New York ISO

2020 RNA REPORT

Reliability Needs Assessment

A Report by the
New York Independent
System Operator

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Executive Summary

This 2020 Reliability Needs Assessment (RNA) provides an evaluation and review of the reliability of the New York bulk electric grid through 2030, considering forecasts of peak power demand, planned upgrades to the transmission system, and changes to the generation mix over the next ten years. The RNA assesses an actionable "base case" set of assumptions, as well as various scenarios that are provided for information. This RNA base case includes projected impacts driven by limitations on generator emissions, while the scenarios include an in-depth look at certain policy goals from the Climate Leadership and Community Protection Act (CLCPA). The RNA also discusses the reliability risks associated with the cumulative impact of environmental laws and regulations, which may affect the availability and flexibility of power plant operation.

COVID-19 Impacts on Demand

The coronavirus outbreak has had a significant impact on New York's economy due to reductions in commercial and industrial activity as New Yorkers adjust their lives by working from home and limiting social interaction. Due to the rapidly evolving nature of the pandemic, the demand forecasts utilized in this study reflect the NYISO's perspective as of April 2020. The sudden departure from historical behavioral patterns caused by New York's response to COVID-19 is unprecedented and creates unique challenges to forecasting the state's energy needs. As the situation evolves and more data becomes available, the NYISO will continue to monitor these forecasts and adjust course accordingly. As further described in the "Next Steps" section, following approval of the RNA by the Board and prior to any solicitation of solutions, the NYISO will consider updates to the peak load forecasts and determine to what extent the forecasts impact any identified system needs.

Actionable Reliability Needs

This 2020 RNA has identified violations or potential violations of reliability criteria ("Reliability Needs") in the base case throughout the entire study period (2024-2030) due to dynamic instability, transmission overloads, and resource deficiencies.[1] The issues identified are primarily driven by a combination of forecasted peak demand and the assumed unavailability of certain generation in New York City affected by the "Peaker Rule."

In 2019, the New York State Department of Environmental Conservation adopted a regulation to limit nitrogen oxides (NOx) emissions from simple-cycle combustion turbines (referred to as the "Peaker

[1] Effective May 1, 2020, the scope of the RNA is limited to years 4-10 of the planning horizon while the NYISO Short-Term Reliability Process is responsible for years 1-3 and also assesses years 4-5.

Rule[2],”). Combustion turbines known as “peakers” typically operate to maintain bulk power system reliability during the most stressful operating conditions, such as periods of peak electricity demand. Many of these units also maintain transmission security by supplying energy within certain constrained areas of New York City and Long Island — known as load pockets. The Peaker Rule, which phases in compliance obligations between 2023 and 2025, will impact turbines located mainly in the lower Hudson Valley, New York City, and Long Island. The Peaker Rule required all impacted plant owners to file compliance plans by March 2, 2020. The plans indicate approximately 1,500 MW of peaker capability would be unavailable during the summer by 2025 to comply with the emissions requirements. A subset of those generators would be unavailable starting in 2023.

With the peakers unavailable, the bulk power transmission system could not securely and reliably serve the forecasted load in New York City (Zone J) throughout the study period. Following the initial phase of the Peaker Rule in 2023, instability of the grid may occur due to a lack of dynamic reactive power capability and inertia available to parts of the New York City grid. These reliability issues include low transient voltage response, loss of generator synchronism, and undamped voltage oscillations. With full implementation of the Peaker Rule in 2025, several 345 kV circuits in the Con Edison service territory would not meet transmission security requirements equating to a deficiency of 700 MW and increasing to at least 1,075 MW by 2030. The duration of the deficiencies range from nine hours in 2025 (3,853 MWh) to 12 hours in 2030 (7,672 MWh). Similar transmission deficiencies would also occur within pockets of Con Edison’s non-bulk system (138 kV), ranging in duration from 10 to 14 hours.

In addition to the transmission security issues, overall resource adequacy deficiencies in Zone J would begin in 2027 and increase to at least 350 MW through 2030. Resource adequacy is the ability of the electric systems to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. The NYISO performs resource adequacy assessments on a probabilistic basis to capture the random nature of system element outages. The New York system is deemed to have sufficient resources if the probability of an unplanned disconnection of firm load (loss of load expectation, or “LOLE”) is equal to or less than the standard of once in every 10 years or 0.1 events per year.

Figure 1 below quantifies each Reliability Need through the study period in terms of generic compensatory resources, in megawatts (MW) or megavolt-amperes (MVA). Compensatory MW/MVA amounts are determined by adding generic “perfect capacity” resources to NYISO zones or substations to effectively satisfy the needs. “Perfect capacity” is a term used to describe resources that are always able to

[2] https://www.dec.ny.gov/regulations/116131.html

produce energy on demand, without any limitations due to factors such as equipment failures or lack of fuel, without energy duration limitations, and without consideration of transmission security or interface impacts. Actual resources would need to be larger in order to achieve the same impact as perfect-capacity resources. The Reliability Needs could be met by combinations of solutions including generation, transmission, energy efficiency, demand response measures, or changes in operating protocols. All Reliability Needs occur within Con Edison's transmission district in New York City (Zone J). Therefore, Con Edison is the Responsible Transmission Owner for regulated backstop solutions, as defined by the NYISO OATT.

Figure 1: Summary of Reliability Needs (Compensatory MW/MVA)

Study Year	Bulk Facilities			Non-Bulk Facilities	
	Resource Adequacy (Zone J, MW)	Transmission Loading (Zone J, MW)	Dynamic Instability (Zone J, MVA)	ConEdison Astoria East/ Corona 138 kV (MW)	ConEdison Greenwood/Fox Hills 138 kV (MW)
2024	below criterion	below criterion	490	115	below criterion
2025	below criterion	700	1,020	110	360
2026	below criterion	760	1,080	115	350
2027	100	820	1,140	120	360
2028	150	900	1,210	125	360
2029	300	990	1,300	170	370
2030	350	1,075	1,390	180	370

In addition to the base case set of assumptions and findings, the RNA provides an assessment of risks to the bulk electric grid under certain scenarios to inform stakeholders and policymakers of potential alternate outcomes. Scenarios are variations on key base case assumptions such as higher load forecast, capacity removal, or deviations from assumed system plans. If they occurred, the events analyzed in the scenarios could change the timing, location, or degree of reliability issues identified in the base case. Each of these variations of the base case for this 2020 RNA indicates potential increased risks of reliability criteria violations in the future. The scenarios include higher peak load than forecasted, additional generator retirements, and "status quo" in which major transmission and generation plans fail to come to fruition.

70x30 Scenario

The Climate Leadership and Community Protection Act (CLCPA) mandates that New York consumers be served by 70% renewable energy by 2030 (70x30). The CLCPA includes specific technology based targets for distributed solar (6,000 MW by 2025), storage (3,000 MW by 2030), and offshore wind (9,000 MW by 2035), and ultimately establishes that the electric sector will be emissions free by 2040. Significant shifts are expected in both the demand and supply sides of the electric grid, and these changes will affect how the power system is currently planned and operated. Beginning with the 2019 Congestion Assessment and Resource Integration Study (CARIS), the NYISO conducted a production cost simulation of a "70x30" scenario of two potential load levels and corresponding resource mixes in order to examine potential system constraints, generator curtailments, and other operational limitations. This *2020 RNA*, along with the *Climate Change Impact and Resilience Study*, build upon the findings of the *2019 CARIS*, and provide further insight focusing on system reliability aspects, such as transmission security and resource adequacy.

As policymakers advance the implementation plan of the CLCPA, the NYISO assessments are intended to complement their efforts, and are not intended to define the specific steps that must be taken to achieve the policy goals. Additional refinements in assumptions, models, and methods in the following years will be necessary as more information becomes available from the perspective of policy implementation.

This 70x30 scenario utilizes the same load forecasts and renewable resource mixes from the 2019 CARIS 70x30 scenario. Approximately 110 sites of land-based wind, offshore wind, and utility-scale solar were added to the system model along with additional behind-the-meter solar across the system. Initial resource adequacy simulations did not identify a measurable loss-of-load expectation in either the higher energy 'Base Load' case or lower energy 'Scenario Load' case. This result indicates a significant surplus of generation resources in the model, equivalent to an installed capacity margin of 210% for the Base Load case and 235% for the Scenario Load case.

In an electric grid with such excess capacity resources, it is reasonable to expect less efficient generation would retire. For this scenario, the NYISO conducted an age-based retirement analysis by removing fossil fuel generators, starting with the oldest, until the New York system is at the resource adequacy reliability criteria. This age-based method is a simple analytical approach as a proxy to represent unit retirements that may occur as surplus resources increase over time. In reality, many factors will affect specific generator status decisions. For the Base Load case approximately 2,800 MW of fossil generation could be removed before the resource adequacy criteria is exceeded, resulting in an installed capacity margin of 191.8%. For the Scenario Load case the installed capacity margin is 173.4% following approximately 12,300 MW of fossil generation removals. Additional analysis demonstrated that alleviating renewable generation pocket transmission constraints, while beneficial from an energy perspective as demonstrated in the 2019 CARIS, would not materially impact the reliability-based need for additional generation resources. Figure 2 and Figure 3 show the resulting resource mix for each case.

Figure 2: Resource Mix in the 70x30 'Base Load' Case at Reliability Criterion

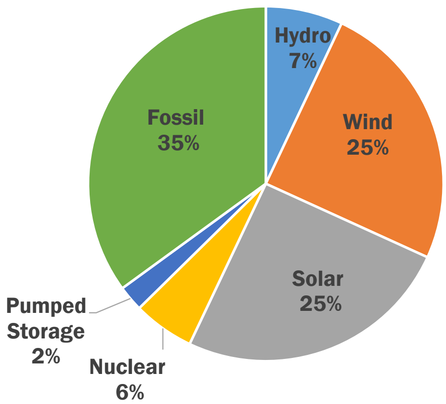
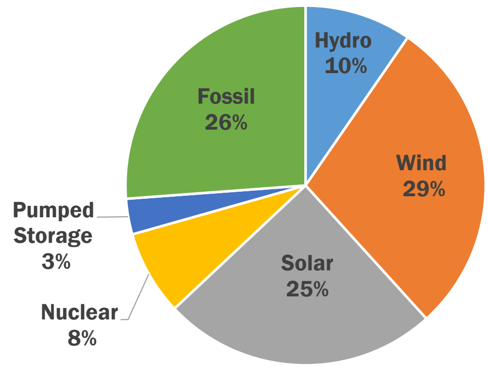


Figure 3: Resource Mix in 70x30 'Scenario Load' Case at Reliability Criterion



The NYISO also conducted sensitivity analysis of these resource mixes for the retirement of the nuclear fleet, and for the consideration of energy storage resources. Retirement of nuclear plants would result in less surplus capacity and therefore more conventional generation (currently fossil-fueled) would need to be retained in order to maintain a reliable system. Energy storage resources may provide a benefit to the system from a reliability standpoint by assisting in meeting peak load (benefits depending on the size, location, and duration of capacity shortfalls), thus allowing for additional fossil units to be retired. Energy storage resources with a duration longer than four hours would provide additional benefit to the system.

The NYISO performed transmission security analysis for the 70x30 Base Load case considering various load levels and coincident intermittent renewable resource generation for a sample hours throughout the year. The results conclude that certain transmission constraints are observed during times of high renewable output, while other constraints would occur under peak load conditions if the intermittent renewable resources are not generating. Dispatchable resources would be needed to fill the gaps created when intermittent renewable resources are not producing energy. Even with a large amount of installed capacity of renewable resources, there would still be a need for significant dispatchable generation to meet reliability requirements at various times throughout the year, including peak load. To maintain system transmission security, approximately 750 MW of dispatchable resources would be needed in addition to the 24,700 MW of dispatchable resources remaining in the model *(i.e.* after age-based removals and peakers).

The NYISO will continue to monitor and track system changes. Subsequent studies, such as the Comprehensive Reliability Plan, the next Reliability Planning Process and Economic Planning Process cycles, and the Climate Change Impact and Resilience Study, will build upon the findings of this 70x30 scenario.

Next Steps

The RNA is the first step of the NYISO Reliability Planning Process. Following NYISO Board approval of the RNA, additional steps are taken, as necessary, to mitigate the identified Reliability Needs. These steps are undertaken to minimize unnecessary solicitations of solutions to the Reliability Needs. Under this process, the NYISO requests updates to the status of proposed projects such as Local Transmission Owner Plans (LTPs), proposed generation and transmission, and demand response. As part of this step, the NYISO will consider updates that meet the inclusion rules, and if necessary, will solicit solutions to the remaining Reliability Needs. The NYISO would then proceed to assess the viability and sufficiency of each of the solutions, as well as to evaluate and select the more efficient and cost effective transmission solution(s) to satisfy the needs, leading to the development of the Comprehensive Reliability Plan (CRP).

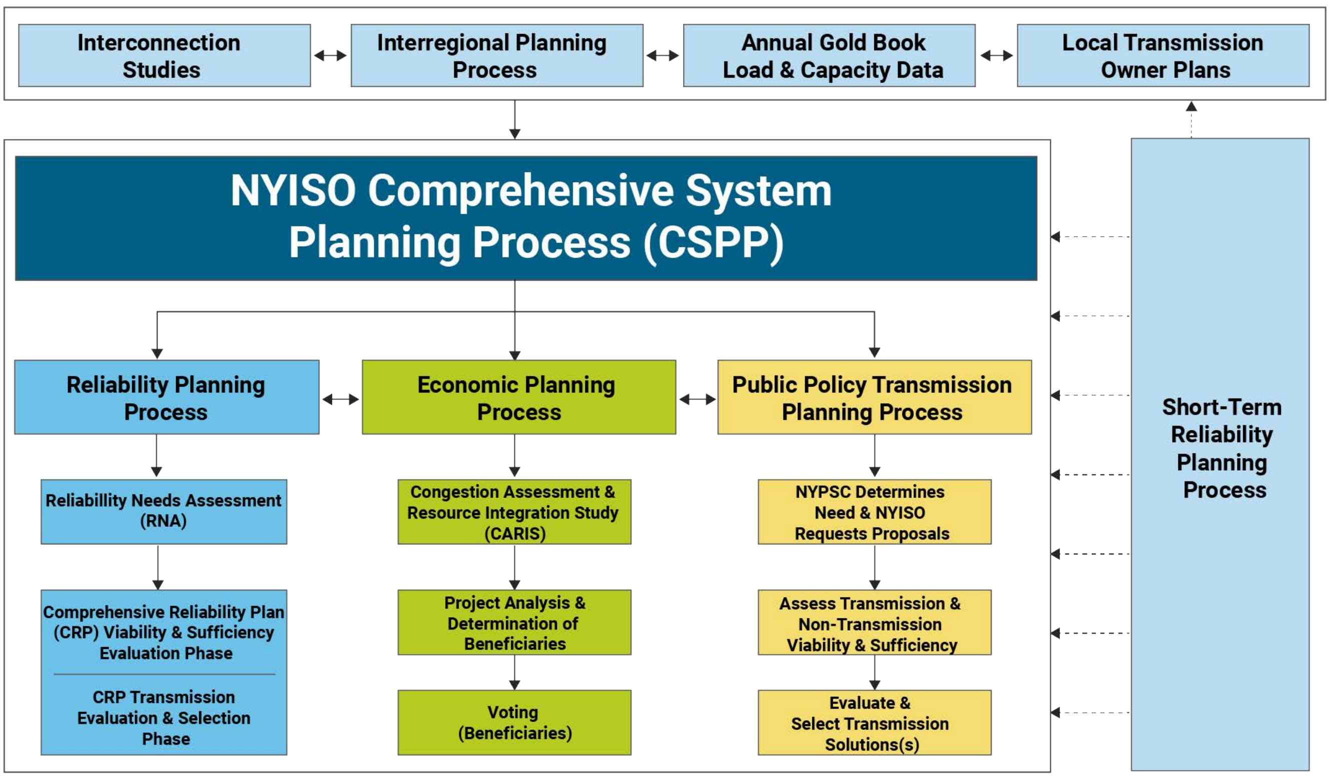
The Comprehensive Reliability Plan provides the plan to maintain system reliability and documents the solutions determined to be viable and sufficient to meet any identified Reliability Needs. If applicable, the Comprehensive Reliability Plan ranks any regulated transmission solutions submitted for the Board to consider for selection of the more efficient or cost effective transmission project. If built, the selected transmission project is eligible for cost allocation and recovery under the NYISO's tariff. Other non-transmission solutions, if built, will recover their cost under state law, such as through retail tariffs established by the New York State Public Service Commission (PSC) and the rates established by the New York Power Authority and the Long Island Power Authority.

Additionally, the needs identified in the Short Term Reliability Process in year 1 through year 3 will be addressed in the applicable quarterly Short Term Assessment of Reliability (STAR), while the needs identified in years 4 and 5 will only be addressed using the Short-Term Reliability Process if the identified Reliability Need cannot timely be addressed through the Reliability Planning Process.

1. Introduction

This report sets forth the NYISO's 2020 RNA and scenario findings for the newly redefined Study Period of years 4 through 10 (*i.e.*, years 2024 through 2030). The RNA is the first of two main components of the Reliability Planning Process, which is one of the three processes that comprise the NYISO's Comprehensive System Planning Process (see Figure 4). The RNA is performed to evaluate electric system reliability according to resource adequacy and transmission security criteria over the Study Period.

Figure 4: The NYISO's Comprehensive System Planning Process (CSPP)



The RNA is developed by the NYISO in conjunction with stakeholders and all interested parties as the first step in the Reliability Planning Process. The RNA assesses the reliability of the New York Bulk Power Transmission Facilities (BPTFs) as the foundation study used in the development of the NYISO Comprehensive Reliability Plan (CRP). Two major study types are performed: resource adequacy and transmission security, over the RNA Study Period (*i.e.,* year 4 through year 10, 2024-2030). If the RNA identifies any violation of reliability criteria[3] for BPTFs, the NYISO will report a Reliability Need quantified by an amount of compensatory megawatts (MW) in a location that would resolve that need. After the

[3] A condition identified by the NYISO in the RNA as a violation or potential violation of Reliability Criteria as defined by the OATT.

NYISO's Board approval of the RNA and if any Reliability Needs are left after the post-RNA Base Case updates process, the NYISO will solicit market-based solutions, designate one or more Responsible Transmission Owners (TOs) to develop regulated backstop solutions to address each identified Reliability Need, and solicit alternative regulated solutions from interested parties.

The CRP details the NYISO's plan for continued reliability of the BPTFs during the Study Period and identifies additional resources, or combinations of resources, that resolve any identified criteria violations in the RNA. New or proposed resources included in the CRP may be provided by market-based solutions developed in response to market forces, and by the request for solutions. If the market does not adequately respond, reliability will be maintained by either regulated backstop solutions developed by the Responsible TOs, which are obligated to provide reliable service to their customers, or alternative regulated solutions being developed by Other Developers. To maintain the long-term reliability of the BPTFs, these additional resources must be readily available or in development at the appropriate time to address the identified need.

Proposed solutions that are submitted in response to an identified Reliability Need are evaluated in the development of the CRP and must satisfy reliability criteria. However, the solutions submitted to the NYISO for evaluation in the CRP do not have to be in the same amounts of MW or locations as the compensatory MW reported in the RNA. There are various combinations of resources and transmission upgrades that could meet the needs identified in the RNA. The reconfiguration of transmission facilities and/or modifications to operating protocols identified in the solution phase could result in changes and/or modifications of the needs identified in the RNA.

This report begins by highlighting the changes to the Reliability Planning Process recently implemented in the NYISO's tariffs and procedures. Next, this report summarizes the prior Reliability Planning Process findings and reliability plans. The report continues with a summary of the load and resource forecast for the RNA Study Period, the RNA Base Case assumptions and methodology, and the RNA findings. Detailed analyses, data and results, and the underlying modeling assumptions are contained in the appendices.

Along with addressing reliability, the Reliability Planning Process is also designed to provide information that is both informative and of value to the New York wholesale electricity marketplace and federal and state policymakers. For informational purposes, this RNA report reviews activities related to environmental regulatory programs and other relevant developments. The RNA report also provides the latest historical information for the past five years of congestion, and related data is posted on the NYISO's website.

An overview of the Reliability Planning Process is illustrated in Figure 2 in **Appendix B** and is described in the Reliability Planning Process Manual.

2. Overview of Reliability Planning Process Changes

The current Reliability Planning Process was approved by the Federal Energy Regulatory Commission (FERC) and its requirements are contained in Attachment Y of the NYISO's Open Access Transmission Tariff (OATT). A detailed process description is contained in the Reliability Planning Process Manual.

In 2019, a major planning process was carved out of the Reliability Planning Process and defined as the Short-Term Reliability Process (STRP). This process was approved by the FERC and its requirements are contained in Attachments Y and FF of the NYISO's OATT. With this process in place, the Reliability Planning Process's Study Period changes from a year 1 to year 10 analysis, into a year 4 to year 10 look ahead. At the same time, the STRP evaluates year 1 through year 5 from the Short Term Assessment of Reliability (STAR) Start Date, with a focus on Short-Term Reliability Needs arising in years 1 through 3 of the Study Period. Each quarterly STRP concludes if the STAR or Generator Deactivation Assessment does not identify a STRP Need, and states whether a STRP Need will be addressed in the Reliability Planning Process or in the STRP.

Short-Term Reliability Process Needs that arise in the Near-Term (within three years) will be addressed using the Short-Term Reliability Process (STRP). Short-Term Reliability Process Needs that are not Near-Term needs on the BPTF will only be addressed using the STRP if an identified Reliability Need cannot timely be addressed through the ISO's Reliability Planning Process. If the Reliability Need is handled through the STRP, the NYISO will solicit market-based solutions of all types, a regulated transmission solution(s), and service offers from Generators, as appropriate. The NYISO will select a solution(s) consistent with the STRP process which may include selecting Generators to remain in service under temporary reliability must run (RMR) agreements until the transmission solution is complete.

One of the changes to the Reliability Planning Process, which was first implemented in the *2016 RNA*, is providing initial ("1st pass") RNA results to stakeholders, usually in June of the first year of the biennial planning process. The stakeholders can provide project updates focused on reducing or eliminating the initial Reliability Needs, such as:

- Updated LTPs
- Changes in BPTFs
- Changes in available resources such as generating unit status or authority to operate in current equipment configuration past a date certain (*e.g.*, due to a new or amended environmental laws or regulations) [4]

[4] This change was implemented in the RPP Manual in 2019.

- Changes in load forecast or demand response resources.

If the NYISO determines that an update does not meet the inclusion rules and/or does not impact the preliminary Reliability Need, the NYISO will not incorporate the change into the final RNA Base Case.

After the NYISO Board of Directors approves the RNA Report, and before NYISO issues a solicitation for regulated backstop, market-based, and alternative regulated solutions, the NYISO will request updated LTPs, NYPA transmission plans, and other[5] status updates relevant to reducing, or eliminating, the Reliability Needs, as timely received from Market Participants, Developers, TOs, and other parties. Changes that would tend to increase the scope of Reliability Needs after the RNA lockdown date will be handled in the STRP or a future RNA, as appropriate. The NYISO will then request solutions for the remaining Reliability Needs, if any.

The 2018 version of the Reliability Planning Process Manual reflected a change in the "RNA Base Case Development Process" section, mainly related to the Base Case inclusion rules applicable to proposed projects, and also to the treatment of generation deactivations in the RNA Base Case. Specifically, additional considerations were added in 2019 to reflect situations in which a Generator Owner lacks authority to operate in its current equipment configuration past a date certain (*e.g.,* due to a new or amended environmental law or regulation).

Further details of the Reliability Planning Process and STRP are contained in **Appendix B** of this report, and also in the Reliability Planning Process Manual located on the NYISO website.

[5] This change was implemented in the RPP Manual in 2019.

3. Summary of Prior Comprehensive Reliability Plans

This RNA is the tenth RNA the NYISO has conducted since the reliability planning process was initially approved by FERC in December 2004. The first three RNA reports identified Reliability Needs and the first three CRPs (2005-2007) evaluated the market-based and regulated backstop solutions submitted in response to those identified needs. The *2009 RNA* and the *2010 RNA* indicated that the system did not exhibit any violations of applicable reliability criteria. Accordingly, the NYISO did not solicit solutions under the Comprehensive Reliability Plan (CRP) process. The *2012 RNA* identified Reliability Needs, and the *2012 CRP* evaluated market-based and regulated solutions in response to those needs.

The *2014 RNA* identified both resource adequacy and transmission security related Reliability Needs, which were subsequently eliminated by the system updates received during the 2014 CRP process.

The *2016 RNA* identified two transmission security Reliability Needs beginning in 2017: the New York State Electric & Gas Corp. (NYSEG) Oakdale 345/115 kV transformer, and the Long Island Power Authority (LIPA) East Garden City to Valley Stream 138 kV line. Subsequent to the October 2016 approval of the RNA, and prior to the start of the CRP, NYSEG and LIPA provided updates to their LTPs. With these updates the two identified Reliability Needs were resolved, and there was no solicitation of solutions under the 2016 Reliability Planning Process cycle.

The *2018 RN*A concluded that the New York State Bulk Power Transmission Facilities will meet all applicable reliability criteria over the 2019 through 2028 study period.

The NYISO has not previously triggered any regulated backstop solutions to meet previously-identified Reliability Needs due to changes in system conditions and the sufficiency of market solutions coming into service.

Figure 5, below, presents the market solutions and TOs' plans that were submitted in response to previous requests for solutions.

Figure 5: Current Status of Tracked Market-Based Solutions and TOs' Plans

Queue #	Project	Submitted	Zone	Original I/S Date	Proposal Type	Target I/S	Included in the 2020 RNA Final Base Case
339	RG&E Station 255	CRP 2012	B	N/A	TO Plan	W 2020	Yes
N/A	National Grid Clay-Teall #10 115kV	CRP 2012	C	N/A	TO Plan	W2020	Yes
N/A	NYSEG Terminal upgrades, on Stolle Road-Gardenville 230 kV Line #66	RNA 2016	A	2019	TO Plan	I/S	Yes
N/A	RG&E Terminal upgrades, on Clay-Pannell PC1 and PC2 345 kV lines.	RNA 2016	C	2019	TO Plan	S2019	Yes
N/A	NYSEG Oakdale 345/115 kV 3rd transformer and substation reconfiguration.	CRP 2016	C	2021	TO Plan	W2021	Yes
N/A	National Grid Clay-Dewitt #3 115kV	CRP 2014	C	2017	TO Plan	W2020	Yes
N/A	Orange and Rockland West Haverstraw 345/138 kV transformer addition	RNA 2018	G	S2021	TO Plan	S2021	Yes
N/A	Brookhaven to Edwards Ave 138 kV line ratings increase, addressing the overload in Eastern Long Island from Y2028	RNA 2018	K	2019	TO Plan	S2019	Yes

4. Regulatory Policy Activities

At the federal, state, and local levels, public policy initiatives are shaping the grid of the future. How the grid is operated to maintain reliability and economic efficiency while achieving these policies requires careful and informed operations, market design, and planning. From this perspective, the NYISO is examining a number of public policy initiatives, and engaging stakeholders and policymakers to identify the challenges and opportunities these initiatives may present to bulk power system reliability and efficiency.

Two initiatives in particular will lead to large changes in the type of resources available to serve the demand in New York. First, the New York State Department of Environmental Conservation (NYSDEC) "Peaker Rule" requires significant emission reductions from older high-emitting gas turbines, or "peakers," such that affected units may be unavailable as early as 2023. The RNA base case accounts for potential impacts from the unavailable generation.

Second, the Climate Leadership and Community Protection Act (CLCPA) is a state law shaping how energy will be supplied in New York State. The CLCPA calls for growing the portion of consumed energy served by renewable resources to 70% by 2030. Looking beyond 2030, the CLCPA requires a zero-emission grid by 2040. The RNA 70x30 Scenario in conjunction with other studies being performed by the NYISO, such as the *Climate Change Impact & Resilience Study*, takes an initial review of the reliability implications of the CLCPA targets.

Figure 6: Summary Table of Key Environmental Regulations and Energy Policies

PUBLIC POLICY INITIATIVE	POLICYMAKING ENTITIES	PUBLIC POLICY GOALS	PUBLIC POLICY IMPLICATIONS
"Peaker Rule" **Ozone Season Oxides of Nitrogen (NOx) Emissions Limits for simple cycle and regenerative combustion turbines**	New York State Department of Environmental Conservation (DEC)	Reduce ozone-contributing pollutants associated with New York State-based peaking unit generation. Compliance obligations phased in between **2023** and **2025**	DEC rule impacts approximately **3,300 MW** of peaking unit capacity in New York State. The NYISO is analyzing compliance plans through its Reliability Needs Assessment (RNA) to determine whether they give rise to reliability needs. Current compliance plans indicate 1,500 MW of capability will be unavailable in 2025.
Indian Point Deactivation	Agreement between New York State and Entergy	Deactivate Indian Point units 2 and 3 by **2020** and **2021**, respectively	The NYISO issued a deactivation assessment finding no reliability need associated with deactivation of Indian Point's **2,311 MW** assuming the addition of certain expected resources. Subsequently, unit 2 deactivated on April 30, 2020. Unit 3 is scheduled to deactivate in **April 2021**

PUBLIC POLICY INITIATIVE	POLICYMAKING ENTITIES	PUBLIC POLICY GOALS	PUBLIC POLICY IMPLICATIONS
New York City Residual Oil Elimination	City of New York	Eliminate combustion of fuel oil numbers 6 and 4 in New York City by **2020** and **2025,** respectively	**2,946 MW** of installed capacity affected by rule
CO_2 Performance Standards for Major Electric Generating Facilities	New York State Department of Environmental Conservation (DEC)	Establish restrictions on carbon dioxide emissions for fossil fuel-fired facilities in New York by **2020**	As of **April 2020,** all coal-fired generation facilities supplying the bulk power system deactivated. NYISO generator deactivation assessments found no reliability needs associated with these deactivations
Regional Greenhouse Gas Initiative (RGGI)	New York and other RGGI states	Reduce carbon dioxide emissions cap by 30% from 2020 to 2030 and expand applicability to currently exempt "peaking units" below current 25 MW threshold	The NYS DEC proposed to expand applicability in NYS to generators of **15 MW** or greater, whereas current rules do not apply to generators **less than 25 MW**
Climate Leadership and Community Protection Act	New York State Public Service Commission, New York State Energy Research and Development Authority, New York State Department of Environmental Conservation, Climate Action Council	**6,000 MW** of distributed solar installed by 2025, **185 trillion** BTU reduction in total energy consumption, including electrification to reduce fossil fuel use in buildings by 2025, **3,000 MW** of storage installed by 2030, **70%** of load supplied by renewable resources by 2030, **9,000 MW** of Offshore Wind Installed by 2035, **100%** of load supplied by zero-emissions resources by 2040	**Transformation of the power grid,** necessitating examination of market structures, planning processes, flexible load, and investment in bulk power system infrastructure
NYS Accelerated Renewable Energy Growth and Community Benefit Act	Office of Renewable Energy Siting (ORES) within the NYS Department of State, New York State Public Service Commission, New York State Energy Research and Development Authority (NYSERDA)	Provides for an accelerated path for the permitting and construction of renewable energy projects instead of through the Article 10 power plant siting law. Requires a comprehensive study to identify cost-effective distribution, local and bulk electric system upgrades to support the state's climate goals, and filing of the study with the New York State Public Service Commission	Intended to help **accelerate siting of eligible renewable resources** in support of state policy goals. Intended to establish new transmission investment priorities to facilitate the achievement of state policies

Peaker Rule: Ozone Season Oxides of Nitrogen (NO_x) Emission Limits for Simple Cycle and Regenerative Combustion Turbines

In December 2019, the DEC issued requirements to reduce emissions of smog-forming pollutants from peaking generation units. Combustion turbines known as "peakers" typically operate to maintain bulk power system reliability during the most stressful operating conditions, such as periods of peak electricity demand. In addition, these units are often called upon at any time, seven days a week and 24 hours a day, to be able to respond to contingencies or other near real time changes on the electric system. By being available on call, the peakers provide value to system reliability even when not actually generating power. Many of these units also maintain transmission security by supplying energy within certain areas of New York City and Long Island — known as load pockets. Load pockets represent transmission-constrained geographic areas where electrical demand can only be served by local generators due to transmission limitations during certain operational conditions.

The Peaker Rule[6], which phases in compliance obligations between 2023 and 2025, will affect approximately 3,300 MW of simple-cycle turbines located mainly in the lower Hudson Valley, New York City and Long Island. The rule required peaking unit owners to submit compliance plans to the DEC in March 2020. These generator compliance plans informed the NYISO's *2020 Reliability Needs Assessment* (RNA) base case assumptions for years 2024-2030. The proposed plans are also being examined in the NYISO Short-Term Reliability Process for the years 2021-2025. The rule provides a phased reduction in emission limits, in 2023 and 2025, during the ozone season (May 1-September 30) and allows several options for achieving compliance with the new lower limits applicable during the ozone season.

Compliance plans submitted to the NYSDEC were provided to the NYISO for assessment and inclusion in the base case. The plans indicate approximately 1,800 MW of nameplate capacity (approximately 1,500 MW of net operating capability) are proposed to ultimately be unavailable during the summer to comply with the emissions requirements. Remaining units stated either that they comply with the emission limits as currently operated, or proposed equipment upgrades to achieve the emissions limits. A summary of the individual generator plans is provided in the Figure 7, Figure 8 and Figure 9.

The regulations include a provision to allow an affected generator to continue to operate up to two years, with a possible further two-year extension, after the compliance deadline if the generator is designated by the NYISO or the local transmission owner as needed to resolve a reliability need until a permanent solution is in place.

[6] https://www.dec.ny.gov/regulations/116131.html

Figure 7: Status Change due to DEC Peaker Rule, Zone G

Units	Nameplate MW	CRIS (MW)		Capability (MW)		2023 Ozone Season	2023 non-Ozone Season	2024 Ozone Season	2024 non-Ozone Season	2025 Ozone Season	2025 non-Ozone Season
		Summer	Winter	Summer	Winter	*May 2023 - September 2023*	*October 2023 - April 2024*	*May 2024 - September 2024*	*October 2024 - April 2025*	*May 2025 - September 2025*	*October 2025 - April 2026*
Coxsackie GT	22	20	26	20	24	O/S	O/S	O/S	O/S	O/S	O/S
South Cairo	22	20	26	18	23	O/S	O/S	O/S	O/S	O/S	O/S
Unavailable MW = Impacted MW	43	40	52	38	46						

O/S - Out-of-service

Figure 8: Status Change due to DEC Peaker Rule, Zone J

Units	Nameplate MW	CRIS (MW)		Capability (MW)		2023 Ozone Season	2023 non-Ozone Season	2024 Ozone Season	2024 non-Ozone Season	2025 Ozone Season	2025 non-Ozone Season
		Summer	Winter	Summer	Winter	*May 2023 - September 2023*	*October 2023 - April 2024*	*May 2024 - September 2024*	*October 2024 - April 2025*	*May 2025 - September 2025*	*October 2025 - April 2026*
Astoria GT1	16	16	21	14	19	I/S	I/S	I/S	I/S	O/S	I/S
Gowanus 1&4 (1-1 through 1-8, and 4-1 through 4-4)	320	279	364	274	365	O/S	I/S	O/S	I/S	O/S	I/S
Gowanus 2&3 (2-1 through 2-8 and 3-1 through 3-8)	320	300	391	278	373	I/S	I/S	I/S	I/S	O/S	I/S
Narrows 1&2 (1-1 through 1-8, and 2-1 through 2-8)	352	309	404	287	380	I/S	I/S	I/S	I/S	O/S	I/S
Ravenswood GTs (01, 10, 11)	69	50	64	41	57	O/S	O/S	O/S	O/S	O/S	O/S
Arthur Kill GT1	20	17	22	12	15	I/S	I/S	I/S	I/S	O/S	O/S
Astoria GTs (2-1 through 2-4, 3-1 through 3-4, 4-1 through 4-4)	558	504	621	415	543	O/S	O/S	O/S	O/S	O/S	O/S
Con Ed 59th St	17	15	20	16	20	I/S	I/S	I/S	I/S	O/S	O/S
Con Ed 74th St	37	39	49	35	41	O/S	O/S	O/S	O/S	O/S	O/S
Con Ed Hudson Ave 5	16	15	20	14	20	O/S	O/S	O/S	O/S	O/S	O/S
Unavailable MW *(Summer Capability)*						779	506	779	506	1,385	533
Available MW (Summer Capability)						606	880	606	880	0	852
Impacted MW	1,725	1,544	1,975	1,385	1,834						

O/S - Out-of-service

I/S - In-service

Figure 9: Status Change due to DEC Peaker Rule, Zone K

Units	Nameplate MW	CRIS (MW)		Capability (MW)		2023 Ozone Season	2023 non-Ozone Season	2024 Ozone Season	2024 non-Ozone Season	2025 Ozone Season	2025 non-Ozone Season
		Summer	Winter	Summer	Winter	*May 2023 - September 2023*	*October 2023 - April 2024*	*May 2024 - September 2024*	*October 2024 - April 2025*	*May 2025 - September 2025*	*October 2025 - April 2026*
Glenwood GT1	16	14.6	19.1	11.4	14.5	O/S	O/S	O/S	O/S	O/S	O/S
Northport GT	16	13.8	18.0	11.7	15.1	O/S	O/S	O/S	O/S	O/S	O/S
Port Jefferson GT1	16	14.1	18.4	12.9	16.6	O/S	O/S	O/S	O/S	O/S	O/S
Unavailable MW = Impacted MW	48	42.5	55.5	36.0	46.2						

O/S - Out-of-service

I/S - In-service

Notes:

1. The service pattern in the last two columns repeats in subsequent years of the RNA Study Period

2. Other compliance plans were submitted in addition to what is shown on this table. The table lists the plants with compliance plans that resulted in a change of status (*i.e.*, as also listed in the 2020 Gold Book Table IV-6)

Indian Point Deactivation

On January 9, 2017, Entergy and New York State announced an agreement to close Indian Point units 2 and 3 in 2020 and 2021, respectively. Following receipt of a deactivation notice from Entergy on November 13, 2017, the NYISO evaluated the proposed deactivation as part of the required generator deactivation assessments it performs for proposed generator retirements. In its analysis, the NYISO assumed that certain power plants then under construction would enter into service. Based on the study's assumptions, the NYISO concluded that the proposed Indian Point deactivation did not result in a Reliability Need. Subsequent reliability planning studies have not altered this outlook. Additional resources identified in the assessment have entered into service, including the CPV Valley and Cricket Valley generators, and, on April 30, 2020, the Indian Point unit 2 deactivated. The NYISO anticipates that Indian Point unit 3 will deactivate by April 30, 2021 without causing a Reliability Need.

New York City Residual Oil Elimination

New York City passed legislation in December 2017 to prohibit the combustion of fuel oil Numbers 6 and 4 within utility boilers in New York City by 2020 and 2025, respectively. The rule is expected to impact 2,946 MW nameplate of generation in New York City. Many Generators in New York City that are connected to the local gas distribution network are required to maintain alternative fuel combustion capabilities and storage capacity.

In addition, the New York State Reliability Council (NYSRC) has a minimum oil-burn requirement rule that is intended to maintain electric system reliability in the event of gas supply interruptions.

Generators have taken steps to convert their facilities to comply with the law. While oil accounts for a relatively small percentage of the total energy production in New York State, it is often called upon to fuel generation during critical periods, such as a gas pipeline break, when severe cold weather limits access to or increases the price of natural gas. Dual-fuel capability serves as both an important tool in meeting reliability and an effective economic hedge against high natural gas prices during periods of high demand for natural gas.

Carbon Dioxide Performance Standards for Major Electric Generating Facilities

The DEC adopted regulations that limit carbon dioxide emissions from existing fossil fuel-fired generators beginning in 2021**.** As a result, approximately 860 MW of coal-fired generation exited the market by April 2020, eliminating coal-fired generation as a supply resource on the bulk power system in the state. New York's coal-fired generation accounted for less than 1% of the total energy produced in the state in 2019. The NYISO assessed these deactivations and concluded[7] that they would not result in reliability needs.

Regional Greenhouse Gas Initiative (RGGI)

RGGI is a multi-state carbon dioxide emissions cap-and-trade initiative requiring affected fossil fuel generators to procure carbon dioxide emissions allowances. The costs for these allowances are factored into the costs of operating fossil fuel-fired generators. Suppliers seek to recover these costs through competitive offers in the wholesale electricity markets. Through this initiative, each participating state determines a set number of allowances, the majority of which are collectively auctioned to generators or other stakeholders. The level of available allowances is established in advance and lowered over time to encourage generators to invest in emissions reduction strategies.

The New York State DEC issued proposed RGGI regulations that would cap New York's carbon dioxide emissions at approximately 21 million tons by 2030.[8] In 2019, New York generators emitted approximately 24.6 million tons of carbon dioxide. The proposed rule seeks to expand applicability to certain generators of 15 MW or greater, whereas currently RGGI rules do not apply to generators less than 25 MW nameplate. New Jersey re-joined the initiative in 2020, Virginia will be joining in 2021, and Pennsylvania has pending legislation to join RGGI. The expansion of the RGGI region and anticipated

[7] See 'Generator Deactivation Assessments' at https://www.nyiso.com/cspp:

Cayuga 1 and 2 Generator Deactivation Assessment (Retirement)

Somerset Generator Deactivation Assessment

Cayuga 1 Generator Deactivation Assessment

[8] https://www.dec.ny.gov/regulations/120061.html

changes to program design features may affect the dynamics of CO_2 emission allowance costs and availability going forward. Tighter requirements through RGGI, however, are not likely to trigger reliability concerns because of program design features such as the Cost Containment Reserve and multi-year compliance periods.

Climate Leadership and Community Protection Act (CLCPA)

On July 18, 2019, the CLCPA was signed into law, codifying the following measures:

- 70% of electricity delivered in New York State must be derived from renewable resources by 2030;
- 100% of the electricity consumed in New York State must be derived from zero-emissions resources by 2040;
- 9,000 MW of offshore wind installed by 2035;
- 6,000 MW of distributed solar energy resources installed by 2025; and
- 3,000 MW of energy storage installed by 2030.

The CLCPA created a 22-member Climate Action Council (CAC) to establish a roadmap for how the state will work towards these goals. The CAC will develop many of the implementation details of the CLCPA. The CLCPA establishes that the CAC should develop a draft scoping plan by the end of 2022 and deliver a final plan to the Governor and the Legislature by the end of 2023.

Accelerated Renewable Energy Growth and Community Benefit Act

In an effort to speed up the siting and construction of large-scale clean energy projects, New York State approved the Accelerated Renewable Energy Growth and Community Benefit Act in April 2020. The act provides an accelerated path for permitting and constructing renewable energy projects by establishing a new Office of Renewable Energy Siting (ORES) within the New York State Department of State.

The act also directs the New York State Department of Public Service, in consultation with NYSERDA, the New York Power Authority (NYPA), the Long Island Power Authority, the investor-owned utilities, and the NYISO, to conduct a comprehensive study to identify cost-effective distribution, local and bulk electric system upgrades to support the state's climate and clean energy policies. This State Power Grid Study is targeted to be completed by end of 2020. The PSC has commenced a proceeding leading to a transmission investment plan utilizing the NYISO's Public Policy Process to select projects, while enabling the PSC to designate NYPA, either on its own or with others, to carry out projects needed expeditiously to achieve the CLCPA goals.[9] NYPA and DPS Staff have petitioned the PSC proposing criteria for ranking transmission

[9] http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=20-E-0197&submit=Search

needs to qualify as Priority Projects. NYPA has proposed the "Northern NY Project" and the "Western NY Energy Link" as meeting these criteria.[10]

[10] See http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={DEEEB5EF-4676-49AD-B8E7-C72681D99C49} and http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={C36465AD-E0AE-4823-86B4-183810F247B2}

5. Base Case Assumptions

The NYISO has established procedures and a schedule for the collection and submission of data and for the preparation of the models used in the RNA. The Reliability Planning Process procedures are designed to allow planning activities to be performed in an open and transparent manner. The Reliability Planning Process is conducted under a defined set of rules that are aligned and coordinated with the related planning activities of the North American Electric Reliability Council (NERC), the Northeast Power Coordinating Council (NPCC), and the New York State Reliability Council (NYSRC). The assumptions underlying the RNA were reviewed at the ESPWG and TPAS and are shown in **Appendix D** of this report.

This section highlights the key assumptions and modeling data updates for the RNA. These include the load forecast model, the forecasted level of special case resources, the change in generation resource status, LTPs, and bulk power transmission projects. As described above, the newly defined RNA Study Period is from 2024 (year 4) through 2030 (year 10).

Both the transmission security and resource adequacy studies in the RNA Base Case use a peak demand and energy forecast originating from the baseline forecast reported in the *2020 Gold Book*. The baseline forecast from the *2020 Gold Book* is derived from energy and peak models that are built based on projections of end-use intensities and economic variables. End-use intensities modeled include those for lighting, refrigeration, cooking, heating, cooling, and other plug loads. The baseline forecast includes the projected impacts of energy efficiency programs, building codes and standards, distributed energy resources, behind-the-meter energy storage, behind-the-meter solar photovoltaic power, electric vehicle usage, and electrification of heating and other end uses. Economic variables considered include gross domestic product (GDP), households, population, and commercial and industrial employment. The baseline forecast also considers the near-term economic impacts of reduced energy consumption resulting from the state's response to COVID-19. For the resource adequacy study, the baseline load forecast was modified by removing the behind-the-meter solar PV impacts in order to model the solar PV explicitly as a generation resource to account for the intermittent nature of its availability.

The RNA Base Cases were developed in accordance with NYISO procedures using projections for the installation and deactivation of generation resources and transmission facilities that were developed in conjunction with Market Participants and TOs:

- For the transmission security evaluations, the power flow RNA Base Case uses the NYISO 2020 FERC 715 filing as a starting point, adding and removing resources consistent with the base case inclusion screening process provided in Section 3 of the Reliability Planning Process Manual. Representations of neighboring systems are derived from interregional transmission planning coordination conducted under the Northeast Power Coordinating Council (NPCC) and the Eastern Interconnection Reliability Assessment Group (ERAG) Multiregional Modeling Working Group (MMWG) processes, and pursuant to the Northeast ISO/RTO Planning Coordination Protocol.

- For the resource adequacy evaluations, the models are developed starting with prior resource adequacy models, and are updated with information from the *2020 Gold Book* and historical data, with the application of the inclusion rules. Information on modeling of neighboring systems is based on the input received from the NPCC CP-8 working group.

Annual Energy and Summer Peak Demand Forecasts

This section reports the baseline forecast, the high load scenario forecast, the behind-the-meter solar PV forecast, and the baseline forecast with projected behind-the-meter solar PV added back. These forecasts are fully detailed in the *2020 Gold Book*. The baseline forecast reflects the expected impacts of energy efficiency, distributed energy resources, and behind-the-meter solar PV on annual energy use and peak loads. The high load scenario forecast reflects faster adoption of electric vehicles and other electrification, and slower adoption of behind-the-meter solar PV and energy efficiency measures. The baseline energy forecast reflects a moderate recession due to COVID-19 impacts, and assumes typical economic growth in the year 2022 and beyond. The high load scenario energy forecast reflects a slight recession and assumes somewhat higher than typical economic growth in the year 2022 and beyond. The baseline and high load scenario peak forecasts do not account for any potential economic impacts associated with COVID-19. The baseline forecast, which already reflects the solar PV behind-the-meter reductions, was modified to add back those impacts. The modified baseline forecast is used for the resource adequacy study to model behind-the-meter solar PV as a generating resource.

The demand-side management impacts included or accounted for in the 2020 Base Case forecast derive from actual and projected spending levels and realization rates for state-sponsored programs such as the Climate Leadership and Community Protection Act (CLCPA), Clean Energy Standard (CES), the Clean Energy Fund (CEF), the NY-SUN initiative, the energy storage initiative, and earlier programs developed as part of the Reforming the Energy Vision (REV) proceedings. The NYISO reviewed and discussed with Market Participants, during meetings of the ESPWG and TPAS, projections for the potential impact of energy efficiency, solar PV, electric vehicles, and other demand-side management impacts over the Study Period. The factors considered in developing the 2020 RNA Base Case forecast are included in **Appendix C** of this report.

The assumptions for the 2020 economic growth, energy efficiency program impacts, and behind-the-meter solar PV impacts were also discussed with Market Participants during meetings of the ESPWG and TPAS in March and April of 2020. The ESPWG and TPAS reviewed and discussed the assumptions used in the 2020 RNA Base Case forecast in accordance with procedures established for the RNA.

The baseline energy forecast for the 2020 RNA is lower than the 2018 RNA baseline forecast, including a 4.2% decline in 2020 and 1.7% decline in 2028. The baseline peak forecast for the 2020 RNA is also lower than the 2018 RNA baseline forecast, including a 1.4% decline in 2020 and 1.1% decline in 2028. The lower energy forecasts are attributed to both economic factors and the continued impact of energy efficiency and behind-the-meter solar PV.

Figure 10 on the next page summarizes the three forecasts used in the 2020 RNA. Figure 12 shows a comparison of the baseline forecasts and energy efficiency program impacts contained in the 2018 RNA and the 2020 RNA. Figure 13 and Figure 14 present actual, weather-normalized forecasts of annual energy and summer peak demand for the 2020 RN*A*. Figure 15 and Figure 16 present the NYISO's projections of annual energy and summer peak demand in the 2020 RNA for energy efficiency, distributed generation, and behind-the-meter solar PV.

Figure 10: 2020 RNA Load and Energy Forecast: Baseline Forecast, and Baseline with BtM Solar PV Forecasts Added Back In

Baseline and Adjusted Baseline Energy Forecasts

Annual GWh	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2020 End-Use Energy Forecast	154,380	158,431	161,852	162,477	163,897	165,132	166,331	167,305	168,188	168,789	169,249
-- Energy Efficiency and Codes & Standards	1,885	3,959	6,200	8,599	11,081	13,582	15,937	18,057	19,921	21,563	23,016
-- BtM Solar PV	2,631	3,274	3,899	4,563	5,193	5,738	6,205	6,591	6,893	7,130	7,289
-- BtM Non-Solar Distributed Generation	1,252	1,416	1,059	940	818	852	877	900	931	956	973
+ Storage Net Energy Consumption	19	43	67	99	130	160	189	221	254	281	309
+ Electric Vehicle Energy	199	345	538	781	1,085	1,456	1,889	2,407	3,031	3,765	4,506
+ Non-EV Electrification	190	457	815	1,289	1,884	2,591	3,337	4,163	5,055	5,997	6,988
2020 Gold Book Baseline Forecast	149,020	150,627	152,114	150,544	149,904	149,167	148,727	148,548	148,783	149,183	149,774
+ BtM Solar PV	2,631	3,274	3,899	4,563	5,193	5,738	6,205	6,591	6,893	7,130	7,289
2020 RNA Base Case Forecast[1]	151,651	153,901	156,013	155,107	155,097	154,905	154,932	155,139	155,676	156,313	157,063

Baseline and Adjusted Baseline Summer Peak Forecasts

Annual MW	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2020 End-Use Peak Demand Forecast	33,319	33,599	33,978	34,220	34,555	34,861	35,208	35,524	35,848	36,108	36,324
-- Energy Efficiency and Codes & Standards	296	591	943	1,322	1,709	2,108	2,488	2,825	3,116	3,360	3,579
-- BtM Solar PV	555	707	841	986	1,102	1,204	1,287	1,351	1,392	1,411	1,411
-- BtM Non-Solar Distributed Generation	218	251	189	169	148	154	158	164	170	174	177
-- BtM Storage Peak Reductions	5	14	26	44	63	91	125	159	206	250	292
+ Electric Vehicle Peak Demand	40	68	103	147	201	261	333	418	513	625	748
+ Non-EV Electrification	11	25	46	72	104	146	187	230	279	327	379
2020 Gold Book Baseline Forecast[2]	32,296	32,129	32,128	31,918	31,838	31,711	31,670	31,673	31,756	31,865	31,992
+ BtM Solar PV	555	707	841	986	1,102	1,204	1,287	1,351	1,392	1,411	1,411
2020 RNA Base Case Forecast[1]	32,851	32,836	32,969	32,904	32,940	32,915	32,957	33,024	33,148	33,276	33,403

[1] For the resource adequacy study, the Gold Book baseline load forecast was modified by removing the behind-the-meter solar PV impacts in order to model the solar PV explicitly as a generation resource to account for the intermittent nature of its availability.

[2] The transmission security power flow RNA base cases use this Gold Book baseline forecast.

Figure 11: 2020 RNA Load and Energy for High Load Scenario: High Load Scenario Forecast, and High Load Scenario Forecast with BtM Solar PV Added Back In

High Load Scenario and Adjusted High Load Scenario Energy Forecasts

Annual GWh	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2020 High Load End-Use Energy Forecast	157,619	160,258	164,181	164,969	166,559	167,968	169,339	170,492	171,550	172,327	172,962
-- Energy Efficiency and Codes & Standards	2,021	4,234	6,612	9,111	11,635	13,768	15,078	15,950	16,557	17,037	17,511
-- BtM Solar PV	2,560	3,079	3,645	4,233	4,794	5,301	5,716	6,052	6,298	6,479	6,612
-- BtM Non-Solar Distributed Generation	1,252	1,416	1,059	940	818	852	877	900	931	956	973
+ Storage Net Energy Consumption	19	43	67	99	130	160	189	221	254	281	309
+ Electric Vehicle Energy	199	345	538	781	1,085	1,456	1,889	2,407	3,031	3,765	4,506
+ Non-EV Electrification	389	996	1,890	2,815	3,897	5,122	6,462	7,873	9,362	10,907	12,588
2020 Gold Book High Load Scenario	152,393	152,913	155,360	154,380	154,424	154,785	156,208	158,091	160,411	162,808	165,269
+ BtM Solar PV	2,560	3,079	3,645	4,233	4,794	5,301	5,716	6,052	6,298	6,479	6,612
2020 RNA High Load Scenario[3]	154,953	155,992	159,005	158,613	159,218	160,086	161,924	164,143	166,709	169,287	171,881

High Load Scenario and Adjusted High Load Scenario Summer Peak Forecasts

Annual MW	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2020 High Load Scenario End-Use Peak Demand	33,452	33,912	34,500	34,778	35,156	35,501	35,887	36,244	36,613	36,915	37,174
-- Energy Efficiency and Codes & Standards	313	629	1,000	1,396	1,791	2,142	2,372	2,534	2,641	2,720	2,800
-- BtM Solar PV	539	658	779	904	1,006	1,101	1,176	1,229	1,260	1,271	1,268
-- BtM Non-Solar Distributed Generation	218	251	189	169	148	154	158	164	170	174	177
-- BtM Storage Peak Reductions	5	14	26	44	63	91	125	159	206	250	292
+ Electric Vehicle Peak Demand	52	85	126	183	248	328	426	537	671	828	994
+ Non-EV Electrification	23	57	111	163	227	300	381	468	555	648	749
2020 Gold Book High Load Scenario	32,452	32,502	32,743	32,611	32,623	32,641	32,863	33,163	33,562	33,976	34,380
+ BtM Solar PV	539	658	779	904	1,006	1,101	1,176	1,229	1,260	1,271	1,268
2020 RNA High Load Scenario[3]	32,991	33,160	33,522	33,515	33,629	33,742	34,039	34,392	34,822	35,247	35,648

3 The high load scenario forecast will be used for the high load resource adequacy scenario.

Figure 12: Comparison of 2018 RNA & 2020 Baseline Forecasts

Comparison of Base Case Energy Forecasts - 2018 & 2020 RNA (GWh)

Annual GWh	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2018 RNA Base Case Forecast[1]	158,370	157,746	157,375	157,279	157,351	157,487	157,669	157,993	158,346		
2020 RNA Base Case Forecast[1]	151,651	153,901	156,013	155,107	155,097	154,905	154,932	155,139	155,676	156,313	157,063
Change from 2018 RNA	-6,719	-3,845	-1,362	-2,172	-2,254	-2,582	-2,737	-2,854	-2,670	NA	NA

Comparison of Base Case Summer Peak Forecasts - 2018 & 2020 RNA (MW)

Annual MW	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2018 RNA Base Case Forecast[1]	33,318	33,225	33,182	33,173	33,204	33,262	33,332	33,420	33,507		
2020 RNA Base Case Forecast[1]	32,851	32,836	32,969	32,904	32,940	32,915	32,957	33,024	33,148	33,276	33,403
Change from 2018 RNA	-467	-389	-213	-269	-264	-347	-375	-396	-359	NA	NA

Comparison of Energy Efficiency and Codes & Standards and BTM Non-Solar Distributed Generation Energy Impacts - 2018 & 2020 RNA (GWh)

Annual GWh	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2018 RNA Base Case Impacts[2]	2,193	3,846	5,071	6,365	7,248	8,681	10,041	10,874	11,354		
2020 RNA Base Case Impacts	3,137	5,375	7,259	9,539	11,899	14,434	16,814	18,957	20,852	22,519	23,989
Change from 2018 RNA	944	1,529	2,188	3,174	4,651	5,753	6,773	8,083	9,498	NA	NA

Comparison of Energy Efficiency and Codes & Standards and BTM Non-Solar Distributed Generation Summer Peak Impacts - 2018 & 2020 RNA (MW)

Annual MW	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2018 RNA Base Case Impacts[2]	373	653	869	1,097	1,252	1,504	1,742	1,886	1,971		
2020 RNA Base Case Impacts	514	842	1,132	1,491	1,857	2,262	2,646	2,989	3,286	3,534	3,756
Change from 2018 RNA	141	189	263	394	605	758	904	1,103	1,315	NA	NA

1 For the resource adequacy study, the Gold Book baseline load forecast was modified by removing the behind-the-meter solar PV impacts in order to model the solar PV explicitly as a generation resource to account for the intermittent nature of its availability.

2 2016 Gold Book values have been adjusted to include only those impacts from 2018 forward, so as to compare directly to the 2018 Gold Book values.

Figure 13: 2020 Baseline and High Load Scenario Energy Forecasts with Solar PV Added Back

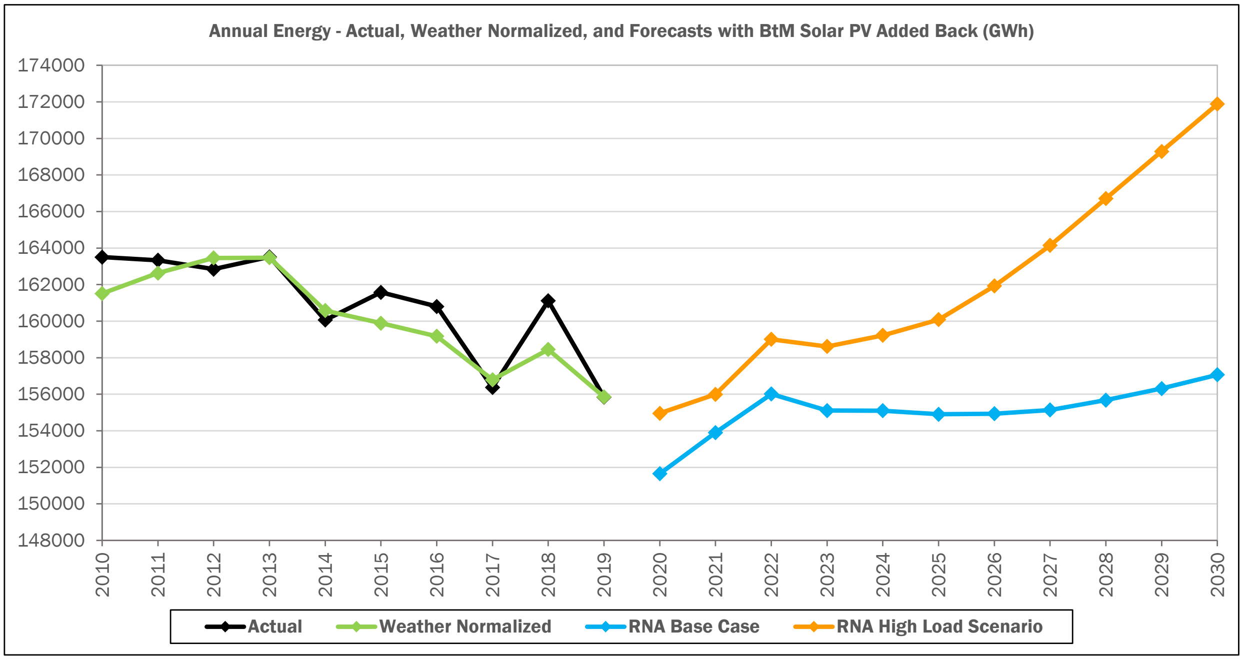


Figure 14: 2020 Baseline and High Load Energy Scenario Summer Peak Demand Forecasts with Solar PV Added Back

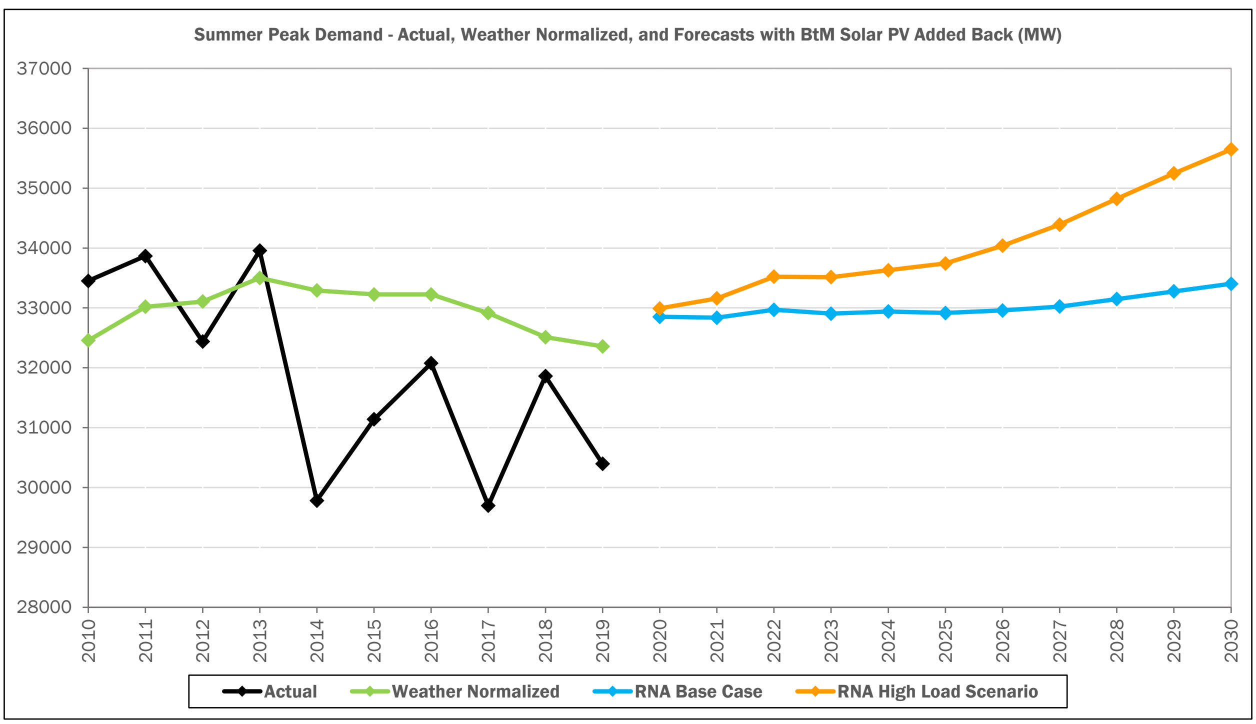


Figure 15: 2020 Baseline Annual Energy Forecast Impacts

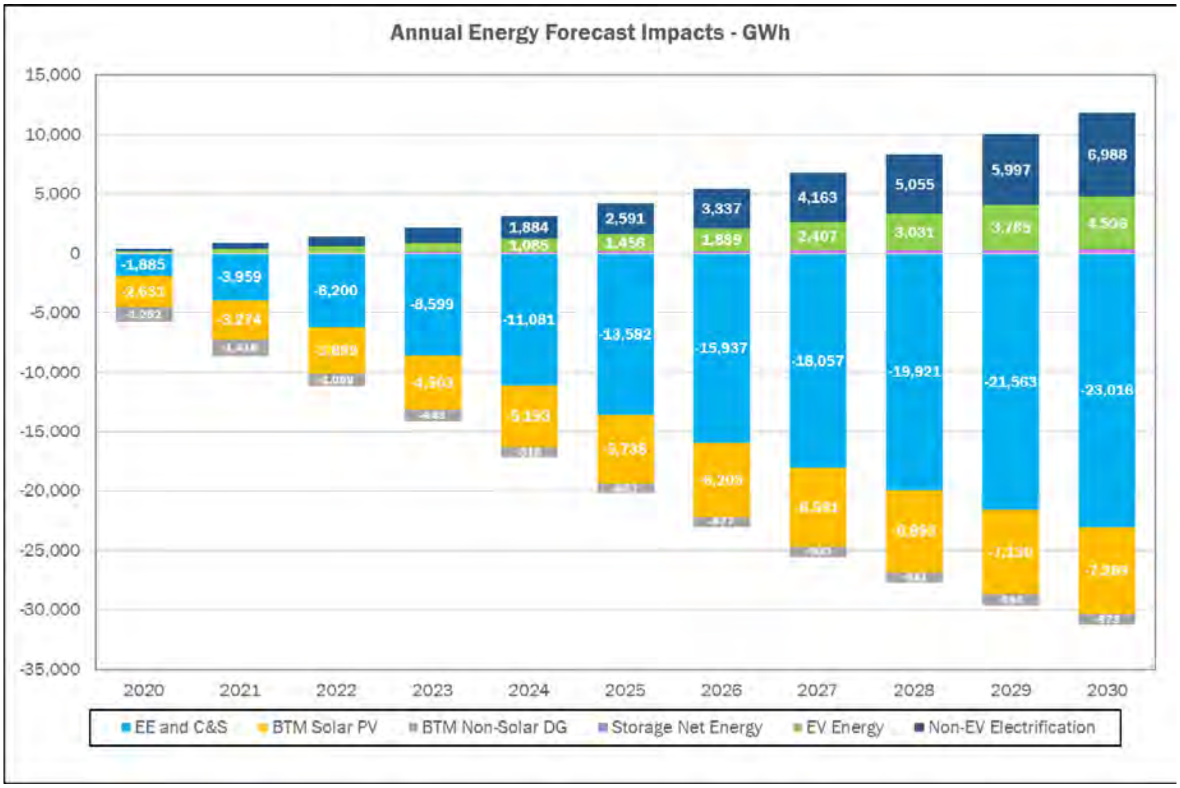
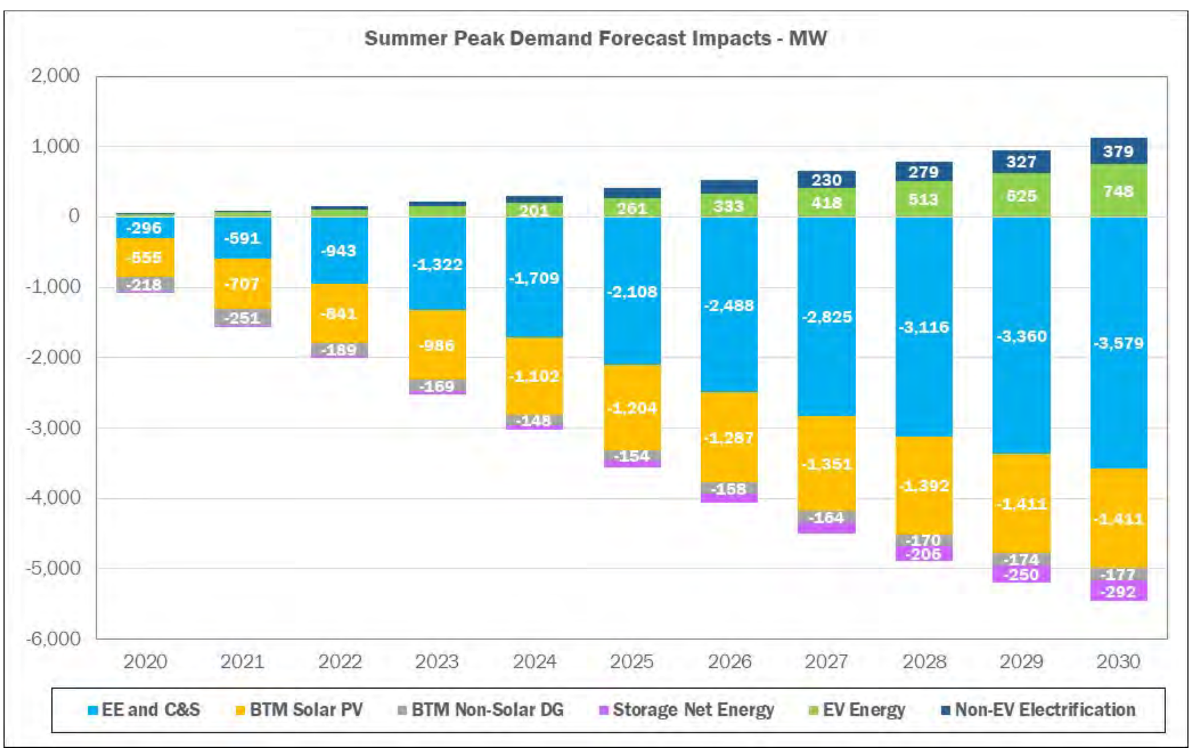


Figure 16: 2020 Baseline Summer Peak Demand Forecast Impacts



For the 2020 RNA resource adequacy assessments, the NYISO uses behind-the meter (BtM) solar PV production data. For General Electric's Multi Area Reliability Simulations (GE-MARS) modeling, the BtM solar PV component is added back in the baseline forecast in order to discretely model the BtM solar PV. The load shapes used in the study were adjusted from the historic shapes to a shape that meets the forecasted zonal peak, NYCA peak, Zones G through J Locality peak, and NYCA Energy Forecast. The combination of the load shapes with the solar shapes results in a set of net load shapes that, at time of NYCA peak, meets the baseline forecast. Discretely modeling BtM solar PV as a resource provides for flexibility to adjust the amount of resource available across the system.

Figure 17: Forecast of BtM Solar PV Coincident Summer Peak Demand Reductions (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2020	34	18	49	4	35	89	78	11	12	74	151	555
2021	49	24	67	4	51	111	96	13	14	90	188	707
2022	67	30	85	5	70	132	111	15	16	106	204	841
2023	88	37	104	5	91	152	125	16	18	122	228	986
2024	112	43	123	6	112	171	135	17	19	136	228	1,102
2025	136	49	138	8	131	187	142	17	21	148	227	1,204
2026	158	55	150	9	147	199	146	17	22	158	226	1,287
2027	176	59	158	11	159	208	147	17	23	168	225	1,351
2028	190	62	162	12	165	214	147	17	24	175	224	1,392
2029	199	63	164	14	168	216	145	16	24	180	222	1,411
2030	203	63	163	15	169	215	143	16	24	180	220	1,411

2020 RNA Resource Additions and Removals

Since the 2019-2028 CRP assumptions were finalized, new resources have been added to the system, some deactivation notices have been withdrawn and the associated facilities have returned to the system, and some other resources have been removed from the 2020 RNA Base Case:

- A total of approximately 543 MW of proposed generation (wind and solar) has been added to the 2020 RNA Base Case as compared with the 2019 - 2028 CRP;
- A total of approximately 2,582 MW of generation have been removed as compared with the 2019 – 2028 CRP Base Case either due to being in a deactivated state (*e.g.,* retired, mothballed, or in an ICAP-Ineligible Forced Outage (IIFO), or proposed to retire or mothball), or as operationally impacted by the DEC Peaker Rule.

The comparison of generation status between the *2019 – 2028 CRP* and *2020 RNA* is detailed in Figure 18, Figure 19, and Figure 20. The MW values represent the Capacity Resources Interconnection Service (CRIS) MW values from the *2020 Gold Book*.

The 2020 RNA special case resource[11] (SCR) MW levels are based on the *2020 Gold Book* value of 1,282 MW, adjusted for their performance for the resource adequacy evaluations. Transmission security analysis, which evaluates normal transfer criteria, does not consider SCRs.

Figure 18: Proposed Projects Included in the 2020 RNA Base Case

Queue #	Project Name	Zone	Point of Interconnection	Summer Peak (MW)	2020 RNA Commercial Operation Date
Proposed Transmission Additions, other than Local Transmission Owner Plans					
Q545A*	Empire State Line	A	Dysinger - Stolle 345kV	n/a	6/2022
556	Segment A Double Circuit	E,F	Edic - New Scotland 345kV	n/a	12/2023
543	Segment B Knickerbocker-Pleasant Valley 345 kV	F,G	Greenbush - Pleasant Valley 345kV	n/a	12/2023
430	Cedar Rapids Transmission Upgrade	D	Dennison - Alcoa 115kV	80	10/2021
System Deliverability Upgrades*	Leeds-Hurley SDU	F,G	Leeds- Hurley SDU 345kV	n/a	summer 2021
Proposed Generations Additions					
387*	Cassadaga Wind	A	Dunkirk - Moon Station 115 kV	126.5	12/2021
396	Baron Winds	C	Hillside - Meyer 230kV	238.4	12/2021
422	Eight Point Wind Energy Center	B	Bennett 115kV	101.8	12/2021
505	Ball Hill Wind	A	Dunkirk - Gardenville 230kV	100.0	12/2022
546	Roaring Brook Wind	E	Chases Lake Substation 230kV	79.7	12/2021
678	Calverton Solar Energy Center	K	Edwards Substation 138kV	22.9	12/2021
			MW Additions from 2019-2028 CRP	543	
			Total MW generation additions	669	

*also included in the 2019-2028 CRP Base Cases

Note: * Also included in the 2019-2028 CRP Base Cases

[11] The term "Special Case Resource" is defined in Section 2.19 of Market Services Tariff and also in the Appendix A of this report (Glossary)

Figure 19: 2020 RNA Generation Deactivations Assumptions

2020 Gold Book Table	Owner/ Operator	Plant Name	Zone	CRIS	2020 RNA Base Case Status*	2019-2028 CRP Base Case Status
Table IV-3: Deactivated Units with Unexpired CRIS Rights Not Listed in Existing Capacity Table III-2	International Paper Company	Ticonderoga	F	7.6	part of SCR program	part of SCR program
	Helix Ravenswood, LLC	Ravenswood 09	J	21.7	out	out
	Binghamton BOP, LLC	Binghamton	C	43.8	out	out
	Helix Ravenswood, LLC	Ravenswood 2-1	J	40.4	out	out
		Ravenswood 2-2	J	37.6		
		Ravenswood 2-3	J	39.2		
		Ravenswood 2-4	J	39.8		
		Ravenswood 3-1	J	40.5		
		Ravenswood 3-2	J	38.1		
		Ravenswood 3-4	J	35.8		
	Cayuga Operating Company, LLC	Cayuga 2	C	154.7	out	out
	Lyonsdale Biomass, LLC	Lyonsdale	E	20.2	out	in
Table IV-4: Deactivated Units Listed in Existing Capacity Table III-2	Exelon Generation Company LLC	Monroe Livingston	B	2.4	out	in
	Innovative Energy Systems, Inc.	Steuben County LF	C	3.2	out	in
	Consolidated Edison Co. of NY, Inc	Hudson Ave 4	J	13.9	out	in
	New York State Elec. & Gas Corp.	Auburn - State St	C	5.8	out	in
	Cayuga Operating Company, LLC	Cayuga 1	C	154.1	out	in
	Consolidated Edison Co. of NY, Inc	Hudson Ave 3	J	16.0	out	in
Table IV-5: Notices of Proposed Deactivations as of March 15, 2020	Albany Energy, LLC	Albany LFGE	F	4.5	out	in
	Somerset Operating Company, LLC	Somerset	A	686.5	out	in
	National Grid	West Babylon 4	K	49.0	out	in
	Entergy Nuclear Power Marketing, LLC	Indian Point 2	H	1,026.5	out	out
		Indian Point 3		1,040.4		
	Change in deactivation since 2019 - 2028 CRP**			956		
	Total 2020 RNA MW assumed as deactivated**			3,522		

change in status

*Consistent with deactivation dates

** does not include peaker retirements

Figure 20: Existing Plants Impacted by DEC's Peaker Rule (Additional Details on Peakers Status by Ozone Season are in Section 4)

2020 Gold Book Table	Owner/ Operator	Plant Name**	Zone	CRIS	2020 RNA Base Case Status (Deactivate starting from)	2019-2028 CRP Base Case Status
Table IV-6: Proposed Status Change to Comply with DEC Peaker Rule	Central Hudson Gas & Elec. Corp.	Coxsackie GT	G	19.9	2023	in
		South Cairo[1]	G	19.8		
	Consolidated Edison Co. of NY, Inc.	74 St. GT 1 & 2	J	39.1	2023	in
		Hudson Ave 5		15.1		
		59 St. GT 1		15.4	2025	
	Helix Ravenswood, LLC	Ravenswood 01	J	8.8	2023	in
		Ravenswood 10		21.2		
		Ravenswood 11		20.2		
	National Grid	Glenwood GT 1	K	14.6	2023	in
		Northport GT		13.8		
		Port Jefferson GT 01		14.1		
	NRG Power Marketing, LLC	Astoria GT 2-1, 2-2, 2-3, 2-4	J	165.8	2023	in
		Astoria GT 3-1, 3-2, 3-3, 3-4		170.7		
		Astoria GT 4-1, 4-2, 4-3, 4-4		167.9		
		Arthur Kill GT1		16.5	2025	
	Astoria Generating Company, L.P.	Gowanus 1-1 through 1-8	J	138.7	Winter -only 2023	in
		Gowanus 4-1 through 4-8		140.1		
		Astoria GT 01		15.7	Winter-only 2025	
		Gowanus 2-1 through 2-8		152.8		
		Gowanus 3-1 through 3-8		146.8		
		Narrows 1-1 through 2-8		309.1		
	Additional total 2020 RNA MW assumed as out of service			1,626		

change in status

Note: NYSDEC's Part 227-3 applies to all simple cycle gas turbines with nameplates equal to or greater than 15 MW. Thus, all simple cycle generators are subject to the rule and all owners of these machines were required to submit compliance plans to the NYSDEC. The compliance plans consist of statements that the generator; (i) already complies with the new NOx limits, (ii) will retire, (iii) will limit operation during the ozone season, and/or (iv) will retrofit emission control technology to meet the emission limits of the new rule. If the plant owners submitted compliance plans that state that the generator will able to operate within the new NOx limits during the ozone season, these generators remain in service in the 2020 RNA base case.

In addition to the projects that met the 2020 RNA inclusion rules (listed in Figure 18), a number of other projects are progressing through the NYISO's interconnection process. Some of these additional generation resources either have accepted their cost allocation as part of a prior Class Year Facilities Study process, or are included in the *Class Year 2019 Facilities Study*, or are candidates for future interconnection facilities studies. These projects are listed in the *2020 Gold Book* and also in **Appendix D**.

Bulk Transmission Projects

The notable bulk transmission projects that met the inclusion rules and are modeled in the *2020 RNA* Base Case are:

- The NextEra Empire State Line Project that was selected by the NYISO Board of Directors in October 2017 to address the Western New York Public Policy Transmission Need. This project includes a new 345 kV circuit and phase angle regulator (PAR) that will alleviate constraints in the Niagara area. The planned in-service date for this project is June 2022.
- The Segment A, AC Transmission joint project, by LS Power and New York Power Authority (NYPA) that was selected by the NYISO Board of Directors in April 2019. The project includes a new double-circuit 345 kV line between Edic and New Scotland substations, two new 345 kV substations at Princetown and Rotterdam, two new 345 kV lines between Princetown to Rotterdam substations, and retirement of the existing Porter to Rotterdam 230 kV lines. The planned in-service date is December 2023.
- The New York Transco Segment B, AC Transmission project, also was selected by the NYISO Board of Directors in April 2019. The project includes a new double-circuit 345/115 kV line from a new Knickerbocker 345 kV switching station to the existing Pleasant Valley substation, 50% series compensation on the Knickerbocker to Pleasant Valley 345 kV line, and retirement of 115 kV lines between Greenbush and Pleasant Valley substations. The planned in-service date is December 2023.

Local Transmission Plans

As part of the NYISO's Local Transmission Planning Process, the New York TOs present their Local Transmission Owner Plans (LTPs) to the NYISO and stakeholders during ESPWG and TPAS meetings. The firm transmission plans presented in the LTPs and reported as firm in the *2020 Gold Book* are included in the 2020 RNA Base Case, with consideration for their in-service dates. A summary of these projects is reported in Appendix D of this report.

Base Case Peak Load and Resources

The 2020 RNA Base Case models the existing generation as adjusted for the unit deactivations listed in the *2020 Gold Book*, and along with the new resource additions that met the base case inclusion rules set forth in Section 3 of the Reliability Planning Process Manual. This capacity is summarized in Figure 21 on the next page, along with the baseline peak load, capacity net purchases and the special case resources (SCRs).

Figure 21: NYCA Peak Load and Resources 2024 through 2030

	Year	2024	2025	2026	2027	2028	2029	2030
Peak Load (MW) - Gold Book 2020 NYCA Baseline								
	NYCA*	31,838	31,711	31,670	31,673	31,756	31,865	31,992
	Zone J*	11,557	11,552	11,609	11,667	11,747	11,836	11,924
	Zone K*	4,853	4,768	4,692	4,651	4,658	4,670	4,690
	Zone G-J*	15,733	15,715	15,772	15,831	15,916	16,015	16,116
Resources (ICAP MW)								
NYCA	Capacity**	37,155	36,551	36,551	36,551	36,551	36,551	36,551
	Net Purchases & Sales	1,954	1,954	1,954	1,954	1,954	1,954	1,954
	SCR	1,282	1,282	1,282	1,282	1,282	1,282	1,282
	Total Resources	40,391	39,787	39,787	39,787	39,787	39,787	39,787
	Capacity/Load Ratio	116.7%	115.3%	115.4%	115.4%	115.1%	114.7%	114.2%
	Cap+NetPurch/Load Ratio	122.8%	121.4%	121.6%	121.6%	121.3%	120.8%	120.4%
	Cap+NetPurch+SCR/Load Ratio	126.9%	125.5%	125.6%	125.6%	125.3%	124.9%	124.4%
Zone J	Capacity**	8,795	8,190	8,190	8,190	8,190	8,190	8,190
	Cap+fullUDR+SCR/Load Ratio	83.0%	77.8%	77.4%	77.0%	76.5%	75.9%	75.3%
Zone K	Capacity**	5,213	5,213	5,213	5,213	5,213	5,213	5,213
	Cap+fullUDR+SCR/Load Ratio	128.8%	131.1%	133.2%	134.4%	134.2%	133.8%	133.3%
Zone G-J	Capacity**	13,509	12,904	12,904	12,904	12,904	12,904	12,904
	Cap+fullUDR+SCR/Load Ratio	91.7%	88.0%	87.7%	87.3%	86.9%	86.3%	85.8%

	Year	2024	2025	2026	2027	2028	2029	2030
Resources (UCAP MW)***								
NYCA	Capacity**	32,467	31,947	31,947	31,947	31,947	31,947	31,947
	Cap+NetPurch+SCR/Load Ratio	110.9%	109.7%	109.8%	109.8%	109.5%	109.1%	108.7%
Zone J	Capacity**	8,122	7,602	7,602	7,602	7,602	7,602	7,602
	Cap+fullUDR+SCR/Load Ratio	75.2%	70.7%	70.3%	70.0%	69.5%	69.0%	68.5%
Zone K	Capacity**	4,728	4,728	4,728	4,728	4,728	4,728	4,728
	Cap+fullUDR+SCR/Load Ratio	118.4%	120.5%	122.5%	123.5%	123.4%	123.0%	122.5%
Zone G-J	Capacity**	12,322	11,802	11,802	11,802	11,802	11,802	11,802
	Cap+fullUDR+SCR/Load Ratio	82.4%	79.2%	78.9%	78.6%	78.2%	77.7%	77.2%

Notes:

*NYCA load values represent baseline coincident summer peak demand. Zones J and K load values represent non-coincident summer peak demand. Aggregate Zones G-J values represent the G-J locality peak.

**NYCA Capacity values include resources electrically internal to NYCA, additions, re-ratings, and retirements (including proposed retirements and mothballs). Capacity values reflect the lesser of CRIS and DMNC values. NYCA resources include the net purchases and sales as per the Gold Book. Zonal totals include the full Unforced Capacity Deliverability Rights (UDRs) for those capacity zones.

- SCR: forecasted MW ICAP value from the 2020 Gold Book.
- Wind, solar, run-of river and landfill gas summer capacity is counted as 100% of nameplate rating.

*** For UCAP calculation, EFORd from GE-MARS output file are used for thermal units. For renewables, installed capacity intermittent resources derating factors (received from IMO team) are used.

Figure 22: Total Capacity/ Load Ratios (%) ICAP vs UCAP for 2030

Zone	ICAP	UCAP	Delta ICAP-UCAP
NYCA	124.4%	108.7%	15.7%
J	75.3%	68.5%	6.9%
K	133.3%	122.5%	10.8%
G-J	85.8%	77.2%	8.5%

Notes:

1. Total Capacity = Capacity* + full UDR + SCR
2. *Capacity = lesser of (CRIS, DMNC). NYCA resources include the net purchases and sales as per the Gold Book.
3. ICAP = Installed Capacity
4. UCAP = Unforced Capacity (takes into consideration generation unavailability)
5. UCAP calculation:
   - For thermal units, average capacity derating factors from the MARS output are used
   - For renewables, installed capacity intermittent resources derating factors are used

As shown in the Figure 21, the total NYCA capacity margin, which is defined as capacity above the baseline load forecast, varies between 24% and 27%. Figure 22 shows a comparison between the total ICAP and total UCAP for 2030; the difference reflects generation unavailability for the resource mix assumed in the RNA Base Case for year 2030.

Figure 23 shows the relative decrease in the capacity margin, by comparing the details of the capacity margins for year 10 between the 2020 RNA (2030) and the 2019-2028 CRP (2028). The analysis reveals two observations:

- Negative net margin shows deterioration in the relative capability to serve load, when comparing the two studies assumptions; and
- Compared to the *2019 CRP*, the system has less overall net resources.

Figure 23: NYCA Load and Resources Comparison with the 2019 - 2028 CRP

Study Year 10	2020 RNA (2030)	2019 - 2028 CRP (2028)	Delta
Baseline[1] Load	31,992	32,469	-477
Total Resources[2]	39,787	41,875	-2,089
Net Margin: Change in (netCapacity - netLoad)			-1,612

Notes:

1. Includes the reductions due to projected energy efficiency programs, building codes and standards, distributed energy resources and behind-the-meter solar photovoltaic resources; it also reflects expected impacts (increases) from projected electric vehicle usage.
2. Includes the total SCRs, and net capacity purchases and sales from the applicable Gold Book.

Figure 24: 2020 RNA Zone J Load and Capacity Comparison with the 2019 - 2028 CRP

Study Year 10	2020 RNA (2030)	2019 - 2028 CRP (2028)	Delta
Baseline[1] Load	11,924	11,429	495
Capacity[2]	8,190	9,562	-1,372
Net Margin: Change in (netCapacity - netLoad)			-1,867

Notes:

1. Includes the reductions due to projected energy efficiency programs, building codes and standards, distribution energy resources and behind-the-meter solar photovoltaic power; it also reflects expected impacts (increases) from projected electric vehicle usage.
2. Does not include the total SCRs, and UDRs from the applicable *Gold Book*.

6. Base Case Reliability Assessments

Overview

This section provides the methodology and results for the resource adequacy and transmission security of the New York BPTF over the RNA Study Period. If any reliability criteria violations are identified, the NYISO identifies Reliability Needs. Violations of the criteria are translated into MW or MVAr amounts to provide a relative quantification of the Reliability Needs, and to support the development of solutions in the CRP.

Methodology for the Determination of Needs

The OATT defines Reliability Needs in terms of total deficiencies relative to reliability criteria determined from the assessments of the BPTF performed in the RNA. There are two steps to analyzing the reliability of the BPTF. The first is to evaluate the security of the transmission system. The second is to evaluate the resource and transmission adequacy of the system, subject to the security constraints.

Transmission security is the ability of the power system to withstand disturbances, such as electric short circuits or unanticipated loss of system elements, and continue to supply and deliver electricity. Transmission security is assessed deterministically with potential disturbances being applied without concern for the likelihood of the disturbance in the assessment. These disturbances (single-element and multiple-element contingencies) are categorized as the design criteria contingencies, which are explicitly defined in the reliability criteria. The impacts resulting from applying these design criteria contingencies are assessed to determine whether thermal loading, voltage, or stability violations will occur. In addition, the NYISO performs a short circuit analysis to determine if the system can clear faulted facilities reliably under short circuit conditions. The NYISO's "Guideline for Fault Current Assessment[12]" describes the methodology for that analysis.

The analysis for the transmission security assessment is conducted in accordance with NERC Reliability Standards, NPCC Transmission Design Criteria, and the NYSRC Reliability Rules. Contingency analysis is performed on the BPTF to evaluate thermal and voltage performance under design contingency conditions using the Siemens PTI PSS®E and PowerGEM TARA programs. Generation is dispatched to match load plus system losses, while respecting transmission security. Scheduled inter-area transfers modeled in the base case between the NYCA and neighboring systems are held constant.

[12] Attachment I of Transmission, Expansion and Interconnection Manual.

For the RNA, over 1,000 design criteria contingencies are evaluated under N-1, N-1-0, and N-1-1 normal transfer criteria conditions to provide that the system is planned to meet all applicable reliability criteria. To evaluate the impact of a single event from the normal system condition (N-1), all design criteria contingencies are evaluated including: single element, common structure, stuck breaker, generator, bus, and HVDC facilities contingencies. An N-1 violation occurs when the power flow on the monitored facility is greater than the applicable post-contingency rating. N-1-0 and N-1-1 analyses evaluate the ability of the system to meet design criteria after a critical element has already been lost. For N-1-0 and N-1-1 analysis, single element contingencies are evaluated as the first contingency. The second contingency (N-1-1) includes all applicable design criteria contingencies evaluated under N-1 conditions. Certain areas of the Con Edison system are designed and operated for the occurrence of a second contingency. This type of combination can be described as N-1-1-0. For N-1-1-0 analysis, after the second contingency occurs, systems adjustments are allowed to secure the system back to normal ratings. This requirement to plan for a second contingency in the Con Edison system is contained in the NYSRC Reliability Rules, Rule G.1. Accordingly, a violation of the N-1-1-0 criterion on the BPTFs in Con Edison district will be identified as Reliability Need in the NYISO's Reliability Needs Assessment.

The process of successive contingency testing (such as N-1-1) allows for corrective actions including generator re-dispatch, PAR adjustments, and HVDC adjustments between the contingencies. For example, for N-1-1 analysis allowable system adjustments occur between the first (N-1-0) and second (N-1-1) contingencies. These corrective actions prepare the system for the next contingency by reducing the flow to normal rating after the first contingency. An N-1-0 violation occurs when the flow cannot be reduced to below the normal rating following the first contingency. An N-1-1 violation occurs when the facility is reduced to below the normal rating following the first contingency, but the power flow following the second contingency exceeds the applicable post-contingency rating.

Resource adequacy is the ability of the electric system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. Resource adequacy considers the transmission systems, generation resources, and other capacity resources, such as demand response. The NYISO performs resource adequacy assessments on a probabilistic basis to capture the random natures of system element outages. If a system has sufficient transmission and generation, the probability of an unplanned disconnection of firm load is equal to or less than the system's standard, which is expressed as a loss of load expectation (LOLE). The New York State bulk power system is planned to meet an LOLE that, at any given point in time, is less than or equal to an involuntary firm load disconnection that is not more frequent than once in every 10 years, or 0.1 events per year. This requirement forms the basis of New York's Installed

Reserve Margin (IRM) requirement and is analyzed on a statewide basis.

If Reliability Needs are identified, various amounts and locations of compensatory MW required for the NYCA to satisfy those needs are determined to translate the criteria violations to understandable quantities. Compensatory MW amounts are determined by adding generic capacity resources to NYISO zones to effectively satisfy the needs. The compensatory MW amounts and locations are based on a review of binding transmission constraints and zonal LOLE determinations in an iterative process to determine various combinations that will result in reliability criteria being met. These additions are used to estimate the amount of resources generally needed to satisfy Reliability Needs. The compensatory MW additions are not intended to represent specific proposed solutions. Resource needs could potentially be met by other combinations of resources in other areas including generation, transmission and demand response measures.

Due to the different types of supply and demand-side resources, and also due to transmission constraints, the amounts and locations of resources necessary to match the level of compensatory MW needs identified will vary. Reliability Needs could be met in part by transmission system reconfigurations that increase transfer limits, or by changes in operating protocols. Operating protocols could include such actions as using dynamic ratings for certain facilities, invoking operating exceptions, or establishing special protection systems.

The procedure to quantify compensatory MW for BPTF transmission security violations is a separate process from calculating compensatory MW for resource adequacy violations. This quantification is performed by first calculating transfer distribution factors on the overloaded facilities. The power transfer used for this calculation is created by injecting power at existing buses within the zone where the violation occurs, and reducing power at an aggregate of existing generators outside of the area.

Transmission Security Base Case Assessments

The following discussion reviews the main findings of the *2020 RNA* transmission security assessments (steady state, stability and short circuit assessments) applicable to the Base Case conditions for the Study Period.

Steady-State Assessments

The RNA requires analysis of the security of the BPTF throughout the Study Period. The BPTF, as defined in this assessment, include all of the facilities designated by the NYISO as a Bulk Power System (BPS) element as defined by the NYSRC and NPCC, as well as other transmission facilities that are relevant to planning the New York State transmission system. To assist in the assessment, the NYISO reviewed previously completed transmission security assessments and used the most recent FERC Form No. 715 power flow cases. The NYISO filed those cases with FERC on April 1, 2020 with updates to the models as described in earlier sections of this report.

For the 2020 RNA transmission security assessment, several transmission security violations (*i.e.,* Reliability Needs) were identified for the Study Period. The transmission security Reliability Needs include both thermal loading criteria violations on the BPTF. For the thermal loading violations, several 345 kV circuits in the Con Edison service territory are overloaded under N-1-1 conditions beginning in year 2025 and increasing through 2030. Additionally, the Con Edison 345 kV system has 345 kV circuit overloads under N-1-1-0 conditions beginning in 2025 and increasing through 2030. Figure 25 summarizes of the worst overload for each BPTF element with a thermal criteria violation under N-1-1 conditions. **Appendix D** provides the details of additional contingency combinations that also result in thermal criteria violations for these BPTFs. Figure 26 provides a summary of the BPTF thermal criteria violations under N-1-1-0 conditions. No BPTF steady state voltage violations are observed for this assessment.

Figure 25: Steady State Transmission Security N-1-1 Violations

Zone	Owner	Monitored Element	Normal Rating (MVA)	Contingency Rating (MVA)	1st Contingency	2nd Contingnecy	2025 Summer Peak Flow (%)	2030 Summer Peak Flow (%)
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Sprainbrook-Dunwoodie 345 kV (W75)	Tower F38 & F39	-	112
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Sprainbrook-Dunwoodie 345 kV (W75)	Tower F38 & F39	-	112
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (72)	110	118
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (71)	108	116
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	Mott Haven-Rainey 345 kV (Q11)	Loss of Ravenswood 3	-	108
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	Mott Haven-Rainey 345 kV (Q12)	Loss of Ravenswood 3	-	108
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Loss of Ravenswood 3	Stuck Breaker at Goethals 5	102	130
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Loss of Ravenswood 3	Gowanus - Goethals 345 kV (26)	103	130
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Loss of Ravenswood 3	Tower W89 & W90	106	109
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Loss of Ravenswood 3	Tower W89 & W90	103	107
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	Loss of Ravenswood 3	Sprainbrook/Dunwoodie 345/138 kV [illegible]	-	106

Figure 26: Steady State Transmission Security N-1-1-0 Violations

Zone	Owner	Monitored Element	Normal Rating (MVA)	Contingency Rating (MVA)	1st Contingency	2nd Contingency	2025 Summer Peak Flow (%)	2030 Summer Peak Flow (%)
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (72)	132	149
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (72)	-	106
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (72)	-	106

Considering the utilization of all available PAR controls, the observed maximum deficiency (*i.e.,* compensatory MW) for the New York City 345/138 kV Transmission Load Area (TLA) in 2025 is 700 MW. Based on the load duration curve shown in Figure 27, the deficiency in 2025 may be observed for approximately nine hours (3,853 MWh). This deficiency increases to 1,075 MW in 2030 and may be observed for approximately 12 hours (7,672 MWh) as shown in Figure 28.

Figure 27: NYC 345/138 kV TLA – Approximate Projection for Year 2025

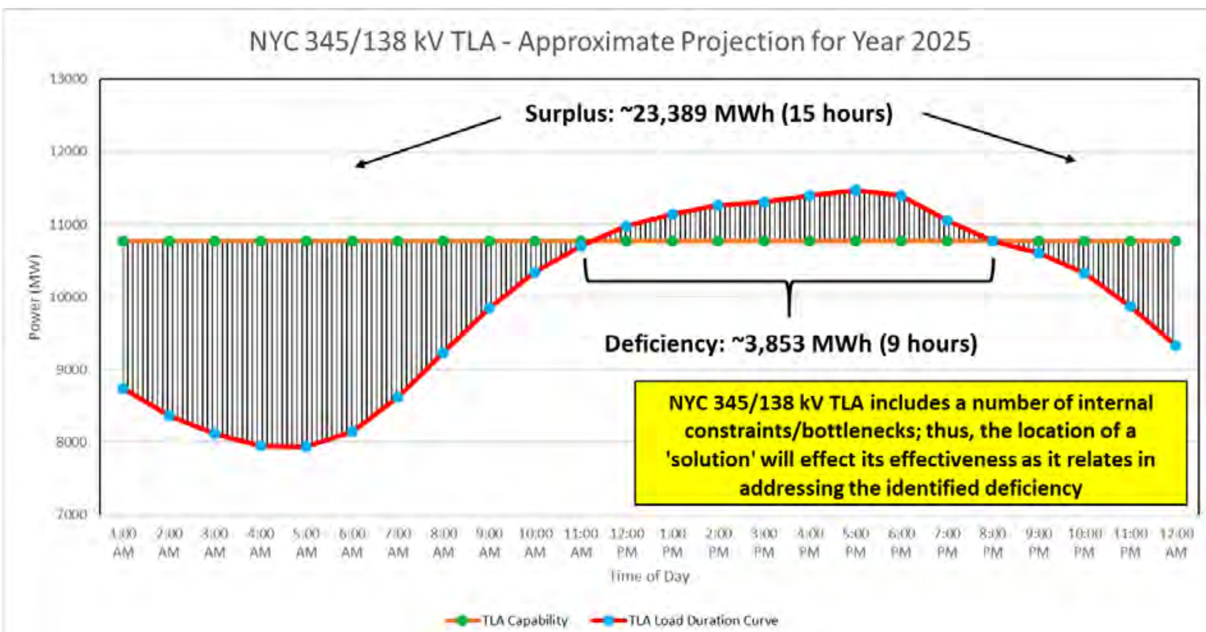
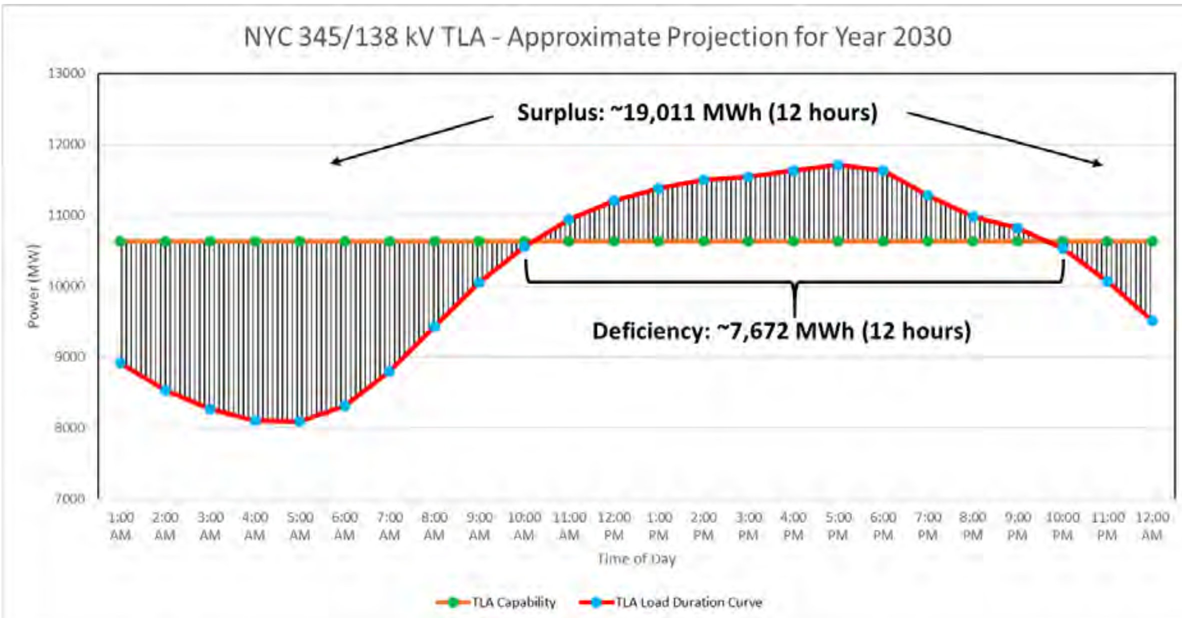


Figure 28: NYC 345/138 kV TLA – Approximate Projection for Year 2030



Steady State Compensatory MW

Transmission security compensatory MW amounts are determined by adding generic resources to combinations of locations of need. The compensatory MW additions are not intended to represent specific solutions, as the impact of specific solutions can depend on the type of the solution and its location on the grid. Rather, the compensatory MW provide a generic order-of-magnitude measure to guide the formulation of solutions. Transmission security needs could potentially be met by combinations of solutions including generation, transmission, energy efficiency, and demand response measures.

The BPTF transmission security violations begin at 700 MW in year 2025 and increase in magnitude through year 2030. The maximum observed compensatory MW amount needed to address the BPTF thermal issues described above is 1,075 MW in 2030.

System Stability Assessments

The dynamic stability Reliability Needs are observed for the entire study period. Dynamic stability issues observed prior to 2024 will be evaluated in the Short-Term Reliability Process. The criteria violations include transient voltage response violations, loss of generator synchronism, and undamped voltage oscillations. The transient voltage response violations arise on transmission facilities owned by Con Edison in its Transmission District and extend into areas adjacent to its service territory. The loss of generator synchronism is observed in generators within or near the Astoria and Greenwood load pockets, and is primarily driven by the transient voltage response in the local area. The undamped voltage oscillations are also primarily in the Con Edison area and are primarily driven by the reduction in dynamic reactive capability and MW to serve the load. The reduction in system inertia may also play a role in the undamped voltage oscillations. For a few N-1-1 events observed, system collapse occurs due to the low voltages. Figure 29 provides a summary of the generator synchronism and transient voltage response dynamic stability criteria Reliability Needs under N-1 and Figure 30 provides a summary for N-1-1 violations.

Figure 29: Dynamic Stability Criteria N-1 Violations

Dynamic Stability Criteria N-1 Violations (1), (2)							
Contingency Name	Contingency Description	2024		2025		2030	
		Generator Synchronism	Transient Voltage Response	Generator Synchronism	Transient Voltage Response	Generator Synchronism	Transient Voltage Response
ConEd08	Fault at E. 13th St. 138 kV with stuck breaker 4E		non-BPTF		non-BPTF		non-BPTF
ConEd12	Fault at Freshkills 138 kV with L/O Arthur Kill 2					x	non-BPTF
ConEd13	Fault at Freshkills 138 kV with stuck breaker BT1-2						non-BPTF
ConEd14	Fault at Greenwood 138 kV with L/O Gowanus 345/138 (T2) kV and PAR					x	non-BPTF
ConEd15	Fault at Greenwood 138 kV with stuck breaker 7S		non-BPTF	x	non-BPTF	x	non-BPTF
ConEd16	Fault at Hellgate 138 kV with stuck breaker 5				non-BPTF		non-BPTF
ConEd25-Q461-Q462	Fault at E. 13th St. 138 kV with stuck breaker		non-BPTF		non-BPTF		non-BPTF
UC11	Fault at Sprainbrook 345 kV and L/O Sprainbrook - Tremont (X28) 345 kV and Buchanan - Sprainbrook (W93/W79) 345 kV		non-BPTF		BPTF & non-BPTF	x	BPTF & non-BPTF
UC25A	Fault at Ravenswood 3 345 kV and L/O Ravenswood 3		BPTF & non-BPTF	x	BPTF & non-BPTF	x	BPTF & non-BPTF
UC25B	Fault at Rainey 345 kV and L/O 60L 345 kV circuit			x	BPTF & non-BPTF	x	BPTF & non-BPTF
UC048A_Q510	Fault at Gowanus 345 kV and L/O Gowanus 345/138 kV 14TR			x	non-BPTF	x	non-BPTF
UC049_Q510	Fault at Gowanus 345 kV with stuck breaker 14				non-BPTF	x	non-BPTF
UC5_Q510	Fault at Farragut 345 kV with stuck breaker 11W						non-BPTF

Notes:

(1). Non-BPTF issues are reported for information only.

(2). Dynamic issues observed prior to 2024 will be evaluated in the Short-Term Reliability Process.

Figure 30: Dynamic Stability Criteria N-1-1 Violations (L/O Ravenswood 3 as First Level Event)

Dynamic Stability Criteria N-1-1 Violations (L/O Ravenswood 3 as First Level Event) (1), (2)							
Contingency Name	Contingency Description	2024		2025		2030	
		Generator Synchronism	Transient Voltage Response	Generator Synchronism	Transient Voltage Response	Generator Synchronism	Transient Voltage Response
ConEd01	Fault at Astoria East 138 kV with stuck breaker 3E						non-BPTF
ConEd02	Fault at Astoria West 138 kV and L/O Astoria CC1 and CC2						non-BPTF
ConEd03	Fault at Astoria West 138 kV with stuck breaker 2N						non-BPTF
ConEd08	Fault at E. 13th St. 138 kV with stuck breaker 4E		non-BPTF		non-BPTF		non-BPTF
ConEd12	Fault at Freshkills 138 kV with L/O Arthur Kill 2				non-BPTF	x	non-BPTF
ConEd13	Fault at Freshkills 138 kV with stuck breaker BT1-2					x	non-BPTF
ConEd14	Fault at Greenwood 138 kV with L/O Gowanus 345/138 (T2) 345 kV and PAR				non-BPTF	x	non-BPTF
ConEd15	Fault at Greenwood 138 kV with stuck breaker 7S		non-BPTF	x	non-BPTF	x	non-BPTF
ConEd16	Fault at Hellgate 138 kV with stuck breaker 5				non-BPTF	x	BPTF & non-BPTF
ConEd20	Fault at Queensbridge 138 kV with stuck breaker 7E						non-BPTF
ConEd23_Q510	Fault at Farragut 345 kV with L/O bus tie					x	BPTF & non-BPTF
ConEd25-Q461-Q462	Fault at E. 13th St. 138 kV with stuck breaker		non-BPTF		non-BPTF		non-BPTF

Dynamic Stability Criteria N-1-1 Violations (L/O Ravenswood 3 as First Level Event) (1), (2)							
		2024		2025		2030	
Contingency Name	**Contingency Description**	**Generator Synchronism**	**Transient Voltage Response**	**Generator Synchronism**	**Transient Voltage Response**	**Generator Synchronism**	**Transient Voltage Response**
TE02-UC02	Fault at E. Fishkill 345 kV with L/O E. Fishkill - Pleasantville 345 kV and Dunwoodie - Pleasantville 345 kV lines						BPTF
TE03-UC03	Fault at Sprainbrook 345 kV and L/O Sprainbrook - Millwood (W64/W99, W79/W93) 345 kV				BPTF & non-BPTF	x	BPTF & non-BPTF
TE20-UC20	Fault at Dunwoodie 345 kV and L/O Dunwoodie - Pleasantville (W89 and W90) 345 kV				BPTF & non-BPTF	x	BPTF & non-BPTF
UC11	Fault at Sprainbrook 345 kV and L/O Sprainbrook - Tremont (X28) 345 kV and Buchanan - Sprainbrook (W93/W79) 345 kV		BPTF & non-BPTF	x	BPTF & non-BPTF		System Collapse
UC19	Fault at Millwood 345 kV and L/O Millwood - Sprainbrook (W82/W65 and W85/W78) 345 kV				non-BPTF		BPTF & non-BPTF
UC25A	Fault at Ravenswood 3 345 kV and L/O Ravenswood 3			x	BPTF & non-BPTF		System Collapse
UC25B	Fault at Rainey 345 kV and L/O 60L 345 kV circuit		non-BPTF	x	BPTF & non-BPTF		System Collapse
UC32_Q510	Fault at Farragut 345 kV and L/O Farragut - Rainey (61) 345 kV					x	BPTF & non-BPTF
UC33_Q510	Fault at Farragut 345 kV and L/O Farragut - Rainey (62) 345 kV					x	BPTF & non-BPTF
UC34_Q510	Fault at Farragut 345 kV and L/O Farragut - Rainey (63) 345 kV					x	BPTF & non-BPTF

Dynamic Stability Criteria N-1-1 Violations (L/O Ravenswood 3 as First Level Event) (1), (2)							
Contingency Name	Contingency Description	2024		2025		2030	
		Generator Synchronism	Transient Voltage Response	Generator Synchronism	Transient Voltage Response	Generator Synchronism	Transient Voltage Response
UC35_Q510	Fault at Farragut 345 kV and L/O Farragut - E. 13th St. (45) 345 kV					x	BPTF & non-BPTF
UC36_Q510	Fault at Farragut 345 kV and L/O Farragut - E. 13th St. (46) 345 kV					x	BPTF & non-BPTF
UC37_Q510	Fault at Farragut 345 kV and L/O Farragut - E. 13th St. (47) 345 kV					x	
UC38_Q510	Fault at Farragut 345 kV and L/O Farragut - E. 13th St. (48) 345 kV					x	BPTF & non-BPTF
UC39_Q510	Fault at Farragut 345 kV and L/O B3402 (modeled out-of-service in base case)					x	BPTF & non-BPTF
UC048A_Q510	Fault at Gowanus 345 kV and L/O Gowanus 345/138 kV 14TR		non-BPTF	x	non-BPTF	x	BPTF & non-BPTF
UC049_Q510	Fault at Gowanus 345 kV with stuck breaker 14			x	non-BPTF	x	non-BPTF
UC57_Q510	Fault at Farragut 345 kV (near 63 line) with stuck breaker 11W					x	BPTF & non-BPTF
UC5_Q510	Fault at Farragut 345 kV (near B44 line) with stuck breaker 11W		non-BPTF	x	BPTF & non-BPTF	x	BPTF & non-BPTF

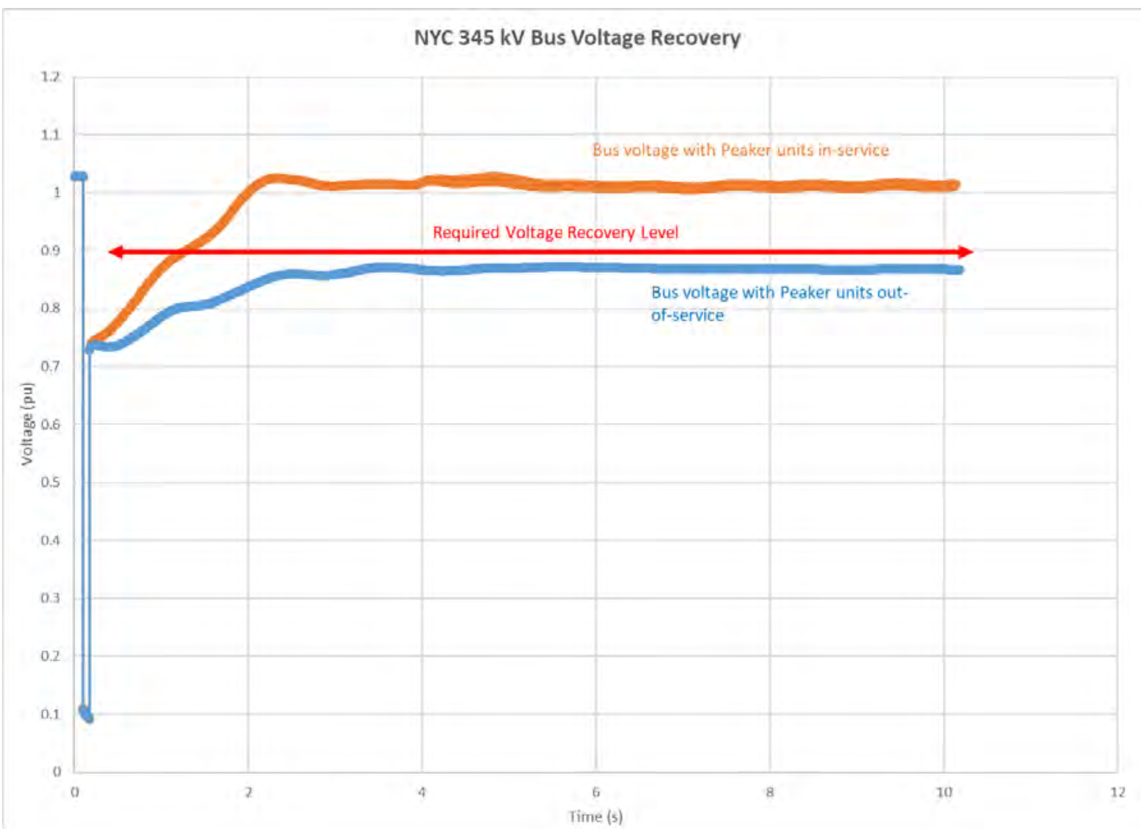
Notes:

(1). Non-BPTF issues are reported for information only.

(2). Dynamic issues observed prior to 2024 will be evaluated in the Short-Term Reliability Process

Figure 31 shows the transient voltage response for a 345 kV bus in the Con Edison service territory that passes the stated criteria as observed in assessments that have the peaker units in-service, as compared to the response observed with the peaker units out-of-service. To pass the transient voltage response criteria, the post-fault value must settle to at least 0.9 p.u. voltage five seconds after the fault has cleared for most Transmission Owners. The PSEG Long Island Criteria is to settle to at least 0.9 p.u. voltage one second after the fault has cleared. When the transient voltage response fails the stated criteria (as shown in Figure 31) this is referred to as fault induced delayed voltage recovery (FIDVR). FIDVR events are driven by end-use load behavior and load composition, primarily the induction motor loads. One of the causes of FIDVR is the stalling of induction motors due to low voltages. When an induction motor stalls, the motors draws excessive reactive power from the grid and require five to six times their typical steady-state running current in this locked-rotor condition,[13] which can eventually lead to a significant loss of generation and load.

Figure 31: New York City (NYC) 345 kV Bus Voltage Recovery



During a fault, the observed voltage drop at a bus depends on the location of the fault on the system

[13] https://www.nerc.com/docs/pc/tis/FIDVR_Tech_Ref%20V1-2_PC_Approved.pdf

relative to the bus and the amount of time the fault remains on the system before it is cleared by protective relaying actions. Following the clearing of a fault on the system by protection system actions, the bus voltage and generator rotor usually enter an oscillatory period. The generator excitation system controls the generator terminal voltage to improve and stabilize the voltages. Nevertheless, depending on the severity of voltages and generator size, the voltages may or may not stabilize. Generator rotor swings after a fault are caused by the accumulation of energy, *i.e.* an imbalance between electrical power and mechanical power, during the fault. After the clearing of the fault, the generator rotor swings (or "oscillations") dissipate that accumulated energy over time. For a stable system response, these oscillations damps out over time to an acceptable post-fault value. For an unstable system response, the system may observe unacceptable damping, system separation, cascading, and generating units losing synchronism with the system.

As shown in Figure 29 and Figure 30, several contingencies result in loss of generator synchronism with the transmission system. A primary driver to the loss of synchronism for these machines is the sustained low voltages following the clearing of the fault. Examples of low voltages as observed from the high-side of the generator step-up (GSU) transformer are shown in Figure 32 in response to a contingency. As can be seen in Figure 32, the sustained low voltages are also observed at the high side of the GSU and remain in the NERC PRC-024 "may trip" zone. In this example, due to the sustained low voltages an equilibrium point for the generators is not reached, and the generators lose synchronism with the system. As shown in Figure 33, Generator 1 loses synchronism and trips off line at about 3.5 seconds and Generator 2 goes out of synchronism and trips off line at about 10 seconds. The rotor angles plotted in Figure 33 are relative to the system average rotor angle.

Figure 32: High Side of GSU Voltage

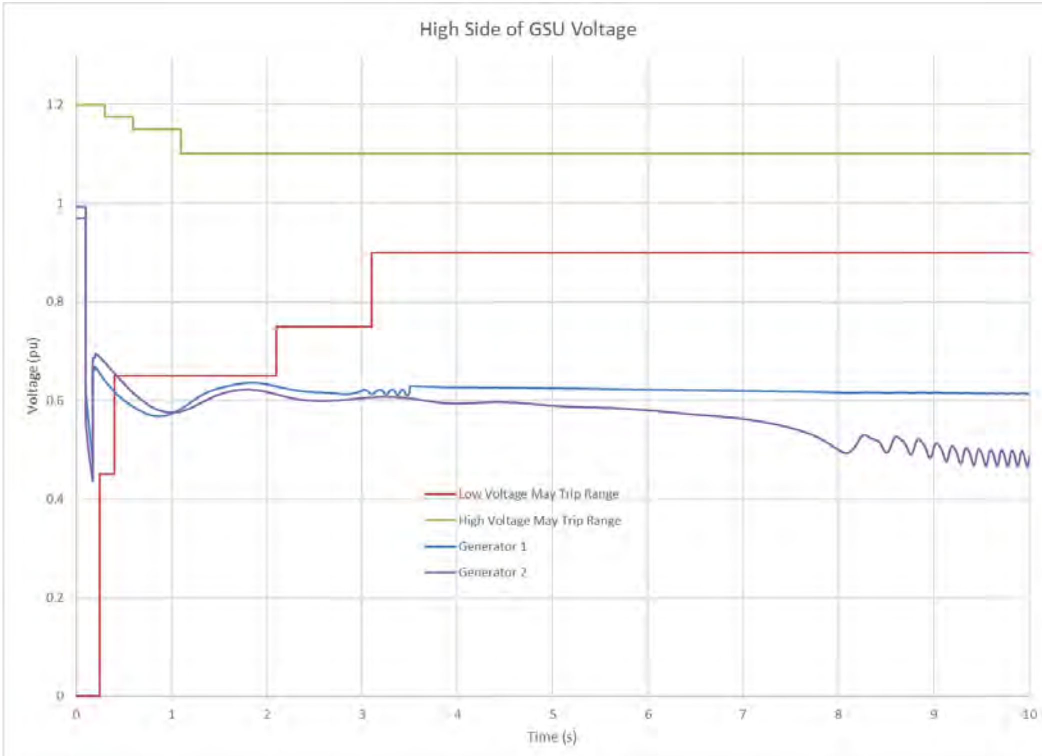
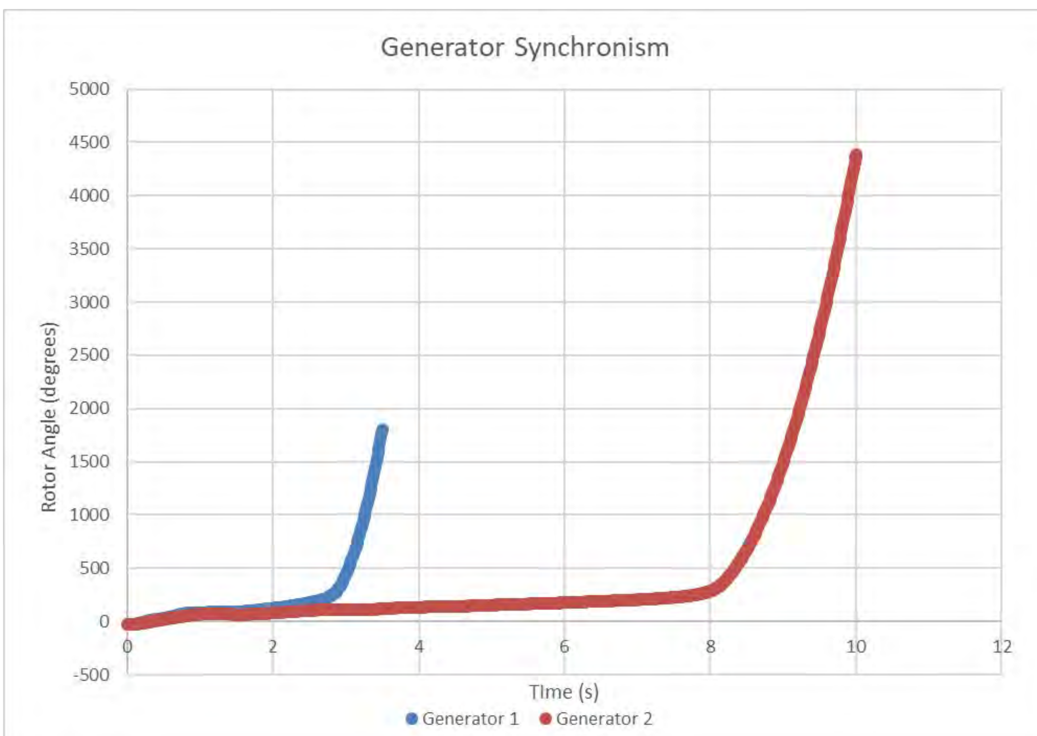


Figure 33: Generator Synchronism



Stability Compensation

In the pre-fault (N-0) system condition, voltages are maintained with various static (*e.g.* fixed and switched shunt devices, transmission circuits) and dynamic (*e.g.* Generators, FACTS devices, STATCOMS) reactive resources maintaining voltages within prescribed ranges. Manual adjustments to these devices occur as load and other system conditions change in order to maintain the required voltage level.

During the dynamic simulation timeframe, sufficient dynamic reactive resources to sustain transient voltage support during the natural swings of the system are crucial. Generally, the system response to these swings to maintain voltage comes from generator excitation system response, STATCOMs, static VAr compensators (SVCs), wind and solar plant voltage controls, and other fast-acting resources.[14] While pre-contingency voltages can be maintained using static reactive resources, the dynamic system response timeframe focuses primarily on dynamic reactive capability due to the transient nature of large power and voltage swings and the short response time required.

The BPTF dynamic stability criteria violations compensatory values are measured by modeling fictitious generators at the Farragut 345 kV, Astoria East 138 kV, and Greenwood North 138 kV buses with a MW size determined by the compensatory MW for thermal violations. Focusing on the event combination of the loss of Ravenswood 3 followed by event UC11 (as one of the more severe events), reactive capability was added to the fictitious generators to the point where the BPTF transient voltage violations, sustained oscillations, and generator synchronism criteria violations are no longer observed. Figure 34 provides a description of dynamic compensation needed to address the event combination of the loss of Ravenswood 3 followed by event UC11. The impact of the added dynamic reactive capability is highly non-linear and other event combinations and the location of the fictitious generators may cause significant variance to the values stated in Figure 34.

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[14] https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability%20Guideline%20-%20Reactive%20Power%20Planning.pdf

Figure 34: Description of Dynamic MVA Added to System

Dynamics Compensatory Resource Values (1)						
	Machine MVA			Pgen (MW)		
Location	2024	2025	2030	2024	2025	2030
Farragut 345 kV	350	400	700	0	230	525
Astoria East 138 kV	140	170	225	110	110	180
Greenwood North 138 kV	0	450	465	0	360	370
Total	490	1,020	1,390	110	700	1,075

Notes:

(1). BPTF dynamic issues observed prior to 2024 will be evaluated in the Short-Term Reliability Process

Short Circuit Assessments

The required short circuit assessment in the RNA includes the calculation of symmetrical short circuit current to ascertain whether the circuit breakers at stations connecting the BPTF could be subject to fault current levels in excess of their rated interrupting capability. The analysis was performed for 2025 (year 5), reflecting the study conditions outlined in the **Section 5**. The calculated fault levels do not change significantly after year 5 in the Study Period as no new generation or transmission changes are modeled in the RNA, and the methodology for fault duty calculation is not sensitive to load growth. For this assessment no over-dutied circuit breakers were identified. The detailed results of the short circuit assessment are provided in **Appendix D** of this report.

Transmission Owner Local Criteria Violations

As described in the following sections, Con Edison and Central Hudson each identified transmission security issues in their service territory on their non-BPTF system. The local non-BPTF criteria violations identified below are provided for information only, as the RNA identifies only BPTF Reliability Needs.

Central Hudson Assessment

Central Hudson currently owns and operates two 25 MVA (nameplate) combustion turbines that are subject to the DEC Peaker Rule, namely the Coxsackie and South Cairo generators. Both of these generators provide local substation reserve capacity for transformer outages and post-contingency voltage support for the Westerlo transmission loop. Without these generators, there is no reserve capability for local transformer outages and the Westerlo loop is voltage constrained. These transmission security issues would begin in 2023 and continue through the study period.

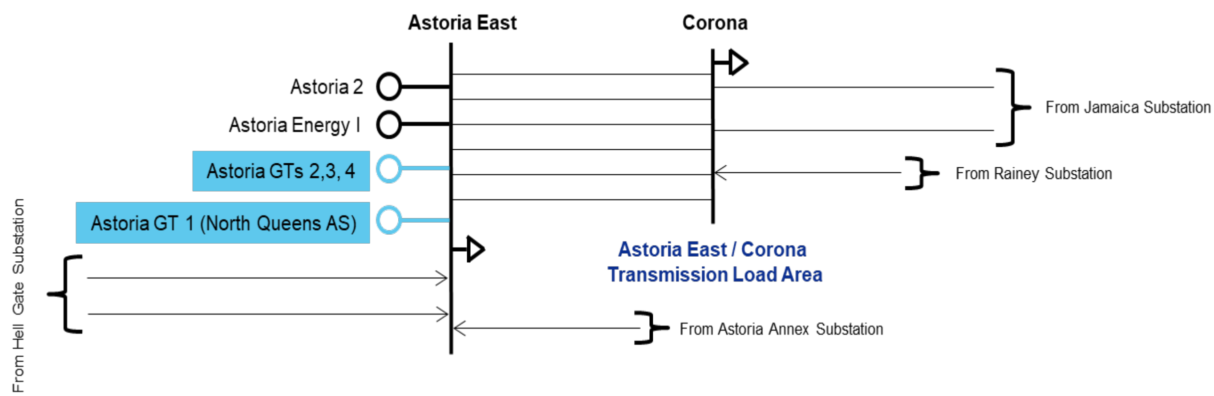
Con Edison Assessment

The transmission security criteria violations observed in the Con Edison service territory are primarily due to deficiencies that are observed in the Astoria East/Corona 138 kV Transmission Load Area (TLA) and the Greenwood/Fox Hills 138 kV TLA.

Astoria East/Corona 138 kV TLA

Figure 35 shows the high-level topology of the Astoria East/Corona 138 kV TLA. The boundary feeders for this TLA include the feeders from the Hell Gate, Astoria Annex, Rainey, and Jamaica substations.

Figure 35: Astoria East/ Corona 138 kV TLA



In 2023, thermal overloads are observed on the Astoria East/Corona 138 kV TLA boundary feeders, which are designed to a second contingency (N-1-1-0) based on the applicable Con Edison local design criteria.

Considering the utilization of all available phase angle regulator (PAR) controls, the maximum observed deficiency (*i.e.,* compensatory MW) within this TLA ranges from 110 MW in 2023 to 180 MW in 2030 as shown in Figure 36. As shown in Figure 37 and Figure 38, the Astoria East/Corona 138 kV TLA does not peak with the coincident system peak. Based on the load duration curves shown in Figure 37 and Figure 38, the TLA may be deficient over 10 hours (659 MWh) on a peak day in 2023, increasing to 13 hours (1,461 MWh) on a peak day in 2030.

Figure 36: Astoria East/ Corona 138 kV TLA Deficiency

Year	2023	2024	2025	2026	2027	2028	2029	2030
Deficiency (MW)	110	115	110	115	120	125	170	180

Figure 37: Astoria East/Corona 138 kV Load Duration Curve for 2023

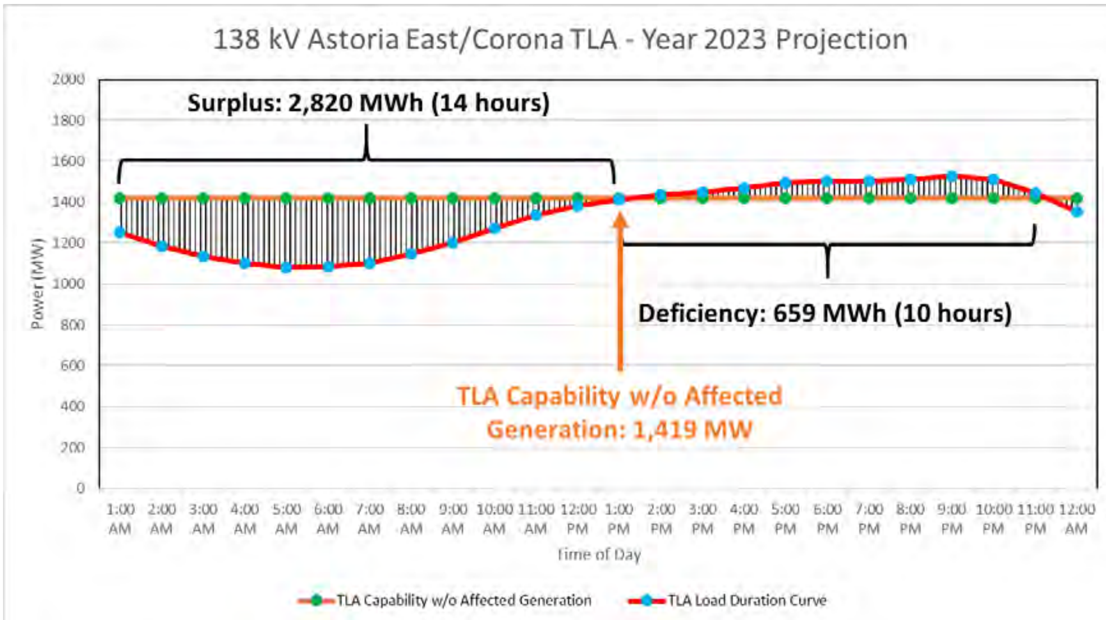
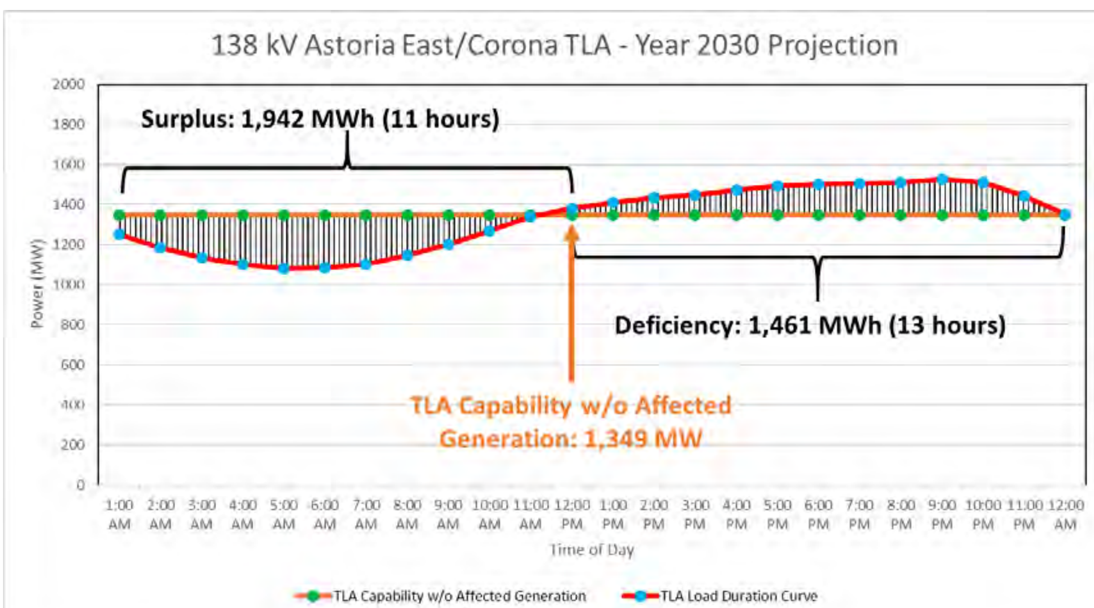


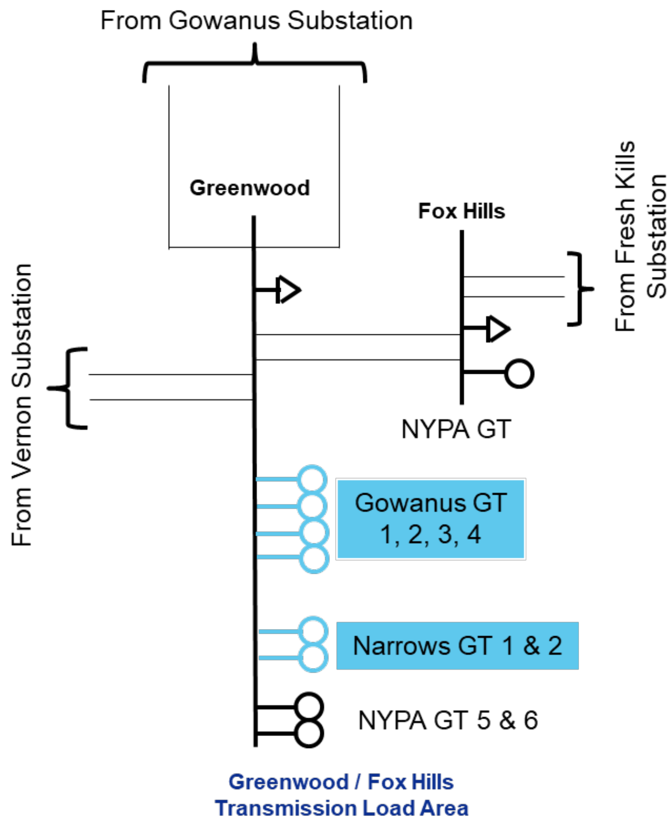
Figure 38: Astoria East/Corona 138 kV Load Duration Curve for 2030



Greenwood/Fox Hills 138 kV TLA

Figure 39 shows the high-level topology of the Greenwood/Fox Hills 138 kV TLA. The boundary feeders for this TLA include the feeders from the Vernon, Gowanus, and Fresh Kills substations.

Figure 39: Greenwood/Fox Hills 138 kV TLA



In 2025, thermal overloads and voltage violations are observed on the Greenwood/Fox Hills 138 kV TLA boundary feeders in the steady state (N-0) condition, which are exacerbated under N-1 and N-1-1 conditions.

Considering the utilization of all available PAR controls, the maximum observed deficiency (*i.e.,* compensatory MW) within this TLA of 360 MW in 2025 to 370 MW in 2030 as shown in Figure 40. Based on the load duration curve shown in Figure 41, the TLA may be deficient over 14 hours (3,571 MWh) over a 14 hour period on a peak day in 2025. The load duration curve for 2030 in Figure 42 shows that while the amount of hours that the TLA is deficient does not increase compared to 2025, due to the increased deficiency on peak, the total MWh of the deficiency increases to 3,696 MWh.

Figure 40: Greenwood/Fox Hills 138 kV TLA Deficiency

Year	2025	2026	2027	2028	2029	2030
Deficiency (MW)	360	350	360	360	370	370

Figure 41: Greenwood/Fox Hills 138 kV TLA Load Duration Curve for 2025

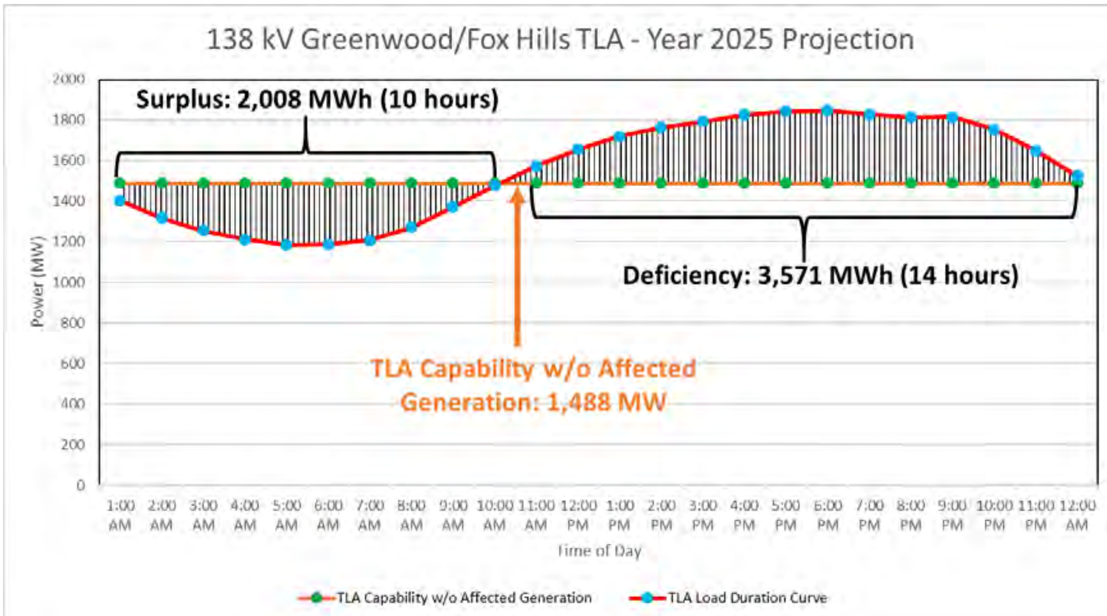
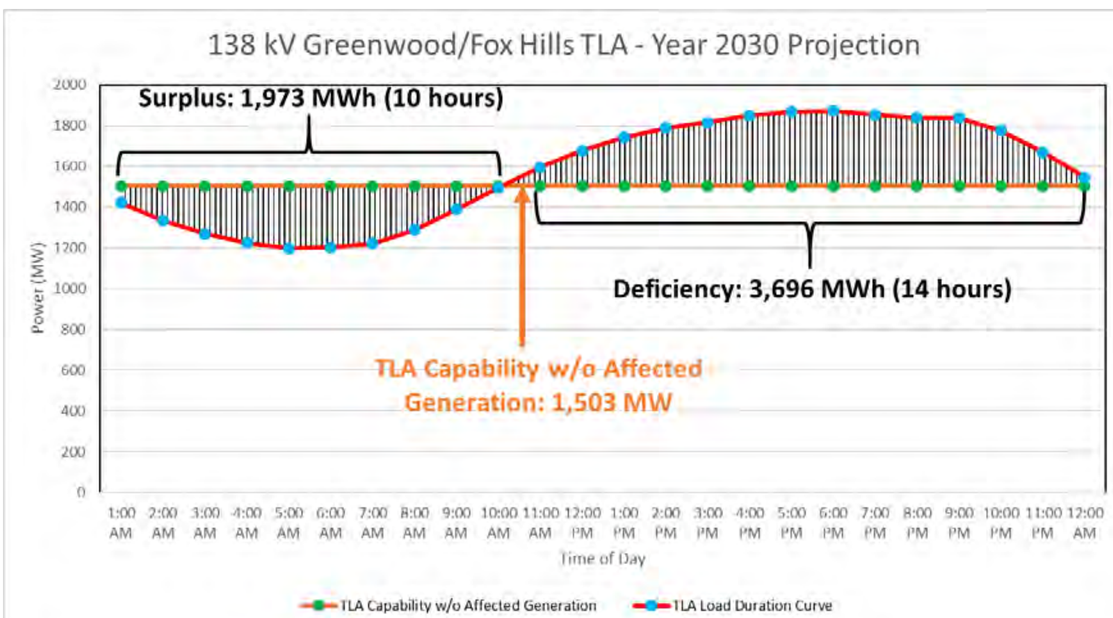


Figure 42: Greenwood/Fox Hills 138 kV TLA Load Duration Curve for 2030



Resource Adequacy Base Case Assessments

The following discussion reviews the main findings of the *2020 RNA* resource adequacy assessments applicable to the Base Case conditions for the Study Period.

Resource Adequacy Model

The NYISO conducts its resource adequacy analysis using the GE-MARS software package, which performs probabilistic simulations of outages of capacity and select transmission resources. The program employs a sequential Monte Carlo simulation method and calculates expected values of reliability indices such as LOLE (days/year) and includes load, generation, and transmission representation. Additional modeling details and links to various stakeholders' presentations are in the assumptions matrix, **Appendix D**. In determining the reliability of a system, there are several types of randomly occurring events that are taken into consideration. Among these are the forced outages of generation and transmission, and deviations from the forecasted loads.

Generation Model

The NYISO models the generation system in GE-MARS using several types of units. Thermal units considerations include: random forced outages as determined by Generator Availability Data System (GADS) — calculated EFORd and the Monte Carlo draw, scheduled and unplanned maintenance, and thermal derates. Renewable resource units (*i.e.,* solar PV, wind, run-of-river hydro and landfill gas) are modeled using five years of historical production data. Co-generation units are also modeled using a capacity and load profile for each unit.

Load Model

The load model in the NYISO GE-MARS model consists of historical load shapes and load forecast uncertainty (LFU). The NYISO uses three historical load shapes in the GE-MARS model (2002, 2006 and 2007) in seven different load levels using a normal distribution. LFU is applied to every hour of these historical shapes and each of the seven load levels are run through the GE-MARS model.

External Areas Model

The NYISO models the four external Control Areas interconnected to the NYCA; (ISO-New England, PJM, Ontario and Quebec). The transfer limits between the NYCA and the external areas are set in collaboration with the NPCC CP-8 Working Group and are shown in the MARS Topology Figure 46. Additionally, the probabilistic model used in the 2020 RNA to assess resource adequacy employs a number of methods aimed at preventing overreliance on support from the external systems. These include imposing a limit of 3,500 MW to the total emergency assistance from all neighbors, modeling simultaneous peak days, and modeling the long-term purchases and sales with neighboring control areas.

MARS Topology

The NYISO models the amount of power that could be transferred across the system in GE-MARS using interface transfer limits applied to the connections between the GE-MARS areas[15] ("bubble-and-pipe" model).

Summary of major GE-MARS topology changes[16] (as compared with the 2019-2028 CRP):

- Marion-Farragut 345kV cables (B and C) assumed out-of-service
- 71, 72, M51, M52 series reactors assumed bypassed after deactivation of Indian Point Unit Nos. 2 and 3
- Rainey – Corona transmission project in-service impacting J to K limits
- AC Transmission Public Policy Segment A and B Projects added starting January 2024
- Removal of Cedars bubble/tie to Zone D model; adding the MW from the bubble to the HQ to D tie limit.
- Updates to Zone K Imports/Exports
- Somerset retirement impacts
- The external areas model for PJM and ISO-NE were simplified by consolidating the five PJM areas (bubbles) into one, and the eight ISO-NE areas into one.

The emergency transfer criteria limits used in the GE-MARS model were developed from an assessment of analysis of the 2020 RNA power flow base cases, and analysis performed for other studies. Figure 43, Figure 44 and Figure 45 provide the thermal and voltage emergency transfer limits for the major NYCA interfaces. The 2018 RNA transfer limits are presented for comparison purposes.

15 No generation pockets in Zone J and Zone K are modeled in detail in MARS.

16 Links to related stakeholders' presentations are in the Appendix D, assumptions matrix.

Figure 43: Transmission System Thermal Emergency Transfer Limits

Interface	2020 RNA						2018 RNA			
	For information only			Study Years: 2024 - 2030			Study Years: 2019 - 2028			
	2021	2022	2023	2024	2025	2030	2021	2022	2023	2028
Dysinger East	*1700*	*2200*	*2200*	*2200*	2200	*2200*	1700	2300	2300	*2300*
Central East MARS	*4450*	*4450*	*4450*	*4925*	4925	*4925*	4450	4450	4450	*4450*
E to G (Marcy South)*	*1750*	*1750*	*1750*	*2300*	2300	*2300*	2275	2275	2275	*2275*
F to G	*3475*	*3475*	*3475*	*5400*	5400	*5400*	3475	3475	3475	*3475*
UPNY-SENY MARS*	*5250*	*5250*	*5250*	*7150*	7150	*7150*	5600	5600	5600	*5600*
I to J	*4350*	*4350*	*4350*	*4350*	4350	*4350*	4400	4400	4400	*4400*
I to K (Y49/Y50)	*1293*	*1293*	*1293*	*1293*	1293	*1293*	1293	1293	1293	*1293*

Notes:
Grey italic font: Limit was not calculated

*change in limit between 2018 RNA and 2020 RNA is due to different modeling method used in GE-MARS. Additional topology changes details are in Appendix D.

Figure 44: Transmission System Voltage Emergency Transfer Limits

Interface	2020 RNA						2018 RNA			
	For information only			Study Years: 2024 - 2030			Study Years: 2019 - 2028			
	2021	2022	2023	2024	2025	2030	2021	2022	2023	2028
Dysinger East	*2850*	*2850*	*2850*	*2850*	2850	*2850*	2800	2900	2900	*2900*
Central East MARS	*3100*	*3100*	*3100*	*3925*	3925	*3925*	3100	3100	3100	*3100*
Central East Group	*5000*	*5000*	*5000*	*5650*	5650	*5650*	5000	5000	5000	*5000*
UPNY-ConEd	*7000*	*7000*	*7000*	*7375*	7375	*7375*	6250	6250	6250	*6250*
I to J & K	*5825*	*5825*	*5825*	*6200*	6200	*6200*	5600	5600	5600	*5600*

Note: Grey italic font: Limit was not calculated

Figure 45: Transmission System Base Case Emergency Transfer Limits

Interface	2020 RNA												2018 RNA							
	For information only						Study Years: 2024 - 2030						Study Years: 2019 - 2028							
	2021		2022		2023		2024		2025		2030		2021		2022		2023		2028	
Dysinger East	*1700*	*T*	*2200*	*T*	*2200*	*T*	*2200*	*T*	2200	T	*2200*	*T*	1700	T	2300	T	2300	T	*2300*	*T*
Central East MARS	*3100*	*V*	*3100*	*V*	*3100*	*V*	*3925*	*V*	3925	V	*3925*	*V*	3100	V	3100	V	3100	V	*3100*	*V*
Central East Group	*5000*	*V*	*5000*	*V*	*5000*	*V*	*5650*	*V*	5650	V	*5650*	*V*	5000	V	5000	V	5000	V	*5000*	*V*
E to G (Marcy South)	*1750*	*T*	*1750*	*T*	*1750*	*T*	*2300*	*T*	2300	T	*2300*	*T*	2275	T	2275	T	2275	T	*2275*	*T*
F to G	*3475*	*T*	*3475*	*T*	*3475*	*T*	*5400*	*T*	5400	T	*5400*	*T*	3475	T	3475	T	3475	T	*3475*	*T*
UPNY-SENY MARS	*5250*	*T*	*5250*	*T*	*5250*	*T*	*7150*	*T*	7150	T	*7150*	*T*	5600	T	5600	T	5600	T	*5600*	*T*
I to J	*4350*	*T*	*4350*	*T*	*4350*	*T*	*4350*	*T*	4350	T	*4350*	*T*	4400	T	4400	T	4400	T	*4400*	*T*
I to K (Y49/Y50)	*1293*	*T*	*1293*	*T*	*1293*	*T*	*1293*	*T*	1293	T	*1293*	*T*	1293	T	1293	T	1293	T	*1293*	*T*
I to J & K	*5643*	*T*	*5643*	*T*	*5643*	*T*	*5643*	*T*	5643	T	*5643*	*T*	5600	C	5600	C	5600	C	*5600*	*C*

Notes:
Grey italic font: Limit was not calculated

T - Thermal, V - Voltage, C – Combined

There are large increases in transfer capability modeled starting in year 2024 in the *2020 RNA*. The increases reflect the impact of including the AC Transmission Public Policy projects. Comparing limits in year 2023 to year 2024, increases are represented to the thermal limits of 550 MW for the E to G interface, 1,925 MW for the F to G interface, and 1,900 MW for the UPNY-SENY MARS interface. There are also increases to the voltage limits of 825 MW for the Central East MARS interface, 650 MW for the Central East Group interface, and 375 MW for the UPNY-Con Ed interface.

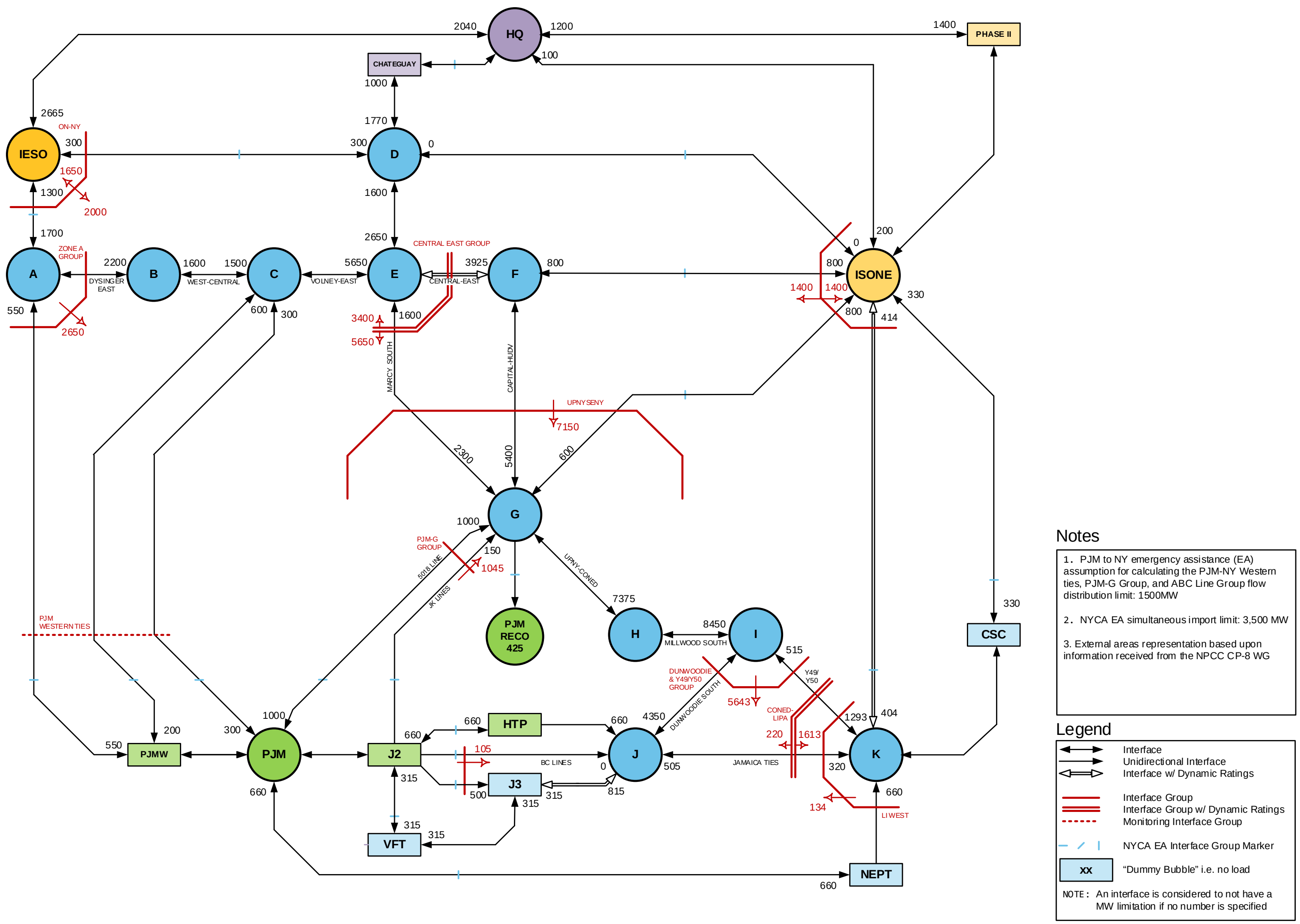
The NYISO modeled a decrease in the thermal transfer limit for Dysinger East of 100 MW primarily due to the retirement of the Somerset generation unit in Zone A.

Comparing the transfer limits reported for year 2021 through 2023 to the previous RNA, there is an increase of 750 MW on the UPNY-Con Ed voltage limit for the 2020 RNA. The primary cause for this increase is a change in the study assumption for the operation of the series reactors on the Dunwoodie – Mott Haven 345 kV cables (71, 72) and the Sprain Brook – W. 49th Street cables (M51, M52). For the 2020 RNA, these series reactors were modeled as bypassed. This study assumption also resulted in a decrease of 50 MW in the I to J interface thermal limit.

The E to G interface thermal limit was modeled using a dynamic limit table in the 2020 RNA MARS topology. The interface limit ranged from 1750 MW to a maximum of 2250 MW based on the availability of the CPV Valley generation units. Starting in year 2024 the dynamic limit table was replaced with a single interface limit of 2300 MW. The increase in the limit is the result of transmission facility upgrades included in the AC Transmission Public Policy projects. Similarly, the UPNY-SENY MARS interface was modeled using a dynamic limit table ranging from 5100 MW to a maximum of 5350 MW. With the large increase in transfer capability when including the AC Transmission projects in 2024, the model was simplified by using a single limit of 7150 MW, and does not constrain the flow of power in the GE-MARS simulation.

The topology used in the GE-MARS model for the 2020 RNA Base Case is represented in Figure 46.

Figure 46: 2020 RNA Topology Years 4-10 (2024 -2030)



Additionally, for information only, Figure 47 and Figure 48 represent the initial three years preceding the newly-defined RNA Study Period.

New York ISO

Figure 47: Topology Year 1 (2021)

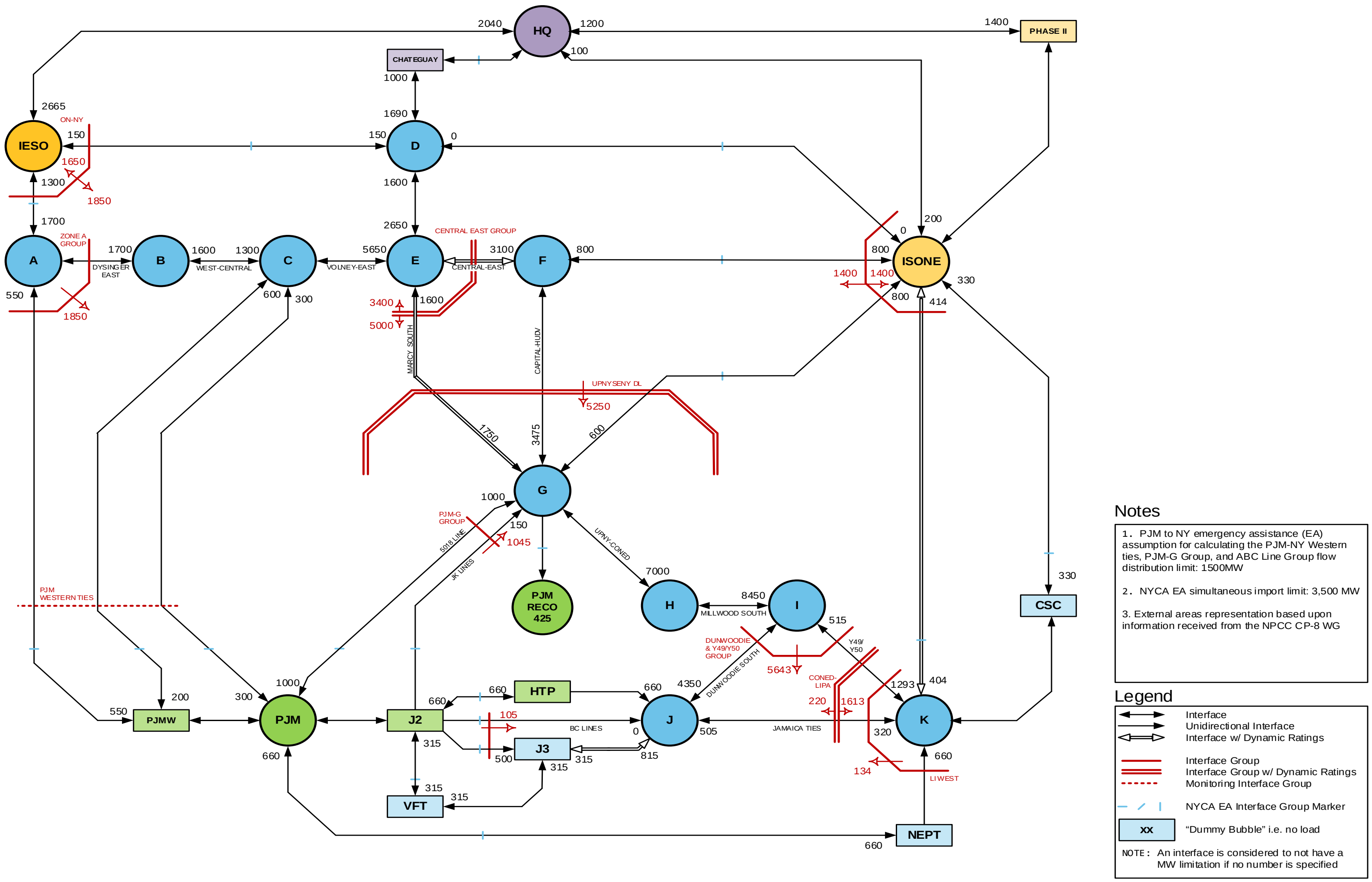
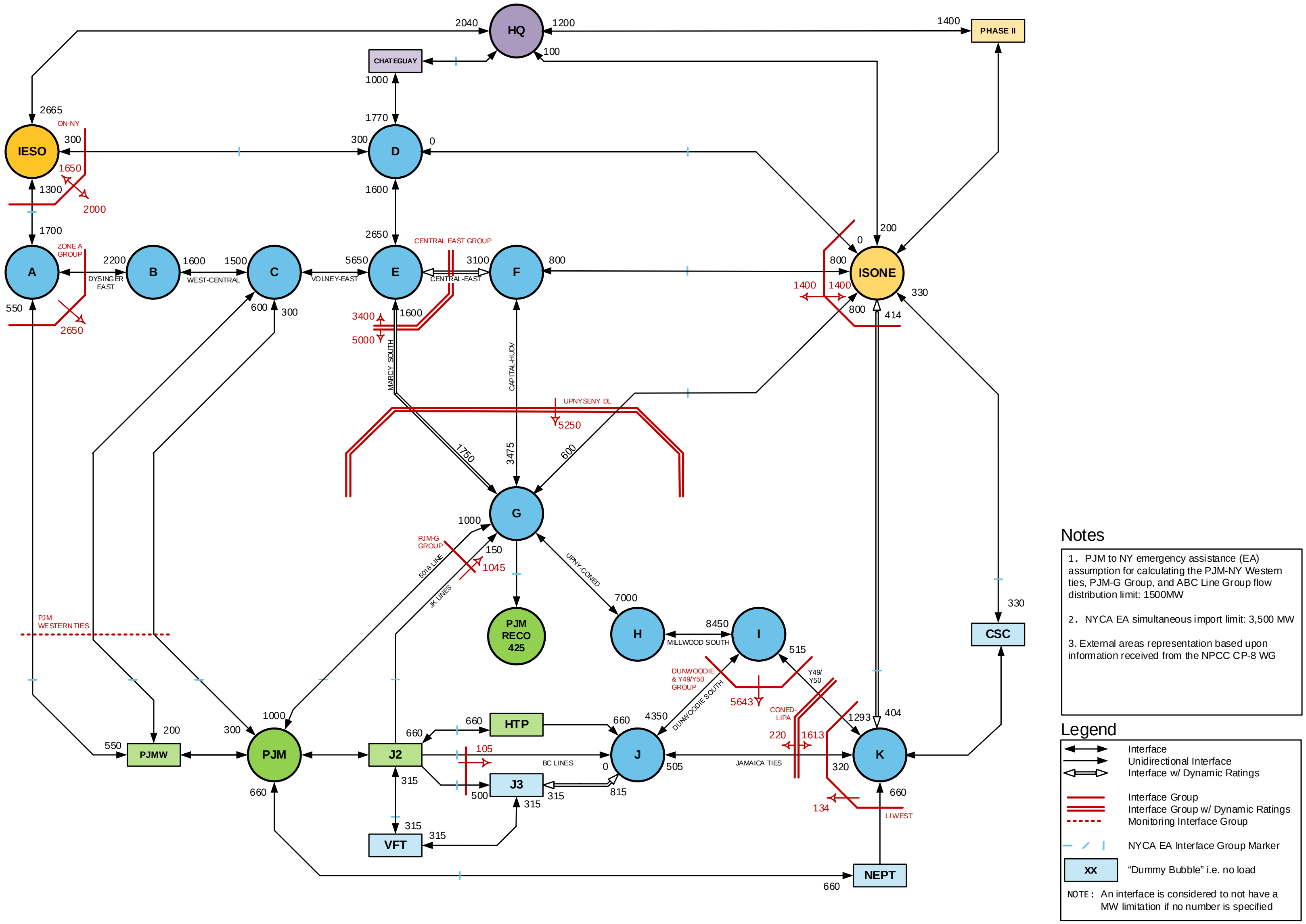


Figure 48: Topology Year 2- 3 (2022- 2023)



Resource Adequacy Base Case Results

The 2020 RNA Base Case resource adequacy studies shows that the LOLE for the NYCA is at or above the criterion of 0.1 days/year starting 2026. The NYCA LOLE results are presented in Figure 49 below.

Figure 49: NYCA Resource Adequacy Results

Study Year	NYCA Baseline Summer Peak Load (MW)	Area J Peak Load (MW) (Non-coincident)	RNA Base Case NYCA LOLE (days/year)
2024	31,838	11,557	0.04
2025	31,711	11,552	0.08
2026	31,670	11,609	0.10
2027	31,673	11,667	0.12
2028	31,756	11,747	0.13
2029	31,865	11,836	0.17
2030	31,992	11,924	0.19

Note: NYCA load values represent baseline coincident summer peak demand.
Zones J and K load values represent non-coincident summer peak demand.
Aggregate Zones G-J values represent the G-J peak demand.

The LOLE is at or above the criterion of one day in 10 years, or 0.1 days per year, starting year 6 (2026) of the RNA Study Period, and increases through year 10 (2030). Therefore, the NYISO identifies resource adequacy Reliability Needs starting in 2027 (with 2026 being at the 0.10 days/year criterion).

The deficiencies identified in this 2020 RNA are driven by the compound effect of increasing load forecast (*e.g.*, +495 MW in 2030) and loss of generation in Zone J (*e.g.*, –1,372 MW in 2030) see Figure 50. Compared to the 2019 - 2028 CRP, the system has less overall net resources. The Base Case models reflect the application of the generator compliance plans for the DEC's Peaker Rule to affected plants in New York City (Zone J), Long Island (Zone K), and Hudson Valley (Zone G). In Figure 50, the negative net margin shows deterioration in the relative capability to serve load, when comparing the assumptions in the two studies.

Figure 50: 2020 RNA Zone J Load and Capacity Comparison with the 2019 – 2028 CRP

Study Year 10	2020 RNA (Y2030)	2019 - 2028 CRP (Y2028)	Net Delta
Baseline[1] Load	11,924	11,429	495
Capacity[2]	8,190	9,562	-1,372
Net Margin: Change in (netCapacity - netLoad)			**-1,867**

Notes:

1. Includes the reductions due to projected energy efficiency programs, building codes and standards, distribution energy resources and behind-the-meter solar photovoltaic power; it also reflects expected impacts (increases) from projected electric vehicle usage.
2. Does not includes the total SCRs, and UDRs from the Gold Book.

Resource Adequacy Compensatory MW

Resource adequacy compensatory MW amounts are determined by adding generic "perfect capacity" resources to each zone individually, or in combinations of zones, to address the shortfall.

"Perfect capacity" is capacity that is not derated (*e.g.,* due to ambient temperature or unit unavailability caused by factors such as equipment failures or lack of fuel), not subject to energy duration limitations, and not tested for transmission security or interface impacts. Actual resources would need to be larger in order to achieve the same impact as perfect-capacity resources.

The compensatory MW additions are not intended to represent specific solutions, as the impact of specific solutions can depend on the type of the solution and its location on the grid. Rather, the compensatory MW levels provide a generic order-of-magnitude measure to guide solutions. Resource needs could potentially be met by combinations of solutions including generation, transmission, energy efficiency, and demand response measures.

Figure 51: Compensatory MW Additions for Resource Adequacy Violations

Study Year	NYCA LOLE (dy/yr)	Zones for Additions			
		Only in A-F	Only in G-I	Only in J	Only in K
2024	0.04	-	-	-	-
2025	0.09	-	-	-	-
2026	0.10	-	-	-	-
2027	0.12	700	700	100	not feasible
2028	0.14	1,600	1,650	150	not feasible
2029	0.17	not feasible	not feasible	300	not feasible
2030	0.19	not feasible	not feasible	350	not feasible

Observations:

- Adequate compensatory MW must be located within, or injected into, Zone J because of transmission constraints into Zone J observed starting in 2029. This result is exemplified by the fact that no compensatory MW in any of the other NYCA zones will help bring the LOLE back below 0.1 days/year.
- Potential solutions to address the 350 compensatory MW resource adequacy deficiency in Zone J by 2030 (100 MW in 2027) could include a combination of additional transfer capability into Zone J and/or resources located within Zone J, and/or demand-side solutions. However, solutions would also need to address the Zone J local[17] transmission load area deficiencies identified in the transmission security evaluations.

Transmission Limit Relaxation Sensitivity

To determine if transmission reinforcements would be beneficial, a "NYCA free flow" test was executed. A free flow simulation is one in which NYCA LOLEs are determined without considering any transmission transfer limitations within the NYCA system. This provides an indication of whether any LOLE violations identified are purely resource related or if they are caused by limitations in the transmission system.

Following removal of the NYCA internal limits, the NYCA LOLE decreased to well below the criterion throughout the Study Period. This result indicates that there is no statewide resource deficiency and that transmission reinforcement to inject resources into Zone J is a potential option to resolve the identified resource adequacy Reliability Need.

The results are in Figure 52 below, and indicate that transmission improvements can also eliminate the LOLE violations.

[17] No local transmission load area limits are modeled for the resource adequacy assessment – deficiencies at this local level are identified in the transmission security assessments.

Figure 52: NYCA Free Flow Simulation Results

Study Year	RNA Base Case NYCA LOLE (days/year)	Free Flow Case NYCA LOLE (days/year)
2024	0.04	0.02
2025	0.08	0.03
2026	0.10	0.03
2027	0.12	0.03
2028	0.13	0.03
2029	0.17	0.04
2030	0.19	0.04

The NYISO performed additional topology limits variations to identify relieving which interfaces helps the most. This information provides additional insights to support solutions development:

- Increasing the transfer limits on the interface between Zones I and J only (I_to_J or Dunwoodie South interface): An increase of 450 MW resolved the needs in 2030. This value is larger than the identified Compensatory MW value of 350 MW because the I_to_J interface is not always fully available due to partial outage states.
- Modeling the I_to_J (Dunwoodie South) interface with no limit: The NYCA LOLE decreased to 0.05 days/year in 2030, which is close to the 0.04 days/year NYCA free flow result. This result confirms that Zone J is the critical area in the GE-MARS analysis RNA Base Case, and that any injection from any interface into Zone J would mitigate the resource adequacy zonal deficiency.

Additional free flow variations results are in **Appendix D**.

Beyond adding capacity or decreasing load in Zone J, increasing the interface limits into Zone J would mitigate or fully address the resource adequacy deficiency. However, solutions would also need to address the Zone J local[18] transmission load area deficiencies identified in the transmission security evaluations.

Base Case Key Findings

- The dynamic stability Reliability Needs are observed for the entire Study Period. Following the initial phase of the Peaker Rule in 2023, instability of the grid may occur due to a lack of dynamic reactive power capability and inertia available to parts of the New York City grid. The criteria violations include transient voltage response violations, loss of generator synchronism,

[18] No local transmission load area limits are modeled for the resource adequacy assessment – deficiencies at this local level are identified in the transmission security assessments.

and undamped voltage oscillations.

- With full implementation of the Peaker Rule in 2025, several 345 kV circuits in the Con Edison service territory would also be overloaded equating to a deficiency of 700 MW and increasing to at least 1,075 MW by 2030. The duration of the deficiency ranges from nine hours in 2025 (3,853 MWh) to 12 hours in 2030 (7,672 MWh).
- Similar transmission deficiencies would also occur within pockets of Con Edison's non-bulk system (138 kV), ranging in duration from 10 to 14 hours.
- The system exceeds the LOLE criterion of one day in 10 years, or 0.1 days per year, starting in 2027, and increasing through 2030. Therefore, the NYISO identifies resource adequacy Reliability Needs starting 2027.
- The deficiencies identified in this *2020 RNA* are driven by the compound effect of the increasing load forecast (*i.e.,* +495 MW in 2030) and loss of generation in Zone J (*i.e.*, –1,372 MW in 2030).
- Potential solutions to address the 350 compensatory MW resource deficiency in Zone J by 2030 (100 MW in 2027) could include a combination of increased transfer capability into Zone J and/or resources located within Zone J, and/or demand-side solutions. However, solutions would also need to address the Zone J local[19] transmission load area deficiencies identified in the transmission security evaluations.

[19] No local transmission load area limits are modeled for the resource adequacy assessment – deficiencies at this local level are identified in the transmission security assessments.

7. Base Case Variation Scenarios

The NYISO, in conjunction with stakeholders and Market Participants, developed reliability scenarios pursuant to Section 31.2.2.5 of Attachment Y of the OATT. Scenarios are variations on the preliminary (1st pass) RNA Base Case to assess the impact of possible changes in key study assumptions which, if they occurred, could change the timing, location, or degree of violations of reliability criteria on the NYCA system during the Study Period, and are presented for information only. There were no changes between the preliminary RNA Base Case and the final Base Case. RNA scenarios are provided for information only, and do not lead to Reliability Needs identification or mitigation. The NYISO evaluated the following scenarios as part of this RNA, with an identification of the type of assessment performed:

1. **High Load Forecast Scenario – Resource Adequacy**
    - The 2020 Gold Book High Load forecast were used for the resource adequacy analysis.
2. **Zonal Resource Adequacy Margins (ZRAM) - Resource Adequacy**
    - Identification of the maximum level of zonal MW capacity that can be removed without either causing NYCA LOLE violations, or exceeding the zonal capacity.
3. **"Status-quo" Scenario - Transmission Security and Resource Adequacy**
    - Removal of proposed major transmission and generation projects assumed in the RNA Base Case.

Additionally, the NYISO proposed to perform two exploratory scenarios, further detailed in **Appendix E**:

4. **Further Simplified External Areas Model[20] - Resource Adequacy**
    - Starting with the simplified external model described in footnote 20 and also in the assumptions matrix in Appendix D, removing all load and generation from external areas along with removing interfaces between external areas, followed by inserting fixed amounts of capacity in each external area.
5. **Different Load Shape - Resource Adequacy**
    - The RNA Base Cases use historical load shapes from 2002, 2006, and 2007 for resource

[20] During the 2020 RNA, the External Areas Model for the RNA Base Case was simplified to consolidate five PJM (mid-Atlantic) areas into a single area and eight ISO-NE areas into a single area.

adequacy analysis. The Climate Change Phase 1 study developed forward-looking hourly load shapes. Load shapes will continue to be discussed with the Load Forecast Task Force and other stakeholders.

The results of the scenarios 1-3 are summarized in the following sections; the exploratory scenarios 4 and 5 are in the **Appendix E**; the 70x30 scenarios are in **Section 8** below.

High Load Forecast Scenario

The RNA Base Case forecast includes impacts associated with projected energy reductions coming from statewide energy efficiency and behind-the-meter solar PV programs. The High Load Forecast scenario excludes these energy efficiency program impacts from the peak forecast, resulting in the higher forecast levels. The comparison of the High and Baseline forecasted loads is provided in the Figure 53 below. There is an increase of 2,388 MW in the peak load in 2030, as compared to the Base Case forecast. Given that the peak load in the High Load forecast is higher than in the Base Case, the probability of violating the LOLE criterion increases, and violations would occur starting in 2025. The NYCA LOLE results are in Figure 55.

Figure 53: 2020 Gold Book NYCA High Load vs. Baseline Summer Peak Forecast

Year	High Load	Baseline Load	Delta (High Load - Baseline Load)
2024	32,623	31,838	785
2025	32,641	31,711	930
2026	32,863	31,670	1,193
2027	33,163	31,673	1,490
2028	33,562	31,756	1,806
2029	33,976	31,865	2,111
2030	34,380	31,992	2,388

Figure 54: 2020 Gold Book Zone J High Load vs. Non-coincident Summer Peak Forecast

Year	High Load	Baseline Load	Delta (High Load - Baseline Load)
2024	11,751	11,557	194
2025	11,775	11,552	223
2026	11,884	11,609	275
2027	12,009	11,667	342
2028	12,158	11,747	411
2029	12,315	11,836	479
2030	12,467	11,924	543

Figure 55: 2020 RNA Resource Adequacy High Load Scenario NYCA LOLE Results

Study Year	2024	2025	2026	2027	2028	2029	2030
2020 RNA Base Case	0.04	0.08	0.10	0.12	0.14	0.17	0.19
High Load Scenario	0.07	0.15	0.19	0.26	0.35	0.49	0.63

This scenario indicates that if expected energy efficiency and peak load reduction programs do not materialize at expected levels, the criterion violations would be observed two years earlier, starting in 2025.

Zonal Resource Adequacy Margin (ZRAM)

The RNA Base Case results show that the LOLE is at the resource adequacy criterion in 2026 and exceeds 0.10 days/year starting in 2027.

Scenario analyses were performed to determine the amount of capacity in each zone that could be removed before the NYCA LOLE reaches 0.10 days/year, and offer another relative measure of how close the system is from violating reliability criteria. This simulation is applicable to any RNA Study Years that have LOLE levels that are below criterion, *i.e.*, from 2024 through 2026. The NYISO reduced capacity one zone at a time to determine when violations occur, in the same manner as the compensatory "perfect" MW are added to mitigate resource adequacy violations, but with the opposite impact. The zonal resource margin analysis is summarized in Figure 56.

Figure 56: Zonal Resource Adequacy Margin (MW)

Study Year	2024	2025	2026	2027	2028	2029	2030
LOLE	0.04	0.09	0.10*	0.12	0.14	0.17	0.19
Zone A	-850	-400	-50	-	-	-	-
Zone B	-850	-400	-50	-	-	-	-
Zone C	-1,500	-400	-50	-	-	-	-
Zone D	-1,500	-400	-50	-	-	-	-
Zone E	EZR	-400	-50	-	-	-	-
Zone F	-1,500	-400	-50	-	-	-	-
Zone G	-1,500	-400	-50	-	-	-	-
Zone H	EZR	EZR	-50	-	-	-	-
Zone I	EZR	EZR	-50	-	-	-	-
Zone J	-450	-50	0	-	-	-	-
Zone K	-1,400	-550	-150	-	-	-	-
Zones A-F	-1,500	-400	-50	-	-	-	-
Zones G-I	-1,500	-400	-50	-	-	-	-

Note: EZR - exceeds zonal resources (*i.e.*, all generation can be removed without causing a violation)

*LOLE for year 2026 is 0.097

The ZRAM assessment identifies a maximum level of capacity that can be removed from each zone without causing NYCA LOLE criterion violations. However, the impacts of removing capacity on the reliability of the transmission system and on transfer capability are highly location dependent. Thus, in reality, lower amounts of capacity removal are likely to result in reliability issues at specific transmission locations. The NYISO did not attempt to assess a comprehensive set of potential scenarios that might arise from specific unit retirements. Therefore, actual proposed capacity removal from any of these zones would need to be further studied in light of the specific capacity locations in the transmission network to determine whether any additional violations of reliability criteria would result. Additional transmission security analysis, such as N-1-1 analysis, would need to be performed for any contemplated plant retirement in any zone.

Status-Quo Scenario

This scenario evaluates the reliability of the system under the assumption that no major transmission or generation projects come to fruition within the RNA Study Period. This includes the removal of all proposed transmission and generation projects that have met 2020 RNA Base Case inclusion rules and removal of generators that require modifications to comply with the DEC's Peaker Rule.

The results of this scenario are in the Figure 57:

Figure 57: 2020 RNA Resource Adequacy Status-quo Scenario NYCA LOLE Results

Study Year	2024	2025	2026	2027	2028	2029	2030
Base Case	0.04	0.08	0.10	0.12	0.14	0.17	0.19
Status-quo Scenario	0.07	0.13	0.14	0.17	0.19	0.23	0.25

From a resource adequacy perspective, this scenario indicates that if expected generation and transmission projects are not built, the criterion violation advances by two years to 2025.

The steady state transmission security results show, as compared to the RNA base case, additional overloads are observed under N-1-1 conditions in the Orange and Rockland and the Con Edison service territories. No additional voltage issues were observed. The results of the steady state transmission security N-1-1 evaluation of the BPTF for this scenario are shown in Figure 58.

Figure 58: 2020 RNA Transmission Security Status-quo Scenario Results

Zone	Owner	Circuit	Observed in RNA Base Results
G	O&R	Chester-Shoemaker 138 kV (27)	
G	O&R	Chester-Sugarloaf 138 kV (28)	
G	O&R	Shoemaker-Shoemaker Tap (29)	
G	O&R	Middletown Tap/Shoemaker Tap 345/138 kV	
I/J	ConEd	Sprainbrook- W49th St 345 kV (51)	X
I/J	ConEd	Sprainbrook- W49th St 345 kV (52)	X
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	X
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	X
I/J	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	X
I/J	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	X
I/J	ConEd	Dunwoodie 345/138 kV (W73)	X
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	X
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	X
J	ConEd	Goethals-Gowanus 345 kV (26)	X
J	ConEd	Goethals-Gowanus 345kV (25)	X
J	ConEd	Farragut 345/138 kV (TX8)	
J	ConEd	Farragut 345/138 kV (TX9)	

8. 70x30 Scenario

The Climate Leadership and Community Protection Act (CLCPA) mandates that New York consumers be served by 70% renewable energy by 2030 (70x30). The CLCPA includes specific technology based targets for distributed solar (6,000 MW by 2025), storage (3,000 MW by 2030), and offshore wind (9,000 MW by 2035), and ultimately establishes that the electric sector will be emissions free by 2040. Significant shifts are expected in both the demand and supply sides of the electric grid, and these changes will affect how the power system is currently planned and operated. To assist the evaluation of these impacts, the 2019 CARIS 70x30 scenario kicked-off the assessment using production cost simulation tools to provide a "first look." Focusing on the impact to energy flows, the NYISO modeled these policy targets for the year 2030 in order to examine potential system constraints, generator curtailments, and other operational limitations.

Subsequent studies, such as this 2020 RNA scenario, as well as the *Climate Change Impact and Resilience Phase II Study*, build upon the findings of the 2019 CARIS scenario, and provide further insight focusing on system reliability aspects such as transmission security and resource adequacy.

As policymakers advance the implementation plan of the CLCPA, the NYISO assessments are intended to complement their efforts, and are not intended to define the specific steps that must be taken to achieve the policy goals. Additional refinements in assumptions, models, and methods in the following years will be necessary as more information becomes available from policy implementation perspectives and simulation methods and models perspectives.

Scope

This 70x30 Scenario consists of a series of cases to study the potential reliability impact of several renewable energy mix and load levels assumptions. This study does not define the formula to calculate the percentage of renewable energy relative to end-use energy, (*i.e.,* how to account for 70% renewable energy for the "70 by 30" target). As policymakers advance on the implementation plan of CLCPA, this NYISO assessment is intended to complement their efforts, and is not intended to define the specific steps that must be taken to achieve the policy goals. Instead, the findings are intended to provide insight into the resource adequacy and transmission security reliability impacts of two load levels and their corresponding renewable resources mix evaluated in the 2019 CARIS Phase I study. The goal of the analysis is to augment the CARIS insights on congestion and curtailments with reliability perspectives.

A number of key modeling assumptions and approaches may have major impact on the results. To help readers understand the scope of this assessment, considerations that are outside of the scope of this analysis are described below:

1. **Percentage of renewable energy relative to end-use energy:** This study does not define the formula to calculate the percentage of renewable energy relative to end-use energy, (*i.e.,* how to account for 70% renewable energy for the 70 by 30 or 70x30 target). Rather, two potential renewable build-out levels were defined and modeled in the 2019 CARIS study, (and used in this study), for corresponding load levels to approximate the potential future resource mix in 2030.

2. **Renewable mix modeling**

   I. **Siting and sizing**: New renewable generators are modeled as interconnecting to 115 kV or greater bus voltage levels, guided by the NYISO Interconnection Queue. There are many alternative possible interconnection points, but this assessment assumes a single approach for sizing and siting of renewable generation. Impacts of siting generators at lower voltage buses are outside the scope of this study. Nevertheless, the NYISO recognizes that constraints at the distribution level will affect the downstream constraints, which may change the energy flows at the higher voltage level.

   II. **Operational constraints:** Renewable resources are modeled as 8,760 hourly resource shapes for the resource adequacy MARS simulations. These generation profiles are synthetically generated resource shapes constructed using publicly available data and tools. This deterministic modeling approach will not capture the uncertainty involved with particular renewable resources.

   Also, this analysis does not consider potential reliability impacts due to:

   - Changes on the transmission system as a result of the resource additions or subtractions;
   - Unit commitment, ramp rate constraints, and other production cost modeling techniques;
   - Sub-hourly variation in renewable generation.

3. **Transmission system modeling:** These scenarios are not an interconnection level assessment of the renewable buildouts, and do not review detailed engineering requirements, capacity deliverability, or impact to the New York system reserve margin. Also, for the resource

adequacy evaluations, the MARS topology was only slightly changed to restrict flows from Zone K to Zone J, due to DEC Peaker Rule related unit retirement assumptions. No other change was implemented to reflect the impacts of any modification simulated in the scenarios, such as the addition of renewable resources, and the removal of fossil-fueled units.

4. **External area representation:** As the neighboring regions develop their own plans to achieve higher renewable generation penetration, those regions' demand, generation supply, and transmission system may change. At the time of this report, the plans for NYISO's neighboring regions are taking shape. The external area representation remains consistent with the RNA Base Case. An, exception is the HQ's model, where import from Hydro Quebec (HQ) to Zone D is modeled as a unit in MARS with hourly MW shape from the CARIS output into Zone D along with the addition of a 1,310 MW proxy tie from Hydro Quebec (HQ) to Zone J. If the neighboring areas increase their renewable generation, it is possible that the renewable curtailment amounts assumed in the New York system from this analysis are underestimated.

5. **COVID-19 impacts:** Due to the rapidly evolving nature of the pandemic, the impacts to the load forecast and other economic indicators are difficult to predict, and are not included in these scenarios.

Assumptions

The RNA 70x30 Scenario assumptions are based on the 2019 CARIS 70x30 renewable resource mix and associated load forecasts. The *2019 CARIS* assumptions were based on the *2019 Gold Book*, and used GE MAPS for production cost simulations, and its findings are intended to provide insight of the extent to which transmission constraints may prevent the delivery of renewable energy to New York consumers. The RNA 70x30 Scenarios is intended to supplement the 2019 CARIS 70x30 analysis of congestion and resource curtailment by providing insights on potential reliability impacts.

The 2019 CARIS 70x30 Scenario assessed two load levels labeled as 'Base Load' and 'Scenario Load' (described below). The production cost simulation utilized an hourly load profile for each of the load levels, and the simulation output provided an hourly dispatch profile for the two renewable resource mixes. The hourly dispatch profiles take into consideration transmission constraints that cause curtailments, as identified and described in the *2019 CARIS* report. That simulation output is utilized in this RNA scenario to the resource adequacy and transmission security models, as applicable.

The scenario cases also reflect removal of all of the peaker units, including those which subsequently provided compliance plans, affected by the DEC Peaker Rule in 2023 and 2025. For consistency with the 2019 CARIS 70x30 Scenario, the scenario cases includes removal of those peakers kept in service in the RNA Base. This includes removal of 1,232 MW of peaking generators from Zone K.

Load Assumptions

Two load models from the 2019 CARIS 70x30 Scenario are used for the RNA 70x30 Scenario:

1. **'Base Load',** representing a higher energy shape (153 TWh) and a higher peak forecast (31,303 MW); the 2002 load shape (8,760 hours) was scaled up to 2028 energy forecast from the 2019 Gold Book. The same load shape was used for all MARS load levels; and

2. **'Scenario Load',** representing lower energy shape (136 TWh) and a lower peak forecast (25,312 MW); the CARIS-developed load shape was scaled to match CARIS 70x30 'Scenario Load' energy and peak demand forecast. The same load shape was used for all MARS load levels.

Figure 59: Summer Energy and Peak Demand Forecast Zonal Distribution

70x30 Base Load	A	B	C	D	E	F	G	H	I	J	K	NYCA
Net Load Energy (GWh)	14,590	9,695	15,394	5,337	7,095	11,312	9,544	2,807	5,881	51,749	19,608	153,012
Net Load Peak (MW)*	2,537	1,937	2,653	718	1,264	2,197	2,174	637	1,405	11,589	4,730	31,303
+ BtM-PV at Zonal Peak (MW)	368	60	556	13	518	584	246	35	35	352	102	2,757
Total Load Peak (MW)	2,905	1,997	3,209	731	1,782	2,781	2,420	672	1,440	11,941	4,832	34,060

70x30 Scenario Load	A	B	C	D	E	F	G	H	I	J	K	NYCA
Net Load Energy (GWh)	13,034	7,757	12,626	5,101	5,694	9,654	7,911	2,848	5,952	46,354	19,026	135,958
Summer Net Load Peak (MW)*	2,112	1,417	2,171	651	1,052	1,988	1,912	625	1,385	9,129	3,914	25,312
+ BtM-PV at Summer Zonal Peak (MW)	77	16	0	0	0	0	22	2	5	64	24	269
Total Summer Load Peak (MW)	2,189	1,433	2,171	651	1,052	1,988	1,934	627	1,390	9,193	3,938	25,581
Winter Net Load Peak (MW)*	2,234	1,310	2,264	740	1,246	1,934	1,607	636	1,065	7,344	3,841	23,779
+ BtM-PV at Winter Zonal Peak (MW)	0	0	0	0	0	0	0	0	0	0	0	0
Total Winter Load Peak (MW)	2,234	1,310	2,264	740	1,246	1,934	1,607	636	1,065	7,344	3,841	23,779

Note: *Non-coincident zonal peak

Because the 2019 CARIS assumptions are based on the *2019 Gold Book*, Figure 60 is a comparison of the 2019 and 2020 Gold Book loads, for information.

Figure 60: Load and Energy Comparison between the 2019 and 2020 Gold Book Forecasts

Energy (GWh)	A	B	C	D	E	F	G	H	I	J	K	NYCA
70x30 Base Load	14,590	9,695	15,394	5,337	7,095	11,312	9,544	2,807	5,881	51,749	19,608	153,012
2020 GB Y2030	13,931	9,461	15,371	5,925	7,176	11,293	8,713	2,994	5,566	49,450	19,894	149,774

Energy Delta (GWh)	A	B	C	D	E	F	G	H	I	J	K	NYCA
70x30 Base Load - 2020 GB Y2030	659	234	23	-588	-81	19	831	-187	315	2,299	-286	3,238

Summer Non-Coincident Peak (MW)	A	B	C	D	E	F	G	H	I	J	K	NYCA Coincident Peak
70x30 Base Load	2,537	1,937	2,653	718	1,264	2,197	2,174	637	1,405	11,589	4,730	31,303
2020 GB Y2030	2,748	2,004	2,813	734	1,318	2,353	2,139	660	1,494	11,924	4,690	31,992

Summer Non-Coincident Peak Delta (MW)	A	B	C	D	E	F	G	H	I	J	K	NYCACoincident Peak
70x30 Base Load - 2020 GB Y2030	-211	-67	-160	-16	-54	-156	35	-23	-89	-335	40	-689

Coincident peak demand is the projected zonal load during the date and hour of the NYCA system-wide peak. The NYCA coincident peak typically occurs in late afternoon during July or August. Non-coincident peak demand is the projected maximum load for each individual zone across a year or season.

Renewable Mix Assumptions

For the two load levels assessed in the 2019 CARIS 70x30 Scenario, the NYISO assumed a renewable resource mix distributed across the state by zone. This RNA 70x30 Scenario models the same zonal renewable resource distribution. The nameplate capacity of the renewable resource mix is provided in Figure 61 below.

Figure 61: Renewable Mix Assumptions for each Load Level

70x30 'Base Load Case' (Nameplate MW)

Zone/Type	OSW	LBW	UPV	BTM-PV
A	-	2,286	4,432	995
B	-	314	505	298
C	-	2,411	2,765	836
D	-	1,762	-	76
E	-	2,000	1,747	901
F	-	-	3,592	1,131
G	-	-	2,032	961
H	-	-	-	89
I	-	-	-	130
J	4,320	-	-	950
K	1,778	-	77	1,176
Total	**6,098**	**8,772**	**15,150**	**7,542**

70x30 'Scenario Load Case' (Nameplate MW)

Zone/Type	OSW	LBW	UPV	BTM-PV
A	-	1,640	3,162	995
B	-	207	361	298
C	-	1,765	1,972	836
D	-	1,383	-	76
E	-	1,482	1,247	901
F	-	-	2,563	1,131
G	-	-	1,450	961
H	-	-	-	89
I	-	-	-	130
J	4,320	-	-	950
K	1,778	-	77	1,176
Total	**6,098**	**6,477**	**10,832**	**7,542**

Additional modeling details, by type:

- **Land-based wind (LBW):** Hourly dispatch profiles (MWh shapes) are applied from CARIS simulation output, including curtailments observed in the production simulation, for each of the two load shapes. CARIS used the 2009 National Renewable Energy Laboratory (NREL) hourly data as input.
- **Off-shore wind (OSW):** Hourly dispatch profiles (MWh shapes) are applied from CARIS simulation output, including curtailments observed in the production simulation, for each of the two load shapes. CARIS used the 2009 National Renewable Energy Laboratory (NREL) hourly data as input.
- **Utility-scale PV (UPV):** Hourly dispatch profiles (MWh shapes) are applied from CARIS simulation output, including curtailments observed in the production simulation, for each of the two load shapes. CARIS used the 2017 production data for existing plants and the 2006 NREL hourly data for new plants as input.
- **Behind-the-Meter PV (BtM PV):** Hourly dispatch profile (MWh shapes) are applied from CARIS simulation output, for each of the two load shapes. The CARIS behind-the-meter solar profiles are based on hourly shapes created using NREL's PV Watt tool.

Storage Assumptions

A four-hour battery storage is modeled in each NYISO zone, using the newly developed GE MARS Energy Limited Resource Type 4 (EL4) model.[21] The scenario assumes the same zonal MW distribution modeled in the 2019 CARIS 70x30 scenario, as shown in the Figure 62 below. In these simulations, the EL4 units discharge their MW when the system is deficient, and recharge their energy when the system has an excess of capacity. Units are modeled with a maximum energy discharge per day of four times their maximum hourly discharge value. This paradigm allows the unit to discharge fully in four hours, or for longer if not at full discharge. Also, at this time, only 100% roundtrip efficiency can be modeled in MARS, which does not account for losses in charge/discharge cycle.

[21] The MARS Energy Limited Resource type 4 (EL4) unit was introduced in the GE MARS version 3.29.1499 to better reflect battery behavior.

Figure 62: Storage Zonal MW Distribution

Zone	MW
A	150
B	90
C	120
D	180
E	120
F	240
G	100
H	100
I	100
J	1,320
K	480
NYCA	3,000

External areas

PJM, Ontario and ISO-NE are modeled using same method as 2020 RNA Base Case. Imports from Hydro Quebec (HQ) to Zone D are modeled as a generator in MARS with an hourly MW shape from the CARIS output. Consistent with the CARIS assumptions, the model for this 70x30 Scenario includes a generic HVDC tie from HQ directly to Zone J, capable of 1,310 MW. The generic HVDC tie is modeled as a generator in MARS with an hourly MW shape from the CARIS output.

Resource Adequacy Methodology and Results

GE's MARS program is used for resource adequacy analysis of the 70x30 Scenario. The GE MARS tool employs a sequential Monte Carlo simulation method, and calculates, on an area and system basis, standard reliability indices such as daily and hourly LOLE (days/year and hours/year). New MARS cases were developed based on the assumptions described above, and sensitivities were performed to better understand the impact of various factors. The three steps described above are detailed in the following pages.

Step 1: Renewable Mix on Two Load Levels

Model the 70x30 'Base Load' and 'Scenario Load' along with their corresponding renewable resources mix output and calculate NYCA LOLE.

These initial resource adequacy simulations did not identify a measurable LOLE in either the 'Base Load' or 'Scenario Load' 70x30 cases. This result occurs because large amounts of additional renewable generation were modeled to meet the 70% energy goal, while retaining in the models the existing fossil fuel generators; which in turn leads to an increase in the available generation. In addition, the transmission system model (MARS topology) was not revised to reflect the potential impacts of increasing the penetration of renewable resources.

Figure 63 and Figure 64 below show the resource mix for the two load levels with the renewables added and no fossil removal.

Figure 63: Resource Mix in the 70x30 'Base Load' Case before Capacity Removal

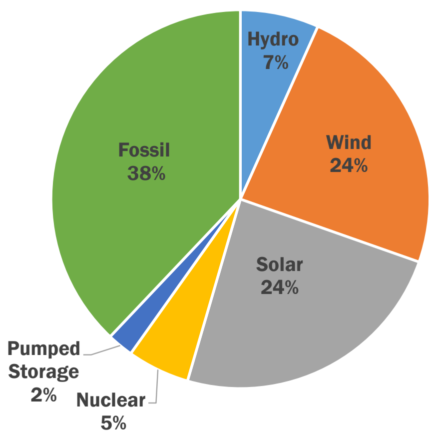
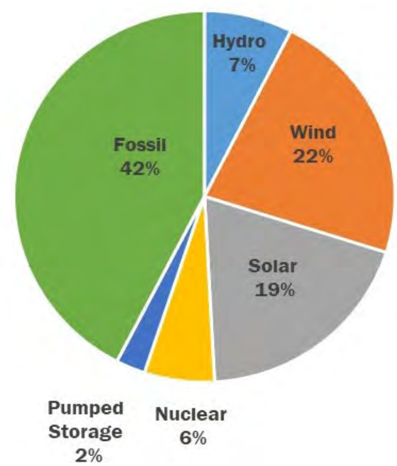


Figure 64: Resource Mix in the 70x30 'Scenario Load' Case before Capacity Removal



Step 2: Capacity Removal

Additional simulation were performed to gauge the sensitivity of the system to capacity removal. Two types of removals are simulated, with results in the figures below:

- A Zonal Resource Adequacy Margin (ZRAM) analysis: ZRAM analysis identifies the amounts of generic "perfect capacity" resources that can be removed from a zone while still meeting the LOLE criterion. "Perfect capacity" is capacity that is not derated (*e.g.,* due to ambient temperature or unit unavailability caused by factors such as equipment failures or lack of fuel), not subject to energy duration limitations, and not tested for transmission security or interface impacts. Actual resources would need to be larger in order to achieve the same impact as perfect-capacity resources.
- An age-based retirement analysis where fossil units are removed from the model, starting with the oldest, until the New York system is at LOLE criteria. This age-based approach is a simple analytical approach as a proxy to represent unit retirements that may occur as surplus resources increase. In reality many factors will affect specific generator status decisions.

Figure 65: ZRAM Results on the Initial 70x30 Cases

Cases	NYCA LOLE	ZONE A	ZONE B	ZONE C	ZONE D	ZONE E	ZONE F	ZONE G	ZONE H	ZONE I	ZONE J	ZONE K
Base Case	0.19	∞	∞	∞	∞	∞	∞	∞	∞	∞	350	∞
70x30 Base Load Case	0.00	-2,400	EZR	-5,200	-1,750	EZR	-7,200	-5,400	EZR	EZR	-1,500	-1,250
70x30 Scenario Load Case	0.00	-3,550	EZR	-5,550	-1,750	EZR	EZR	EZR	EZR	EZR	-4,200	-1,400

Notes:

- Negative numbers indicate the amount of MW that can be removed from a zone (one zone at a time in this case) without causing a violation. For instance, NYCA LOLE reaches 0.1 days/year when 1,500 MW of "perfect capacity" is removed from Zone J in the 'Base Load' Case.
- EZR - exceeds zonal resources: *i.e.,* all generation from the respective zone can be removed without causing a NYCA LOLE violation.
- The generation pockets in Zone J and Zone K are not modeled in detail in MARS, and the values identified here may be larger as a result.

The ZRAM analysis results show that many of the zones in the NYCA can have all internal resources removed without causing a violation of the LOLE criterion (*i.e.*, those labeled 'EZR'), a result pointing to the large renewable additions upstate.

Figure 66: Fossil Removal Based on 70x30 'Base Load' Scenario Cases

	Total Thermal Capacity Left (MW)				Cumulative Capacity Removed (MW)				
Cases (Age >=)	Zone J	Zone K	Other Zones	Total	Zone J	Zone K	Other Zones	Total	NYCA LOLE
Total	8,190	3,962	15,012	27,165	0	0	0	0	0.00
70	6,978	3,564	14,616	25,160	1,212	398	396	2,005	0.02
68	6,601	3,371	14,616	24,590	1,589	591	396	2,575	0.05
67*	6,386	3,360	14,616	24,364	1,804	602	396	2,801	0.11
67	6,236	3,360	14,616	24,214	1,954	602	396	2,951	0.15

Notes:

- Case 67: most, but not all units 67 and older were retired in this case.
- Case 67*: a special evaluation of Case 67 where the marginal unit was derated, instead of fully removed, to obtain an LOLE closer to 0.1 days/year.

The age-based analysis for the 'Base Load' scenario identifies that the removal of generators at least 67 years old would reduce the total capacity by 2,951 MW, which would exceed the LOLE criterion. An additional analysis was performed to bring the LOLE closer to the 0.1 days/year criterion by derating the capacity of the marginal unit (Case 67*), which identifies that the NYCA will exceed the LOLE criterion once 2,801 MW have been removed from the system, of which 1,804 MW is from Zone J. The age-based fossil removal method has the effect to primarily remove the units from Zones J and K, accelerating the rate of LOLE reaching its criterion violation. Because Zone J is driving the LOLE at criterion, and not upstate generation, additional fossil generation can be removed from the upstate zones without affecting the LOLE at criterion.

Figure 67, Figure 68 and Figure 69 below show the resources mix for NYCA, Zone J and Zone K respectively, with the renewables added and fossil removal up to the point of an LOLE criterion violation for 70x30 'Base Load' case. The fossil generation percentages are calculated based on the minimum of CRIS and DMNC, while solar and wind generation are based on nameplate rating.

Figure 67: NYCA Resource Mix in 70x30 'Base Load' Case at Criterion

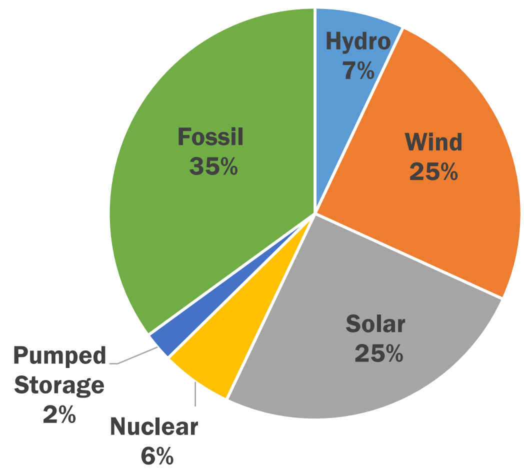


Figure 68: Zone J Resource Mix in 70x30 'Base Load' Case at Criterion

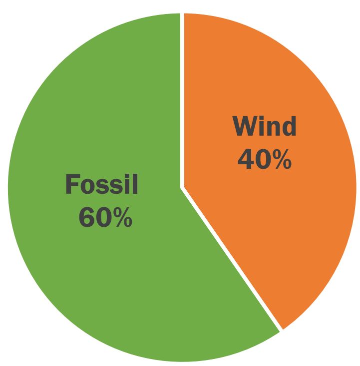


Figure 69: Zone K Resource Mix in 70x30 'Base Load' Case at Criterion

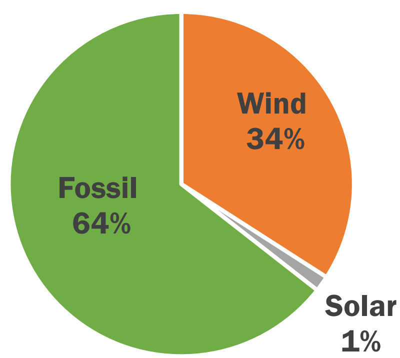


Figure 70 shows a comparison between the total installed capacity and unforced capacity for 70x30 Base Load case when the system is close to LOLE criterion. To bring the model to criterion, approximately 2,800 MW of fossil generation were removed resulting in an installed capacity margin of 191.8%, equivalent to an unforced capacity margin of 114%. Out of 2,800 MW, approximately 1,800 MW were removed from Zone J, resulting in installed capacity margin of 92% in Zone J, equivalent to unforced capacity margin of 61%.

Figure 70: 70x30 'Base Load' Load and Capacity Totals, ICAP vs. UCAP

	70x30 'Base Load' (ICAP)	70x30 'Base Load' (UCAP)[1]
NYCA Totals		
Load (net of BtM Solar)	31,303	31,303
Renewable Additions (offshore&land wind, utility solar)	30,020	7,861
Total capacity in the 70x30 model before age-based removal[2]	62,837	38,322
Total thermal capacity in the 70x30 model before age-based removal	27,165	25,444
Total fossil units in the 70x30 model before age-based capacity removal	23,822	22,175
Total nuclear in the 70x30 model before age-based capacity removal	3,343	3,269
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	2,801	2,629
Total capacity ("model at criterion")	60,036	35,693
Capacity/ Load Ratio	191.8%	114.0%
NY_J Totals		
Load (net of BtM Solar)	11,589	11,589
Total capacity in 70x30 Case	12,510	8,761
Total fossil units in 70x30 model before age-based fossil removal	8,190	7,602
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	1,804	1,701
Total capacity ("model at criterion")	10,706	7,060
Capacity/Load Ratio	92.4%	60.9%
NY_K Totals		
Load (net of BtM Solar)	4,730	4,730
Total capacity in 70x30 Case	5,782	4,400
Total fossil units in 70x30 model before fossil removal	3,962	3,745
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	602	579
Total capacity ("model at criterion")	5,180	3,821
Capacity/Load Ratio	109.5%	80.8%

Notes
1. UCAP calculation:
   - For thermal units, MARS EFORd data is used.
   - For renewables, UCAP is calculated based on the average output during peak hours.
2. Reflects additional peaker removal in Zone K.
3. Calculated based on 70x30 'Base Load' Case 67.*

Figure 71: Fossil Removal Based on 70x30 'Scenario Load'

	Total Thermal Capacity Left (MW)				Cumulative Capacity Removed (MW)				
Cases (Age >=)	**Zone J**	**Zone K**	**Other Zones**	**Total**	**Zone J**	**Zone K**	**Other Zones**	**Total**	**NYCA LOLE**
Total	8,190	3,962	15,012	27,165	0	0	0	0	0.00
50	4,354	1,541	11,228	17,124	3,836	2,421	3,784	10,041	0.03
40	4,354	1,393	10,247	15,995	3,836	2,569	4,765	11,170	0.07
39	4,354	1,349	10,197	15,901	3,836	2,613	4,815	11,264	0.09
38	3,563	1,325	9,935	14,824	4,627	2,637	5,077	12,341	0.11

The age-based analysis for the "Scenario Load" shows that the removal of generators at least 38 years old would cause NYCA to exceed the LOLE criterion. This equates to a removal of 12,341 MW from the system, with the zonal distribution shown in Figure 71. The age-based fossil removal method has the effect of primarily removing units from Zones J and K, accelerating the rate of reaching the LOLE criterion. Because mainly Zone K deficiencies are driving the LOLE at criterion in this scenario, additional fossil generation can be removed from the upstate zones without affecting the LOLE at criterion.

Figure 72, Figure 73 and Figure 74 below show the resource mix for NYCA, Zone J and Zone K respectively, with the renewables added and fossil removal until an LOLE violation results for 70x30 Scenario Load case. The fossil generation percentages are calculated based on minimum between CRIS and DMNC, while solar and wind generation are based on nameplate rating.

Figure 72: NYCA Resource Mix in 70x30 'Scenario Load' Case at Criterion

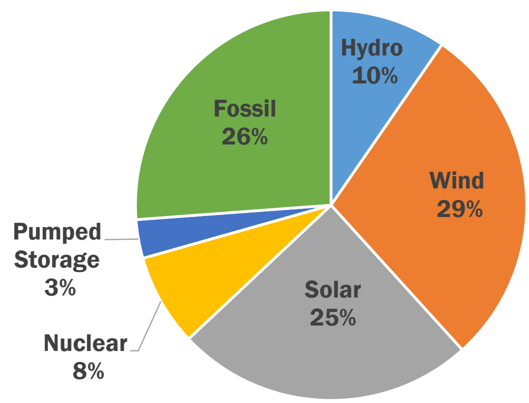


Figure 73: Zone J Resource Mix in 70x30 'Scenario Load' Case at Criterion

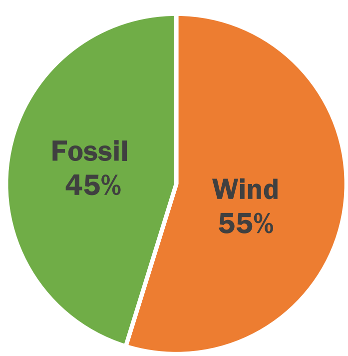


Figure 74: Zone K Resource Mix in 70x30 'Scenario Load' Case at Criterion

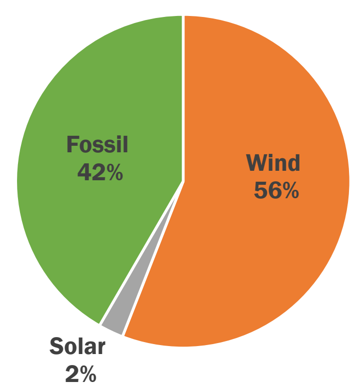


Figure 75 shows a comparison between the total installed capacity and unforced capacity for 70x30 Scenario Load case when the system is close to LOLE criterion violation. To bring the model to criterion, approximately 12,350 MW of fossil generation were removed resulting in an installed capacity margin of 173.4%, equivalent to an unforced capacity margin of 103.7%. Out of 12,350 MW, approximately 4,600 MW and 2,650 MW were removed from Zone J and Zone K, respectively resulting in installed capacity margin of 97% in Zone J and 80% in Zone K.

Figure 75: 70x30 'Scenario Load' Load and Capacity Totals, ICAP vs UCAP

	70x30 'Scenario Load' (ICAP)	70x30 'Scenario Load' (UCAP)[1]
NYCA Totals		
Load (net of BtM Solar)	25,312	25,312
Renewable Additions (offshore&land wind, utility solar)	23,407	6,082
Total capacity in the 70x30 model before age-based fossil removal[2]	56,224	36,543
Total thermal capacity in the 70x30 model before age-based removal	27,165	25,444
Total fossil units in the 70x30 model before age-based capacity removal	23,822	22,174
Total nuclear in the 70x30 model before age-based capacity removal	3,343	3,269
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	12,341	10,295
Total capacity ("model at criterion")	43,883	26,246
Capacity/ Load Ratio	173.4%	103.7%
NY_J Totals		
Load (net of BtM Solar)	9,129	9,129
Total capacity in 70x30 Case	13,460	8,759
Total fossil units in 70x30 model before age-based fossil removal	8,190	7,602
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	4,627	4,152
Total capacity ("model at criterion")	8,833	4,607
Capacity/Load Ratio	96.8%	50.5%
NY_K Totals		
Load (net of BtM Solar)	3,914	3,914
Total capacity in 70x30 Case	5,782	4,391
Total fossil units in 70x30 model before fossil removal	3,962	3,745
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	2,637	2,502
Total capacity ("model at criterion")	3,145	1,889
Capacity/Load Ratio	80.3%	48.3%

Notes
1. UCAP calculation:
- For thermal units, MARS EFORd data is used.
- For renewables, UCAP is calculated based on the average output during peak hours.

2. Reflects additional peaker removal in Zone K.
3. Calculated based on 70x30 'Scenario Load' Case 38.

Sensitivity: Nuclear Generation Retirement

As a sensitivity analysis for this capacity removal step, the nuclear units are removed from the system, which equates to the removal of 3,343 MW summer capacity, all located upstate. In this analysis, first the nuclear generation is removed, followed by the fossil plants removal by age until the LOLE criterion is violated. This exercise identifies how much fossil MW can be removed before exceeding the criterion. It is important to note these nuclear units may continue in operation beyond 2030 and this sensitivity analysis should not be interpreted as forecasting any deactivation.

Figure 76: Nuclear Retirement Sensitivity based on 70x30 "Base Load" Case

	Total Thermal Capacity Left (MW)				Cumulative Capacity Removed (MW)				
Cases (Age >=)	Zone J	Zone K	Other Zones	Total	Zone J	Zone K	Other Zones	Total	NYCA LOLE
Total	8,190	3,962	11,669	23,822	0	0	**3,343	3,343	0.00
70	6,978	3,564	11,273	21,817	1,212	398	3,739	5,348	0.02
68	6,601	3,371	11,273	21,247	1,589	591	3,739	5,918	0.06
67*	6,386	3,360	11,273	21,021	1,804	602	3,739	6,144	0.11
67	6,236	3,360	11,273	20,871	1,954	602	3,739	6,294	0.17

Notes:

- Case 67: most, but not all units 67 and older were retired in this case.
- Case 67*: a special evaluation of Case 67 where the marginal unit was derated instead of fully removed to obtain an LOLE closer to 0.1 days/year.
- **3,343: the amount of nuclear MW removed in the sensitivity.

Observations:

- The removal of the nuclear units did not significantly affect the LOLE results on the case before the age-based fossil removals, because the addition of upstate renewable resources outweigh the loss of nuclear capacity.
- The results previously identified in the age-based retirement analysis on the 'Base Load' case were effectively unchanged by the removal of the nuclear units. Specifically, the 3,343 MW of retirement of the upstate nuclear units does not significantly impact the NYCA LOLE results because the needs are driven by downstate capacity deficiencies. It is important to note that other benefits of existing generation, such as voltage and stability support, were not captured in this resource adequacy simulation.
- NYCA meets the LOLE criterion with 5,918 MW removed, of which 2,575 MW fossil (5,918 - 3,343 = 2,575).
- NYCA exceeds the LOLE criterion when 6,144 MW are removed (at 67*), of which 3,343 MW are nuclear units, and 2,801 MW are fossil-fueled units.

Figure 77: Nuclear Retirement Sensitivity based on 70x30 "Scenario Load" Case

Cases (Age >=)	Total Thermal Capacity Left (MW)				Cumulative Capacity Removed (MW)				NYCA LOLE
	Zone J	Zone K	Other Zones	Total	Zone J	Zone K	Other Zones	Total	
Total	8,190	3,962	11,669	23,822	0	0	**3,343	3,343	0.00
50	4,354	1,541	7,885	13,781	3,836	2,421	7,127	13,384	0.04
45	4,354	1,541	7,010	12,906	3,836	2,421	8,002	14,259	0.07
41	4,354	1,526	7,002	12,883	3,836	2,436	8,010	14,282	0.08
40	4,354	1,393	6,904	12,652	3,836	2,569	8,108	14,513	0.14

Observations:

- NYCA meets the LOLE criterion in 2030 with 14,282 MW of existing generation removed.
  - 14,282 – 3,343 nuclear = 11,170 MW fossil removed with nuclear units out of service, versus 11,264 MW fossil removed when nuclear units are modeled in service.
- As a result of the removal of nuclear units, the removal of 14,513 MW of thermal generation would exceed the LOLE criterion. Of that amount, 11,170 MW is from fossil fuel generators.

Sensitivity: Energy Storage Resources

One of the New York's CLCPA goals is to add 3,000 MW of energy storage resources by 2030. In this sensitivity, the storage resources are distributed across the NY system, and the age-based removal is simulated on both the initial 70x30 analysis from Step 1, and on the nuclear retirement sensitivity. Four-hour duration storage resources are assumed, using the MARS EL4 model.

For each of the two load cases, with the model at the LOLE criterion, the NYISO added storage based on the zonal distribution utilized in the CARIS 70x30 Scenario, and recalculated the NYCA LOLE to determine impact on resource adequacy.

Figure 78 identifies the amount of fossil fuel generation that is removed from the system to exceed the LOLE criterion.

Figure 78: Storage Sensitivity Fossil MW Removed by Age to Exceed LOLE

		Fossil MW Removed to Reach LOLE Criterion Violation	
		Nuclear In-Service	***3,343 MW Nuclear Out-Of-Service***
Base Load' case	Without ESRs	2,801	2,801
	With 3000 MW ESRs	3,062	3,037
Scenario Load' scenario case	Without ESRs	12,341	11,170
	With 3000 MW ESRs	13,133	11,550

Note: the values in this table should not be used to approximate the Effective Load Carrying Capability (ELCC) of storage resources because the analysis was not conditioned to perform this type of analysis.

On the ‘Base Load’ cases, the benefit of the energy storage resources is limited to around 250 MW (*i.e.*, with additional storage, and with or without the existing nuclear units, around 260 MW of additional fossil can be removed to reach NYCA LOLE violation).These effects occur mainly because of the location of the capacity shortfalls (in Zones J and K), due to the storage resource allocation (1,320 MW in Zone J and 480 MW in Zone K), and due to the duration of the events, with many longer than four hours.

For the Scenario Load cases, the energy storage resources have additional benefits. Specifically, with existing nuclear units in-service, and the additional storage resources in service, approximately 800 MW of additional fossil can be removed to reach LOLE violation. With existing nuclear units out of service, and the additional storage resources in service, approximately 380 MW of additional fossil can be removed to reach LOLE violation.

An additional simulation was performed to gauge the impact of using an eight-hour EL4 model on the ‘Base Load’ scenario. When comparing with the four-hour model, a lot more (*e.g*. approximately 1,450 MW for this specific simulation) fossil generation is removed until the LOLE criterion is exceeded. Results are shown in the Figure 79 below.

To better quantify the locational benefit of energy storage resources, a simulation was performed on the Base Load case that evaluated only modeling the Zone J resources. The results are consistent with those in Figure 78, indicating that for the modeled system energy storage resources are most effective in Zone J. This result is driven largely by the location of unit retirements in this scenario.

Figure 79: 4-Hour vs. 8-Hour Energy Storage Sensitivity

		Fossil MW Removed to Reach LOLE Criterion Violation (Nuclear in-service)	
		4-hour ESR	***8-hour ESR***
'Base Load' case	Without ESRs	2,801	2,801
	With 3000 MW ESRs	3,062	4,516

Sensitivity: Resolve Local Transmission Constraints

The production cost analysis performed in CARIS showed that renewable resources were curtailed due to local transmission bottlenecks. As part of the resource adequacy analysis, the NYISO modeled the output renewable shapes, including the CARIS-simulated curtailments, in the initial analysis. This sensitivity analyzes the impact of modeling the input renewables shapes with no curtailment reflected.

The use of non-curtailed renewables does not significantly affect the resource adequacy results. This output demonstrates that alleviating the local constraints that caused the curtailments, while beneficial from an annual energy production perspective as shown in CARIS, does not offset the need for dispatchable generation to meet reliability requirements at peak load.

Transmission Security Methodology and Results

The purpose of this assessment is to identify reliability risks focusing on the steady-state thermal loading on the BPTF for N-1 and N-1-1 conditions. The transmission security assessment for 70x30 models six different output levels of intermittent renewable resources and load levels. The basis for the load and renewable resource mix is the 70x30 Base Load case. Figure 80 shows the load level for each case along with the assumption for land-based wind, off-shore wind, and solar. For the solar dispatch, both the behind-the-meter and in front of the meter solar are dispatched to the same percentage. Dispatchable resources are needed to fill the gaps created when intermittent renewable resources are not producing sufficient power to serve load. The amount of dispatchable resources included in the transmission security base case is approximately 24,700 MW (after age-based removals and peaker removals).

Figure 80: 70x30 Scenario Transmission Security Case Assumptions ('Base Load' Case)

Case #	Case Load (Net Load including BtM solar reductions, MW)	Land-Based Wind	Off-Shore Wind	Solar
		(% of Pmax)	(% of Pmax)	(% of Pmax)
1	Day Peak Load (30,000)	10	20	45
2	Evening Peak Load (31,100)	0	0	0
3	Light Load (12,500 MW)	15	45	0
4	Light Load (12,500 MW)	0	0	0
5	Shoulder Load (21,500 MW)	0	0	40
6	Shoulder Load (21,500 MW)	15	45	40

The age-based fossil removals for the Base Load resource adequacy scenario, with no energy storage resources (ESR), are also modeled in this assessment, including the removal of units that were in service prior to January 1, 1963. This removal amounts to a total of 2,586 MW summer capability. The 2,586 MW removal is utilized in the transmission security analysis, as it is the last point of generation removal prior to observing resource adequacy LOLE violations.

The pairings of similar load levels (*e.g.,* Cases 1 & 2, Cases 3 & 4, and Cases 5 & 6) with different levels of renewable resource penetration shows that a balance in load and generation is achievable (*i.e.,* the case was able to match load plus losses with the available generation under N-0). While transmission security analysis for this assessment does not consider an 8,760-hour type of load and generation variety, the six cases considered cover, within reasonable bounds, load levels that can be seen for many hours. For all cases (except Case 2), the renewable generation mix shown in Figure 80 was selected based on observations from the CARIS 70x30 'Base Load' results for similar load levels. Case 2 reflects the potential for an evening peak load assuming no MW output from the wind and solar resources. The evening peak load reflects approximately 93% of the peak load observed during the day peak with no output from the behind-the-meter solar. For this assessment, after peaker generation removals and age-based removals, both 10-minute and 30-minute operating reserve levels were maintained by utilizing the remaining synchronous generation.

Case 1 and Case 2 result in N-1 thermal loading criteria violations. These violations are observed on the Rainey 345/138 kV (8W) (both Case 1 and Case 2) and the Rainey 345/138 kV (8E) (Case 1 only) transformers. These violations are primarily driven by local load pocket deficiencies created by the age-based generation removals. No N-1 thermal loading criteria violations are observed in Cases 3, 4, 5, or 6.

Case 1 and Case 2 have N-1-1 thermal loading criteria violations. These violations are summarized in Figure 81. In addition to the transmission security issues observed in the RNA Base Case, overloads are observed in the O&R and PSEG-LI service territories.

The thermal loading issues indicate transmission constraints that may occur with high renewable output, as well under peak load conditions without these resources. To secure the transmission system, additional dispatchable resources would be needed. To maintain system transmission security, approximately 750 MW of dispatchable resources would be needed in addition to the 24,700 MW of dispatchable resources remaining in the model (*i.e*. after age-based removals and peakers). This assessment did not consider the potential duration of the deficiencies or the sudden loss of all off-shore wind. Rather, contingency events for renewable resources only considered loss of resources due to electrical faults. For all cases, the NYISO locational reserves requirements were achieved by utilizing dispatchable generation.

Figure 81: N-1-1 Thermal Load Criteria Violations

Zone	Owner	Circuit	Observed in RNA Base Results	Case 1	Case 2
G	O&R	Shoemaker-Shoemaker Tap (29)		x	x
G	O&R	Middletown Tap/Shoemaker Tap 345/138 kV		x	x
J	ConEd	Sprainbrook-W49th St 345 kV (51)	x	x	x
J	ConEd	Sprainbrook-W49th St 345 kV (52)	x	x	x
J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	x	x	x
J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	x	x	x
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	x	x	x
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	x	x	x
J	ConEd	Goethals-Gowanus 345 kV (26)	x		x
J	ConEd	Goethals-Gowanus 345kV (25)	x		x
J	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	x	x	x
J	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	x	x	x
J	ConEd	Rainey West - Farragut East 345 kV (61)		x	x
J	ConEd	Rainey 345/138 kV (8W)		x	x
J	ConEd	Rainey 345/138 kV (8E)		x	
K	LIPA	Dunwoodie - Shore Rd 345 kV (Y50)			x
K	LIPA	Kings - Pilgrim 138 kV (880)			x
K	LIPA	Kings - West Bus 138 kV			x
K	LIPA	Elwood 2 - Greenlawn 138kV (138-673)			x
K	LIPA	Valley Stream 2 - East Garden City 2 138 kV			x
K	LIPA	Syosset - Greenlawn 138 kV (138-676)			x
K	LIPA	Syosset - Oakwood 138 kV (138-675)			x
K	LIPA	Northport 3 - Pilgrim 138 kV (138-679)			x
K	LIPA	Northport 1 - Pilgrim 138 kV (138-677)			x
K	LIPA	Elwood 1 - Northport 2 138 kV (138-681)			x

Key Findings of the 70x30 Scenario

As policymakers advance an implementation plan for the CLCPA, this assessment is intended to complement their efforts and provide information about possible challenges. The 70x30 RNA scenario builds on the 2019 CARIS 70x30 scenario to model state-mandated policy goals, and supplements the 2019 CARIS Key Findings.

1. **Adding renewables:** The NYCA system represented in cases with the renewable resource mix added is reliable with a significant surplus of resources when not taking into consideration potential retirements.
2. **Surplus generation:** Depending on load, approximately 10% (70x30 Base Load) - 45% (70x30 Scenario Load) of fossil plants could be removed before exceeding LOLE criterion. The age-based approach to remove fossil plants results in concentrating the removal in zones that had the least amount of generation surplus. The total fossil removal also depends on other factors such as unit unavailability, maintenance and location.
3. **Nuclear sensitivity:** Retirement of nuclear plants would result in less surplus capacity and therefore more conventional generation (currently fossil-fueled) would need to be retained in order to maintain a reliable system.
4. **Energy storage resources:** Energy storage resources may provide a benefit to the system from a reliability standpoint by assisting in meeting peak load (subject to limitations identified in this report), thus allowing for additional fossil units to be retired. Resources with a duration longer than four hours would provide additional benefit to the system.
5. **Curtailments due to local constraints**: Alleviating the local transmission constraints that cause renewable curtailments, while beneficial from an annual energy production perspective as shown in CARIS, would not significantly offset the need for conventional generation to meet system demands reliably.
6. **Dispatchable generation**: Even with a high output from intermittent renewable resources, there is still a need for significant amounts of dispatchable generation to meet reliability requirements at various times throughout the year, including peak load. Dispatchable resources would be needed to fill the gaps created when intermittent renewable resources are not producing energy. Even with a large amount of installed capacity of renewable resources, there would still be a need for significant dispatchable generation to meet reliability requirements at various times throughout the year, including peak load. To maintain system

transmission security, approximately 750 MW of dispatchable resources would be needed in addition to the 24,700 MW of dispatchable resources remaining in the model (*i.e*. after age-based removals and peakers).

7. **Additional Resource Adequacy Considerations**: The resource adequacy simulations did not consider potential reliability impacts due to:
   - Intra-zonal constraints on the transmission system;
   - Changes on the transmission system as a result of the resource additions or subtractions; and
   - Unit commitment, ramp rate constraints, and other production cost modeling techniques.
8. **Transmission security thermal considerations:** Thermal loading issues are observed in the peak load case with a high penetration of land-based wind, off-shore wind, and solar, as well as in a peak case without these resources. Dispatchable resources beyond those identified in resource adequacy would be needed in the downstate area to address thermal reliability criteria violations.

The NYISO will continue to monitor and track system changes. Subsequent studies, such as the Comprehensive Reliability Plan, the Climate Change Impact and Resilience Study, and future economic and public policy planning studies will build upon the findings of this 70x30 Scenario. To inform policymakers, investors and other stakeholders as implementation unfolds, these forward-looking studies will provide further assessment of the CLCPA.

9. Reliability Compliance Obligations and Activities

The Reliability Needs Assessment is not the only NYISO work product or activity related to reliability planning. The purpose of this section is to discuss the NERC Planning Coordinator and Transmission Planner obligations fulfilled by the NYISO as well as the other NPCC and NYSRC planning compliance obligations. The NYISO has various compliance obligations under NERC, NPCC, and the NYSRC. The periodicity of these requirements varies amongst the standards and requirements. While achieving compliance with all NERC, NPCC, and NYSRC obligations is critical to ensuring the continued reliability of the transmission system, this section primarily discusses in some detail the planning compliance requirements that closely align with this Reliability Needs Assessment. The full details of the compliance obligations are found within the reliability standards and requirements themselves. Publically available results for the compliance activities listed below are found on the NYISO website under Planning – Reliability Compliance[22].

The purpose of the NERC Reliability Standards is to "define the reliability requirements for planning and operating the North American bulk power system and are developed using a results-based approach that focuses on performance, risk management, and entity capabilities." The objective of NPCC Directory #1 and the NYSRC Reliability Rules and Compliance Manual are to provide a "design-based approach" to design and operate the bulk power system to a level of reliability that will not result in the loss or unintentional separation of a major portion of the system from any of the planning and operations contingencies with the intent of avoiding instability, voltage collapse and widespread cascading outages. Figure 82 shows the various NERC Standards with requirements applicable to the NYISO as a NERC registered Planning Coordinator and/or Transmission Planner. The NPCC planning compliance obligations are primarily located in NPCC Regional Reliability Reference Directory #1 Design and Operation of the Bulk Power System. The NYSRC planning compliance obligations are located in the Reliability Rules and Compliance Manual.

Fundamental to any reliability study is the accuracy modeling data provided by the entities responsible for providing the data. The data requirements for the development of the steady state, dynamics, and short circuit models is provided in the NYISO Reliability Analysis Data Manual (RAD Manual).[23] This data primarily comes from compliance with NERC MOD standards. Much of this data is collected through the annual database update process outlined in the RAD Manual and the annual FERC Form 715 filing to which the transmitting utilities certify, to the best of their knowledge, the accuracy of the

[22] https://www.nyiso.com/planning-reliability-compliance

[23] https://www.nyiso.com/documents/20142/2924447/rel-anl-data-mnl.pdf

data. Additional compliance obligations provide for the accuracy of the modeling data through comparison to actual system events (*e.g.,* MOD-026, MOD-026, and MOD-033).

Following the completion of the annual database update, these databases are used for study work such as the Reliability Planning Process, and for many other compliance obligations such as those listed in Figure 82. Planning studies similar to the Reliability Planning Process include the NPCC/NYSRC Area Transmission Reviews (ATRs) and the NERC TPL-001 assessments.

Figure 82: List of NERC Standards for Planning Coordinators and Transmission Planners

Standard Name	Title	Purpose
FAC-002	Facility Interconnection Studies	To study the impact of interconnecting new or materially modified Facilities to the Bulk Electric System.
FAC-010	System Operating Limits Methodology for the Planning Horizon	To ensure that System Operating Limits (SOLs) used in the reliable planning of the Bulk Electric System (BES) are determined based on an established methodology or methodologies.
FAC-013	Assessment of Transfer Capability for the Near-Term Transmission Planning Horizon	To ensure that Planning Coordinators have a methodology for, and perform an annual assessment to identify potential future Transmission System weaknesses and limiting Facilities that could impact the Bulk Electric System's (BES) ability to reliably transfer energy in the Near-Term Transmission Planning Horizon.
FAC-014	Establish and Communicate System Operating Limits	To ensure that System Operating Limits (SOLs) used in the reliable planning and operation of the Bulk Electric System (BES) are determined based on an established methodology or methodologies.
IRO-017	Outage Coordination	To ensure that outages are properly coordinated in the Operations Planning time horizon and Near-Term Transmission Planning Horizon.
MOD-020	Providing Interruptible Demands and Direct Control Load Management Data to System Operators and Reliability Coordinators	To ensure that assessments and validation of past events and databases can be performed, reporting of actual demand data is needed. Forecast demand data is needed to perform future system assessments to identify the need for system reinforcement for continued reliability. In addition to assist a proper real-time operating, load information related to controllable Demand-Side Management programs is needed.
MOD-026	Verification of Models and Data for Generator Excitation Control System or Plant Volt/VAR Control Functions	To verify that the generator excitation control system or plant volt/var control function model (including the power system stabilizer model and the impedance compensator model) and the model parameters used in dynamic simulations accurately represent the generator excitation control system or plant volt/var control function behavior when assessing Bulk Electric System (BES) reliability.
MOD-027	Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions	To verify that the turbine/governor and load control or active power/frequency control model and the model parameters, used in dynamic simulations that assess Bulk Electric System (BES) reliability, accurately represent generator unit real power response to system frequency variations.

Standard Name	Title	Purpose
MOD-031	Demand and Energy Data	To provide authority for applicable entities to collect Data, energy and related data to support reliability studies and assessments to enumerate the responsibilities and obligations of requestors and respondents of that data.
MOD-032	Data for Power System Modeling and Analysis	To establish consistent modeling data requirements and reporting procedures for development of planning horizon cases necessary to support analysis of the reliability of the interconnected transmission system.
MOD-033	Steady State and Dynamic System Model Validation	To establish consistent validation requirements to facilitate the collection of accurate data and building of planning models to analyze the reliability of the interconnected transmission system.
PRC-002	Disturbance Monitoring and Reporting Requirements	To have adequate data available to facilitate analysis of Bulk Electric System (BES) Disturbances
PRC-006	Automatic Underfrequency Load Shedding	To establish design and documentation requirements for automatic underfrequency load shedding (UFLS) programs to arrest declining frequency, assist recovery of frequency following underfrequency events and provide last resort system preservation measures.
PRC-006-NPCC	Automatic Underfrequency Load Shedding	The NPCC Automatic Underfrequency Load Shedding (UFLS) regional Reliability Standard establishes more stringent and specific NPCC UFLS program requirements than the NERC continent-wide PRC-006 standard. The program is designed such that declining frequency is arrested and recovered in accordance with established NPCC performance requirements stipulated in this document.
PRC-010	Undervoltage Load Shedding	To establish an integrated and coordinated approach to the design, evaluation, and reliable operation of Undervoltage Load Shedding Programs (UVLS Programs).
PRC-023	Transmission Relay Loadability	Protective relay settings shall not limit transmission loadability; not interfere with system operators' ability to take remedial action to protect system reliability and; be set to reliably detect all fault conditions and protect the electrical network from these faults.
PRC-026	Relay Performance During Stable Power Swings	To ensure that load-responsible protective relays are expected to not trip in response to stable power swings during non-Fault conditions.
TPL-001	Transmission System Planning Performance Requirements	Establish Transmission system planning performance requirements within the planning horizon to develop a Bulk Electric System (BES) that will operate reliably over a broad spectrum of System conditions and following a wide range of probable Contingencies.
TPL-007	Transmission System Planned Performance for Geomagnetic Disturbance Events	Establish requirements for Transmission system planned performance during geomagnetic disturbance (GMD) events.

NPCC/NYSRC Area Transmission Reviews

The NPCC/NYSRC Area Transmission Reviews (ATRs) are performed on an annual basis to demonstrate that conformance with the performance criteria specified in NPCC Directory #1 and the NYSRC Reliability Rules. The ATR is prepared in accordance with NPCC and NYSRC procedures that require the assessment to be performed annually, with a Comprehensive Area Transmission Review performed at least every five years. Either an Interim or an Intermediate review can be conducted between Comprehensive reviews, as appropriate. In an Interim review, the planning coordinator summarizes the changes in planned facilities and forecasted system conditions since the last Comprehensive review and assesses the impact of those changes. No new analysis are required for an Interim review. An Intermediate review covers all the elements of a Comprehensive review, but the analysis may be limited to addressing only significant issues, considering the extent of the system changes. In the ATRs, the NYISO assesses the BPTF for a period four to six years in the future (the NYISO evaluates year five of the Study Period). The most recent NYISO Comprehensive ATR (2015) was completed in June 2016.[24] The most recent annual ATR (2019)[25] evaluated study year 2024 and found that the planned system through year 2024 conforms to the reliability criteria described in the NYSRC Reliability Rules and NPCC Directory #1. The 2020 ATR, currently underway, is a Comprehensive review, to be completed mid-2021. Seven assessments are required as part of each ATR.

The first assessment evaluates the steady state and dynamics transmission security. For instances where the transmission security assessments results indicate that the planned system does not meet the specified criteria, a corrective action plan is incorporated to achieve conformance. As part of the ATRs, and also for compliance with NERC FAC-013, thermal, voltage, and stability transfer limits are performed to identify the limiting constraints for power transfers. The most resent ATR found no steady state or dynamics transmission security criteria violations.

For the second assessment, steady state and dynamics analysis are conducted to evaluate the performance of the system for low probability extreme contingencies. The purpose of the extreme contingency analysis is to examine the post contingency steady state conditions, as well as stability, overload, cascading outages, and voltage collapse, to obtain an indication of system robustness and to determine the extent of any potential widespread system disturbance. In instances where the extreme contingency assessment concludes there are serious consequences, the NYISO evaluates implementing a change to design or operating practices to address the issues.

The extreme contingency analysis included in the most recent ATR concludes that the system remained stable during most events and showed no thermal overloads over short-term emergency (STE) ratings or significant voltage violations on the BPTF. For the events that did show voltage, thermal, or dynamics issues, these events were local in nature (loss of local load or reduction of location generation)

[24] https://www.nyiso.com/planning-reliability-compliance

[25] https://www.nyiso.com/documents/20142/1397660/2019-NYISO-Interim-ATR-Final.pdf

and did not result in a widespread system disturbance.

The third assessment evaluates extreme system conditions that have a low probability of occurrence such as high peak load conditions (*e.g.*, 90th percentile load) resulting from extreme weather or the loss of fuel supply from a given resource (*e.g.,* loss of all gas units under winter peak load). The extreme system conditions evaluate various design criteria contingencies to evaluate the post contingency steady state conditions, as well as stability, overload, cascading outages and voltage collapse. The evaluation of extreme contingencies indicate system robustness and determine the extent of any potential widespread system disturbance. In instances where the extreme contingency assessment concludes that there are serious consequences, the NYISO evaluates implementing a change to design or operating practices to address the issues. For the extreme system conditions evaluated in the most recent ATR, the assessment found no steady state or dynamics transmission security criteria violations.

The fourth assessment evaluates the breaker fault duty at BPTF buses. The most recent ATR found no over-dutied breakers on BPTF buses.

The fifth assessment evaluates other requirements specific to the NYSRC Reliability Rules including an evaluation of the impacts of planned system expansion or configuration facilities on the NYCA System Restoration Plan and Local Area Operation Rules for New York City Operations, loss of gas supply – New York City, and loss of gas supply – Long Island.

The sixth assessment is a review of Special Protection Systems (SPSs). This review evaluates the designed operation and possible consequences of failure to operate or mis-operation of the SPS within the NYCA.

The seventh assessment is a review of requested exclusions to the NPCC Directory #1 criteria.

NERC Planning Assessments (TPL-001)

The NERC TPL-001 assessment (Planning Assessment) is performed annually. The purpose of the Planning Assessment is to demonstrate conformance with the applicable NERC transmission system planning performance requirements for the NYCA Bulk Electric System (BES). The Planning Assessment is a coordinated study between the NYISO and New York Transmission Owners.

The required system conditions to evaluate for this assessment include planned system representations over a 10-year study period for a variety of system conditions. Figure 83 provides a description of the steady state, dynamics, and short circuit cases required to be evaluated in the Planning Assessment.

Figure 83: Description of NERC TPL-001 Planning Assessment Study Cases

Case Description	Steady State	Dynamics	Short Circuit
System Peak Load (Year 1 or 2)	x		
System Peak Load (Year 5)	x	x	x
System Peak Load (Year 10)	x	x[1]	
System Off-Peak Load (One of the 5 years)	x	x	
System Peak Load (Year 1 or 2) Sensitivity	x		
System Peak Load (Year 5) Sensitivity	x	x	
System Off-Peak Load (One of the 5 years) Sensitivity	x	x	

Notes:

1. Only required to be assessed to address the impact of proposed material generation additions or changes in that timeframe.

The steady state and dynamics transmission security analyses evaluate the New York State BES to meet the applicable criteria. As part of this assessment, the unavailability of major transmission equipment with a lead time of more than a year is also assessed. The fault duty at BES buses are evaluated in the short-circuit representation. When the steady state, dynamics, or short circuit analysis indicates an inability of the system to meet the performance requirements in the standard, a corrective action plan is developed addressing how the performance requirements will be met. Corrective action plans are reviewed in subsequent Planning Assessments for continued validity and implementation status.

For each steady state and dynamics case, the Planning Assessment evaluates the system response to extreme contingencies. Similar to the ATR, when the Planning Assessment extreme contingency analysis concludes there is cascading caused by an extreme contingency, the NYISO evaluates possible actions designed to reduce the likelihood or mitigate the consequences and adverse impacts.

The most recent NERC Planning Assessment for compliance with TPL-001 was completed in June 2020. As this study contains Critical Energy Infrastructure Information (CEII), it is not posted on the NYISO website. Generally, the results of this study are consistent with the ATR studies. Given that the study scope of this assessment is different from the ATR is different (because the ATR evaluates the BPTF while the TPL evaluates the BES), criteria violations were observed. The corrective action plans for criteria violations are generally addressed in the affected Transmission Owner's LTP and/or the proposed transmission facilities listed in Section 7 of the Load and Capacity Data Report.

Resource Adequacy Compliance Efforts

NPCC's Directory 1 defines a compliance obligation for the NYISO, as Resource Planner and Planning Coordinator, to perform a resource adequacy study evaluating a five-year planning horizon. The NYISO delivers a report every year under this study process to verify the system against the one-day-in-ten-years loss of load expectation (LOLE) criterion, usually based on the latest available RNA/CRP results and assumptions. The New York Area Review of Resource Adequacy completed reports are available at: https://www.nyiso.com/planning-reliability-compliance.

NYSRC Reliability Rules have recently added a requirement[26] that the NYISO deliver a Long Term Resource Adequacy Assessment report every RNA year, and an annual update in the non-RNA years. The NYISO will first implement this requirement after finalizing the 2020 RNA.

The NYISO is also actively involved in other activities such as the NERC's annual Long Term Reliability Assessment (LTRA), along with its biennial Probabilistic Assessment (ProbA), performed by NERC with the input from all the NERC Regions and Areas, as well as NPCC's Long Range Adequacy Overview (LROA).

[26] NYSRC Reliability Rule A.3, R.3.

10. New York Grid Assessments and Initiatives

Clean energy policies are reshaping the grid in unprecedented ways. New York's electric industry is transforming from a grid that is powered by traditional synchronous, controllable generation to more non-emitting, weather-dependent intermittent resources and distributed generation. The increase in the intermittent and distributed generation, along with the related penetration of inverter-based technology, creates new challenges. The wholesale markets in New York are continuing to evolve to provide the price and investment signals necessary to reflect system needs and to incent resources capable of resolving those needs.

The NYISO is forecasting higher growth in energy usage, which can be attributed in part to the increasing impact of electric vehicle usage and other electrification (*i.e.*, conversion of home heating, cooking, water heating, and other end-uses from fossil-fuel based systems to electric systems) especially in the later years of the planning horizon. Significant load-reducing impacts are expected to occur due to energy efficiency initiatives and the growth of distributed behind-the-meter energy resources, such as solar PV. The relative behind-the-meter solar impact on peak declines over time as the summer peak is expected to shift slightly further into the evening.

The NYISO has initiated a number of assessments of the impacts of various policies, including:

- ***2019 Congestion Assessment and Resource Integration Study ("CARIS"), Phase I*** – The NYISO's congestion assessment under the Economic Planning Process. The recent study contains a 70x30 scenario; one of the key findings is that renewable generation pockets are likely to develop throughout the state as the existing transmission grid would be overwhelmed by the significant renewable capacity additions. The results support the conclusion that additional transmission expansion, at both bulk and local levels, will be necessary to efficiently deliver renewable energy to New York consumers.
- ***Climate Change Study Phase I: Long Term Load Impacts*** – This study was performed by the NYISO in collaboration with Itron. The core finding is that temperatures are rising across New York and will have a significant impact on electric grid demand.
- ***Climate Change Study Phase II: Reliability and Resiliency*** - The NYISO retained the Analysis Group (AG) to develop/analyze resource mixes to serve load under the CLCPA 2040 state goals and then analyze various climate change-related scenarios that could impact the electric system. One reasoned approach to gain an understanding of the challenges that may be faced was to develop book-end type resource mixes where one of the key variables is increasing the

major interface capability versus the status quo. Using these bookend resource mixes, analysis can be performed and conclusions developed that can then be interpolated for mixes between the bookends. As the major interface capability is increased, the levels of land-based wind and upstate solar resources that can be incorporated into the system will increase. This increase in the capability of the transmission system from upstate to downstate will allow the output from significant increases in those renewable resources located upstate to serve load downstate. The Analysis Group also analyzed scenarios to determine the reliability impacts of heat waves, cold spells, droughts, and severe storms. One of the conclusions of the AG work is the need for significant amounts of a dispatchable emission-free resource in the downstate area. A key driving factor in terms of the amount of generation resource buildout needed is the CLCPA 2040 forecast from the Climate Change Phase 1 study. This load forecast shows a significantly higher winter peaking load level when compared to the summer peak, and therefore the resource mix needed to meet the winter peak demand.

- ***Climate Change Study Phase III: Markets*** – to be initiated in 2021
- ***Reliability and Market Considerations For A Grid In Transition:*** The NYISO initiated a white paper followed by assessments focusing on potential market enhancements. The NYISO supports reliability through three complementary markets: energy, ancillary services, and capacity. Each market addresses distinct reliability needs through competitive market pricing that benefits New York consumers while reducing costs. Together, energy, ancillary services, and capacity market revenues provide economic signals for new investment, retirement decisions, and participation by demand response providers. The *Grid in Transition* looked into how the wholesale markets in New York can continue to provide the pricing and investment signals necessary to reflect system needs and to incent resources capable of resolving those needs.

In addition to these NYISO initiatives, the State of New York is engaging in its own analysis of the future needs of the electric transmission system. The Accelerated Renewable Energy Growth and Community Benefit Act (the "Act")[27] enacted in 2020 calls for the New York State Department of Public Service (DPS) to "undertake a comprehensive study for the purpose of identifying distribution upgrades, local transmission upgrades, and bulk transmission investments that are necessary or appropriate to facilitate the timely achievement of the CLCPA targets."[28] The Act states that the DPS will conduct that

27 L. 2020, ch. 58, Part JJJ, § 7(5).

28 Id., § 7(2).

study in consultation with the New York State Energy Research and Development Authority ("NYSERDA"), the Power Authority of the State of New York (NYPA), the Long Island Power Authority ("LIPA"), the New York Independent System Operator, Inc. (NYISO), and the utilities.[29] The NYISO is providing technical support and input for the study.

A Grid In Transition: Reliability Gap Analysis

As part of the *Grid in Transition* white paper, the NYISO conducted a reliability gap analysis to identify ways in which the transition towards intermittent resources could lead to operational circumstances that may violate system reliability requirements. The analysis included potential areas that the NYISO must be prepared to address in order to continue to meet mandatory reliability standards, such as:

- **Maintaining ability to balance load and generation:** Balancing high levels of intermittent generation with system demand that may be difficult to forecast in real-time operations.
- **Maintaining 10-minute operating reserves:** High levels of intermittent resources may result in challenges to maintaining sufficient 10-minute operating reserves and disturbance-control performance requirements.
- **Maintaining total 30-minute operating reserves:** High levels of intermittent resources may lead to challenges in meeting operating reserve requirements in response to longer-term variations in generation levels from intermittent generation.
- **Maintaining ability to meet daily energy requirements:** Reliance on high levels of intermittent resources and limited energy storage resources may present challenges to meeting control-performance requirements and daily energy requirements in real-time operations.
- **Maintaining reliable transmission operations:** It may become difficult to forecast system and locational demand requirements in real time when operating under high levels of intermittent generation.
- **Maintaining black start capability:** The NYISO may be challenged to effectively restore the system within expected timeframes following a blackout given a system with high levels of intermittent generation.
- **Maintaining voltage support capability:** The NYISO may be challenged to meet voltage performance requirements with high levels of intermittent generation.
- **Maintaining frequency response capability:** The NYISO may be challenged to meet frequency performance requirements for a power system with high levels of intermittent generation.

[29] Id.

- **Maintaining resource adequacy:** The NYISO may be challenged to maintain acceptable levels of resource adequacy.
- **Maintaining the ability to manage supply resource outage schedules:** The NYISO may be challenged to manage supply resource maintenance outage scheduling.

These concepts will continued to be explored in the *2021-2030 Comprehensive Reliability Plan* and numerous other reliability studies in the near future. None of the identified potential reliability gaps relative to intermittent resources represent near-term concerns. However, the challenge for the NYISO is to design and implement a portfolio of market products, reliability planning, and operational enhancements that facilitate achievement of clean energy policies while maintaining system reliability through the competitive wholesale electricity markets. There may also be a need for review of established reliability criteria to address reliability gaps that may arise due to the changing system operating characteristics as New York transitions to a zero emission resource mix.

11. Observations and Recommendations

This 2020 Reliability Needs Assessment (RNA) assesses the resource adequacy and transmission security of the New York Control Area (NYCA) Bulk Power Transmission Facilities (BPTF) from study year[30] 4 (*i.e.*, 2024) through year 10 (*i.e.*, 2030), which constitutes the Study Period of this RNA.

This 2020 Reliability Needs Assessment finds that there are Reliability Needs on the Bulk Power Transmission Facilities during the Study Period due to both resource adequacy and transmission security reliability criteria violations. The deficiencies identified are mainly due to the compound effect of load forecast increases and the assumed loss of generation in Zone J (New York City), affected by the Department of Environmental Conservation's (DEC's) Peaker Rule.

In 2020, the New York State Department of Environmental Conservation adopted a regulation to limit nitrogen oxides (NOx) emissions from simple-cycle combustion turbines ("Peaking Units") (referred to as the "Peaker Rule"). The Peaker Rule required all impacted plant owners to file compliance plans by March 2, 2020. NYISO considered the affected Generators' compliance plans in the development of the 2020 Reliability Needs Assessment Base Case.

From the resource adequacy perspective, the Loss of Load Expectation (LOLE) is at or above New York State Reliability Council's (NYSRC's) and Northeast Power Coordinating Council's (NPCC's) criterion of one day in 10 years, or 0.1 days per year, starting in year 6 (2026) of the RNA Study Period, and increasing through year 10 (2030). Therefore, the NYISO identifies resource adequacy Reliability Needs starting in 2027, with the year 2026 being at the resource adequacy criterion with an LOLE of 0.10 days/year.

The transmission security Reliability Needs include both thermal loading criteria violations on the BPTF as well as dynamic stability criteria violations. For thermal loading, several 345 kV circuits in the Con Edison service territory are overloaded under N-1-1 conditions beginning in year 2025 and increasing through 2030. Additionally, the Con Edison 345 kV system has violations of an NYSRC local reliability rule to design and operate 345 kV transmission system for the occurrence of a second contingency (N-1-1-0). The 345 kV circuit overloads under N-1-1-0 conditions in Zone J begin in 2025 (with a deficiency of 700 MW) and increasing through 2030 (with a deficiency of 1,075 MW). The duration of the deficiency ranges

30 In 2019 the NYISO proposed to stakeholders creating a Short-Term Reliability Process ("STRP") to evaluate and address reliability impacts resulting from both Generator deactivations and other drivers of Reliability Needs that are identified in a quarterly Short-Term Assessment of Reliability study. The NYISO made a tariff filing at FERC to create the STRP in February 2020, requesting a May 1, 2020 effective date. The FERC accepted the NYISO filing on April 30, 2020, and the first quarterly STAR commenced on July 15, 2020. The 2020 RNA also incorporates the effects of these tariff changes by assessing Reliability Needs in years 4-10 of the Study Period, while the STRP assesses five years from its start date, with a focus on addressing needs in years 1-3 of the Study Period.

from 9 hours in 2025 (3,853 MWh) to 12 hours in 2030 (7,672 MWh).

The dynamic stability criteria Reliability Needs are observed for the entire Study Period. The criteria violations include violations of transient voltage response, loss of generator synchronism, and undamped voltage oscillations. The transient voltage response violations arise on transmission facilities owned by Con Edison in its Transmission District but extending into areas adjacent to their service territory. The loss of generator synchronism is observed in generators within or near the Astoria and Greenwood load pockets and is primarily driven by the transient voltage response violations in the local area.

In addition, the *2020 Reliability Need Assessment* analyzes risks to the BPTF under certain scenarios to inform NYISO stakeholders when developing projects, as well as informing policy makers when formulating state policy.

The results of the 2020 Reliability Need Assessment scenarios indicate that a higher load level, or proposed projects assumed in service in the Reliability Need Assessment Base Case not materializing, or additional removal of capacity, could cause additional Reliability Needs, or Reliability Needs that occur earlier.

In addition to the above-referenced scenarios, the NYISO also discusses the reliability risks associated with the cumulative impact of environmental laws and regulations, which may affect the flexibility in plant operation and may make fossil-fueled plants energy-limited resources.

A number of recent state policies and initiatives, along with various Department of Environmental Conservation rulemakings are underway that have the potential to significantly change the resource mix in the New York Control Area. These include the Climate Leadership and Community Protection Act (CLCPA), the Accelerate Renewable Energy Growth and Community Benefit Act, the Clean Energy Standard, the Offshore Wind Master Plan, the Large-Scale Renewable Program, the Zero Emission Credits Program for the James A. FitzPatrick, R.E Ginna and Nine Mile Point nuclear power plants, and the implementation of the DEC Peaker Rule. The NYISO will continue to monitor these and other developments to determine whether changing system resources and conditions could impact the reliability of the Bulk Power Transmission Facilities.

As part of its ongoing Reliability Planning Process, the NYISO monitors and tracks the progress of market-based projects and regulated backstop solutions, together with other resource additions and retirements, consistent with its obligation to protect confidential information under its Code of Conduct. Among other things, the NYISO closely follows: 1. units interconnecting through the NYISO's interconnection processes; 2. the development and installation of local transmission facilities; 3. additions, mothballs or retirements of generators; 4. the status of mothballed/retired facilities; 5. the continued implementation of New York State energy efficiency programs, solar PV installations, new wind facilities, new storage facilities, and other additions due to the Clean Energy Standard and the CLCPA; 6. participation in the NYISO demand response programs; and 7. the implementation of the DEC Peaker Rule and other new and proposed environmental regulations that affect the existing generation fleet.

12. Next Steps

This *2020 Reliability Needs Assessment* finds that there are Reliability Needs on the Bulk Power Transmission Facilities during the Study Period (i.e., 2024-2030) due to both resource adequacy and transmission security Reliability Criteria violations. All Reliability Needs occur within Con Edison's transmission district in New York City (Zone J). Therefore, Con Edison is the Responsible Transmission Owner, as defined by the NYISO OATT. The following are the next steps to be taken in the Reliability Planning Process.

RNA Base Case Update: Following NYISO Board approval, additional steps are taken to further minimize unnecessary solicitations. The process allows the NYISO to update the RNA Base Case by considering status changes of proposed projects such as Local Transmission Owner Plans (LTPs), proposed generation and transmission, and load forecast or demand response. As part of this step, the NYISO would consider only those updates that may reduce or eliminate the Reliability Needs and that met the inclusion rules. This would include any updates to the peak load forecast based on the NYISO's current understanding of residual impacts from COVID-19.

Solution Solicitation and Initial Review: If any Reliability Needs remain after these Base Case updates, the NYISO will solicit market-based solutions, regulated backstop solutions, and alternative regulated solutions to address the remaining Reliability Needs. The interested and qualified Developers and Other Developers, as well as the Responsible Transmission Owner(s) can submit solutions within 60 calendar days from the solicitation. The Responsible Transmission Owner(s) must submit regulated backstop solution(s) to address the Reliability Needs identified in their service territory, which can be generation, transmission, demand side or combinations. Any Transmission Owner or Other Developer can submit an alternative regulated solution and any Developer can submit a market-based solution. The NYISO will review the solutions for completeness.

Viability and Sufficiency Assessments: The NYISO will evaluate whether each proposed solution is viable and is sufficient to satisfy the identified Reliability Need by the need date. The proposed solutions may include multiple components and resource types. When evaluating proposed solutions to Reliability Needs from any Developer, all resource types – generation, transmission, demand response, or a combination of these resource types – will be considered on a comparable basis as potential solutions to the Reliability Needs identified. All solutions will be evaluated in the same general timeframe.

Establishment of Trigger Date of Proposed Regulated Solutions: Upon receipt of all proposed regulated solutions pursuant to OATT Section 31.2.5.1, the NYISO will notify all Developers if any Developer has proposed a lead time for the implementation of its regulated solution that could result in a

Trigger Date for the regulated solution within 36 months of the date of the ISO's presentation of the Viability and Sufficiency Assessment to the ESPWG. The NYISO will independently analyze the lead time proposed by each Developer for the implementation of its regulated solution. The NYISO will use the Developer's estimate and the NYISO's analysis to establish the NYISO Trigger Date for each regulated solution. The NYISO will also establish benchmark lead times for proposed market-based solutions.

Viability and Sufficiency Report: The NYISO will present its Viability and Sufficiency Assessment to stakeholders, interested parties, and the NYDPS for comment and will indicate at that time whether any of the proposed regulated solutions found to be viable and sufficient will have a Trigger Date within 36 months of the date of the NYISO's presentation of the Viability and Sufficiency Assessment to the ESPWG.

Evaluation and Selection of Proposed Regulated Transmission Solutions: If the NYISO determines that the Trigger Date of any Developer's proposed regulated solution that was found to be viable and sufficient will occur within 36 months of the date of the NYISO's presentation of the Viability and Sufficiency Assessment to the ESPWG, the NYISO will request that all Developers of regulated transmission solutions that the NYISO determined were viable and sufficient submit to the NYISO their project information, as applicable, for: (i) a proposed regulated backstop transmission solution, or (ii) a proposed alternative regulated transmission solution**.**

The Comprehensive Reliability Plan documents the NYISO's findings regarding the viability and sufficiency of solutions, the trigger dates of regulated solutions, and any recommendations that implementation of regulated solutions is necessary to maintain system reliability. The draft CRP will reflect any input from the NYDPS. If the CRP cannot be completed in the two-year planning cycle, the NYISO will notify stakeholders and provide an estimated completion date and an explanation of the reasons the additional time is required. The NYISO will include in the draft CRP the list of Developers that qualify and will identify the proposed solutions that it has determined are viable and sufficient to satisfy the identified Reliability Need(s) by the need date. The NYISO will identify in the CRP the regulated backstop solution that the NYISO has determined will meet the Reliability Need by the need date and the Responsible Transmission Owner. If the NYISO determines at the time of the issuance of the CRP that sufficient market-based solutions will not be available in time to meet a Reliability Need, and finds that it is necessary to take action to ensure reliability, it will state in the CRP that the development of regulated solutions (regulated backstop or alternative regulated solution) is necessary.

Short-Term Reliability Process: Additionally, the needs identified in the Short-Term Reliability Process in year 1 through year 3 will be addressed in the applicable quarterly Short-Term Assessment of Reliability (STAR), while the needs identified in years 4 and 5 will only be addressed using the Short-Term

Reliability Process if the identified Reliability Need cannot timely be addressed through the Reliability Planning Process.

New York ISO

A Report by the
New York Independent
System Operator

APPENDICES

2020 Reliability Needs Assessment (RNA)

November 2020

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Appendix A - 2020 Reliability Needs Assessment Glossary

Annual Transmission Reliability Assessment (ATRA): An assessment, conducted by the NYISO staff in cooperation with Market Participants, to determine the System Upgrade Facilities required for each generation project and Class Year Transmission Project included in this Assessment to interconnect to the New York State Transmission System in compliance with Applicable Reliability Standards and the NYISO Minimum Interconnection Standard. *(Source: Attachment S of OATT)*

Area Transmission Review (ATR): The NYISO, in its role as Planning Coordinator, is responsible for providing an annual report to the NPCC Compliance Committee in regard to its Area Transmission Review in accordance with the NPCC Reliability Compliance and Enforcement Program and in conformance with the NPCC Design and Operation of the Bulk Power System. *(Source: NPCC Directory #1)*

Baseline Forecast: The baseline forecasts from the NYISO's Gold Book report the expected NYCA load, and include the projected impacts of energy efficiency programs, building codes and standards, distributed energy resources, behind-the-meter energy storage, behind-the-meter solar photovoltaic power (solar PV), electric vehicle usage, and electrification of heating and other end uses. The baseline forecasts are used in the RNA Base Cases for determining Bulk Power Transmission Facilities Reliability Needs for the RNA Study Period. *(Source: 2020 Gold Book)*

Best Technology Available (BTA): NYS DEC policy establishing performance goals for new and existing electricity generating plants for Cooling Water Intake Structures. The policy applies to plants with design intake capacity greater than 20 million gallons/day and prescribes reductions in fish mortality. The performance goals call for the use of wet, closed-cycle cooling systems at existing generating plants. *(Source: Section 316(b), Clean Water Act, United States Environmental Protection Agency)*

New York State Bulk Power Transmission Facility (BPTF): The facilities identified as the New York State Bulk Power Transmission Facilities in the annual Area Transmission Review submitted to NPCC by the ISO pursuant to NPCC requirements. *(Source: Attachment Y of OATT definitions)*

CARIS: The Congestion Assessment and Resource Integration Study for economic planning developed by the ISO in consultation with the Market Participants and other interested parties pursuant to Section 31.3 of this Attachment Y. (*Source: NYISO OATT*)

Clean Energy Standard (CES): State initiative for 70% of electricity consumed in New York State to be produced from renewable sources by 2030.

Climate Leadership and Community Protection Act (CLCPA): State statute enacted in 2019 to address and mitigate the effects of climate change. Among other requirements, the law mandates that; (i) 70% of energy consumed in New York State be sourced from renewable resources by 2030, (ii) greenhouse gas emissions must be reduced by 40% by 2030, (iii) the electric generation sector must be zero greenhouse gas emissions by 2040, and (iv) greenhouse gas emissions across all sectors of the economy must be reduced by 85% by 2050. (*Source: 2019 CARIS Phase I*)

Contingencies: An actual or potential unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch, or other electrical element. A contingency also may include multiple components, which are related by situations leading to simultaneous component outages. *(Source: NYSRC Reliability Rules)*

Dependable Maximum Net Capability (DMNC): The sustained maximum net output of a Generator, as demonstrated by the performance of a test or through actual operation, averaged over a continuous time period as defined in the ISO Procedures. *(Source: OATT Definitions)*

Electric System Planning Work Group (ESPWG): The Electric System Planning Work Group, or any successor work group or committee designated to fulfill the functions assigned to the ESPWG in this tariff. *(Source: Attachment S of OATT)*

Emergency Transfer Criteria: It is intended that the NYS Bulk Power System be operated within Normal Transfer Criteria at all times insofar as possible. However, in the event that adequate facilities are not available to supply firm load within Normal Transfer Criteria, emergency transfer criteria may be invoked. Under emergency transfer criteria, transfers may be increased up to, but not exceed, emergency ratings and limits as follows:

a. Pre-contingency line and equipment loadings may be operated up to LTE ratings for up to four (4) hours, provided the STE ratings are set appropriately. Otherwise, pre-contingency line and equipment loadings must be within normal ratings. Pre-contingency voltages and transmission interface flows must be within applicable pre-contingency voltage and stability limits.

b. Post-contingency line and equipment loadings within STE ratings. Post-contingency voltages and transmission interface flows within applicable post-contingency voltage and stability limits. *(Source: NYSRC Reliability Rules)*

Fault: An electrical short circuit. *(Source: NYSRC Reliability Rules)*

Federal Energy Regulatory Commission (FERC): The Federal Energy Regulatory Agency within the U.S. Department of Energy that approves the NYISO's tariffs and regulates its operation of the bulk electricity grid, wholesale power markets, and planning and interconnection processes.

FERC Form 715: An annual report that is required by transmitting utilities operating grid facilities that are rated at or above 100 kV. The report consists of transmission systems maps, a detailed description of transmission planning Reliability Criteria, detailed descriptions of transmission planning assessment practices, and detailed evaluation of anticipated system performance as measured against Reliability Criteria.

Forced Outage: An unscheduled inability of a Market Participant's Generator to produce Energy that does not meet the notification criteria to be classified as a scheduled outage or de-rate as established in ISO Procedures. If the Forced Outage of a Generator starts on or after May 1, 2015, the Forced Outage will expire at the end of the month which contains the 180th day of its Forced Outage but may be extended if the Market Participant has Commenced Repair of its Generator. *(Source: Market Services Tariff-MST-Definitions)*

Gold Book: Annual NYISO publication of its Load and Capacity Data Report.

Installed Capacity (ICAP): External or Internal Capacity, in increments of 100 kW that is made available pursuant to Tariff requirements and ISO Procedures *(Source: NYISO's MST Definitions).*

Installed Capacity Requirement (ICR): The annual statewide requirement established by the NYSRC in order to ensure resource adequacy in the NYCA. *(Source: NYSRC Reliability Rules)*

Installed Reserve Margin (IRM): The amount of installed electric generation capacity above 100% of the forecasted peak electric demand that is required to meet NYSRC resource adequacy criteria. Most studies in recent years have indicated a need for a 15-20% reserve margin for adequate reliability in New York.

Local Transmission Plan (LTP): The Local Transmission Owner Plan, developed by each Transmission Owner, which describes its respective plans that may be under consideration or finalized for its own Transmission District. *(Source: Attachment Y of OATT)*

Local Transmission Planning Process (LTPP): The Local Planning Process conducted by each Transmission Owner for its own Transmission District. *(Source: Attachment Y of OATT)*

Loss of Load Expectation (LOLE): The probability (or risk) of disconnecting any firm load due to resource deficiencies shall be, on average, not more than once in ten years. Compliance with this criterion shall be evaluated probabilistically, such that the loss of load expectation (LOLE) of disconnecting firm load due to resource deficiencies shall be, on average, no more than 0.1 day per year. This evaluation shall make due allowance for demand uncertainty, scheduled outages and deratings, forced outages and deratings, assistance over interconnections with neighboring control areas, NYS Transmission System emergency transfer capability, and capacity and/or load relief from available operating procedures. *(Source: NYSRC Reliability Rules)*

Market Monitoring Unit: "Market Monitoring Unit" shall mean the consulting or other professional services firm, or other similar entity, retained by the Board, as specified in Section 30.4.2 of Attachment O, that is responsible for carrying out the Core Market Monitoring Functions and the other functions that are assigned to it in Attachment O. The Market Monitoring Unit shall recommend Tariff and market rule changes, but shall not participate in the administration of the ISO's Tariffs, except as specifically authorized in Attachment O. *(Source: Attachment O of MST)*

Market Participant: An entity, excluding the ISO, that produces, transmits, sells, and/or purchase for resale Unforced Capacity, Energy or Ancillary Services in the Wholesale Market. Market Participants include: Transmission Customers under the ISO OATT, Customers under the ISO Services Tariff, Power Exchanges, Transmission Owners, Primary Holders, LSEs, Suppliers and their designated agents. Market Participants also include entities buying or selling TCCs. *(Source: MST Definitions)*

New York Control Area (NYCA): New York Control Area (NYCA): The Control Area that is under the control of the ISO which includes transmission facilities listed in the ISO/TO Agreement Appendices A-1 and A-2, as amended from time-to-time, and generation located outside the NYS Power System that is subject to protocols (*e.g.,* telemetry signal biasing) which allow the ISO and other Control Area operator(s) to treat some or all of that generation as though it were part of the NYS Power System. *(Source: MST Definitions)*

New York State Department of Environmental Conservation (NYSDEC): The agency that implements the New York State Environmental Conservation Law, with some programs also governed by federal law.

New York Independent System Operator (NYISO): Formed in 1997 and commencing operations in 1999, the NYISO is a not-for-profit organization that manages New York's bulk electricity grid — an over 11,000-mile network of high voltage lines that carry electricity throughout the state. The NYISO also oversees the state's wholesale electricity markets. The organization is governed by an independent Board of Directors and a governance structure made up of committees with Market Participants and stakeholders as members.

New York State Department of Public Service (NYDPS): As defined in the New York Public Service Law, it serves as the staff for the New York State Public Service Commission.

New York State Energy Research and Development Authority (NYSERDA): A corporation created under the New York State Public Authorities law and funded by the System Benefits Charge (SBC) and other sources. Among other responsibilities, NYSERDA is charged with conducting a multifaceted energy and environmental research and development program to meet New York State's diverse economic needs, and administering state System Benefits Charge, Renewable Portfolio Standard, energy efficiency programs, the Clean Energy Fund, and the NY-Sun Initiative.

New York State Public Service Commission (NYPSC): The New York State Public Service Commission is the decision making body of the New York State Department of Public Service. The PSC regulates the state's electric, gas, steam, telecommunications, and water utilities and oversees the cable industry. The Commission has the responsibility for setting rates and ensuring that safe and adequate service is provided by New York's utilities. In addition, the Commission exercises jurisdiction over the siting of major gas and electric transmission facilities.

NY-Sun Initiative: A program initiated by Governor Cuomo in 2012 and administered by NYSERDA for the purpose of obtaining more than 6,000 MW-DC of behind-the-meter solar PV by the end of 2023.

New York State Reliability Council (NYSRC): An organization established by agreement among the Member Systems of the New York Power Pool (the "NYSRC Agreement"). *(Source: OATT Definitions)*

Normal Transfer Criteria*:* Under normal transfer criteria, adequate facilities are available to supply firm load with the bulk power transmission system within applicable normal ratings and limits as follows:

a. Pre-contingency line and equipment loadings within normal *rating*s. Pre-contingency voltages and transmission *interface* flows within applicable pre-contingency voltage and *stability limit*s.

b. Post-contingency line and equipment loadings within applicable *emergency* (LTE or STE) *rating*s. Post-contingency voltages and transmission *interface* flows within applicable post-contingency voltage and *stability limit*s.

All contingencies listed in Table B2 "NYSRC Planning Design Criteria: Contingency Event, "in the reliability rules apply under normal transfer criteria. *(Source: NYSRC Reliability Rules)*

Normal Transfer Limit: The maximum allowable transfer is calculated based on thermal, voltage, and stability testing, considering contingencies, ratings, and limits specified for normal conditions. The normal transfer limit is the lowest limit based on the most restrictive of these three maximum allowable transfers. *(Source: NYSRC Reliability Rules)*

North American Electric Reliability Corporation (NERC): The North American Electric Reliability Council or, as applicable, the North American Electric Reliability Corporation. *(Source: OATT Definitions)*

Northeast Power Coordinating Council (NPCC): The Northeast Power Coordinating Council, or any successor organization. *(Source: Attachment Y of OATT)*

Open Access Transmission Tariff (OATT): Document of Rates, Terms and Conditions, regulated by the FERC, under which the NYISO provides transmission service. The OATT is a dynamic document to which revisions are made on a collaborative basis by the NYISO, New York's Electricity Market Stakeholders, and the FERC.

Order 890: Adopted by FERC in February 2007, Order 890 is a change to FERC's 1996 transmission open access regulations (established in Orders 888 and 889). Order 890 is intended to provide for more effective competition, transparency and planning in wholesale electricity markets and transmission grid operations, as well as to strengthen the Open Access Transmission Tariff (OATT) with regard to non-discriminatory transmission service. Order 890 requires Transmission Providers — including the NYISO — to have a formal planning process that provides for a coordinated transmission planning process, including reliability and economic planning studies.

Order 1000: The Final Rule entitled Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities, issued by the Commission on July 21, 2011, in Docket RM10-23-001, as modified on rehearing, or upon appeal. (See FERC Stats & Regs. ¶ 31,323 (2011) (Order No. 1000), on reh'g and clarification, 139 FERC ¶ 61,132 (Order No. 1000-A), on reh'g and clarification, 141 FERC ¶ 61,044 (2012) (Order No. 1000- B). *(Source: Attachment Y of OATT)*

Outage: The forced or scheduled removal of generating capacity or a transmission line from service.

Peak Demand: The maximum instantaneous power demand, measured in megawatts (MW), and also known as peak load, is usually measured and averaged over an hourly interval.

Queue Position: Queue position shall mean the order of a valid Interconnection Request, Study Request, or Transmission Interconnection Application relative to all other pending Requests, that is established based upon the date and time of receipt of the valid Interconnection Request by NYISO, unless specifically provided otherwise in an applicable transition rule set forth in Attachment P, Attachment X or Attachment Z to the ISO OATT. *(Source: Attachment X of OATT)*

Rating: The operational limits of an electric system, facility, or element under a set of specified conditions.

i. *Normal Rating*: The capacity rating of a transmission facility that may be carried through consecutive twenty- four (24) hour load cycles.

ii. *Long Time Emergency (LTE) Rating:* The capacity rating of a transmission facility that can be carried through infrequent, non- consecutive four (4) hour periods.

iii. *Short Time Emergency (STE) Rating*: The capacity rating of a transmission facility that may be carried during very infrequent contingencies of fifteen (15) minutes or less duration. *(Source: NYSRC Reliability Rules)*

Reasonably Available Control Technology for Oxides of

Nitrogen (NOx RACT): Regulations promulgated by NYSDEC for the control of emissions of nitrogen oxides (NOx) from fossil fuel-fired power plants. The regulations establish presumptive emission limits for each type of fossil fueled generator and fuel used in an electric generator in NY. The NOx RACT limits are part of the State Implementation Plan for achieving compliance with the National Ambient Air Quality Standard (NAAQS) for ozone. *(Source: 6 NYCRR Part 227-2)*

Reactive Power Resources: Facilities such as generators, high voltage transmission lines, synchronous condensers, capacitor banks, and static VAr compensators that provide reactive power. Reactive power is the portion of electric power that establishes and sustains the electric and magnetic fields of alternating-current equipment. Reactive power is usually expressed as kilovolt-amperes reactive (kVAr) or megavolt-ampere reactive (MVAr).

Regional Greenhouse Gas Initiative (RGGI): A cooperative effort by a group of Northeast and Mid-Atlantic states to limit power sector greenhouse gas emissions using a market-based cap-and-trade approach. *(Source: https://www.rggi.org/)*

Reliability: The degree of performance of the bulk electric system that results in electricity being delivered to customers within accepted standards and in the amount desired. Reliability may be measured by the frequency, duration, and magnitude of adverse effects on the electric supply. Electric system reliability can be addressed by considering two basic and functional aspects of the electric system — adequacy and security.

i. *Adequacy:* The ability of the electric systems to supply the aggregate electrical demand and energy requirements of their customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. Note: Adequacy encompasses both generation and transmission.

ii. *Security:* The ability of the electric system to withstand disturbances such as electric short circuits or unanticipated loss of system elements. The ability of the power system to withstand the loss of one or more elements without involuntarily disconnecting firm load. *(Source: NYSRC Reliability Rules)*

Reliability Criteria: The electric power system planning and operating policies, standards, criteria, guidelines, procedures, and rules promulgated by the North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Council (NPCC), and the New York State Reliability Council (NYSRC), as they may be amended from time to time. *(Source: Attachment Y of OATT definition)*

Reliability Need: A condition identified by the ISO as a violation or potential violation of one or more Reliability Criteria. *(Source: Attachment Y of OATT definition)*

Reliability Needs Assessment (RNA): The Reliability Needs Assessment as approved by the ISO Board under this Attachment. *(Source: Attachment Y of OATT definition)*

Reliability Planning Process (RPP): The process set forth in this Attachment Y by which the ISO determines in the RNA whether any Reliability Need(s) on the BPTFs will arise in the Study Period and addresses any identified Reliability Need(s) in the CRP, as the process is further described in Section 31.1.2.2. (Source: Attachment Y of OATT)

Reliability Solutions:

i. *Alternative Regulated Solutions (ARS)*: Regulated solutions submitted by a TO or other developer in response to a solicitation for solutions to a Reliability Need identified in an RNA.

ii. *Gap Solution:* A solution to a Reliability Need that is designed to be temporary and to strive to be compatible with permanent market-based proposals. A permanent regulated solution, if appropriate, may proceed in parallel with a Gap Solution. Note: The NYISO may call for a Gap Solution to an imminent threat to reliability of the Bulk Power Transmission Facilities if no market-based solutions, regulated backstop solutions, or alternative regulated solutions can meet the Reliability Needs in a timely manner.

iii. *Market-Based Solutions:* Investor-proposed projects that are driven by market needs to meet future reliability requirements of the bulk electricity grid as outlined in the RNA. Those solutions can include generation, transmission and demand response Programs.

iv. *Regulated Backstop Solutions*: Proposals required of certain TOs to meet Reliability Needs as outlined in the RNA. Those solutions can include generation, transmission or demand response. Non-Transmission Owner developers may also submit regulated solutions. *(Source: Attachment Y of OATT)*

Responsible Transmission Owner (Responsible TO): The Transmission Owner or Transmission Owners designated by the ISO, pursuant to Section 31.2.4.3, to prepare a proposal for a regulated backstop solution to a Reliability Need or to proceed with a regulated solution to a Reliability Need. The Responsible Transmission Owner will normally be the Transmission Owner in whose Transmission District the ISO identifies a Reliability Need and/or that owns a transmission facility on which a Reliability Need arises. *(Source: Attachment Y of OATT definitions)*

RNA Study Period: The seven-year time period encompassing years 4 through 10 following the year in which the RNA is conducted, which is used in the RNA and the CRP. For example, the 2020 RNA covers the 7-year Study Period of 2024 through 2030. *(Source: Attachment Y of OATT definitions with STAR).*

Short-Term Assessment of Reliability (STAR): The ISO's assessment, in coordination with the Responsible Transmission Owner(s), of whether a Short-Term Reliability Process Need will result from a Generator becoming Retired, entering into a Mothball Outage, a Generator being unavailable due to an ICAP Ineligible Forced Outage, or from other changes to the availability of Resources or to the New York State Transmission System. The ISO performs STARs on a quarterly basis, commencing on the dates specified in ISO Procedures.

Short-Term Reliability Process: The process set forth in this Attachment FF by which the ISO evaluates and addresses the reliability impacts resulting from both: (i) Generator Deactivation Reliability Need(s), and/or (ii) other Reliability Needs on or affecting the BPTFs that are identified in a STAR. The Short-Term Reliability Process evaluates reliability needs in years one through five of the ten-year Study Period, with a focus on needs in years one through three.

Short-Term Reliability Process Need: A Generator Deactivation Reliability Need or a condition identified by the ISO in a STAR as a violation or potential violation of one or more Reliability Criteria on the BPTF.

Short-Term Reliability Process Solution: A solution to address a Short-Term Reliability Process Need, which may include (i) an Initiating Generator, (ii) a solution proposed pursuant to Section 38.4, or (iii) a Generator identified by the ISO pursuant to Section 38.5.

Short-Term Assessment of Reliability Start Date: The date on which the ISO next commences a STAR after the ISO issues a written notice to a Market Participant pursuant to Section 38.3.1.4 indicating that the Generator Deactivation Notice for its Generator is complete. If a Market Participant's Generator enters into an ICAP Ineligible Forced Outage pursuant to Section 5.18.2.1 of the ISO Services Tariff, then the Short-Term Assessment of Reliability Start Date is the date on which the ISO next commences a STAR; except (i) when the ISO determines that it should commence a stand alone Generator Deactivation Assessment based on the potential for an immediate reliability need to arise (see Section 38.3.4), or (ii) when the ISO is able to and elects to add a Generator that is in an ICAP Ineligible Forced Outage to a STAR that has already begun. Under either exception [(i) or (ii)], the Short-Term Assessment of Reliability Start Date is the date on which the Generator entered an ICAP Ineligible Forced Outage. *(Source: Attachment Y, Section 38.1)*

Special Case Resource ("SCR"): Demand Side Resources whose Load is capable of being interrupted upon demand at the direction of the ISO, and/or Demand Side Resources that have a Local Generator, which is not visible to the ISO's Market Information System and is rated 100 kW or higher, that can be operated to reduce Load from the NYS Transmission System or the distribution system at the direction of the ISO. Special Case Resources are subject to special rules, set forth in Section 5.12.11.1 of this ISO Services Tariff and related ISO Procedures, in order to facilitate their participation in the Installed Capacity market as Installed Capacity Suppliers. (Source: NYISO MST Tariff Definitions)

System Benefits Charge (SBC): An amount of money, charged to ratepayers on their electric bills, which is administered and allocated by NYSERDA towards energy-efficiency programs, research and development initiatives, low-income energy programs, and environmental disclosure activities.

Transfer Capability: The measure of the ability of interconnected electrical systems to reliably move or transfer power from one area to another over all transmission facilities (or paths) between those areas under specified system conditions.

Transmission Constraints: Limitations on the ability of a transmission system to transfer electricity during normal or emergency system conditions.

Transmission Owner (TO): A public utility or authority that owns transmission facilities and provides Transmission Service under the NYISO's tariffs

Unforced Capacity: The measure by which Installed Capacity Suppliers will be rated, in accordance with formulae set forth in the ISO Procedures, to quantify the extent of their contribution to satisfy the NYCA Installed Capacity Requirement, and which will be used to measure the portion of that NYCA Installed Capacity Requirement for which each LSE is responsible (*Source: Market Services Tariff (MST) Definitions)*.

Unforced Capacity Deliverability Rights: Unforced Capacity Deliverability Rights (UDRs) are rights, as measured in MWs, associated with (i) new incremental controllable transmission projects, and (ii) new projects to increase the capability of existing controllable transmission projects that have UDRs, that provide a transmission interface to a Locality. When combined with Unforced Capacity which is located in an External Control Area or non-constrained NYCA region either by contract or ownership, and which is deliverable to the NYCA interface in the Locality in which the UDR transmission facility is electrically located, UDRs allow such Unforced Capacity to be treated as if it were located in the Locality, thereby contributing to an LSE's Locational Minimum Installed Capacity Requirement. To the extent the NYCA interface is with an External Control Area the Unforced Capacity associated with UDRs must be deliverable to the Interconnection Point (Source: MST Definitions)

Weather Normalized: Adjustments made to normalize the impact of weather when making energy and peak demand forecasts. Using historical weather data, energy analysts can account for the influence of extreme weather conditions and adjust actual energy use and peak demand to estimate what would have happened if the hottest day or the coldest day had been the typical, or "normal," weather conditions. "Normal" is usually calculated by taking the average of the previous 20 years of weather data.

Zone: One of the eleven regions in the NYCA connected to each other by identified transmission interfaces and designated as Load Zones A-K.

Appendix B - The Reliability Planning Process

This appendix presents an overview of the NYISO's Reliability Planning Process (RPP). A detailed discussion of the RPP, including applicable Reliability Criteria, is contained in NYISO Manual titled "Reliability Planning Process Manual 26," which is posted on the NYISO's website.

The NYISO RPP is an integral part of the NYISO's overall Comprehensive System Planning Process (CSPP). The CSPP is comprised of four components:

- Local Transmission Planning Process (LTPP),
- Reliability Planning Process (RPP), along with the newly defined quarterly Short Term Reliability Process (STRP)
- Congestion Assessment and Resource Integration Study (CARIS), and
- Public Policy Transmission Planning Process.

As part of the LTPP, local Transmission Owners perform transmission security studies for their BPTFs in their transmission areas according to all applicable criteria. Links to the Transmission Owner's LTPs can be found on the NYISO's website. The LTPP provides inputs for the RPP and STRP.

During the RPP, the NYISO conducts the Reliability Needs Assessment (RNA) and Comprehensive Reliability Plan (CRP). The RNA evaluates the resource adequacy and transmission security of the bulk power system over the RNA study period (i.e. year 4 through year 10). In identifying resource adequacy needs, the NYISO identifies the amount of resources in megawatts (known as "compensatory megawatts") and the locations in which they are needed to meet those needs. After the RNA is complete, the NYISO requests and evaluates market-based solutions, regulated backstop solutions, and alternative regulated solutions that address the identified Reliability Needs. This step results in the development of the CRP for the seven-year study period (*i.e.,* year 4 through year 10).

The RPP is a long-range assessment of both resource adequacy and transmission reliability of the New York bulk power system conducted over a seven-year planning horizon. There are two different aspects to analyzing the bulk power system's reliability in the RNA: adequacy and security. Adequacy is a planning and probabilistic concept. A system is adequate if the probability of having sufficient transmission and generation to meet expected demand is equal to or less than the system's standard, which is expressed as a loss of load expectation (LOLE). The New York State bulk power system is planned to meet an LOLE that, at any given point in time, is less than or equal to an involuntary load disconnection that is not more frequent than once in every 10 years, or 0.1 days per year. This requirement forms the basis of New York's installed reserve margin (IRM) resource adequacy requirement.

Transmission Security is an operating and deterministic concept. N-1 events are evaluated to assess their impact on the system, as viewed from the normal (or 'N') system condition. N-1-0 and N-1-1 analysis evaluates the ability of the system to meet design criteria after a critical element has already been lost. An N-1or N-1-1 violation occurs when the power flowing through a transmission element exceeds its applicable rating (thermal violation) or the voltage at a bus exceeds its specified range (voltage violation).

Certain areas of the Con Edison system are designed and operated for the occurrence of a second contingency. This type of combination can be described as N-1-1-0. For N-1-1-0 analysis, after the second contingency occurs, systems adjustments are allowed to secure the system back to normal ratings. The Con Edison planning criteria are contained in the NYSRC Reliability Rules, Rule G.1. Accordingly, a violation of the N-1-1-0 criterion on the BPTFs in the Con Edison Transmission District will be identified as a Reliability Need in the NYISO's Reliability Needs Assessment.

The RPP is anchored in the market-based philosophy of the NYISO and its Market Participants, which posits that market solutions should be the preferred choice to meet the identified Reliability Needs reported in the RNA. In the CRP, the reliability of the bulk power system is assessed and solutions to Reliability Needs evaluated in accordance with existing Reliability Criteria of the North American Electric Reliability Corporation (NERC), the Northeast Power Coordinating Council, Inc. (NPCC), and the New York State Reliability Council (NYSRC) as they may change from time to time. These criteria and a description of the nature of long-term bulk power system planning are described in detail in the applicable planning manual, and are briefly summarized below. In the event that market-based solutions do not materialize to meet a Reliability Need in a timely manner, the NYISO designates the Responsible TO or Responsible TOs or developer of an alternative regulated solution to proceed with a regulated solution in order to maintain system reliability. The NYISO may provide regulated cost recovery for transmission solutions constructed to meet a Reliability Need. Under the RPP, the NYISO also has an affirmative obligation to report historic congestion across the transmission system. In addition, the draft RNA is provided to the Market Monitoring Unit for review and consideration of whether market rules changes are necessary to address an identified failure, if any, in one of the NYISO's competitive markets. If market failure is identified as the reason for the lack of market-based solutions, the NYISO will explore appropriate changes in its market rules with its stakeholders and Independent Market Monitor. The RPP does not substitute for the planning that each TO conducts to maintain the reliability of its own bulk and non-bulk power systems.

The NYISO does not license or construct projects to respond to identified Reliability Needs reported in the RNA. The ultimate approval of those projects lies with regulatory agencies such as the FERC, the NYPSC/NYDPS, environmental permitting agencies, and local governments. The NYISO monitors the progress and continued viability of proposed market and regulated projects to meet identified needs, and reports its findings in annual plans.

In 2019, a major planning process was carved out of the RPP and defined as the Short-Term Reliability Process (STRP). This process was approved by the FERC and its requirements are contained in Attachments Y and FF of the NYISO's OATT. With this process in place, the RPP's Study Period changes from a year 1 to year 10 analysis, into a year 4 to year 10 look ahead. At the same time, the STRP evaluates year 1 through year 5 from the Short Term Assessment of Reliability (STAR) Start Date, with a focus on Short-Term Reliability Needs arising in years 1 through 3 of the Study Period.

Consistent with Section 38.2 of the OATT, Short-Term Reliability Process Needs that arise within three years of the later of (a) the conclusion of the 365 day prior notice period for that is described in Section 38.3.1.1 of the OATT for Generator Deactivation Reliability Needs, or (b) the posting of a completed Short-Term Assessment of Reliability (STAR) for other Reliability Needs on the BPTF, will be addressed using the Short-Term Reliability Process.

Short-Term Reliability Process Needs that arise in the Near Term (within three years) will be addressed using the Short-Term Reliability Process (STRP). Short-Term Reliability Process Needs that are not Near-Term needs on the BPTF (years 4 through 5) will only be addressed using the STRP if an identified Reliability Need cannot timely be addressed through the ISO's Reliability Planning Process. If the Reliability Need is handled through the STRP, the NYISO will solicit market-based solutions of all types, a regulated transmission solution(s), and service offers from Generators, as appropriate. The NYISO will select a solution(s) consistent with the STRP process which may include selecting Generators to remain in service under temporary Reliability Must Run (RMR) agreements until the transmission solution is complete.

STRP Needs that arise more than three years after the later of (x) the conclusion of the 365 day prior notice period for Generator Deactivation Reliability Needs, or (y) the posting of a completed STAR for other Reliability Needs on the BPTF, will only be addressed using the STRP if the identified Reliability Need cannot timely be addressed through the RPP set forth in this Attachment Y.

The CRP also provides inputs for the NYISO's economic planning process known as CARIS. CARIS Phase 1 examines congestion on the New York bulk power system and the costs and benefits of alternatives to alleviate that congestion. During CARIS Phase 2, the NYISO evaluates specific transmission project proposals for regulated cost recovery.

Another component of the CSPP is the Public Policy Transmission Planning Process. Under this component, interested entities propose, and the NYPSC identify, transmission needs driven by Public Policy Requirements. The NYISO then requests that interested entities submit proposed solutions to the Public Policy Transmission Need(s) identified by the NYPSC. The NYISO evaluates the viability and sufficiency of the proposed solutions to satisfy the identified Public Policy Transmission Need. Upon a confirmation by the NYPSC that a need for a transmission solution still exists, the NYISO then evaluates and may select the more efficient or cost-effective transmission solution to the identified need. The NYISO develops the Public Policy Transmission Planning Report containing its findings regarding the proposed solutions. This report is reviewed by NYISO stakeholders and approved by the Board of Directors.

In concert with each of the NYISO's regional planning processes, interregional planning is conducted with NYISO's neighboring control areas in the United States and Canada under the Northeastern ISO/RTO Planning Coordination Protocol. The NYISO participates in interregional planning and may consider Interregional Transmission Projects in its regional planning processes.

Figure 1 summarizes the CSPP and Figure 2 summarizes the RPP process.

Figure 1: NYISO's Comprehensive System Planning Process (CSPP)

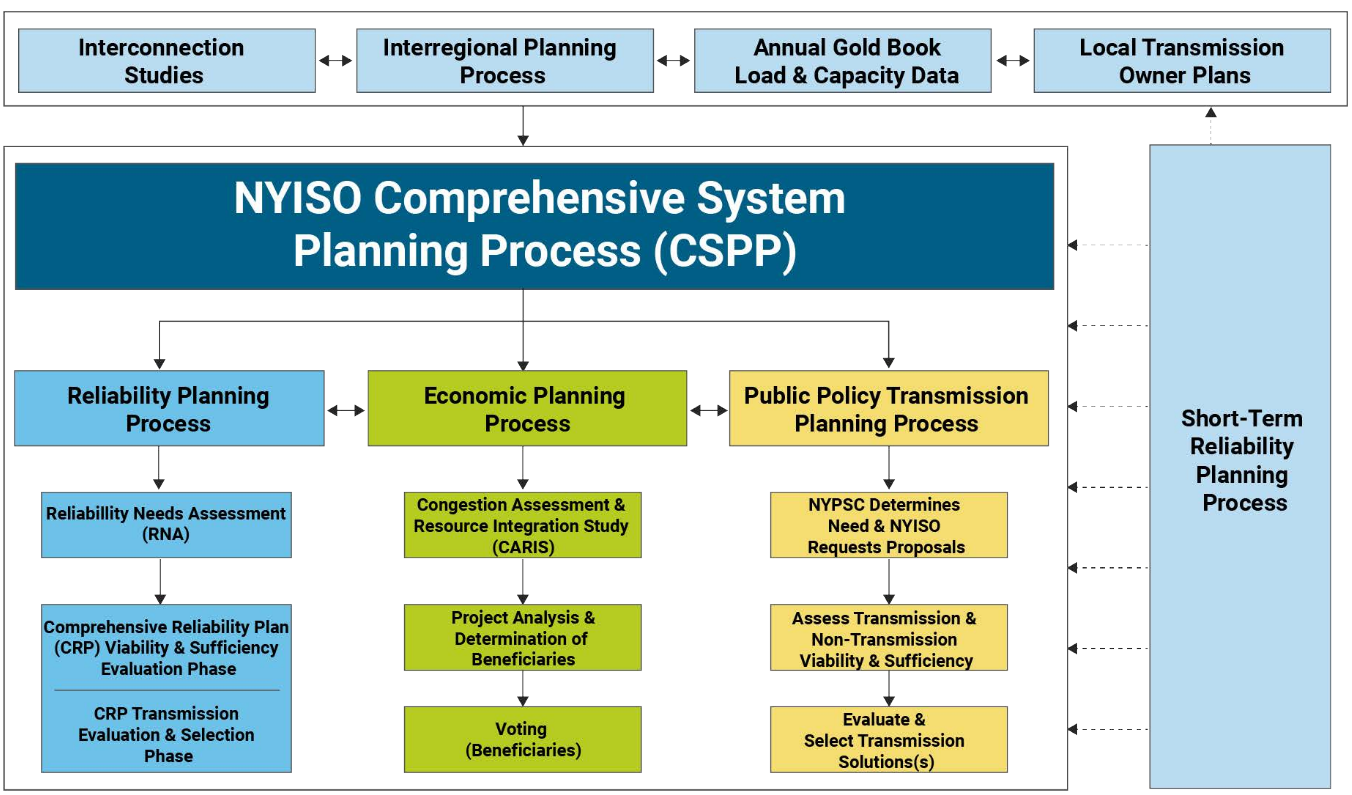
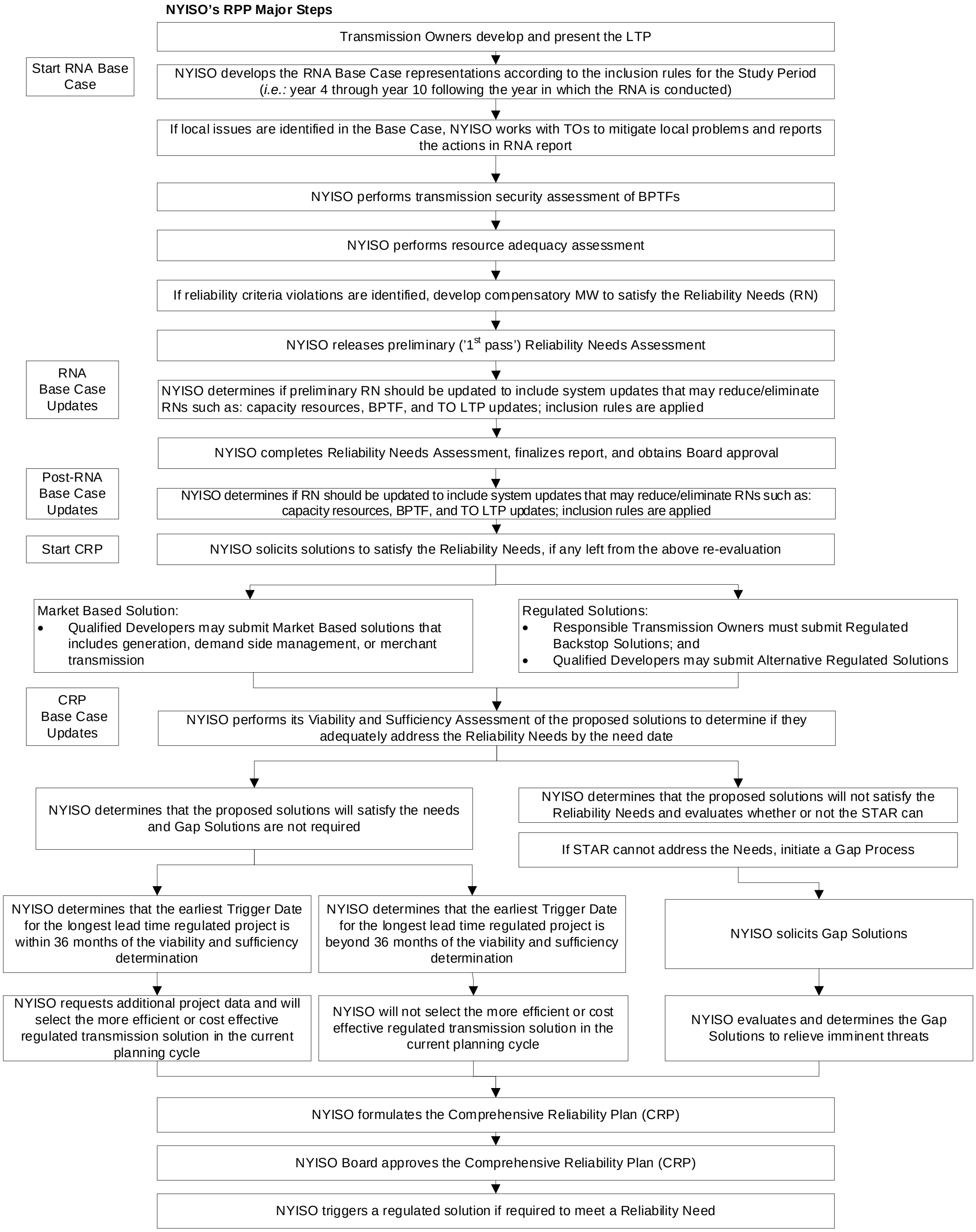


Figure 2: NYISO RPP



Notes:
* If an immediate threat to the reliability of the power system is identified, a Gap Solution outside of the normal RPP cycle may be requested by the NYISO Board.

Appendix C - Load and Energy Forecast 2021-2030

Historical Overview

In order to perform the 2020 RNA, a forecast of summer and winter peak demands and annual energy requirements was produced for the years 2020 - 2030. The New York Control Area (NYCA) is a summer peaking system and is expected to remain a summer peaking system over the study period. In longer term, the NYISO may become a winter peaking system in the mid-2030s due to increasing electrification primarily via heat pumps and electric vehicles. Both summer and winter peaks show considerable year-to-year variability due to the influence of peak-producing weather conditions for the seasonal peaks. Annual energy is also influenced by weather conditions over the entire year. However, the resulting variation in annual energy levels is relatively lower.

Figure 3 below reports the NYCA historic seasonal peaks and annual energy growth since 2010. The table provides both actual results and weather-normalized results, together with annual average growth rates for each table entry. The growth rates are averaged over the period 2010 to 2019.

Figure 3: Historical Energy and Seasonal Peak Demand - Actual and Weather-Normalized

	Annual Energy - GWh		Summer Peak - MW		Winter Peak - MW		
Year	Actual	Weather Normalized	Actual	Weather Normalized	Winter	Actual	Weather Normalized
2010	163,505	161,513	33,453	32,458	2010-11	24,654	24,452
2011	163,329	162,628	33,867	33,019	2011-12	23,901	24,630
2012	162,840	163,458	32,439	33,106	2012-13	24,659	24,630
2013	163,514	163,473	33,956	33,502	2013-14	25,739	24,610
2014	160,059	160,576	29,782	33,291	2014-15	24,648	24,500
2015	161,572	159,884	31,139	33,226	2015-16	23,319	24,220
2016	160,798	159,169	32,075	33,225	2016-17	24,164	24,416
2017	156,370	156,795	29,699	32,914	2017-18	25,081	24,265
2018	161,114	158,445	31,861	32,512	2018-19	24,727	24,114
2019	155,832	155,848	30,397	32,357	2019-20	23,253	24,123
	-0.53%	**-0.40%**	**-1.06%**	**-0.03%**		**-0.65%**	**-0.15%**

Forecast Overview

Figure 4 below shows historical and forecast growth rates of annual energy for five different regions in New York and in total. The 5 regions are Zones A to E, Zones F and G, H and I, Zone J, and Zone K. Figure 5 shows historical and forecast growth rates of summer and winter peak demand for the same 5 regions. The corresponding load forecast uncertainty values for each of 5 regions are also included.

Figure 4: Annual Energy and Average Growth – Actual and Forecast

	Annual Energy - GWh					
Year	**A to E**	**F&G**	**H&I**	**J**	**K**	**NYCA**
2010	54,458	21,778	9,233	55,114	22,922	163,505
2011	55,879	21,501	9,186	54,059	22,704	163,329
2012	56,238	21,784	9,029	53,487	22,302	162,840
2013	56,899	21,995	9,190	53,316	22,114	163,514
2014	55,132	21,844	8,974	52,541	21,568	160,059
2015	54,548	22,487	9,146	53,485	21,906	161,572
2016	54,286	22,273	8,995	53,653	21,591	160,798
2017	52,938	21,492	8,859	52,266	20,815	156,370
2018	55,210	22,340	8,878	53,360	21,326	161,114
2019	53,089	21,403	8,792	52,003	20,545	155,832
2020	51,275	20,635	8,277	48,964	19,869	149,020
2021	52,181	20,801	8,364	49,242	20,039	150,627
2022	52,856	20,887	8,450	49,715	20,206	152,114
2023	52,821	20,694	8,376	48,835	19,818	150,544
2024	52,808	20,532	8,372	48,628	19,564	149,904
2025	52,705	20,371	8,371	48,433	19,287	149,167
2026	52,561	20,230	8,388	48,444	19,104	148,727
2027	52,368	20,113	8,415	48,562	19,090	148,548
2028	52,170	20,036	8,453	48,777	19,347	148,783
2029	51,990	19,997	8,505	49,115	19,576	149,183
2030	51,864	20,006	8,560	49,450	19,894	149,774

	Average Annual Growth - Percent					
Period	A to E	F&G	H&I	J	K	NYCA
2010-19	-0.28%	-0.19%	-0.54%	-0.64%	-1.21%	-0.53%
2020-30	0.11%	-0.31%	0.34%	0.10%	0.01%	0.05%
2010-14	0.31%	0.08%	-0.71%	-1.19%	-1.51%	-0.53%
2014-19	-0.75%	-0.41%	-0.41%	-0.21%	-0.97%	-0.53%
2020-25	0.55%	-0.26%	0.23%	-0.22%	-0.59%	0.02%
2025-30	-0.32%	-0.36%	0.45%	0.42%	0.62%	0.08%

Figure 5: Actual and Forecast Seasonal Peak Demand and Average Growth, and LFU Multipliers

	Summer Coincident Peak - MW						Winter Coincident Peak - MW					
Year[1]	A to E	F&G	H&I	J	K	NYCA	A to E	F&G	H&I	J	K	NYCA
2010	9,483	4,738	2,187	11,213	5,832	33,453	8,617	3,411	1,453	7,661	3,512	24,654
2011	9,670	4,648	2,240	11,374	5,935	33,867	8,434	3,383	1,383	7,323	3,378	23,901
2012	9,932	4,630	2,046	10,722	5,109	32,439	8,885	3,462	1,457	7,456	3,399	24,659
2013	9,859	4,750	2,238	11,456	5,653	33,956	9,047	3,689	1,599	7,810	3,594	25,739
2014	8,212	4,069	1,917	10,567	5,017	29,782	8,789	3,481	1,491	7,481	3,406	24,648
2015	9,196	4,445	1,962	10,410	5,126	31,139	8,182	3,357	1,342	7,274	3,164	23,319
2016	9,437	4,451	2,028	10,990	5,169	32,075	8,534	3,416	1,447	7,482	3,285	24,164
2017	8,450	4,095	1,941	10,241	4,972	29,699	8,745	3,650	1,439	7,822	3,425	25,081
2018	8,985	4,568	2,024	10,890	5,394	31,861	8,504	3,684	1,475	7,674	3,390	24,727
2019	8,708	4,404	1,965	10,015	5,305	30,397	8,088	3,322	1,321	7,398	3,124	23,253
2020	9,269	4,519	2,077	11,316	5,115	32,296	8,392	3,462	1,351	7,551	3,374	24,130
2021	9,245	4,482	2,073	11,300	5,029	32,129	8,429	3,457	1,360	7,630	3,327	24,203
2022	9,235	4,457	2,081	11,397	4,958	32,128	8,490	3,462	1,385	7,847	3,290	24,474
2023	9,219	4,431	2,074	11,362	4,832	31,918	8,549	3,465	1,401	7,984	3,251	24,650
2024	9,206	4,412	2,076	11,395	4,749	31,838	8,613	3,473	1,427	8,202	3,229	24,944
2025	9,189	4,394	2,072	11,390	4,666	31,711	8,667	3,481	1,456	8,432	3,215	25,251
2026	9,172	4,382	2,079	11,446	4,591	31,670	8,715	3,491	1,492	8,720	3,217	25,635
2027	9,158	4,373	2,087	11,504	4,551	31,673	8,754	3,502	1,525	8,971	3,236	25,988
2028	9,149	4,371	2,095	11,583	4,558	31,756	8,789	3,518	1,560	9,259	3,278	26,404
2029	9,145	4,373	2,107	11,670	4,570	31,865	8,830	3,539	1,603	9,591	3,325	26,888
2030	9,147	4,381	2,118	11,757	4,589	31,992	8,875	3,569	1,647	9,934	3,363	27,388

	Average Annual Growth - Percent						Average Annual Growth - Percent					
Period	A to E	F&G	H&I	J	K	NYCA	A to E	F&G	H&I	J	K	NYCA
2010-19	-0.94%	-0.81%	-1.18%	-1.25%	-1.05%	-1.06%	-0.70%	-0.29%	-1.05%	-0.39%	-1.29%	-0.65%
2020-30	-0.13%	-0.31%	0.20%	0.38%	-1.08%	-0.09%	0.56%	0.30%	2.00%	2.78%	-0.03%	1.27%
2010-14	-3.53%	-3.73%	-3.24%	-1.47%	-3.69%	-2.86%	0.50%	0.51%	0.65%	-0.59%	-0.76%	-0.01%
2014-19	1.18%	1.59%	0.50%	-1.07%	1.12%	0.41%	-1.65%	-0.93%	-2.39%	-0.22%	-1.71%	-1.16%
2020-25	-0.17%	-0.56%	-0.05%	0.13%	-1.82%	-0.36%	0.65%	0.11%	1.51%	2.23%	-0.96%	0.91%
2025-30	-0.09%	-0.06%	0.44%	0.64%	-0.33%	0.18%	0.48%	0.50%	2.50%	3.33%	0.90%	1.64%

	Load Forecast Uncertainty Multipliers					Load Forecast Uncertainty Multipliers				
Bin	A to E	F&G	H&I	J	K	A to E	F&G	H&I	J	K
Bin 1	116.02%	117.17%	113.56%	110.73%	116.38%	112.22%	112.22%	112.22%	112.22%	112.22%
Bin 2	111.11%	111.70%	109.46%	107.33%	111.97%	107.77%	107.77%	107.77%	107.77%	107.77%
Bin 3	105.70%	105.70%	104.06%	102.89%	105.98%	103.69%	103.69%	103.69%	103.69%	103.69%
Bin 4	100.00%	99.36%	97.68%	97.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Bin 5	94.22%	92.89%	90.66%	91.91%	91.88%	96.69%	96.69%	96.69%	96.69%	96.69%
Bin 6	88.58%	86.48%	83.35%	85.86%	82.34%	93.76%	93.76%	93.76%	93.76%	93.76%
Bin 7	83.28%	80.33%	76.06%	79.79%	75.52%	91.22%	91.22%	91.22%	91.22%	91.22%

[1] Years listed reflect the NYISO capability year; For example, the year 2010 reflects the winter period spanning 2010-2011

Forecast Methodology

In addition to developing load forecasts for each of the load zones, the NYISO received and evaluated forecasts from all Transmission Owners, which were used in combination with the forecasts the NYISO developed. The NYISO employs a multi-stage process to develop load forecasts for each of the eleven zones within the NYCA.

In the first stage, baseline energy and peak models are built based on projections of end-use intensities and economic variables. End-use intensities modeled include those for lighting, refrigeration, cooking, heating, cooling, and other plug loads. Appliance end-use intensities are generally defined as the product of saturation levels (average number of units per household or commercial square foot) and efficiency levels (energy usage per unit or a similar measure). End-use intensities specific to New York are estimated from appliance saturation and efficiency levels in both the residential and commercial sectors. These intensities include the projected impacts of energy efficiency programs and improved codes and standards. Economic variables considered include Gross Domestic Product (GDP), households, population, and commercial and industrial employment. Projected long-term weather trends from the NYISO Climate Change Impact Study Phase I are included in the end-use models.

In the second stage, the incremental impacts of additional policy-based energy efficiency, behind-the-meter solar PV and distributed generation are deducted from the forecast; and the incremental impacts of electric vehicle usage and other electrification are added to the forecast. The impacts of net electricity consumption of energy storage units due to charging and discharging are added to the energy forecasts, while the peak reducing impacts of behind-the-meter energy storage units are deducted from the peak forecasts. In the final stage, the NYISO aggregates load forecasts by Zone. The 2020 summer peak forecast is the 2020 ICAP forecast.

Forecast Results

Figure 6 through Figure 16 include information on the 2020 Baseline forecast specific to the 2020 RNA look ahead period. Annual energy, summer, and winter peak forecasts and the corresponding average annual growth rates are provided for reference along with comparisons to the 2018 RNA baseline forecast used (Gold Book forecasts). Behind-the-meter impacts on summer peak reductions and total zonal peak requirements (demand and solar PV) are also provided.

Figure 6: Gold Book Baseline Energy Forecast Growth Rates - 2020 to 2030

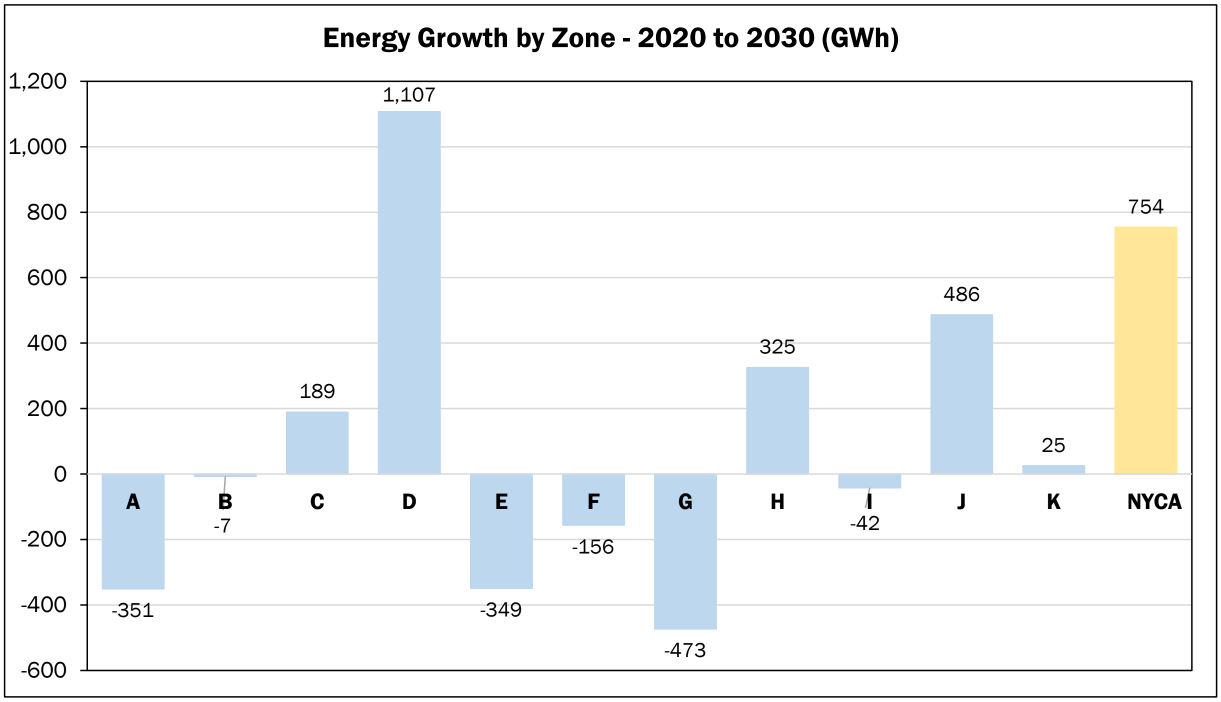


Figure 7: 2028 Energy Forecast Comparison between 2018 Gold Book and 2020 Gold Book

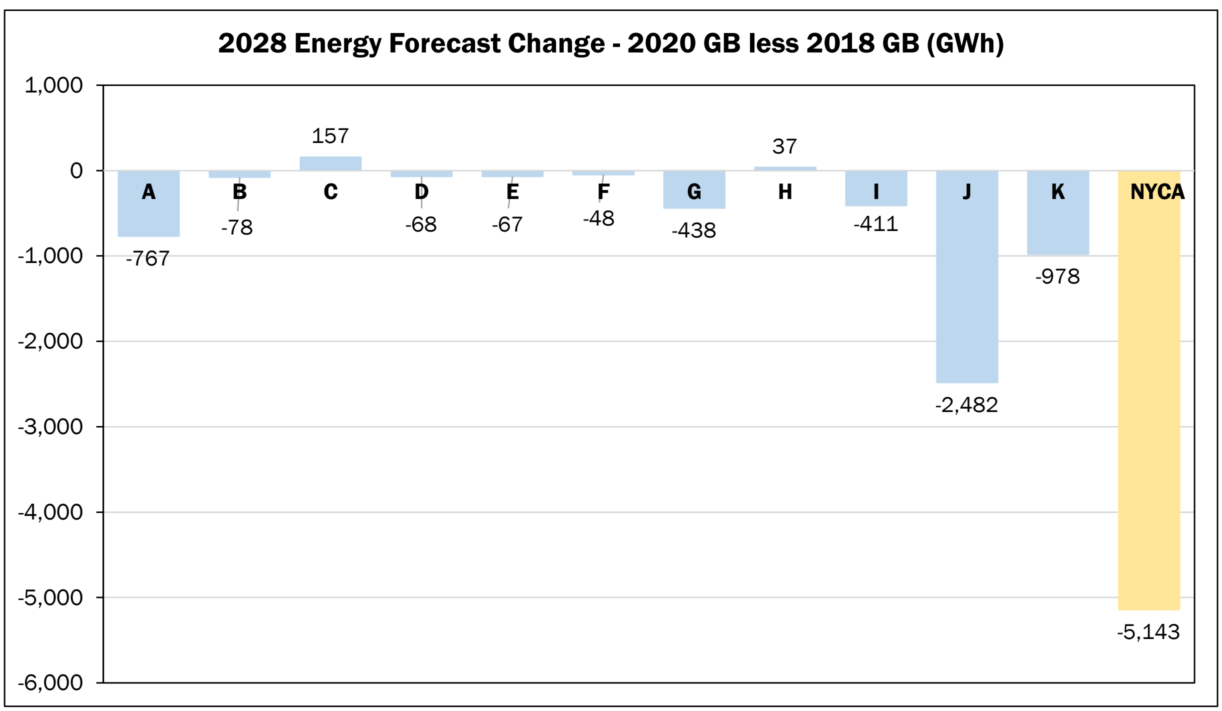


Figure 8: Gold Book Baseline Summer Coincident Peak Demand Forecast Growth Rates – 2020 to 2030

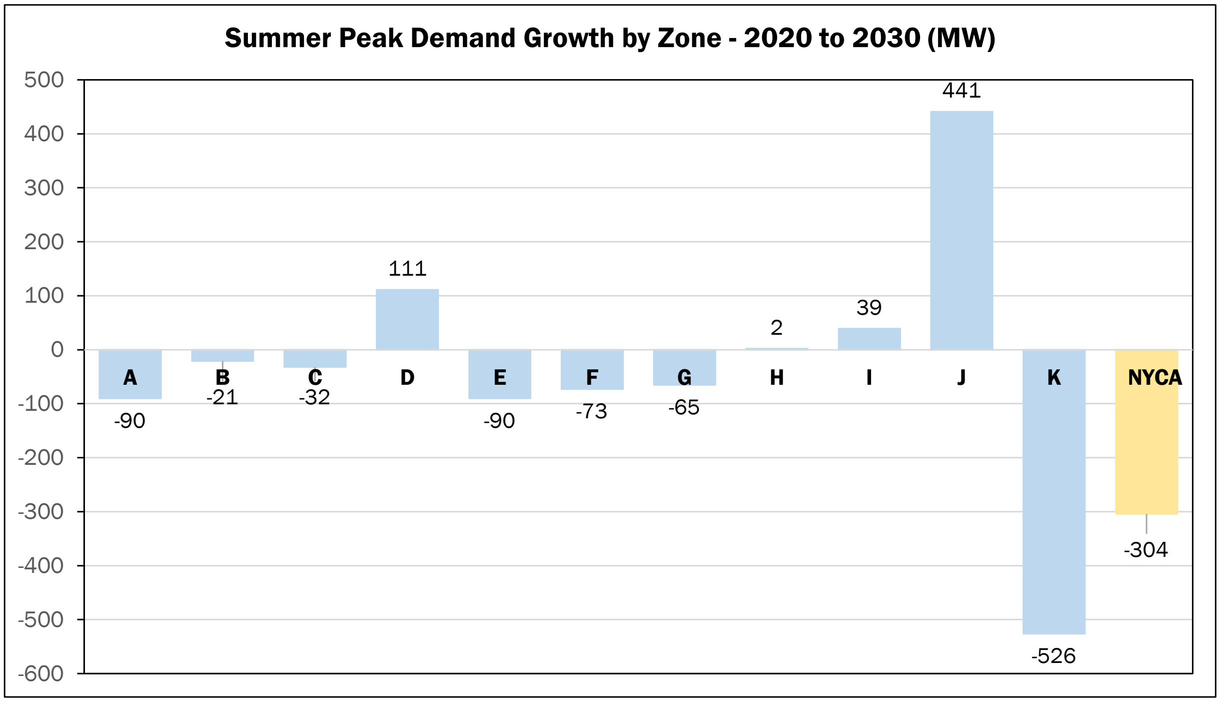


Figure 9: 2028 Summer Peak Forecast Comparison between 2018 Gold Book and 2020 Gold Book

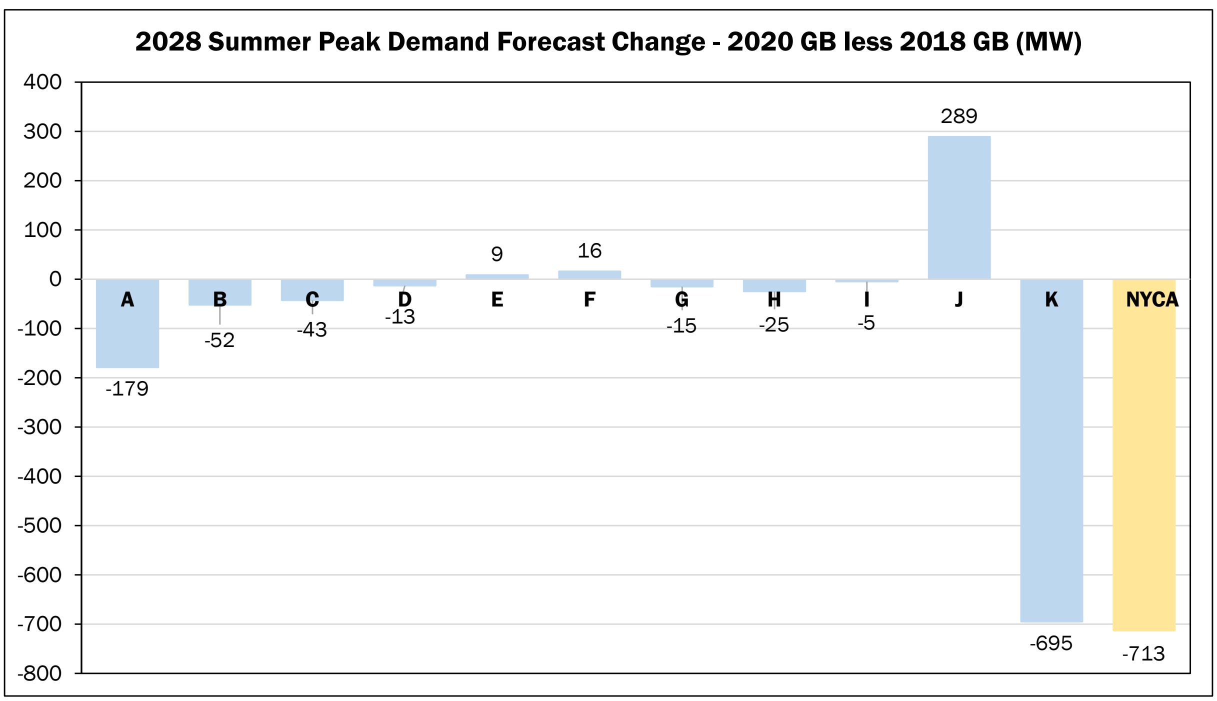


Figure 10: Annual Energy by Zone - Actual and 2020 Gold Book Baseline Forecast (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2010	15,903	10,128	16,209	4,312	7,906	11,394	10,384	2,969	6,264	55,114	22,922	163,505
2011	16,017	10,040	16,167	5,903	7,752	11,435	10,066	2,978	6,208	54,059	22,704	163,329
2012	15,595	10,009	16,117	6,574	7,943	11,846	9,938	2,930	6,099	53,487	22,302	162,840
2013	15,790	9,981	16,368	6,448	8,312	12,030	9,965	2,986	6,204	53,316	22,114	163,514
2014	15,890	9,902	16,347	4,835	8,158	12,010	9,834	2,886	6,088	52,541	21,568	160,059
2015	15,761	9,906	16,299	4,441	8,141	12,422	10,065	2,847	6,299	53,485	21,906	161,572
2016	15,803	9,995	16,205	4,389	7,894	12,298	9,975	2,856	6,139	53,653	21,591	160,798
2017	15,261	9,775	15,819	4,322	7,761	11,823	9,669	2,883	5,976	52,266	20,815	156,370
2018	15,894	10,090	16,561	4,670	7,995	12,375	9,965	2,807	6,071	53,360	21,326	161,114
2019	14,872	9,715	15,809	4,825	7,868	11,829	9,574	2,816	5,976	52,003	20,545	155,832
2020	14,282	9,468	15,182	4,818	7,525	11,449	9,186	2,669	5,608	48,964	19,869	149,020
2021	14,441	9,602	15,400	5,154	7,584	11,542	9,259	2,774	5,590	49,242	20,039	150,627
2022	14,540	9,697	15,578	5,431	7,610	11,612	9,275	2,847	5,603	49,715	20,206	152,114
2023	14,446	9,665	15,557	5,622	7,531	11,531	9,163	2,876	5,500	48,835	19,818	150,544
2024	14,367	9,643	15,558	5,777	7,463	11,475	9,057	2,899	5,473	48,628	19,564	149,904
2025	14,280	9,616	15,538	5,875	7,396	11,420	8,951	2,919	5,452	48,433	19,287	149,167
2026	14,196	9,585	15,514	5,930	7,336	11,375	8,855	2,935	5,453	48,444	19,104	148,727
2027	14,111	9,547	15,478	5,950	7,282	11,337	8,776	2,949	5,466	48,562	19,090	148,548
2028	14,038	9,510	15,438	5,948	7,236	11,312	8,724	2,963	5,490	48,777	19,347	148,783
2029	13,976	9,479	15,399	5,935	7,201	11,296	8,701	2,977	5,528	49,115	19,576	149,183
2030	13,931	9,461	15,371	5,925	7,176	11,293	8,713	2,994	5,566	49,450	19,894	149,774

Figure 11: Summer Coincident Peak Demand by Zone - Actual and 2020 Gold Book Baseline Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2010	2,663	1,985	2,846	552	1,437	2,339	2,399	700	1,487	11,213	5,832	33,453
2011	2,556	2,019	2,872	776	1,447	2,233	2,415	730	1,510	11,374	5,935	33,867
2012	2,743	2,107	2,888	774	1,420	2,388	2,242	653	1,393	10,722	5,109	32,439
2013	2,549	2,030	2,921	819	1,540	2,392	2,358	721	1,517	11,456	5,653	33,956
2014	2,227	1,617	2,574	527	1,267	2,033	2,036	584	1,333	10,567	5,017	29,782
2015	2,632	1,926	2,705	557	1,376	2,294	2,151	617	1,345	10,410	5,126	31,139
2016	2,672	2,008	2,812	561	1,384	2,328	2,123	636	1,392	10,990	5,169	32,075
2017	2,439	1,800	2,557	502	1,152	2,032	2,063	607	1,334	10,241	4,972	29,699
2018	2,391	1,947	2,747	600	1,300	2,378	2,190	631	1,393	10,890	5,394	31,861
2019	2,367	1,841	2,592	603	1,305	2,224	2,180	652	1,313	10,015	5,305	30,397
2020	2,662	1,948	2,728	583	1,348	2,352	2,167	647	1,430	11,316	5,115	32,296
2021	2,641	1,943	2,719	613	1,329	2,329	2,153	646	1,427	11,300	5,029	32,129
2022	2,626	1,941	2,715	640	1,313	2,313	2,144	646	1,435	11,397	4,958	32,128
2023	2,610	1,938	2,711	663	1,297	2,297	2,134	646	1,428	11,362	4,832	31,918
2024	2,597	1,936	2,708	682	1,283	2,285	2,127	647	1,429	11,395	4,749	31,838
2025	2,585	1,935	2,705	693	1,271	2,276	2,118	647	1,425	11,390	4,666	31,711
2026	2,575	1,933	2,702	699	1,263	2,271	2,111	648	1,431	11,446	4,591	31,670
2027	2,569	1,932	2,700	700	1,257	2,269	2,104	648	1,439	11,504	4,551	31,673
2028	2,567	1,930	2,698	699	1,255	2,271	2,100	649	1,446	11,583	4,558	31,756
2029	2,569	1,928	2,697	696	1,255	2,274	2,099	649	1,458	11,670	4,570	31,865
2030	2,572	1,927	2,696	694	1,258	2,279	2,102	649	1,469	11,757	4,589	31,992

Figure 12: Winter Coincident Peak Demand by Zone - Actual and 2020 Gold Book Baseline Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2010-11	2,413	1,606	2,657	645	1,296	1,825	1,586	526	927	7,661	3,512	24,654
2011-12	2,220	1,535	2,532	904	1,243	1,765	1,618	490	893	7,323	3,378	23,901
2012-13	2,343	1,568	2,672	954	1,348	1,923	1,539	510	947	7,456	3,399	24,659
2013-14	2,358	1,645	2,781	848	1,415	1,989	1,700	625	974	7,810	3,594	25,739
2014-15	2,419	1,617	2,689	725	1,339	1,925	1,556	537	954	7,481	3,406	24,648
2015-16	2,253	1,486	2,469	667	1,307	1,861	1,496	453	889	7,274	3,164	23,319
2016-17	2,295	1,600	2,573	671	1,395	1,867	1,549	530	917	7,482	3,285	24,164
2017-18	2,313	1,533	2,766	735	1,398	2,012	1,638	506	933	7,822	3,425	25,081
2018-19	2,107	1,566	2,668	747	1,416	2,066	1,618	534	941	7,674	3,390	24,727
2019-20	2,100	1,460	2,482	741	1,305	1,854	1,468	479	842	7,398	3,124	23,253
2020-21	2,227	1,559	2,525	751	1,330	1,899	1,563	493	858	7,551	3,374	24,130
2021-22	2,229	1,556	2,531	782	1,331	1,899	1,558	494	866	7,630	3,327	24,203
2022-23	2,240	1,557	2,547	810	1,336	1,907	1,555	498	887	7,847	3,290	24,474
2023-24	2,251	1,559	2,561	836	1,342	1,914	1,551	501	900	7,984	3,251	24,650
2024-25	2,266	1,564	2,576	858	1,349	1,925	1,548	505	922	8,202	3,229	24,944
2025-26	2,281	1,569	2,588	873	1,356	1,936	1,545	509	947	8,432	3,215	25,251
2026-27	2,296	1,575	2,598	883	1,363	1,948	1,543	513	979	8,720	3,217	25,635
2027-28	2,310	1,581	2,605	890	1,368	1,959	1,543	517	1,008	8,971	3,236	25,988
2028-29	2,325	1,587	2,610	893	1,374	1,971	1,547	522	1,038	9,259	3,278	26,404
2029-30	2,342	1,594	2,616	897	1,381	1,984	1,555	527	1,076	9,591	3,325	26,888
2030-31	2,360	1,602	2,624	901	1,388	1,999	1,570	532	1,115	9,934	3,363	27,388

Figure 13: 2020 Gold Book Behind-the-Meter Solar PV Baseline Annual Energy Reductions by Zone (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2020	199	95	261	18	202	431	363	49	64	335	614	2,631
2021	282	125	345	20	285	529	436	57	71	397	727	3,274
2022	384	158	437	24	381	631	505	63	78	460	778	3,899
2023	505	194	533	28	488	733	566	68	86	526	836	4,563
2024	635	230	622	34	592	831	614	72	93	588	882	5,193
2025	766	264	700	40	687	918	652	76	99	644	892	5,738
2026	885	294	762	48	766	992	681	77	105	694	901	6,205
2027	988	318	810	57	825	1,052	702	77	110	742	910	6,591
2028	1,069	337	846	66	868	1,096	716	79	115	782	919	6,893
2029	1,132	351	870	74	900	1,132	727	79	119	817	929	7,130
2030	1,178	360	889	83	922	1,158	736	80	120	825	938	7,289

Figure 14: 2020 RNA Base Case Annual Energy Forecast with BTM Solar PV Added Back (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2020	14,481	9,563	15,443	4,836	7,727	11,880	9,549	2,718	5,672	49,299	20,483	151,651
2021	14,723	9,727	15,745	5,174	7,869	12,071	9,695	2,831	5,661	49,639	20,766	153,901
2022	14,924	9,855	16,015	5,455	7,991	12,243	9,780	2,910	5,681	50,175	20,984	156,013
2023	14,951	9,859	16,090	5,650	8,019	12,264	9,729	2,944	5,586	49,361	20,654	155,107
2024	15,002	9,873	16,180	5,811	8,055	12,306	9,671	2,971	5,566	49,216	20,446	155,097
2025	15,046	9,880	16,238	5,915	8,083	12,338	9,603	2,995	5,551	49,077	20,179	154,905
2026	15,081	9,879	16,276	5,978	8,102	12,367	9,536	3,012	5,558	49,138	20,005	154,932
2027	15,099	9,865	16,288	6,007	8,107	12,389	9,478	3,026	5,576	49,304	20,000	155,139
2028	15,107	9,847	16,284	6,014	8,104	12,408	9,440	3,042	5,605	49,559	20,266	155,676
2029	15,108	9,830	16,269	6,009	8,101	12,428	9,428	3,056	5,647	49,932	20,505	156,313
2030	15,109	9,821	16,260	6,008	8,098	12,451	9,449	3,074	5,686	50,275	20,832	157,063

Figure 15: 2020 Gold Book Behind-the-Meter Solar PV Baseline Summer Coincident Peak Demand Reductions by Zone (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2020	34	18	49	4	35	89	78	11	12	74	151	555
2021	49	24	67	4	51	111	96	13	14	90	188	707
2022	67	30	85	5	70	132	111	15	16	106	204	841
2023	88	37	104	5	91	152	125	16	18	122	228	986
2024	112	43	123	6	112	171	135	17	19	136	228	1,102
2025	136	49	138	8	131	187	142	17	21	148	227	1,204
2026	158	55	150	9	147	199	146	17	22	158	226	1,287
2027	176	59	158	11	159	208	147	17	23	168	225	1,351
2028	190	62	162	12	165	214	147	17	24	175	224	1,392
2029	199	63	164	14	168	216	145	16	24	180	222	1,411
2030	203	63	163	15	169	215	143	16	24	180	220	1,411

Figure 16: 2020 RNA Base Case Summer Coincident Peak Demand Forecast with BTM Solar PV Added Back (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2020	2,696	1,966	2,777	587	1,383	2,441	2,245	658	1,442	11,390	5,266	32,851
2021	2,690	1,967	2,786	617	1,380	2,440	2,249	659	1,441	11,390	5,217	32,836
2022	2,693	1,971	2,800	645	1,383	2,445	2,255	661	1,451	11,503	5,162	32,969
2023	2,698	1,975	2,815	668	1,388	2,449	2,259	662	1,446	11,484	5,060	32,904
2024	2,709	1,979	2,831	688	1,395	2,456	2,262	664	1,448	11,531	4,977	32,940
2025	2,721	1,984	2,843	701	1,402	2,463	2,260	664	1,446	11,538	4,893	32,915
2026	2,733	1,988	2,852	708	1,410	2,470	2,257	665	1,453	11,604	4,817	32,957
2027	2,745	1,991	2,858	711	1,416	2,477	2,251	665	1,462	11,672	4,776	33,024
2028	2,757	1,992	2,860	711	1,420	2,485	2,247	666	1,470	11,758	4,782	33,148
2029	2,768	1,991	2,861	710	1,423	2,490	2,244	665	1,482	11,850	4,792	33,276
2030	2,775	1,990	2,859	709	1,427	2,494	2,245	665	1,493	11,937	4,809	33,403

Appendix D - Resource Adequacy and Transmission System Security Assessments

The analysis performed during the Reliability Needs Assessment requires the development of base cases for transmission security analysis and for resource adequacy analysis. The power flow system model is used for transmission security assessment and also for the development of the transfer limits to be implemented in the Multi-Area Reliability Simulation (MARS) model. The NYISO conducts comprehensive assessment of the transmission system through a series of steady-state power flow, transient stability, and short circuit studies.

The NYISO used the MARS model to determine whether adequate resources would be available to meet the NYSRC and NPCC reliability criteria of one day in ten years (0.1 days/year). The results identify LOLE violations, and details are in the Section 6 of the RNA report.

The MARS model was also used to evaluate selected scenarios.

2020 RNA Assumptions Matrix

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
Load Parameters				
1	Peak Load Forecast	Adjusted 2018 Gold Book NYCA baseline peak load forecast. The GB 2018 baseline peak load forecast includes the impact (reduction) of behind-the-meter (BtM) solar at the time of NYCA peak. For the Resource Adequacy load model, the deducted BtM solar MW was added back to the NYCA zonal loads, which then allows for a discrete modeling of the BtM solar resources.	Similar method	2 variations, same as the two CARIS 70x30 Scenarios: 1. RNA 70x30 NYCA High Load, similar to CARIS's Case Labeled 'Base Load' 2. RNA 70x30 NYCA Low Load, similar to CARISs Case Labeled "Scenario Load"
2	Load Shapes (Multiple Load Shapes)	Used Multiple Load Shape MARS Feature 8,760 hour historical load shapes were used as base shapes for LFU bins: Bin 1: 2006 Bin 2: 2002 Bins 3-7: 2007 Peak adjustments on a seasonal basis. For the BtM Solar adjustment, the BtM shape is added back to account for the impact of the BtM generation on both on-peak and off-peak hours.	Similar method	Single year load shape that includes BtM taken directly from CARIS 70x30 Case original load (losses not included)
3	Load Forecast Uncertainty (LFU)	Used updated summer LFU values for the 11 NYCA zones.	Updated via Load Forecast Task Force (LFTF) process Reference: April 13 2020 LFTF presentation: https://www.nyiso.com/documents/20142/11883362/LFU_Summary.pdf	Same as 2020 RNA Base Case
Generation Parameters				

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
1	**Existing** Generating Unit Capacities	2018 Gold Book values. Use summer min (DMNC vs. CRIS). Use winter min (DMNC vs. CRIS). Adjusted for RNA inclusion rules.	Similar method	Same as 2020 RNA Base Case
2	**Proposed New Units Inclusion** Determination	GB2018 with Inclusion Rules Applied	Similar method	Off-shore wind, land-based wind and utility scale PV added to align with CARIS 70x30 Case Renewable Resources mix
3	Retirement, Mothballed Units, IIFO	GB2018 with Inclusion Rules Applied	Similar method	Units that are retired in 2020 RNA Base Case. Additionally, all unit impacted by DEC's Peaker Rule were removed to align with CARIS 70x30 Case assumptions
4	Forced and Partial Outage Rates	Five-year (2013-2017) GADS data for each unit represented. Those units with less than five years – use representative data. Transition Rates representing the Equivalent Forced Outage Rates (EFORd) during demand periods over the most recent five-year period For new units or units that are in service for less than three years, NERC 5-year class average EFORd data are used.	Similar method	Same as 2020 RNA Base Case
5	Planned Outages	Based on schedules received by the NYISO and adjusted for history	Similar method	Same as 2020 RNA Base Case
6	Summer Maintenance	Nominal 50 MW (25 in J and 25 in K)	None	Same as 2020 RNA Base Case

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
7	Combustion Turbine Derates	Derate based on temperature correction curves For new units: used data for a unit of same type in same zone, or neighboring zone data.	Similar method	Same as 2020 RNA Base Case
8	Existing Landfill Gas Plants	**New method:** Actual hourly plant output over the period 2013-2017. Program randomly selects a LFG shape of hourly production over the 2013-2017 for each model replication. Probabilistic model is incorporated based on five years of input shapes, with one shape per replication randomly selected in the Monte Carlo process.	Similar method	Same as 2020 RNA Base Case
9	Existing **Wind** Units (>5 years of data)	Actual hourly plant output over the period 2013-2017. Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in Monte Carlo process	Similar method	8,760 hourly shapes based on output profile from CARIS 70x30 case. Notes: 1. CARIS 70x30 case output profile captures curtailments observed in the CARIS MAPS simulations 2. CARIS 70x30 case wind shape input based on 2009 NREL data.
10	Existing **Wind** Units (<5 years of data)	For existing data, the actual hourly plant output over the period 2013-2017 is used. For missing data, the nameplate normalized average of units in the same load zone is scaled by the unit's nameplate rating.	Similar method	8,760 hourly shapes based on output profile from CARIS 70x30 case. Notes: 1. CARIS 70x30 case output profile captures curtailments observed in the CARIS MAPS simulations 2. CARIS 70x30 case wind shape input

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
				based on 2009 NREL data.
11a	Proposed **Land based Wind** Units	Inclusion Rules Applied to determine the generator status. The nameplate normalized average of units in the same load zone is scaled by the unit's nameplate rating.	Similar method	8,760 hourly shapes based on output profile from CARIS 70x30 case. Notes: 1. CARIS 70x30 case output profile captures curtailments observed in the CARIS MAPS simulations 2. CARIS 70x30 case wind shape input based on 2009 NREL data.
11b	Proposed **Offshore Wind** Units	N/A	N/A	8,760 hourly shapes based on output profile from CARIS 70x30 case. Notes: 1. CARIS 70x30 case output profile captures curtailments observed in the CARIS MAPS simulations 2. CARIS 70x30 case wind shape input based on 2009 NREL data.
12a	Existing **Utility-scale Solar Resources**	The 31.5 MW Upton metered solar capacity: probabilistic model chooses from 5 years of production data output shapes covering the period 2013-2017 (one shape per replication is randomly selected in Monte Carlo process.)	Similar method	8,760 hourly shapes based on output profile from CARIS 70x30 case. Notes: 1. CARIS 70x30 case output profile captures curtailments. 2. CARIS 70x30 case existing utility scale PV shape input based on Y2017 historical data.

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
12b	Proposed **Utility-scale Solar Resources**	Inclusion Rules Applied to determine the generator status. The nameplate normalized average of units in the same load zone is scaled by the unit's nameplate rating.	Similar method	8,760 hourly shapes based on output profile from CARIS 70x30 case. Notes: 1. CARIS 70x30 case output profile captures curtailments. 2. CARIS 70x30 case future utility scale PV shape input based on 2006 NREL data.
13	Projected **BtM Solar Resources**	The large projection of increasing retail (BtM) solar installations over the 10-year period require a discrete model with detailed hourly performance. **New method:** A 8,760 hourly shape was created by using NREL's PV Watt[1] tool. MARS will randomly select a daily shape from the current month for each day of each month of each replication.	**New Method:** Will use 5-year of inverter production data. Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in Monte Carlo process **Reference**: April 6, 2020 TPAS/ESPWG meeting materials	8,760 hourly shape from CARIS 70x30 output. Note: CARIS BtM solar profile based on hourly shape created using NREL's PV Watt tool.
14	Existing **BTM-NG Program**	**New category:** These are former load modifiers to sell capacity into the ICAP market. Modeled as cogen type 2 unit in MARS. Unit capacity set to CRIS value, load modeled with weekly pattern that can change monthly.	Similar method	Same as 2020 RNA Base Case
15	Existing **Small Hydro** Resources	**New method:** Actual hourly plant output over the period 2013-2017. Program randomly selects a hydro shape of hourly production over the 5-year window for each model replication. The randomly	Similar method	Same as 2020 RNA Base Case

[1] NREL's PVWatts Calculator, credit of the U.S. Department of Energy (DOE)/NREL/Alliance (Alliance for Sustainable Energy, LLC).

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
		selected shape is multiplied by their current nameplate rating.		
16	Existing **Large Hydro**	Probabilistic Model based on 5 years of GADS data. Transition Rates representing the Equivalent Forced Outage Rates (EFORd) during demand periods over the most recent five-year period (2013-2017). Methodology consistent with thermal unit transition rates.	Similar method	Same as 2020 RNA Base Case
17	Proposed **Energy Storage**	N/A	N/A	Utilize MARS Energy Storage model, which allows for charging and discharging, and also includes temporal constraints (*e.g.*, hours/days or hours/month)
Transaction - Imports / Exports				
1	Capacity Purchases	Grandfathered Rights and other awarded long-term rights Modeled using MARS explicit contracts feature.	Similar method	Same as 2020 RNA Base Case except for imports from HQ, see HQ section for additional information. Add 1310 MW HVDC connection between HQ and Zone J
2	Capacity Sales	These are long-term contracts filed with FERC. Modeled using MARS explicit contracts feature. Contracts sold from ROS (Zones: A-F). ROS ties to external pool are derated by sales MW amount	Similar method	Same as 2020 RNA Base Case

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
3	FCM Sales	Model sales for known years Modeled using MARS explicit contracts feature. Contracts sold from ROS (Zones: A-F). ROS ties to external pool are derated by sales MW amount	Similar method	Same as 2020 RNA Base Case
4	UDRs	Updated with most recent elections/awards information (VFT, HTP, Neptune, CSC)	Similar method	Same as 2020 RNA Base Case
5	EDRs	N/A	**New category:** Cedars Uprate 80 MW. Increased the HQ to D by 80 MW. Note: the Cedar bubble has been removed and its corresponding MW was reflected in HQ to D limit. References: 1. March 16, 2020 ESPWG/TPAS 2. April 6, 2020 TPAS/ESPWG	Not modeled (see HQ section for additional information)
6	Wheel-Through Contract	n/a	**New category:** 300 MW HQ through NYISO to ISO-NE. Modeled as firm contract. Reduced the transfer limit from HQ to NYISO by 300 MW and increased the transfer limit from NYISO to ISO-NE by 300 MW.	Not modeled (see HQ section for additional information)
MARS Topology: a simplified bubble-and-pipe representation of the transmission system				
0			**Summary of major topology changes** (as compared with the 2018-2019 RPP): Link1)-7); Link8)-9); Link10)	Same as 2020 RNA Base Case + LIPA topology updates for the 70x30 scenario additional (to the Base Case) peakers removal

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
			1) Marion-Farragut 345kV cables (B and C) assumed out of service 2) 71, 72, M51, M52 series reactors assumed by-passed after deactivation of Indian Point 3) Moses – St. Lawrence (L33P) tie line assumed out of service 4) Rainey – Corona transmission project in service impacting J to K limits 5) UPNY-SENY simplification 2021-2023 before the addition of AC PPTPP projects 6) AC PPTPs Segment A and B Projects Added starting 2024 7) Removal of Cedars bubble/tie to Zone D model; adding the MW from the bubble to the tie HQ to D tie limit. 8) Removal of PJM-SENY Group Interface 9) Updates to Zone K Imports/Exports 10) Somerset retirement impacts 11) The external areas model for PJM and ISO-NE were simplified by consolidating the 5 PJM areas (bubbles) into one, and the 8 ISO-NE areas into one.	
1	Interface Limits	Developed by review of previous studies and	Similar method	Same as 2020 RNA Base Case

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
		specific analysis during the RNA study process		
2	New Transmission	Based on TO- provided firm plans (via Gold Book 2018 process) and proposed merchant transmission; inclusion rules applied	Similar method	Same as 2020 RNA Base Case
3	AC Cable Forced Outage Rates	All existing cable transition rates updated with data received from ConEd and PSEG-LIPA to reflect most recent five-year history	Similar method	Same as 2020 RNA Base Case
4	UDR unavailability	Five-year history of forced outages	Similar method	Same as 2020 RNA Base Case
Emergency Operating Procedures				
1	Special Case Resources	SCRs sold for the program discounted to historic availability (“effective capacity”). Summer values calculated from the latest available July registrations, held constant for all years of study. 5 calls/month	Similar method but with 15 calls/year Note: also, combined the two SCR steps (generation and load zonal MW)	Same as 2020 RNA Base Case
2	EDRP Resources	2018 Gold Book with effective capacity modeled. Resources sold for the program and discounted to historic availability. Summer values calculated from July 2018 registrations and forecast growth. Values held constant for all years of study.	Not modeled: the values are less than 2 MW.	Same as 2020 RNA Base Case
3	Other EOPs	Based on TO information, measured data, and NYISO forecasts	Similar method	Same as 2020 RNA Base Case
External Control Areas				

#	Parameter	2018 RNA/CRP (2018 GB) Study Period: 2019 -2028	2020 RNA (2020 GB) Study Period: 2024(y4) - 2030 (y10)	2020 RNA 70x30 Scenario Case Study Period: 2030
1	PJM	As per RNA Procedure External model (load, capacity, topology) provided by PJM/NPCC CP-8 WG. PJM is a 5-zone model. LOLE of pool adjusted to be between 0.10 and 0.15 days per year by adjusting capacity pro-rata in all areas.	**New model:** Simplified model: The 5 PJM MARS areas (bubbles) were consolidated into one	Same as 2020 RNA Base Case
2	ISONE	As per RNA Procedure External model (load, capacity, topology) provided by PJM/NPCC CP-8 WG. LOLE of pool adjusted to be between 0.10 and 0.15 days per year by adjusting capacity pro-rata in all areas.	**New model:** Simplified model: The 8 ISO-NE MARS areas (bubbles) were consolidated into one	Same as 2020 RNA Base Case
3	HQ	As per RNA Procedure External model (load, capacity, topology) provided by PJM/NPCC CP-8 WG. LOLE of pool adjusted to be between 0.10 and 0.15 days per year by adjusting capacity pro-rata in all areas.	Similar method	HQ bubble not modeled for consistency with CARIS. Imports from HQ modeled as injections based upon usage profile from MAPS analysis. No flows between HQ and IESO or ISONE.
4	IESO	As per RNA Procedure External model (load, capacity, topology) provided by PJM/NPCC CP-8 WG. LOLE of pool adjusted to be between 0.10 and 0.15 days per year by adjusting capacity pro-rata in all areas.	Similar method	Same as 2020 RNA Base Case
5	Reserve Sharing	All NPCC Control Areas indicate that they will share reserves **equally** among all members before sharing with PJM.	Similar method	Same as 2020 RNA Base Case
6	NYCA Emergency Assistance Limit	Implemented a statewide limit of 3,500 MW	Similar method	Implemented a statewide (excluding assistance from HQ) limit of 3,500 MW
Miscellaneous				
1	MARS Model Version	Version 3.22.6	3.29.1499	3.29.1499

Assumptions Matrix for Transmission Security Assessment

Parameter	2020 RNA Transmission Security Studies Modeling Assumptions	2020 RNA 70x30 Scenario Case Study Period: 2030	Source
Peak Load	NYCA baseline coincident summer peak forecast, which already includes EE and DG (including solar) reductions.	NYCA baseline coincident summer peak forecast for 2030 with adjustments to BTM Solar in accordance with the CARIS 70x30 Base Load.	2020 Gold Book
Load Model	ConEd: voltage varying	No Change	2020 FERC 715 filing
	Rest of NYCA: constant power	No Change	
System Representation	Per updates received through Databank process (Subject to RNA base case inclusion rules).	No Change	NYISO RAD Manual, 2020 FERC 715 filing
Inter-area Interchange Schedules	Consistent with ERAG MMWG interchange schedule.	No Change	2020 FERC 715 filing, MMWG
Inter-area Controllable Tie Schedules	Consistent with applicable tariffs and known firm contracts or rights.	No Change	2020 FERC 715 filing
In-City Series Reactors	Consistent with ConEdison operating protocol. Note: series reactors on 71, 72, M51, and M52 are modeled by-passed with Y49, 41, and 42 series reactors modeled in-service.	No Change	2020 FERC 715 filing, Con Edison protocol
SVCs, FACTS	Set at zero pre-contingency; allowed to adjust post-contingency	No Change	NYISO T&D Manual
Transformer & PAR taps	Taps allowed to adjust pre-contingency; fixed post-contingency.	No Change	2020 FERC 715 filing
Switched Shunts	Allowed to adjust pre-contingency; fixed post-contingency.	No Change	2020 FERC 715 filing
Fault Current analysis settings	Per Fault Current Assessment Guideline.	No Change	NYISO Fault Current Assessment Guideline

Summary of Proposed Generation and Transmission Assumptions

The figures below summarize similar information from the report, depicted in different ways.

Figure 17: Generation Additions by Year

Summer of Year	New unit Addition	Zone	MW (Summer)	Total Additions
Y2021	-	-	0	0
Y2022	Cassadaga Wind	A	126	126
	Baron Winds	C	238	364
	Eight Point Wind Enery Center	B	101	466
	Roaring Brook Wind	E	80	545
	Calverton Solar Energy Center	K	23	568
Y2023	Ball Hill Wind	A	100	668
Y2024	-	-	0	668
Y2025	-	-	0	668
Y2026	-	-	0	668
Y2027	-	-	0	668
Y2028	-	-	0	668
Y2029	-	-	0	668
Y2030	-	-	0	668

Figure 18: Deactivations and Peaker Rule Status Change by Year

Summer of Year	Retired Unit	Zone	MW (Summer)	Total Removal
Y2021	Somerset	A	676	676
	Albany LFG	F	5	681
	Indian Point 2	H	1,012	1,692
	West Babylon	K	49	1,741
	Indian Point 3	H	1,036	2,778
Y2022	-	-	0	2,778
Y2023	Zone A	A	0	2,778
	Zone G	G	38	2,816
	Zone J	J	773	3,589
	Zone K	K	36	3,625
Y2024	-	-	0	3,625
Y2025	Zone A	A	0	3,625
	Zone G	G	0	3,625
	Zone J	J	605	4,230
	Zone K	K	0	4,230
Y2026	-	-		4,230
Y2027	-	-		4,230
Y2028	-	-		4,230
Y2029	-	-		4,230
Y2030	-	-		4,230

Figure 19: NYCA and Zone J Summaries

Year	NYCA (MW)				
	Additions	Reratings	Deactivations	Net capacity	Summer Coincident Baseline Load
Y2021	0	0	2,778	37,334	32,129
Y2022	568	0	2,778	37,902	32,128
Y2023	668	0	3,625	37,155	31,918
Y2024	668	0	3,625	37,155	31,838
Y2025	668	0	4,230	36,551	31,711
Y2026	668	0	4,230	36,551	31,670
Y2027	668	0	4,230	36,551	31,673
Y2028	668	0	4,230	36,551	31,756
Y2029	668	0	4,230	36,551	31,865
Y2030	668	0	4,230	36,551	31,992

Year	Zone J (MW)				
	Additions	Reratings	Deactivations	Net capacity	Peak Load
Y2021	0	0	0	9,568	11,300
Y2022	0	0	0	9,568	11,397
Y2023	0	0	773	8,795	11,362
Y2024	0	0	773	8,795	11,395
Y2025	0	0	1,378	8,190	11,390
Y2026	0	0	1,378	8,190	11,446
Y2027	0	0	1,378	8,190	11,504
Y2028	0	0	1,378	8,190	11,583
Y2029	0	0	1,378	8,190	11,670
Y2030	0	0	1,378	8,190	11,757

The additional proposed projects from the Interconnection Queue are shown in Figure 20 and Figure 21.

Figure 20: Additional Proposed Generation Projects from the 2020 Gold Book

Queue	Owner/ Operator	Proposed Generator Project	Zone	Proposed Date*	Requested CRIS (MW)[1]	Summer (MW)
Completed Class Year Facilities Study						
387	Cassadaga Wind, LLC	Cassadaga Wind	A	Dec-20	126.0	126.5
396	Baron Winds, LLC	Baron Winds	C	Dec-20	300.0	238.4
422	NextEra Energy Resources, LLC	Eight Point Wind Enery Center	B	Dec-20	101.2	101.8
363	Anbaric Development Parners, LLC	Poseidon Offshore	K	Jan-21	500.0	500.0
349	Taylor Biomass Energy Montgomery, LLC	Taylor Biomass	G	Apr-21	19.0	19.0
505	RES America Development Inc.	Ball Hill Wind	A	Dec-22	100.0	100.0
393	NRG Berrians East Development, LLC	Berrians East Replacement	J	Feb-23	508.0	431.0
Completed CRIS Requests						
430	HQUS	Cedar Rapids Transmission Upgrade	D	Oct-21	80.0	N/A
Class Year 2019						
618	North Park Energy, LLC	High River Solar	F	Nov-20	90.0	90.0
519	Canisteo Wind Energy LLC	Canisteo Wind	C	Dec-20	290.7	290.7
531	Invenery Wind Development LLC	Number 3 Wind Energy	E	Dec-20	105.8	105.8
546	Atlantic Wind, LLC	Roaring Brook Wind	E	Dec-20	79.7	79.7
579	Bluestone Wind, LLC	Bluestone Wind	E	Dec-20	124.2	124.2
617	North Park Energy, LLC	Watkins Glen Solar	C	Dec-20	50.0	50.0
678	LI Solar Generation, LLC	Calverton Solar Energy Center	K	Dec-20	22.9	22.9
683	KCE NY 2, LLC	KCE NY 2	G	Jun-21	200.0	200.0
535	sPower Development Company, LLC	Riverhead Expansion	K	Oct-21	36.0	36.0
644	Hecate Energy Columbia County 1, LLC	Columbia County 1	F	Oct-21	60.0	60.0
495	Mohawk Solar LLC	Mohawk Solar	F	Nov-21	90.5	90.5
571	Heritage Renewables, LLC	Heritage Wind	A	Nov-21	200.1	200.1
591	Geronimo Energy, LLC	High Top Solar	C	Nov-21	20.0	20.0
629	Silver Lake Solar, LLC	Silver Lake Solar	C	Nov-21	24.9	24.9
637	Flint Mine Solar LLC	Flint Mine Solar	G	Nov-21	100.0	100.0
706	High Brigde Wind, LLC	High Brigde Wind	E	Nov-21	100.8	100.8
560	Atlantic Wind, LLC	Deer River Wind	E	Dec-21	100.0	100.0
594	North Park Energy, LLC	NW Energy	C	Dec-21	60.0	60.0
595	North Park Energy, LLC	SW Energy	A	Dec-21	100.0	100.0
596	Invenergy Wind Development LLC	Alle Catt II Wind	A	Dec-21	339.8	339.8
619	North Park Energy, LLC	East Point Solar	F	Dec-21	50.0	50.0
697	Helix Ravenswood, LLC	Ravenswood Energy Storage 1	J	May-22	129.0	129.0
698	Helix Ravenswood, LLC	Ravenswood Energy Storage 2	J	May-22	129.0	129.0
746	Energy Storage Resouces, LLC	Peconic River Energy Storage	K	Jun-22	150.0	150.0
620	North Park Energy, LLC	North Side Solar	D	Nov-22	180.0	180.0
718	Cortland Energy Center,LLC	Cortland Energy Center	C	Nov-22	50.0	50.0
720	North Light Energy Center, LLC	North Light Energy Center	C	Nov-22	80.0	80.0
721	Excelsior Energy Center, LLC	Excelsior Energy Center	A	Nov-22	280.0	280.0
612	Deepwater Wind South Fork, LLC	South Fork Wind Farm	K	Dec-22	96.0	96.0
695	Deepwater Wind South Fork, LLC	South Fork Wind Farm II	K	Dec-22	40.0	40.0
704	Bear Ridge Solar, LLC	Bear Ridge Solar	A	Dec-22	100.0	100.0
791	Danskammer Energy LLC	Danskammer Energy Center	G	Oct-23	88.9	595.5
276	EDF Renewables Development, Inc.	Homer Solar Energy Center	C	Dec-23	90.0	90.0
668	North Bergen Liberty Generating, LLC	Liberty Generating Alternative	J	Feb-24	1,172.0	1,171.0
737	Equinor Wind US LLC	Empire Wind	J	Dec-24	816.0	816.0
738	Equinor Wind US LLC	Empire Wind II	K	Dec-24	816.0	816.0
778	Astoria Generating Company LP	Gowanus Gas Turbine Facility Repowering	J	May-24	0.0	549.0

Queue	Owner/ Operator	Proposed Generator Project	Zone	Proposed Date*	Requested CRIS (MW)[1]	Summer (MW)
CRIS Requests						
	Innovative Energy Systems, LLC	Fulton County Landfill	F	Oct-20	3.2	N/A
	Seneca Energy II, LLC	Ontario Landfill	B	Oct-20	3.6	N/A
	BSC Owner LLC	Spring Creek Tower	J	Oct-20	8.0	N/A
	Energy Storage Resources, LLC	Eagle Energy Storage	J	Nov-21	20.0	N/A
	Gernonimo Energy, LLC	Blue Stone Solar	G	Jul-21	20.0	N/A
	Energy Storage Resources, LLC	Queen City Energy Storage	K	Sep-21	19.2	N/A
	Strata Storage, LLC	Groundvault Energy Storage	J	Nov-21	12.5	N/A
	Strata Storage, LLC	Stillwell Energy Storage	J	Nov-21	10.0	N/A
	Strata Storage, LLC	Cleancar Energy Storage	J	Nov-21	15.0	N/A
	KCE NY 14, LLC	KCE NY 14	G	Sep-20	20.0	N/A
	Hannacroix Solar Facility, LLC	Hannacroix Solar	G	Oct-20	3.2	N/A
	RWE Solar Development, LLC	Monsey 44-6	G	May-20	5.0	N/A
	RWE Solar Development, LLC	Monsey 44-2	G	May-20	5.0	N/A
	RWE Solar Development, LLC	Monsey 44-3	G	May-20	5.0	N/A
	RWE Solar Development, LLC	Cuddebackville Battery	G	Jan-22	10.0	N/A
	RWE Solar Development, LLC	Jewett Avenue	J	May-22	20.0	N/A
	KCE NY 18, LLC	KCE NY 18	G	Jun-21	20.0	N/A
	Yonkers Grid, LLC	Yonkers Grid	J	Sep-22	20.0	N/A
	King's Plaza Energy LLC	King's Plaza	J	Oct-20	6.0	N/A
	Gravity Renewables, Inc	Dahowa Hydroelectric	F	Oct-20	10.5	N/A
	Enel Green Power North America, Inc.	Cuddebackville	G	May-22	10.0	N/A
734	ELP Ticonderoga Solar, LLC	ELP Ticonderoga Solar	F	May-21	20.0	N/A
741	Bluestone Wind, LLC	Bluestone Battery Storage	E	Aug-20	10.0	N/A
744	Granada Solar LLC	Magruder Solar	G	Dec-20	20.0	N/A
756	Rising Solar, LLC	Rising Solar II	G	Nov-21	20.0	N/A
770	KCE NY 8a LLC	KCE NY 8a	G	May-20	20.0	N/A
804	KCE NY 10, LLC	KCE NY 10	A	Sep-20	20.0	N/A
Future Class Year Candidates						
520	EDP Renewables North America	Rolling Upland Wind	E	Oct-19	72.6	72.6
468	Apex Clean Energy LLC	Galloo Island Wind	C	Dec-19	110.4	110.4
523	Dunkirk Power, LLC	Dunkirk Unit 2	A	Apr-20	75.0	75.0
524	Dunkirk Power, LLC	Dunkirk Unit 3 & 4	A	Apr-20	370.0	370.0
496	Renovo Energy Center, LLC	Renovo Energy Center	C	Jun-20	480.0	480.0
372	Dry Lots Wind, LLC	Dry Lots Wind	E	Dec-20	33.0	33.0
445	Lighthouse Wind, LLC	Lighthouse Wind	A	Dec-20	201.3	201.3
526	Atlantic Wind, LLC	North Ridge Wind	D	Dec-20	100.0	100.0
624	Franklin Solar, LLC	Franklin Solar	D	Dec-20	150.0	150.0
686	Invenergy Solar Development North America LLC	Bull Run Solar Eneryg Center	D	Dec-20	170.0	170.0
693	Renovo Energy Center, LLC	Renovo Energy Center Uprate	C	Apr-21	515.0	515.0
498	ESC Tioga County Power, LLC	Tioga County Power	C	May-21	550.0	550.0
740	Oakdale Battery Storage LLC	Oakdale battery Storage	C	Aug-21	120.0	120.0
474	EDP Renewables North America	North Slope Wind	D	Oct-21	200.0	200.0
466	Atlantic Wind, LLC	Bone Run Wind	A	Dec-21	132.0	132.0
574	Atlantic Wind, LLC	Mad River Wind	E	Dec-21	450.0	450.0
745	Energy Storage Resources, LLC	Huckleberry Ridge Energy	G	Apr-22	100.0	100.0
699	Helix Ravenswood, LLC	Ravenswood Gas	J	Jun-22	238.5	238.5
719	East Ling Energy Center	East Light Energy Center	F	Nov-22	40.0	40.0
497	Invenergy Wind Development LLC	Bull Run	D	Dec-22	303.6	303.6
521	Invenergy NY, LLC	Bull Run II Wind	D	Dec-22	145.4	145.4
449	Stockbridge Wind, LLC	Stockbridge Wind	C	Oct-23	72.6	72.6

Queue	Owner/ Operator	Proposed Generator Project	Zone	Proposed Date*	Requested CRIS (MW)[1]	Summer (MW)
		Other Non Class Year Generators				
775	Puckett Solar, LLC (Conti)	Puckett Solar	E	Apr-20	20.0	20.0
570	Hecate Energy, LLC	Albany County	F	Jun-20	20.0	20.0
598	Hecate Energy, LLC	Albany County II	F	Jun-20	20.0	20.0
581	SED NY Holdings LLC	Hills Solar	E	Jul-20	20.0	20.0
584	SED NY Holdings LLC	Dog Corners Solar	C	Aug-20	20.0	20.0
586	SED NY Holdings LLC	Watkins Rd Solar	E	Aug-20	20.0	20.0
735	ELP Stillwater Solar LLC	ELP Stillwater Solar	F	Aug-20	20.0	20.0
638	Pattersonville Solar Facility, LLC	Pattersonville	F	Oct-20	20.0	20.0
759	KCE NY 6, LLC	KCE NY 6	A	Oct-20	20.0	20.0
590	Duke Energy Renewables Solar, LLC	Scipio Solar	C	Nov-20	20.0	20.0
592	Duke Energy Renewables Solar, LLC	Niagara Solar	B	Nov-20	20.0	20.0
513	Stoney Creek Energy, LLC	Orangeville	C	Dec-20	20.0	20.0
572	Hecate Energy Greene 1 LLC	Greene County 1	G	Dec-20	20.0	20.0
573	Hecate Energy Greene 2 LLC	Greene County 2	G	Dec-20	10.0	10.0
575	Little Pond Solar, LLC	Little Pond Solar	G	Dec-20	20.0	20.0
589	Duke Energy Renewables Solar, LLC	North Country Solar	E	Dec-20	15.0	15.0
621	Blue Stone Solar Energy, LLC	Saugerties Solar	G	Dec-20	20.0	20.0
649	CR Fuel Cell, LLC	Clare Rose	K	Dec-20	13.9	13.9
669	SED NY Holdings LLC	Clay Solar	C	Dec-20	20.0	20.0
670	SED NY Holdings LLC	Skyline Solar	E	Dec-20	20.0	20.0
682	Grissom Solar, LLC	Grissom Solar	F	Dec-20	20.0	20.0
748	Regan Solar, LLC (Conti)	Grissom Solar II	F	Dec-20	20.0	20.0
564	Rock District Solar, LLC	Rock District Solar	F	Apr-21	20.0	20.0
565	Tayandenega Solar, LLC	Tayandenega Solar	F	Apr-21	20.0	20.0
730	Darby Solar, LLC	CS Easton Solar 1	F	Mar-21	20.0	20.0
731	Branscomb Solar, LLC	CS Easton Solar 2	F	Mar-21	20.0	20.0
768	Janis Solar, LLC	Janis Solar	C	Mar-21	20.0	20.0
545	Sky High Solar, LLC	Sky High Solar	C	May-21	20.0	20.0
666	Martin Rd Solar LLC	Martin Solar	A	Oct-21	20.0	20.0
715	EDF Renewables Development, Inc.	Suffragette Solar	C	Nov-21	20.0	20.0
487	LI Energy Storage System, LLC	Far Rockawary Battery Storage	K	Dec-21	20.0	20.0
597	Hecate Energy Greene County 3 LLC	Greene County 3	G	Dec-21	20.0	20.0
650	BRT Fuel Cell, LLC	Brookhaven Rail Terminal	K	May-22	18.5	18.5
667	Bakerstand Solar LLC	Bakerstand Solar	A	Oct-22	20.0	20.0

included in the 2020 RNA Base Case

included in the 2019 - 2028 CRP

* Generation projects that met 2020 RNA Inclusion Rule are assumed to be in-service one year later than 2020 GB Proposed Date to reflect the potential impact of Covid-19 on construction and completion.

Figure 21: Additional Proposed Transmission Projects from the 2020 Gold Book

Queue	Owner	Terminals	
Proposed Merchant Transmission Projects			
506	Empire State Connector Corp.	Marcy 345kV	Gowanus 345kV
631, 15	Transmission Developers Inc.	Hertel 735kV (Quebec)	New Scotland, Astoria Annex 345kV
458,15	Transmission Developers Inc.	Hertel 735kV (Quebec)	Astoria Annex 345kV
Proposed TIP Projects (included in FERC 715 Base Case)			
430	Empire State Connector Corp.	Dennison	Alcoa
545A	NextEra Energy Transmission NY	Dysinger (New Station)	East Stolle (New Station)
545A	NextEra Energy Transmission NY	Dysinger (New Station)	Dysinger (New Station)
556	NGRID	Porter	Rotterdam
556	NGRID	Porter	Rotterdam
556	NGRID	Edic	New Scotland
556	NAT/NYPA/NGRID	Edic	Rotterdam
556	NAT/NYPA	Rotterdam	Princetown
556	NAT/NYPA	Edic	Princetown
556	NAT/NYPA	Princetown	New Scotland
556	NGRID	Princetown	New Scotland
543	NGRID	Greenbush	Hudson
543	NGRID	Hudson	Pleasant Valley
543	NGRID	Schodack	Churchtown
543	NGRID	Churchtown	Pleasant Valley
543	NGRID	Milan	Pleasant Valley
543	NGRID	Lafarge	Pleasant Valley
543	NGRID	North Catskill	Milan
543	O&R	Shoemaker, Middle	Sugarloaf, Chester
543	NGRID	New Scotland	Alps
543	New York Transco	Schodack	Churchtown
543	New York Transco	Churchtown	Pleasant Valley
543	NGRID	Lafarge	Churchtown
543	NGRID	North Catskill	Churchtown
543	New York Transco	Knickerbocker	Pleasant Valley
543	New York Transco	Knickerbocker	Knickerbocker
543	NGRID	Knickerbocker	New Scotland
543	NGRID	Knickerbocker	Alps
543	New York Transco	Shoemaker	Sugarloaf
543	New York Transco	Shoemaker, Middle	Sugarloaf, Chester

included in the 2020 RNA Base Case

included in the 2019 - 2028 CRP

RNA Power Flow Base Case Development

The NYISO developed the 2020 RNA Base Cases used to analyze the performance of the transmission system from the 2020 FERC 715 filing power flow case library. The load representation in the power flow model is the summer peak load forecast reported in the 2020 Gold Book Table 1-3a baseline forecast of coincident peak demand. The system representation for the NPCC Areas in the base cases is from the 2019 Base Case Development libraries compiled by the NPCC SS-37 Base Case Development working group. The NYISO derived the PJM system representation from the PJM Regional Transmission Expansion Plan (RTEP) planning process models. The remaining models are from the Eastern Interconnection Reliability Assessment Group (ERAG) Multiregional Modeling Working Group (MMWG) 2019 power flow model library.

The NYISO utilized the RNA Base Case inclusion rules to screen the projects and plans for inclusion or exclusion from the 2020 RNA Base Case. The NYISO revised the RNA Base Case inclusion rules as set forth in Section 3 of the Reliability Planning Process Manual (Manual 26).

Specifically, the 2020 RNA Base Case does not include all projects currently listed on the NYISO's interconnection queue or those shown in the 2020 Gold Book. Rather, it includes only those which met the screening requirements, as shown in the Figure 18 of the main report. The generation deactivation assumptions are reflected in Figure19 and Figure 20 of the main report. The firm transmission plans included in the RNA Base Case are listed in Figure 22 on the next page.

New York ISO

Figure 22: Firm Transmission Plans included in 2020 RNA Base Case

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
Firm Plans (5) (included in FERC 715 Base Case)											
ConEd	Jamaica	Jamaica	Reconfiguration	In-Service	2019	138	138		N/A	N/A	Reconfiguration
ConEd	East 13th Street	East 13th Street	xfmr	In-Service	2019	345	345		N/A	N/A	Replacing xfmr 10 and xfmr 11
ConEd	Gowanus	Gowanus	xfmr	In-Service	2019	345	345		N/A	N/A	Replacing xfmr T2
ConEd	East 13th Street	East 13th Street	Reconfiguration	In-Service	2019	345	345		N/A	N/A	Reconfiguration (xfmr 10 -xfmr 11)
ConEd	Rainey	Corona	xfmr/Phase shifter	In-Service	2019	345/138	345/138	1	268 MVA	320 MVA	xfmr/Phase shifter
LIPA	Far Rockaway	Far Rockaway	Reconfiguration	In-Service	2019	34.5	34.5		N/A	N/A	Reconfigure 34.5 kV switchgear
LIPA	Elwood	Elwood	Breaker	In-Service	2019	138	138		N/A	N/A	Install double bus tie - Operate Normally Open
LIPA	Canal	Southampton	5.20	In-Service	2019	69	69	1	1107	1169	2500 kcmil XLPE CU
LIPA	Deer Park	Deer Park	-	W	2019	69	69	1	N/A	N/A	Install 27 MVAR Cap Bank
LIPA	MacArthur	MacArthur	-	W	2019	69	69	1	N/A	N/A	Install 27 MVAR Cap Bank
LIPA	West Hempstead	East Garden City	-2.92	In-Service	2019	69	69	1	1158	1245	477 ACSS
LIPA	West Hempstead	Hempstead	0.97	In-Service	2019	69	69	1	1158	1245	477 ACSS
LIPA	Hempstead	East Garden City	1.95	In-Service	2019	69	69	1	1158	1245	477 ACSS
LIPA	Pilgrim	West Bus	-11.86	In-Service	2019	138	138	1	2087	2565	2493 ACAR
LIPA	West Bus	Kings	8.25	In-Service	2019	138	138	1	2087	2565	2493 ACAR
LIPA	Pilgrim	Kings	4.81	In-Service	2019	138	138	1	2087	2565	2493 ACAR
NGRID	Golah	Golah	Cap Bank	In-Service	2019	115	115	1	18MVAR	18MVAR	Capacitor Bank
NGRID	Falls Park	Schodack(NG)	17.33	In-Service	2019	115	115	1	186 MVA	227 MVA	Loop for NYSEG Sub Will Reconfigure NG Line #14 Into Two New Lines
NGRID	Falls Park	Churchtown	9.41	In-Service	2019	115	115	1	175 MVA	206 MVA	Loop for NYSEG Sub Will Reconfigure NG Line #14 Into Two New Lines

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
NGRID	Batavia	Batavia	Cap Bank	In-Service	2019	115	115	1	30MVAR	30MVAR	Second Capacitor Bank
NGRID	Battenkill	Eastover Road	-22.72	In-Service	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Battenkill	Schaghticoke (New Station)	14.31	In-Service	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Schaghticoke (New Station)	Eastover Road	8.41	In-Service	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Mohican	Luther Forest	-34.47	In-Service	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Mohican	Schaghticoke (New Station)	28.13	In-Service	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Ohio St	Ohio St		In-Service	2019	115	115		N/A	N/A	New Distribution Station at Ohio Street
NGRID	Albany Steam	Greenbush	6.14	In-Service	2019	115	115	2	1190	1527	Reconductor Albany - Greenbush 115kV lines 1 & 2
NGRID	Schodack	Churchtown	-26.74	In-Service	2019	115	115	1	937	1141	Line removal tapped by Falls Park Project
NGRID	Sodeman Rd	Sodeman Rd		In-Service	2019	115	115		N/A	N/A	New Distribution Station at Sodeman Road
NGRID	Dewitt	Dewitt		In-Service	2019	115	115		N/A	N/A	New Distribution Station at Dewitt
NGRID	Luther Forest	Schaghticoke (New Station)	6.34	In-Service	2019	115	115	1	1280	1563	New Schaghticoke Switching Station
NGRID	Seneca	Seneca	-	In-Service	2019	115/22	115/22	-	50MVA	50MVA	Damage/Failure on TR2
NGRID	Mortimer	Mortimer	Reconfiguration	In-Service	2019	115	115	1	N/A	N/A	Reconfiguration of Station
NGRID	Mohican	Butler	3.50	S	2019	115	115	1	TBD	TBD	Replace 3.5 miles of conductor w/min 336.4 ACSR
NYSEG	Wood Street	Carmel	1.34	In-Service	2019	115	115	1	261 MVA	261 MVA	477 ACSR
NYSEG	Flat Street	Flat Street	xfmr	In-Service	2019	115/34.5	115/34.5	2	40MVA	45.2MVA	Transformer #2
NYSEG	Falls Park 115/34.5kV			In-Service	2019	115/34.5	115/34.5				Tap to interconnect NG Line #14
NYSEG	Falls Park	Falls Park	xfmr	In-Service	2019	115/34.5	115/34.5	1	62 MVA	70 MVA	Transformer #1

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
RGE	Station 42	Station 23	Phase Shifter	In-Service	2019	115	115	1	253 MVA	253 MVA	Phase Shifter
RGE	Station 23	Station 23	xfmr	In-Service	2019	115/11.5/11.5	115/11.5/11.5	2	75 MVA	84 MVA	Transformer
RGE	Station 23	Station 23	xfmr	W	2019	115/34.5	115/34.5	2	75 MVA	84 MVA	Transformer
CHGE	North Chelsea	North Chelsea	xfmr	S	2020	115/69	115/69	1	564	728	Replace Transformer 1
CHGE	Fishkill Plains	East Fishkill	2.05	S	2020	115	115	1	995	1218	1-1033.5 ACSR
CHGE	North Catskill	North Catskill	xfmr	W	2020	115/69	115/69	2	560	726	Replace Transformer 4 & 5
ConEd	Buchanan North	Buchanan North	Reconfiguration	S	2020	345	345		N/A	N/A	Reconfiguration (bus work related to decommissioning of Indain Point 2)
LIPA	Meadowbrook	East Garden City	-3.11	S	2020	69	69	1	458	601	4/0 CU
LIPA	East Garden City	Lindbergh	2.50	S	2020	69	69	1	575	601	750 kcmil CU
LIPA	Lindbergh	Meadowbrook	2.11	S	2020	69	69	1	458	601	4/0 CU
LIPA	Elmont	Floral Park	-1.59	S	2020	34.5	34.5	1	644	816	477 AL
LIPA	Elmont	Belmont	1.82	S	2020	34.5	34.5	1	342	457	2/0 CU
LIPA	Belmont	Floral Park	2.04	S	2020	34.5	34.5	1	644	816	477 AL
LIPA	MacArthur	-	Cap Bank	S	2020	69	69	1	27MVAR	27 MVAR	Capacitor bank
NGRID	Rosa Rd	Rosa Rd	-	S	2020	115	115		N/A	N/A	Install 35.2MVAR Cap Bank at Rosa Rd
NGRID	Rotterdam	Curry Rd	7	S	2020	115	115	1	808	856	Replace 7.0 miles of mainly 4/0 Cu conductor with 795kcmil ACSR 26/7
NGRID	Elm St	Elm St	xfmr	S	2020	230/23	230/23	1	118MVA	133MVA	Add a fourth 230/23kV transformer
NGRID	West Ashville	West Ashville		S	2020	115	115		N/A	N/A	New Distribution Station at West Ashville
NGRID	Spier	Rotterdam (#2)	-32.74	S	2020	115	115	1	1168	1416	New Lasher Rd Switching Station
NGRID	Spier	Lasher Rd (New Station)	21.69	S	2020	115	115	1	1168	1416	New Lasher Rd Switching Station

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
NGRID	Lasher Rd (New Station)	Rotterdam	11.05	S	2020	115	115	1	2080	2392	New Lasher Rd Switching Station
NGRID	Spier	Luther Forest (#302)	-34.21	S	2020	115	115	1	916	1070	New Lasher Rd Switching Station
NGRID	Spier	Lasher Rd (New Station)	21.72	S	2020	115	115	1	916	1118	New Lasher Rd Switching Station
NGRID	Lasher Rd (New Station)	Luther Forest	12.49	S	2020	115	115	1	990	1070	New Lasher Rd Switching Station
NGRID	Rotterdam	Rotterdam	-	S	2020	115	115	2	N/A	N/A	Install Series Reactors at Rotterdam Station on lines 17 & 19
NGRID	Huntley	Lockport	6.9	S	2020	115	115	2	1303	1380	Replace 6.9 miles of 36 and 37 lines
NGRID	Two Mile Creek	Two Mile Creek		S	2020	115	115		N/A	N/A	New Distribution Station at Two Mile Creek
NGRID	Maple Ave	Maple Ave		S	2020	115	115		N/A	N/A	New Distribution Station at Maple Ave
NGRID	Randall Rd	Randall Rd		S	2020	115	115		N/A	N/A	New Distribution Station at Randall Road
NGRID	GE	Geres Lock	7.14	S	2020	115	115	1	785	955	Reconductoring 4/0CU & 336 ACSR to 477 ACCR (Line #8)
NGRID	Gardenville 115kV	Gardenville 115kV	-	S	2020	-	-	-	-	-	Rebuild of Gardenville 115kV Station to full breaker and a half
NGRID	Rotterdam	Woodlawn	7	S	2020	115	115	1			Replace 7.0 miles of mainly 4/0 Cu conductor with 795kcmil ACSR 26/7
NGRID	Gardenville 230kV	Gardenville 115kV	xfmr	S	2020	230/115	230/115	-	347 MVA	422 MVA	Replacement of 230/115kV TB#4 stepdown with larger unit
NGRID	Oswego	Oswego	-	W	2020	115	115		N/A	N/A	Rebuild of Oswego 115kV Station
NYPA	Fraser Annex	Fraser Annex	SSR Detection	S	2020	345	345	1	1793 MVA	1793 MVA	MSSC SSR Detection Project
NYPA	Niagara	Rochester	-70.20	W	2020	345	345	1	2177	2662	2-795 ACSR
NYPA	Somerset	Rochester	-44.00	W	2020	345	345	1	2177	2662	2-795 ACSR
NYPA	Niagara	Station 255 (New Station)	66.40	W	2020	345	345	1	2177	2662	2-795 ACSR
NYPA	Somerset	Station 255 (New Station)	40.20	W	2020	345	345	1	2177	2662	2-795 ACSR
NYPA	Station 255 (New Station)	Rochester	3.80	W	2020	345	345	2	2177	2662	2-795 ACSR

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
NYPA	Niagara 230 kV	Niagara 230 kV	Breaker	W	2020	230	230	1	N/A	N/A	Add a new breaker
NYPA	Niagara 230 kV	Niagara 115 kV	Autotransformer	S	2020	230	115	1	240 MVA	240 MVA	Replace Niagara AT #1
NYPA	Astoria 138 kV	Astoria 13.8 kV	Astoria CC GSU Refurbishment	W	2020	138	18	1	234	234	Astoria CC GSU Refurbishment
NYSEG	Watercure Road	Watercure Road	xfmr	W	2020	345/230	345/230	1	426 MVA	494 MVA	Transformer #2 and Station Reconfiguration
NYSEG	Willet	Willet	xfmr	W	2020	115/34.5	115/34.5	1	39 MVA	44 MVA	Transformer #2
NYSEG	Coddington	E. Ithaca (to Coddington)	8.07	W	2020	115	115	1	307 MVA	307 MVA	665 ACCR
O & R	West Nyack	West Nyack	Cap Bank	S	2020	138	138	1	-	-	Capacitor Bank
O & R	Harings Corner (RECO)	Closter (RECO)	3.20	S	2020	69	69	1	1098	1312	UG Cable
O & R	Ramapo	Ramapo	xfmr	S	2020	345/138	345/138	1	731	731	-
RGE	Station 122-Pannell-PC1	Station 122-Pannell-PC1		S	2020	345	345	1	1314 MVA-LTE	1314 MVA-LTE	Relay Replacement
RGE	Station 262	Station 23	1.46	W	2020	115	115	1	2008	2008	Underground Cable
RGE	Station 33	Station 262	2.97	W	2020	115	115	1	2008	2008	Underground Cable
RGE	Station 262	Station 262	xfmr	W	2020	115/34.5	115/34.5	1	58.8MVA	58.8MVA	Transformer
RGE	Station 255 (New Station)	Rochester	3.80	W	2020	345	345	1	2177	2662	2-795 ACSR
RGE	Station 255 (New Station)	Station 255 (New Station)	xfmr	W	2020	345/115	345/115	1	400 MVA	450 MVA	Transformer
RGE	Station 255 (New Station)	Station 255 (New Station)	xfmr	W	2020	345/115	345/115	2	400 MVA	450 MVA	Transformer
RGE	Station 255 (New Station)	Station 418	9.60	W	2020	115	115	1	1506	1807	New 115kV Line
RGE	Station 255 (New Station)	Station 23	11.10	W	2020	115	115	1	1506	1807	New 115kV Line
CHGE	Hurley Avenue	Leeds	Static synchronous	S	2021	345	345	1	2336	2866	21% Compensation
LIPA	Valley Stream	East Garden City	7.36	S	2021	138	138	1	1171	1171	2000 SQMM XLPE

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
LIPA	Amagansett	Montauk	-13.00	S	2021	23	23	1	577	657	750 kcmil CU
LIPA	Amagansett	Navy Road	12.74	S	2021	23	23	1	577	657	750 kcmil CU
LIPA	Navy Road	Montauk	0.26	S	2021	23	23	1	577	657	750 kcmil CU
LIPA	Riverhead	Wildwood	10.63	S	2021	138	138	1	1399	1709	1192ACSR
LIPA	Riverhead	Canal	16.49	S	2021	138	138	1	1000	1110	2368 KCMIL (1200 mm^2) Copper XLPE
LIPA	Deer Park	-	Cap Bank	S	2021	69	69	1	27MVAR	27 MVAR	Capacitor bank
NGRID	Clay	Dewitt	10.24	S	2021	115	115	1	220MVA	268MVA	Reconductor 4/0 CU to 795ACSR
NGRID	Clay	Teall	12.75	S	2021	115	115	1	220 MVA	268MVA	Reconductor 4/0 CU to 795ACSR
NGRID	Gardenville 230kV	Gardenville 115kV	xfmr	S	2021	230/115	230/115	-	347 MVA	422 MVA	Replacement of 230/115kV TB#3 stepdown with larger unit
NGRID	Huntley 115kV	Huntley 115kV	-	S	2021	230	230	-	N/A	N/A	Rebuild of Huntley 115kV Station
NGRID	Mortimer	Mortimer	xfmr	S	2021	115	115		50MVA	50MVA	Replace Mortimer 115/69kV Transformer
NGRID	Mortimer	Mortimer	-	S	2021	115	115		N/A	N/A	Second 115kV Bus Tie Breaker at Mortimer Station
NGRID	New Bethlehem	New Bethlehem	-	S	2021	115	115		N/A	N/A	New Bethlehem 115/13.2kV station
NGRID	New Cicero	New Cicero		S	2021	115	115		N/A	N/A	New Distribution Station at New Cicero
NGRID	Mountain	Lockport	0.08	S	2021	115	115	2	174MVA	199MVA	Mountain-Lockport 103/104 Bypass
NGRID	Royal Ave	Royal Ave	-	S	2021	115/13.2	115/13.2	-	-	-	Install new 115-13.2 kV distribution substation in Niagara Falls (Royal Ave)
NGRID	Niagara	Packard	3.4	W	2021	115	115	1	344MVA	449MVA	Replace 3.4 miles of 192 line
NYPA	Moses 230 kV	Adirondack 230 kV	Series Compensation	S	2021	230	230	-	±13.2kV	±13.2kV	Voltage Source Series Compensation
NYPA	St. Lawrence 230kV	St. Lawrence 115kV	xfmr	S	2021	230/115	230/115	1	TBD	TBD	Replacement of St. Lawrence AutoTransformer #2
NYPA	Plattsburg 230 kV	Plattsburg 115 kV	xfmr	W	2021	230/115	230/115	1	249	288	Refurbishment of Plattsburgh Auto Transformer #1

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
NYPA	Astoria Annex	Astoria Annex	Shunt Reactor	W	2021	345	345	2	TBD	TBD	
O & R	Lovett 345 kV Station (New	Lovett	xfmr	S	2021	345/138	345/138	1	562 MVA	562 MVA	Transformer
O & R	Little Tor	-	Cap Bank	S	2021	138	138	1	32 MVAR	32 MVAR	Capacitor bank
O & R	Deerpak	Port Jervis	2	S	2021	69	69	1		1604	
O & R	Westtown	Port Jervis	7	S	2021	69	69	1		1604	
O & R/ConEd	Ladentown	Buchanan	-9.5	S	2021	345	345	1	3000	3211	2-2493 ACAR
O & R/ConEd	Ladentown	Lovett 345 kV Station (New	5.5	S	2021	345	345	1	3000	3211	2-2493 ACAR
O & R/ConEd	Lovett 345 kV Station (New	Buchanan	4	S	2021	345	345	1	3000	3211	2-2493 ACAR
CHGE	St. Pool	High Falls	5.61	W	2022	115	115	1	1010	1245	1-795 ACSR
CHGE	High Falls	Kerhonkson	10.03	W	2022	115	115	1	1010	1245	1-795 ACSR
CHGE	Modena	Galeville	4.62	W	2022	115	115	1	1010	1245	1-795 ACSR
CHGE	Galeville	Kerhonkson	8.96	W	2022	115	115	1	1010	1245	1-795 ACSR
CHGE	Hurley Ave	Saugerties	11.40	W	2022	69	115	1	1114	1359	1-795 ACSR
CHGE	Kerhonkson	Kerhonkson	xfmr	W	2022	115/69	115/69	1	564	728	Add Transformer 3
CHGE	Kerhonkson	Kerhonkson	xfmr	W	2022	115/69	115/69	1	564	728	Add Transformer 4
CHGE	Rock Tavern	Sugarloaf	12.10	W	2022	115	115	1	N/A	N/A	Retire SL Line
CHGE	Sugarloaf	NY/NJ State Line	10.30	W	2022	115	115	2	N/A	N/A	Retire SD/SJ Lines
NGRID	South Oswego	Indeck (#6)	-	S	2022	115	115	1	-	-	Install High Speed Clearing on Line #6
NGRID	Porter	Porter	-	S	2022	230	230		N/A	N/A	Porter 230kV upgrades
NGRID	Watertown	Watertown		S	2022	115	115		N/A	N/A	New Distribution Station at Watertown

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
NGRID	Golah	Golah	xfmr	S	2022	69	69		50MVA	50MVA	Replace Golah 69/34.5kV Transformer
NGRID	Niagara	Packard	3.7	S	2022	115	115	1	344MVA	449MVA	Replace 3.7 miles of 191 line
NGRID	Lockport	Mortimer	56.5	S	2022	115	115	3	-	-	Replace Cables Lockport-Mortimer #111, 113, 114
NGRID	Niagara	Packard	3.7	W	2022	115	115	2	344MVA	449MVA	Replace 3.7 miles of 193 and 194 lines
NGRID	Gardenville	Big Tree	6.3	W	2022	115	115	1	221MVA	221MVA	Gardenville-Arcade #151 Loop-in-and-out of NYSEG Big Tree
NGRID	Big Tree	Arcade	28.6	W	2022	115	115	1	129MVA	156MVA	Gardenville-Arcade #151 Loop-in-and-out of NYSEG Big Tree
NGRID	Coffeen	Coffeen	-	S	2022	115	115	-	TBD	TBD	Terminal equipment replacements
NGRID	Browns Falls	Browns Falls	-	S	2022	115	115	-	TBD	TBD	Terminal equipment replacements
NGRID	Taylorville	Taylorville	-	S	2022	115	115	-	TBD	TBD	Terminal equipment replacements
NYPA	Niagara 345 kV	Niagara 230 kV	xfmr	W	2022	345/230	345/230	1	TBD	TBD	Replacement of Niagara AutoTransformer #3
NYSEG	South Perry	South Perry	xfmr	W	2022	115/34.5	115/34.5	1	59 MVA	67 MVA	Transformer #3
NYSEG	South Perry	South Perry	xfmr	W	2022	230/115	230/115	1	246 MVA	291 MVA	Transformer
NYSEG	Fraser	Fraser	xfmr	W	2022	345/115	345/115	1	305 MVA	364 MVA	Transformer #2 and Station Reconfiguration
NYSEG	Fraser 115	Fraser 115	Rebuild	W	2022	115	115		N/A	N/A	Station Rebuild to 4 bay BAAH
NYSEG	Delhi	Delhi	Removal	W	2022	115	115		N/A	N/A	Remove 115 substation and terminate existing lines to Fraser 115 (short distance)
NYSEG	Erie Street Rebuild	Erie Street Rebuild	Rebuild	W	2022	115	115				Station Rebuild
NYSEG	Big Tree Road	Big Tree Road	Rebuild	W	2022	115	115				Station Rebuild
NYSEG	Meyer	Meyer	xfmr	W	2022	115/34.5	115/34.5	2	59.2MVA	66.9MVA	Transformer #2
O & R	Ramapo (NY)	South Mahwah	5.50	W	2022	138	138	2	1980	2120	1272 ACSS
RGE	Station 168	Mortimer (NG Trunk #2)	26.4	W	2022	115	115	1	145 MVA	176 MVA	Station 168 Reinforcement Project

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
RGE	Station 168	Elbridge (NG Trunk # 6)	45.5	W	2022	115	115	1	145 MVA	176 MVA	Station 168 Reinforcement Project
RGE	Station 127	Station 127	xfmr	W	2022	115/34.5	115/34.5	1	75MVA	75MVA	Transformer #2
CHGE	Saugerties	North Catskill	12.46	W	2023	69	115	1	1114	1359	1-795 ACSR
NGRID	Cortland	Clarks Corners	0.2	S	2023	115	115	1	147MVA	170MVA	Replace 0.2 miles of 1(716) line and series equipment
NGRID	Maplewood	Menands	3	S	2023	115	115	1	220 MVA	239 MVA	Reconductor approx 3 miles of 115kV Maplewood – Menands #19
NGRID	Maplewood	Reynolds	3	S	2023	115	115	1	217 MVA	265 MVA	Reconductor approx 3 miles of 115kV Maplewood – Reynolds Road #31
NGRID	Elm St	Elm St	-	S	2023	230/23	230/23	-	118MVA	133MVA	Replace TR2 as failure
NGRID	Packard	Huntley	9.1	W	2023	115	115	1	262MVA	275MVA	Walck-Huntley #133, Packard-Huntley #130 Reconductor
NGRID	Walck	Huntley	9.1	W	2023	115	115	1	262MVA	275MVA	Walck-Huntley #133, Packard-Huntley #130 Reconductor
NGRID	Kensington Terminal	Kensington Terminal	-	W	2023	115/23	115/23	-	50MVA	50MVA	Replace TR4 and TR5
NGRID	Malone	Malone	-	S	2023	115	115	-	TBD	TBD	Station Rebuild
NGRID	Taylorville	Boonville	-	S	2023	115	115	-	TBD	TBD	Install series reactors on the 5 and 6 lines. Size TBD
NYPA	Moses	Adirondack	78	S	2023	230	345	2	1088	1329	Replace 78 miles of both Moses-Adirondack 1&2
NYPA	Niagara 345 kV	Niagara 230 kV	xfmr	W	2023	345/230	345/230	1	TBD	TBD	Replacement of Niagara AutoTransformer #5
NYSEG	Gardenville	Gardenville	xfmr	W	2023	230/115	230/115	1	316 MVA	370 MVA	NYSEG Transformer #3 and Station Reconfiguration
NYSEG	Wood Street	Wood Street	xfmr	W	2023	345/115	345/115	1	327 MVA	378 MVA	Transformer #3
O & R	Burns	West Nyack	5.00	S	2023	138	138	1	940	940	UG Cable
O & R	Shoemaker	Pocatello	2.00	W	2023	69	69	1	1604	1723	795 ACSS
O & R	Sugarloaf	Shoemaker	12.00	W	2023	69	138	2	1062	1141	397 ACSS
ConEd	Hudson Ave East	New Vinegar Hill	xfmrs/PARs/Feeders	S	2024	138/27	138/27		N/A	N/A	New Hudson Ave Distribution Switching Station

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
ConEd	Farragut	Farragut	Reconfiguration	S	2024	138	138		N/A	N/A	Install PASS Breaker
NGRID	Dunkirk	Laona	-	S	2024	115	115	2	N/A	N/A	Remove series reactors from New Road Switch Station and install new to Moons Switch Station
NGRID	Laona	Moons	-	S	2024	115	115	2	N/A	N/A	Remove series reactors from New Road Switch Station and install new to Moons Switch Station
NGRID	Golah	Golah	Reconfiguration	S	2024	115	115		-	-	Add a Golah 115kV bus tie breaker
NGRID	Dunkirk	Dunkirk	-	S	2024	115	115		N/A	N/A	Rebuild of Dunkirk 115kV Station
NGRID	Gardenville	Dunkirk	20.5	S	2024	115	115	2	1105	1346	Replace 20.5 miles of 141 and 142 lines
NGRID	Homer Hill	Homer Hill	-	S	2024	115	115	-	116MVA	141MVA	Homer Hill Replace five OCB
NGRID	Inghams	Saint Johnsville	2.94	W	2024	115	115	1	1114	1359	Reconductor 2.94mi of 2/0 + 4/0 Cu (of 7.11mi total) to 795 ACSR
NGRID	Inghams 115kV	Inghams 115kV	Breaker	W	2024	115	115	-	2000	2000	Add series breaker to Inghams R15 (Inghams - Meco #15 115kV)
NGRID	Schenectady International	Rotterdam	0.93	W	2024	69	115	1	1114	1359	Reconductor 0.93mi of 4/0 Cu + 336.4 ACSR (of 21.08mi total) to 795 ACSR
NGRID	Rotterdam	Schoharie	0.93	W	2024	69	115	1	1114	1359	Reconductor 0.93mi of 4/0 Cu (of 21.08mi total) to 795 ACSR
NYSEG	Westover 115	Westover	Removal	W	2024	115	115		N/A	N/A	Remove 115 substation and terminate existing lines to Oakdale 115 (short distance)
O & R	Montvale (RECO)	-	Cap Bank	S	2024	69	69	1	32 MVAR	32 MVAR	Capacitor bank
O & R	Ramapo	Sugarloaf	17.00	W	2024	138	138	1	1980	2120	1272 ACSS
O & R	Burns	Corporate Drive	5.00	W	2024	138	138	1	1980	2120	1272 ACSS
RGE	Station 418	Station 48	7.6	W	2024	115	115	1	175 MVA	225 MVA	New 115kV Line
RGE	Station 82	Station 251 (Upgrade Line		W	2024	115	115	1	400MVA	400MVA	Line Upgrade
RGE	Mortimer	Station 251 (Upgrade Line	1.00	W	2024	115	115	1	400MVA	400MVA	Line Upgrade
LIPA	Southampton	Deerfield	4.00	S	2025	69	138	1	1171	1171	2000 SQMM XLPE
NGRID	Stoner	Rotterdam	9.81	W	2025	115	115	1	1398	1708	Reconductor 9.81mi of 4/0 Cu + 336.4 ACSR (of 23.12mi total) to 1192.5 ACSR

Transmission Owner	Terminals		Line Length in Miles	In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings (4)		Project Description / Conductor Size
				Prior to (2)	Year	Operating	Design		Summer	Winter	
NGRID	Meco	Rotterdam	9.81	W	2025	115	115	1	1398	1708	Reconductor 9.96mi of 4/0 Cu + 336.4 ACSR (of 30.79mi total) to 1192.5 ACSR
LIPA	Syosset	Shore Rd	11.00	S	2026	138	138	1	1171	1171	2000 SQMM XLPE
LIPA	Syosset	Shore Rd	Phase Shifter	S	2026	138	138	1	TBD	TBD	Phase Shifter
NGRID	Niagara	Gardenville	26.3	S	2026	115	115	1	275MVA	350MVA	Packard-Erie / Niagara-Garenville Reconfiguration
NGRID	Packard	Gardenville	28.2	S	2026	115	115	2	168MVA	211 MVA	Packard-Gardenville Reactors, Packard-Erie / Niagara-Garenville Reconfiguration
NGRID	Mortimer	Pannell	15.7	S	2026	115	115	2	221MVA	270MVA	
NGRID/NYSEG	Erie St	Gardenville	5.5	S	2026	115	115	1	139MVA	179MVA	Packard-Erie / Niagara-Garenville Reconfiguration, Gardenville add breakers
O & R	West Nyack	West Nyack	-	S	2026	138	138	1			Station Reconfiguration
O & R	West Nyack (NY)	Harings Corner (RECO)	7.00	W	2026	69	138	1	1604	1723	795 ACSS

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2020 RNA MARS Model Base Case Development

The NYISO developed the system representations for PJM, Ontario, New England, and Hydro Quebec modeled in the 2020 RNA Base Case from the NPCC CP-8 2020 Summer Assessment. To avoid overdependence on emergency assistance from the external areas, the emergency operating procedure data was removed from the model for each external area. In addition, the capacity of the external areas was further modified such that the LOLE value of each external area was a minimum value of 0.10 and capped at a value of 0.15 throughout Study Period.

The topology used in the MARS model RNA Base Case is located in Figures 28 to 30 in the body of the report. The internal transfer limits modeled are the summer emergency ratings derived from the RNA power flow cases discussed above. The NYISO developed external transfer limits from the NPCC CP-8 Summer Assessment MARS database with changes based upon the RNA Base Case assumptions.

Emergency Thermal Transfer Limit Analysis for Resource Adequacy Assessments

The NYISO performed analyses of the RNA Base Cases to determine emergency thermal transfer limits for the key interfaces used in the MARS resource adequacy analysis. Figure 23 below reports the emergency thermal transfer limits for the RNA base system conditions.

Figure 23: Emergency Thermal Transfer Limits (MW)

Interface	2025	
Dysinger East	2200	1
Moses South	2650	2
Central East MARS	4925	3
F to G	5400	3
I to J	4350	4
I to K (Y49/Y50)	1293	5

	Limiting Facility	Rating	Contingency
1	Niagara - Dysinger 345 kV	1685	Niagara - Dysinger 345 kV
2	Chases Lake - Porter 230 KV	516	Chateaugay - Massena - Marcy 765 kV
3	New Scotland - Knickerbocker 345 kV	1423	Pre-disturbance
4	Mott Haven - Rainey 345 kV	785	Pre-disturbance
5	Dunwoodie - Shore Rd. 345 kV	653	Pre-disturbance

Figure 24: Dynamic Limit Tables (MW)

Year	Interface	Oswego Complex Units*					
		All available	Any 1 out	Any 2 out	Any 3 out	Any 4 out	Any 5 (or more) out
2021 - 2023	Central East MARS	3100	3050	2990	2885	2770	2645
	Central East Group	5000	4925	4840	4685	4510	4310
2024 - 2030	Central East MARS	3925	3875	3815	3710	3595	3470
	Central East Group	5650	5575	5490	5335	5160	4960

* 9 Mile Point 1, 9 Mile Point 2, FitzPatrick, Oswego 5, Oswego 6, Independence (Modeled as one unit in MARS)

Year	Interface	Barrett Steam units (1 and 2)		
		Both available	Any 1 out	Both out
All	Con Ed-LIPA (towards Zone J)	220	200	130

Year	Interface	Northport Steam 1 - 4	
		All available	Any out
All	Norwalk CT to Zone K (NNC)	260	404

Year	Interface	Arthur Kill 2, Arthur Kill 3, Linden Cogen			
		All available	Any AK 2 or Linden out	AK 3 out	Any 2 out
All	A Line & VFT (towards Zone J)	200	500	700	815

Year	Interface	CPV Valley units		
		Both available	Any 1 out	Both out
2021 - 2023	E to G (Marcy South)	1750	2000	2250

Year	UPNYSNY Limit (MW)	Units Available		
		CPV Valley	Cricket Valley	Athens
2021- 2023	5250	2	3	3
	5100	2	3	2
	5350	1	3	3
	5200	2	2	3
	5150	2	1	3
	5250	1	1	3
	5100	2	0	3
	5350	All other conditions		

The method for modeling the UPNY-SENY interface in the MARS topology was changed for the 2020 RNA. However, the changes apply to years 2021 through 2023, which are not included in the 2020 RNA study period. Beginning in year 2024, the UPNY-SENY interface is modeled as a single limit because of the large increases in transfer capability resulting from addition of the AC Transmission projects.

In the 2018 RNA MARS topology, the UPNY-SENY interface was modeled in a non-standard way because of limitations of the MARS program. For study years 2021 through 2023 in the 2018 RNA, a fictitious interface (UPNYSNY2) was modeled that included the generation output from the Cricket Valley and CPV Valley plants. A set of dynamic limit tables was applied to UPNYSNY2 to control the flow across the traditional UPNY-SENY interface. This modeled required having the Cricket Valley and the CPV Valley plants in their own MARS areas separate from Zone G. The MARS program was subsequently updated to simplify the model for the 2020 RNA. With these program updates, the interface limits can simply be applied to the traditional UPNY-SENY MARS interface, which eliminates the need to define the fictitious interface. It also allows the two plants to be modeled directly in Zone G, which avoids MARS treating them differently than the other units in Zone G. The UPNYSNY2 limits were replaced with UPNY-SENY MARS limits for the 2020 RNA, as shown in Figure 25.

Figure 25: 2018 RNA and 2020 RNA UPNYSNY Dynamic Limit Table

Year	2020 RNA	2018 RNA	Units Available		
	UPNY-SENY MARS Limit	UPNYSNY2 Limit	CPV Valley	Cricket Valley	Athens
2021- 2023	5250	6950	2	3	3
	5100	6750	2	3	2
	5350	6700	1	3	3
	5200	6550	2	2	3
	5150	6150	2	1	3
	5250	5950	1	1	3
	5100	5800	2	0	3
	5350	6600	All other conditions		

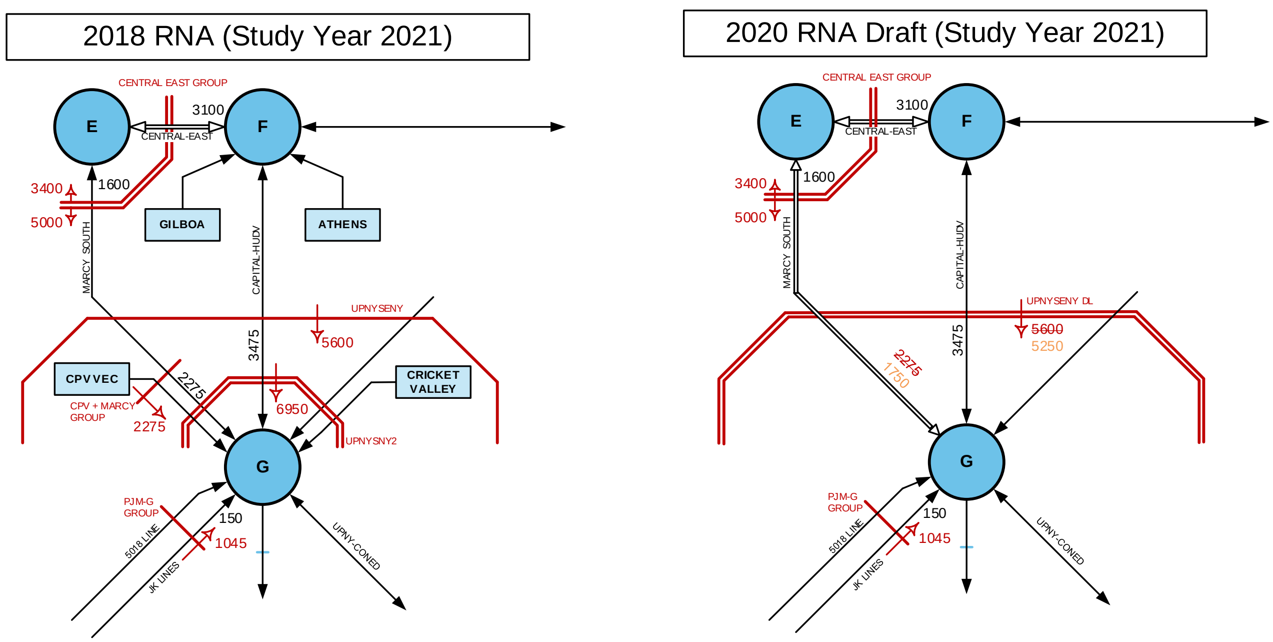
The E to G (Marcy South) interface was also updated for the 2020 RNA. In the 2018 RNA, a joint interface, CPV + Marcy Group, was utilized to capture the impact of the CPV Valley plant on the E to G interface. A flow calculation on the joint interface effectively reduced the limit on E to G by 90% of the CPV Valley plant output. For the 2020 RNA, this model was replaced with a DLT model applied to the E to G interface as shown in Figure 26. The joint interface and flow calculation were removed and the CPV Valley units were modeled directly in Zone G instead of as a separate MARS area.

Figure 26: E to G Dynamic Limit Table

E to G	CPV Valley
1750	2
2000	1
2250	0

The modeling changes resulted in flows and LOLE results that were extremely close when the models were tested and compared. The new simplified models are more straightforward to implement, maintain and verify in the MARS database.

Figure 27: UPNYSNY Topology Diagram in 2018 RNA and 2020 RNA



Additional "Free Flow" MARS Simulations Observations

To determine if transmission reinforcements would be beneficial, a "NYCA free flow" test was executed, with results in the body of the report. A "free flow" simulation is one in which NYCA LOLEs are determined without considering any transmission transfer limitations within the NYCA system. This provides an indication of whether any LOLE violations identified are purely resource related or if they are caused by limitations in the transmission system.

When removing the NYCA internal limits, the NYCA LOLE decreased to below the criterion level throughout the Study Period, indicating that there is no statewide resource deficiency. It also showed that transmission reinforcement, which would provide an injection into Zone J where the deficiency is located, is a potential option to resolve the identified resource adequacy Reliability Need.

Additional topology limits variations were performed to identify which specific interface transfer capability increases help the most, and to provide additional insights. The table below summarizes those simulations.

Figure 28: Free Flow Variations Results and Observations

Case	2030 NYCA LOLE (days/year)	Notes
Base Case	0.187	I to J (Dunwoodie South) at 4350 MW G to H (UPNY-ConEd) at 7375 MW
Removing dynamic limit from J_to_J3	0.14	Increasing limit J to J3 from 200 MW to 815 MW for most loss of load events. However, only 420 MW can flow on the interface because the ABC interface limitations.
I_to_J +450 MW	0.097	Minimum of +450MW on Dunwoodie South to bring LOLE just below 0.1 days/year
I_to_J unlimited	0.053	5,660 MW max flow on I to J observed in this MARS simulation
G_to_H & I_to_J unlimited	0.049	If Dunwoodie-South is unlimited, then UPNY-ConEd unlimited also has a positive impact on further decreasing the NYCA LOLE
B&C Cabes in	0.116	Allowing for additional 210 MW into J has a positive effect of decreasing the NYCA LOLE; however, LOLE still above its criterion of 0.1 days/year
Free Flow	0.042	All NYCA internal limits removed – brings the NYCA LOLE to significantly lower values

2020 RNA Short Circuit Assessment

Figure 29 below provides the results of NYISO's short circuit screening test for year 5 (2025) of the Study Period. Individual Breaker Analysis (IBA) is required for any breakers the ratings of which were exceeded by the maximum bus fault current. Either NYISO or the responsible Transmission Owner performed the analyses.

Figure 29: 2020 RNA Fault Current Analysis Summary Table for 2025 System Representation

Substation	Nominal Voltage (kV)	Lowest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Overdutied
ACADEMY	345	63.0	Con Ed	35.0	N	N
ADIRONDACK	230	32.4	N. Grid	10.5	N	N
AES SOMERSET	345	40.0	NYSEG	16.7	N	N
ALPS	345	39.0	N. Grid	17.4	N	N
ALPS_EAST	345	N/A[2]	N. Grid	7.9	N	N
ALPS_PAR 1	345	N/A[2]	N. Grid	7.9	N	N
ALPS_PAR 2	345	N/A[2]	N. Grid	7.9	N	N
ASTE-ERG	138	63.0	Con Ed	49.7	N	N
ASTE-WRG	138	63.0	Con Ed	49.7	N	N
ASTORIA W-N	138	63.0	Con Ed	43.6	N	N
ASTORIA W-S	138	63.0	Con Ed	43.6	N	N
AstoriaAnnex	345	63.0	NYPA	44.8	N	N
ATHENS	345	49.0	N. Grid	35.0	N	N
BARRETT1	138	63.0	LIPA	48.8	N	N
BARRETT2	138	63.0	LIPA	48.9	N	N
BAYONNE	345	50.0	Con Ed	25.3	N	N
BOONVILLE	115	23.0	N. Grid	10.8	N	N
BOWLINE 2	345	40.0	O&R	26.8	N	N
BOWLINE1	345	40.0	O&R	27.0	N	N
BRKHAVEN	138	63.0	LIPA	26.8	N	N
BUCH138	138	40.0	Con Ed	15.5	N	N
BUCHANAN N	345	63.0	Con Ed	25.1	N	N
BUCHANAN S	345	63.0	Con Ed	37.1	N	N
C.ISLIP	138	38.9	LIPA	27.6	N	N
CANANDAIGUA	230	40.0	NYSEG	8.5	N	N
CARLE PL	138	63.0	LIPA	39.0	N	N
CHASES LAKE	230	39.0	N. Grid	9.6	N	N
CHURCHTOWN	115	21.4	NYSEG	8.3	N	N

[2] Future station with no LCB rating yet.

Substation	Nominal Voltage (kV)	Lowest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Overdutied
CLARKS CNRS	345	40.0	NYSEG	11.6	N	N
CLARKS CNRS	115	40.0	NYSEG	17.4	N	N
CLAY	345	49.0	N. Grid	33.7	N	N
CLAY	115	45.0	N. Grid	38.7	N	N
COOPERS CRN	345	40.0	NYSEG	19.0	N	N
COOPERS CRN4	115	22.6	NYSEG	14.9	N	N
COOPERS CRN8	115	23.1	NYSEG	14.9	N	N
CORONA-N	138	63.0	Con Ed	49.4	N	N
CORONA-S	138	63.0	Con Ed	49.4	N	N
CRICKET VLLY	345	63.0	Con Ed	37.5	N	N
DEWITT	345	39.0	N. Grid	18.9	N	N
DEWITT	115	39.0	N. Grid	29.6	N	N
DOLSON AVE	345	63.0	NYPA	20.7	N	N
DUFFY AVE	345	58.6	LIPA	8.2	N	N
Duley	230	40.0	NYPA	7.6	N	N
DUN NO	138	40.0	Con Ed	35.5	N	N
DUN NO S6	138	63.0	Con Ed	29.5	N	N
DUN SO	138	40.0	Con Ed	30.9	N	N
DUN SO N7	138	63.0	Con Ed	26.8	N	N
DUNKIRK	230	33.0	N. Grid	10.1	N	N
DUNWOODIE	345	63.0	Con Ed	59.6	N	N
E FISHKILL	345	63.0	CH	44.6	N	N
E FISHKILL	115	40.0	CH	24.2	N	N
E13 ST	138	63.0	Con Ed	48.6	N	N
E13ST 45	345	63.0	Con Ed	53.7	N	N
E13ST 46	345	63.0	Con Ed	53.7	N	N
E13ST 47	345	63.0	Con Ed	52.2	N	N
E13ST 48	345	63.0	Con Ed	51.7	N	N
EASTOVER 230	230	49.0	N. Grid	10.8	N	N
EASTOVER N	115	49.0	N. Grid	25.3	N	N
EASTVIEW	138	63.0	Con Ed	37.0	N	N
EDIC	345	39.0	N. Grid	36.5	N	N
EGC PAR	345	63.0	NYPA	9.9	N	N
EGC-1	138	80.0	LIPA	65.3	N	N
EGC-2	138	80.0	LIPA	65.3	N	N
ELBRIDGE	345	40.0	N. Grid	16.0	N	N
ELBRIDGE D	115	49.0	N. Grid	26.6	N	N
ELWOOD 1	138	63.0	LIPA	38.3	N	N

Substation	Nominal Voltage (kV)	Lowest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Overdutied
ELWOOD 2	138	63.0	LIPA	38.0	N	N
FARRAGUT	345	63.0	Con Ed	57.9	N	N
FITZPATRICK	345	37.0	NYPA	41.1	Y	N
FIVE MILE RD	345	49.0	N. Grid	7.7	N	N
FIVE MILE RD	115	49.0	N. Grid	14.4	N	N
FRASER	345	40.0	NYSEG	19.3	N	N
FRASER	115	40.0	NYSEG	19.0	N	N
FREEPORT	138	63.0	LIPA	34.2	N	N
FRESH KILLS	345	63.0	Con Ed	26.8	N	N
FRESH KILLS	138	40.0	Con Ed	32.1	N	N
GARDEN (NM)	34.5	21.0	N. Grid	17.5	N	N
GARDENVILLE	115	42.0	N. Grid	40.8	N	N
GARDENVILLE1	230	31.0	N. Grid	20.2	N	N
GILBOA 345	345	50.0	NYPA	25.3	N	N
GLNWD NO	138	63.0	LIPA	43.4	N	N
GLNWD SO	138	63.0	LIPA	43.0	N	N
GOTHLS	345	63.0	Con Ed	29.6	N	N
GOWANUS	345	63.0	Con Ed	28.7	N	N
GREENLWN	138	63.0	LIPA	28.3	N	N
HAUPAGUE	138	63.0	LIPA	21.5	N	N
High Sheldon	230	40.0	NYSEG	10.3	N	N
HILLSIDE #4	115	21.1	NYSEG	19.0	N	N
HILLSIDE #8	115	22.0	NYSEG	19.0	N	N
HILLSIDE 230	230	35.9	NYSEG	14.4	N	N
HILLSIDE#4	34.5	21.7	NYSEG	18.1	N	N
HOLBROOK	138	63.0	LIPA	47.9	N	N
HOLTSGT-GTs	138	63.0	LIPA	44.1	N	N
HUNTLEY 68	230	30.0	N. Grid	17.4	N	N
HUNTLEY 70	230	50.0	N. Grid	17.4	N	N
HURLEY	345	40.0	CH	18.7	N	N
HURLEY AVE	115	37.9	CH	16.6	N	N
INDEPENDENCE	345	44.0	N. Grid	39.0	N	N
JAMAICA	138	63.0	Con Ed	47.6	N	N
KNICKERBOCKR	345	40.0	N. Grid	27.6	N	N
LADENTOWN	345	63.0	O&R	39.1	N	N
LAFAYETTE	345	40.0	N. Grid	17.8	N	N
LCST GRV	138	63.0	LIPA	38.0	N	N
LEEDS	345	37.0	N. Grid	35.8	N	N

Substation	Nominal Voltage (kV)	Lowest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Overdutied
LHH WHITE	115	38.1	N. Grid	11.8	N	N
LKE SCSS1	138	63.0	LIPA	37.5	N	N
LOVT	138	40.0	O&R	28.7	N	N
LOVT_345	345	63.0	O&R	35.7	N	N
MARCY 345	345	63.0	NYPA	35.1	N	N
MARCY 765	765	63.0	NYPA	10.2	N	N
MASSENA 765	765	63.0	NYPA	7.9	N	N
MEYER	230	40.0	NYSEG	8.4	N	N
MEYER	115	18.9	NYSEG	11.9	N	N
MEYER	34.5	21.7	NYSEG	11.4	N	N
MHTX2	138	50.0	Con Ed	13.8	N	N
Midd Tap	345	63.0	CH	19.2	N	N
MILLR PL	138	63.0	LIPA	14.6	N	N
MILLWOOD	345	63.0	Con Ed	46.1	N	N
MILLWOOD 138	138	40.0	Con Ed	19.0	N	N
MOTT HAVEN	345	63.0	Con Ed	55.2	N	N
NEWBRID	138	80.0	LIPA	64.9	N	N
NEWBRIDG	345	58.6	LIPA	8.4	N	N
NIAGARA 345	345	63.0	NYPA	33.5	N	N
NIAGRA E 115	115	42.2	NYPA	37.1	N	N
NIAGRA E 230	230	63.0	NYPA	53.8	N	N
NIAGRA W 115	115	42.2	NYPA	27.9	N	N
NIAGRA W 230	230	63.0	NYPA	53.8	N	N
NMP#1	345	50.0	N. Grid	42.7	N	N
NMP#2	345	50.0	N. Grid	43.6	N	N
NRTHPRT1	138	63.0	LIPA	59.4	N	N
NRTHPRT1-2	138	63.0	LIPA	59.4	N	N
NRTHPRT2	138	63.0	LIPA	59.4	N	N
NRTHPRT3	138	63.0	LIPA	45.2	N	N
NRTHPRT4	138	63.0	LIPA	45.2	N	N
NSCOT 77B	345	39.0	N. Grid	38.0	N	N
NSCOT 99B	345	39.0	N. Grid	37.8	N	N
NSCOT33	115	49.0	N. Grid	43.6	N	N
NSCOT77	115	48.0	N. Grid	43.5	N	N
NSCOT99	115	49.0	N. Grid	43.5	N	N
OAKDALE	115	40.0	NYSEG	27.1	N	N
OAKDALE	34.5	23.0	NYSEG	19.4	N	N
OAKDALE 345	345	40.0	NYSEG	12.7	N	N

Substation	Nominal Voltage (kV)	Lowest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Overdutied
OAKWOOD	138	63.0	LIPA	27.4	N	N
ONEIDA EAST	115	23.0	N. Grid	13.3	N	N
ONEIDA WEST	115	23.0	N. Grid	13.3	N	N
OSWEGO	345	44.0	N. Grid	32.5	N	N
OSWEGO M3	115	40.0	N. Grid	21.2	N	N
PACKARD 2&3	230	49.0	N. Grid	39.5	N	N
PACKARD 4&5	230	49.0	N. Grid	39.5	N	N
PACKARD 6	230	49.0	N. Grid	39.6	N	N
PACKARD NRTH	115	62.0	N. Grid	29.5	N	N
PACKARD STH	115	58.0	N. Grid	26.3	N	N
Patnode	230	63.0	NYPA	10.5	N	N
PILGRIM	138	63.0	LIPA	57.6	N	N
PL VILLE	345	63.0	Con Ed	22.5	N	N
PL VILLW	345	63.0	Con Ed	22.8	N	N
PLATTSBURGH	115	20.3	NYPA	16.9	N	N
PLEASANT VAL	115	37.9	CH	24.5	N	N
PLTVLLEY	345	63.0	Con Ed	51.5	N	N
PORTER	230	21.0	N. Grid	17.6	N	N
PORTER	115	59.0	N. Grid	38.8	N	N
PT JEFF	138	63.0	LIPA	31.7	N	N
Q396BRNPSU	230	40.0	NYSEG	7.6	N	N
Q505_POI	230	50.0	N. Grid	8.7	N	N
Q545A_DYSING	345	50.0	TransCo	22.0	N	N
Q545A_ESTSTO	345	50.0	TransCo	8.9	N	N
Q545A_PAR	345	50.0	TransCo	9.5	N	N
Q546_230_TRA	230	40.0	N. Grid	8.8	N	N
Q556 NS66K	345	50.0	N. Grid	37.9	N	N
Q556 Rott345	345	N/A[3]	N. Grid	25.5	N	N
Q556_Prince	345	N/A[3]	N. Grid	30.5	N	N
RAINEY	345	63.0	Con Ed	57.2	N	N
RAMAPO	345	63.0	Con Ed	44.1	N	N
REYNOLDS	345	39.0	N. Grid	15.1	N	N
REYNOLDS RD	115	63.0	N. Grid	40.3	N	N
RIVERHD	138	63.0	LIPA	17.2	N	N
RNKNKOMA	138	63.0	LIPA	35.8	N	N
ROBINSON RD.	230	43.1	NYSEG	13.8	N	N

[3] Future station with no LCB rating yet.

Substation	Nominal Voltage (kV)	Lowest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Overdutied
ROBINSON RD.	115	37.9	NYSEG	17.6	N	N
ROBINSON RD.	34.5	21.9	NYSEG	8.8	N	N
ROCK TAV	115	39.6	CH	25.2	N	N
ROCK TAVERN	345	63.0	CH	34.1	N	N
Roseton	345	63.0	CH	38.3	N	N
ROSLYN	138	63.0	LIPA	29.1	N	N
ROTTERDAM66H	230	39.0	N. Grid	11.1	N	N
ROTTERDAM77H	230	23.0	N. Grid	11.1	N	N
ROTTERDAM99H	230	23.0	N. Grid	11.1	N	N
RULND RD	138	63.0	LIPA	43.6	N	N
Ryan	230	40.0	NYPA	10.8	N	N
S OSWEGO	115	37.0	N. Grid	20.8	N	N
S RIPLEY	230	40.0	N. Grid	9.0	N	N
S013A	115	37.6	RGE	25.8	N	N
S080 345kV	345	40.0	RGE	19.9	N	N
S080 922	115	40.0	RGE	16.9	N	N
S082 B2	115	40.0	RGE	37.4	N	N
S082 B3	115	40.0	RGE	37.3	N	N
S122	345	40.0	RGE	18.3	N	N
S122 B1	115	50.0	RGE	33.1	N	N
S255	345	63.0	RGE	19.7	N	N
S255	115	40.0	RGE	22.0	N	N
SCHUYLER	115	23.0	N. Grid	15.0	N	N
SCRIBA	345	54.0	N. Grid	46.4	N	N
SCRIBA C	115	40.0	N. Grid	10.5	N	N
SCRIBA D	115	40.0	N. Grid	10.4	N	N
SECT 11	138	63.0	Con Ed	42.7	N	N
SECT 12	138	63.0	Con Ed	42.7	N	N
SHORE RD	345	63.0	LIPA	28.9	N	N
SHORE RD1	138	57.8	LIPA	46.8	N	N
SHORE RD2	138	57.8	LIPA	46.7	N	N
SHOREHAM1	138	63.0	LIPA	27.2	N	N
SHOREHAM2	138	63.0	LIPA	27.2	N	N
SILLS RD1	138	63.0	LIPA	31.5	N	N
SMAH	138	40.0	RECO	25.3	N	N
SPRAINBROOK	345	63.0	Con Ed	60.0	N	N
ST LAWRN 115	115	40.6	NYPA	38.8	N	N
ST LAWRN 230	230	32.4	NYPA	32.2	N	N

Substation	Nominal Voltage (kV)	Lowest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Overdutied
STOLLE	115	23.9	NYSEG	19.8	N	N
STOLLE ROAD	345	40.0	NYSEG	8.8	N	N
STOLLE ROAD	230	40.0	NYSEG	13.7	N	N
STONEYRIDGE	230	40.0	NYSEG	8.0	N	N
STONY CREEK	230	40.0	NYSEG	9.3	N	N
SUGLF 345TAP	345	63.0	CH	25.6	N	N
SYOSSET	138	63.0	LIPA	33.0	N	N
Teall A	115	39.0	N. Grid	26.9	N	N
Teall B	115	39.0	N. Grid	26.9	N	N
TERMINAL	115	23.0	N. Grid	16.0	N	N
VALLEY	115	39.0	N. Grid	8.3	N	N
VERNON-E	138	63.0	Con Ed	45.5	N	N
VERNON-W	138	63.0	Con Ed	32.7	N	N
VLY STRM1	138	63.0	LIPA	54.9	N	N
VLY STRM2	138	63.0	LIPA	55.1	N	N
VOLNEY	345	45.0	N. Grid	36.5	N	N
W 49 ST	345	63.0	Con Ed	54.1	N	N
WADNGRV1	138	56.4	LIPA	25.1	N	N
WATERCURE230	230	40.0	NYSEG	14.4	N	N
WATERCURE345	345	40.0	NYSEG	9.4	N	N
WATKINS	115	39.0	N. Grid	8.4	N	N
Wethersfield	230	40.0	NYSEG	9.1	N	N
WHAV	138	40.0	O&R	29.2	N	N
WILDWOOD	138	63.0	LIPA	27.0	N	N
WILLIS 230	230	40.0	NYPA	13.5	N	N
WOOD ST.	115	40.0	NYSEG	19.7	N	N
WOODARD	115	23.0	N. Grid	15.6	N	N
YAHNUNDASIS	115	16.0	N. Grid	6.6	N	N

2020 RNA Transmission Security Violations

The NYISO identified Reliability Needs resulting from the transmission security evaluations. The transmission security Reliability Needs include both thermal loading criteria violations on the BPTF as well as dynamic stability criteria violations. For thermal loading, several 345 kV circuits in the Con Edison service territory are overloaded under N-1-1 conditions beginning in year 2025 and increasing through 2030. Additionally, the Con Edison 345 kV system has 345 kV circuit overloads under N-1-1-0 conditions beginning in 2025 and increasing through 2030. For N-1-1, Figure 30 shows the state transmission security violations for the top 10 contingency combinations. For N-1-1-0, Figure 31 only reports the controlling contingency combination of the loss of Ravenswood 3 followed by Dunwoodie — Mott Haven (72) 345 kV.

The NYISO observed dynamic stability criteria Reliability Needs for the entire study period. The criteria violations include transient voltage response violations and loss of generator synchronism. The transient voltage response violations are primarily in the Con Edison area but extend into areas adjacent to their service territory. The loss of generator synchronism is observed in generators within or near the Astoria and Greenwood load pockets, and is primarily driven by the delayed voltage recovery in the local area. Figure 32 and Figure 33 shows the BPTF buses with transient voltage response violations and the earliest year that each bus manifests the criteria violations for a given contingency.

Figure 30: Transmission Security N-1-1 Violations of the 2020 RNA Base Case

Transmission Security N-1-1 Violations of the 2020 RNA Base Case								
Zone	**Owner**	**Monitored Element**	**Normal Rating (MVA)**	**Contingency Rating (MVA)**	**1st Contingency**	**2nd Contingency**	**2025 Summer Peak Flow (%)**	**2030 Summer Peak Flow (%)**
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Sprainbrook-Dunwoodie 345 kV (W75)	Tower F38 & F39	-	112
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Loss of Ravenswood 3	Stuck breaker at W 49th St 5	-	104
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Loss of Astoria Energy 2	Stuck breaker at W 49th St 5	-	103
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Bayonne-Gowanus 345 kV (G27)	Stuck breaker at W 49th St 5	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Loss of Bayonne	Stuck breaker at W 49th St 5	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Farragut-Gowanus 345 kV (42)	Stuck breaker at Sprainbrook RS4	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Dunwoodie-Mott Haven 345 kV (71)	Stuck breaker at Sprainbrook RS4	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Dunwoodie-Mott Haven 345 kV (72)	Stuck breaker at Sprainbrook RS4	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Loss of Ravenswood 3	Stuck breaker at Sprainbrook RS4	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Loss of Astoria Energy 2	Stuck breaker at Sprainbrook RS4	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Sprainbrook-Dunwoodie 345 kV (W75)	Tower F38 & F39	-	112
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Farragut-Gowanus 345 kV (42)	Stuck breaker at Sprainbrook RS5	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Dunwoodie-Mott Haven 345 kV (71)	Stuck breaker at Sprainbrook RS5	-	102
J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Dunwoodie-Mott Haven 345 kV (72)	Stuck breaker at Sprainbrook RS5	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Loss of Ravenswood 3	Stuck breaker at Sprainbrook RS5	-	102

Transmission Security N-1-1 Violations of the 2020 RNA Base Case								
Zone	**Owner**	**Monitored Element**	**Normal Rating (MVA)**	**Contingency Rating (MVA)**	**1st Contingency**	**2nd Contingency**	**2025 Summer Peak Flow (%)**	**2030 Summer Peak Flow (%)**
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Loss of Astoria Energy 2	Stuck breaker at Sprainbrook RS5	-	102
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Bayonne-Gowanus 345 kV (G27)	Stuck breaker at Sprainbrook RS5	-	101
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Loss of Bayonne	Stuck breaker at Sprainbrook RS5	-	101
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	-	-	-	-
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	-	-	-	-
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (72)	110	118
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Loss of Ravenswood 3	Stuck breaker at Mott Haven 7	110	118
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Loss of Ravenswood 3	Stuck breaker at Mott Haven 3	110	118
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Loss of Ravenswood 3	Stuck breaker at Dunwoodie 8	107	115
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Dunwoodie-Mott Haven 345 kV (72)	Loss of Ravenswood 3	109	114
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Dunwoodie-Shore Road 345 kV (Y50)	Stuck breaker at Dunwoodie 7	-	104
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Freshkills 345/138 kV (TB1)	Dunwoodie-Mott Haven 345 kV (72)	-	102
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Freshkills 345/138 kV (TB1)	Stuck breaker at Mott Haven 3	-	102
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Freshkills 345/138 kV (TB1)	Stuck breaker at Mott Haven 7	-	102
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Bayonne-Gowanus 345 kV (G27)	Dunwoodie-Mott Haven 345 kV (72)	-	102

Transmission Security N-1-1 Violations of the 2020 RNA Base Case								
Zone	**Owner**	**Monitored Element**	**Normal Rating (MVA)**	**Contingency Rating (MVA)**	**1st Contingency**	**2nd Contingency**	**2025 Summer Peak Flow (%)**	**2030 Summer Peak Flow (%)**
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Loss of Bayonne	Dunwoodie-Mott Haven 345 kV (72)	-	102
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Sprainbrook-W 49th St 345 kV (51)	Stuck breaker at Sprainbrook RS4	101	101
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Sprainbrook-W 49th St 345 kV (52)	Stuck breaker at Sprainbrook RS5	101	101
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (71)	108	116
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Loss of Ravenswood 3	Stuck breaker at Mott Haven BTE	108	116
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Loss of Ravenswood 3	Stuck breaker at Mott Haven 2	108	116
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Dunwoodie-Mott Haven 345 kV (71)	Loss of Ravenswood 3	108	114
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Loss of Ravenswood 3	Stuck breaker at Dunwoodie 3	105	113
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Dunwoodie-Shore Road 345 kV (Y50)	Stuck breaker at Dunwoodie 5	-	103
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Dunwoodie-Mott Haven 345 kV (71)	Stuck breaker at Sprainbrook RS4	-	102
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Dunwoodie-Mott Haven 345 kV (71)	Stuck breaker at Sprainbrook RS5	-	102
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Freshkills 345/138 kV (TB1)	Dunwoodie-Mott Haven 345 kV (71)	-	101
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Freshkills 345/138 kV (TB1)	Stuck breaker at Mott Haven BTE	-	101
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	785	925	Freshkills 345/138 kV (TB1)	Stuck breaker at Mott Haven 2	-	101
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	Mott Haven-Rainey 345 kV (Q11)	Loss of Ravenswood 3	-	108

Transmission Security N-1-1 Violations of the 2020 RNA Base Case								
Zone	**Owner**	**Monitored Element**	**Normal Rating (MVA)**	**Contingency Rating (MVA)**	**1st Contingency**	**2nd Contingency**	**2025 Summer Peak Flow (%)**	**2030 Summer Peak Flow (%)**
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	Mott Haven-Rainey 345 kV (Q12)	Loss of Ravenswood 3	-	108
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	Loss of Ravenswood 3	Stuck breaker at Rainey 4W	-	101
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	Loss of Ravenswood 3	Stuck breaker at Rainey 7W	-	101
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	-	-	-	-

Transmission Security N-1-1 Violations of the 2020 RNA Base Case								
Zone	**Owner**	**Monitored Element**	**Normal Rating (MVA)**	**Contingency Rating (MVA)**	**1st Contingency**	**2nd Contingency**	**2025 Summer Peak Flow (%)**	**2030 Summer Peak Flow (%)**
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	-	-	-	-
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	785	925	-	-	-	-
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Loss of Ravenswood 3	Stuck Breaker at Goethals 5	102	130
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Loss of Ravenswood 3	Gowanus - Goethals 345 kV (25)	-	128
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Loss of Ravenswood 3	Stuck Breaker at Goethals 3	-	128
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Loss of Ravenswood 3	Stuck Breaker at Goethals 9	-	127
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Loss of Ravenswood 3	Stuck Breaker at Gowanus 6	-	114
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Sprainbrook-W 49th St 345 kV (51)	Stuck Breaker at Goethals 5	-	110
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Sprainbrook-W 49th St 345 kV (52)	Stuck Breaker at Goethals 5	-	110
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Sprainbrook-W 49th St 345 kV (51)	Stuck Breaker at Goethals 3	-	108
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Sprainbrook-W 49th St 345 kV (52)	Stuck Breaker at Goethals 3	-	108
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Sprainbrook-W 49th St 345 kV (51)	Gowanus - Goethals 345 kV (25)	-	108
J	ConEd	Goethals-Gowanus 345 kV (26)	518	738	Sprainbrook-W 49th St 345 kV (52)	Gowanus - Goethals 345 kV (25)	-	108

Transmission Security N-1-1 Violations of the 2020 RNA Base Case								
Zone	**Owner**	**Monitored Element**	**Normal Rating (MVA)**	**Contingency Rating (MVA)**	**1st Contingency**	**2nd Contingency**	**2025 Summer Peak Flow (%)**	**2030 Summer Peak Flow (%)**
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Loss of Ravenswood 3	Gowanus - Goethals 345 kV (26)	103	130
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Loss of Ravenswood 3	Stuck Breaker at Goethals 8	102	130
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Sprainbrook-W 49th St 345 kV (51)	Gowanus - Goethals 345 kV (26)	101	111
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Sprainbrook-W 49th St 345 kV (52)	Gowanus - Goethals 345 kV (26)	101	111
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Sprainbrook-W 49th St 345 kV (51)	Stuck Breaker at Goethals 8	-	110
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Sprainbrook-W 49th St 345 kV (52)	Stuck Breaker at Goethals 8	-	110
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Dunwoodie-Mott Haven 345 kV (72)	Gowanus - Goethals 345 kV (26)	-	107
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Dunwoodie-Mott Haven 345 kV (72)	Stuck Breaker at Goethals 8	-	107
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Dunwoodie-Mott Haven 345 kV (71)	Gowanus - Goethals 345 kV (26)	-	106
J	ConEd	Goethals-Gowanus 345kV (25)	518	738	Dunwoodie-Mott Haven 345 kV (71)	Stuck Breaker at Goethals 8	-	105
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Loss of Ravenswood 3	Tower W89 & W90	106	109
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Dunwoodie-Mott Haven 345 kV (71)	Tower W89 & W90	-	105
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Dunwoodie-Mott Haven 345 kV (72)	Tower W89 & W90	-	105
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Freshkills 345/138 kV (TB1)	Tower W89 & W90	-	105
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Gowanus 345/138 kV (14TR)	Tower W89 & W90	-	104

Transmission Security N-1-1 Violations of the 2020 RNA Base Case								
Zone	**Owner**	**Monitored Element**	**Normal Rating (MVA)**	**Contingency Rating (MVA)**	**1st Contingency**	**2nd Contingency**	**2025 Summer Peak Flow (%)**	**2030 Summer Peak Flow (%)**
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Sprainbrook-W 49th St 345 kV (51)	Tower W89 & W90	-	104
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Sprainbrook-W 49th St 345 kV (52)	Tower W89 & W90	-	104
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Bayonne-Gowanus 345 kV (G27)	Tower W89 & W90	-	104
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Loss of Bayonne	Tower W89 & W90	-	104
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	366	423	Freshkills 345/138 kV (TA1)	Tower W89 & W90	-	104
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Loss of Ravenswood 3	Tower W89 & W90	103	107
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Farragut-Gowanus 345 kV (42)	Tower W89 & W90	-	106
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Sprainbrook-W 49th St 345 kV (51)	Tower W89 & W90	-	105
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Sprainbrook-W 49th St 345 kV (52)	Tower W89 & W90	-	105
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Bayonne-Gowanus 345 kV (G27)	Tower W89 & W90	-	105
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Loss of Bayonne	Tower W89 & W90	-	105
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Gowanus 345/138 kV (14TR)	Tower W89 & W90	-	104
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Freshkills 345/138 kV (TA1)	Tower W89 & W90	-	103
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Dunwoodie-Shore Road 345 kV (Y50)	Tower W89 & W90	-	102
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Dunwoodie-Mott Haven 345 kV (71)	Tower W89 & W90	-	102

Transmission Security N-1-1 Violations of the 2020 RNA Base Case								
Zone	**Owner**	**Monitored Element**	**Normal Rating (MVA)**	**Contingency Rating (MVA)**	**1st Contingency**	**2nd Contingency**	**2025 Summer Peak Flow (%)**	**2030 Summer Peak Flow (%)**
I	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	309	438	Dunwoodie-Mott Haven 345 kV (72)	Tower W89 & W90	-	102
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	Loss of Ravenswood 3	Sprainbrook/Dunwoodie 345/138 kV (N7)	-	106
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	Loss of Ravenswood 3	Stuck breaker at Sprainbrook RN3	-	106
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	Loss of Ravenswood 3	Stuck breaker at Sprainbrook RN4	-	106
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	Loss of Ravenswood 3	Stuck breaker at Sprainbrook RN5	-	106
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	Loss of Ravenswood 3	Stuck breaker at Sprainbrook RN6	-	106
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	-	-	-	-
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	-	-	-	-
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	-	-	-	-
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	-	-	-	-
I	ConEd	Dunwoodie 345/138 kV (W73)	310	388	-	-	-	-

Figure 31: Transmission Security N-1-1-0 Violations of the 2020 RNA Base Case

Transmission Security N-1-1-0 Violations of the 2020 RNA Base Case								
Zone	**Owner**	**Monitored Element**	**Normal Rating (MVA)**	**Contingency Rating (MVA)**	**1st Contingency**	**2nd Contingency**	**2025 Summer Peak Flow (%)**	**2030 Summer Peak Flow (%)**
I/J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	785	925	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (72)	132	149
I/J	ConEd	Sprainbrook-W49th St 345 kV (51)	844	1029	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (72)	-	106
I/J	ConEd	Sprainbrook-W49th St 345 kV (52)	844	1029	Loss of Ravenswood 3	Dunwoodie-Mott Haven 345 kV (72)	-	106

Figure 32: BPTF Bus List for Transient Voltage Response N-1 Violation

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
126249	26T	345	10	NYC	CONED	2030	(2), (3)
126262	BUCHANAN N	345	8	MILLWOOD	CONED	2025	(2), (3)
126263	BUCHANAN S	345	8	MILLWOOD	CONED	2025	(1), (2), (3)
126265	COGNTECH	345	10	NYC	CONED	2030	(2), (3)
126266	DUNWOODIE	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126267	E VIEW 2N	345	9	DUNWOODIE	CONED	2025	(2), (3)
126268	E VIEW 1N	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126269	E VIEW 2S	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126270	E VIEW 1S	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126272	E13ST 45	345	10	NYC	CONED	2024	(1), (2), (3)
126273	E13ST 46	345	10	NYC	CONED	2024	(1), (2), (3)
126274	E13ST 47	345	10	NYC	CONED	2024	(1), (2), (3)
126275	E13ST 48	345	10	NYC	CONED	2024	(1), (2), (3)
126277	FARRAGUT	345	10	NYC	CONED	2024	(1), (2), (3)
126280	FARRAGUT TX9	345	10	NYC	CONED	2024	(1), (2), (3)
126282	FRESH KILLS	345	10	NYC	CONED	2030	(2), (3)
126283	GOTHLS	345	10	NYC	CONED	2030	(2), (3)
126284	GOTHLS R	345	10	NYC	CONED	2030	(2)
126285	GOW R4	345	10	NYC	CONED	2030	(2), (3)
126286	GOW R16	345	10	NYC	CONED	2030	(2), (3)
126287	GOWANUS	345	10	NYC	CONED	2030	(2), (3)
126291	MILLWOOD	345	8	MILLWOOD	CONED	2025	(1), (2), (3)
126292	PL VILLE	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126293	PL VILLW	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126295	RAINEY	345	10	NYC	CONED	2024	(1), (2), (3)
126298	SPRAINBROOK	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
126299	REACBUS	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126301	TREMONT	345	10	NYC	CONED	2025	(2), (3)
126304	W 49 ST	345	10	NYC	CONED	2024	(1), (2), (3)
126305	WOOD A	345	8	MILLWOOD	NYSEG	2030	(2), (3)
126306	WOOD B	345	8	MILLWOOD	NYSEG	2025	(1), (2), (3)
126319	WOOD C	345	8	MILLWOOD	NYSEG	2025	(1), (2), (3)
126342	W74 TAP	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126343	W73 TAP	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126517	REACM51	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126518	REACM52	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126590	GOWANUS 41SR	345	10	NYC	CONED	2024	(1), (2), (3)
126591	GOWANUS 42SR	345	10	NYC	CONED	2024	(1), (2), (3)
126600	REAC71	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126601	REAC72	345	9	DUNWOODIE	CONED	2025	(1), (2), (3)
126641	MOTT HAVEN	345	10	NYC	CONED	2024	(1), (2), (3)
126642	RAINEY WEST	345	10	NYC	CONED	2024	(1), (2), (3)
126643	RAINEY EAST	345	10	NYC	CONED	2024	(1), (2), (3)
126644	FARRAGUT WES	345	10	NYC	CONED	2024	(1), (2), (3)
126645	FARRAGUT EAS	345	10	NYC	CONED	2024	(1), (2), (3)
126847	ACADEMY	345	10	NYC	CONED	2025	(1), (2), (3)
126865	RAV3 60M	345	10	NYC	CONED	2024	(1), (2), (3)
126866	RAV3 60L	345	10	NYC	CONED	2024	(1), (2)
127100	B44	345	10	NYC	CONED	2024	(1), (2), (3)
128248	ANNTRHIGH	345	10	NYC	CONED	2024	(1), (2), (3)
128252	BAYONNE	345	10	NYC	CONED	2030	(2), (3)
128315	Q516GSU_HV	345	10	NYC	CONED	2030	(2), (3)
128699	MILLW345_C1	345	8	MILLWOOD	CONED	2025	(1), (2), (3)

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
128700	MILLW345_C2	345	8	MILLWOOD	CONED	2025	(1), (2), (3)
128701	ASTOR REAC	345	10	NYC	NYPA	2024	(1), (2), (3)
128702	BAYO_XFMR_HV	345	10	NYC	CONED	2030	(2), (3)
128822	E.G.C.-1	345	11	L ISLAND	LIPA	2025	(1), (2), (3)
128823	E.G.C.-2	345	11	L ISLAND	LIPA	2025	(1), (2), (3)
128824	EGC DUM	345	11	L ISLAND	LIPA	2025	(1), (2), (3)
128825	EGC PAR	345	11	L ISLAND	LIPA	2025	(1), (2), (3)
128830	HMP HRBR	345	11	L ISLAND	LIPA	2025	(1), (2), (3)
128835	SHORE RD	345	11	L ISLAND	LIPA	2024	(1), (2), (3)
128842	NEPTCONV	345	11	L ISLAND	LIPA	2025	(2), (3)
128847	NWBRG	345	11	L ISLAND	LIPA	2025	(2), (3)
129202	BARRETT1	138	11	L ISLAND	LIPA	2030	(2), (3)
129203	BARRETT2	138	11	L ISLAND	LIPA	2030	(2), (3)
129204	BRRT PH	138	11	L ISLAND	LIPA	2030	(2), (3)
129205	BRTGT1-8	138	11	L ISLAND	LIPA	2030	(2), (3)
129206	BRTGT9-12	138	11	L ISLAND	LIPA	2030	(2), (3)
129233	VLY STRM	138	11	L ISLAND	LIPA	2025	(2), (3)
129234	VLY STRM2	138	11	L ISLAND	LIPA	2025	(2), (3)
129235	V STRM P	138	11	L ISLAND	LIPA	2024	(1), (2), (3)
129247	L SUCS	138	11	L ISLAND	LIPA	2025	(1), (2), (3)
129248	L SUCS2	138	11	L ISLAND	LIPA	2025	(1), (2), (3)
129249	L SUCSPH	138	11	L ISLAND	LIPA	2024	(1), (2), (3)
129265	CARLE PL	138	11	L ISLAND	LIPA	2025	(2), (3)
129270	E.G.C.	138	11	L ISLAND	LIPA	2030	(2), (3)
129271	E.G.C.-2	138	11	L ISLAND	LIPA	2030	(2), (3)
129276	FREEPORT	138	11	L ISLAND	LIPA	2030	(2), (3)
129281	GLNWD GT	138	11	L ISLAND	LIPA	2025	(1), (2), (3)

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
129282	GLNWD NO	138	11	L ISLAND	LIPA	2025	(1), (2), (3)
129283	GLNWD SO	138	11	L ISLAND	LIPA	2025	(1), (2), (3)
129288	ROSLYN	138	11	L ISLAND	LIPA	2025	(1), (2), (3)
129293	SHORE RD	138	11	L ISLAND	LIPA	2025	(1), (2), (3)
129294	SHORE RD2	138	11	L ISLAND	LIPA	2025	(1), (2), (3)
129305	LCST GRV	138	11	L ISLAND	LIPA	2030	(2)
129310	NEWBRGE	138	11	L ISLAND	LIPA	2030	(2), (3)
130758	WOODA345	345	8	MILLWOOD	NYSEG	2030	(2), (3)
130759	WOODB345	345	8	MILLWOOD	NYSEG	2025	(1), (2), (3)
130877	WOODC345	345	8	MILLWOOD	NYSEG	2025	(1), (2), (3)
135222	WOOD D	345	8	MILLWOOD	NYSEG	2030	(2), (3)
146874	LOVETT345 ST	345	7	HUDSON	O&R	2030	(2), (3)
147829	ASTOR345	345	10	NYC	NYPA	2024	(1), (2), (3)
147857	DVNPT NK	345	9	DUNWOODIE	NYPA	2025	(1), (2), (3)
148707	AST_E_2	345	10	NYC	NYPA	2025	(1), (2), (3)

Notes:

Event (1) UC11

Event (2) UC25A

Event (3) UC25B

Figure 33: BPTF Bus List for Transient Voltage Response N-1-1 Violation

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
126249	26T	345	10	NYC	CONED	2025	(4), (5), (6), (9), (10), (11), (12), (13), (14), (15), (19)
126262	BUCHANAN N	345	8	MILLWOOD	CONED	2025	(5), (8), (9), (10), (11), (12), (13), (14), (15), (19)
126263	BUCHANAN S	345	8	MILLWOOD	CONED	2025	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
126265	COGNTECH	345	10	NYC	CONED	2025	(4), (5), (6), (9), (10), (11), (12), (13), (14), (15), (19)
126266	DUNWOODIE	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126267	E VIEW 2N	345	9	DUNWOODIE	CONED	2025	(2), (5), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126268	E VIEW 1N	345	9	DUNWOODIE	CONED	2024	(2), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126269	E VIEW 2S	345	9	DUNWOODIE	CONED	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126270	E VIEW 1S	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126272	E13ST 45	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (14), (15), (16), (18), (19)
126273	E13ST 46	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (15), (16), (18), (19)
126274	E13ST 47	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126275	E13ST 48	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (16), (18), (19)
126277	FARRAGUT	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (13), (14), (15), (16)

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
126280	FARRAGUT TX9	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126282	FRESH KILLS	345	10	NYC	CONED	2025	(4), (5), (6), (9), (10), (11), (12), (13), (14), (15), (19)
126283	GOTHLS	345	10	NYC	CONED	2025	(4), (5), (6), (9), (10), (11), (12), (13), (14), (15), (19)
126284	GOTHLS R	345	10	NYC	CONED	2030	(15), (19)
126285	GOW R4	345	10	NYC	CONED	2025	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
126286	GOW R16	345	10	NYC	CONED	2025	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
126287	GOWANUS	345	10	NYC	CONED	2025	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
126290	LADENTWN	345	7	HUDSON	CONED	2030	(19)
126291	MILLWOOD	345	8	MILLWOOD	CONED	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
126292	PL VILLE	345	9	DUNWOODIE	CONED	2024	(2), (4), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
126293	PL VILLW	345	9	DUNWOODIE	CONED	2024	(2), (4), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
126295	RAINEY	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126298	SPRAINBROOK	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126299	REACBUS	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
126301	TREMONT	345	10	NYC	CONED	2025	(1), (2), (4), (5), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
126304	W 49 ST	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126305	WOOD A	345	8	MILLWOOD	NYSEG	2025	(4), (6), (8), (9), (10), (11), (12), (13), (14), (15), (19)
126306	WOOD B	345	8	MILLWOOD	NYSEG	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
126319	WOOD C	345	8	MILLWOOD	NYSEG	2025	(4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (19)
126342	W74 TAP	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126343	W73 TAP	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126517	REACM51	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126518	REACM52	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126590	GOWANUS 41SR	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126591	GOWANUS 42SR	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126600	REAC71	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126601	REAC72	345	9	DUNWOODIE	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
126641	MOTT HAVEN	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126642	RAINEY WEST	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126643	RAINEY EAST	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126644	FARRAGUT WES	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126645	FARRAGUT EAS	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126847	ACADEMY	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126865	RAV3 60M	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
126866	RAV3 60L	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
127100	B44	345	10	NYC	CONED	2024	(1), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16)
128248	ANNTRHIGH	345	10	NYC	CONED	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
128252	BAYONNE	345	10	NYC	CONED	2025	(4), (5), (6), (9), (10), (11), (12), (13), (14), (15), (19)

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
128315	Q516GSU_HV	345	10	NYC	CONED	2025	(4), (5), (6), (9), (10), (11), (12), (13), (14), (15), (19)
128699	MILLW345_C1	345	8	MILLWOOD	CONED	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
128700	MILLW345_C2	345	8	MILLWOOD	CONED	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
128701	ASTOR REAC	345	10	NYC	NYPA	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
128702	BAYO_XFMR_HV	345	10	NYC	CONED	2025	(4), (5), (6), (9), (10), (11), (12), (13), (14), (15), (19)
128822	E.G.C.-1	345	11	L ISLAND	LIPA	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (17), (18), (19)
128823	E.G.C.-2	345	11	L ISLAND	LIPA	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (17), (18), (19)
128824	EGC DUM	345	11	L ISLAND	LIPA	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (17), (18), (19)
128825	EGC PAR	345	11	L ISLAND	LIPA	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (17), (18), (19)
128830	HMP HRBR	345	11	L ISLAND	LIPA	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (17), (18), (19)
128835	SHORE RD	345	11	L ISLAND	LIPA	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (17), (18), (19)
128842	NEPTCONV	345	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (10), (11), (12), (13), (15), (19)

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
128847	NWBRG	345	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (10), (11), (12), (13), (15), (19)
129202	BARRETT1	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (11), (15), (19)
129203	BARRETT2	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (11), (15), (19)
129204	BRRT PH	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (9), (19)
129205	BRTGT1-8	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (11), (15), (19)
129206	BRTGT9-12	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (11), (15), (19)
129233	VLY STRM	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (19)
129234	VLY STRM2	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (19)
129235	V STRM P	138	11	L ISLAND	LIPA	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
129247	L SUCS	138	11	L ISLAND	LIPA	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
129248	L SUCS2	138	11	L ISLAND	LIPA	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
129249	L SUCSPH	138	11	L ISLAND	LIPA	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
129265	CARLE PL	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (10), (11), (12), (15), (19)
129270	E.G.C.	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (9), (15), (19)
129271	E.G.C.-2	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (9), (15), (19)
129276	FREEPORT	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (9), (19)
129281	GLNWD GT	138	11	L ISLAND	LIPA	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
129282	GLNWD NO	138	11	L ISLAND	LIPA	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
129283	GLNWD SO	138	11	L ISLAND	LIPA	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
129288	ROSLYN	138	11	L ISLAND	LIPA	2025	(4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (19)

Bus Number	Bus Name	Base kV	Area Num	Area Name	Owner Name	Earliest Year of observed transient voltage response violations	Contingency Events which result in transient voltage response violations for this bus (See Note Below)
129293	SHORE RD	138	11	L ISLAND	LIPA	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
129294	SHORE RD2	138	11	L ISLAND	LIPA	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
129310	NEWBRGE	138	11	L ISLAND	LIPA	2025	(5), (6), (9), (19)
130758	WOODA345	345	8	MILLWOOD	NYSEG	2025	(3), (4), (6), (8), (9), (10), (11), (12), (13), (14), (15), (19)
130759	WOODB345	345	8	MILLWOOD	NYSEG	2024	(2), (4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
130877	WOODC345	345	8	MILLWOOD	NYSEG	2025	(4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (19)
135222	WOOD D	345	8	MILLWOOD	NYSEG	2025	(4), (6), (8), (9), (10), (11), (12), (13), (14), (15), (19)
146874	LOVETT345 ST	345	7	HUDSON	O&R	2025	(4), (5), (6), (8), (9), (10), (11), (12), (13), (14), (15), (19)
147829	ASTOR345	345	10	NYC	NYPA	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)
147857	DVNPT NK	345	9	DUNWOODIE	NYPA	2024	(2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (19)
148707	AST_E_2	345	10	NYC	NYPA	2024	(1), (2), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (18), (19)

Notes:

Event (1) ConEd16
Event (2) ConEd23_Q510
Event (3) TE02-UC02
Event (4) TE03-UC03
Event (5) TE20-UC20
Event (6) UC11
Event (7) UC19
Event (8) UC25A
Event (9) UC25B
Event (10) UC32_Q510
Event (11) UC33_Q510
Event (12) UC34_Q510
Event (13) UC35_Q510
Event (14) UC36_Q510
Event (15) UC38_Q510
Event (16) UC39_Q510
Event (17) UC048A_Q510
Event (18) UC57_Q510
Event (19) UC5_Q510

Appendix E – Additional Exploratory Scenario Analysis

Additional to the scenarios described in the body of the RNA report, the NYISO performed two exploratory scenarios:

1. Further Simplified External Areas Model - Resource Adequacy only
   - Starting with the simplified external model described in footnote 8 and also in the assumptions matrix in Appendix D, the NYISO removed all load and generation from external areas along with removing interfaces between external areas, followed by inserting fixed amounts of capacity in each external area.
2. Different Load Shape - Resource Adequacy only
   - The Resource Adequacy Base Cases use historical load shapes from 2002, 2006, and 2007. The Climate Change Phase 1 study developed forward-looking hourly load shapes. This exploratory scenario identified that additional collaboration with the Load Forecast Task Force and other stakeholders will be initiated, to identify if and how future-looking load shapes would better represent an ever-changing system.

Further Simplified External Areas Model

During the 2020 RNA, the External Areas Model for the RNA Base Case was simplified to consolidate five PJM (mid-Atlantic) areas into a single area and eight ISO-NE areas into a single area.

This further simplified scenario evaluates an alternative model for the external, non-NYCA, regions in the MARS model. Starting in this RNA, the NYISO simplified the representation of each external region so that they are represented by a single area, as shown in Figure 46**.** in the main report. This scenario expands on this work by evaluating if additional simplifications to the external region model can be made while maintaining consistent results.

To achieve this objective, the NYISO performed the following actions in each external region to simplify the representation and to model a system in which the NYCA receives no emergency assistance:

- Removing all load and generation from each external region;
- Remove pool-to-pool ties between external regions; and
- Disable the ability of UDRs to return from the host external region, while still allowing emergency assistance over the interface if the resource is otherwise unavailable.

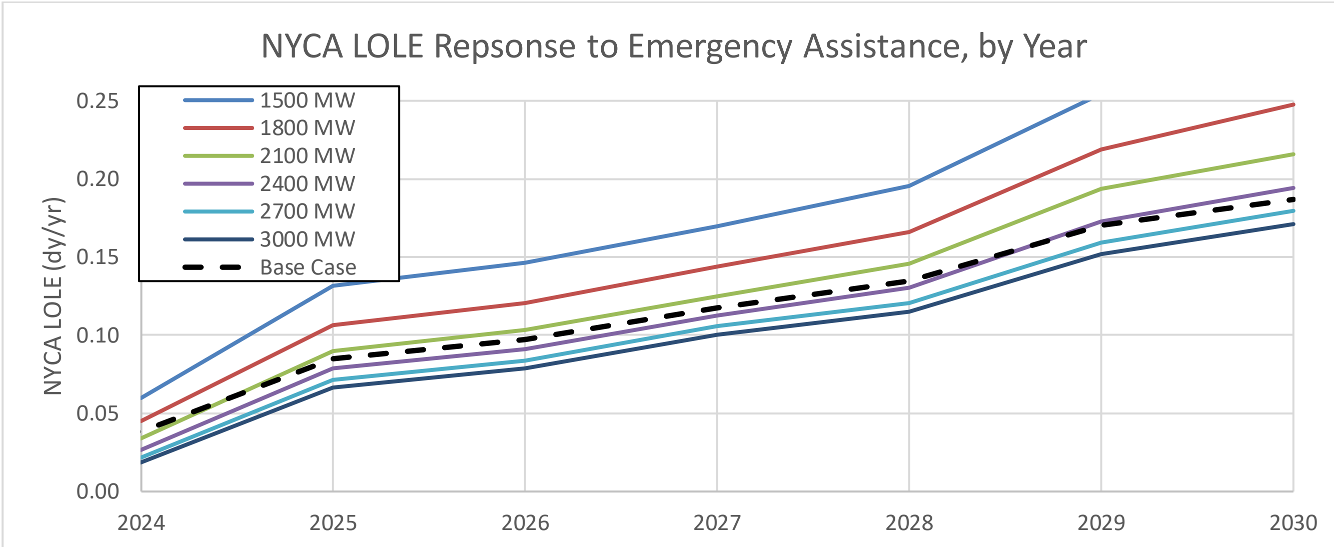
With the baseline set, the NYISO evaluated the impact of adding fixed, always-available capacity resources to each of the external regions. This analysis revealed the NYCA LOLE was not particularly sensitive to capacity additions in any one region (*e.g.,* adding 600 MW in New England yielded a similar result to adding 600 MW in Ontario), subject to transfer limit constraints (*e.g.,* New England could not provide more than 1,400 MW total).

The next phase of this analysis evaluated the impact of modeling discrete capacity combinations in each external region, as shown in Figure 34. For low levels of total assistance, the results aligned with the single area adjustments previously discussed (*i.e.,* the 1,200 MW cumulative result was similar to adding 1,200 MW to PJM or New England). Figure 34 also includes the observed NYCA LOLE for 2030, when compared to the Base Case results (0.186), between 2,400 and 2,700 MW of always-available assistance replace the external model. The amount of assistance needed through time increased. See Figure 35, showing the 2024 Base Case result (0.016) using between 1,800 and 2,100 MW of assistance.

Figure 34: Amount of Assistance Needed in the Simulation through Time

Case ID	HQ	IESO	ISONE	PJM	Total	2030 NYCA LOLE (dy/yr)
Case 0	0	0	0	0	0	0.812
Case 1	300	0	0	0	300	0.652
Case 2	300	300	300	300	1,200	0.354
Case 3	300	400	400	400	1,500	0.292
Case 4	300	500	500	500	1,800	0.248
Case 5	300	600	600	600	2,100	0.216
Case 6	300	700	700	700	2,400	0.194
Case 7	300	800	800	800	2,700	0.18
Case 8	300	900	900	900	3,000	0.171
Case 9	300	1,000	1,000	1,000	3,300	0.166

Figure 35: NYCA LOLE Response to Emergency Assistance



The next, and final, phase of this exploratory analysis was to apply derates to the amount of available emergency assistance based upon the Area K load, as a proxy for NYCA Load. The derates were applied by utilizing MARS functionality for ambient temperature derates to thermal units. This approach allows for the simplified model to mimic the original model by having potentially less assistance available in the higher load levels. Two derate profiles were tested, shown in Figure 36, on the 2,400, 2,700, and 3,000 MW assistance cases Figure 37 to Figure 39, respectively.

Figure 36: Emergency Assistance Profiles Tested

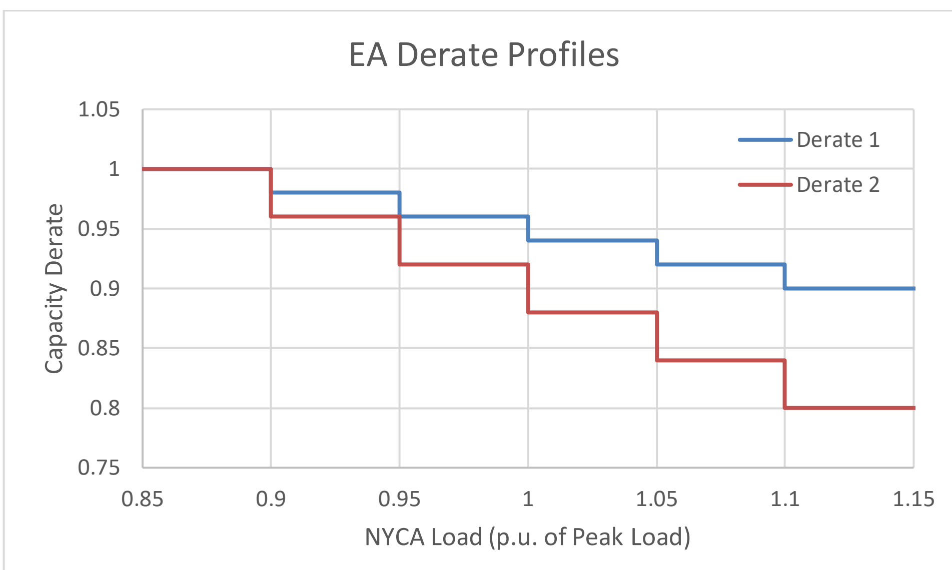


Figure 37: Base Emergency Assistance Level: 2400 MW

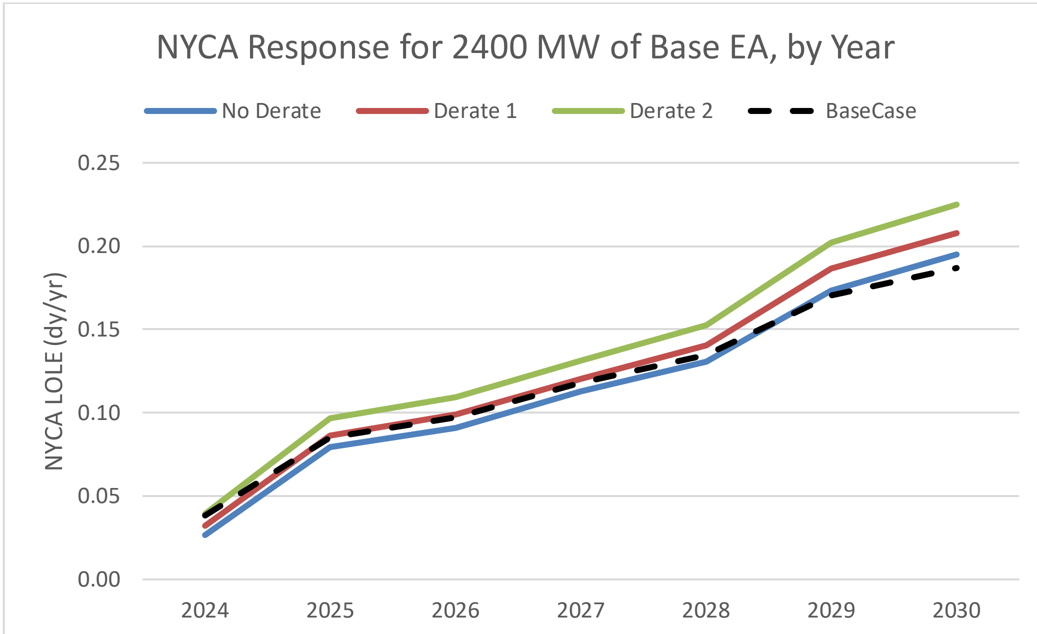


Figure 38: Base Emergency Assistance Level: 2700 MW

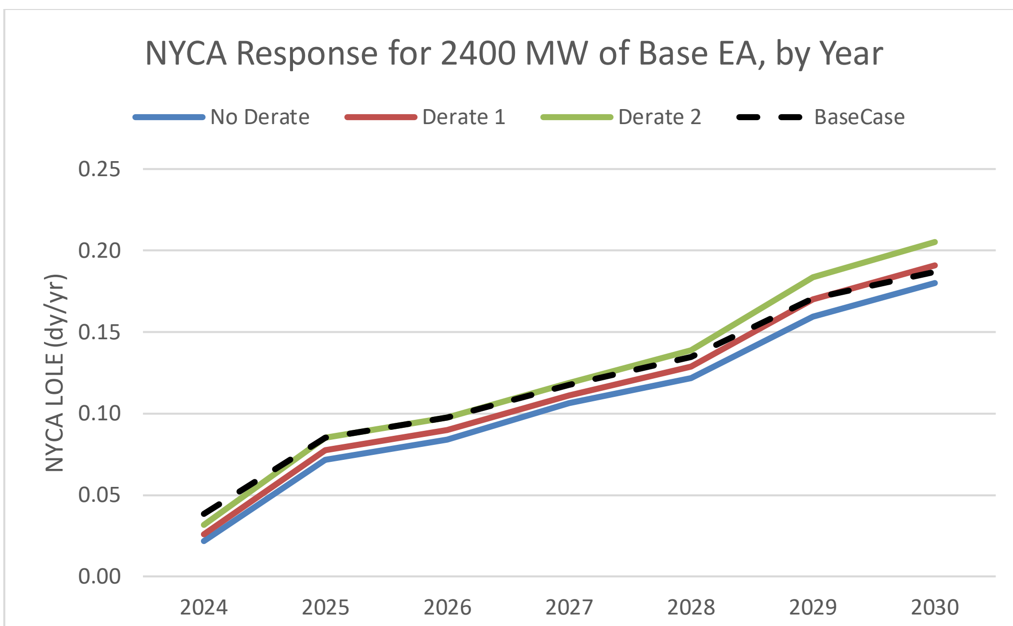
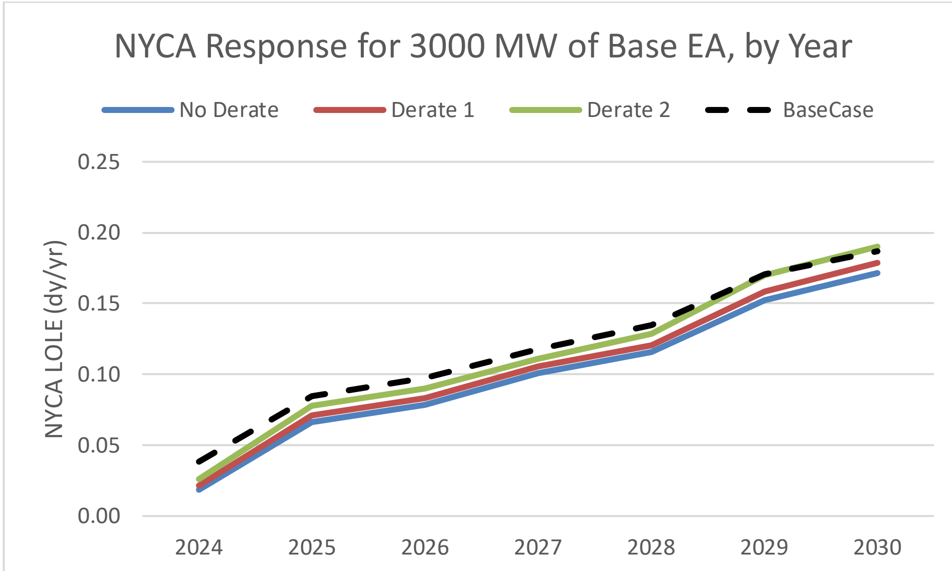


Figure 39: Base Emergency Assistance Level: 3000 MW



The NYISO intends to continue refining this analysis with discussion at the Electric System Planning Working Group and other stakeholder forums, as applicable in order to determine potential changes.

Different Load Shape - Resource Adequacy only

The Resource Adequacy Base Cases use historical shapes from 2002, 2006, and 2007, a practice established in the 2014 RNA. These shapes were selected to represent differing weather conditions, 2006 for extreme hot weather, 2002 for consistent but not extreme weather, and 2007 for typical weather. These shapes are aligned with the load forecast uncertainly levels, 2006 associated with the highest, 2002 with the second highest, and 2007 associated with the remaining uncertainty levels. Prior to the 2014 RNA, resource adequacy analysis was performed using only the 2002 reference shape.

In 2019, the NYISO engaged in the Climate Change Phase 1 Study to develop a set of future-looking hourly load shapes considering various energy efficiency and climate goals. The outputs from the Phase 1 study feeds into the Phase 2 study, which is analyzing reliability impact issues with a potential 2040 power system. The NYISO will continue to explore building on the work from the Climate Change studies for application in future resource adequacy analysis, and intends to collaborate with the Load Forecasting Task Force and other stakeholders' forums, as applicable in order to determine potential changes to be studied.

Appendix F - Historic Congestion

Appendix A of Attachment Y of the OATT states:

As part of its CSPP, the ISO will prepare summaries and detailed analysis of historic and projected congestion across the NYS Transmission System. This will include analysis to identify the significant causes of historic congestion in an effort to help Market Participants and other interested parties distinguish persistent and addressable congestion from congestion that results from onetime events or transient adjustments in operating procedures that may or may not recur. This information will assist Market Participants and other stakeholders to make appropriately informed decisions.

The historic congestion information can be found on the NYISO website:

https://www.nyiso.com/ny-power-system-information-outlook (Congested Elements Reports)

Also, information on the NYISO's Economic Planning Studies can be found here:

https://www.nyiso.com/library (Planning Reports, Economic Planning Studies (CARIS))