2018 RNA REPORT

Reliability Needs Assessment

A Report by the
New York Independent
System Operator

Final Report
Approved October 16, 2018

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Executive Summary

This 2018 Reliability Needs Assessment (RNA) assesses the resource adequacy and transmission security of the New York Control Area (NYCA) Bulk Power Transmission Facilities (BPTF) from year 2019 through 2028, the Study Period of this RNA.

This 2018 Reliability Needs Assessment finds that the Reliability Criteria are met throughout the Study Period.

The Reliability Needs Assessment is the first step of the NYISO Reliability Planning Process. As a product of this step, the NYISO documents the Reliability Needs in the Reliability Needs Assessment report, which ultimately is presented to the NYISO Board of Directors for approval.

Following NYISO Board approval, additional steps are taken as necessary to address identified Reliability Needs, if any. First the NYISO requests updates to Local Transmission Owner Plans (LTPs). As part of this step, the NYISO would consider updates to Local Transmission Owner Plans and, if still necessary, solicit market-based solutions, regulated backstop solutions, and alternative regulated solutions to the identified Reliability Needs. The NYISO would then proceeds to assess the viability and sufficiency of each of the possible solutions, leading to the development of the Comprehensive Reliability Plan (CRP).

The Comprehensive Reliability Plan provides the 10-year plan to maintain system reliability and documents the solutions determined to be viable and sufficient to meet any identified Reliability Needs. If appropriate, 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.

Summary of Resource Adequacy Results

From the resource adequacy perspective, the New York Control Area is within the Loss of Load Expectation (LOLE) criterion (one day in 10 years, or 0.1 days per year) throughout the Study Period; therefore, the NYISO identifies no resource adequacy related Reliability Need. The trend of load decrease continues; for example, the summer peak baseline load forecast is 1,464 MW lower in 2023 as compared with the 2016 Reliability Needs Assessment. When recent and planned capacity deactivations were included in the calculation for comparison, the net statewide surplus increased by 1,817 MW as compared with the 2016 Reliability Needs Assessment (see Figure 1 on the next page).

Figure 1: 2018 RNA Load and Capacity Comparison with the 2016 RNA

Year 2023	2018 RNA	2016 RNA	Delta
Baseline* Load	32,284	33,748	-1,464
Total Resources**	41,500	41,147	353
Net Margin: Change in (net capacity - net load)			1,817

Notes:

*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.

**includes the total Special Case Resources (SCR), and net capacity purchases and sales from the Gold Book 2018 (also shown in Figure 15).

Summary of Transmission Security Results

The NYISO identifies no Reliability Need resulting from the transmission security evaluations.

Preliminary evaluations identified a transmission security Reliability Need on a BPTF facility in eastern Long Island, which was subsequently addressed by the transmission owner via an LTP update (details in the "Resource Adequacy Assessment" section).

Summary of Scenario Results

The 2018 Reliability Need Assessment analyzes risks to the BPTF under certain scenarios to inform our stakeholders when developing projects, as well as policy makers when formulating state policy.

Scenarios are variations on the Reliability Need Assessment Base Case that the NYISO reports for information purpose to assess the impact of possible changes in key study assumptions, such as higher load forecast, capacity removal, and additional transmission build-outs (*e.g.,* transmission driven by public policy). If they occurred, the events analyzed in the scenarios could change the timing, location, or degree of violations of applicable Reliability Criteria on the NYCA system during the Study Period.

The results of the 2018 Reliability Need Assessment scenarios indicate that a higher load level or additional removal of capacity could cause resource adequacy Reliability Needs.

The scenarios evaluated as part of this Reliability Need Assessment are described below, including an identification of the type of assessment performed:

- **High Load** (topline, previously known as econometric) Forecast – Resource Adequacy Scenario:

  This high load scenario simulated the removal of the impacts of energy efficiency programs, building codes and standards, and behind-the-meter solar PV programs from the baseline peak forecast. This results in a 3,685 MW increase in peak load in the year 2028 as compared with the baseline forecast of the same year. Given that the peak load in the topline forecast is higher than the baseline forecast, the probability of exceeding the LOLE criterion increases, and violations occur starting from year 2025.

- **Zonal Capacity at Risk** – Resource Adequacy Scenario:

  The zonal capacity at risk scenario identifies a maximum level of "perfect capacity[1]" that can be removed from a zone without causing NYCA LOLE violations.

  For example, for year 2019, removal of perfect capacity up to 2,700 MW in Zones A through F; 2,400 MW in Zones G through I; 1,400 MW in Zone J; or 850 MW in Zone K would not result in a NYCA resource adequacy violation.

- **AC Transmission New York Public Policy Transmission Need** – Transmission Security:

  The NYISO identified assessing the impact of AC Transmission on the BPTF scenario only if there were Reliability Needs that the project could potentially mitigate or resolve. Since there were no Reliability Needs identified, the scenario was not performed.

In addition to the above-referenced scenarios, the NYISO also discusses the 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 Clean Energy Standard, the Offshore Wind Master Plan, the Large-Scale Renewable Program and Zero Emission Credits Program for the James A. FitzPatrick, R.E Ginna and Nine Mile Point nuclear power plants. 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. The other tracked resources include: 1. units interconnecting through the NYISO's interconnection processes; 2. the development and installation of local transmission facilities; 3. additions, mothballs or

[1] " Perfect capacity" is capacity that is not derated (*e.g.*, due to ambient temperature or unit unavailability) and not tested for transmission security or interface impacts

retirements of generators; 4. the status of mothballed/retired facilities; 5. the continued implementation of New York State energy efficiency programs, solar PV installations, additions due to the Clean Energy Standard, and similar programs; 6. participation in the NYISO demand response programs; and 7. the impact of new and proposed environmental regulations on the existing generation fleet.

Introduction

This report sets forth the NYISO's 2018 Reliability Needs Assessment (RNA) and scenario findings for the Study Period (years 2019 through 2028).

The RNA is developed by the NYISO in conjunction with Market Participants and all interested parties as the first step in the Reliability Planning Process (RPP). The RNA is the foundation study used in the development of the NYISO Comprehensive Reliability Plan (CRP). The RNA is performed to evaluate electric system reliability for both resource adequacy and transmission security over a 10-year study period. If the RNA identifies any violation of Reliability Criteria for Bulk Power Transmission Facilities (BPTF), the NYISO will report a Reliability Need quantified by an amount of compensatory megawatts (MW) in a location that would resolve that need. After NYISO's Board approval of the RNA and if any Reliability Needs are left after the LTP update process, the NYISO will request market-based solutions, designate one or more Responsible Transmission Owners (TOs) to develop a regulated backstop solution to address each identified Reliability Need, and solicit alternative regulated proposals from interested parties.

The CRP details the NYISO plan for continued reliability of the Bulk Power Transmission Facilities (BPTF) 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 any request for solutions following the approval of an RNA. If the market does not adequately respond, reliability will be maintained by either regulated backstop solutions developed by the 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 BPTF, 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 RPP recently implemented in the NYISO's tariffs and procedures. Next, this report summarizes the prior RPP findings and reliability plans. The report continues with a summary of the load and resource forecast for the next 10 years, 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 RPP is also designed to provide information that is both informative and of value to the New York wholesale electricity marketplace and federal and state policy makers.

For informational purposes, this RNA report reviews activities related to environmental regulatory programs and other relevant developments. Also for informational purposes, this RNA report also provides the latest historical information and is available for the past five years of congestion on the NYISO's website. The 2018 RPP will serve as the foundation for the 2019 Congestion Assessment and Resource Integration Study (CARIS), which will present more detailed evaluation of system congestion. Just as important as the electric system plan is the process of planning itself. Electric system planning is an ongoing process of evaluating, monitoring, and updating as conditions warrant.

Overview of RPP Changes

The current RPP 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). The detailed process of the RPP is contained in the Reliability Planning Process Manual (RPP Manual).

One of the changes to the RPP, which was first implemented in the 2016 RNA, is providing preliminary RNA results to stakeholders in June of the first year of the biennial planning process. The stakeholders can provide project updates focused on mitigating the preliminary Reliability Needs, if any are identified. The NYISO then incorporates system changes that may impact the preliminary results and that had occurred since the initial lock down date of the RNA assumptions into the Base Case before finalizing the results. The NYISO considers the following updates:

- Changes in BPTFs
- Change in resources such as generating unit status, load forecast, or demand response that may impact the preliminary Reliability Needs, and
- Updates to previously submitted Local Transmission Owner Plans (LTPs) or New York Power Authority (NYPA) plans that have reached a stage of development sufficient to be included and that may impact the preliminary Reliability Needs

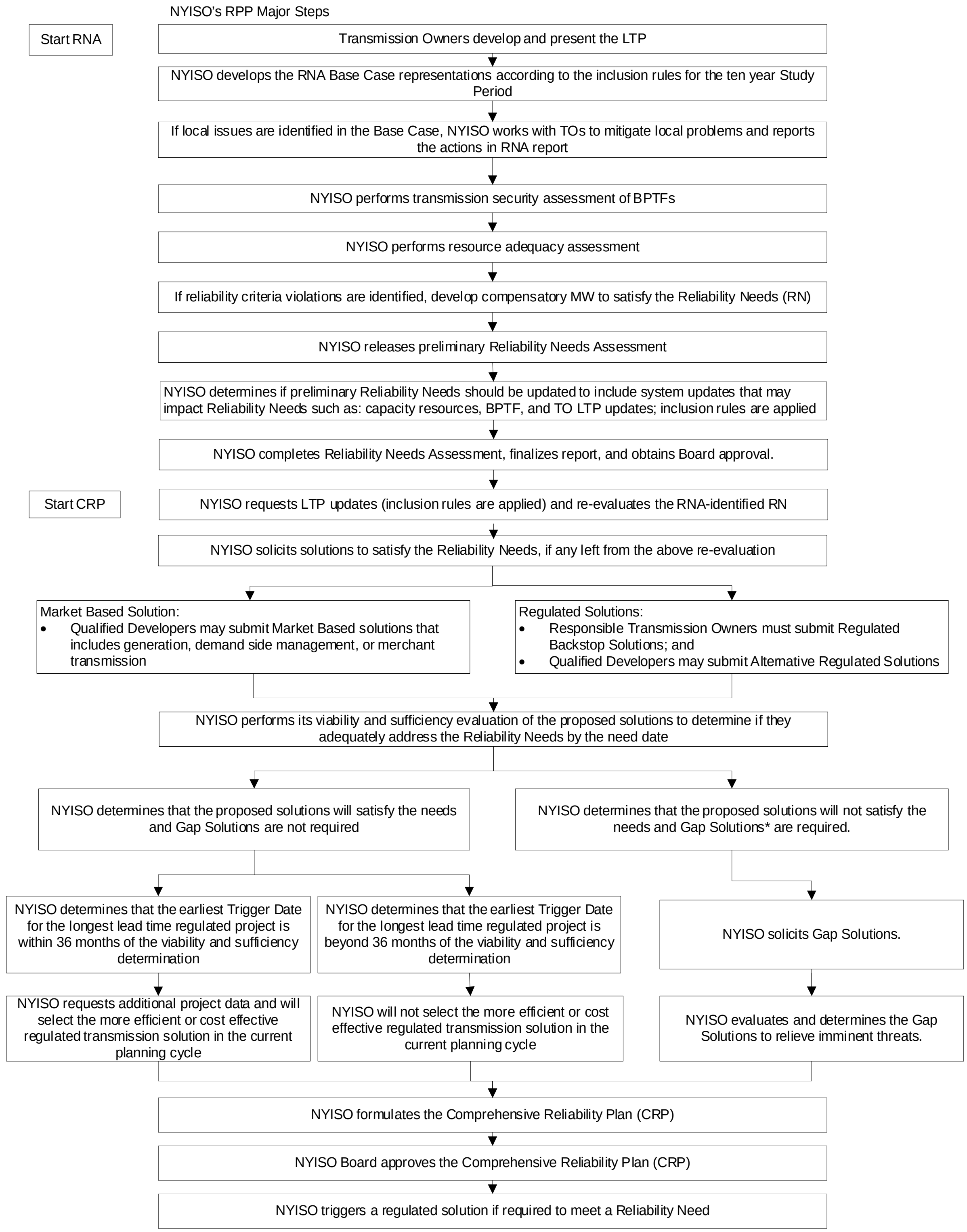
If the NYISO determines that an update does not meet the inclusion rules and/or does not impact the preliminary Reliability Need, then the NYISO does not incorporate the change into the final RNA Base Case.

After the NYISO Board of Directors approves the RNA Report, if Reliability Needs are identified the NYISO will request updates to the Transmission Owners' LTPs and NYPA transmission plans before issuing a request for regulated backstop, market-based, and alternative regulated solutions. Prior to responding to the RNA, the Responsible TOs will report at the Electric System Planning Working Group (ESPWG) and the Transmission Planning Advisory Subcommittee (TPAS) information regarding any updates in their LTPs that could affect the Reliability Needs. Also, NYPA, at the NYISO's request, reports at the ESPWG and TPAS any information about its transmission plans that could affect the Reliability Needs. The NYISO will present at the ESPWG and TPAS updates to its determination under Section 31.2.2.4.2 of Attachment Y to the OATT with respect to the Transmission Owners' LTPs. The NYISO will then request solutions to the Reliability Needs, if necessary, after incorporating the updates to the Transmission Owners' LTPs and NYPA transmission plans and their impacts on the Reliability Needs.

The 2018 version of the RPP Manual 26 reflects 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.

Further details of the RPP, including the CRP and RNA processes, are contained in **Appendix B** of this report, and also in the RPP Manual located on the NYISO website. An overview of the RPP, including the updated RNA process, is illustrated in Figure 2 on the next page, and is also described in the RPP Manual 26.

Figure 2: NYISO Reliability Planning Process (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.

Summary of Prior CRPs

This is the ninth RNA since the NYISO's Comprehensive System Planning Process (CSPP) was 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, hence there was no need for the NYISO to solicit solutions under the 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 (as described in the Manual 26), 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 RPP cycle.

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

Figure 3 below presents the market solutions and TOs' plans that were submitted in response to previous requests for solutions.

Figure 3: Current Status of Tracked Market-Based Solutions & TOs' Plans

Queue #	Project	Submitted	Zone	Nameplate (MW)	CRIS (MW)	Summer (MW)	Proposal Type	Current Status	Included in the 2018 RNA Base Case
339	Station 255	CRP2012	B	N/A	N/A	N/A	TO's Plans	Q4 2020	Yes
-	Clay-Teall #10 115kV	CRP2012	C	N/A	N/A	N/A	TO's Plans National Grid	Q4 2019	Yes

RNA Base Case Assumptions, Drivers, and Methodology

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 CSPP procedures are designed to allow its planning activities to be performed in an open and transparent manner under a defined set of rules and to be aligned and coordinated with the related 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. The Study Period analyzed in this 2018 RNA is from year 2019 (year 1) through 2028 (year 10).

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.

Both the security and adequacy studies in the RNA Base Case use a peak demand and energy forecast originating from the baseline forecast reported in the 2018 Gold Book. The baseline forecast from the 2018 Gold Book includes the load-reducing impacts of energy efficiency programs, building codes and standards, distributed energy generation, and behind-the-meter solar PV power, along with expected impacts (load-increasing) of electric vehicle usage. The econometric forecast incorporates only the growth due to the economy and does not account for the load-reducing impacts of the aforementioned programs. 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 Case was 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. The changes in resources were included in the RNA Base Case using the NYISO 2018 FERC 715 filing as a starting point, adding and removing resources consistent with the base case inclusion screening process provided in Section 3.3 of the RPP Manual (Manual 26). For the resource adequacy study, resources in the NYCA that choose to participate in markets outside of New York are modeled using the GE-MARS contracts modeling feature, whereby their capacity is removed from the NYCA for the years of the transaction and reflected in the neighboring market's control area load and capacity balance to meet their modeled LOLE target.

Representations of neighboring systems are derived from interregional transmission planning coordination conducted under the NPCC and ERAG MMWG processes, and pursuant to the Northeast ISO/RTO Planning Coordination Protocol.

Annual Energy and Summer Peak Demand Forecasts

This section reports the baseline forecast, the topline (formerly known as econometric) 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 2018 Gold Book. The baseline forecast includes the impacts of energy efficiency, distributed energy resources, and behind-the-meter solar PV. The topline forecast does not include those impacts. The baseline forecast, which already reflects the solar PV behind-the-meter reductions, was modified to add back those impacts. This modified 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 2018 Base Case forecast derive from actual and projected spending levels and realization rates for state-sponsored programs such as the Clean Energy Fund and the NY-Sun Initiative. They also include the impacts of building codes and appliance efficiency standards, distributed generation, and electric vehicles. 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 2018 RNA base case forecast are included in **Appendix C** of this report.

The assumptions for the 2018 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 2018. The ESPWG and TPAS reviewed and discussed the assumptions used in the 2018 RNA base case forecast in accordance with procedures established for the RNA.

The annual average energy growth rate of the baseline forecast in the 2018 Gold Book decreased by 0.14% as compared to a 0.16% reduction in the 2016 Gold Book. The 2018 Gold Book's annual average baseline summer peak demand declined by 0.13% as compared to 0.21% growth in the 2016 Gold Book. The lower energy growth rate is attributed to both economic factors and the continued impact of energy efficiency and behind-the-meter solar PV.

Figure 4 on the next page summarizes the three forecasts used in the 2018 RNA. Figure 5 shows a comparison of the baseline forecasts and energy efficiency program impacts contained in the 2016 RNA and the 2018 RNA. Figure 6 and Figure 7 present actual, weather-normalized forecasts of annual energy and summer peak demand for the 2018 RNA. Figure 8 and Figure 9 present the NYISO's projections of annual energy and summer peak demand in the 2018 RNA for energy efficiency, distributed generation, and behind-the-meter solar PV.

Figure 4: 2018 RNA Load and Energy Forecast: Econometric, Baseline, and Baseline with SPV Forecasts Added Back In

Topline, Baseline and Adjusted Energy Forecasts

Annual GWh	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
2018 Topline[1]	160,320	162,836	164,449	165,478	166,332	167,530	168,485	170,054	171,596	172,753	173,586
2018 Gold Book Baseline	156,120	156,649	155,567	154,567	153,898	153,593	153,476	153,454	153,504	153,691	153,926
+ 2018 Solar PV	1,768	2,301	2,803	3,179	3,477	3,686	3,875	4,033	4,165	4,302	4,420
2018 RNA Base Case[3]	157,888	158,950	158,370	157,746	157,375	157,279	157,351	157,487	157,669	157,993	158,346

Energy Impacts of Energy Efficiency, Distributed Resources & Solar PV

Cumulative GWh	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Solar PV	1,768	2,301	2,803	3,179	3,477	3,686	3,875	4,033	4,165	4,302	4,420
EE & Distributed Generation	2,432	3,886	6,079	7,732	8,957	10,251	11,134	12,567	13,927	14,760	15,240
Total	4,200	6,187	8,882	10,911	12,434	13,937	15,009	16,600	18,092	19,062	19,660

Econometric, Baseline and Adjusted Summer Peak Forecast

Annual MW	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
2018 Topline[1]	33,763	34,099	34,367	34,554	34,727	34,946	35,132	35,442	35,750	35,982	36,154
2018 Gold Book Baseline[2]	32,904	32,857	32,629	32,451	32,339	32,284	32,276	32,299	32,343	32,403	32,469
+ 2018 Solar PV (MW AC)	440	566	689	774	843	889	928	963	989	1,017	1,038
2018 RNA Base Case[3]	33,344	33,423	33,318	33,225	33,182	33,173	33,204	33,262	33,332	33,420	33,507

Summer Peak Demand Impacts of Energy Efficiency, Distributed Generation & Solar PV

Cumulative MW	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Solar PV (MW AC)	440	566	689	774	843	889	928	963	989	1,017	1,038
EE & Distributed Generation	419	676	1,049	1,329	1,545	1,773	1,928	2,180	2,418	2,562	2,647
Total	859	1,242	1,738	2,103	2,388	2,662	2,856	3,143	3,407	3,579	3,685

[1] The topline forecast will be used for the high load resource adequacy scenario.

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

[3] 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.

Figure 5: Comparison of 2016 RNA & 2018 Baseline Forecasts

Comparison of Base Case Energy Forecasts - 2016 & 2018 RNA (GWh)

Annual GWh	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
2016 RNA Base Case[1]	160,198	160,166	160,055	159,535	159,667	159,919	160,134	160,291	160,438		
2018 RNA Base Case[1]	157,888	158,950	158,370	157,746	157,375	157,279	157,351	157,487	157,669	157,993	158,346
Change from 2016 RNA	-2,310	-1,216	-1,685	-1,789	-2,292	-2,640	-2,783	-2,804	-2,769	NA	NA

Comparison of Base Case Peak Forecasts - 2016 & 2018 RNA (MW)

Annual MW	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
2016 RNA Base Case[1]	33,825	33,948	34,019	34,120	34,256	34,393	34,515	34,646	34,803		
2018 RNA Base Case[1]	33,344	33,423	33,318	33,225	33,182	33,173	33,204	33,262	33,332	33,420	33,507
Change from 2016 RNA	-481	-525	-701	-895	-1,074	-1,220	-1,311	-1,384	-1,471	NA	NA

Comparison of Energy Impacts from Statewide Energy Efficiency & Distributed Generation - 2016 RNA & 2018 RNA (GWh)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
2016 RNA Base Case[1,2]	1,586	2,894	4,094	5,230	6,226	7,198	8,140	9,070	10,010		
2018 RNA Base Case[1]	2,432	3,886	6,079	7,732	8,957	10,251	11,134	12,567	13,927	14,760	15,240
Change from 2016 RNA	846	992	1,985	2,502	2,731	3,053	2,994	3,497	3,917	NA	NA

Comparison of Peak Impacts from Statewide Energy Efficiency & Distributed Energy - 2016 RNA & 2018 RNA (MW)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
2016 RNA Base Case[1,2]	290	488	661	820	942	1,061	1,175	1,292	1,408		
2018 RNA Base Case[1]	419	676	1,049	1,329	1,545	1,773	1,928	2,180	2,418	2,562	2,647
Change from 2016 RNA	129	188	388	509	603	712	753	888	1,010	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 6: 2018 Topline and Baseline with SPV Energy Forecasts

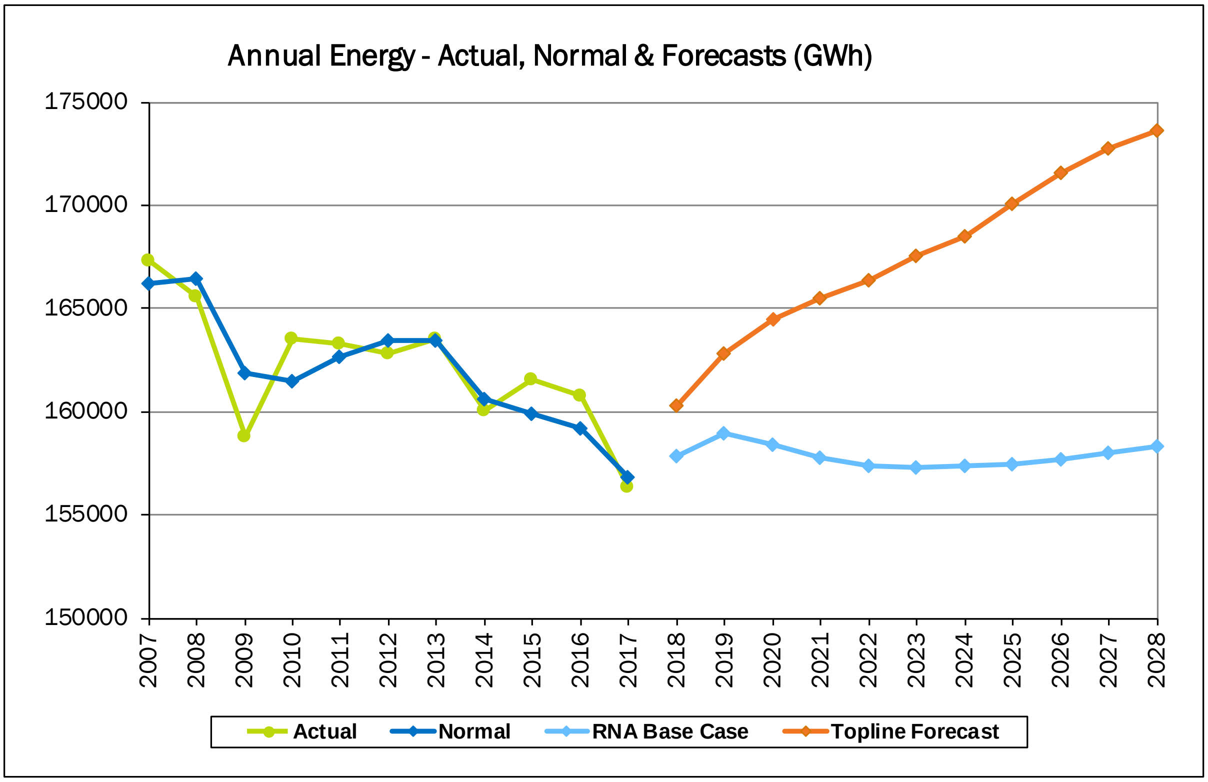


Figure 7: 2018 Topline and Baseline with SPV Summer Peak Demand Forecast

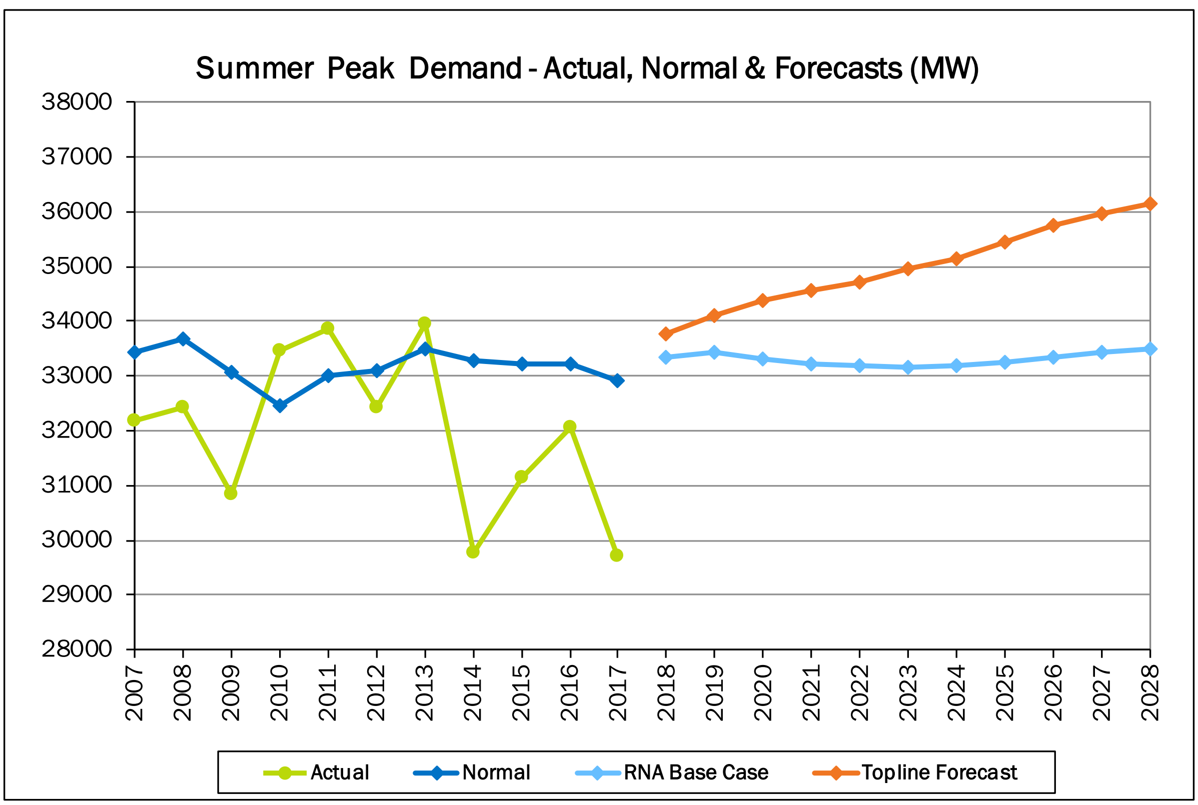


Figure 8: 2018 Energy Efficiency, Distributed Generation and Behind-the-Meter Solar PV – Annual Energy Forecast

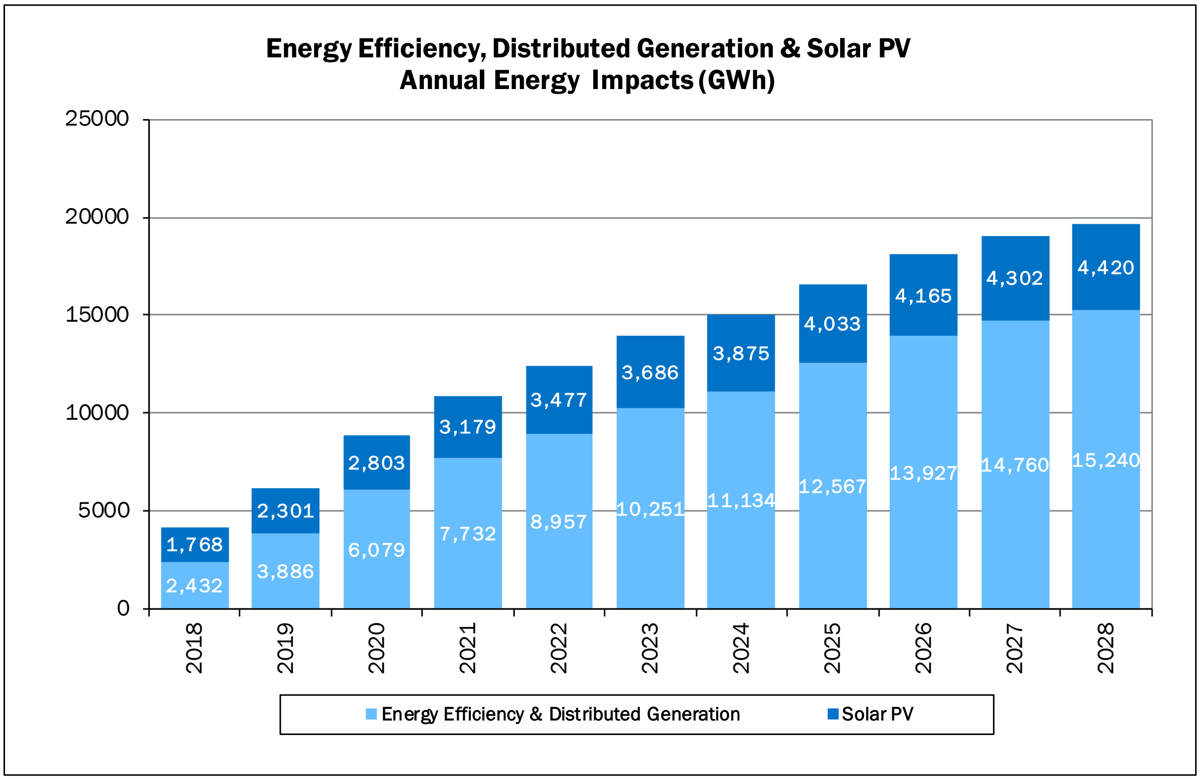
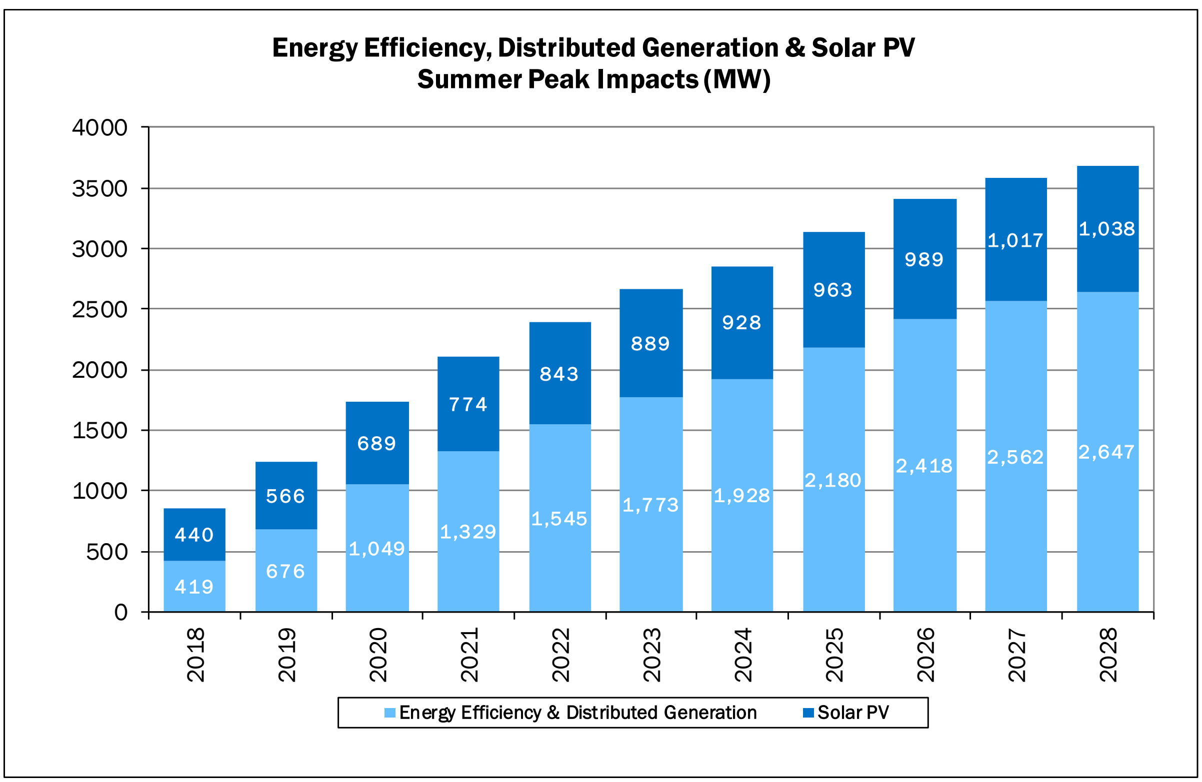


Figure 9: 2018 Energy Efficiency, Distributed Generation and Behind-the-Meter Solar PV – Summer Peak Forecast



In the 2018 RNA, the NYISO uses the baseline forecast adding behind-the-meter solar PV back in to conduct the resource adequacy base case. The purpose of using that baseline forecast as the load forecast is to properly account for the uncertainty in the load forecast resulting from solar PV as an intermittent resource. The load shapes used in the study were adjusted consistent with the NYISO's past practice from the historic shape to a shape that meets the forecasted criteria of 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 criteria of the baseline forecast. Discretely modeling behind-the-meter solar PV as a resource also offers the benefit of being able to adjust the amount of resource available across the system. To model the behind-the-meter forecasted solar PV in the GE-MARS model, 8,760 hourly shapes are created by using NREL's PV Watt[2] tool. The shapes are applied during the load adjustment to account for their impact on both on-peak and off-peak hours. GE-MARS will randomly select a daily shape from the current month for each day of each month of each replication.

Figure 10: Forecast of Solar PV BTM Reductions in Coincident Summer Peak Demand (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2018	23	17	41	3	25	58	75	8	12	54	124	440
2019	30	25	57	4	34	69	99	10	15	68	155	566
2020	39	33	75	6	45	80	122	11	17	81	180	689
2021	46	38	88	7	52	87	140	12	18	91	195	774
2022	52	42	99	8	58	93	155	12	20	100	204	843
2023	56	45	106	9	62	98	167	13	21	107	205	889
2024	60	47	113	9	66	102	178	13	22	112	206	928
2025	63	50	118	10	69	106	186	14	23	117	207	963
2026	65	51	122	10	72	108	194	14	23	121	209	989
2027	68	53	126	11	74	111	201	15	24	124	210	1,017
2028	70	54	130	11	76	113	207	15	24	127	211	1,038

Forecast of Special Case Resources

The 2018 RNA Special Case Resource[3] (SCR) MW levels are based on the 2018 Gold Book value of 1,219 MW, adjusted for their performance for the resource adequacy evaluations. Transmission security analysis, which evaluates normal transfer criteria, does not consider SCRs.

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

[3] SCR (*Section 2.19 of Market Services Tariff*): 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 the ISO Services Tariff and related ISO Procedures, in order to facilitate their participation in the Installed Capacity market as Installed Capacity Suppliers.

Resource Additions and Removals

Since the 2016 RNA assumptions, resources have been added to the system, some mothball notices have been withdrawn and the associated facilities have returned to the system, and some resources have been removed from the 2018 RNA Base Case:

- A total of approximately 1,600 MW of proposed generation has been added to the 2018 RNA Base Case as compared with the 2016 RNA.
- A total of approximately 1,150 MW of generation has been removed as compared with the 2016 RNA Base Case because these units are currently in a deactivation state (*e.g.,* retired, mothballed, or in an ICAP-Ineligible Forced Outage, or proposed to retire or mothball).

The comparison of generation status between the 2016 RNA and 2018 RNA is detailed in Figure 11 and Figure 12 on the next page. The MW values represent the Capacity Resources Interconnection Service (CRIS) MW values from the 2018 Gold Book.

In addition to the projects that met the 2018 RNA inclusion rules (listed in Figure 11), 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 currently ongoing Class Year 2017 Facilities Study, or are candidates for future interconnection facilities studies. These projects are listed in the Gold Book 2018 and also in Figure 13 and Figure 14.

Figure 11: Proposed Projects Included in the 2018 RNA Base Case

Queue #	Project Name	Zone	CRIS Request	SP MW	Interconnection Status	Included in RNA Base Case From Beginning of
Proposed Transmission Additions, other than Local Transmission Owner Plans (LTPs)						
530	Western NY PPTPP Empire State Line	Regulated Transmission Solutions	n/a/	n/a	TIP Facility Study	Study Year 4
SDU	Leeds-Hurley SDU	System Deliverability Upgrades (SDU)	n/a	n/a	SDU triggered for construction in CY11	Study Year 2
Proposed Generation Additions						
251	CPV Valley Energy Center[1]	G	680.0	677.6	CY11	Study Year 1
349	Taylor Biomass	G	19.0	19.0	CY11	Study Year 3
395	Copenhagen Wind	E	79.9	79.9	CY15	Study Year 1
403	Bethlehem Energy Center Uprate	F	78.1	72.0	CY15	Study Year 1
387	Cassadaga Wind	A	126.0	126.0	CY17	Study Year 2
421	Arkwright Summit	A	78.4	78.0	CY17	Study Year 1
444	Cricket Valley Energy Center II	G	1020.0	1020.0	CY17	Study Year 2
461	East River 1 Uprate	J	n/a	2.0	CY17	Study Year 1
462	East River 2 Uprate	J	n/a	2.0	CY17	Study Year 1
467	Shoreham Solar	K	24.9	25.0	CY17	Study Year 1
510	Bayonne Energy Center II	J	120.4	120.4	CY17	Study Year 1
511	Ogdensburg	E	79.0	79.0	CY17	Study Year 1
N/A	Nine Mile Point 2	C	63.4	63.4	CY17 (CRIS only)	Study Year 1
N/A	East River 6	J	8.0	N/A	CY17 (CRIS only)	Study Year 1
MW additions from 2016 RNA			1,598	1,588		
Total MW gen. additions			2,377	2,364		

Also included in the 2016 RNA

Notes:

1. On August 1, 2018, the New York State Department of Environmental Conservation (DEC) denied the January 2018 application of Competitive Power Ventures Valley Energy Center (CPV Valley) to renew its Air State Facility (ASF) permit for the reasons set forth in the DEC's letter. Subsequently, Supreme Court, Albany County, issued a Temporary Restraining Order regarding the DEC's determination. The NYISO will continue to monitor the status of the CPV Valley facility.

Figure 12: 2018 RNA Generation Deactivations Assumptions

Owner/Operator	Plant Name	Zone	CRIS	2018 RNA Base Case	2016 RNA Base Case
Helix Ravenswood LLC	Ravenswood 04	J	15.2	out	out
	Ravenswood 05	J	15.7	out	out
	Ravenswood 06	J	16.7	out	out
International Paper Company	Ticonderoga	F	7.6	part of the SCR program	in
Niagara Generation LLC	Niagara Bio-Gen	A	50.5	out	out
NRG Power Marketing LLC	Dunkirk 2	A	97.2	out	out
	Huntley 67	A	196.5	out	out
	Huntley 68	A	198.0	out	out
	Astoria GT 05	J	16.0	out	out
	Astoria GT 07	J	15.5	out	out
	Astoria GT 08	J	15.3	out	out
	Astoria GT 10	J	24.9	out	out
	Astoria GT 11	J	23.6	out	out
	Astoria GT 12	J	22.7	out	out
	Astoria GT 13	J	24.0	out	out
ReEnergy Black River LLC	Chateaugay Power	D	18.6	out	out
Binghamton BOP, LLC	Binghamton	C	43.8	out	in
Helix Ravenswood, LLC	Ravenswood 09	J	21.7	out	in
Entergy Nuclear Power Marketing, LLC	Indian Point 2	H	1027.0	out	in
	Indian Point 3	H	1040.0	out	in
Selkirk Cogen Partners, LP	Selkirk 1	F	82.1	out	in
	Selkirk 2	F	291.3	out	in
J- Power USA Generation, LP Edgewood Energy, LLC	PPL Pilgrim ST GT1	K	45.6	out	in
	PPL Pilgrim ST GT2	K	46.2		
Helix Ravenswood, LLC	Ravenswood 2-1	J	40.4	out	in
	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		
Lyonsdale Biomass, LLC	Lyonsdale (Burrows)	E	20.2	out	in
R.E. Ginna Nuclear Power Plant, LLC	Ginna	B	582.0	in	out
Cayuga Operating Company, LLC	Cayuga 1	C	154.1	in	out
	Cayuga 2	C	154.7	in	out
Entergy Nuclear Power Marketing LLC	Fitzpatrick 1	C	858.9	in	out
change in status	Changes in deactivations since 2016 RPP		1,147		
	Total 2018 RNA MW assumed as deactivated		3,647		

Figure 13: Additional Proposed Generation Projects from the 2018 Gold Book

Queue	Owner/Operator	Proposed Generation Project Name	Zone	Proposed Date*	Requested CRIS (MW)	Summer (MW)
Completed Class Year Facilities Study						
251	CPV Valley, LLC	CPV Valley Energy Center	G	Feb-18	680.0	677.6
395	Copenhagen Wind Farm, LLC	Copenhagen Wind	E	Nov-18	79.9	79.9
349	Taylor Biomass Energy Montgomery, LLC	Taylor Biomass	G	Apr-21	19.0	19.0
Class Year 2017						
511	AG Energy, LP	Ogdensburg	E	May-18	79.0	79.0
467	Shoreham Solar Commons LLC	Shoreham Solar	K	Jun-18	24.9	25.0
421	EDP Renewables North America	Arkwright Summit	A	Oct-18	78.4	78.4
422	NextEra Energy Resources, LLC	Eight Point Wind Energy Center	B	Dec-18	101.2	101.2
505	RES America Development Inc.	Ball Hill Wind	A	Dec-18	100.0	100.0
387	Cassadaga Wind, LLC	Cassadaga Wind	A	Dec-19	126.0	126.0
396	Baron Winds, LLC	Baron Winds	C	Dec-19	300.0	300.0
468	Apex Clean Energy LLC	Galloo Island Wind	C	Dec-19	108.9	110.4
444	Cricket Valley Energy Center, LLC	Cricket Valley Energy Center II	G	Jan-20	1020.0	1020.0
523	Dunkirk Power, LLC	Dunkirk Unit 2	A	Apr-20	85.0	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
494	Alabama Ledge Wind Farm LLC	Alabama Ledge Wind	A	Oct-20	79.8	79.8
498	ESC Tioga County Power, LLC	Tioga County Power	C	May-21	550.0	550.0
393	NRG Berrians East Development, LLC	Berrians East Replacement	J	Jun-22	508.0	508.0
Class Year 2017 CRIS Requests						
430	HQUS	Cedar Rapids Transmission Upgrade	D	N/A	80.0	N/A
	LI Energy Storage System, LLC	Montauk Battery Storage	K	N/A	5.0	N/A
	LI Energy Storage System, LLC	East Hampton Battery Storage	K	N/A	5.0	N/A
	ConEd	East River 6	J	fall 2017 (target end CY17)	8.0	N/A
477	Riverhead Solar Farm, LLC	Riverhead Solar	K	N/A	20.0	N/A
	Nine Mile Point Nuclear Station, LLC	Nine Mile Point Unit 2	C	fall 2017 (target end CY17)	63.4	N/A
	East Coast Power, LLC	Linden Cogen	J	N/A	37.2	N/A
Other Non Class Year Generators						
513	Stoney Creek Energy, LLC	Orangeville	C	Mar-18	0.0	20.0
477	Riverhead Solar Farm, LLC	Riverhead Solar	K	Oct-18	N/A	20.0
N/A	Cubit Power One Inc.	Arthur Kill Cogen	J	Apr-18	N/A	11.1
Future Class Year Candidates						
276	Air Energie TCI, Inc.	Crown City Wind	C	Dec-18	TBD	90.0
495	Mohawk Solar LLC	Mohawk Solar	F	Dec-18	TBD	98.0
514	RES America Developments Inc.	Empire Wind	F	Oct-19	TBD	120.0
449	Stockbridge Wind, LLC	Stockbridge Wind	E	Dec-19	TBD	72.6
347	Franklin Wind Farm, LLC	Franklin Wind	E	Dec-19	TBD	50.4
519	Canisteo Wind Energy LLC	Canisteo Wind	C	Dec-19	TBD	290.7
531	Invenergy Wind Development LLC	Number 3 Wind	E	Dec-19	TBD	105.8
382	Astoria Generating Co.	South Pier Improvement	J	Jun-20	TBD	91.2

Queue	Owner/Operator	Proposed Generation Project Name	Zone	Proposed Date*	Requested CRIS (MW)	Summer (MW)
Future Class Year Candidates						
445	Lighthouse Wind, LLC	Lighthouse Wind	A	Dec-20	TBD	201.3
372	Dry Lots Wind, LLC	Dry Lots Wind	E	Dec-20	TBD	33.0
371	South Mountain Wind, LLC	South Mountain Wind	E	Dec-20	TBD	18.0
526	Atlantic Wind, LLC	North Ridge Wind	E	Dec-20	TBD	100.0
361	US PowerGen Co.	Luyster Creek Energy	J	Jun-21	TBD	401.0
474	EDP Renewables North America	North Slope Wind	D	Oct-21	TBD	200.0
466	Atlantic Wind, LLC	Bone Run Wind	A	Dec-21	TBD	132.0
383	NRG Energy, Inc.	Bowline Gen. Station Unit #3	G	Jun-22	TBD	775.0
Proposed Generation Re-ratings - Incremental MW Capability						
461	Consolidated Edison Co. of NY, Inc.	East River 1 Uprate	J	IS	0.0	2.0
462	Consolidated Edison Co. of NY, Inc.	East River 2 Uprate	J	IS	0.0	2.0
403	PSEG Power New York	Bethlehem Energy Center	F	2017-2019	78.1	72.0
510	Bayonne Energy Center	Bayonne Energy Center II	J	2018/03	TBD	120.4
512	Northbrook Lyons Falls	Lyons Falls Mill Hydro	E	2018/03	0.0	2.5
338	Rochester Gas & Electric Corp	Station 2	B	2018/09	0.0	6.3
401	Caithness Long Island II, LLC	Caithness Long Island II	K	2019/05	TBD	599.0
516	East Coast Power LLC	Linden Cogen Uprate	J	2020/05	TBD	234.4
in 2018 RNA		Total Gold Book MW not included in the 2018 RNA Base Case				6,336
in 2016 RNA						

* at the time of the study

Figure 14: Additional Proposed Transmission Projects from the 2018 Gold Book

Queue	Owner	Terminals	
Proposed Merchant Transmission Projects			
358	West Point Partners	Leeds 345kV	Buchanan North 345kV
458	Transmission Developers Inc.	Hertel 735kV (Quebec)	Astoria Annex 345kV
363	Poseidon Transmission , LLC	Deans 500kV (PJM)	Ruland Road 138kV
Proposed TIP Projects (included in FERC 715 Base Case)			
430	H.Q. Energy Services U.S. Inc.	Alcoa 115kV	Dennison 115kV
545A	Empire State Line Project	Dysinger & East Stolle Stations	summer 2022
in the 2018 RNA			

Local Transmission Plans

As part of the NYISO's Local Transmission Planning Process (LTPP), TOs present their LTPs to the NYISO and stakeholders during ESPWG and TPAS meetings. The firm transmission plans presented in the TO LTPs and that were reported as firm in the 2018 Gold Book are included in the 2018 RNA Base Case. A summary of these projects are reported in **Appendix D** of this report. LIPA presented a firm LTP update to address the Reliability Need that was found in year 10 at the June 28 joint ESPWG/TPAS meeting. The LTP includes increasing the ratings on the Brookhaven to Edwards Ave 138 kV line.

Bulk Transmission Projects

The notable bulk transmission project that met the inclusion rules and is modeled in the 2018 RNA Base Case is the Western New York Public Policy Project – Empire State Line Project that was selected by the NYISO Board in October 2017. This project includes a new 345 kV circuit and phase angle regulator (PAR) that will alleviate constraints in the Niagara area. The proposed in service date for this project is Summer 2022.

Base Case Peak Load and Resources Summaries

The 2018 RNA's resource adequacy base case modeled as resources the existing generation adjusted for the unit retirements, mothballing, and proposals to retire or mothball announced as of April 4, 2018, along with the new resource additions that met the base case inclusion rules set forth in Section 3 of the RPP Manual. This capacity is summarized in Figure 15 on the next page, along with the baseline peak load, capacity net purchases and the SCRs.

Figure 15: NYCA Peak Load and Resources 2019 through 2028

Year		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
		Peak Load (MW) -Gold Book 2018 NYCA Baseline									
	NYCA*	32,857	32,629	32,451	32,339	32,284	32,276	32,299	32,343	32,403	32,469
	Zone J*	11,474	11,410	11,363	11,336	11,328	11,335	11,350	11,372	11,399	11,429
	Zone K*	5,323	5,278	5,246	5,231	5,229	5,237	5,251	5,268	5,287	5,306
	Zone G-J*	15,815	15,715	15,639	15,594	15,574	15,576	15,591	15,616	15,648	15,685
		Resources (MW)									
NYCA	Capacity**	39,230	39,358	38,339	38,339	38,339	38,339	38,339	38,339	38,339	38,339
	Net Purchases & Sales	1,279	1,785	1,800	1,942	1,942	1,942	1,942	1,942	1,942	1,942
	SCR	1,219	1,219	1,219	1,219	1,219	1,219	1,219	1,219	1,219	1,219
	Total Resources	41,728	42,362	41,358	41,500	41,500	41,500	41,500	41,500	41,500	41,500
	Capacity/Load Ratio	119.4%	120.6%	118.1%	118.6%	118.8%	118.8%	118.7%	118.5%	118.3%	118.1%
	Cap+NetPurch/Load Ratio	123.3%	126.1%	123.7%	124.6%	124.8%	124.8%	124.7%	124.5%	124.3%	124.1%
	Cap+NetPurch+SCR/Load Ratio	127.0%	129.8%	127.4%	128.3%	128.5%	128.6%	128.5%	128.3%	128.1%	127.8%
Zone J	Capacity**	9,562	9,562	9,562	9,562	9,562	9,562	9,562	9,562	9,562	9,562
	Cap+UDR+SCR/Load Ratio	95.2%	95.8%	96.2%	96.4%	96.5%	96.4%	96.3%	96.1%	95.9%	95.6%
Zone K	Capacity**	5,220	5,220	5,220	5,220	5,220	5,220	5,220	5,220	5,220	5,220
	Cap+UDR+SCR/Load Ratio	117.6%	118.6%	119.3%	119.6%	119.7%	119.5%	119.2%	118.8%	118.4%	117.9%
Zone G-J	Capacity**	15,371	15,373	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354
	Cap+UDR+SCR/Load Ratio	106.4%	107.1%	101.1%	101.3%	101.5%	101.5%	101.4%	101.2%	101.0%	100.8%

Legend:

*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 G-J coincident peak, which is non-coincident with NYCA.

**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 reflect the awarded UDRs for those capacity zones.

Notes:

- SCR: forecasted MW ICAP value from the 2018 Gold Book.
- Wind generator summer capacity is counted as 100% of nameplate rating.
- The MW load in this table is the Gold Book baseline load (*e.g.*, reflects expected reduction related with the projected behind-the-meter solar photovoltaic, energy efficiency programs, building codes and standards, distributed energy resources

As shown in the Figure 15, the total NYCA capacity margin (defined as capacity above the baseline load forecast) varies between 27.0 % in 2019 (year 1), 28.5 % in 2023 (year 5), and 27.8 % in 2028 (year 10). For relative comparison purposes, these percentages are significantly above the required 18.2 % NYCA Installed Reserve Margin (IRM) for the 2018-2019 Capability Year.

Figure 16 below shows in a different way the relative increase in the capacity margin, by comparing the details of the capacity margins for year 5 (2023) between the 2018 RNA and the 2016 RNA:

1. The 2018 RNA NYCA baseline load forecast is 1,464 MW lower;
2. The NYCA capacity resources are 353 MW higher; and
3. This increase in net resources contributes to an 1,817 MW increase in the net margin as compared with the 2016 RNA.

Figure 16: Load and Resources Comparison of Year 2023 (MW)

Year 2023	2018 RNA	2016 RNA	Delta
Baseline Load	32,284	33,748	-1,464
Total Resources*	41,500	41,147	353
Net Margin: Change in (netCapacity - netLoad)			1,817

Note: * Total Resources include net purchases and sales and the Special Case Resources as shown in Figure 15.

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 adequacy of the system, subject to the security constraints. The transmission adequacy and the resource adequacy assessments are performed together.

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, explicitly defined in the Reliability Criteria. The impacts when applying these design criteria contingencies are assessed to determine that no 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[4]" describes the methodology for that analysis.

The analysis for the transmission security assessment is conducted in accordance with NERC

[4] Attachment I of Transmission, Expansion and Interconnection Manual

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.

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 analysis evaluates 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.

The process of N-1-0 and N-1-1 testing allows for corrective actions including generator re-dispatch, PAR adjustments, and HVDC adjustments between the first and second contingency. 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 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. 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 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.

Reliability Needs Assessment

Overview

Reliability is defined and measured using the security and adequacy concepts described in the "RNA Base Case Assumptions, Drivers, and Methodology" section. This study evaluates the resource adequacy and transmission system adequacy and security of the New York BPTF over a ten-year Study Period. Through the RNA, the NYISO identifies Reliability Needs in accordance with applicable Reliability Criteria. Violations of this criterion are translated into MW or MVAR amounts to quantify the Reliability Need.

Reliability Needs for Base Case

Below are the principal findings of the 2018 RNA applicable to the Base Case conditions for the Study Period including: transmission security assessment (steady state, stability and short circuit assessment); resource and transmission adequacy assessment; system stability assessments; and scenario analyses.

Transmission Security Assessment

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, which the NYISO filed with FERC on April 1, 2018.

For the 2018 RNA transmission security assessment, the preliminary transmission security analysis only identified one transmission security violation (*i.e.,* preliminary Reliability Need) for the Study Period. The preliminary Reliability Need identified was in eastern Long Island. This preliminary Reliability Need is generally driven by LIPA load growth in eastern Long Island under the identified N-1-0 condition which is where the system is restored to normal limits following an event. The year of need is year 10 (2028) of the Study Period and the eastern Long Island overload is approximately 1%. Figure 17 depicts the region impacted by the transmission security constraint. The red X in the Figure 17 in the next page shows the contingency and the red arrow shows the overload. At the June 28 ESPWG/TPAS meeting, LIPA presented a firm LTP update to address this preliminary Reliability Need. The LTP includes increasing the ratings on the Brookhaven to Edwards Ave 138 kV line. With this increase in rating, the overload is resolved and no Reliability Need is identified by this evaluation.

Figure 17: Approximate Area of Preliminary Transmission Security Need

The transmission security assessment also observed thermal violations in year 1 (2019); however, these overloads are not considered Reliability Needs since responsible TOs have LTPs identified in the 2018 Gold Book and will use interim operating procedures to maintain the security of the system until the LTP is placed in-service. Details of the 2019 thermal violations are provided below:

- Starting in 2019 (year 1), the N-1-1 analysis shows overloads in Central New York on the National Grid (NGrid) Clay-Teall (#10) 115 kV and Clay-Dewitt (#3) 115 kV lines. These overloads were also identified in the 2016 RNA. In its LTP, National Grid plans to reconductor these circuits by Winter 2020. In the interim, operating procedures will be used to maintain the security of the system.

- Starting in 2019 (year 1), the N-1-1 analysis shows an overload on the Orange and Rockland Utilities (O&R) West Haverstraw 345/138 kV transformer. In its LTP, O&R plans to install a new transformer source (Lovett 345kV/138kV station) by Summer 2021. In the interim, operating procedures will be used to maintain the security of the system.

Short Circuit Assessment

The required performance of the 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 2023 (year 5), reflecting the study conditions outlined in this "RNA Base Case Assumptions, Drivers, and Methodology" section. The calculated fault levels will 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.

System Stability Assessment

The 2016 NYISO Intermediate Area Transmission Review, which evaluated 2021, includes stability assessments. Additionally, the Indian Point Generator Deactivation Assessment, which was completed in December 2017, evaluated stability for year 2023. The stability analyses were all conducted in conformance with the applicable NERC standards, NPCC criteria, and NYSRC Reliability Rules. These analyses found no stability criteria violations.

Resource Adequacy Assessment

The NYISO conducts its resource adequacy analysis using the GE-MARS software package, which performs a probabilistic simulation of outages of capacity and select transmission resources. The NYISO models the transmission system in GE-MARS using interface transfer limits applied to the connections between the GE-MARS areas.

The emergency criteria transfer limits used in the GE-MARS model were developed from an assessment of analysis of the 2018 RNA power flow base case, and analysis performed for other studies. Figure 18, Figure 19 and Figure 20on next page provide the thermal and voltage emergency transfer limits for the major NYCA interfaces. The 2016 RNA transfer limits are presented for comparison purposes.

Figure 18: Transmission System Thermal Emergency Transfer Limits

Interface	2018 RNA study						2016 RNA study		
	2019	2020	2021	2022	2023	2028	2019	2020	2021
Dysinger East	*1700*	*1700*	*1700*	*2300*	2300	same as 2023	1700	1700	1700
Central East MARS	*4450*	*4450*	*4450*	*4450*	4450	same as 2023	4475	4475	4475
E to G (Marcy South)	*2275*	*2275*	*2275*	*2275*	2275	same as 2023	2275	2275	2275
F to G	*3475*	*3475*	*3475*	*3475*	3475	same as 2023	3475	3475	3475
UPNY-SENY MARS	*5500*	*5600*	*5600*	*5600*	5600	same as 2023	5600	5600	5600
I to J	*4400*	*4400*	*4400*	*4400*	4400	same as 2023	4400	4400	4400
I to K (Y49/Y50)	*1293*	*1293*	*1293*	*1293*	1293	same as 2023	1190	1190	1190

Notes: Grey italic font: Limit was not calculated

Figure 19: Transmission System Voltage Emergency Transfer Limits

Interface	2018 RNA study						2016 RNA study		
	2019	2020	2021	2022	2023	2028	2019	2020	2021
Dysinger East	*2125*	*2125*	*2800*	*2900*	2900	same as 2023	2125	2800	2800
Central East MARS	*3100*	*3100*	*3100*	*3100*	3100	same as 2023	3050	3050	3050
Central East Group	*5000*	*5000*	*5000*	*5000*	5000	same as 2023	4925	4925	4925
UPNY-ConEd	*5750*	*5750*	*6250*	*6250*	6250	same as 2023	5750	5750	5750
I to J & K	*5600*	*5600*	*5600*	*5600*	5600	same as 2023	5600	5600	5600

Note:

Grey italic font: Limit was not calculated

Figure 20: Transmission System Base Case Emergency Transfer Limits

Interface	2018 RNA study											2016 RNA study					
	2019		2020		2021		2022		2023		2028	2019		2020		2021	
Dysinger East	*1700*	*T*	*1700*	*T*	*1700*	*T*	*2300*	*T*	2300	T	same as 2023	1700	T	1700	T	1700	T
Central East MARS	*3100*	*V*	*3100*	*V*	*3100*	*V*	*3100*	*V*	3100	V	same as 2023	3050	V	3050	V	3050	V
Central East Group	*5000*	*V*	*5000*	*V*	*5000*	*V*	*5000*	*V*	5000	V	same as 2023	4925	V	4925	V	4925	V
E to G (Marcy South)	*2275*	*T*	*2275*	*T*	*2275*	*T*	*2275*	*T*	2275	T	same as 2023	2275	T	2275	T	2275	T
F to G	*3475*	*T*	*3475*	*T*	*3475*	*T*	*3475*	*T*	3475	T	same as 2023	3475	T	3475	T	3475	T
UPNY-SENY MARS	*5500*	*T*	*5600*	*T*	*5600*	*T*	*5600*	*T*	5600	T	same as 2023	5600	T	5600	T	5600	T
I to J	*4400*	*T*	*4400*	*T*	*4400*	*T*	*4400*	*T*	4400	T	same as 2023	4400	T	4400	T	4400	T
I to K (Y49/Y50)	*1293*	*T*	*1293*	*T*	*1293*	*T*	*1293*	*T*	1293	T	same as 2023	1190	T	1190	T	1190	T
I to J & K	*5600*	*C*	*5600*	*C*	*5600*	*C*	*5600*	*C*	5600	C	same as 2023	5590	T	5590	T	5590	T

Notes:

T - Thermal, V - Voltage, C – Combined

Limit was not calculated

The Dysinger East limit increases by 600 MW in study year 2022 for the 2018 RNA. The primary cause for increasing the limit is the inclusion of the Western NY Public Policy Transmission Project in the planned system.

The Dysinger East voltage limit increases significantly in 2021. The primary cause is the addition of the

Station 255 project in Zone B, which includes two new 345/115 kV transformers and a new 345 kV line section from Station 255 to Station 80. However, this increase in the voltage limit does not impact the GE-MARS topology since the thermal transfer limit is more constraining throughout the Study Period.

The Central East GE-MARS and Central East Group interfaces increased 50 MW and 75 MW, respectively, due to cancellation of the proposed retirement of the FitzPatrick unit, which was modeled in the 2016 RNA.

Beginning in study year 2020 a series of dynamic limit tables is used to control flow on the UPNY-SENY interface. In study year 2019 the NYISO implemented the same formulaic model that was used in the 2016 RNA. Replacing the formulaic model for UPNY-SENY is necessary to capture the impact that the Cricket Valley project, which is planned to enter into service by 2020, will have on the UPNY-SENY transfer limit. The model was developed to respect the unique impacts that three generation plants (Athens, CPV Valley, Cricket Valley) have on the UPNY-SENY transfer limit. The dynamic limits table feature in GE-MARS allows for the application of a specific transfer limit based on specific commitment statuses of the generators at those plants. A table of the limits used in the new model can be found on **Figure 14 of Appendix D** of this report.

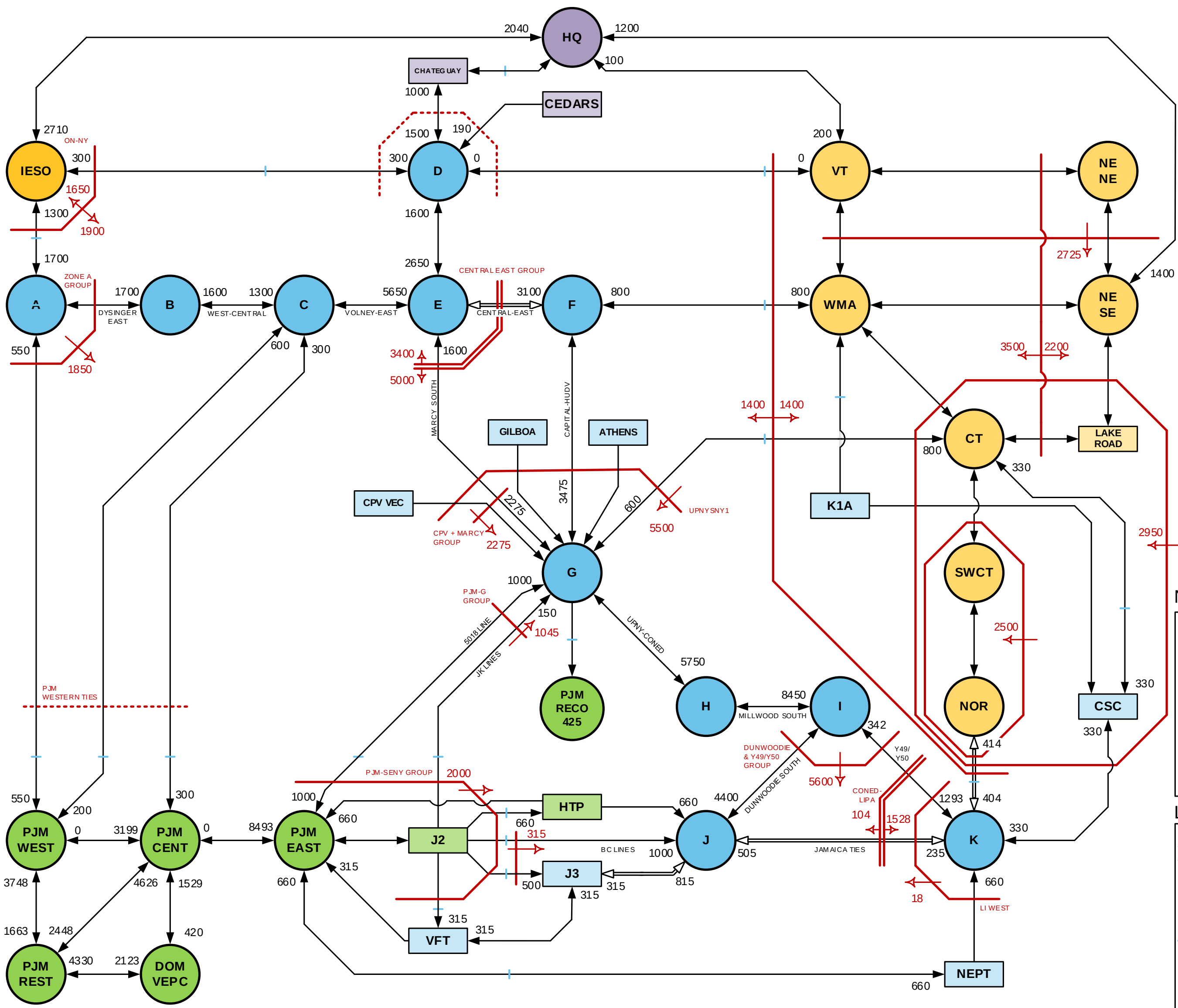
The UPNY-Con Ed voltage limit increases by 500 MW in year 2021 of the 2018 RNA. The primary cause of this increase is the retirement of the Indian Point Energy Center.

The I to K (Y49/Y50) interface limit increases by 103 MW from the previous RNA. This increase was the result of a change in the rating of the facility that was limiting in the 2016 RNA, Shore Road – Glenwood South 138 kV.

The topology used in the GE-MARS model for the 2018 RNA Base Case is represented in Figure 21, Figure 22, Figure 23 and Figure 24 on the next pages. Figure 21 represents the RNA topology for Study Year 2019. Figure 22 represents the RNA topology for the Study Year 2020 when Cricket Valley Energy Center was assumed in service. Figure 23 represents the RNA topology for Study Year 2021 when Indian Point Energy Center Units 2 and 3 are assumed fully retired.

Figure 24 represents RNA topology for Study Years starting 2022 through 2028 when the Western New York Public Policy Transmission Project is assumed in service. The modeled internal transfer limits are summer period emergency transfer criteria transfer limits developed from analysis of the RNA power flow cases. The NYISO derived the external interface transfer limits from the NPCC CP-8 Summer Assessment GE-MARS database with changes based upon the RNA Base Case assumptions.

Figure 21: 2018 RNA Topology Year 1 (2019)



Notes

1. PJM to NY emergency assistance (EA) assumption for calculating the PJM-NY Western ties, PJM-G Group, and ABC Line Group flow distribution limit: 1500MW

2. NYCA EA simultaneous import limit: 3,500 MW

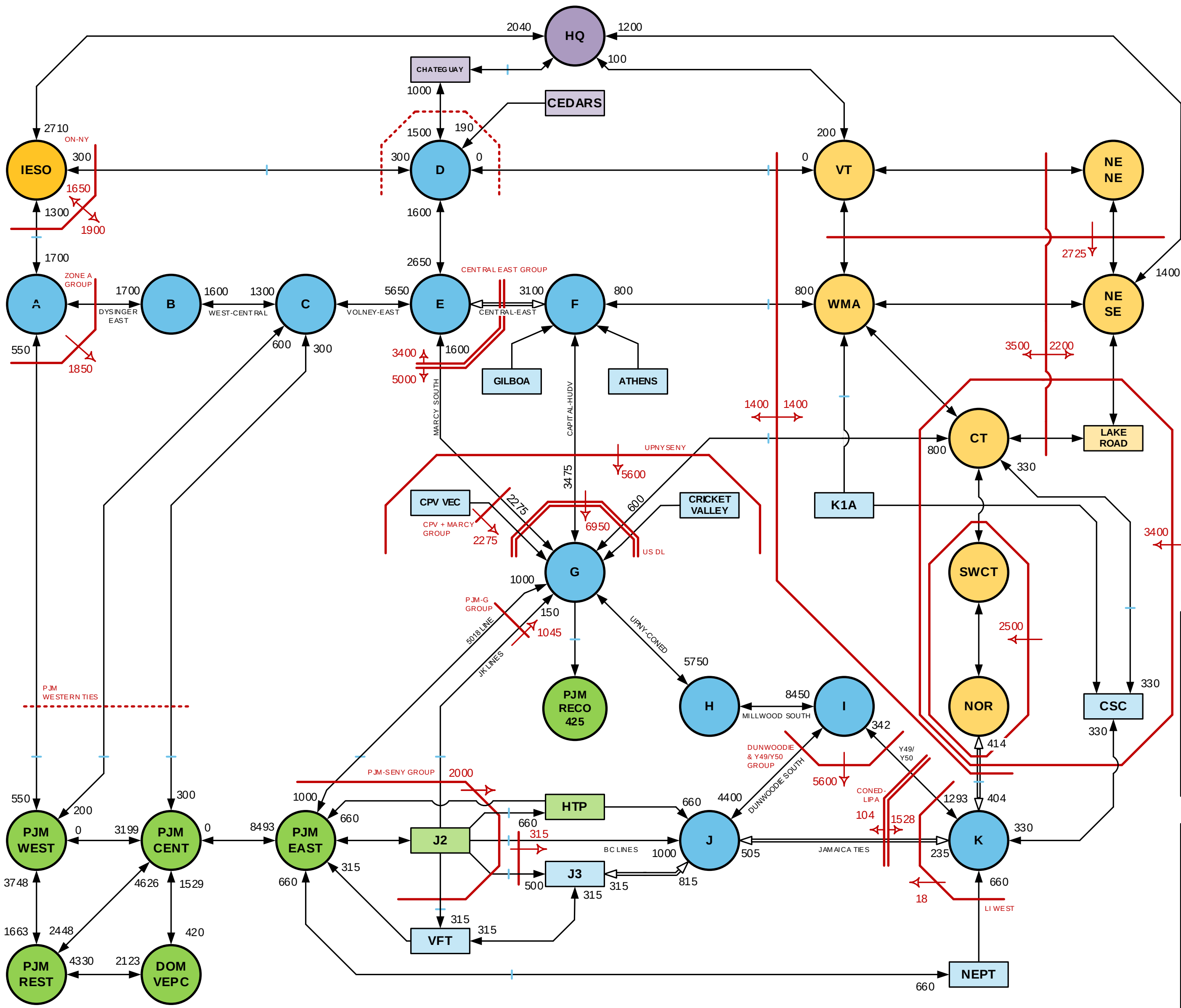
3. External areas representation based upon information received from the NPCC CP-8 WG

Legend

- Interface
- Unidirectional Interface
- Interface w/ Dynamic Ratings
- Interface Group
- Interface Group w/ Dynamic Ratings
- Monitoring Interface Group
- NYCA EA Interface Group Marker
- xx "Dummy Bubble"

NOTE: An interface is considered to not have a MW limitation if no number is specified

Figure 22: 2018 RNA Topology Year 2 (2020)



Notes

1. PJM to NY emergency assistance (EA) assumption for calculating the PJM-NY Western ties, PJM-G Group, and ABC Line Group flow distribution limit: 1500MW

2. NYCA EA simultaneous import limit: 3,500 MW

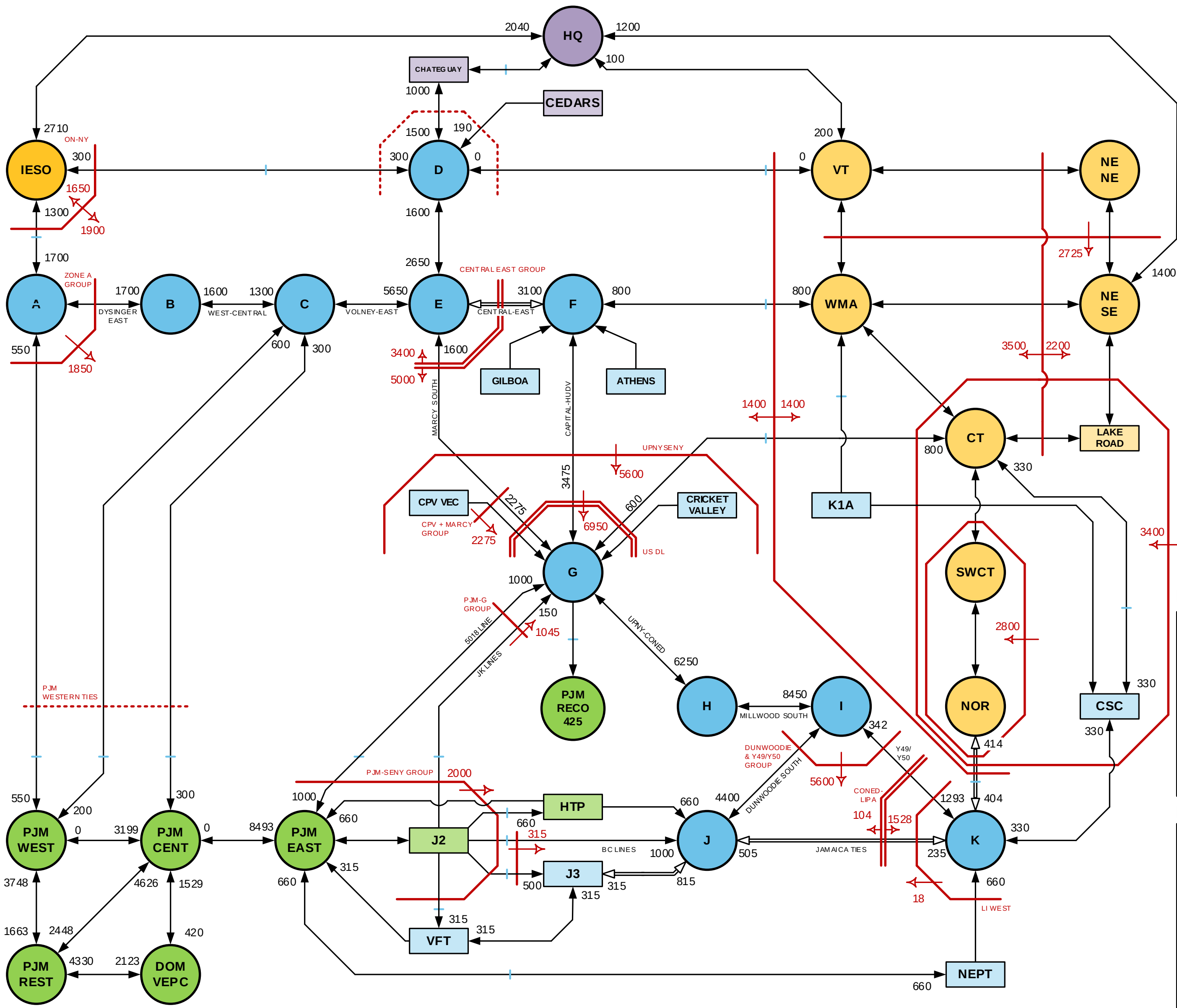
3. External areas representation based upon information received from the NPCC CP-8 WG

Legend

- Interface
- Unidirectional Interface
- Interface w/ Dynamic Ratings
- Interface Group
- Interface Group w/ Dynamic Ratings
- Monitoring Interface Group
- NYCA EA Interface Group Marker
- xx "Dummy Bubble"

NOTE: An interface is considered to not have a MW limitation if no number is specified

Figure 23: 2018 RNA Topology Year 3 (2021)



Notes

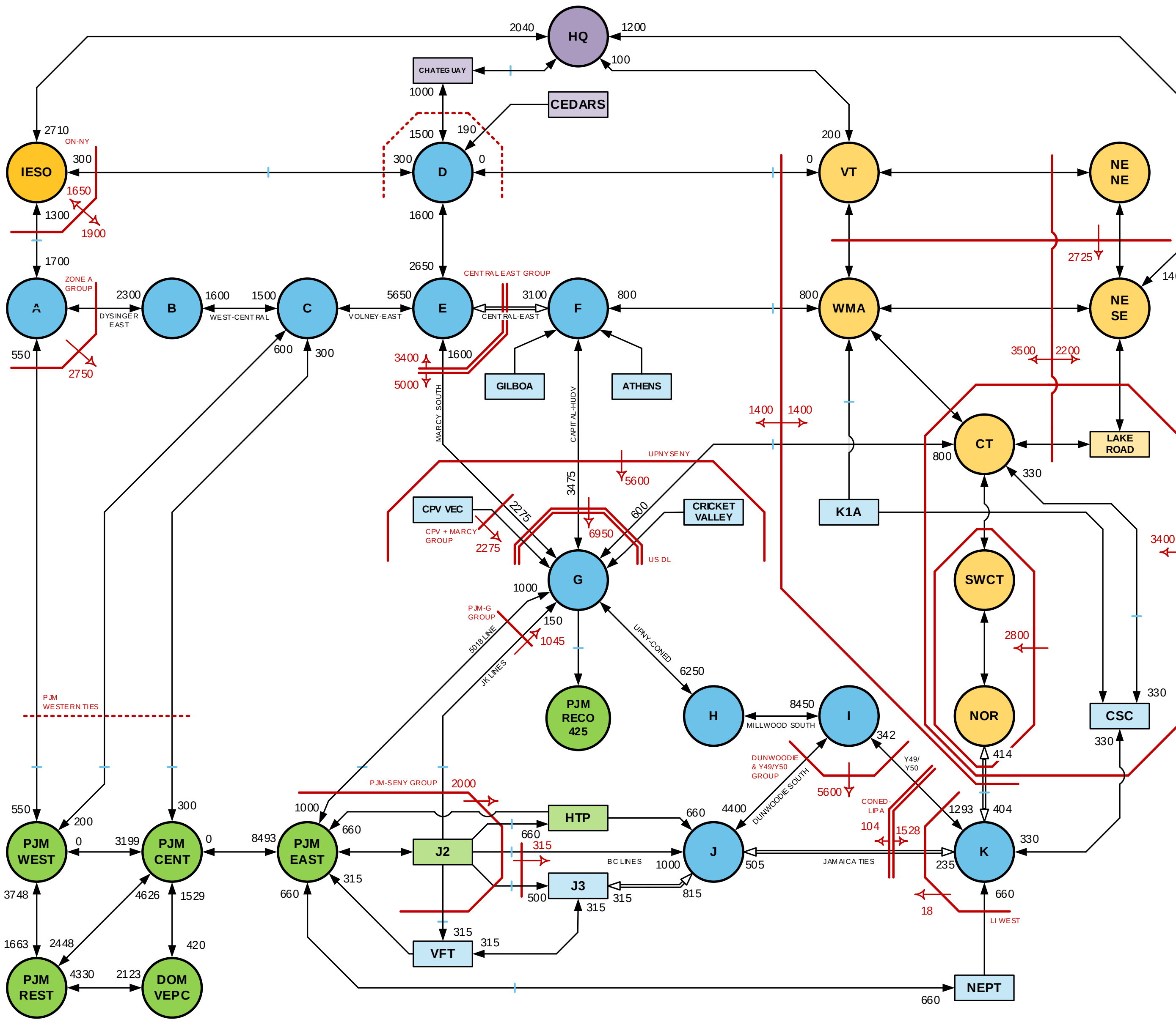
1. PJM to NY emergency assistance (EA) assumption for calculating the PJM-NY Western ties, PJM-G Group, and ABC Line Group flow distribution limit: 1500MW
2. NYCA EA simultaneous import limit: 3,500 MW
3. External areas representation based upon information received from the NPCC CP-8 WG

Legend

- Interface
- Unidirectional Interface
- Interface w/ Dynamic Ratings
- Interface Group
- Interface Group w/ Dynamic Ratings
- Monitoring Interface Group
- NYCA EA Interface Group Marker
- xx "Dummy Bubble"

NOTE: An interface is considered to not have a MW limitation if no number is specified

Figure 24: 2018 RNA Topology Year 4 through 10 (2022-28)



Notes

1. PJM to NY emergency assistance (EA) assumption for calculating the PJM-NY Western ties, PJM-G Group, and ABC Line Group flow distribution limit: 1500MW

2. NYCA EA simultaneous import limit: 3,500 MW

3. External areas representation based upon information received from the NPCC CP-8 WG

Legend

- Interface
- Unidirectional Interface
- Interface w/ Dynamic Ratings
- Interface Group
- Interface Group w/ Dynamic Ratings
- Monitoring Interface Group
- NYCA EA Interface Group Marker
- XX "Dummy Bubble"

NOTE: An interface is considered to not have a MW limitation if no number is specified

The results of the 2018 RNA Base Case resource adequacy studies show that the LOLE for the NYCA does not exceed the criterion of 0.1 days per year throughout the ten-year Study Period. The NYCA LOLE results are presented in Figure 25 below.

Figure 25: NYCA Resource Adequacy Measure (in LOLE)

2018 RNA Base Case Results	
Year	NYCA LOLE
2019	0.01
2020	0.00
2021	0.01
2022	0.01
2023	0.01
2024	0.01
2025	0.01
2026	0.01
2027	0.01
2028	0.01

The decrease in NYCA LOLE from 2019 to 2020 is mainly the result of the addition of the Cricket Valley Energy Center, while the increase from 2020 to 2021 is mainly the result of Indian Point assumed deactivation.

RNA Scenarios

Introduction

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 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. The NYISO evaluated the following scenarios as part of the 2018 RNA, with an identification of the type of assessment performed:

- High Load (Gold Book's topline – former econometric) Forecast Scenario – Resource Adequacy Only
- Zonal Capacity at Risk Scenario – Resource Adequacy Only
- AC Transmission Public Policy Transmission Needs – Transmission Security Only and contingent upon Reliability Needs identification in the RNA Base Case

Resource Adequacy Scenarios LOLE Results

The results of the resource adequacy scenarios are summarized in the following sections and in Figure 27 in the next page.

High Load (Topline) Forecast Scenario

The RNA Base Case forecast includes impacts (reductions) associated with projected energy reductions coming from statewide energy efficiency and BtM solar PV programs. The topline forecast scenario excludes these energy efficiency program impacts from the peak forecast, resulting in the higher forecast levels. The results are shown in Figure 4 from "Annual Energy and Summer Peak Demand Forecasts" section, with the delta shown in the Figure 26 on the next page. This results in a 3,685 MW higher peak load in 2028, as comparing with the Base Case forecast. Given that the peak load in the topline forecast is higher than the Base Case, the probability of violating the LOLE criterion increases and violations would occur starting in 2025. The results are in Figure 27.

Figure 26: High Load (Topline) vs. Baseline Summer Peak Forecast

Year	Topline Load	Baseline Load	Delta Topline - RNA Base Case
2019	34,099	32,857	1,242
2020	34,367	32,629	1,738
2021	34,554	32,451	2,103
2022	34,727	32,339	2,388
2023	34,946	32,284	2,662
2024	35,132	32,276	2,856
2025	35,442	32,299	3,143
2026	35,750	32,343	3,407
2027	35,982	32,403	3,579
2028	36,154	32,469	3,685

Figure 27: 2018 RNA Resource Adequacy Scenarios NYCA LOLE Results

Scenario	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Base Case	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
High Load Forecast	0.03	0.02	0.06	0.07	0.09	0.09	0.11	0.13	0.17	0.18

Zonal Capacity at Risk

The zonal capacity at risk 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.

The zonal capacity at risk analysis is summarized in Figure 28 on the next page.

Figure 28: 2018 RNA Zonal Capacity at Risk[5] (MW[6])

Load Zones	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Zone A	1,450	1,500	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,350
Zone B[1]	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR
Zone C	2,700	3,200	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,300
Zone D	1,900	1,900	1,900	1,850	1,850	1,850	1,850	1,850	1,850	1,800
Zone E[1]	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR
Zone F	2,700	3,200	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,300
Zone G	2,400	2,900	2,100	2,100	2,100	2,100	2,100	2,100	2,100	1,950
Zone H[1]	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR
Zone I[1]	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR
Zone J	1,400	1,500	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,100
Zone K	850	950	900	900	900	900	900	850	850	800

[1] EZR = Exceeds Zonal Resources

Zonal Groups	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Zones A-F	2,700	3,200	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,300
Zones G-I	2,400	2,950	2,100	2,100	2,100	2,100	2,100	2,100	2,100	1,950

5 Zonal "capacity at risk" refers to the amount of MW of zonal "perfect capacity" which, if lost, can lead to NYCA LOLE violations

6 This is "perfect capacity" which is capacity that is not derated (*e.g.*, due to ambient temperature or unit unavailability) and not tested for transmission security or interface impacts

Regulatory Policy Activities

Federal, state and local government regulatory programs may impact the operation and reliability of the BPTF. Compliance with state and federal regulatory initiatives and permitting requirements may require investment by the owners of New York's existing thermal power plants. If the owners of those plants have to make considerable investments, the cost of these investments could impact whether they remain available in the NYISO's markets and therefore potentially affect the reliability of the BPTF. The purpose of this section is to review the status of regulatory programs and their potential grid impacts. The following regulatory programs – each at various points in the development and implementation – are summarized on the next page:

PUBLIC POLICY INITIATIVE	POLICY GOAL	POLICYMAKING ENTITY	NY GRID RESOURCE IMPACTS
Clean Energy Standard (CES)	50% of energy consumed in New York State generated from renewable resources by **2030**.	New York State Public Service Commission (PSC) / New York State Energy Research and Development Authority (NYSERDA)	About **17,000 MW** of new, largely intermittent capacity to enter grid and markets.
New York City Residual Oil Elimination	Eliminate combustion of fuel oil numbers 6 and 4 in New York City by **2020 and 2025**, respectively.	New York City	About **3,000 MW** of installed capacity could be affected.
Offshore Wind Development	Develop 2,400 MW of offshore wind capacity by **2030.**	New York State Public Service Commission (PSC) / New York State Energy Research and Development Authority (NYSERDA)	As much as **2,400 MW** of new intermittent capacity interconnecting to the grid in southeastern New York by 2030.
Part 251: Carbon Dioxide Emissions Limits	Establish restrictions on carbon dioxide emissions for fossil fuel-fired facilities in New York by **2020**.	New York State Department of Environmental Conservation (DEC)	**1,000 MW** of coal-fired capacity expected to deactivate or re-power.
Regional Greenhouse Gas Initiative (RGGI)	Reduce carbon dioxide emissions cap by 30% from **2020 to 2030** and expand applicability to currently exempt "peaking units" below current 25 MW threshold.	New York and other RGGI states	**26,100 MW** of installed capacity participate in RGGI.
Smog-Forming Pollutants Rule Proposal	Reduce ozone-contributing pollutants associated with New York State-based peaking unit generation.	New York State Department of Environmental Conservation (DEC)	DEC proposal is under development. There is nearly **3,500 MW** of peaking unit capacity in New York State.
Storage Deployment Target	Reduce costs and install storage capacity by **2025.**	New York State Public Service Commission (PSC) / New York State Energy Research and Development Authority (NYSERDA) / New York Power Authority (NYPA)	Installation of **1,500 MW** of battery storage capacity.
U.S. Clean Water Act	Adoption of "Best Technology Available for Cooling Water Intake" to protect aquatic biota.	U.S. Environmental Protection Agency / New York State Department of Environmental Conservation (DEC)	**16,900 MW** of installed capacity must achieve compliance upon licensing renewal.

Clean Energy Standard

In August 2016, the New York State Public Service Commission (PSC) adopted a Clean Energy Standard (CES), requiring that 50% of the energy consumed in New York State be generated from renewable resources by 2030 (50-by-30 goal). Under the CES, electric utilities and others serving load in New York State are responsible for securing a defined percentage of the load they serve from eligible renewable and nuclear resources. The load serving entities will comply with the CES by either procuring qualifying credits or making alternative compliance payments.

In order to achieve the 50-by-30 goal, the PSC determined that approximately 70,500 GWh of total renewable energy will need to be generated by 2030 – including approximately 29,200 GWh of new renewable energy production in addition to existing levels of production at the time the order was adopted. Currently, the New York State Energy Research and Development Authority (NYSERDA) is offering long-term (20 year) contracts for Renewable Energy Credits (RECs) associated with eligible renewable resources, and administer the procurement of Zero-Emissions Credits (ZECs) associated with the generation from eligible nuclear plants.

New York City Residual Oil Elimination

New York City passed legislation in December 2017 that will prohibit the combustion of fuel oil Numbers 6 and 4 within the borders of New York City by 2020 and 2025, respectively. The rule is expected to impact the fuel of about 3,000 MW of generation in New York City. Many generators in New York City that are connected to the local gas distribution network are required by reliability rules to maintain alternative fuel combustion capabilities – most notably oil. The rule is intended to provide assurance that system reliability can be maintained in the event of gas supply interruptions during high demand periods. Typically, these interruptions occur in the winter months when gas is needed for heating.

These generators will need to decide whether to invest in the fuel storage, and handling equipment necessary 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 on an annual basis, it is often called upon to fuel generation during critical periods when severe cold weather limits access to natural gas and system demand is typically higher than normal for the season. Dual-fuel capability serves as both an important tool in meeting reliability, and as an effective economic hedge against high natural gas prices during periods of high demand for natural gas as a heating fuel.

Offshore Wind Development

In his January 2017 State of the State address, Governor Cuomo called for the development of up to 2,400 MW of offshore wind to be constructed by 2030. In his 2018 address, the Governor called for a solicitation for as much as 800 MW of offshore wind.

The NYISO has assessed a variety of scenarios to determine whether 2,400 MW of offshore wind production could be injected into the grid without thermal overloads. The NYISO's analysis concluded that it was feasible to accommodate the injection of 2,400 MW of offshore wind without overloading transmission lines and violating thermal reliability criteria. This assessment did not examine system upgrade costs or other interconnection costs that would likely be associated with reliably delivering new capacity on the grid. These types of issues will ultimately come to light as specific proposed projects are examined through the NYISO's interconnection study process.

After incorporating the NYISO's analysis of the feasibility of injecting 2,400 MW of offshore wind on the grid, the New York State Energy Research and Development Authority (NYSERDA) issued the *New York State Offshore Wind Master Plan* in January 2018 that discusses many issues around the siting of such facilities, as well as options for various approaches the state may take to procure the resource. Recently, the New York PSC issued an order providing that NYSERDA, with the involvement of the Long Island Power Authority (LIPA) and the New York Power Authority (NYPA) will procure offshore wind RECs (ORECs) from developers for up to 2,400 MW of offshore wind, starting with an initial procurement of 800 MW later this year.

Part 251: Carbon Dioxide Emissions Limits

Governor Cuomo has called for the elimination of coal-fired power generation in New York State by 2020, directing the New York State Department of Environmental Conservation (DEC) to implement carbon dioxide emissions restrictions from fossil fuel-fired generators. As a result, the roughly 1,100 MW of remaining coal-fired generation capacity in New York State is expected to exit the market in 2020. New York's coal-fired generation accounted for less than 1% of the total energy produced in the state in 2017. Upon receipt of deactivation notices from the generators, the NYISO's planning processes will assess whether such deactivations trigger potential reliability needs.

Regional Greenhouse Gas Initiative (RGGI)

RGGI is a multi-state carbon dioxide emissions cap-and-trade initiative that requires affected generators to procure emissions allowances enabling them to emit carbon dioxide. The cost for these allowances is essentially factored into the costs of operating the generator, and recovered through the NYISO's wholesale market. Through this initiative, each participating state is allotted a set number of allowances, which are auctioned to generators or other stakeholders. For the initiative to be successful at reducing carbon dioxide emissions, the level of available allowances must be established in advance and lowered over time to encourage generators to invest in emissions reduction strategies or prepare for increasing costs associated with procurement of the allowances. Based on previous program reviews, the RGGI states had a schedule of allowances through 2020.

Through a program review in 2017, the RGGI states agreed to a number of program changes, including a 30% cap reduction between 2020 and 2030, essentially ratcheting down the availability of allowances to generators that produce greenhouse gases. More recently, in his 2018 State of the State address, Governor Cuomo directed the New York State Department of Environmental Conservation (DEC) to expand RGGI by grouping together currently exempt peaking units below 25 MW in nameplate capacity. While at the same time, other states have indicated a desire to join the initiative, which may affect the dynamics of allowance cost and availability going forward.

Tighter requirements through RGGI are not likely to trigger reliability concerns, but again, when combined with the numerous public policy action described in this section, raises uncertainties about the makeup of the future grid.

Smog-Forming Pollutants Rule Proposal

In his 2018 State of the State address, Governor Cuomo announced that the DEC will propose emissions requirements intended to reduce emissions of smog-forming pollutants from peaking units, and as much as 3,500 MW could be affected.

"Peakers," as they are commonly known, have historically operated to maintain grid reliability during the most stressful conditions on the grid, such as periods of high demand. Many of these units also maintain reliability in specific regions of New York City and Long Island – known as load pockets. Load pockets represent transmission-constrained geographic areas where energy needs in that area can only be served by local generators, due to the inability to import energy over the transmission system during certain high-demand conditions.

The NYISO will continue to monitor the development of new emissions rules that may impact the operation of peaking units.

Storage Deployment Target

Governor Cuomo's 2018 State of the State address also called for a $200 million investment from the New York Green Bank to support the development and deployment of up to 1,500 MW of energy storage capacity by 2025. The goal of the initiative is to drive down costs for storage while strategically deploying storage resources in locations where they best serve the needs of the grid. The New York State Energy Research and Development Authority (NYSERDA) will initially focus on storage pilots and activities that reduce barriers to deploying storage, including permitting, customer acquisition costs, interconnection, and financing costs.

U.S. Clean Water Act: Best Technology Available for Plant Cooling Water Intake

The U.S. Environmental Protection Agency (EPA) has issued a new Clear Water Act Section 316b rule providing standards for the design and operation of power plant cooling systems. This rule will be implemented by New York State Department of Environmental Conservation (DEC), which has finalized a policy for the implementation of the Best Technology Available (BTA) for plant cooling water intake structures. This policy is activated upon renewal of a plant's water withdrawal and discharge permit. Based upon a review of current information available from the DEC, the NYISO has estimated that 16,900 MW of nameplate capacity is affected by this rule, some of which could be required to undertake major system retrofits, including closed cycle cooling systems.

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:
http://www.nyiso.com/public/markets_operations/services/planning/documents/index.jsp

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

http://www.nyiso.com/public/markets_operations/services/planning/planning_studies/index.jsp

Observations and Recommendations

This 2018 Reliability Needs Assessment (RNA) assesses both the resource adequacy and transmission security of the New York Control Area (NYCA) bulk power transmission system from year 2019 through 2028, the Study Period of this RNA.

This 2018 Reliability Needs Assessment finds that the adequacy and security criteria are met throughout the Study Period.

From the resource adequacy perspective, the New York Control Area is within the Loss of Load Expectation (LOLE) criterion (1 day in 10 years, or 0.1 events per year) throughout the Study Period. The trend of load decrease continues: for example, the summer peak baseline load forecast is 1,464 MW lower in 2023 as compared with the 2016 Reliability Needs Assessment. When recent and planned capacity deactivations were included in the calculation, the net statewide surplus increased by 1,817 MW as compared with the 2016 Reliability Needs Assessment (see Figure 1).

In addition, the 2018 Reliability Need Assessment provides analysis of risks to the Bulk Power Transmission Facilities under certain scenarios to inform our stakeholders when developing projects, as well as to inform policy makers when formulating state policy.

The results of the 2018 Reliability Need Assessment scenarios results indicate that a higher load level or additional removal of capacity could cause resource adequacy Reliability Needs.

In addition to the above-referenced scenarios, the NYISO also analyzed the risks associated with the cumulative impact of environmental laws and regulations, which may affect the flexibility in plant operation and may make fossil plants energy-limited resources. The RNA discusses the environmental regulations that affect long-term power system planning and highlights the impacts of various environmental drivers on resource availability.

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. The other tracked resources include: 1. units interconnecting through the NYISO's interconnection processes; 2. the development and installation of local transmission facilities; 3. additions, mothballs or retirement of generators; 4. the status of mothballed/retired facilities; 5. the continued implementation of New York State energy efficiency, solar PV installations, clean energy standards, and similar programs; 6. participation in the NYISO demand response programs; and 7. the impact of new and proposed environmental regulations on the existing generation fleet.

APPENDICES

2018 Reliability Needs Assessment (RNA)

A Report by the
New York Independent
System Operator

Final

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Appendix A - 2018 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 and merchant transmission project included in the Applicable Reliability Standards, 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)*

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)*

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: 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): Capacity of a facility accessible to the NYS Bulk Power System, that is capable of supplying and/or reducing the demand for energy in the NYCA for the purpose of ensuring that sufficient energy and capacity is available to meet the reliability rules. *(Source: NYSRC Reliability Rules)*

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): 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: OATT Definitions)

New York State Department of Environmental Conservation (NYSDEC): The agency that implements 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 11,056-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 3,000 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, relative to all other pending valid Interconnection Requests, that is established based upon the date and time of receipt of the valid Interconnection Request by NYISO. *(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 as 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 277-2)*

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 nine Northeast and Mid-Atlantic states (not including New Jersey or Pennsylvania) to limit 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 NYISO in the RNA as a violation or potential violation of 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 biennial process that includes evaluation of resource adequacy and transmission system security of the state's bulk electricity grid over a 10-year period and evaluates solutions to meet those needs. The RPP consists of two studies: the RNA, which identifies potential problems, and the CRP, which evaluates specific solutions to those problems. *(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)*

Special Case Resources (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: Section 2.19 of Market Services Tariff: Special Case Resource ("SCR"))*

Study Period: The 10-year time period evaluated in the RNA and CRP. Note: Study Year 1 is the year after the RPP cycle starts and projecting forward 10 years. For example, the 2018 RNA covers the 10-year Study Period of 2019 through

2028. *(Source: Attachment Y of OATT 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

Transmission Planning Advisory Subcommittee (TPAS): The Transmission Planning Advisory Subcommittee, or any successor work group or committee designated to fulfill the functions assigned to TPAS pursuant to this Attachment. *(Source: Attachment Y of OATT)*

Unforced Capacity Deliverability Rights (UDR): 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),
- 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.

During the RPP, the NYISO conducts the Reliability Needs Assessment (RNA) and Comprehensive Reliability Plan (CRP). The RNA evaluates the adequacy and security of the bulk power system over a ten-year study period. 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 ten-year study period.

The RPP is a long-range assessment of both resource adequacy and transmission reliability of the New York bulk power system conducted over a ten-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).

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.

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.

In the event that there is a potential loss of resources due to a proposed generator retirement or mothballing, the NYISO will administer its Generator Deactivation Process (GDP) for Generator

Deactivation Notices that it receives. If necessary, the NYISO will seek solutions to address any Generator Deactivation Reliability Needs identified through that process. The NYISO may enter into Reliability Must Run (RMR) contracts with generators with rate recovery under its tariffs, until a permanent solution is completed. In addition, the NYISO may request solutions outside of its normal planning cycle if there appears to be an imminent threat to the reliability of the Bulk Power Transmission System arising from causes other than deactivating generation.

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 these four components, 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 29 summarizes the CSPP and Figure 30 summarizes the RPP process.

Figure 29: NYISO's Comprehensive System Planning Process (CSPP)

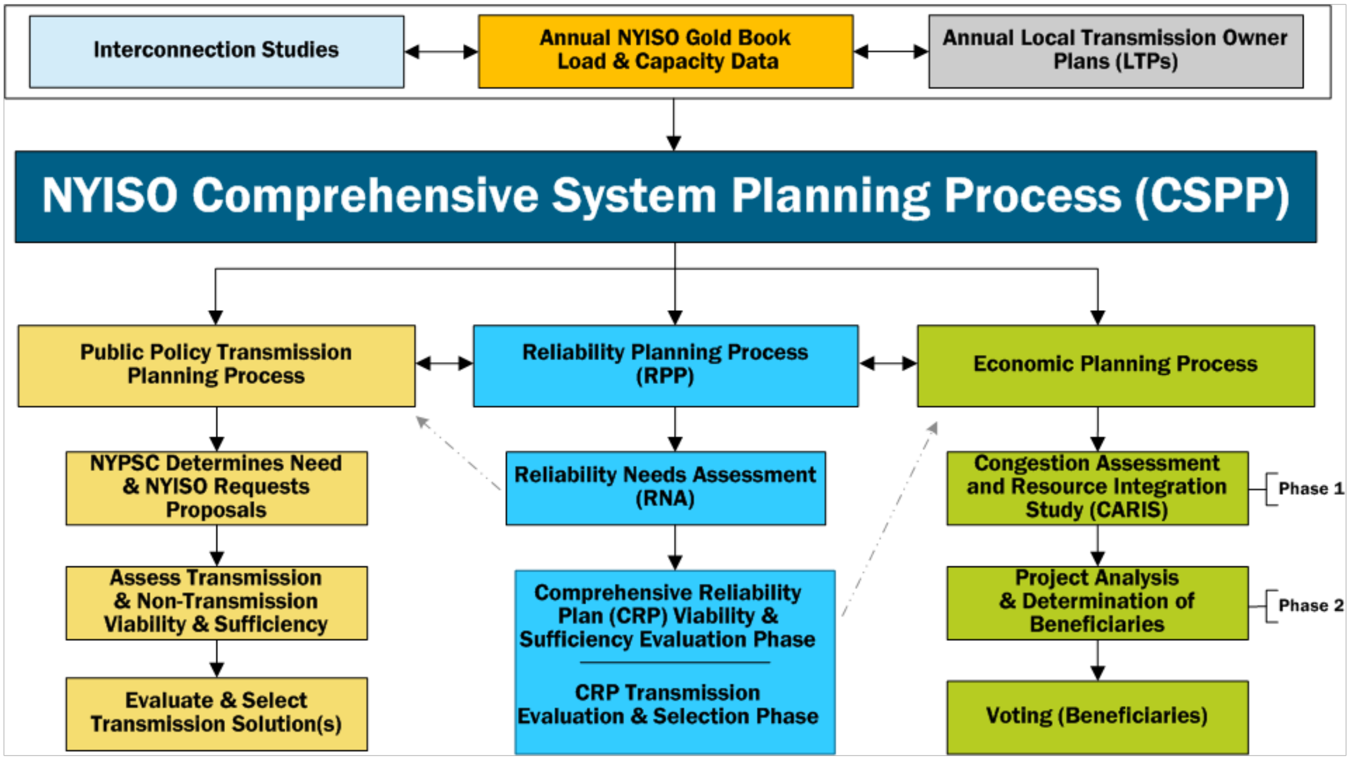
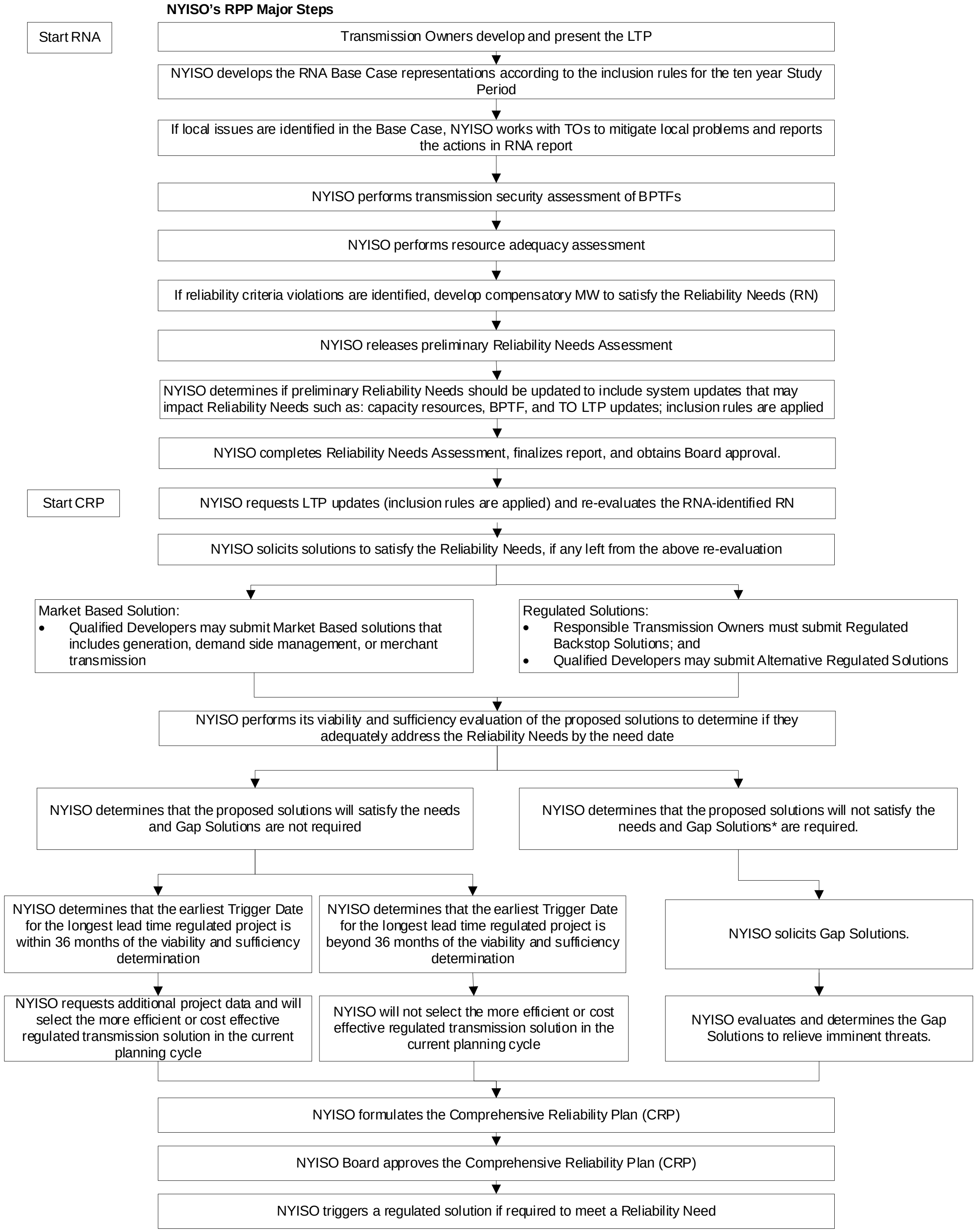


Figure 30: NYISO RPP



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 2018-2028

Summary

In order to perform the 2018 RNA, a forecast of summer and winter peak demands and annual energy requirements was produced for the years 2018 - 2028. The electricity forecast is based on projections of New York's economy performed by Moody's Analytics in August 2017. The forecast includes detailed projections of employment, output, income, and other factors for twenty-three regions in New York State. This appendix provides a summary of the electric energy and peak demand forecasts and the key economic input variables used to produce the forecasts. **Figure 31** provides a summary of key economic and electric system growth rates from 2007 to 2028.

Figure 31: Summary of Economic & Electric System Growth Rates – Actual & Forecast

	Average Annual Growth			
	2007-2012	2012-2017	2018-2023	2023-2028
Total Employment	0.18%	1.57%	0.52%	0.34%
Gross State Product	1.43%	0.90%	1.51%	1.47%
Population	0.49%	0.13%	0.00%	0.02%
Total Real Income	1.20%	1.95%	1.47%	1.60%
Weather Normalized Summer Peak	-0.20%	-0.12%	-0.38%	0.11%
Weather Normalized Annual Energy	-0.33%	-0.83%	-0.33%	0.04%

Historic Overview

The New York Control Area (NYCA) is a summer peaking system and its summer peak grew faster than annual energy and winter peak over the period from 2007 to 2017 on a weather-adjusted basis. 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 influenced by weather conditions over the entire year, which is much less variable than peak-producing conditions.

Figure 32 below reports the NYCA historic seasonal peaks and annual energy growth since 2007. 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 2007 to 2017.

Figure 32: Historic 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	Year	Actual	Weather Normalized
2007	167,339	166,173	32,169	33,444	2007-08	25,021	25,490
2008	165,612	166,468	32,433	33,670	2008-09	24,673	25,016
2009	158,780	161,908	30,845	33,063	2009-10	24,074	24,537
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
	-0.68%	-0.58%	-0.80%	-0.16%		0.02%	-0.49%

Forecast Overview

Figure 33 below shows historic and forecast growth rates of annual energy and summer peak demand for four different regions in New York and in total. The four regions are Zones A to F, Zones G to I, Zone J, and Zone K.

Figure 33: Annual Energy and Summer Peak Demand - Actual & Forecast

	Annual Energy- GWh					Summer Coincident Peak - MW				
Year	A to F	G to I	J	K	NYCA	A to F	G to I	J	K	NYCA
2007	69,888	19,955	54,750	22,748	167,341	11,475	4,349	10,970	5,375	32,169
2008	68,830	19,486	54,835	22,461	165,612	11,890	4,333	10,979	5,231	32,433
2009	64,982	18,806	53,100	21,892	158,780	11,382	4,034	10,366	5,063	30,845
2010	65,852	19,617	55,114	22,922	163,505	11,822	4,586	11,213	5,832	33,453
2011	67,314	19,252	54,059	22,704	163,329	11,903	4,655	11,374	5,935	33,867
2012	68,084	18,967	53,487	22,302	162,840	12,320	4,288	10,722	5,109	32,439
2013	68,929	19,155	53,316	22,114	163,514	12,251	4,596	11,456	5,653	33,956
2014	67,142	18,808	52,541	21,568	160,059	10,245	3,953	10,567	5,017	29,782
2015	66,970	19,211	53,485	21,906	161,572	11,490	4,113	10,410	5,126	31,139
2016	66,584	18,970	53,653	21,591	160,798	11,765	4,151	10,990	5,169	32,075
2017	64,761	18,528	52,266	20,815	156,370	10,482	4,004	10,241	4,972	29,699
2018	64,830	18,497	52,242	20,551	156,120	11,817	4,362	11,403	5,322	32,904
2019	66,056	18,355	51,860	20,378	156,649	11,924	4,324	11,339	5,270	32,857
2020	65,654	18,215	51,484	20,214	155,567	11,839	4,289	11,276	5,225	32,629
2021	65,221	18,089	51,173	20,084	154,567	11,769	4,260	11,229	5,193	32,451
2022	64,892	18,000	50,992	20,014	153,898	11,717	4,242	11,202	5,178	32,339
2023	64,688	17,954	50,942	20,009	153,593	11,684	4,230	11,194	5,176	32,284
2024	64,547	17,934	50,954	20,041	153,476	11,666	4,225	11,201	5,184	32,276
2025	64,443	17,928	50,989	20,094	153,454	11,660	4,225	11,216	5,198	32,299
2026	64,369	17,933	51,043	20,159	153,504	11,662	4,228	11,238	5,215	32,343
2027	64,349	17,958	51,143	20,241	153,691	11,671	4,233	11,265	5,234	32,403
2028	64,353	17,989	51,259	20,325	153,926	11,682	4,240	11,294	5,253	32,469
2007-17	-0.8%	-0.7%	-0.5%	-0.9%	-0.7%	-0.9%	-0.8%	-0.7%	-0.8%	-0.8%
2018-28	-0.1%	-0.3%	-0.2%	-0.1%	-0.1%	-0.1%	-0.3%	-0.1%	-0.1%	-0.1%
2007-17	-0.5%	-1.0%	-0.5%	-0.4%	-0.5%	1.4%	-0.3%	-0.5%	-1.0%	0.2%
2018-28	-1.0%	-0.5%	-0.5%	-1.4%	-0.8%	-3.2%	-1.4%	-0.9%	-0.5%	-1.7%
2018-23	0.0%	-0.6%	-0.5%	-0.5%	-0.3%	-0.2%	-0.6%	-0.4%	-0.6%	-0.4%
2023-28	-0.1%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.2%	0.3%	0.1%

Forecast Methodology

The NYISO methodology for producing the long-term forecasts for the Reliability Needs Assessment is described below.

End-use forecasts were developed for zonal energy using monthly data from 2006 through 2017. For each zone, the NYISO estimated a statistically-adjusted end use model of total energy in a zone. The inputs to the model included economic drivers (such as employment and population), cooling degree days, and heating degree days, and trends in technologies for major residential and commercial end uses, such as lighting, cooling, refrigeration, and others. Each zonal forecast was evaluated and compared to historic data, both actual and weather-adjusted usage. The zonal model chosen for the forecast was the one that best represented recent history and the regional growth for that zone. The NYISO also received and evaluated forecasts from all Transmission Owners, which were used in combination with the forecasts the NYISO developed.

The NYISO derive summer & winter non-coincident and coincident peak forecasts from the end use models and compared the results to a method that relied upon trend in load factors. The 2018 summer peak forecast was matched to coincide with the 2018 ICAP forecast.

Demand Side Management

The NYISO developed individual energy and demand forecasts for:

- Energy efficiency impacts;
- Building codes and appliance standards;
- Distributed generation;
- Behind-the-meter solar photovoltaic (PV); and
- Electric vehicles.

The NYISO considered the following factors in developing the 2018 RNA baseline forecast:

- NYPSC-approved spending levels for the programs under its jurisdiction, as described in the Clean Energy Fund Order and related information from NYSERDA;
- Expected realization rates, participation rates, and timing of planned energy efficiency programs;
- Impacts of new appliance efficiency standards, and building codes and standards;
- Specific energy efficiency plans proposed by Long Island Public Authority, The Power Authority of the State of New York, and Consolidated Edison Company of New York, Inc.;
- Results of residential and commercial surveys prepared by NYSERDA and the US Energy Information Administration;
- Actual and projected impacts of behind-the-meter solar PV installations; and
- Actual and projected impacts of distributed energy generation installation.

Once the energy and demand trends of these impacts were developed, the NYISO produced zonal level forecasts by incorporating these end use trends into the statistically adjusted end-use models.

Figure 34: Gold Book Zonal Energy Forecast Growth Rates - 2018 to 2028

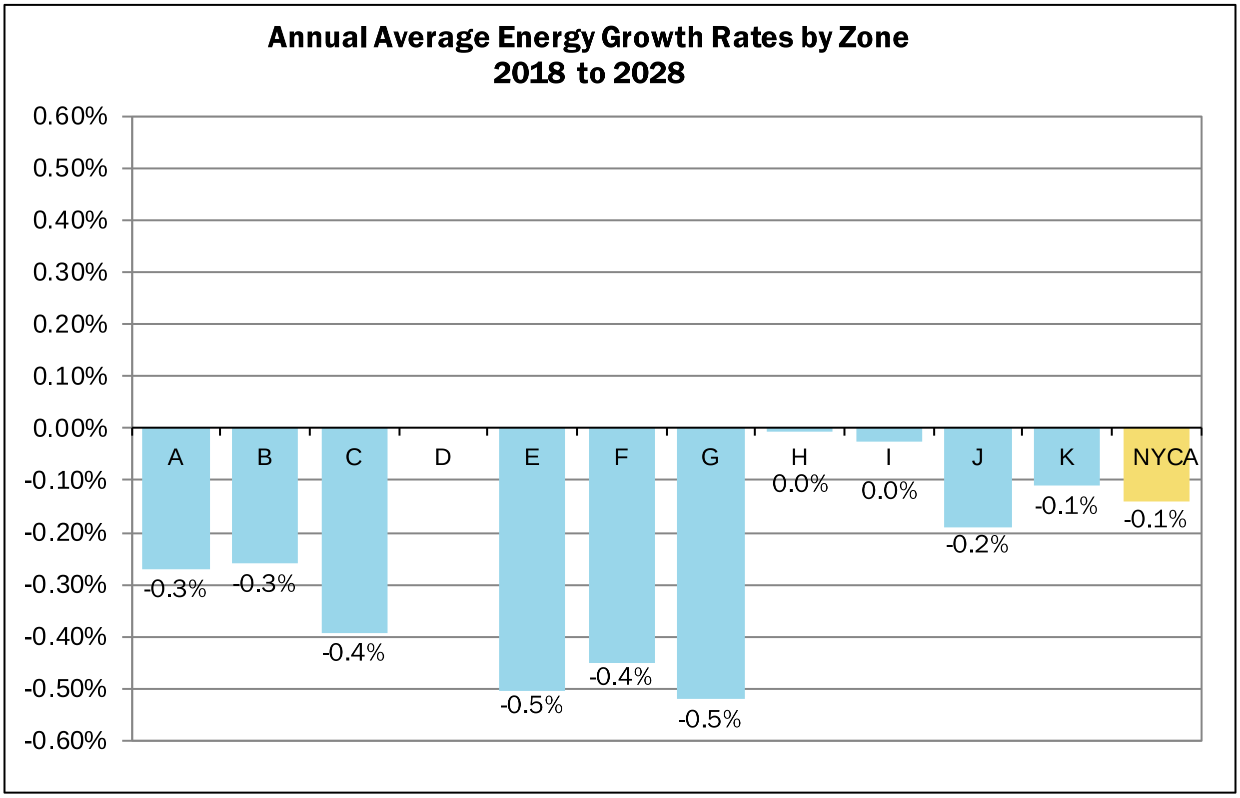


Figure 35: Gold Book Summer Peak Demand Zonal Forecast Growth Rates - 2018 to 2028

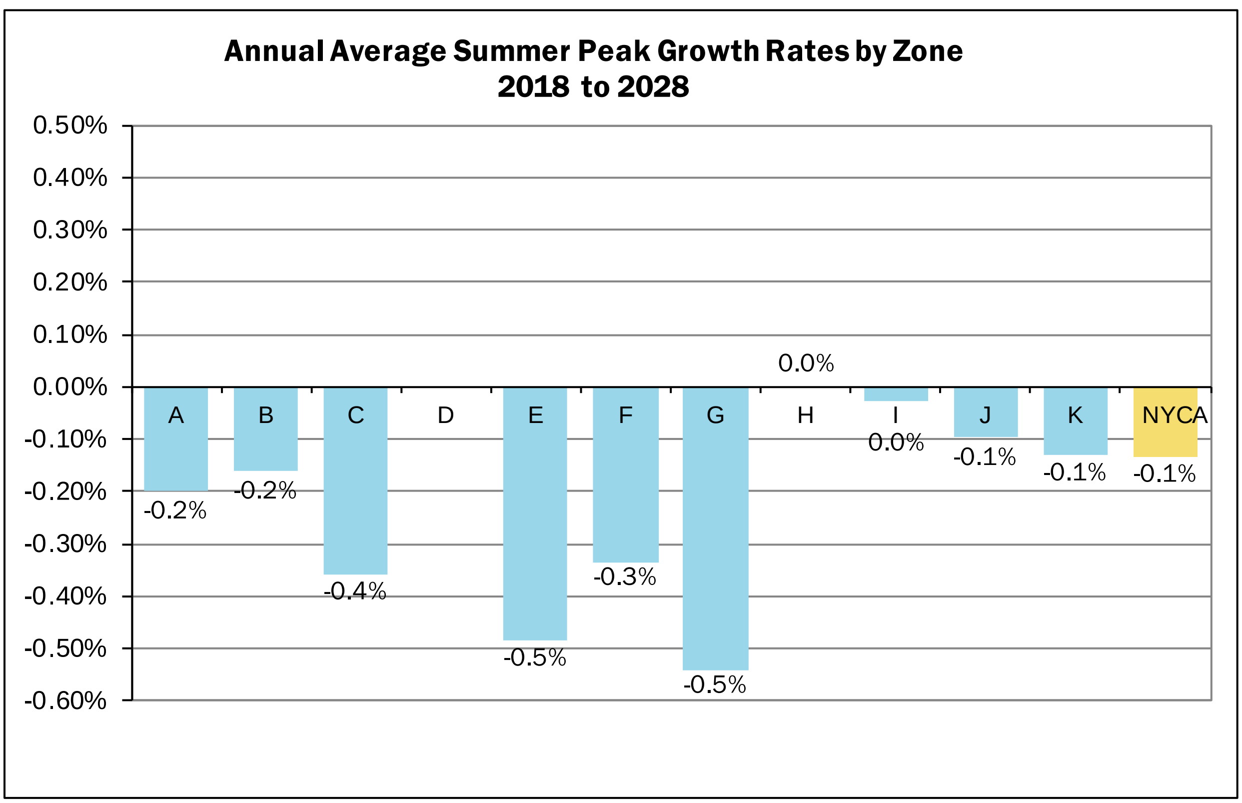


Figure 36: Annual Energy by Zone – Actual & 2018 Gold Book Baseline Forecast (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2007	16,258	10,207	17,028	6,641	7,837	11,917	10,909	2,702	6,344	54,750	22,748	167,341
2008	15,835	10,089	16,721	6,734	7,856	11,595	10,607	2,935	5,944	54,835	22,461	165,612
2009	15,149	9,860	15,949	5,140	7,893	10,991	10,189	2,917	5,700	53,100	21,892	158,780
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	15,211	9,841	15,894	4,320	7,681	11,883	9,653	2,928	5,916	52,242	20,551	156,120
2019	15,135	9,776	15,773	5,990	7,605	11,777	9,561	2,913	5,881	51,860	20,378	156,649
2020	15,052	9,709	15,648	6,049	7,529	11,667	9,469	2,899	5,847	51,484	20,214	155,567
2021	14,972	9,648	15,533	6,039	7,460	11,569	9,382	2,887	5,820	51,173	20,084	154,567
2022	14,908	9,605	15,444	6,031	7,408	11,496	9,310	2,882	5,808	50,992	20,014	153,898
2023	14,869	9,582	15,386	6,026	7,374	11,451	9,259	2,884	5,811	50,942	20,009	153,593
2024	14,842	9,570	15,346	6,022	7,349	11,418	9,222	2,889	5,823	50,954	20,041	153,476
2025	14,821	9,565	15,315	6,019	7,330	11,393	9,194	2,896	5,838	50,989	20,094	153,454
2026	14,806	9,566	15,292	6,017	7,315	11,373	9,174	2,904	5,855	51,043	20,159	153,504
2027	14,803	9,575	15,284	6,016	7,307	11,364	9,165	2,915	5,878	51,143	20,241	153,691
2028	14,805	9,588	15,281	6,016	7,303	11,360	9,162	2,926	5,901	51,259	20,325	153,926

Figure 37: Summer Coincident Peak Demand by Zone – Actual & 2018 Gold Book Baseline Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2007	2,592	1,860	2,786	795	1,257	2,185	2,316	595	1,438	10,970	5,375	32,169
2008	2,611	2,001	2,939	801	1,268	2,270	2,277	657	1,399	10,979	5,231	32,433
2009	2,595	1,939	2,780	536	1,351	2,181	2,159	596	1,279	10,366	5,063	30,845
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	2,801	2,014	2,841	521	1,308	2,332	2,233	674	1,455	11,403	5,322	32,904
2019	2,784	2,001	2,816	719	1,293	2,311	2,205	671	1,448	11,339	5,270	32,857
2020	2,769	1,990	2,792	717	1,279	2,292	2,179	668	1,442	11,276	5,225	32,629
2021	2,757	1,981	2,772	715	1,267	2,277	2,157	666	1,437	11,229	5,193	32,451
2022	2,748	1,974	2,757	714	1,259	2,265	2,141	666	1,435	11,202	5,178	32,339
2023	2,742	1,971	2,747	713	1,253	2,258	2,129	666	1,435	11,194	5,176	32,284
2024	2,739	1,970	2,741	713	1,249	2,254	2,121	667	1,437	11,201	5,184	32,276
2025	2,739	1,972	2,738	712	1,247	2,252	2,117	668	1,440	11,216	5,198	32,299
2026	2,740	1,974	2,738	712	1,246	2,252	2,115	670	1,443	11,238	5,215	32,343
2027	2,743	1,978	2,739	712	1,246	2,253	2,114	672	1,447	11,265	5,234	32,403
2028	2,746	1,982	2,741	712	1,246	2,255	2,115	674	1,451	11,294	5,253	32,469

Figure 38: Winter Coincident Peak Demand by Zone – Actual & 2018 Gold Book Baseline Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2007-08	2,336	1,536	2,621	936	1,312	1,886	1,727	524	904	7,643	3,596	25,021
2008-09	2,274	1,567	2,533	930	1,289	1,771	1,634	529	884	7,692	3,570	24,673
2009-10	2,330	1,555	2,558	648	1,289	1,788	1,527	561	813	7,562	3,443	24,074
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	2,295	1,520	2,618	834	1,332	1,944	1,554	493	903	7,440	3,336	24,269
2019-20	2,275	1,513	2,600	882	1,318	1,933	1,548	491	894	7,377	3,304	24,135
2020-21	2,250	1,507	2,582	879	1,302	1,924	1,544	489	885	7,315	3,271	23,948
2021-22	2,235	1,500	2,566	879	1,292	1,915	1,539	487	880	7,271	3,253	23,817
2022-23	2,226	1,495	2,559	878	1,286	1,908	1,536	488	878	7,247	3,250	23,751
2023-24	2,222	1,492	2,558	879	1,283	1,902	1,535	490	879	7,237	3,253	23,730
2024-25	2,219	1,490	2,556	880	1,283	1,898	1,536	493	880	7,237	3,256	23,728
2025-26	2,216	1,490	2,559	880	1,282	1,896	1,539	494	882	7,242	3,262	23,742
2026-27	2,215	1,489	2,562	880	1,283	1,894	1,542	495	883	7,251	3,268	23,762
2027-28	2,213	1,490	2,563	882	1,283	1,892	1,546	497	885	7,261	3,274	23,786
2028-29	2,212	1,490	2,566	882	1,284	1,891	1,548	499	888	7,273	3,279	23,812

Figure 39: Behind-the-Meter Solar PV and 2018 RNA Base Case Annual Energy by Zone – (GWh)

2018 Gold Book Behind the Meter Solar PV Summer Peak Demand Forecast

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2018	23	17	41	3	25	58	75	8	12	54	124	440
2019	30	25	57	4	34	69	99	10	15	68	155	566
2020	39	33	75	6	45	80	122	11	17	81	180	689
2021	46	38	88	7	52	87	140	12	18	91	195	774
2022	52	42	99	8	58	93	155	12	20	100	204	843
2023	56	45	106	9	62	98	167	13	21	107	205	889
2024	60	47	113	9	66	102	178	13	22	112	206	928
2025	63	50	118	10	69	106	186	14	23	117	207	963
2026	65	51	122	10	72	108	194	14	23	121	209	989
2027	68	53	126	11	74	111	201	15	24	124	210	1,017
2028	70	54	130	11	76	113	207	15	24	127	211	1,038

2018 RNA Baseline Forecast With Solar PV

2018	2,824	2,031	2,882	524	1,333	2,390	2,308	682	1,467	11,457	5,446	33,344
2019	2,814	2,026	2,873	723	1,327	2,380	2,304	681	1,463	11,407	5,425	33,423
2020	2,808	2,023	2,867	723	1,324	2,372	2,301	679	1,459	11,357	5,405	33,318
2021	2,803	2,019	2,860	722	1,319	2,364	2,297	678	1,455	11,320	5,388	33,225
2022	2,800	2,016	2,856	722	1,317	2,358	2,296	678	1,455	11,302	5,382	33,182
2023	2,798	2,016	2,853	722	1,315	2,356	2,296	679	1,456	11,301	5,381	33,173
2024	2,799	2,017	2,854	722	1,315	2,356	2,299	680	1,459	11,313	5,390	33,204
2025	2,802	2,022	2,856	722	1,316	2,358	2,303	682	1,463	11,333	5,405	33,262
2026	2,805	2,025	2,860	722	1,318	2,360	2,309	684	1,466	11,359	5,424	33,332
2027	2,811	2,031	2,865	723	1,320	2,364	2,315	687	1,471	11,389	5,444	33,420
2028	2,816	2,036	2,871	723	1,322	2,368	2,322	689	1,475	11,421	5,464	33,507

Appendix D - Transmission System Security and Resource Adequacy 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 showed no resource adequacy needs in any of the ten-year Study Period (i.e., 2019 to 2028). The MARS model was also used to evaluate selected scenarios.

2018 RNA Assumption Matrix

#	Parameter	2016 RNA/CRP Study Period: 2017 (y1) - 2026 (y10)	2018 RNA Study Period: 2019 (y1) - 2028 (y10)
Load Parameters			
1	Peak Load Forecast	Adjusted 2016 Gold Book NYCA baseline peak load forecast. The GB 2016 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.	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.
2	Load Shape (Multiple Load Shape)	Used Multiple Load Shape MARS Feature 8760 h historical load shapes were used as base shapes for LFU bins: Bin 1: 2006 Bin 2: 2002 Bins 3-7: 2007 Peak adjustments are being performed on a seasonal basis.	Used Multiple Load Shape MARS Feature 8760 h historical load shapes were used as base shapes for LFU bins: Bin 1: 2006 Bin 2: 2002 Bins 3-7: 2007 Peak adjustments are being performed on a seasonal basis.
3	Load Forecast Uncertainty (LFU)	Used prior year LFU bin weight figures.	Used updated summer LFU values for the 11 NYCA zones.
Generation Parameters			
4	Existing Generating Unit Capacities	2016 Gold Book values. Used min (DMNC vs. CRIS). Adjusted for RNA inclusion rules.	2018 Gold Book values. Use summer min (DMNC vs. CRIS). Use winter min (DMNC vs CRIS). Adjusted for RNA inclusion rules.
5	Proposed New Units (Non- Renewable)	GB2016 with Inclusion Rules Applied	GB2018 with Inclusion Rules Applied
6	Retirements, Mothballed units, IIFO	GB2016 with Inclusion Rules Applied	GB2018 with Inclusion Rules Applied
7	Forced and Partial Outage Rates	Five-year (2011-2015) 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	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

#	Parameter	2016 RNA/CRP Study Period: 2017 (y1) - 2026 (y10)	2018 RNA Study Period: 2019 (y1) - 2028 (y10)
8	Planned Outages	Based on schedules received by the NYISO and adjusted for history	Based on schedules received by the NYISO and adjusted for history
9	Summer Maintenance	n/a	Nominal MW
10	Combustion Turbine Derates	Derate based on temperature correction curves	Derate based on temperature correction curves
11	Landfill gas plants	The landfill gas units are assumed to be 2-state units.	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.
12	Existing Wind Units (>5 years of data)	Actual hourly plant output over the period 2011-2015. Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in Monte Carlo process	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
13	Existing Wind Units (<5 years of data)	For existing data, the actual hourly plant output over the period 2011-2015 is used. For missing data, the nameplate normalized average of units in the same load zone is scaled by the unit's nameplate.	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.
14	Proposed Wind Units	Inclusion Rules Applied to determine the generating unit status. The nameplate normalized average of units in the same load zone is scaled by the unit's nameplate.	Inclusion Rules Applied to determine the generating unit status. The nameplate normalized average of units in the same load zone is scaled by the unit's nameplate.
15	Utility-scale Solar Resources	The 31.5 MW metered solar capacity: probabilistic model chooses from 4 years of production data output shapes covering the period 2012-2015. One shape per replication is randomly selected in Monte Carlo process.	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.

#	Parameter	2016 RNA/CRP Study Period: 2017 (y1) - 2026 (y10)	2018 RNA Study Period: 2019 (y1) - 2028 (y10)
16	BtM Solar Resources	The large projection of increasing retail (BtM) solar installations over the 10- year period required a discrete model with some level of detailed hourly performance. 5 years of hourly historic irradiance data from 18 stations in NY was used to develop the required hourly patterns to discretely model this resource. (One shape per replication is randomly selected in Monte Carlo process.)	The large projection of increasing retail (BtM) solar installations over the 10- year period required a discrete model with some level of detailed hourly performance. New method: 8760 hourly shapes are created by using NREL's PV Watt tool *(NREL's PVWatts Calculator, credit of the U.S. Department of Energy (DOE)/NREL/Alliance (Alliance for Sustainable Energy, LLC)*. The shapes are applied during the load adjustment to account for the impact of the BtM generation on both on peak and off peak hours. MARS will randomly select a daily shape from the current month for each day of each month of each replication.
17	BTM-NG Program	n/a	New category: These are former load modifiers to sell capacity into the ICAP market. Model as cogen type 2 unit in MARS. Unit capacity set to CRIS value, load modeled with weekly pattern that can change monthly.
18	Small Hydro Resources	Review of 5- years of unit production data over the years 2011 to 2015 with applicable deration: 46% derate applied to all Run-of-River units, calculated by reviewing unit contribution during peak hours of summer months	New method: Actual hourly plant output over the period 2013-2017. Program randomly selects a Hydro shape of hourly production over the 2013-2017 for each model replication.
19	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 (2011-2015). Methodology consistent with thermal unit transition rates.	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.
20	Capacity Purchases	Grandfathered Rights and other awarded long-term rights including 20 MW CRIS potentially awarded to HQUS in CY15, additional to the existing 1,090 MW. Modeled using MARS explicit contracts feature.	Grandfathered Rights and other awarded long-term rights Modeled using MARS explicit contracts feature.

#	Parameter	2016 RNA/CRP Study Period: 2017 (y1) - 2026 (y10)	2018 RNA Study Period: 2019 (y1) - 2028 (y10)
Transaction - Imports / Exports			
21	Capacity Sales	These are long-term contracts filed with FERC. Modeled as equivalent contracts sold from ROS (surplus Zones: A,C,D,F,F1). ROS ties to external pool are derated by sales MW amount	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
22	FCM Sales	Modeled as equivalent contracts sold from ROS (surplus Zones: A,C,D,F). ROS ties to external pool are derated by the sales MW amount	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
23	UDRs	Updated with most recent information.	Updated with most recent elections/awards information (VFT, HTP, Neptune, CSC)
Topology			
24	Interface Limits	Developed by review of previous studies and specific analysis during the RNA study process	Developed by review of previous studies and specific analysis during the RNA study process
25	New Transmission	Based on TO- provided firm plans (via Gold Book 2016 process) and proposed merchant transmission; inclusion rules applied	Based on TO- provided firm plans (via Gold Book 2018 process) and proposed merchant transmission; inclusion rules applied
26	AC Cable Forced Outage Rates	All existing cable transition rates updated with info received from ConEd and PSEG-LIPA to reflect most recent five-year history	All existing cable transition rates updated with info received from ConEd and PSEG-LIPA to reflect most recent five-year history
27	UDR unavailability	Reflected as part of the AC cables calculation	Five-year history of forced outages
Emergency Operating Procedures			
28	Special Case Resources	SCRs sold for the program discounted to historic availability ('effective capacity'). Final Base Cases summer values calculated from the July 2016 registrations, held constant for all years of study	SCRs sold for the program discounted to historic availability ('effective capacity'). Final Base Cases summer values will be calculated from the July 2016 registrations, held constant for all years of study
29	EDRP Resources	2016 Gold Book with effective capacity modeled Those sold for the program discounted to historic availability. Summer values calculated from July 2016 registrations and forecast growth. Values held constant for all years of study.	2018 Gold Book with effective capacity modeled Those sold for the program discounted to historic availability. Summer values will be calculated from July 2018 registrations and forecast growth. Values held constant for all years of study.

#	Parameter	2016 RNA/CRP Study Period: 2017 (y1) - 2026 (y10)	2018 RNA Study Period: 2019 (y1) - 2028 (y10)
30	Other EOPs	Based on TO information, measured data, and NYISO forecasts	Based on TO information, measured data, and NYISO forecasts
External Control Areas			
31	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.	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.
32	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.	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.
33	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.	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.
34	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.	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.
35	Reserve Sharing	All NPCC Control Areas indicate that they will share reserves equally among all members before sharing with PJM.	All NPCC Control Areas indicate that they will share reserves equally among all members before sharing with PJM.
36	NYCA Emergency Assistance Limit	No specific NYCA-wide limit	Implemented a statewide limit of 3500 MW
Miscellaneous			
37	MARS Model Version	Version 3.20.5	Version 3.22.6

Assumption Matrix for Transmission Security Assessment

Parameter	2018 RNA Transmission Security Studies Modeling Assumptions	Source
Peak Load	NYCA baseline coincident summer peak forecast, which already includes EE and DG (including BtM solar) reductions	2018 Gold Book
Load model	ConEd: voltage varying	2018 FERC 715 filing
	Rest of NYCA: constant power	
System representation	Per updates received through Databank process (Subject to RNA base case inclusion rules)	NYISO RAD Manual, 2018 FERC 715 filing
Inter-area interchange schedules	Consistent with ERAG MMWG interchange schedule	2018 FERC 715 filing, MMWG
Inter-area controllable tie schedules	Consistent with applicable tariffs and known firm contracts or rights	2018 FERC 715 filing
In-city series reactors	Consistent with ConEdison operating protocol (all series reactors in-service for summer)	2018 FERC 715 filing, ConEd protocol
SVCs, FACTS	Set at zero pre-contingency; allowed to adjust post-contingency	NYISO T&D Manual
Transformer & PAR taps	Taps allowed to adjust pre-contingency; fixed post-contingency	2018 FERC 715 filing
Switched shunts	Allowed to adjust pre-contingency; fixed post-contingency	2018 FERC 715 filing
Fault current analysis settings	Per Fault Current Assessment Guideline	NYISO Fault Current Assessment Guideline

RNA Power Flow Base Case Development and Thermal Transfer Limit Results

Development of RNA Power Flow Base Cases

The NYISO developed the 2018 RNA Base Cases used in analyzing the performance of the transmission system from the 2018 FERC 715 filing power flow case library. The load representation in the power flow model is the summer peak load forecast reported in the 2018 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 2017 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) 2017 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 2018 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 2018 RNA Base Case does not include all projects currently listed on the NYISO's interconnection queue or those shown in the 2018 Gold Book. Rather, it includes only those which met the screening requirements, as shown in the Figure 13 of the main report. The generation deactivation assumptions are reflected in Figure12 of the main report. The firm transmission plans included in the RNA Base Case are listed in Figure 40 on the next page.

Figure 40: Firm Transmission Plans included in 2018 RNA Base Case

Transmission Owner	Terminals		Line Length in Miles	Expected 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)					
CHGE	East Fishkill	Shenandoah	1.98	W	2018	115	115	1	1210	1225	1-1033 ACSR
CHGE	Hurley Avenue	Leeds	Series Compensation	S	2020	345	345	1	2336	2866	21% Compensation
CHGE	St. Pool	High Falls	5.61	W	2020	115	115	1	1010	1245	1-795 ACSR
CHGE	High Falls	Kerhonkson	10.03	W	2020	115	115	1	1010	1245	1-795 ACSR
CHGE	Modena	Galeville	4.62	W	2020	115	115	1	1010	1245	1-795 ACSR
CHGE	Galeville	Kerhonkson	8.96	W	2020	115	115	1	1010	1245	1-795 ACSR
ConEd	East 13th Street	East 13th Street	Reconfiguration	In-Service	2017	345	345		N/A	N/A	Reconfiguration(xfrmr 12 - xfmr 13)
ConEd	East 13th Street	East 13th Street	Reconfiguration	In-Service	2018	345	345		N/A	N/A	Reconfiguration(xfmr 14 - xfmr 15)
ConEd	Greenwood	Greenwood	Reconfiguration	In-Service	2018	138	138		N/A	N/A	Reconfiguration
ConEd	Jamaica	Jamaica	Reconfiguration	In-Service	2018	138	138		N/A	N/A	Reconfiguration
ConEd	Jamaica	Jamaica	Reconfiguration	S	2019	138	138		N/A	N/A	Reconfiguration
ConEd	East 13th Street	East 13th Street	xfmr	S	2019	345	345		N/A	N/A	Replacing xmfr 10 and xmfr 11
ConEd	Gowanus	Gowanus	xfmr	S	2019	345	345		N/A	N/A	Replacing xfmr T2
ConEd	East 13th Street	East 13th Street	Reconfiguration	S	2019	345	345		N/A	N/A	Reconfiguration (xmfr 10 - xmfr 11)
ConEd	Rainey	Corona	xfmr/Phase shifter	S	2019	345/138	345/138	1	268 MVA	320 MVA	xmfr/ Phase shifter
LIPA	Ridge	Coram	-8.50	S	2018	69	69	1	883	976	795 AL
LIPA	Ridge	West Bartlett	5.85	S	2018	69	69	1	883	976	795 AL

Transmission Owner	Terminals		Line Length in Miles	Expected 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	West Bartlett	Coram	2.65	S	2018	69	69	1	883	976	795 AL
LIPA	West Hempstead	East Garden City	-2.92	S	2018	69	69	1	1158	1245	477 ACSS
LIPA	West Hempstead	Hempstead	0.97	S	2018	69	69	1	1158	1245	477 ACSS
LIPA	Hempstead	East Garden City	1.95	S	2018	69	69	1	1158	1245	477 ACSS
LIPA	Pilgrim	West Bus	-11.86	S	2019	138	138	1	2087	2565	2493 ACAR
LIPA	West Bus	Kings Hwy	5.86	S	2019	138	138	1	2087	2565	2493 ACAR
LIPA	Pilgrim	Kings Hwy	6.00	S	2019	138	138	1	2087	2565	2493 ACAR
NGRID	Mohican	Battenkill	14.20	In-Service	2017	115	115	1	933	1140	Replace 14.2 miles of conductor w/min 1033.5 ACSR
NGRID	Mohican	Luther Forest	34.47	In-Service	2017	115	115	1	937	1141	Replace 14.2 miles of conductor w/min 795 kcmil ACSR 26/7
NGRID	Edic	Edic	xfmr	In-Service	2017	345/115	345/115	2	505MVA	603MVA	Add Transformer for MVEdge (TR#5&#6)
NGRID	Edic	Marcy Nanocenter	1.3	In-Service	2017	115	115	2	556MVA	680MVA	New Circuit to Customer Station (MVEdge)
NGRID	Eastover Road	Eastover Road	xfmr #2	In-Service	2018	230/115	230/115	1	381MVA	466MVA	New/2nd 230/115kV Transformer
NGRID	Gardenville	Erie	0.3	W	2017	115	115	1	939	1144	Replace 400CU and 636AL with 636 ACSR
NGRID	Oneida	Porter	Reactor	S	2018	115	115	1	-		Install reactor on Line #7; 8%
NGRID	Porter	Yahnundasis	Reactor	S	2018	115	115	1	-		Install reactor on Line #3; 12%
NGRID	Elm St	Elm St	xfmr	S	2018	230/23	230/23	1	118MVA	133MVA	Add a fourth 230/23kV transformer
NGRID	Schodack	Churchtown	-26.74	S	2018	115	115	1	937	1141	Line removal tapped by Falls Park Project
NGRID	Rotterdam	Rotterdam	-	S	2018	115	115		N/A	N/A	Reconfigure Rotterdam 115kV station to eliminate R1 and R82 Contingencies
NGRID	Menands	State Campus	5	W	2018	115	115	1	744	744	Replace 3.2 miles of 4/0 Cu conductor with 795kcmil ACSR 26/7

Transmission Owner	Terminals		Line Length in Miles	Expected 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	Ticonderoga	Ticonderoga	-	W	2018	115	115		N/A	N/A	Install 20MVAR Cap Bank at Ticonderoga
NGRID	Wolf Rd	Menands	4.54	W	2018	115	115	1	808	856	Replace 2.1 miles of 4/0 Cu conductor with 795kcmil ACSR 26/7
NGRID	Golah	Golah	Cap Bank	W	2018	115	115	1	18MVAR	18MVAR	Capacitor Bank
NGRID	Rotterdam	Curry Rd	7	S	2019	115	115	1	808	856	Replace 7.0 miles of mainly 4/0 Cu conductor with 795kcmil ACSR 26/7
NGRID	Batavia	Batavia	Cap Bank	S	2019	115	115	1	30MVAR	30MVAR	Second Capacitor Bank
NGRID	Battenkill	Eastover Road	-22.72	S	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Battenkill	Schaghticoke (New Station)	14.31	S	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Schaghticoke (New Station)	Eastover Road	8.41	S	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Mohican	Luther Forest	-34.47	S	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Mohican	Schaghticoke (New Station)	28.13	S	2019	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Luther Forest	Schaghticoke (New Station)	6.34	S	2019	115	115	1	1280	1563	New Schaghticoke Switching Station
NGRID	Huntley	Lockport	6.9	S	2019	115	115	2	1303	1380	Replace 6.9 miles of 36 and 37 lines
NGRID	Mortimer	Mortimer	-	S	2019	115	115		N/A	N/A	Second 115kV Bus Tie Breaker at Mortimer Station
NGRID	Rosa Rd	Rosa Rd	-	S	2019	115	115		N/A	N/A	Install 35MVAR Cap Bank at Rosa Rd
NGRID	Ohio St	Ohio St		S	2019	115	115		N/A	N/A	New Distribution Station at Ohio Street
NGRID	Dewitt	Dewitt		S	2019	115	115		N/A	N/A	New Distribution Station at Dewitt
NGRID	Clay	Dewitt	10.24	W	2019	115	115	1	220MVA	268MVA	Reconductor 4/0 CU to 795ACSR
NGRID	Clay	Teall	12.75	W	2019	115	115	1	220 MVA	268MVA	Reconductor 4/0 CU to 795ACSR
NGRID	Mortimer	Mortimer	Reconfiguration	W	2019	115	115	1	N/A	N/A	Reconfiguration of Station

Transmission Owner	Terminals		Line Length in Miles	Expected 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	Spier	Rotterdam (#2)	-32.74	W	2019	115	115	1	1168	1416	New Lasher Rd Switching Station
NGRID	Spier	Lasher Rd (New Station)	21.69	W	2019	115	115	1	1168	1416	New Lasher Rd Switching Station
NGRID	Lasher Rd (New Station)	Rotterdam	11.05	W	2019	115	115	1	2080	2392	New Lasher Rd Switching Station
NGRID	Spier	Luther Forest (#302)	-34.21	W	2019	115	115	1	916	1070	New Lasher Rd Switching Station
NGRID	Spier	Lasher Rd (New Station)	21.72	W	2019	115	115	1	916	1118	New Lasher Rd Switching Station
NGRID	Two Mile Creek	Two Mile Creek		W	2019	115	115		N/A	N/A	New Distribution Station at Two Mile Creek
NGRID	Lasher Rd (New Station)	Luther Forest	12.49	W	2019	115	115	1	990	1070	New Lasher Rd Switching Station
NGRID	Rotterdam	Rotterdam	-	W	2019	115	115		N/A	N/A	Install Series Reactors at Rotterdam Station on lines 17 & 19
NGRID	Albany Steam	Greenbush	6.14	W	2019	115	115	2	1190	1527	Reconductor Albany - Greenbush 115kV lines 1 & 2
NGRID	West Ashville	West Ashville		W	2019	115	115		N/A	N/A	New Distribution Station at West Ashville
NGRID	Sodeman Rd	Sodeman Rd		W	2019	115	115		N/A	N/A	New Distribution Station at Sodeman Road
NGRID	South Oswego	Indeck (#6)	-	S	2020	115	115	1	-	-	Install High Speed Clearing on Line #6
NGRID	Huntley 230kV	Huntley 230kV	-	S	2020	230	230	-	N/A	N/A	Rebuild of Huntley 230kV Station
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	Dunkirk	Dunkirk	-	S	2020	115	115	1			Add second bus tie breaker
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	-	W	2020	-	-	-	-	-	Rebuild of Gardenville 115kV Station to full breaker and a half
NGRID	Oswego	Oswego	-	W	2020	115	115		N/A	N/A	Rebuild of Oswego 115kV Station

Transmission Owner	Terminals		Line Length in Miles	Expected 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	Niagara	Packard	3.7	S	2021	115	115	2	331MVA	358MVA	Replace 3.7 miles of 193 and 194 lines
NGRID	New Bethlehem	New Bethlehem	-	S	2021	115	115		N/A	N/A	New Bethlehem 115/13.2kV station
NGRID	Gardenville 230kV	Gardenville 115kV	xfmr	S	2021	230/115	230/115	-	347 MVA	422 MVA	Replacement of 230/115kV TB#4 stepdown with larger unit
NGRID	Porter	Porter	-	S	2022	230	230		N/A	N/A	Porter 230kV BPS upgrades
NGRID	Watertown	Watertown		S	2022	115	115		N/A	N/A	New Distribution Station at Watertown
NGRID	Dunkirk	Dunkirk	-	W	2022	115	115		N/A	N/A	Rebuild of Dunkirk 115kV Station
NGRID	Gardenville	Dunkirk	20.5	S	2023	115	115	2	1105	1346	Replace 20.5 miles of 141 and 142 lines
NYPA	Coopers Corners	Rock Tavern	-46.1	In-Service	2017	345	345	1	3072	3768	New Dolson Avenue Ring Bus Station for CPV Valley project
NYPA	Coopers Corners	Dolson Avenue	32.21	In-Service	2017	345	345	1	3000	3000	New Dolson Avenue Ring Bus Station for CPV Valley project
NYPA	Dolson Avenue	Rock Tavern	13.89	In-Service	2017	345	345	1	3000	3000	New Dolson Avenue Ring Bus Station for CPV Valley project
NYPA	Moses	Moses	Cap Bank	In-Service	2017	115	115	1	100 MVAR	100 MVAR	Cap Bank Installation to Replace Moses Synchronous Condensers
NYPA	Cumberland Head	Gordon Landing	1.63	In-Service	2017	115	230	1	1147	1404	Replacement of PV-20 Submarine Cable
NYPA	Moses	Moses	GSU	In-Service	2017	115/13.8/ 13.8	115/13.8/ 13.8	1	TBD	TBD	Replacement of St. Lawrence Hydro Unit GSU #8
NYPA	Moses	Moses	GSU	In-Service	2017	115/13.8/ 13.8	115/13.8/ 13.8	1	TBD	TBD	Replacement of St. Lawrence Hydro Unit GSU #7
NYPA	Marcy 765	Marcy 345	xfmr	W	2018	765/345	765/345	1	1488 MVA	1793 MVA	Install the Marcy Auto Transformer 1(AT1) spare phase to Marcy AT2
NYPA	Niagara	Rochester	-70.2	W	2020	345	345	1	2177	2662	2-795 ACSR
NYPA	Somerset	Rochester	-44	W	2020	345	345	1	2177	2662	2-795 ACSR
NYPA	Niagara	Station 255 (New Station)	66.4	W	2020	345	345	1	2177	2662	2-795 ACSR
NYPA	Somerset	Station 255 (New Station)	40.2	W	2020	345	345	1	2177	2662	2-795 ACSR

Transmission Owner	Terminals		Line Length in Miles	Expected 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	Station 255 (New Station)	Rochester	3.8	W	2020	345	345	1	2177	2662	2-795 ACSR
NYSEG	Elbridge	State Street	14.5	In-Service	In-Service	115	115	1	250 MVA	305 MVA	1033 ACSR
NYSEG	Elbridge	State Street	14.5	In-Service	In-Service	115	115	1	1255	1531	Reconductor 336.4 ACSR to 1194 KCM
NYSEG	Wood Street	Katonah	11.7	In-Service	In-Service	115	115	1	1160	1360	477 ACSR
NYSEG	Wethersfield	Meyer	-31.5	S	2018	230	230	1	1080	1310	795 ACSR
NYSEG	South Perry	Meyer	20	S	2018	230	230	1	1080	1310	795 ACSR
NYSEG	Wethersfield	South Perry	11.5	S	2018	230	230	1	1080	1310	795 ACSR
NYSEG	South Perry	South Perry	xfmr	S	2018	230/115	230/115	1	246 MVA	291 MVA	Transformer
NYSEG	Stephentown	Stephentown	xfmr	S	2018	115/34.5	115/34.5	1	37 MVA	44MVA	Transformer #2
NYSEG	Wood Street	Carmel	1.34	W	2018	115	115	1	261MVA	261MVA	477 ACSR
NYSEG	Flat Street	Flat Street	xfmr	W	2018	115/34.5	115/34.5	2	40MVA	45.2MVA	Transformer #2
NYSEG	Pawling	-	Cap Bank	W	2018	115	115	1	88MVAR	88MVAR	Capacitor Bank
NYSEG	Falls Park 115/34.5kV			S	2019	115/34.5	115/34.5				Tap to interconnect NG Line #14
NYSEG	Falls Park	Schodack(NG)	17.91	S	2019	115	115	1	186 MVA	227 MVA	Tap to interconnect NG Line #14
NYSEG	Falls Park	Churchtown	9.68	S	2019	115	115	1	175 MVA	206 MVA	Tap to interconnect NG Line #14
NYSEG	Falls Park	Falls Park	xfmr	S	2019	115/34.5	115/34.5	1	62 MVA	70 MVA	Transformer #1
NYSEG	Meyer	Meyer	xfmr	S	2019	115/34.5	115/34.5	2	59.2MVA	66.9MVA	Transformer #2
NYSEG	Willet	Willet	xfmr	W	2019	115/34.5	115/34.5	1	39 MVA	44 MVA	Transformer #2
NYSEG	Watercure Road	Watercure Road	xfmr	W	2019	345/230	345/230	1	426 MVA	494 MVA	Transformer #2 and Station Reconfiguration

Transmission Owner	Terminals		Line Length in Miles	Expected 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	
NYSEG	Gardenville	Gardenville	xfmr	W	2019	230/115	230/115	1	316 MVA	370 MVA	NYSEG Transformer #3 and Station Reconfiguration
NYSEG	Oakdale 345	Oakdale 115	xfmr	W	2021	345/115	345/115/ 34.5	1	494MVA	527 MVA	Transformer #3 and Station Reconfiguration
NYSEG	Fraser	Fraser	xfmr	W	2021	345/115	345/115	1	305 MVA	364 MVA	Transformer #2 and Station Reconfiguration
NYSEG	Coopers Corners	Coopers Corners	xfmr	S	2022	345/115	345/115	1	232 MVA	270 MVA	Transformer #3 and Station Reconfiguration
NYSEG	Coopers Corners	Coopers Corners	xfmr	S	2022	115/34.5	115/34.5	1	58 MVA	66 MVA	Transformer #2 and Station Reconfiguration
NYSEG	Wood Street	Wood Street	xfmr	S	2022	345/115	345/115	1	327 MVA	378 MVA	Transformer #3
NYSEG	Mountaindale	Old Falls	5.44	S	2022	115	115	1	108	133	Tap 115kV line and Station Reconfiguration to 115kV Operation
NYSEG	Old Falls	West Woodbourne	0.8	S	2022	115	115	1	108	133	Tap 115kV line and Station Reconfiguration to 115kV Operation
O & R	West Nyack	West Nyack	Cap Bank	S	2018	69	69	1	-	-	Capacitor Bank
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
O & R	Lovett 345 kV Station (New	Lovett	xfmr	S	2021	345/138	345/138	1	562 MVA	562 MVA	Transformer
RGE	Station 122 (Station	Station 122 (Station	xfmr	In-Service	In- Service	345/115	345/115	3	494 MVA	527 MVA	Transformer Replacement and Station Reconfiguration (GRTA)
RGE	Station 80	Station 80	-	In-Service	In- Service	345	345				Station 80 Reconfiguration (GRTA)
RGE	Station 33	Station 262	2.97	S	2019	115	115	1	2008	2008	Underground Cable
RGE	Station 262	Station 23	1.46	S	2019	115	115	1	2008	2008	Underground Cable
RGE	Mortimer	Station 251 (Upgrade Line	1	S	2019	115	115	1	400MVA	400MVA	Line Upgrade
RGE	Station 23	Station 23	xfmr	S	2019	115/11.5/ 11.5	115/11.5/ 11.5	2	75 MVA	84 MVA	Transformer

Transmission Owner	Terminals		Line Length in Miles	Expected 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 23	Station 23	xfmr	S	2019	115/34.5	115/34.5	2	75 MVA	84 MVA	Transformer
RGE	Station 42	Station 23	Phase Shifter	S	2019	115	115	1	253 MVA	253 MVA	Phase Shifter
RGE	Station 262	Station 262	xfmr	S	2019	115/34.5	115/34.5	1	58.8MVA	58.8MVA	Transformer
RGE	Station 122-Pannell-PC1	Station 122-Pannell-PC1		S	2019	345	345	1	1314 MVA-LTE	1314 MVA-LTE	Relay Replacement
RGE	Station 82	Station 251 (Upgrade Line		W	2019	115	115	1	400MVA	400MVA	Line Upgrade
RGE	Station 168	Mortimer (NG Trunk #2)	26.4	S	2020	115	115	1	145 MVA	176 MVA	Station 168 Reinforcement Project
RGE	Station 168	Elbridge (NG Trunk # 6)	45.5	S	2020	115	115	1	145 MVA	176 MVA	Station 168 Reinforcement Project
RGE	Station 418	Station 48	7.6	S	2020	115	115	1	175 MVA	225 MVA	New 115kV Line
RGE	Station 255 (New Station)	Rochester	3.8	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	9.6	W	2020	115	115	1	1506	1807	New 115kV Line
RGE	Station 255 (New Station)	Station 23	11.1	W	2020	115	115	1	1506	1807	New 115kV Line

Emergency Thermal Transfer Limit Analysis

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 41 below reports the emergency thermal transfer limits for the RNA base system conditions.

Figure 41: Emergency Thermal Transfer Limits

Interface	2023	
Dysinger East	2300	1
Volney East	5650	2
Moses South	2650	3
Central East MARS	4450	4
F to G	3475	5
I to J	4400	6
I to K (Y49/Y50)	1293	7

	Limiting Facility	Rating	Contingency
1	Packard - Huntley 230 kV (77)	746	Packard 230/115 kV BK 3
2	Oakdale - Fraser 345 kV	1380	Edic - Fraser 345 kV
3	Marcy 765/345 kV T2 transformer	1971	Marcy 765/345 kV T1
4	Edic - New Scotland 345 kV	1724	Marcy - New Scotland 345 kV
5	Leeds-Pleasant Valley 345 kV	1724	Athens - Pleasant Valley 345 kV
6	Mott Haven - Rainey 345 kV	785	Pre-disturbance
7	Dunwoodie - Shore Rd. 345 kV	653	Pre-disturbance

Figure 42: Dynamic Limit Tables

Year	Interface	Oswego Complex Units*					
		All available	Any 1 out	Any 2 out	Any 3 out	Any 4 out	Any 5 (or more) out
All	Central East MARS	3100	3050	2990	2885	2770	2645
	Central East Group	5000	4925	4840	4685	4510	4310

* 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)	104	74	0
	Jamaica Ties	505	390	236

Year	Interface	Northport Units	
		All available	Any out
All	Norwalk CT to 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

US DL Limit (MW)	Units Available		
	CPV Valley	Cricket Valley	Athens
6950	2	3	3
6750	2	3	2
6700	1	3	3
6550	2	2	3
6150	2	1	3
5950	1	1	3
5800	2	0	3
6600	All other conditions		

2018 RNA MARS Model Base Case Development

The NYISO developed the system representations for PJM, Ontario, New England, and Hydro Quebec modeled in the 2018 RNA Base Case from the NPCC CP-8 2017 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 through year 10.

The topology used in the MARS model RNA Base Case is located in Figures 21 to 24 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.

2018 RNA Short Circuit Assessment

Figure 43 below provides the results of NYISO's short circuit screening test for year 5 (2023) 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 43: 2018 RNA Fault Current Analysis Summary Table for 2023 System Representation

Substation	Nominal Voltage (kV)	Smallest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Over-dutied
ACADEMY	345	63	Con Ed	31.6	N	N
ADIRONDACK	230	25	N. Grid	9.4	N	N
AES SOMERSET	345	40	NYSEG	22.6	N	N
ALPS	345	40	N. Grid	17.8	N	N
ASTE-ERG	138	63	Con Ed	56.4	N	N
ASTE-WRG	138	63	Con Ed	56.4	N	N
ASTORIA W-N	138	45	Con Ed	43.8	N	N
ASTORIA W-S	138	45	Con Ed	43.8	N	N
ASTOR345	345	63	NYPA	46.1	N	N
ATHENS	345	48.8	N. Grid	33.9	N	N
BARRETT1	138	63	LIPA	48.2	N	N
BAYONNE	345	50	Con Ed	26.0	N	N
BOONVILLE	115	29.7	N. Grid	10.6	N	N
BOWLINE 2	345	40	O&R	26.4	N	N
BOWLINE1	345	40	O&R	26.6	N	N
BRKHAVEN	138	37	LIPA	26.8	N	N
BUCH138	138	40	Con Ed	16.4	N	N
BUCHANAN N	345	63	Con Ed	25.2	N	N
BUCHANAN S	345	63	Con Ed	35.0	N	N
C.ISLIP	138	38.9	LIPA	28.0	N	N
CANANDAIGUA	230	40	NYSEG	6.6	N	N
CARLE PL	138	63	LIPA	40.7	N	N
CHASES LAKE	230	40	N. Grid	8.9	N	N
CLARKS CNRS	115	40	NYSEG	18.3	N	N
CLARKS CNRS	345	40	NYSEG	11.8	N	N
CLAY	345	49.1	N. Grid	33.3	N	N
CLAY	115	44.4	N. Grid	37.6	N	N
COOPERS CRN	345	40	NYSEG	18.9	N	N
COOPERS CRN4	115	22.6	NYSEG	19.4	N	N
COOPERS CRN8	115	22.6	NYSEG	19.4	N	N

Substation	Nominal Voltage (kV)	Smallest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Over-dutied
CORONA-N	138	63	Con Ed	56.0	N	N
CORONA-S	138	63	Con Ed	56.0	N	N
DEWITT	115	63	N. Grid	28.6	N	N
DEWITT	345	40	N. Grid	18.9	N	N
DUFFY AVE	345	58.6	LIPA	8.4	N	N
DULEY	230	40	NYPA	7.6	N	N
DUN NO	138	40	Con Ed	34.6	N	N
DUN SO	138	40	Con Ed	30.1	N	N
DUNKIRK	230	29.6	N. Grid	9.4	N	N
DUNWOODIE	345	63	Con Ed	48.4	N	N
E13 ST	138	63	Con Ed	49.7	N	N
E FISHKILL	115	40	CH	24.4	N	N
E FISHKILL	345	63	Con Ed	42.1	N	N
E13ST 46	345	63	Con Ed	53.9	N	N
EASTOVER	230	50	N. Grid	10.8	N	N
EASTOVER N	115	50	N. Grid	24.7	N	N
EASTVIEW	138	63	Con Ed	35.9	N	N
EDIC	345	40	N. Grid	33.0	N	N
EGC PAR	345	63	NYPA	24.7	N	N
EGC-1	138	80	LIPA	69.1	N	N
EGC-2	138	80	LIPA	69.1	N	N
ELBRIDGE D	115	63	N. Grid	27.6	N	N
ELBRIDGE	345	40	N. Grid	16.0	N	N
ELWOOD 1	138	63	LIPA	39.0	N	N
ELWOOD 2	138	63	LIPA	38.7	N	N
FARRAGUT	345	63	Con Ed	59.8	N	N
FITZPATRICK	345	37	NYPA	41.1	Y	N
FIVE MILE RD	115	39.7	N. Grid	14.3	N	N
FIVE MILE RD	345	40	N. Grid	7.3	N	N
FRESH KILLS	345	63	Con Ed	27.7	N	N
FRESH KILLS	138	40	Con Ed	36.4	N	N
FRASER	115	40	NYSEG	18.5	N	N
FRASER	345	40	NYSEG	19.2	N	N
FREEPORT	138	63	LIPA	35.5	N	N
GARDEN (NM)	34.5	21	N. Grid	16.9	N	N
GARDEN BS3	115	39.9	N. Grid	38.5	N	N
GARDEN BS4	115	39.9	N. Grid	38.7	N	N
GARDEN BS5-7	115	39.9	N. Grid	38.7	N	N
GARDEN BS6-8	115	39.9	N. Grid	38.8	N	N
GARDENVILLE1	230	32.2	N. Grid	19.5	N	N

Substation	Nominal Voltage (kV)	Smallest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Over-dutied
GILBOA 345	345	50	NYPA	24.9	N	N
GLNWD NO	138	63	LIPA	44.3	N	N
GLNWD SO	138	63	LIPA	43.8	N	N
GOTHLS	345	63	Con Ed	30.5	N	N
GOWANUS	345	63	Con Ed	29.7	N	N
GREENLWN	138	63	LIPA	28.8	N	N
HAUPAGUE	138	63	LIPA	21.9	N	N
HIGH SHELDON	230	40	NYSEG	10.0	N	N
HILLSIDE #4	115	21.0	NYSEG	18.7	N	N
HILLSIDE #8	115	21.0	NYSEG	18.7	N	N
HILLSIDE 230	230	35.8	NYSEG	14.1	N	N
HILLSIDE#4	34.5	21.6	NYSEG	18.0	N	N
HOLBROOK	138	63	LIPA	48.2	N	N
HOLTSGT-GTs	138	63	LIPA	44.6	N	N
HUNTLEY 68	230	31.8	N. Grid	17.2	N	N
HUNTLEY 70	230	35.8	N. Grid	17.2	N	N
HURLEY	345	40	CH	18.6	N	N
HURLEY AVE	115	37.8	CH	16.3	N	N
INDEPENDENCE	345	41.9	N. Grid	38.3	N	N
JAMAICA	138	63	Con Ed	49.1	N	N
LADENTOWN	345	63	O&R	38.3	N	N
LAFAYETTE	345	40	N. Grid	17.8	N	N
LCST GRV	138	63	LIPA	39.3	N	N
LEEDS	345	40	N. Grid	34.6	N	N
LHH WHITE	115	38.1	N. Grid	10.8	N	N
LKE SCSS1	138	63	LIPA	38.0	N	N
MARCY 345	345	63	NYPA	32.3	N	N
MARCY 765	765	63	NYPA	9.8	N	N
MASSENA 765	765	63	NYPA	7.8	N	N
MEYER	34.5	21.6	NYSEG	11.1	N	N
MEYER	115	18.8	NYSEG	11.3	N	N
MEYER	230	40	NYSEG	7.3	N	N
MIDDLETOWN TAP	345	63	CH	18.9	N	N
MILLR PL	138	63	LIPA	14.7	N	N
MILLWOOD 138	138	40	Con Ed	19.3	N	N
MILLWOOD	345	63	Con Ed	42.2	N	N
MOTT HAVEN	345	63	Con Ed	49.2	N	N
NEWBRID	138	80	LIPA	67.9	N	N
NEWBRIDG	345	58.6	LIPA	8.5	N	N

Substation	Nominal Voltage (kV)	Smallest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Over-dutied
NIAGARA 345	345	63	NYPA	34.4	N	N
NIAGRA E 115	115	41.4	NYPA	37.8	N	N
NIAGRA E 230	230	63	NYPA	54.4	N	N
NIAGRA W 115	115	41.4	NYPA	27.7	N	N
NIAGRA W 230	230	63	NYPA	54.4	N	N
NMP#1	345	50	N. Grid	43.2	N	N
NMP#2	345	50	N. Grid	43.8	N	N
NRTHPRT1	138	63	LIPA	61.6	N	N
NRTHPRT1-2	138	63	LIPA	61.6	N	N
NRTHPRT2	138	63	LIPA	61.6	N	N
NRTHPRT3	138	63	LIPA	46.1	N	N
NRTHPRT4	138	63	LIPA	46.1	N	N
NSCOT 77B	345	40	N. Grid	31.2	N	N
NSCOT 99B	345	40	N. Grid	31.2	N	N
NSCOT33	115	63	N. Grid	46.3	N	N
NSCOT77	115	63	N. Grid	46.3	N	N
NSCOT99	115	63	N. Grid	46.3	N	N
OAKDALE	34.5	22.9	NYSEG	20.0	N	N
OAKDALE	115	40	NYSEG	30.4	N	N
OAKDALE 345	345	40	NYSEG	12.9	N	N
OAKWOOD	138	63	LIPA	27.9	N	N
ONEIDA EAST	115	28.4	N. Grid	13.2	N	N
ONEIDA WEST	115	28.4	N. Grid	13.2	N	N
OSWEGO	345	40.6	N. Grid	32.2	N	N
OSWEGO M3	115	40	N. Grid	20.8	N	N
PACKARD 2&3	230	47.8	N. Grid	39.9	N	N
PACKARD 4&5	230	47.8	N. Grid	39.9	N	N
PACKARD 6	230	50	N. Grid	40.0	N	N
PACKARD NRTH	115	63	N. Grid	29.4	N	N
PACKARD STH	115	63	N. Grid	26.3	N	N
PATNODE	230	63	NYPA	10.6	N	N
PILGRIM	138	63	LIPA	59.6	N	N
PLATTSBURGH	115	20.7	NYPA	17.6	N	N
PLEASANT VAL	115	37.8	CH	27.6	N	N
PLTVLLEY	345	63	Con Ed	46.4	N	N
PORTER	230	21.1	N. Grid	19.3	N	N
PORTER	115	55.6	N. Grid	40.5	N	N
PT JEFF	138	63	LIPA	32.0	N	N
PL VILLW	345	63	Con Ed	21.8	N	N
PL VILLE	345	63	Con Ed	21.5	N	N

Substation	Nominal Voltage (kV)	Smallest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Over-dutied
RAINEY	345	63	Con Ed	55.8	N	N
RAMAPO	345	63	Con Ed	42.9	N	N
REYNOLDS	345	40	N. Grid	15.4	N	N
REYNOLDS RD	115	43	N. Grid	38.2	N	N
RIVERHD	138	63	LIPA	18.0	N	N
RNKNKOMA	138	63	LIPA	36.3	N	N
ROBINSON RD.	34.5	21.8	NYSEG	8.8	N	N
ROBINSON RD.	115	37.9	NYSEG	17.7	N	N
ROBINSON RD.	230	43	NYSEG	13.7	N	N
ROCK TAV	115	39.5	CH	25.2	N	N
ROCK TAVERN	345	63	CH	33.7	N	N
ROSETON	345	63	CH	37.5	N	N
ROSLYN	138	63	LIPA	30.5	N	N
ROTTERDAM66H	230	40	N. Grid	13.6	N	N
ROTTERDAM77H	230	23.6	N. Grid	13.5	N	N
ROTTERDAM99H	230	23.2	N. Grid	13.6	N	N
RULND RD	138	63	LIPA	45.0	N	N
RYAN	230	40	NYPA	10.8	N	N
S OSWEGO	115	39.2	N. Grid	20.4	N	N
S RIPLEY	230	40	N. Grid	8.8	N	N
S013A	115	37.6	RGE	24.5	N	N
S080 345kV	345	40	RGE	18.7	N	N
S080 922	115	39.1	RGE	16.6	N	N
S082 B2	115	40	RGE	35.9	N	N
S082 B3	115	40	RGE	35.8	N	N
S122	345	40	RGE	17.6	N	N
DUN NO S6	138	63	Con Ed	29.1	N	N
DUN SO N7	138	63	Con Ed	26.4	N	N
SCHUYLER	115	36	N. Grid	15.3	N	N
SCRIBA	345	48.3	N. Grid	46.6	N	N
SCRIBA C	115	40	N. Grid	10.4	N	N
SCRIBA D	115	40	N. Grid	10.4	N	N
SHORE RD	345	63	LIPA	27.1	N	N
SHORE RD1	138	57.8	LIPA	47.4	N	N
SHORE RD2	138	57.8	LIPA	47.4	N	N
SHOREHAM1	138	52.2	LIPA	27.8	N	N
SHOREHAM2	138	63	LIPA	27.8	N	N
SILLS RD1	138	63	LIPA	31.6	N	N
SMAH	138	40	RECO	26.7	N	N
SPRAINBROOK	345	63	Con Ed	49.4	N	N

Substation	Nominal Voltage (kV)	Smallest Breaker Rating (kA)	Owner	Maximum Bus Fault (kA)	IBA Required	Breaker(s) Over-dutied
ST LAWRN 115	115	41.4	NYPA	41.4	N	N
ST LAWRN 230	230	33.1	NYPA	32.1	N	N
STOLLE	115	23.9	NYSEG	19.5	N	N
STOLLE ROAD	345	40	NYSEG	8.9	N	N
STOLLE ROAD	230	40	NYSEG	13.4	N	N
STONEYRIDGE	230	40	NYSEG	7.3	N	N
STONY CREEK	230	40	NYSEG	8.9	N	N
SUGLF 345TAP	345	63	CH	25.3	N	N
SYOSSET	138	63	LIPA	33.8	N	N
TEALL	115	40	N. Grid	25.9	N	N
TERMINAL	115	28.4	N. Grid	16.9	N	N
SECT 11	138	63	Con Ed	42.3	N	N
SECT 12	138	63	Con Ed	42.2	N	N
MHTX2	138	50	Con Ed	13.7	N	N
VALLEY	115	40	N. Grid	8.4	N	N
VERNON-E	138	63	Con Ed	46.5	N	N
VERNON-W	138	63	Con Ed	34.0	N	N
VLY STRM1	138	63	LIPA	53.2	N	N
VLY STRM2	138	63	LIPA	53.4	N	N
VOLNEY	345	44.8	N. Grid	36.1	N	N
W 49 ST	345	63	Con Ed	50.9	N	N
WADNGRV1	138	56.4	LIPA	25.6	N	N
WATERCURE230	230	40	NYSEG	14.1	N	N
WATERCURE345	345	40	NYSEG	9.3	N	N
WATKINS	115	40	N. Grid	8.6	N	N
WETHERSFIELD	230	40	NYSEG	8.7	N	N
WHAV	138	40	O&R	25.8	N	N
WILDWOOD	138	63	LIPA	27.8	N	N
WILLIS 230	230	33.1	NYPA	13.5	N	N
WOOD ST.	115	40	NYSEG	19.7	N	N
WOODARD	115	35.7	N. Grid	15.5	N	N
YAHNUNDASIS	115	25.1	N. Grid	6.5	N	N

2018 RNA Transmission Security Violations

The preliminary transmission security assessment identified a Reliability Need in year 10 (2028) in Eastern Long Island. A LIPA LTP update at the June 28 ESPWG/TPAS meeting resolved this Reliability Need. Also, the transmission security assessment observed thermal violations in year 1 (2019); however, these overloads are not considered Reliability Needs because the Responsible TOs have LTPs identified in the 2018 Gold Book to address them, and will use interim operating procedures to maintain the security of the system until the LTPs are placed in-service. Year 1, year 5, and year 10 were studied and the top 10 BPTF violations identified in the analyses are shown in **Figure 44** on the next page. The mitigation plans are discussed in the report.

Figure 44: 2018 RNA Transmission Security Analysis Summary Table

Study Year	Zone	Owner	Monitored Element	Base Case Rating [MVA]	Contingency Rating [MVA]	Initial Condition	Contingency	% Overload
Preliminary Reliability Needs (subsequently mitigated by LIPA's updated LTPs)								
Y-10	K	LIPA	Brookhaven - Edwards Ave. (#864) 138	**264**	324	138-890	Base Case	101
Transmission Security Violations that are being addressed with Mitigation Plans and LTPs								
Y-01	C	N. Grid	Clay - Dewitt (#3) 115 (Clay - Bartell Rd)	116	**120**	CLAY - TEAL 10 115	SB:DEWI345_R220	109
Y-01	C	N. Grid	Clay - Dewitt (#3) 115 (Clay - Bartell Rd)	116	**120**	CLAY - TEAL 10 115	SB:DEWI345_R915	109
Y-01	C	N. Grid	Clay - Dewitt (#3) 115 (Clay - Bartell Rd)	116	**120**	CLAY - TEAL 10 115	SB:DEWI345_R130	109
Y-01	C	N. Grid	Clay - Dewitt (#3) 115 (Clay - Bartell Rd)	116	**120**	CLAY - TEAL 10 115	DEWITT 345/115 2TR	107
Y-01	C	N. Grid	Clay - Dewitt (#3) 115 (Clay - Bartell Rd)	116	**120**	CLAY - DEW 5 115	SB:DEWI345_R220	103
Y-01	C	N. Grid	Clay - Dewitt (#3) 115 (Clay - Bartell Rd)	116	**120**	CLAY - DEW 5 115	SB:DEWI345_R915	103
Y-01	C	N. Grid	Clay - Dewitt (#3) 115 (Clay - Bartell Rd)	116	**120**	CLAY - DEW 5 115	SB:DEWI345_R130	103
Y-01	C	N. Grid	Clay - Dewitt (#3) 115 (Clay - Bartell Rd)	116	**120**	DEWITT 345/115 2TR	SB:CLAY115_R875	102
Y-01	C	N. Grid	Clay - Dewitt (#3) 115 (Clay - Bartell Rd)	116	**120**	OS - EL - LFYTE 345 17	CLAY - DEW 345 13	102

Study Year	Zone	Owner	Monitored Element	Base Case Rating [MVA]	Contingency Rating [MVA]	Initial Condition	Contingency	% Overload
Transmission Security Violations that are being addressed with Mitigation Plans and LTPs								
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	CLAY - DEW 3 115	SB:DEWI345_R220	113
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	CLAY - DEW 3 115	SB:DEWI345_R915	113
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	CLAY - DEW 3 115	SB:DEWI345_R130	113
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	CLAY - DEW 3 115	DEWITT 345/115 2TR	110
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	DEWITT 345/115 2TR	CLAY - TEAL 11 115	108
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	DEWITT 345/115 2TR	SB:CLAY115_R865	107
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	DEWITT 345/115 2TR	SB:CLAY115_R110	107
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	CLAY - TEAL 11 115	SB:DEWI345_R220	104
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	CLAY - TEAL 11 115	SB:DEWI345_R915	104
Y-01	C	N. Grid	Clay - Teall (#10) 115 (Clay - Bartell Rd - Pine Grove)	116	120	CLAY - TEAL 11 115	SB:DEWI345_R130	104

Study Year	Zone	Owner	Monitored Element	Base Case Rating [MVA]	Contingency Rating [MVA]	Initial Condition	Contingency	% Overload
Y-01	G	O&R	W. Haverstraw (#671) 345/138	501	**607**	O&RLINE-60	SB:LADE_6-56-2	103
Y-01	G	O&R	W. Haverstraw (#671) 345/138	501	**607**	O&RLINE-60	BOWLN 345/138 TR	103
Y-01	G	O&R	W. Haverstraw (#671) 345/138	501	**607**	BOWLN 345/138 TR	O&RLINE-60	103
Y-01	G	O&R	W. Haverstraw (#671) 345/138	501	**607**	O&RLINE-60	LDNTWN - BOWLINE 345 68	102
Y-01	G	O&R	W. Haverstraw (#671) 345/138	501	**607**	LDNTWN - BOWLINE 345 68	O&RLINE-60	102