty

Reserve Requirements

- **The NYISO will continue to monitor net load error and power system performance, while considering when procuring additional reserve for managing uncertainty is necessary.**
  - As discussed during the September 26, 2019 MIWG meeting, the NYISO analyzed historical net load error.*
  - See the next slide for a description of net load error.
- **The NYISO will monitor system conditions as we transition to the grid of the future. Various operational metrics will be monitored, including:**
  - Control Performance Standards (CPS)
  - Disturbance Control Standard (DCS)
  - Several other metrics that are important to consider:
    - Alert or Major Emergency State Declarations for operating reserve deficiencies
    - Increased instances of NYCA generation loss greater than or equal to 500 MW
    - Installed wind and solar capacity

*Link to the September 26, 2019 MIWG presentation:
https://www.nyiso.com/documents/20142/8414685/9_26_2019_Reserves_for_Resource_Flexibility_FINAL.pdf/ba7fb774-49d5-0c96-1d2c-664a2c9c3c05

Net Load Error

- **The NYISO analyzed uncertainty by calculating the net load error in the 30-minute timeframe.**
  - Behind the meter solar generation is currently accounted for in the NYISO's load forecast.
  - Net load error is defined in this context as the load forecast error net of the wind forecast error:

    (Forecast Load – Actual Load) – (Forecast Wind – Actual Wind)
- **Net load error in the 30-minute timeframe did not surpass current reserve requirements for any reserve region.**

Operational Metrics

Operational Performance Metrics Monitoring

- **A future with additional weather-dependent generation may require that the NYISO procure additional operating reserves to account for uncertainty.**
  - In addition to net load error, the NYISO will continue to monitor operational metrics to determine when procuring additional reserves for managing uncertainty is necessary.
- **Operational metrics are reviewed continuously by the NYISO.**
  - The Operations Performance Metrics Monthly Report is reviewed with stakeholders each month.*
- **The following slides outline select metrics that are relevant to the review of operating reserve requirements.**
  - The majority of the metrics are already found in the monthly report.
  - NYISO is also considering the addition of a new chart to the monthly report (see the next slide).

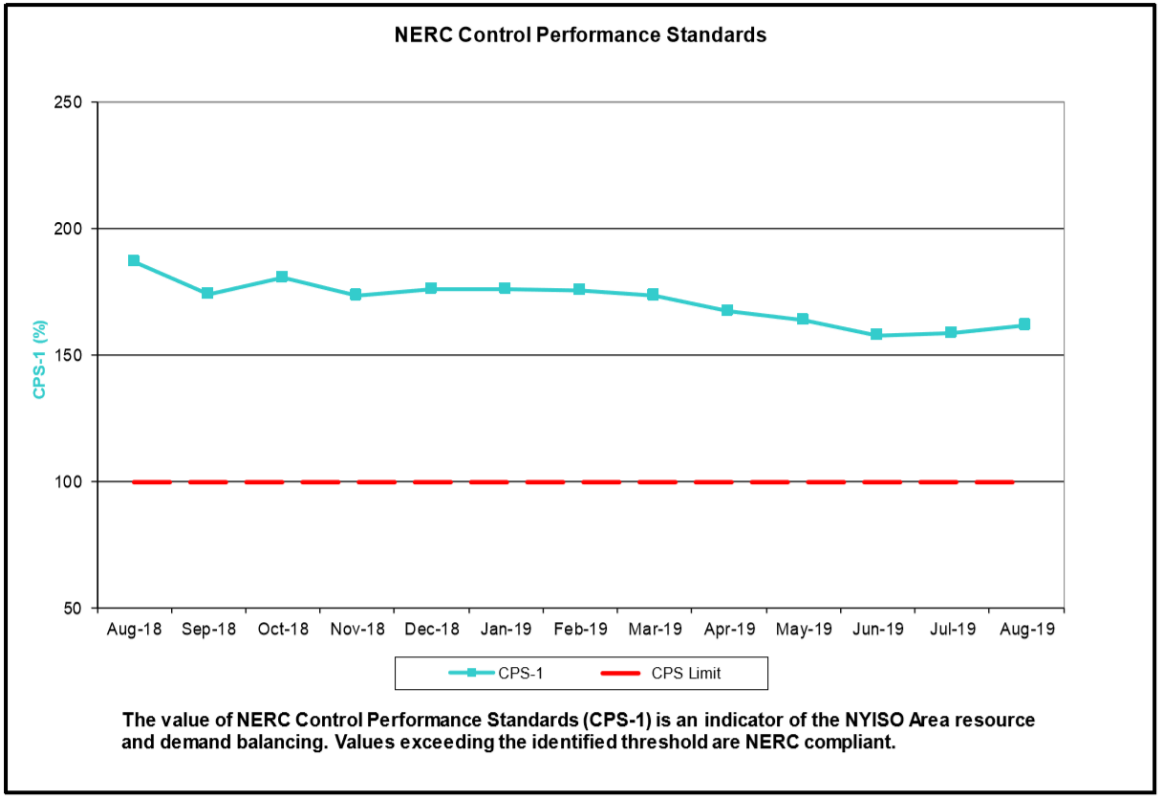
*Link to September 25, 2019 Management Committee meeting Operations Performance Metrics Monthly Report:
https://www.nyiso.com/documents/20142/8352422/03%20Operations_Report.pdf/c0fbd6ce-fd31-2273-9ba3-46d5d658b31e

Net Forecast Error

- **The NYISO is considering including a new chart within the Operations Performance Metrics Monthly Report to track "net forecast error."**
  - This new chart would be intended to provide additional information regarding differences between forecasted and actual load as well as intermittent resource output.

Control Performance Standards (CPS)

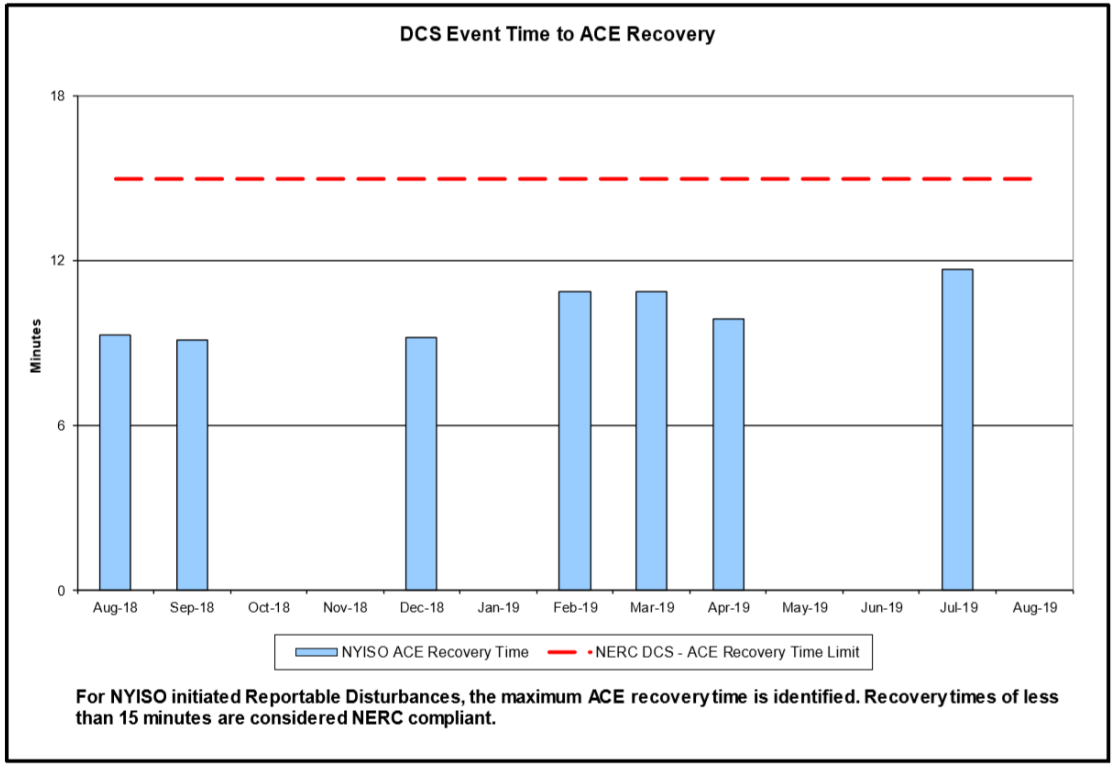
- **As noted in the Grid in Transition Whitepaper, the NYISO will monitor CPS to determine if a review of reserve requirements is necessary.***
  - A CPS-1 score at or approaching less than or equal to 100% indicates that a review of reserve requirements may be necessary.
  - The CPS-1 limit is set by NERC.



*For further information on CPS-1, please see BAL-001-2 of the NERC Reliability Standards: https://www.nerc.com/pa/Stand/Reliability%20Standards%20Complete%20Set/RSCompleteSet.pdf

Disturbance Control Standard (DCS)

- **As noted in the Grid in Transition Whitepaper, the NYISO will monitor the DCS to determine if a review of reserve requirements is necessary.***
  - A DCS event time to recovery of 15 minutes or more indicates that a review of reserve requirements may be necessary.
  - DCS measures the NYISO's recovery of ACE after a resource loss of >500 MW.



*For further information on DCS, please see BAL-002-3 of the NERC Reliability Standards: https://www.nerc.com/pa/Stand/Reliability%20Standards%20Complete%20Set/RSCompleteSet.pdf

Additional Metrics

- **Alert State or Major Emergency State Declarations for an operating reserve deficiency are important to consider when reviewing reserve requirements.**
  - The reason for the operating reserve deficiency is important in this context.
    - A loss of generation could lead to a need to review reserve requirements, whereas the loss of a transmission line would likely not indicate such a review is necessary.

For further information, please see page 3 of the Operations Performance Metrics Monthly Report at the following link:
https://www.nyiso.com/documents/20142/8352422/03%20Operations_Report.pdf/c0fbd6ce-fd31-2273-9ba3-46d5d658b31e

Additional Metrics

- Increased instances of reserve activations for a NYCA generation loss of greater than or equal to 500 MW are also important to consider when determining the need to review of reserve requirements.

For further information, please see page 5 of the Operations Performance Metrics Monthly Report at the following link: https://www.nyiso.com/documents/20142/8352422/03%20Operations_Report.pdf/c0fbd6ce-fd31-2273-9ba3-46d5d658b31e

Additional Metrics

- **Installed wind capacity and installed solar capacity are tracked in the Operations Performance Metrics Monthly Report.***
  - Wind nameplate capacity is currently 1,985 MW
  - Solar nameplate capacity is currently 1,644 MW
    - The majority of solar in the NYCA currently does not participate directly in the wholesale markets.
- **Future wind and solar technologies and locations are likely to differ from current conditions, thus, at this time, it is not possible to identify a specific wind or solar capacity level that would indicate a review of reserve requirements is necessary.**

*For further information, please see the chart title in the first chart of each page at page 10 and 11 of the Operations Performance Metrics Monthly Report at the following link:
https://www.nyiso.com/documents/20142/8352422/03%20Operations_Report.pdf/c0fbd6ce-fd31-2273-9ba3-46d5d658b31e

Proposed SENY Reserve Enhancements

Normal Transfer Criteria

- **The NYISO proposes to procure an additional 500 MW of 30-minute reserves in the SENY reserve region (zones G-K).[1]**
  - The current SENY 1,300 MW 30-minute reserve requirement serves to bring transmission assets to Emergency Transfer Criteria after suffering a contingency.
    - This proposal increases the portion of the total statewide reserve requirement carried in SENY from 1,300 MW to 1,800 MW.
  - Procuring additional 30-minute reserves in the SENY reserve region will provide ready access to additional resource flexibility through a market-based mechanism to bring transmission assets to Normal Transfer Criteria following a contingency.
    - Absent such a mechanism, out of market actions may be required to return facilities to Normal Transfer Criteria following a contingency.
- **Proposal contemplates shifting of current locational reserve procurements only and does not propose to increase the 2,620 MW level of 30-minute total reserves procured statewide (NYCA).**
- **This additional reserve would be procured at all times in the Day-Ahead and Real-Time Markets.**

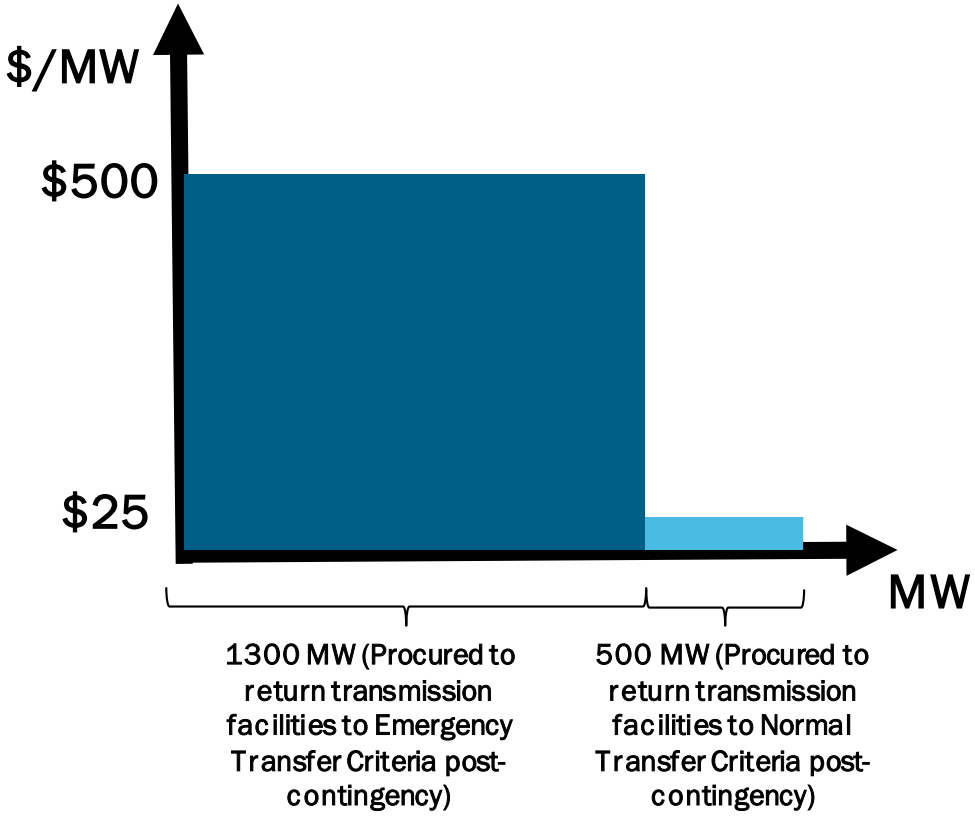
[1] For further information, please see Appendix I: Normal Transfer Criteria Analysis

Normal Transfer Criteria

- The Central East transmission constraint that led to the creation of the East of Central-East reserve region is currently a voltage collapse Interconnection Reliability Operating Limit (IROL).
  - The current East of Central-East reserve requirements are sufficient to reestablish flows under the IROL limit after suffering the worst contingency.
- The NYC (Zone J) reserve requirements already provides sufficient capability to return to Normal Transfer Criteria following a contingency, thus no increase to the NYC reserve requirement is necessary.
- The NYISO does not recommend changes to the LI reserve requirement at this time, due to the concern that this could result in more reserves being held on LI than is actually deliverable to the rest of the NYCA.[1]

[1]For a discussion of the LI Reserve Modeling, please see the presentation at the following link: https://www.nyiso.com/documents/20142/1403425/LI%20Reserve%20Modeling%20-%20Nov%20MIWG%20FINAL.pdf/439eb65b-879c-fa77-6337-b36eb5435bbf

Proposed SENY 30-Minute Reserve Demand Curve



Scarcity Pricing Logic

- **The NYISO proposes that the $25/MW demand curve value for the additional 500 MW in SENY be maintained during an SCR/EDRP activation.**
  - Any Scarcity Reserve Requirement in SENY would be added to the $500/MW "step" of the SENY 30-minute reserve demand curve.
  - This treatment is similar to the treatment of the East of Central-East reserve region during an SCR/EDRP activation.*

*For further information on the treatment of the East of Central-East reserve region during an SCR/EDRP activation, see p.78 of the Ancillary Services Manual: https://www.nyiso.com/documents/20142/2923301/ancserv.pdf/df83ac75-c616-8c89-c664-99dfea06fe2f

SENY Reserve Requirement during a Thunderstorm Alert (TSA)

- **The proposed 1,800 MW SENY 30 minute reserves requirement will be reduced to zero MW during a TSA.**
  - During a TSA, the current SENY 30-minute operating reserve requirement is reduced to 0 MW.

Next Steps

Next Steps

- **The NYISO will continue to monitor operational metrics to determine whether a further review of reserve requirements is warranted in the future.**
- **December 2019**
  - Present proposed Consumer Impact Analysis methodology.
- **January 2020**
  - Continue to discuss proposal (and associated tariff revisions).
  - Present Consumer Impact Analysis for proposal.
- **February 2020**
  - Seek stakeholder approval of proposal at BIC and MC.

Appendix I: Normal Transfer Criteria Analysis

Normal Transfer Criteria Analysis

- **The NYISO conducted an analysis to determine the proposed additional reserve quantity.**
  - A summer case was analyzed with transmission facility flow into SENY at limits.
  - The analysis confirmed that the current 1,300 MW 30-minute reserve requirement provides ready access to sufficient resource capability to recover from the first worst contingency in SENY, and return transmission facilities into SENY to Emergency Transfer Criteria post-contingency.
    - Emergency Transfer Criteria in this case indicates that post-contingency facility flow would be below short-term emergency (STE) ratings.

Normal Transfer Criteria Analysis (Continued)

- **The analysis further demonstrated that increasing the SENY 30-minute reserve requirement by an additional 500 MW provides ready access to resource capability that allows the NYISO to return transmission facilities into SENY to Normal Transfer Criteria post-contingency.**
  - Normal Transfer Criteria in this case indicates that post-contingency flow would be below long-term emergency (LTE) ratings.

SENY 30-Minute Reserve Demand Curve

- **The current 1,300 MW SENY 30-minute reserve requirement returns transmission assets to Emergency Transfer Criteria following a contingency.**
  - The demand curve price for SENY 30-minute reserve is currently $500/MWh.
  - When evaluating whether to call Special Case Resources/ Emergency Demand Response Program ("SCR/EDRP") resources in SENY, currently valued at $500/MWh, NYISO Operations currently uses post-contingency Emergency Transfer Criteria.
- **As discussed, the addition to the SENY 30-minute reserve requirement will provide a market-based mechanism to bring transmission assets to Normal Transfer Criteria following a contingency.**
  - The NYISO proposes a reserve demand curve price of $25/MWh for the 500 MW increase in the SENY 30-minute reserve requirement.
  - This lower demand curve price recognizes that reserves procured for Emergency Transfer Criteria are more valuable than reserves procured for Normal Transfer Criteria.

Appendix II: Uncertainty Analysis Results

Uncertainty Analysis: Overview

- **Additional reserve procurements can help provide ready access to capability to account for system uncertainty introduced by weather-dependent resources (distributed and grid-connected), as well as potentially volatile load.**
  - The NYISO analyzed uncertainty in load, as well as weather-depended resource output.
  - Increasing reserve procurements when appropriate will send price signals incenting resources needed for the grid of the future.

Net Load Error Calculation

- **The NYISO analyzed uncertainty by calculating the net load error in the 30-minute timeframe.**
  - Behind the meter solar generation is currently accounted for in the NYISO's load forecast.
  - Net load error is defined in this context as the load forecast error net of the wind forecast error:

    Net Load Error = (Forecast Load – Actual Load) – (Forecast Wind – Actual Wind)
  - The NYISO considered a number of factors in assessing net load error, including differentiating data by hour, by the predicted load level, etc.
  - Three years of data were included (May 27, 2016 to April 30, 2019)
  - The data was at a 5-minute granularity.
- **The load forecast uncertainty value was determined for forecasts 30-minutes out.**
  - A negative value would indicate an under forecast of load and/or an over forecast of wind.

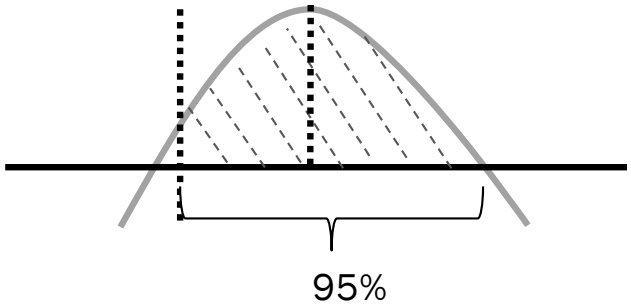
Data Categories

- **The NYISO conducted an "analysis of variance" (ANOVA) to determine appropriate categorization of the data.**
  - A number of categories were considered, including:
    - Time (month, day, hour)
    - Load forecast level
    - Wind forecast level (where applicable)

Net Load Error Observations

- A “Z-value” for a normal distribution most closely matching the dataset was used to calculate the net load error that accounted for 95% of all observations

Mean - (Z-Value*Standard Deviation) = Net Load Error with 95% Confidence



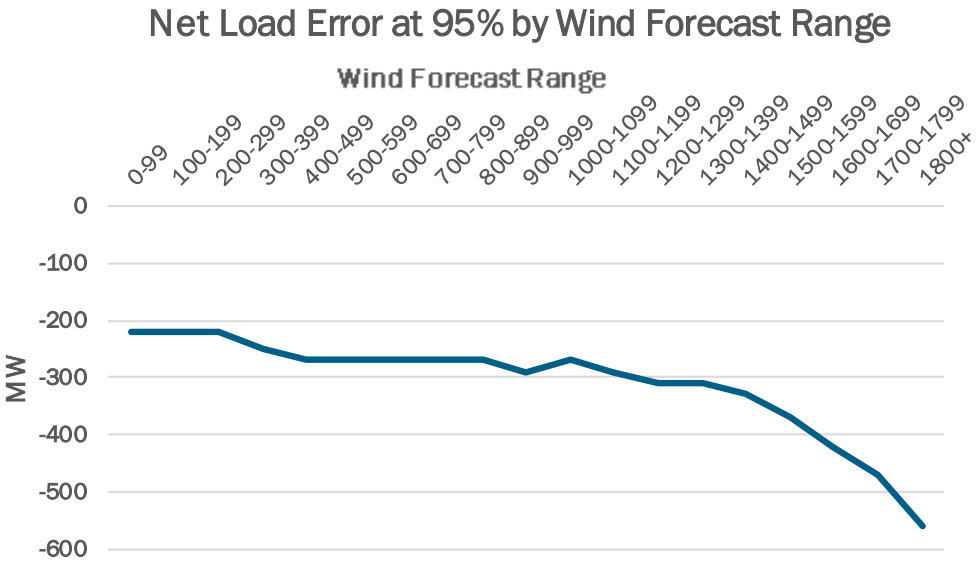
Data Analysis

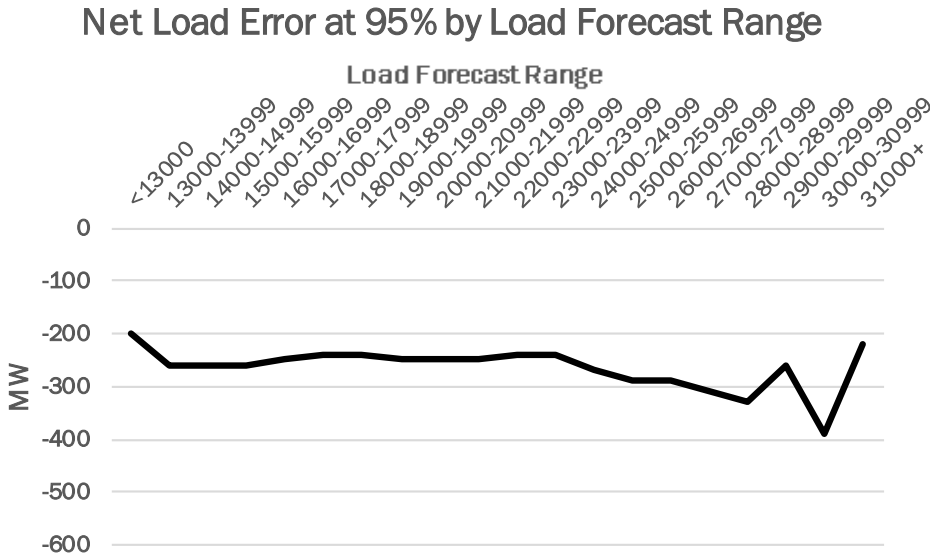
- **The NYISO arranged net load error data for each locational reserve region.**
  - The net load error was driven by the load forecast level for each category and reserve region pair, except for NYCA 30-minute reserves, which was driven by the wind forecast level (for example, see the next slide).

Category	Reserve Region	Looking Out:
Wind Forecast	NYCA	30 Minutes
Load Forecast	EAST	30 Minutes
Load Forecast	SENY	30 Minutes
Load Forecast	NYC	30 Minutes

Data Analysis Results

- For example, these charts depict the NYCA 30-minute net load error at 95% confidence.





Net Load Error with 95% Confidence

- **NYCA 30 minute**
  - A wind forecast between 800 MW and 899 MW in the table at right indicates that, when fitted to a normal distribution, 95% of the observations fall below a net load error of -270 MW.

Wind Forecast Range	Net Load Error 95% Confidence
0-99	-240
100-199	-240
200-299	-240
300-399	-260
400-499	-290
500-599	-290
600-699	-280
700-799	-270
800-899	-270
900-999	-280
1000-1099	-290
1100-1199	-290
1200-1299	-330
1300-1399	-330
1400-1499	-340
1500-1599	-370
1600-1699	-420
1700-1799	-470
1800+	-560

Net Load Error with 95% Confidence

- **EAST 30 minute**
  - A load forecast between 12,400 MW and 13,199 MW in the table at right indicates that, when fitted to a normal distribution, 95% of the observations fall below a net load error of -140 MW.

Load Forecast Range	Net Load Error 95% Confidence
<7600	-180
7600-8399	-150
8400-9199	-140
9200-9999	-140
10000-10799	-150
10800-11599	-150
11600-12399	-140
12400-13199	-140
13200-13999	-160
14000-14799	-180
14800-15599	-170
15600-16399	-180
16400-17199	-150
17200-17999	-180
18000-18799	-150
18800-19599	-150
19600-20399	-150
20400-21199	-220
21200-21999	-180
22000+	-150

Net Load Error with 95% Confidence

- **SENY 30 minute**
  - A load forecast between 10,900 MW and 11,599 MW in the table at right indicates that, when fitted to a normal distribution, 95% of the observations fall below a net load error of -130 MW.

Load Forecast Range	Net Load Error 95% Confidence
<7400	-90
7400-8099	-130
8100-8799	-130
8800-9499	-140
9500-10199	-130
10200-10899	-120
10900-11599	-130
11600-12299	-150
12300-12999	-160
13000-13699	-150
13700-14399	-160
14400-15099	-130
15100-15799	-180
15800-16499	-180
16500-17199	-180
17200-17899	-90
17900-18599	-230
18600-19299	-210
19300-19999	-140
20000+	-80

Net Load Error with 95% Confidence

- **NYC 30 minute**
  - A load forecast between 4,800 MW and 5,199 MW in the table at right indicates that, when fitted to a normal distribution, 95% of the observations fall below a net load error of -60 MW.

Load Forecast Range	Net Load Error 95% Confidence
<4000	-60
4000-4399	-60
4400-4799	-70
4800-5199	-60
5200-5599	-70
5600-5999	-70
6000-6399	-60
6400-6799	-70
6800-7199	-90
7200-7599	-90
7600-7999	-90
8000-8399	-80
8400-8799	-90
8800-9199	-100
9200-9599	-110
9600-9999	-110
10000-10399	-150
10400-10799	-110
10800+	-80

Appendix III: Operating Reserves Overview

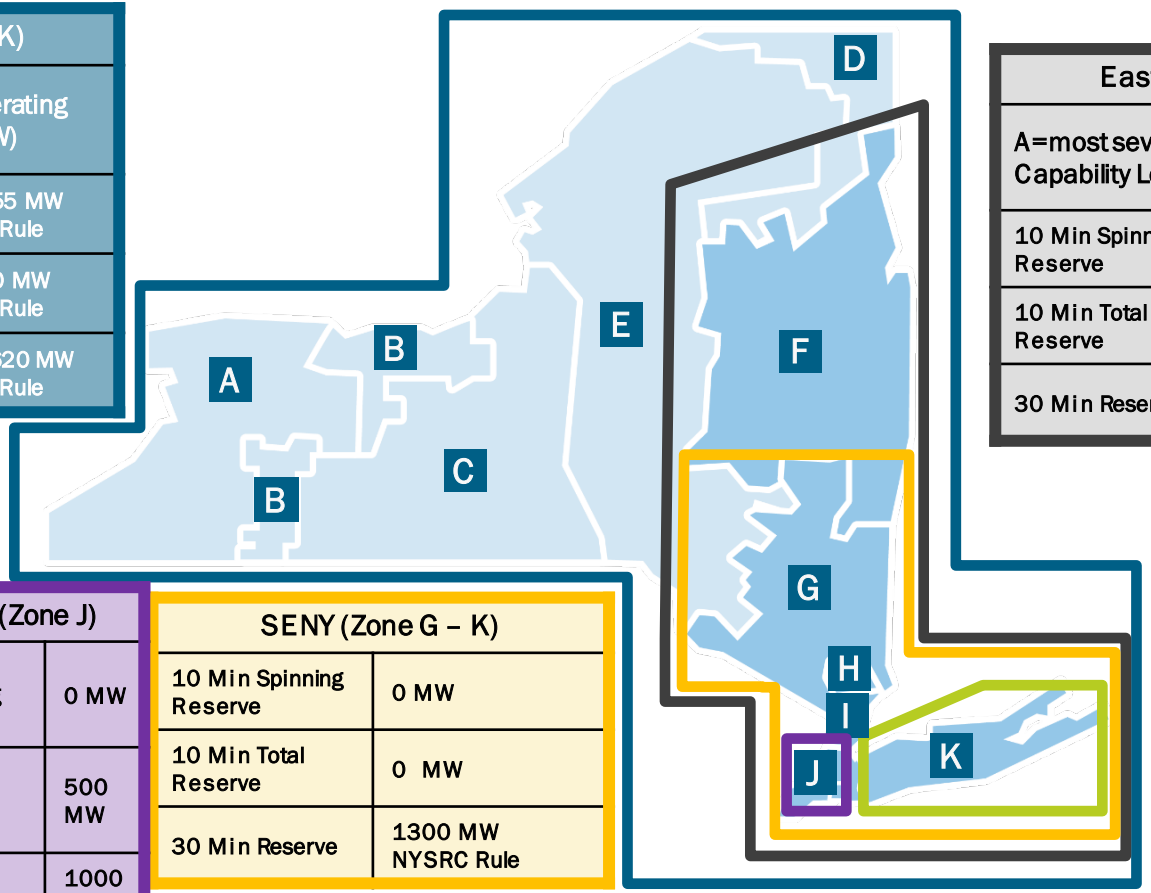
Operating Reserves Overview

- **10-Minute Spinning Reserve:**
  - Currently synchronized to the NYS power system
  - Can change output or reduce demand level in 10 minutes
  - If a resource is capable of providing this product, it is capable of providing all reserve products
- **10-Minute Non-Synchronized Reserve:**
  - Can be started, synchronized, and change output level or reduce demand within 10 minutes
  - If a resource is capable of providing this product, it is also capable of providing 30-Minute Reserve
- **30-Minute Reserve (Spinning and Non-Synchronized):**
  - Spinning: Currently synchronized and can change output level or reduce demand within 30 minutes
  - Non-synchronized: Can be started, synchronized, and change output level or reduce demand within 30 minutes

Current NYISO Operating Reserve Requirements

NYCA (Zone A – K)	
A=most severe NYCA Operating Capability Loss (1310 MW)	
10 Min Spinning Reserve	½ A=655 MW NYSRC Rule
10 Min Total Reserve	A=1310 MW NYSRC Rule
30 Min Reserve	2xA=2620 MW NYSRC Rule

A	WEST
B	GENESE
C	CENTRL
D	NORTH
E	MHK VL
F	CAPITL
G	HUD VL
H	MILLWD
I	DUNWOD
J	N.Y.C.
K	LONGIL



East (Zone F – K)	
A=most severe NYCA Operating Capability Loss (1310 MW)	
10 Min Spinning Reserve	¼ A=330 MW NERC, NPCC Rule
10 Min Total Reserve	1200 MW NYSRC Rule
30 Min Reserve	1200 MW NERC, NPCC Rule

NYC (Zone J)	
10 Min Spinning Reserve	0 MW
10 Min Total Reserve	500 MW
30 Min Reserve	1000 MW

SENY (Zone G – K)	
10 Min Spinning Reserve	0 MW
10 Min Total Reserve	0 MW
30 Min Reserve	1300 MW NYSRC Rule

Long Island (Zone K)	
10 Min Spinning Reserve	0 MW
10 Min Total Reserve	120 MW NERC, NPCC Rule
30 Min Reserve	270 – 540 MW Max limits NYSRC Rule

DRAFT – FOR DISCUSSION PURPOSES ONLY

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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