Reserves for Resource Flexibility

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Agenda

- Background
- Normal Transfer Criteria
- Uncertainty Analysis
- Next Steps
- Appendix I: Normal Transfer Criteria Analysis
- 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.

2019 Energy Market Design Reserve Projects

- **The NYISO is discussing three projects in 2019 that are directly relevant to the reserve market.**
  - These projects are independent; one may be approved and implemented without the others.
- **Reserves for Resource Flexibility (Proposed 2020 milestone: Deploy)**
  - Increase reserve requirements to account for uncertainty on the transmission system.
- **More Granular Operating Reserve (Not Prioritized for 2020)**
  - Establish reserve requirements for certain load pockets in NYC.
- **Ancillary Services Shortage Pricing (Proposed 2020 milestone: MDC)**
  - Reevaluate the demand curve prices used for ancillary services.

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 appropriate in the NYISO reserve regions will incent the right resources in the right locations to help the NYISO operate the grid of the future reliably.
- **Uncertainty in the level of load, wind, solar and other factors means that procuring additional reserves may be appropriate.**
  - The analysis outlined in future slides seeks to quantify the impact of this uncertainty on the system today.

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").**
   - The NYISO evaluated changes in net load uncertainty that result from increasing reliance on wind and solar generation.
   - The NYISO is also considering what, if any, additional metrics are appropriate to consider when evaluating whether additional reserve procurements may be warranted.

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Normal Transfer Criteria

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/ stability limit.
  - It is not appropriate to evaluate normal transfer criteria for such a limit, as normal transfer criteria is an evaluation of thermal limits.
- The NYC (Zone J) reserve region already provides sufficient capability to return to Normal Transfer Criteria following a contingency, thus no additional 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

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.

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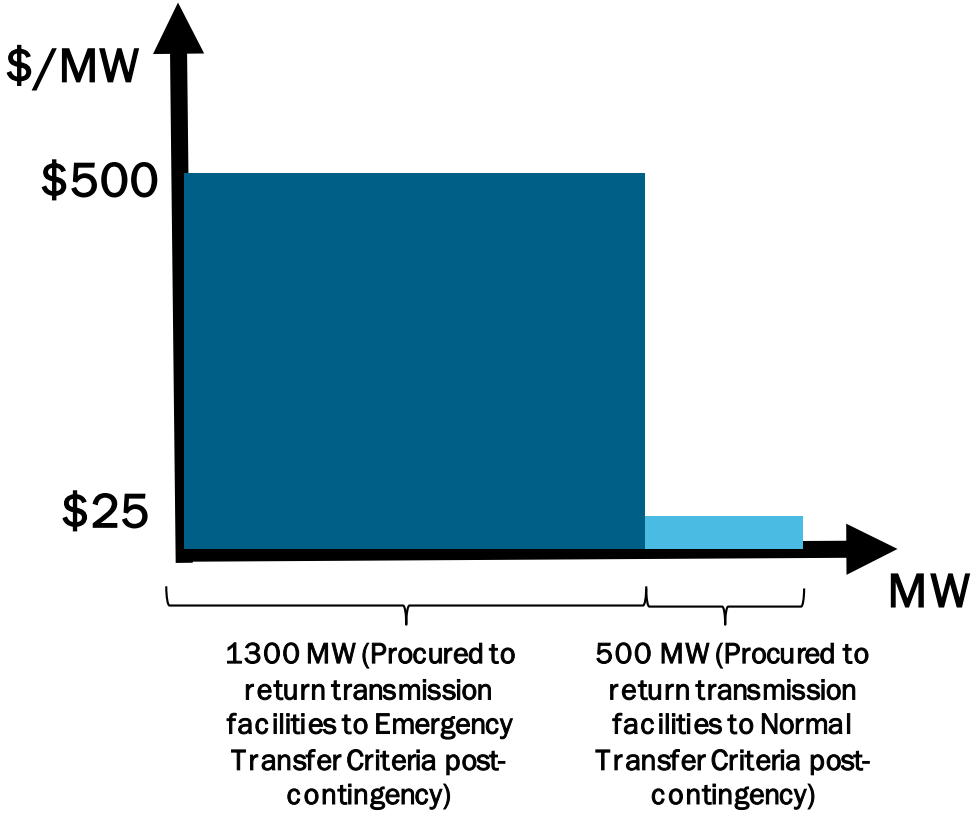
Proposed SENY 30-Minute Reserve Demand Curve



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Uncertainty Analysis

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.

Uncertainty Analysis

- **The NYISO analyzed uncertainty by calculating the net load error in the 30-minute timeframe.[1]**
  - 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)
  - The NYISO considered a number of factors in assessing net load error, including differentiating data by hour, by the predicted load level, etc.

[1]For further information regarding the analysis, please see Appendix II of this presentation.

Next Steps

Next Steps

- **Net Load Error is one possible metric that the NYISO could use to monitor system conditions as we transition to the grid of the future.**
  - The NYISO will also consider what, if any, additional metrics are appropriate to leverage to determine future adjustments to reserve procurements.
- **The NYISO will return to a future ICAPWG/MIWG meeting to discuss the process for evaluating changes to reserve procurements moving forward.**

Next Steps

- **Q4 2019**
  - Discuss the process for reviewing changes to reserve procurements moving forward
  - Present Market Design Concept Proposal
- **2020**
  - Deploy revisions to the SENY reserve requirement and SENY 30-minute reserve demand curve.
  - Implement methodology/process for adjusting reserve procurements over time.

Appendix I: Normal Transfer Criteria Analysis

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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.

Appendix II: Uncertainty Analysis Results

Net Load Error Calculation

- **The NYISO calculated the load forecast error net of the wind forecast error.**
  - Three years of data were included (May 27, 2016 to April 30, 2019)
  - The data was at a 5-minute granularity.

    Net Load Error = (Forecast Load – Actual Load) – (Forecast Wind – Actual Wind)

- **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.

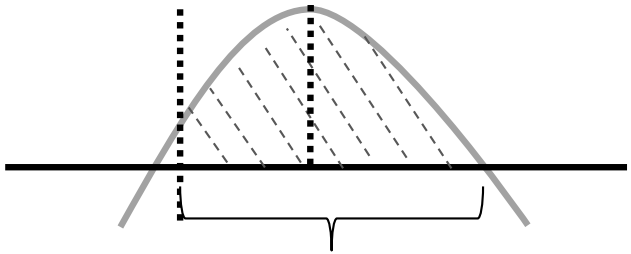
Data Categories

- **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



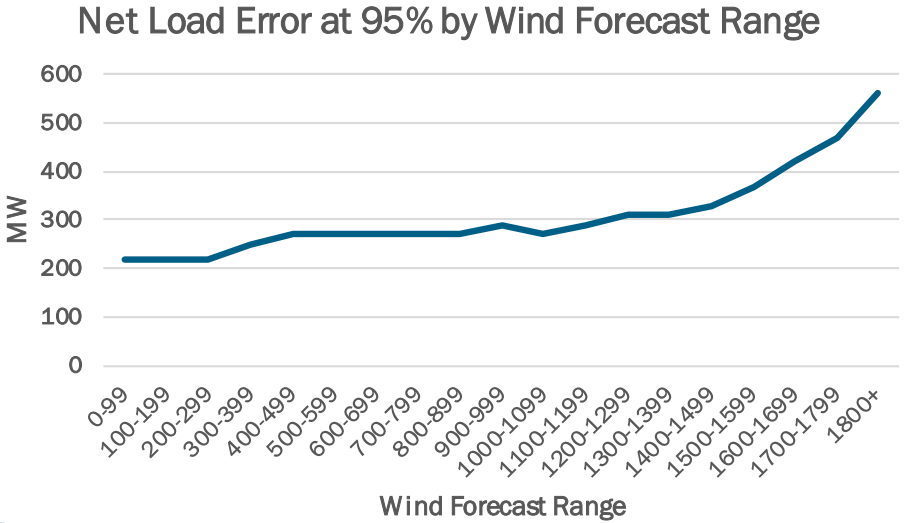
Data Analysis

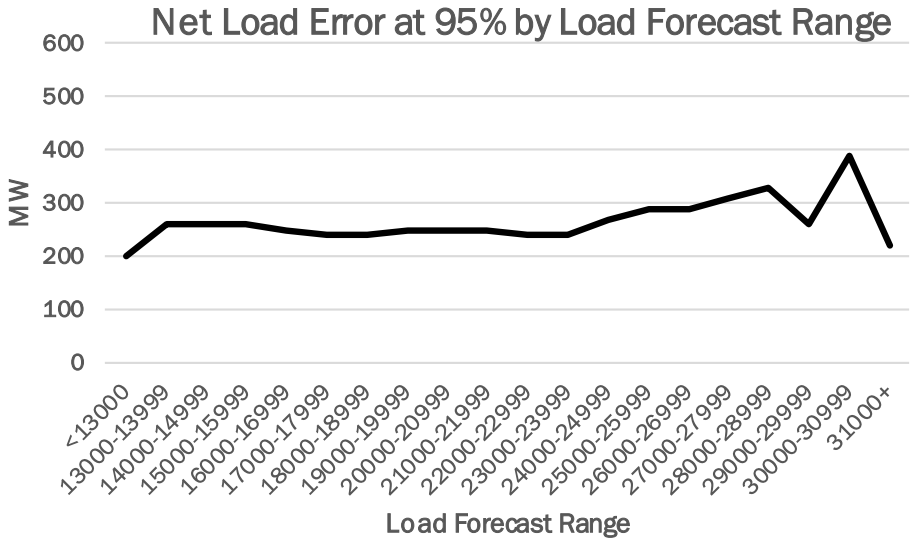
- **The NYISO arranged net load error data for each locational reserve region.**
  - The net load forecast error was driven by the load forecast level for each category and reserve region pair, except for NYCA 30-minute reserve, which was driven by the wind forecast level (for example, see the next slide).
- **Net load error data in the following slides that would otherwise be negative (indicating an under-forecast) is expressed as a positive value.**

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 forecast error at 95% confidence.





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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

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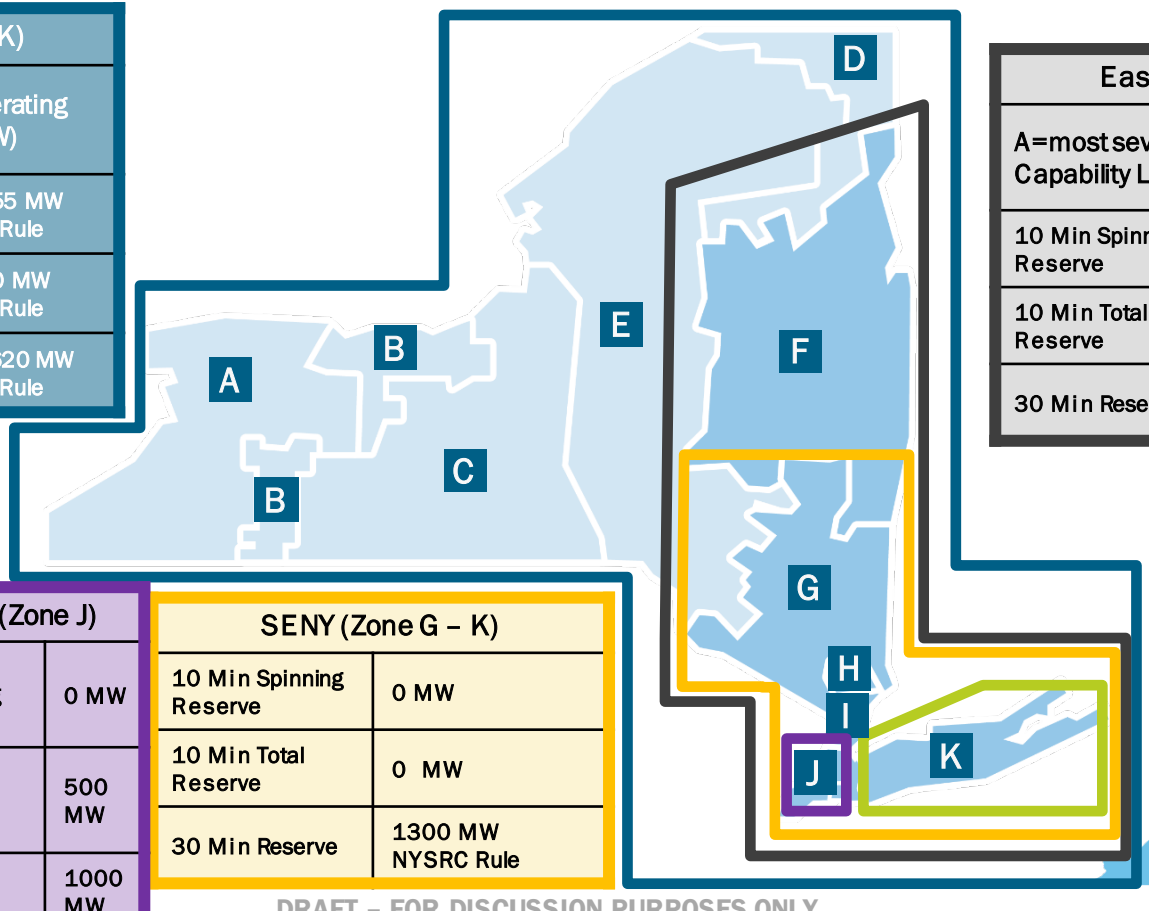
Current NYISO Operating Reserve Requirements

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

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- 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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