2016 Reliability Needs Assessment

New York Independent System Operator

FINAL REPORT

October 18, 2016

Caution and Disclaimer

Table of Contents

Table of Tables

Table of Figures

Executive Summary

This 2016 Reliability Needs Assessment (RNA) assesses both the transmission and resource adequacy and the transmission security of the New York Control Area (NYCA) bulk power transmission system from year 2017 through 2026, the "Study Period" of this RNA.

This 2016 Reliability Needs Assessment finds two transmission security related Reliability Needs in portions of the Bulk Power Transmission Facilities (BPTF) beginning in 2017:

- the New York State Electric & Gas Corp. (NYSEG) Oakdale 345/115 kV transformer, and
- the Long Island Lighting Company d/b/a Long Island Power Authority (LIPA) East Garden City to Valley Stream 138 kV line.

This 2016 Reliability Needs Assessment finds that the resource adequacy criterion is 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, the NYISO initiates the next step, which starts by requesting Local Transmission Owner Plans (LTPs) updates. As part of this step, the NYISO will consider updates to Local Transmission Owner Plans and, if necessary, solicit market-based solutions, regulated backstop solutions, and alternative regulated solutions to the identified Reliability Needs. The NYISO 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 documentation of the solutions determined to be viable and sufficient to meet the identified Reliability Needs and, if appropriate, 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 would be eligible for cost allocation and recovery under the NYISO's tariff.

Summary of Transmission and Resource Adequacy Results

From the transmission and 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 ten-year Study Period. This is mainly attributable to the decrease in the summer peak baseline load forecast of approximately 2,300 MW in 2021 as compared with the

2014 Reliability Needs Assessment. When recent and planned capacity deactivations were included in the calculation, the net statewide surplus increased by approximately 3,000 MW as compared with the 2014 Reliability Needs Assessment and about 975 MW as compared with the 2014 Comprehensive Reliability Plan (see **Table E-1**).

Table E-1: 2016 RNA Load and Capacity Comparison with the 2014 RNA and 2014 CRP (MW)

2016 RNA vs. 2014 RNA

Year 2021	2016 RNA	2014 RNA	Delta 2016RNA - 2014RNA
Baseline Load	33,555	35,890	-2,335
SCR	1,248	1,189	59
Total Capacity without SCRs	39,899	39,322	577
Net Change in Capacity less Load			2,971

2016 RNA vs. 2014 CRP

Year 2021	2016 RNA	2014 CRP	Delta 2016RNA - 2014CRP
Baseline Load	33,555	35,765	-2,210
SCR	1,248	1,189	59
Total Capacity without SCRs	39,899	41,193	-1,294
Net Change in Capacity less Load			975

Summary of Transmission Security Results

The 2016 Reliability Needs Assessment has identified two transmission security related Reliability Needs in portions of the Bulk Power Transmission Facilities. Specifically, **Table E-2** and **Figure E-1** show that the identified transmission security issues occur in Long Island and Western New York beginning in 2017.

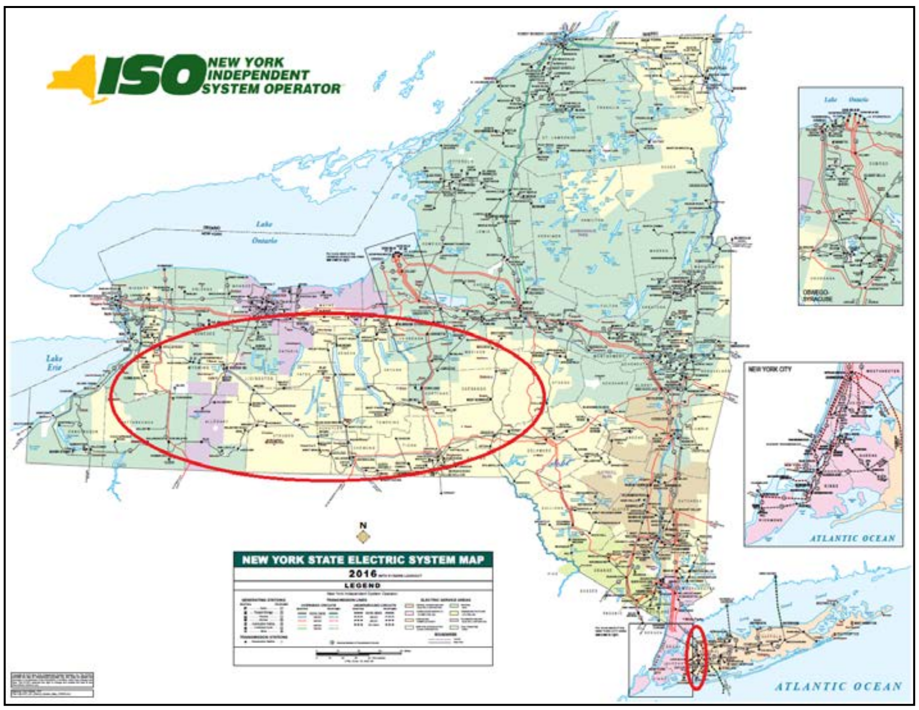
Table E-2: 2016 RNA Transmission Security Reliability Needs

Zone	Owner	Monitored Element	Year of Need
C	NYSEG	Oakdale 345/115 2TR	2017
K	LIPA	East Garden City-Valley Stream (#262) 138	2017

In Long Island, the East Garden City to Valley Stream 138 kV line could not be secured within applicable thermal ratings when another 138 kV line is out-of-service (also known as an "N-1-1" condition). The power flow on this facility is driven by the combination of LIPA load in western Long Island and the scheduled 300 MW wheel between ConEdison and LIPA. This overload has now been identified as a result of no longer reducing the wheel following an outage, for which ConEdison's contractual portion of Y50 is assumed to be delivered to ConEdison, thus reducing the portion of western Long Island load that is capable of being served through the overloaded facility from generating sources in eastern Long Island.

The Oakdale 345/115 kV transformer also could not be secured within applicable thermal ratings under certain transmission line outage conditions. This overload was noted in the 2014 Reliability Needs Assessment as well. At that time, NYSEG provided an update to their Local Transmission Owner Plans that included a third Oakdale transformer and reconfiguration of the Oakdale 345 kV substation. NYSEG's planned in-service date was 2018, which met the inclusion rules and therefore addressed the Reliability Need identified in the 2014 Reliability Needs Assessment. However, as part of the 2016 Gold Book reporting process, NYSEG updated the in-service date to the winter of 2021, which does not meet the inclusion rules for this 2016 Reliability Needs Assessment Base Case. Without this project in the Base Case, the Oakdale transformer remains overloaded.

Figure E-1: Areas of the Transmission Security Related Reliability Needs



The two transmission security related Reliability Needs listed in **Table E-2** will be eligible for the NYISO to solicit solutions if those Reliability Needs remain unresolved by further updates to Local Transmission Owner Plans. Following such a solicitation by the NYISO, developers may submit market-based solutions and alternative regulated solutions for evaluation as part of the 2016 Comprehensive Reliability Plan.

As a backstop to market-based solutions, the NYISO employs a process to define responsibility should the market fail to provide an adequate solution to an identified Reliability Need. The Responsible Transmission Owners for the identified Reliability Needs, NYSEG and LIPA, will be tasked to develop detailed regulated backstop solutions for evaluation in the 2016 Comprehensive Reliability Plan.

Given the limited time between the identification of the transmission security related Reliability Needs in this Reliability Needs Assessment report and their occurrence in 2017, the use of demand response and operating procedures, including load shedding under emergency conditions, may be necessary to maintain reliability during peak load periods until permanent solutions can be put in place. Accordingly, the Responsible Transmission Owners will present at the Electric System Planning Working Group (ESPWG) and at the Transmission Planning Advisory Subcommittee (TPAS) any updates to their LTPs that impact the Reliability Needs identified in the 2016 Reliability Needs Assessment, including their proposed operating procedures pending completion of their permanent solutions, for review and acceptance by the NYISO and consideration for inclusion in the 2016 Comprehensive Reliability Plan.

Summary of Scenario Results

In addition, the 2016 Reliability Needs Assessment provides analysis of risks to the Bulk Power Transmission Facilities under certain scenarios to assist stakeholders and developers in developing and proposing market-based and regulated reliability solutions, as well as policy makers to formulate state policy.

Scenarios are variations on the Reliability Needs Assessment Base Case to assess the impact of possible changes in key study assumptions, such as higher load forecast (i.e., not including the benefits of retail solar photovoltaic ("solar PV", or "behind-the-meter solar PV") and of energy efficiency programs), capacity retirements or sales (e.g., all nuclear units retire, remaining coal units deactivate, etc.), and additional transmission build-outs (e.g., transmission driven by public policy) which, if they occurred, could change the timing, location, or degree of violations of applicable Reliability Criteria on the NYCA system during the Study Period.

As demonstrated in the 2016 Reliability Needs Assessment scenarios, a higher load level or additional retirement of capacity (nuclear, etc) could cause resource adequacy Reliability Needs.

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

- High Load (Econometric) Forecast – Resource Adequacy

    The High Load Forecast Scenario excludes the energy efficiency program impacts and retail solar PV programs from the baseline peak forecast. This results in a 2,962 MW increase in peak load in the year 2026 as compared with the Reliability Needs Assessment Base Case forecast of the same year. Given that the peak load in the econometric forecast is higher than the Reliability Needs Assessment Base Case, the probability of exceeding the LOLE criterion increases, and violations occur as soon as 2019.

- Zonal Capacity at Risk – Resource Adequacy

  The Zonal Capacity at Risk Scenario identifies a maximum level of "perfect capacity" (*i.e.,* no transmission adequacy or security assessments were performed to identify further limitations) that can be removed from a zone without causing NYCA LOLE violations.

  For year 2017, removal of up to 1,500 MW in Zones A through F; 1,150 MW in Zones G through I; 950 MW in Zone J; or 750 MW in Zone K would not result in a NYCA resource adequacy violation.

- Indian Point Energy Center Plant Retirement – Resource Adequacy

  This scenario simulates the retirement of the Indian Point Energy Center by removing about 2,060 MW of capacity from Zone H, and finds that significant violations of resource adequacy criteria would occur immediately in 2017.

  Specifically, the NYCA LOLE would be 0.21 in 2017. Beyond 2017, the LOLE would remain above the 0.1 LOLE threshold through the Study Period. Compared with the 2014 Reliability Needs Assessment, the resulting LOLE violations are lower, but continue to substantially exceed the LOLE requirement should the Indian Point Plant retire.

- No Coal – Resource Adequacy

  This scenario assesses a case in which there are no coal-fired power plants operating in New York State. It found a relatively small increase in the LOLE from 0.04 to 0.06 days per year in 2017.

- No Nuclear – Resource Adequacy

  This scenario assesses the retirement of the remaining nuclear power plants in New York State (in addition to Ginna and FitzPatrick already being assumed as retired in the Reliability Needs Assessment Base Case). The resulting loss of approximately 4,000 MW would increase the LOLE from 0.04 to 0.36 days per year in 2017.

- Continued Forward Capacity Sales to External Control Areas – Resource Adequacy

  This scenario finds an increase in the NYCA LOLE from 0.02 to 0.04 days per year in 2020 as a result of holding the capacity sales to New England constant from 2018 to the end of the Study Period in 2026. This assessment does not address the impacts on major transmission interface transfer capabilities caused by the capacity sales to New England.

- 90/10 Load Forecast – Transmission Security

  The 90/10 forecast for the statewide coincident summer peak load is on average approximately 2,500 MW higher than the baseline summer peak 50/50 forecast used in the Reliability Needs Assessment Base Case.

  The two primary regions of Reliability Needs identified in the Reliability Needs Assessment Base Case are exacerbated under 90/10 coincident peak load conditions, including the occurrence of additional facility overloads in those regions.

- Western New York Public Policy Transmission Need – Transmission Security

  Given the preliminary identification of Reliability Needs in Western New York, the NYISO analyzed a scenario in which a transmission project has been completed in response to the Western New York Public Policy Transmission Need. The objective of the Western New York Public Policy Transmission Need is to relieve congestion in Western New York, including access to increased output from the Niagara hydroelectric facility and additional imports of renewable energy from Ontario.

  The analysis finds that a transmission project that addresses the Western New York Public Policy Transmission Need, once in-service, would reinforce the Western New York system reliability beyond the currently assumed Local Transmission Owner Plans, and would resolve the Oakdale 345/115 kV transformer overload.

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: (i) units interconnecting to the bulk power transmission system; (ii) the development and installation of local transmission facilities; (iii) additions, mothballs or retirement of generators; (iv) the status of mothballed/retired facilities; (v) the continued implementation of New York State energy efficiency, solar PV installations, clean energy standards, and similar programs; (vi) participation in the NYISO demand response programs; and (vii) the impact of new and proposed environmental regulations on the existing generation fleet.

A number of recent developments affect the Bulk Power Transmission Facilities, including the Clean Energy Standard Order issued by New York State Public Service Commission (NYPSC) on August 1, 2016, mandating implementation of a “Large-Scale Renewable Program” and a “Clean Energy Standard,” along with establishing “Facility Costs for the R.E Ginna and Nine Mile Point Nuclear Power Plants.” The NYISO will continue to monitor these and other developments.

1. Introduction

This report sets forth the NYISO's 2016 Reliability Needs Assessment (RNA) and scenario findings for the Study Period (years 2017 through 2026).

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 and adequacy 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) that would be necessary to resolve that need. After NYISO Board approval of the RNA, the NYISO will request market-based and alternative regulated proposals from interested parties to address the identified Reliability Needs, and designate one or more Responsible Transmission Owners to develop a regulated backstop solution to address each identified Reliability Need.

The CRP provides a plan for continued reliability of the bulk power system during the study period depending on a combination of additional resources. The resources may be provided by market-based solutions developed in response to market forces and the request for solutions following the approval of this RNA. If the market does not adequately respond, reliability will be maintained by either regulated solutions being developed by the TOs, which are obligated to provide reliable service to their customers, or alternative regulated solutions being developed by others. To maintain the bulk power system's long-term reliability, these additional resources must be readily available or in development at the appropriate time to address the specific need. 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. 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.

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 with the changes to the RPP that were implemented since the 2014 RNA and affect the 2016 RNA process. Next, this report summarizes the 2014 CRP findings and prior 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 for years 2017 through 2026. Detailed analyses, data and results, and the underlying modeling assumptions are contained in the appendices.

For informational purposes, this RNA report also provides the latest historical information available for the past five years of congestion via a link to the NYISO's website. The 2016 CRP will serve as the foundation for the 2017 Congestion Assessment and Resource Integration Study (CARIS), which will present more detailed evaluation of system congestion.

2. Overview of RPP Changes

The RPP has undergone substantive changes since the 2014 RNA. 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).

The primary change to the RPP that affects the 2016 RNA is that the NYISO provided "preliminary RNA results" to stakeholders during the drafting of the report. The stakeholders were then able to provide substantive updates that may impact the results. The NYISO then incorporated system changes that may impact the preliminary results and that had occurred since the initial lock down date of the RNA assumptions matrix into the Base Case before finalizing the results. The NYISO considered the following updates:

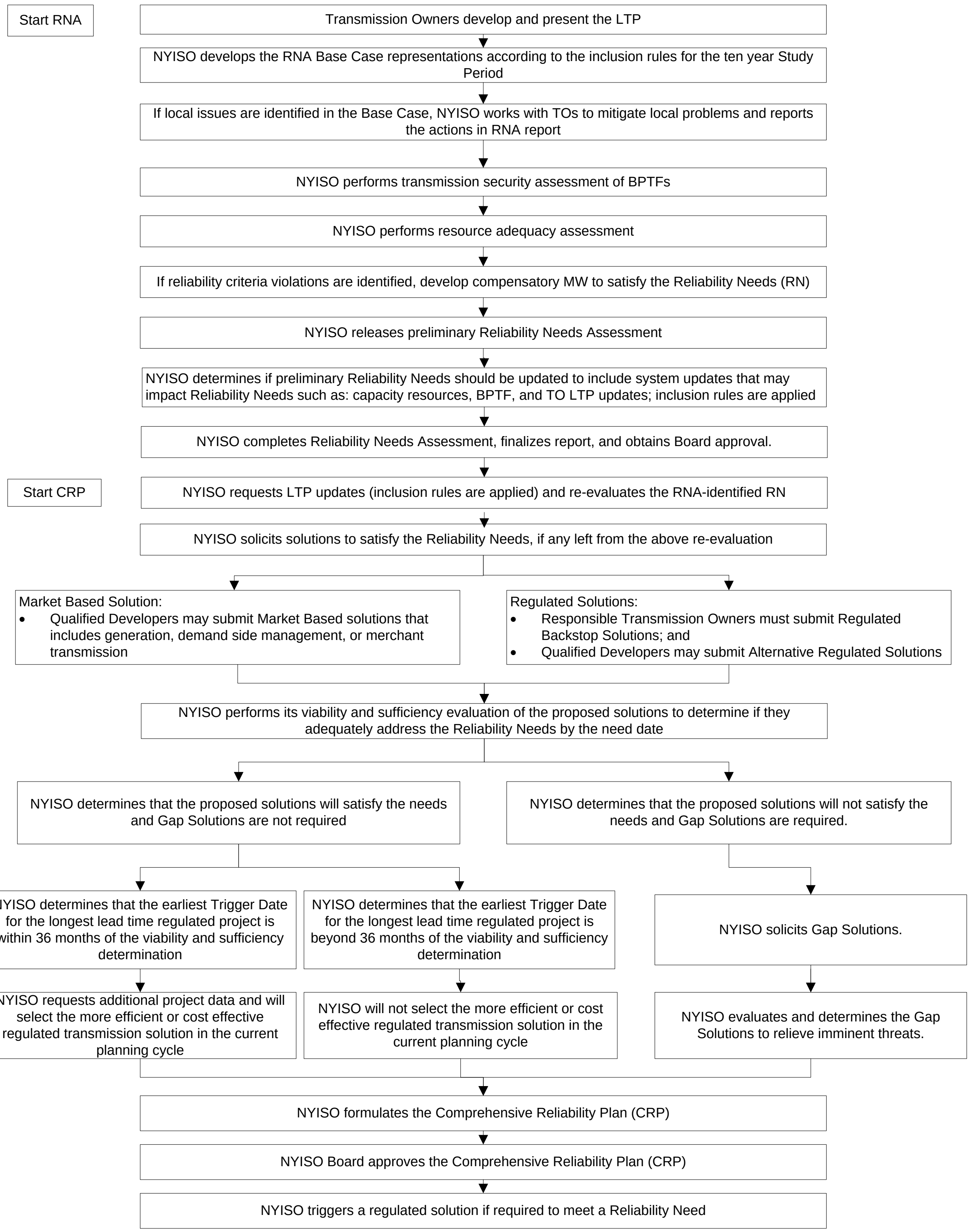
- Updates to previously submitted Local Transmission Owner Plans (LTPs) or New York Power Authority (NYPA) plans that have reached a stage of development to be included and that may impact the preliminary Reliability Needs,
- Changes in Bulk Power Transmission Facilities, and
- Change in resources such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

If the NYISO determines that an update did not meet the inclusion rules and/or did 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, 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 to meet the Reliability Needs identified in the RNA. Prior to responding to the RNA, the Responsible Transmission Owner(s) will report at the Electric System Planning Working Group (ESPWG) and the Transmission Planning Advisory Subcommittee (TPAS) information regarding any updates in its LTPs that could affect the Reliability Needs. Also, NYPA, at the NYISO's request, will similarly report 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 with recognition of the updates to the Transmission Owners' LTPs and NYPA transmission plans and their impacts on the Reliability Needs, if any. Developers should use this information in responding to the Reliability Needs, as appropriate. 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 2-1** below. This figure has been updated from the one in the RPP Manual in order to reflect further clarifications.

Figure 2-1: NYISO Reliability Planning Process (RPP)



3. Summary of Prior CRPs

This is the eighth 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 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.

Table 3-1 presents the market solutions and TOs' plans that were submitted in response to previous requests for solutions.

Table 3-1: Current Status of Tracked Market-Based Solutions & TOs' Plans

Queue #	Project	Submitted	Zone	Original I/S Date	Nameplate (MW)	CRIS (MW)	Summer (MW)	Proposal Type	Current Status	Included in the 2016 RNA Base Case
339	Station 255	CRP2012	B	-	N/A	N/A	N/A	TO Plan	Q4 2019-2020	Yes
-	Clay-Teall #10 115kV	CRP2012	C	2016	N/A	N/A	N/A	TO Plan	Q4 2017	Yes

4. 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 TPAS and ESPWG and are shown in **Appendix D**. The Study Period analyzed in the 2016 RNA is years 2017 through 2026.

This section highlights the key assumptions and modeling data updates for the RNA. These include: (1) the load forecast model, (2) level of Special Case Resources, (3) the change in generation resource status, (4) Local Transmission Owner Plans, and (5) Bulk 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 2016 Gold Book. The baseline forecast includes the impacts of energy efficiency programs, building codes and standards, distributed energy generation, and behind-the-meter solar PV power. The econometric forecast incorporates only the growth due to the economy and does not account for the impacts of the aforementioned programs. For the resource adequacy study, the baseline load forecast was modified by removing the retail 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 Transmission Owners. The changes in resources were included in the RNA Base Case using the NYISO 2016 FERC 715 filing as a starting point, adding and removing resources consistent with the base case inclusion screening process provided in the RPP Manual. Resources in the NYCA that choose to participate in markets outside of New York are modeled as equivalent contracts, 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 coordination conducted under the NPCC, and pursuant to the Northeast ISO/RTO Planning Coordination Protocol.

4.1. Annual Energy and Summer Peak Demand Forecasts

This section reports the baseline forecast, the 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 all obtained from the 2016 Gold Book. The baseline forecast includes the impacts of energy efficiency, distributed energy resources, and behind-the-meter solar PV. The econometric forecast does not include those impacts. The baseline forecast with solar PV has the behind-the-meter solar PV MW forecast added back to the baseline forecast. This forecast is used for the resource adequacy study where behind-the-meter solar PV is modeled as a generating resource.

The demand-side management impacts included, or accounted for, in the 2016 Base Case forecast are based upon 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 and distributed generation. 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, and other demand-side management impacts over the Study Period. The factors considered in developing the 2016 RNA base case forecast are included in **Appendix C**.

The assumptions for the 2016 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 2016. The ESPWG and TPAS reviewed and discussed the assumptions used in the 2016 RNA base case forecast in accordance with procedures established for the RNA.

The annual average energy growth rate of the baseline forecast in the 2016 Gold Book decreased to -0.16%, as compared to 0.16% in the 2014 Gold Book. The 2016 Gold Book's annual average baseline summer peak demand growth decreased to 0.21%, as compared to 0.83% in the 2014 Gold Book. The lower energy growth rate is attributed to both the economy and the continued impact of energy efficiency and behind-the-meter solar PV. While these factors had a smaller impact on summer peak growth than on annual energy growth, peak growth is still expected to be lower in 2016 than it was in 2014. To account for the risk that not all energy efficiency and solar PV impacts will be realized, a high-load growth scenario is modeled.

Table 4-1 below summarizes the three forecasts used in the 2016 RNA. **Table 4-2** shows a comparison of the baseline forecasts and energy efficiency program impacts contained in the 2014 RNA and the 2016 RNA. **Figure 4-1** and **Figure 4-2** present actual, weather-normalized forecasts of annual energy and summer peak demand for the 2016 RNA. **Figure 4-3** and **Figure 4-4** present the NYISO's projections of annual energy and summer peak demand in the 2016 RNA for energy efficiency, distributed generation, and behind-the-meter solar PV.

Table 4-1: 2016 RNA Econometric, Baseline, and Baseline with SPV Forecasts Added Back In

Econometric, Baseline and Adjusted Energy Forecasts

Annual GWh	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2016 Econometric Forecast	163,243	164,818	166,439	167,715	168,804	169,420	170,548	171,772	172,929	174,016	175,103
2016 Baseline Forecast	159,382	158,713	158,431	158,099	157,700	156,903	156,785	156,795	156,800	156,779	156,777
+ 2016 Solar PV Forecast	1,053	1,450	1,767	2,067	2,355	2,632	2,882	3,124	3,334	3,512	3,661
2016 Baseline With SPV	160,435	160,163	160,198	160,166	160,055	159,535	159,667	159,919	160,134	160,291	160,438

Energy Impacts of Energy Efficiency, Distributed Generation & Solar PV

Cumulative GWh	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Solar PV	1,053	1,450	1,767	2,067	2,355	2,632	2,882	3,124	3,334	3,512	3,661
EE & Distributed Generation	2,808	4,655	6,241	7,549	8,749	9,885	10,881	11,853	12,795	13,725	14,665
Total	3,861	6,105	8,008	9,616	11,104	12,517	13,763	14,977	16,129	17,237	18,326

Econometric, Baseline and Adjusted Summer Peak Forecasts

Summer Peak MW	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2016 Econometric Forecast	34,055	34,533	34,922	35,243	35,487	35,747	36,005	36,261	36,497	36,745	37,018
2016 Baseline Forecast	33,360	33,363	33,404	33,477	33,501	33,555	33,650	33,748	33,833	33,926	34,056
+ 2016 Solar PV Forecast	258	363	421	471	518	565	606	645	682	720	747
2016 Baseline With SPV	33,618	33,726	33,825	33,948	34,019	34,120	34,256	34,393	34,515	34,646	34,803

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

Cumulative MW	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Solar PV	258	363	421	471	518	565	606	645	682	720	747
EE & Distributed Generation	437	807	1,097	1,295	1,468	1,627	1,749	1,868	1,982	2,099	2,215
Total	695	1,170	1,518	1,766	1,986	2,192	2,355	2,513	2,664	2,819	2,962

Table 4-2: Comparison of 2014 RNA & 2016 Baseline Forecasts

Comparison of Baseline Energy Forecasts - 2014 & 2016 RNA (GWh)

Annual GWh	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2014 RNA Baseline	163,161	163,214	163,907	163,604	163,753	164,305	165,101	164,830	164,975	165,109	165,721		
2016 RNA Baseline			160,435	160,163	160,198	160,166	160,055	159,535	159,667	159,919	160,134	160,291	160,438
Change from 2014 RNA			-3,472	-3,441	-3,555	-4,139	-5,046	-5,295	-5,308	-5,190	-5,587	NA	NA

Comparison of Baseline Peak Forecasts - 2014 & 2016 RNA (MW)

Annual MW	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2014 RNA Baseline	33,666	34,066	34,412	34,766	35,111	35,454	35,656	35,890	36,127	36,369	36,580		
2016 RNA Baseline			33,360	33,363	33,404	33,477	33,501	33,555	33,650	33,748	33,833	33,926	34,056
Change from 2014 RNA			-1,052	-1,403	-1,707	-1,977	-2,155	-2,335	-2,477	-2,621	-2,747	NA	NA

Comparison of Energy Impacts from Statewide Energy Efficiency & Distributed Generation - 2014 RNA & 2016 RNA (GWh)

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2014 RNA Baseline	1,361	3,096	4,637	5,933	6,987	7,993	8,977	9,879	10,766	11,646	12,513		
2016 RNA Baseline			2,808	4,655	6,241	7,549	8,749	9,885	10,881	11,853	12,795	13,725	14,665
Change from 2014 RNA			-1,829	-1,278	-746	-444	-228	6	115	207	282	NA	NA

Comparison of Peak Impacts from Statewide Energy Efficiency & Distributed Energy - 2014 RNA & 2016 RNA (MW)

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2014 RNA Baseline	224	491	748	925	1,091	1,243	1,401	1,545	1,690	1,832	2,079		
2016 RNA Baseline			437	807	1,097	1,295	1,468	1,627	1,749	1,868	1,982	2,099	2,215
Change from 2014 RNA			-311	-118	6	52	67	82	59	36	-97	NA	NA

Figure 4-1: 2016 Econometric, Baseline and Baseline with SPV Energy Forecasts

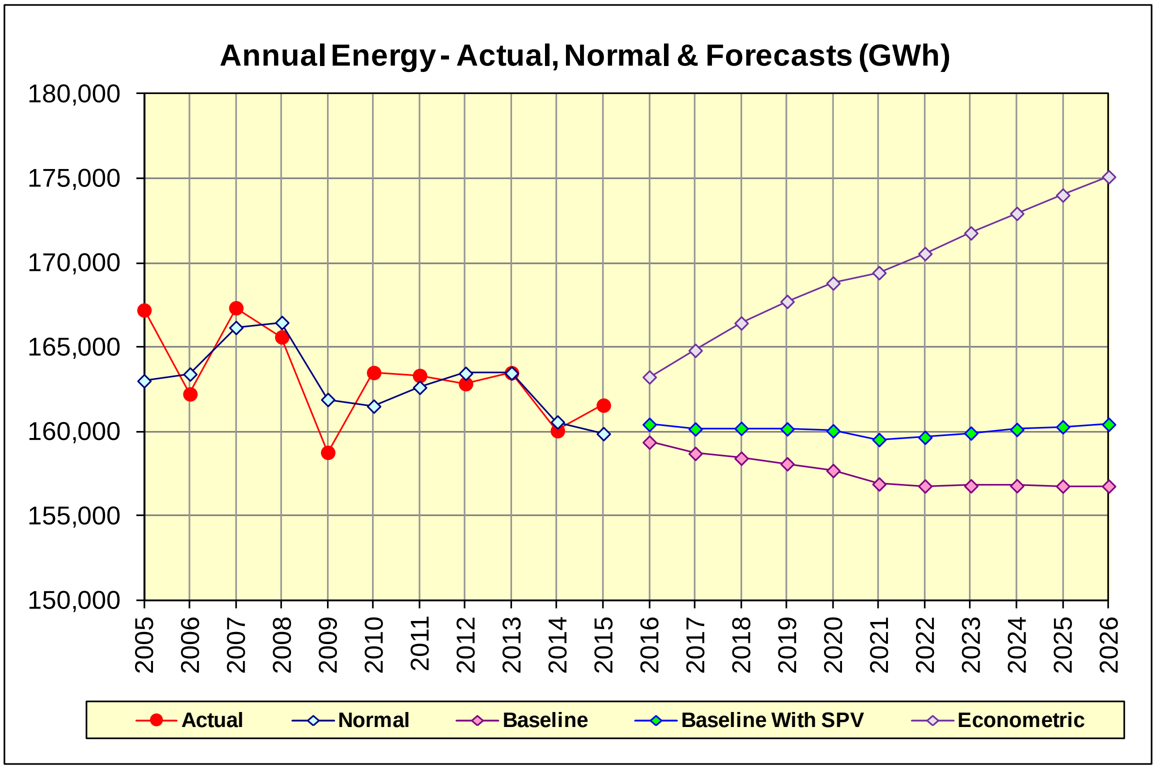


Figure 4-2: Econometric, Baseline and Baseline with SPV Summer Peak Demand Forecast

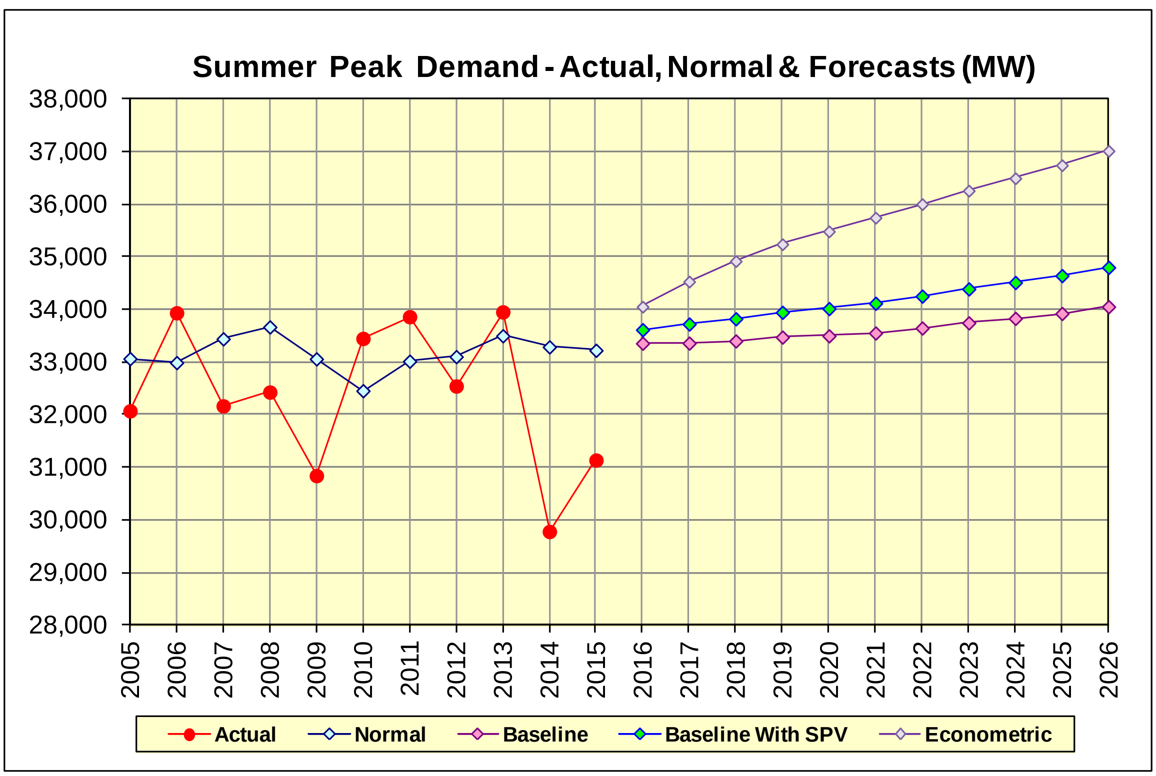


Figure 4-3: 2016 Energy Efficiency & Behind-the-Meter Solar PV – Annual Energy

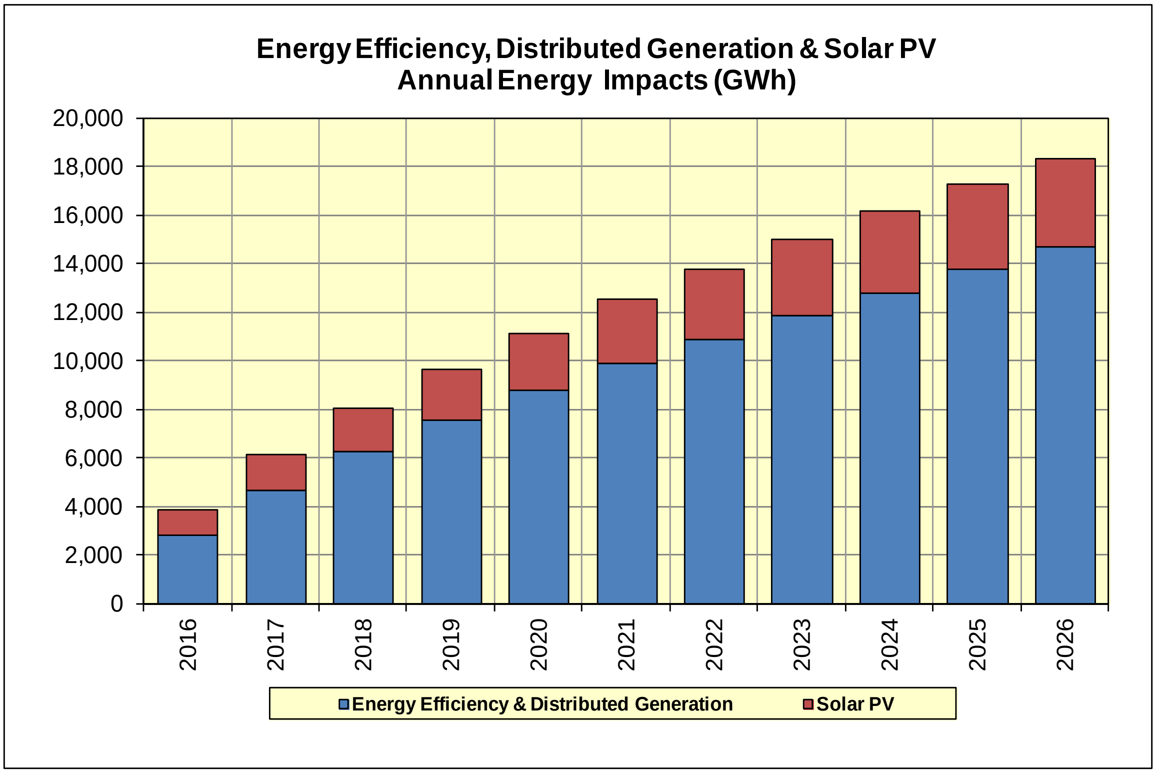
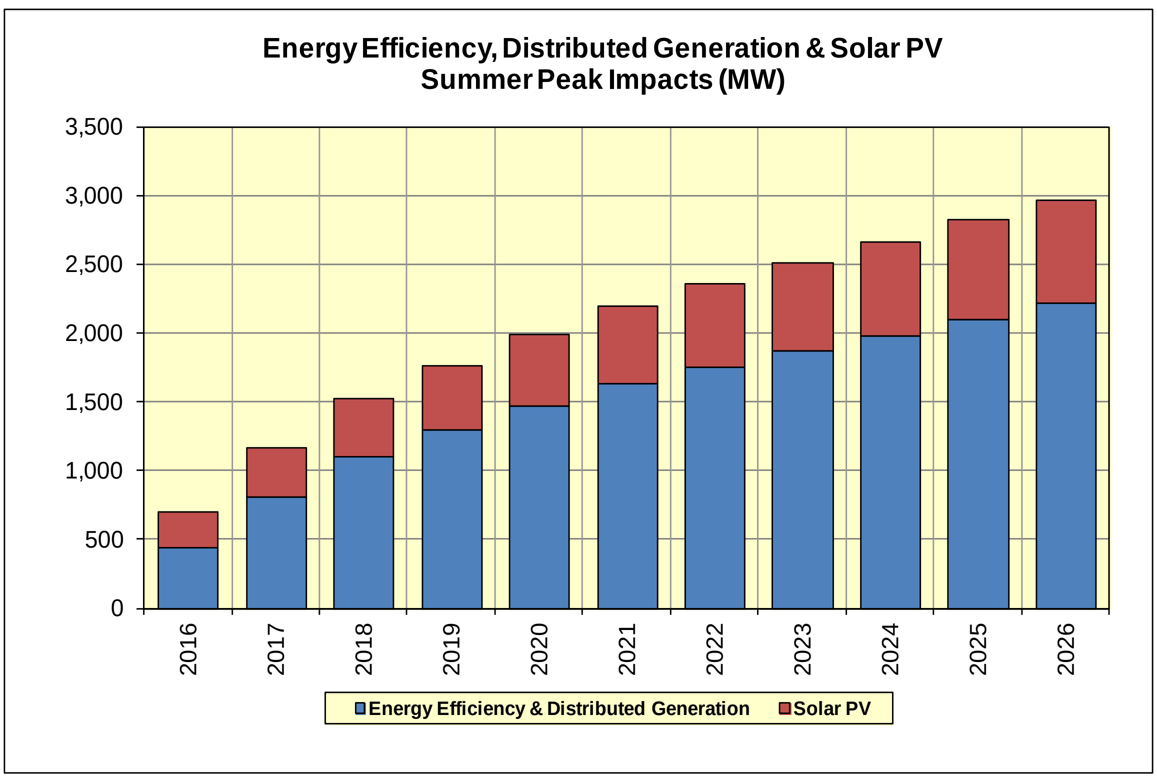


Figure 4-4: 2016 Energy Efficiency & Behind-the-Meter Solar PV – Summer Peak



In the 2016 RNA, the baseline forecast with behind-the-meter solar PV added back in is used as the load forecast for 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, and G-J Locality peak.

To model the behind-the-meter solar PV resource, zonal shapes were created by aggregating measured irradiance data from New York weather stations for years 2011 through 2015. This information was used in conjunction with General Electric's Multi-Area Reliability Simulation (MARS) probabilistic shape selection algorithm to introduce a degree of variability and intermittency into the solar PV model. The ensemble average of the annual shapes meets the forecast for solar PV contribution at the time of NYCA peak.

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.

Table 4-3: 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
2016	10	6	15	2	9	31	30	3	6	25	121	258
2017	14	7	20	2	13	41	37	5	8	43	173	363
2018	16	10	24	2	14	47	46	5	10	52	195	421
2019	18	12	28	3	16	52	54	5	11	62	210	471
2020	21	15	33	3	18	57	63	5	12	69	222	518
2021	24	18	37	4	20	62	71	7	13	78	231	565
2022	27	21	41	4	23	66	80	7	14	89	234	606
2023	30	24	45	4	25	69	87	7	16	101	237	645
2024	32	27	48	5	26	72	93	7	18	114	240	682
2025	34	29	51	5	28	74	98	10	20	128	243	720
2026	36	31	53	5	29	75	101	10	21	139	247	747

4.2. Forecast of Special Case Resources

The 2016 RNA Special Case Resource (SCR) MW levels are based on the 2016 Gold Book value of 1,248 MW, adjusted for their performance. Transmission security analysis, which evaluates normal transfer criteria, does not consider SCRs.

4.3. Capacity Resource Additions and Removals

Since the 2014 RNA and CRP, 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. A total of 1,078 MW has been added to the 2016 RNA Base Case as new generation. Meanwhile, a total of 2,573 MW has been removed from the 2014 RNA and CRP Base Case because these units are currently in a deactivation state (*e.g.*, retired, mothballed, or proposed to retire/mothball). The comparison of generation status between the 2014 RNA and CRP and 2016 RNA is detailed in **Table 4-4** and **Table 4-5** below. The MW values represent the Capacity Resources Interconnection Service (CRIS) MW values as shown in the 2016 Gold Book.

In addition to the projects that met the 2016 RNA inclusion rules (listed in **Table 4-4**), a number of other projects in the NYISO interconnection study queue are also moving forward through the interconnection process, but have not yet been offered as market solutions in this process. Some of these additional generation resources have either accepted their cost allocation as part of a Class Year Facilities Study process or are included in the currently ongoing 2015 Class Year Facilities Study. These projects are listed in the Gold Book 2016 and also in **Table 4-6** and **Table 4-7** below.

Table 4-4: Generation Additions Included in the 2016 RNA Base Case

Project Name	Zone	Requested CRIS MW	2016 RNA *(1st year of Base Case inclusion)*	2014 CRP* Status
CPV Valley Energy Center	G	680	2018	O/S
Taylor Biomass	G	19	2018	**I/S**
Copenhagen Wind	E	79.9	2018	O/S
East River 1 Uprate	J	12.1	2017	O/S
East River 1 Uprate	J	12.1	2017	O/S
Black Oak Wind	C	0	2017	O/S
Sithe Independence Uprate	C	43	2017	O/S
Marble River Wind	D	215.2	2017	O/S
HQ-US *(External CRIS Rights)*	E	20	2017	O/S
Stony Creek Uprate	C	5.9	2017	O/S
Bowline 2 Uprate	G	10	2017	O/S
Total		**1,097**		
Additions from 2014 RNA		**1,078**		

***** The 2014 RNA Base Case was subsequently updated in the 2014 CRP, therefore the 2014 CRP Base Case is used as the reference.
O/S: Out-of-Service; I/S: In-Service

Table 4-5: 2016 RNA Generation Deactivations

OWNER / OPERATOR	STATION UNIT	ZONE	CRIS	2016 RNA Status	2014 CRP Status
Erie Blvd. Hydro - Seneca Oswego	Seneca Oswego Fulton	C	0.7	O/S	O/S
Erie Blvd. Hydro - Seneca Oswego	Seneca Oswego Fulton	C	0.3	O/S	O/S
Long Island Power Authority	Montauk Units #2, #3,	K	6.0	O/S	O/S
NRG Power Marketing LLC	Dunkirk 2	A	**96.2**	**O/S**	I/S
NRG Power Marketing LLC	Dunkirk 3	A	**201.4**	**O/S**	I/S
NRG Power Marketing LLC	Dunkirk 4	A	**199.1**	**O/S**	I/S
ReEnergy Chateaugay LLC	Chateaugay Power	D	18.6	O/S	O/S
Rochester Gas and Electric Corp.	Station 9	B	15.8	O/S	O/S
Syracuse Energy Corporation	Syracuse Energy ST1	C	11.0	O/S	O/S
Syracuse Energy Corporation	Syracuse Energy ST2	C	58.9	O/S	O/S
TC Ravenswood, LLC	Ravenswood 07	J	16.5	O/S	O/S
TC Ravenswood, LLC	Ravenswood 3-3	J	37.7	O/S	O/S
Erie Blvd. Hydro - North Salmon	Hogansburg	D	**0.3**	**O/S**	I/S
Niagara Generation LLC	Niagara Bio-Gen	A	**50.5**	**O/S**	I/S
NRG Power Marketing LLC	Astoria GT 05	J	**16.0**	**O/S**	I/S
NRG Power Marketing LLC	Astoria GT 07	J	**15.5**	**O/S**	I/S
NRG Power Marketing LLC	Astoria GT 12	J	**22.7**	**O/S**	I/S
NRG Power Marketing LLC	Astoria GT 13	J	**24.0**	**O/S**	I/S
NRG Power Marketing LLC	Dunkirk 2	A	97.2	**O/S**	O/S starting May 2015
NRG Power Marketing LLC	Huntley 67	A	**196.5**	**O/S**	I/S
NRG Power Marketing LLC	Huntley 68	A	**198.0**	**O/S**	I/S
Cayuga Operating Company, LLC	Cayuga 1	C	154.1	O/S starting July 1, 2017	O/S starting July 1, 2017
Cayuga Operating Company, LLC	Cayuga 2	C	154.7	O/S starting July 1, 2017	O/S starting July 1, 2017
Entergy Nuclear FitzPatrick LLC	FitzPatrick 1	C	**858.9**	**O/S**	I/S
R.E. Ginna Nuclear Power Plant, LLC	Ginna	B	**582.0**	**O/S**	I/S
NRG Power Marketing LLC	Astoria GT 08	J	**15.3**	**O/S**	I/S
NRG Power Marketing LLC	Astoria GT 10	J	**24.9**	**O/S**	I/S
NRG Power Marketing LLC	Astoria GT 11	J	**23.6**	**O/S**	I/S
TC Ravenswood, LLC	Ravenswood 04	J	**15.2**	**O/S**	I/S
TC Ravenswood, LLC	Ravenswood 05	J	**15.7**	**O/S**	I/S
TC Ravenswood, LLC	Ravenswood 06	J	**16.7**	**O/S**	I/S
		Total	3,144		
	New deactivations from 2014 RNA		**2,573**		

Table 4-6: Additional Proposed Generation Projects from the 2016 Gold Book

QUEUE POS.	OWNER / OPERATOR	STATION UNIT	ZONE	DATE	REQUESTED CRIS (MW)[1]	CRIS[1] (MW)	SUMMER (MW)	UNIT TYPE	CLASS YEAR	Included in 2016 RNA
Completed Class Year Facilities Study										
349	Taylor Biomass Energy Mont., LLC	Taylor Biomass	G	2018/04	N/A	19.0	19	Solid Waste	2011	**yes**
251	CPV Valley, LLC	CPV Valley Energy Center	G	2017/10	N/A	680.0	677.6	Combined Cycle	2011	**yes**
197	PPM Roaring Brook, LLC / PPM	Roaring Brook Wind	E	2017/12	N/A	0.0	78	Wind Turbines	2008	no
Class Year 2015										
431	Greenidge Generation	Greenidge Unit #4	C	2016/09	106.3	TBD	106.3	Stream Turbine		no
395	Copenhagen Wind Farm , LLC	Copenhagen Wind	E	2016/10	79.9	TBD	79.9	Wind Turbines		**yes**
397	EDP Renewables North America	Jericho Rise Wind	D	2017/07	77.7	TBD	77.7	Wind Turbines		no
401	Caithness Long Island II, LLC	Caithness Long Island II	K	2019/05	744.0	TBD	744	Combined Cycle		no
Class Year 2015 CRIS-Only Requests										
	Marble River, LLC	Marble River Wind	D	N/A	215.2	TBD	N/A			**yes**
	HQ-US	HQ-US (External CRIS Rights)	E	N/A	20.0	TBD	N/A			**yes**
	ConEd	East River 1 Uprate	J	N/A	10.0	TBD	N/A			**yes**
	ConEd	East River 2 Uprate	J	N/A	10.0	TBD	N/A			**yes**
	Bowline	Bowline 2	G	N/A	10.0	TBD	N/A			**yes**
	East Coast Power, LLC	Linden Cogeneration Plant	J	N/A	35.5	TBD	N/A			no
	Astoria Energy	CC1 and CC2	J	N/A	27.8	TBD	N/A			no
	Stony Creek Energy, LLC	Stony Creek	C	N/A	5.9	TBD	N/A			**yes**
Future Class Year Candidates										
270	Wind Development Contract Co, LLC	Hounsfield Wind	E	TBD	TBD	TBD	244.8	Wind Turbines		no
382	Astoria Generating Co.	South Pier Improvement	J	2016/06	TBD	TBD	91.2	Combustion Turbines		no
383	NRG Energy, Inc.	Bowline Gen. Station Unit #3	G	2016/06	TBD	TBD	775	Combined Cycle		no
440	Erie Power, LLC	Erie Power	A	2016/08	TBD	TBD	79.4	Combined Cycle		no
467	Invenergy Solar Development, LLC	Tallgrass Solar	K	2016/11	TBD	TBD	25	Solar		no
396	Baron Winds, LLC	Baron Winds	C	2016/12	TBD	TBD	300	Wind Turbines		no
361	US PowerGen Co.	Luyster Creek Energy	J	2017/06	TBD	TBD	401	Combined Cycle		no
372	Dry Lots Wind, LLC	Dry Lots Wind	E	2017/11	TBD	TBD	33	Wind Turbines		no
371	South Mountain Wind, LLC	South Mountain Wind	E	2017/12	TBD	TBD	18	Wind Turbines		no
276	Air Energie TCI, Inc.	Crown City Wind	C	2018/12	TBD	TBD	90	Wind Turbines		no
387	Cassadaga Wind, LLC	Cassadaga Wind	A	2018/12	TBD	TBD	126	Wind Turbines		no
444	Cricket Valley Energy Center, LLC	Cricket Valley Energy Center II	G	2019/08	TBD	TBD	1020	Combined Cycle		no
347	Franklin Wind Farm, LLC	Franklin Wind	E	2019/12	TBD	TBD	50.4	Wind Turbines		no
			Total proposed summer MW not included in 2016 RNA				3,254			

Table 4-7: Additional Proposed Transmission Projects from the 2016 Gold Book

Merchant Queue Position	Developer	Terminals		Summer rating	Project Description /	Class Year	Included in 2016 RNA
Merchant Transmission Projects							
358	West Point Partners	Leeds 345kV	Buchanan North 345kV	1,000	-/+ 320kV Bipolar HVDC cable	TBD	no
305	Transmission Developers Inc.	Hertel 735kV (Quebec)	Astoria Annex 345kV	1,000	-/+ 320kV Bipolar HVDC cable	TBD	no
363	Poseidon Transmission 1, LLC	Deans 500kV (PJM)	Ruland Road 138kV	500	-/+ 200kV Monopole HVDC cable	TBD	no
			Total proposed summer MW not included in 2016 RNA	2,500			

4.4. Local Transmission Plans

As part of the NYISO's Local Transmission Planning Process (LTPP), Transmission Owners presented their LTPs to the NYISO and stakeholders in the fall of 2015. The NYISO reviewed the LTPs and included them in the 2016 Gold Book. The firm transmission plans included in the 2016 RNA Base Case are reported in **Appendix D**. Initial assumptions for inclusion in the RNA were based on data as of May 1, 2016, and updated based on stakeholder input as of July 5, 2016.

The following plans were received for the July 5 updates, and met the RNA Base Case inclusion rules:

- NYSEG/RGE's terminal upgrades (updated LTP), increasing the ratings on Stolle Road-Gardenville 230 kV Line #66, with a projected in-service date of 2019.
- NYSEG/RGE's terminal upgrades (updated LTP), increasing the ratings on both Clay-Pannell PC1 and PC2 345 kV lines, with a projected in-service date of 2019.

4.5. Bulk Transmission Projects

Since the 2014 RNA, additional transmission projects have met the inclusion rules and are modeled in the 2016 RNA Base Case. One project, which was included in the 2014 RNA, was removed from the system model because it is no longer proceeding.

The National Grid installation of 1.5% series reactors at Packard on the two Packard – Huntley 230 kV lines (77 and 78) are included for all years of the study. These devices have been installed and are in-service.

The original Transmission Owners' Transmission Solutions (TOTS) collection of projects included a project for additional cooling capability on the 345 kV cables from Farragut to Gowanus and from Gowanus to Goethals to increase the thermal ratings of these facilities. Due to the subsequent cancellation of the wheeling agreement between Con Edison and PSEG, Con Edison is no longer proceeding with the cable cooling project. As a result, the cooling project, which was included in the 2014 RNA, is not included in the 2016 RNA Base Case.

The Orange and Rockland (O&R) North Rockland station tapping the Ladentown - Buchanan South 345 kV line (Y88) is modeled as in-service in the 2016 RNA Base Case starting in 2018. The North Rockland project includes a 345/138 kV transformer that will connect to the existing O&R Lovett substation.

Series compensation of 21% on the Leeds – Hurley Avenue 345 kV (301) line at Hurley Avenue is modeled as in-service in the 2016 RNA Base Case starting in 2018. This project is a System Deliverability Upgrade (SDU) associated with the CPV Valley Energy Center generation project, which is also modeled as in-service in the same year.

A Con Edison project to install a new phase angle regulator (PAR) controlled path between Rainey 345 kV and Corona 138 kV stations is included in the RNA Base Case starting in 2019. The project consists of a 345/138 kV transformer and 138 kV PAR at Rainey with a 138 kV cable to Corona.

4.6. Base Case Peak Load and Resource Ratios

The capacity used for the 2016 RNA's resource adequacy base case peak load and resource ratio is the existing generation adjusted for the unit retirements, mothballing, and proposals to retire or mothball announced as of April 15, 2016, along with the new resource additions that met the base case inclusion rules set forth in Section 3.1 of the RPP Manual. This capacity is summarized in **Table 4-8**, below.

Table 4-8: NYCA Peak Load and Resource Ratios 2017 through 2026

	Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Peak Load (MW) - Table I-2a GB 2016											
	NYCA*	33,363	33,404	33,477	33,501	33,555	33,650	33,748	33,833	33,926	34,056
	Zone J*	11,696	11,717	11,756	11,760	11,761	11,785	11,807	11,830	11,851	11,907
	Zone K*	5,381	5,354	5,348	5,340	5,370	5,414	5,464	5,501	5,550	5,595
	Zone G-J	16,181	16,206	16,251	16,255	16,260	16,292	16,324	16,357	16,387	16,459
Resources (MW)											
	Capacity**	36,867	37,644	37,644	37,644	37,644	37,644	37,644	37,644	37,644	37,644
	Net Purchases & Sales	1,849	1,584	1,593	2,255	2,255	2,255	2,255	2,255	2,255	2,255
	SCR	1,248	1,248	1,248	1,248	1,248	1,248	1,248	1,248	1,248	1,248
NYCA	Total Resources	**39,965**	**40,476**	**40,485**	**41,147**	**41,147**	**41,147**	**41,147**	**41,147**	**41,147**	**41,147**
	Capacity/Load Ratio	110.5%	112.7%	112.4%	112.4%	112.2%	111.9%	111.5%	111.3%	111.0%	110.5%
	Cap+NetPurch/Load Ratio	116.0%	117.4%	117.2%	119.1%	118.9%	118.6%	118.2%	117.9%	117.6%	117.2%
	Cap+NetPurch+SCR/Load Ratio	119.8%	121.2%	120.9%	122.8%	122.6%	122.3%	121.9%	121.6%	121.3%	120.8%
Zone J	Capacity**	9,554	9,554	9,554	9,554	9,554	9,554	9,554	9,554	9,554	9,554
	Cap+UDR+SCR/Load Ratio	93.3%	93.1%	92.8%	92.8%	92.8%	92.6%	92.4%	92.2%	92.1%	91.7%
Zone K	Capacity**	5,287	5,287	5,287	5,287	5,287	5,287	5,287	5,287	5,287	5,287
	Cap+UDR+SCR/Load Ratio	117.9%	118.5%	118.6%	118.8%	118.1%	117.2%	116.1%	115.3%	114.3%	113.4%
Zone G-J	Capacity**	14,659	15,356	15,356	15,356	15,356	15,356	15,356	15,356	15,356	15,356
	Cap+UDR+SCR/Load Ratio	99.5%	103.6%	103.3%	103.3%	103.3%	103.1%	102.9%	102.7%	102.5%	102.0%

*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, reratings, and retirements (including proposed retirements and mothballs). Capacity values reflect the lesser of CRIS and DMNC values. NYCA resources include the net purchases and sales as per the Gold Book. Zonal totals include the awarded UDRs for those capacity zones as the actual MW are considered confidential.

Notes:

- SCR - Forecasted ICAP value based on 2016 Gold Book. This figure changed for the Final RNA MARS Base Case to 1,192 MW with the July auctions.
- Wind generator summer capacity is counted as 100% of nameplate rating.
- Behind-the-meter solar PV impacts are reflected back into the load levels shown for proper accounting.

As shown in the **Table 4-8** above, the total NYCA capacity margin (defined as capacity above the baseline load forecast) varies between 19.8% in 2017 (year 1), 22.6% in 2021 (year 5), and 20.8 % in 2026 (year 10). For relative comparison purposes, these percentages are significantly above the required 17.5 % NYCA Installed Reserve Margin (IRM) for the 2016-2017 Capability Year.

To further demonstrate the increase in the capacity margin, comparing the details of its capacity margin calculation for mid-year 2021 between the 2014 RNA and the 2016 RNA shows that:

1. The 2016 RNA NYCA baseline load forecast is 2,335 MW lower for 2021;
2. The NYCA SCRs projection is 59 MW higher for 2021; and
3. The NYCA capacity resources are 577 MW higher for 2021.

This increase in net resources contributes to the elimination of the resource adequacy need in the 2016 RNA as compared with those Reliability Needs initially identified in the 2014 RNA.

Table 4-9: Load/Resources Comparison of Year 2021 (MW)

Year 2021	2016 RNA	2014 RNA	Delta	2016 RNA	2014 CRP	Delta
Baseline Load	33,555	35,890	-2,335*	33,555	35,890	-2,210*
SCR	1,248	1,189	59	1,248	1,189	59
Total Capacity without SCRs	39,899	39,322	577	39,899	41,318	-1,294
Net Change in Capacity less Load			**2,971**	**2016 RNA to 2014 CRP**		**975**

*Both the 2014 and 2016 RNA baseline load forecasts included reductions due to the effect of solar PV additions. The 2016 RNA resource adequacy assessment started with the baseline load forecast, added the behind-the-meter solar PV forecast MW back into the baseline load, and then explicitly modeled solar PV MW projections to allow for better probabilistic simulation.

4.7. 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 NYISO planning procedures include both security and adequacy assessments. 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 short circuits or unanticipated loss of system elements, and continue to supply and deliver electricity. 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 NYSRC Reliability Rules. The impacts when applying these design criteria contingencies are assessed to ensure 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 "Guideline for Fault Current Assessment" describes the methodology for that analysis.

The analysis for the transmission security assessment is conducted in accordance with NERC Reliability Standards, NPCC Transmission Design Criteria, and the NYSRC Reliability Rules. AC 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, approximately 1,000 design criteria contingencies are evaluated under N-1, N-1-0, and N-1-1 normal transfer criteria conditions to ensure 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 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 redispatch, 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.

N-1-1 analysis attempts to secure the system after each first contingency. This is accomplished through generation redispatch and PAR adjustments. Where there are several overloads after a first contingency, generation and PAR adjustments are made to minimize the overloads, but not necessarily the number of overloads.

Resource adequacy is the ability of the electric systems to supply the aggregate electricity demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system elements. Resource adequacy considers the transmission systems, generation resources, and other capacity resources, such as demand response. Resource adequacy assessments are performed 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 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 events per year. This requirement forms the basis of New York's Installed Reserve Margin (IRM) requirement and is 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 differing natures of supply and demand-side resources and transmission constraints, the amounts and locations of resources necessary to match the level of compensatory MW needs identified will vary. Resource 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.

5. Reliability Needs Assessment

5.1. Overview

Reliability is defined and measured through the use of the concepts of security and adequacy described in **Section 4**. 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.

5.2. Reliability Needs for Base Case

Below are the principal findings of the 2016 RNA applicable to the Base Case conditions for the (2017-2026) Study Period including: transmission security assessment; short circuit assessment; resource and transmission adequacy assessment; system stability assessments; and scenario analyses.

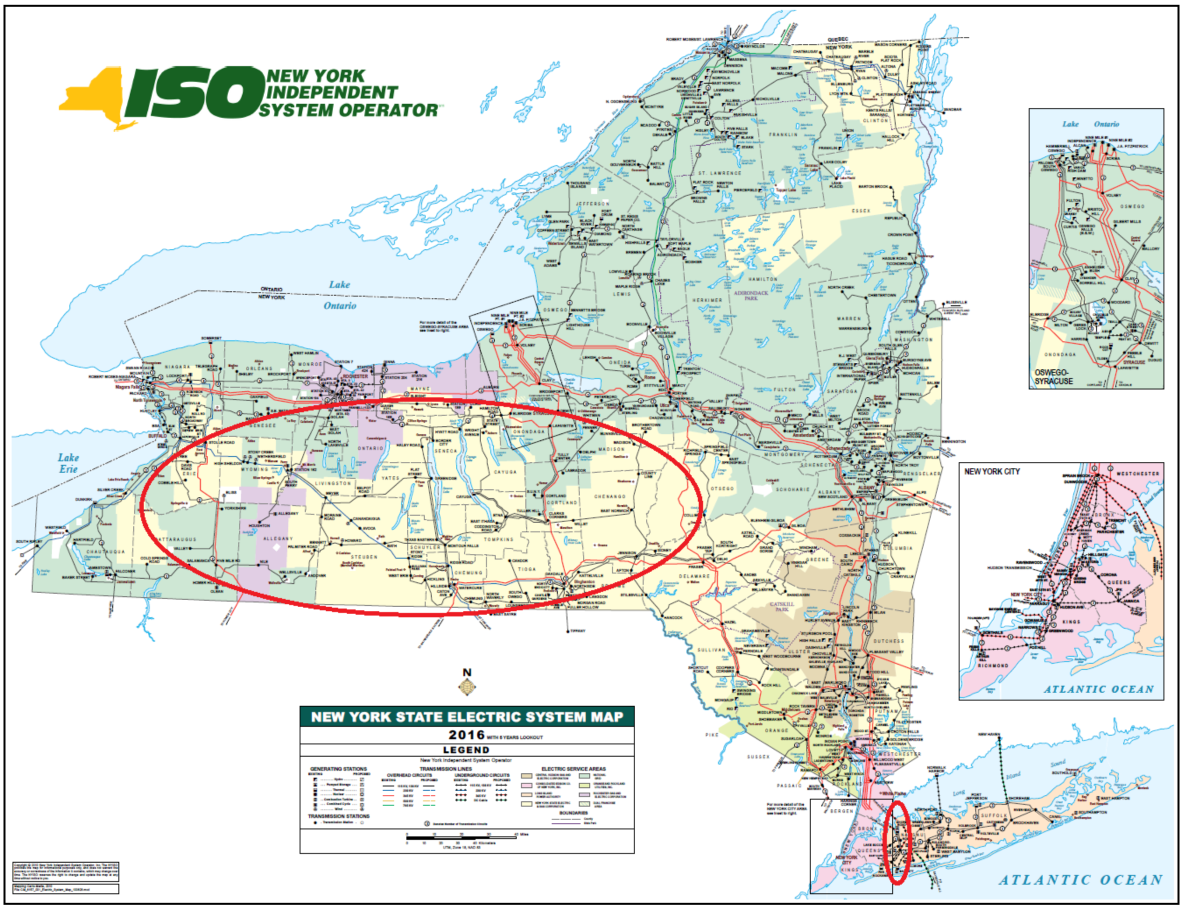
5.2.1. Transmission Security Assessment

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 715 power flow cases, which the NYISO filed with FERC on April 1, 2016.

The transmission security analysis identifies thermal violations on the BPTF throughout the Study Period for N-1-1 conditions. Some of the identified violations for the 2016 RNA Base Case are a continuation of the violations identified in the 2014 RNA for which work is ongoing, while others represent new violations resulting from system changes modeled in the base case. **Table 5-1** provides a summary of the contingency pairs that result in the highest thermal overload on each overloaded BPTF element under N-1-1 conditions. **Table 5-3** provides a summary of the year by which a solution is needed to be in-service to resolve the transmission security violation. **Appendix D** provides a summary of all contingency pairs that result in overloads on the BPTF for the study period.

There are two primary regions with Reliability Needs: Western & Central New York and Long Island. These Reliability Needs are generally driven by recent and proposed generator deactivations. **Figure 5-1** depicts the two regions where the loads may be impacted by transmission security constraints.

Figure 5-1: Approximate Areas of Transmission Security Needs



5.2.1.1. Western and Central New York

The preliminary transmission security analysis identified a number of thermal overloads on the BPTF in the Western and Central New York regions resulting from a lack of transmission and generating resources to serve load and support voltage in the area. Most of the identified violations were addressed by the updates described the **Section 5.2.1.3** below.

The 230 kV system between Niagara and Gardenville includes two parallel 230 kV transmission lines from Niagara to Packard to Huntley to Gardenville, including a number of taps to serve load in the Buffalo area. A third parallel 230 kV transmission line also runs from Niagara to Robinson Rd. to Stolle Rd. to Gardenville. The N-1-1 analysis shows that in 2017, Stolle-Gardenville (#66) 230 kV overloads for loss of Packard-Gardenville (#182) 115 kV followed by the loss of the two parallel Packard-Huntley (#77) and (#78) 230 kV lines which share a common tower. The overload occurs due to a lack of generation and transmission sources in the Buffalo area following the deactivation of the Dunkirk and Huntley generation plants in recent years.

The 345 kV system between Western and Central New York consists of two parallel lines between Syracuse and Rochester (Clay-Pannell 345 kV). The N-1-1 analysis shows that starting in 2017, these lines are overloaded for the loss of Stolle-Gardenville (#66) 230 kV followed by loss of the other parallel Clay-Pannell 345 kV line. Similarly, starting in 2017, Packard-Huntley (#77) 230 kV is overloaded for the loss of Stolle-Gardenville (#66) 230 kV followed by a stuck breaker at Packard 230 kV. The upcoming expiration of the Ginna Reliability Support Service Agreement (RSSA) would remove a significant amount of generation from the underlying system in the Rochester area and will drive an increased loading on the BPTF to serve load. Additionally, while the load forecast for the state has decreased overall, the load forecast in the west has increased from prior years. The combination of an overall lack of generation resources in Western and Central New York and the increased load in that area is largely responsible for the Clay-Pannell and Packard-Huntley overloads. The magnitude of the Clay-Pannell 345 kV and Packard-Huntley 230 kV overloads is directly proportional to the level of Niagara generation output. The N-1-1 analysis shows the Clay-Pannell (#2) 345 kV line loaded at 1,240 MVA in 2017, while Packard-Huntley (#77) 230 kV line is loaded at 646 MVA.

The Oakdale 345/230/115 kV station serves the Binghamton area. Starting in 2017, the N-1-1 analysis shows the Oakdale 345/115 kV #2 transformer is overloaded for the loss of the Packard-Huntley (#77) 230 kV line followed by a stuck breaker at Oakdale 345 kV. Niagara generation is required to back down following the loss of the Packard-Huntley (#77) 230 kV line, significantly reducing flow from Western New York into the Central region and increasing the loading on this source into the underlying 115 kV system. The stuck breaker at Oakdale 345 kV removes additional sources into the Binghamton area by removing a 345 kV line into Oakdale as well as a parallel

345/115 kV transformer. The loading on this facility is aggravated by the deactivation of Cayuga, scheduled to occur following the expiration of the Cayuga RSSA on June 30, 2017.

National Grid's Elbridge 345/115 kV station includes one 345/115 kV transformer that serves the Oswego and Syracuse area and the northern Finger Lakes area. Starting in 2022, the N-1-1 analysis shows an overload on the Elbridge 345/115 kV transformer for loss of the Pannell-Clay (#1) 345 kV line followed by a stuck breaker at Clay 345 kV. This overload is primarily due to power flowing east-to-west to serve load in Central New York and is exacerbated by the deactivation of the Ginna and Cayuga plants.

National Grid's Clay 345/115 kV station includes eight 115 kV transmission connections and two 345/115 kV transformers that serve the Oswego and Syracuse areas. Starting in 2017, the N-1-1 analysis shows overloads in this area on the Clay-Teall (#10) 115 kV line and the Clay-Dewitt (#3) 115 kV line. The 2014 RNA identified transmission security violations on both of these facilities. The overloads on the Clay-Teall (#10) 115 kV line and the Clay-Dewitt (#3) 115 kV line are resolved by the solutions identified in the 2014 CRP starting in 2018. As reported in the 2014 CRP, until the reconductoring on Clay-Teall (#10) line is completed, National Grid will use operating procedures as an interim measure. The operating procedures include switching the load at Pine Grove to an alternative source (Clay-Dewitt (#3) 115 kV) and local load shedding (approximately 110 MW), as necessary. Similarly, until the reconductoring on Clay-Dewitt (#3) line is completed, National Grid will use operating procedures as an interim measure. The operating procedures include switching the load at Bartell Rd. and Pine Grove to an alternative source (Clay-Teall (#10) 115 kV), switching the load at Fly Rd. to an alternative source (Teall-Dewitt (#4) 115 kV), and local load shedding (approximately 85 MW), as necessary.

Starting in 2022, the N-1-1 analysis shows an overload in this area on the Clay-Woodard (#17) 115 kV line. Similarly, starting in 2025, the N-1-1 analysis shows an overload on the Clay-Lockheed Martin (#14) 115 kV line. The overloads in this area are primarily due to power flowing from east to west on the 115 kV system to serve load in Central New York after the loss of a north-to-south 345 kV path and are exacerbated by the deactivation of the Ginna and Cayuga plants.

National Grid's Porter 345/230/115 kV station includes eight 115 kV transmission connections and two 345/115 kV transformers that serve the Utica and Syracuse areas.

The N-1-1 analysis shows that the Porter-Yahnundasis (#3) 115 kV line is overloaded starting in 2017 for the loss of Stolle-Gardenville (#66) 230 kV followed by the loss of a Porter 115 kV bus. Additionally, the N-1-1 analysis shows that the Porter-Oneida (#7) 115 kV line is overloaded starting in 2017 for loss of Porter-Yahnundasis (#3) 115 kV followed by a stuck breaker at Oswego 345 kV. These overloaded facilities were identified in the 2014 RNA and solutions were identified in the 2014 CRP starting in 2018. These overloads are due to power flowing from east to west on the 115 kV system to serve load in the Utica, Syracuse, and Finger Lakes area and are exacerbated by the deactivation of the Ginna and Cayuga plants. National Grid will use an operating procedure as an interim measure until reactors on these 115 kV lines are installed and in-service. The operating procedure includes opening the Oneida-Yahnundasis (#6) 115 kV transmission line, as necessary.

5.2.1.2. Long Island

The transmission security analysis identifies one thermal violation on the BPTF in Long Island.

LIPA's Valley Stream 138 kV station is in southwestern Long Island and includes three 138 kV transmission connections and one PAR that ties into Con Edison's 138 kV system. Starting in 2017, the East Garden City-Valley Stream (#262) 138 kV line is overloaded for the loss of the Barrett-Valley Stream (#292) 138 kV line followed by the loss of the Barrett-Valley Stream (#291) 138 kV line. The power flow on this facility is driven by the combination of LIPA load in western Long Island and the scheduled 300 MW wheel between ConEdison and LIPA. This overload has now been identified as a result of no longer reducing the wheel following an outage, for which ConEdison's contractual portion of Y50 is assumed to be delivered to ConEdison, thus reducing the portion of western Long Island load that is capable of being served through the overloaded facility from generating sources in eastern Long Island.

5.2.1.3. Updated Results for Western and Central NY

The system representation was updated to include Transmission Owners' LTP updates and changes on the BPTF after the initial results of the RNA were provided. These updates included ratings updates in the Long Island area and Clay area, an impedance correction on a 115 kV line in the central area, a load shift on a 115 kV line, and a transformer voltage schedule change. NYSEG/RGE provided LTP updates for the Stolle – Gardenville (#66) 230 kV line which increased the ratings of the line.

NYSEG/RGE also provided LTP updates that increased the ratings of each line for both Clay – Pannell (PC #1 and PC #2) 345 kV line. The in-service dates for each of these projects are 2019. The new ratings are provided in **Appendix D.**

These updates resolved the overloads on the Stolle – Garden (#66) 230 kV line, the Packard – Huntley (#77) 230 kV line, the Clay – Lockheed Martin (#14) 115 kV line, the Clay – Woodard (#17) line, the Elbridge 345/115 kV #1 transformer, the Clay – Pannell (#1) 345 kV line, and the Clay – Pannell (#2) 345 kV line. NYSEG/RG&E will use operating procedures to maintain the security of their system until the upgrades are in-service. These operating procedures include the adjustment of phase-angle regulators, use of special case resources, and possible load shedding of approximately 100 MW under baseline summer peak conditions. The procedures also include manning substations during conditions when load shedding is possible to allow for expedited isolation and restoration of the affected system. The results are reflected in **Table 5-1** and **Table 5-2**.

Table 5-1: 2016 RNA Preliminary Transmission Security Thermal Violations

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	2017 Flow (MVA)	2021 Flow (MVA)	2026 Flow (MVA)	First Contingency	Second Contingency
A	NYSEG	Stolle-Gardenville (#66) 230	474	478	478	509*	515*	520*	Packard-Gardenville (#182) 115	TWR Packard-Huntley 230
A	N. Grid	Packard-Huntley (#77) 230	556	644	746	646*	646*	646*	Stolle-Gardenville (#66) 230	SB Packard 230
C/B	NYPA, RG&E, N. Grid	Clay-Pannell (#1) 345	1195	1195	1195	1238*	1245*	1264*	Stolle-Gardenville (#66) 230	SB Clay 345
C/B	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345	1195	1195	1195	1240*	1247*	1266*	Stolle-Gardenville (#66) 230	SB Clay 345
C	NYSGE	Oakdale 345/115 2TR	428	556	600	565	586	613	Packard-Huntley (#77) 230	SB Oakdale 345
C	N. Grid	Elbridge 345/115 1TR	470	557	717			569*	Pannell-Clay (#1) 345	SB Clay 345
C	N. Grid	Clay-Lockheed Martin (#14) 115 (Clay-Wetzel)	220	252	280			255*	Clay-Woodard (#17) 115	SB Lafayette 345
C	N. Grid	Clay-Woodard (#17) 115 (Clay-Euclid)	220	252	280			256*	Clay-Lockheed Martin (#14) 115	SB Lafayette 345
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	126**			Clay-Teall (#11) 115	SB Dewitt 345
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	131**			Clay-Dewitt (#13) 345	Oswego-Lafayette (#17) 345
E	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	138**			Stolle-Gardenville (#66) 230	Porter Bus D 115
E	N. Grid	Porter-Oneida (#7) 115 (Porter-W. Utica)	116	120	145	125**			Porter-Yahnundasis (#3) 115	SB Oswego 345
K	LI	East Garden City-Valley Stream (#262) 138	211	291	504	293	302	316	Barrett-Valley Stream (#292) 138	Barrett-Valley Stream (#291) 138

* Violations removed in 2nd Pass with Model updates and Interim Operating Procedures (if needed)

** Violations removed due to upgrades identified in 2014 RNA that are in-service 2018 and have Interim Operating Procedures

Table 5-2: 2016 RNA Remaining Transmission Security Thermal Violations

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	2017 Flow (MVA)	2021 Flow (MVA)	2026 Flow (MVA)	First Contingency	Second Contingency
C	NYSGE	Oakdale 345/115 2TR	428	556	600	566	571	596	Packard-Huntley (#77) 230	SB Oakdale 345
K	LI	East Garden City-Valley Stream (#262) 138	226	285	310	300	305	329	Barrett-Valley Stream (#291) 138	Barrett-Valley Stream (#292) 138

Table 5-3: 2016 RNA Transmission Security Reliability Need Year

Zone	Owner	Monitored Element	Year of Need
A	NYSEG	Stolle-Gardenville (#66) 230*	2017
A	N. Grid	Packard-Huntley (#77) 230*	2017
C/B	NYPA, RG&E, N. Grid	Clay-Pannell (#1) 345*	2017
C/B	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345*	2017
C	**NYSGE**	**Oakdale 345/115 2TR**	**2017**
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)*	2017
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)*	2017
E	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)*	2017
E	N. Grid	Porter-Oneida (#7) 115 (Power-W. Utica)*	2017
K	**LIPA**	**East Garden City-Valley Stream (#262) 138**	**2017**
C	N. Grid	Elbridge 345/115 1TR*	2022
C	N. Grid	Clay-Woodard (#17) 115 (Clay-Euclid)*	2022
C	N. Grid	Clay-Lockheed Martin (#14) 115 (Clay-Wetzel)*	2025

* Violations removed with the TO updates

5.2.1.4. Transmission Security Compensatory MW

To provide information to the marketplace regarding the magnitude of the resources that are required to meet the BPTF transmission security needs, **Table 5-4** contains a summary of the minimum compensatory MW to satisfy the transmission security violations identified in **Section 5.2.1**. The compensatory MW identified in **Table 5-4** are for illustrative purposes only and are not meant to limit the specific facilities or types of resources that may be offered as solutions to Reliability Needs. Compensatory MW may reflect modifications to contractual power flow schedules or generation capacity (MVA), demand response, or transmission additions.

Table 5-4: Minimum Compensatory MW Additions for Transmission Security Violations

Zone	Owner	Monitored Element	2017 MVA Overload	2017 Min. Comp. MW	2021 MVA Overload	2021 Min. Comp. MW	2026 MVA Overload	2026 Min. Comp. MW
C	NYSEG	Oakdale 345/115 2TR	10	16	15	25	40	66
K	LI	East Garden City-Valley Stream (#262) 138	15	18	20	24	44	53

5.2.2. Short Circuit Assessment

Performance of a transmission security assessment includes the calculation of symmetrical short circuit current to ascertain whether the circuit breakers in the system could be subject to fault current levels in excess of their rated interrupting capability. The analysis was performed for the year 2021, reflecting the study conditions outlined in **Section 4**. The calculated fault levels would be constant over the second five years of the Study Period as no new generation or transmission is modeled in the RNA for the second five years, and the methodology for fault duty calculation is not sensitive to load growth. No overdutied circuit breakers were identified. The detailed results are presented in **Appendix D** of this report.

5.2.3. System Stability Assessment

The 2015 NYISO Comprehensive Area Transmission Review (CATR), which was completed in June 2016 and evaluated the year 2020, is the most recent CATR. Stability analyses were conducted as part of the 2015 CATR in conformance with the applicable NERC standards, NPCC criteria, and NYSRC Reliability Rules. The analyses found no stability issues (criteria violations) for summer peak load and light load conditions. Stability analysis was also performed using the 2015 CATR stability cases to determine any reliability impacts due to the generation retirements. No reliability impacts were found.

5.2.4. Transmission and Resource Adequacy Assessment

The NYISO conducts its resource adequacy analysis with GE MARS software package, which performs a probabilistic simulation of outages of capacity and transmission resources. The transmission system in MARS is modeled using interface transfer limits.

The emergency transfer limits were developed using the 2016 RNA power flow base case. **Tables 5-5**, **5-6**, and **5-7** below provide the thermal and voltage emergency transfer limits for the major NYCA interfaces. For comparison purposes, the 2014 RNA transfer limits are also presented.

Table 5-5: Transmission System Thermal Emergency Transfer Limits

Interface	2016 RNA study						2014 RNA study		
	2017	2018	2019	2020	2021	2026	2017	2018	2019
Dysinger East	1700	*1700*	*1700*	*1700*	1700	same as 2021	850 - 2850*	825 - 2825*	800 - 2800*
Central East MARS	4425	*4475*	*4475*	*4475*	4475	same as 2021	4500	4500	4500
E to G (Marcy South)	2150	*2275*	*2275*	*2275*	2275	same as 2021	2150	2150	2150
F to G	3475	*3475*	*3475*	*3475*	3475	same as 2021	3475	3475	3475
UPNY-SENY MARS	5500	*5600*	*5600*	*5600*	5600	same as 2021	5600	5600	5600
I to J	4400	*4400*	*4400*	*4400*	4400	same as 2021	4400	4400	4400
I to K (Y49/Y50)	1190	*1190*	*1190*	*1190*	1190	same as 2021	1290	1290	1290

Notes:

* Dynamic limit table based on status of Huntley and Dunkirk units;

Grey italic font: Limit was not calculated

Table 5-6: Transmission System Voltage Emergency Transfer Limits

Interface	2016 RNA study						2014 RNA study		
	2017	2018	2019	2020	2021	2026	2017	2018	2019
Dysinger East	2125	*2125*	*2125*	*2800*	2800	Same as 2021	*2975*	*2975*	2975
Central East MARS	3050	*3050*	*3050*	*3050*	3050	Same as 2021	3100	3100	3100
Central East Group	4925	*4925*	*4925*	*4925*	4925	Same as 2021	5000	5000	5000
UPNY-ConEd	5600	*5750*	*5750*	*5750*	5750	Same as 2021	5210	5210	5210
I to J & K	5400	*5600*	*5600*	*5600*	5600	Same as 2021	5160	5160	5160

Note:

Grey italic font: Limit was not calculated

Table 5-7: Transmission System Base Case Emergency Transfer Limits

Interface	2016 RNA study											2014 RNA study					
	2017		2018		2019		2020		2021		2026	2017		2018		2019	
Dysinger East	1700	T	*1700*	*T*	*1700*	*T*	*1700*	*T*	1700	T	Same as 2021	850 - 2850*	T	825 - 2825*	T	800 - 2800*	T
Central East MARS	3050	V	*3050*	*V*	*3050*	*V*	*3050*	*V*	3050	V	Same as 2021	3100	V	3100	V	3100	V
Central East Group	4925	V	*4925*	*V*	*4925*	*V*	*4925*	*V*	4925	V	Same as 2021	5000	V	5000	V	5000	V
E to G (Marcy South)	2150	T	*2275*	*T*	*2275*	*T*	*2275*	*T*	2275	T	Same as 2021	2150	T	2150	T	2150	T
F to G	3475	T	*3475*	*T*	*3475*	*T*	*3475*	*T*	3475	T	Same as 2021	3475	T	3475	T	3475	T
UPNY-SENY MARS	5500	T	*5600*	*T*	*5600*	*T*	*5600*	*T*	5600	T	Same as 2021	5600	T	5600	T	5600	T
I to J	4400	T	*4400*	*T*	*4400*	*T*	*4400*	*T*	4400	T	Same as 2021	4400	T	4400	T	4400	T
I to K (Y49/Y50)	1190	T	*1190*	*T*	*1190*	*T*	*1190*	*T*	1190	T	Same as 2021	1290	T	1290	T	1290	T
I to J & K	5400	C	*5590*	*T*	*5590*	*T*	*5590*	*T*	5590	T	Same as 2021	5160	C	5160	C	5160	C

Notes:

* Dynamic limit table based on status of Huntley and Dunkirk units

T - Thermal, V - Voltage, C – Combined

Limit was not calculated

The **Dysinger East** limit used in the 2014 RNA was based on dynamic limit tables that reduced the limit when Huntley and Dunkirk units were unavailable. For the 2016 RNA, a single limit is used because the Huntley and Dunkirk units are all modeled as out of service. The increase in the limit from the lowest values is a result of the installation of series reactors on the Packard – Huntley 230 kV circuits, which are the facilities limiting the power transfer.

The Dysinger East voltage limit increases significantly in 2020. This is due to 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 MARS topology since the thermal transfer limit is more constraining throughout the Study Period.

The **Central East** MARS and Central East Group interfaces reductions of 50 MW and 75 MW, respectively, result from the proposed retirement of the FitzPatrick unit.

When comparing the **UPNY-SENY** MARS limits for year 2017 to the previous RNA, there is a reduction of 100 MW. This reduction is caused by the change in the modeling of the Con Ed/PSEG wheel schedule. For the 2014 RNA, 1,000 MW was modeled flowing to PJM on the S. Mahwah to Waldwick ties and 1,000 MW to New York was modeled on the A, B, and C ties. In the 2016 RNA, due to the cancellation of the Con Ed/PSEG agreement to wheel that power, 0 MW is modeled on all of these ties. The modeling change resulted in a 100 MW decrease in the UPNY-SENY MARS limit. This limit is then increased to 5,600 MW in the 2016 RNA in year 2018 when the Leeds – Hurley series compensation project goes into service.

The modeling change of the ConEd/PSEG wheel in the 2016 RNA also results in an increase in the **UPNY-ConEd** and the I to J & K interface limits. No longer modeling the 1,000 MW withdrawal of power from Zone G to supply the wheel reduces the reactive power losses in SENY and increases voltage constrained transfer limits in that area. The reduction in load growth and increase in behind-the-meter solar PV installations also impacts these transfer limits. For year 2017, the UPNY-ConEd limit increases by 390 MW and the I to J & K transfer limit increases by 240 MW when compared to the previous RNA. These limits increase again in year 2018 by 150 MW and 200 MW respectively, once CPV Valley Energy Center enters into service as expected.

The **I to K (Y49/Y50)** interface decreased by 100 MW from the previous RNA. This is due to a reduction in the rating of the limiting facility, Shore Road – Glenwood

South 138 kV. LIPA recently concluded an update of the methodology that is used to calculate their facility ratings. The ratings of several bulk facilities were updated accordingly and will be used for the final RNA Base Case.

The topology used in the MARS model for the final RNA Base Case is represented in **Figures 5-2**, **5-3** and **5-4** below. The modeled internal transfer limits are the summer emergency ratings derived from the RNA power flow cases. The external transfer limits are developed from the NPCC CP-8 Summer Assessment MARS database with changes based upon the RNA Base Case assumptions.

Figure 5-2: 2016 RNA Final Topology Year 1 (2017)

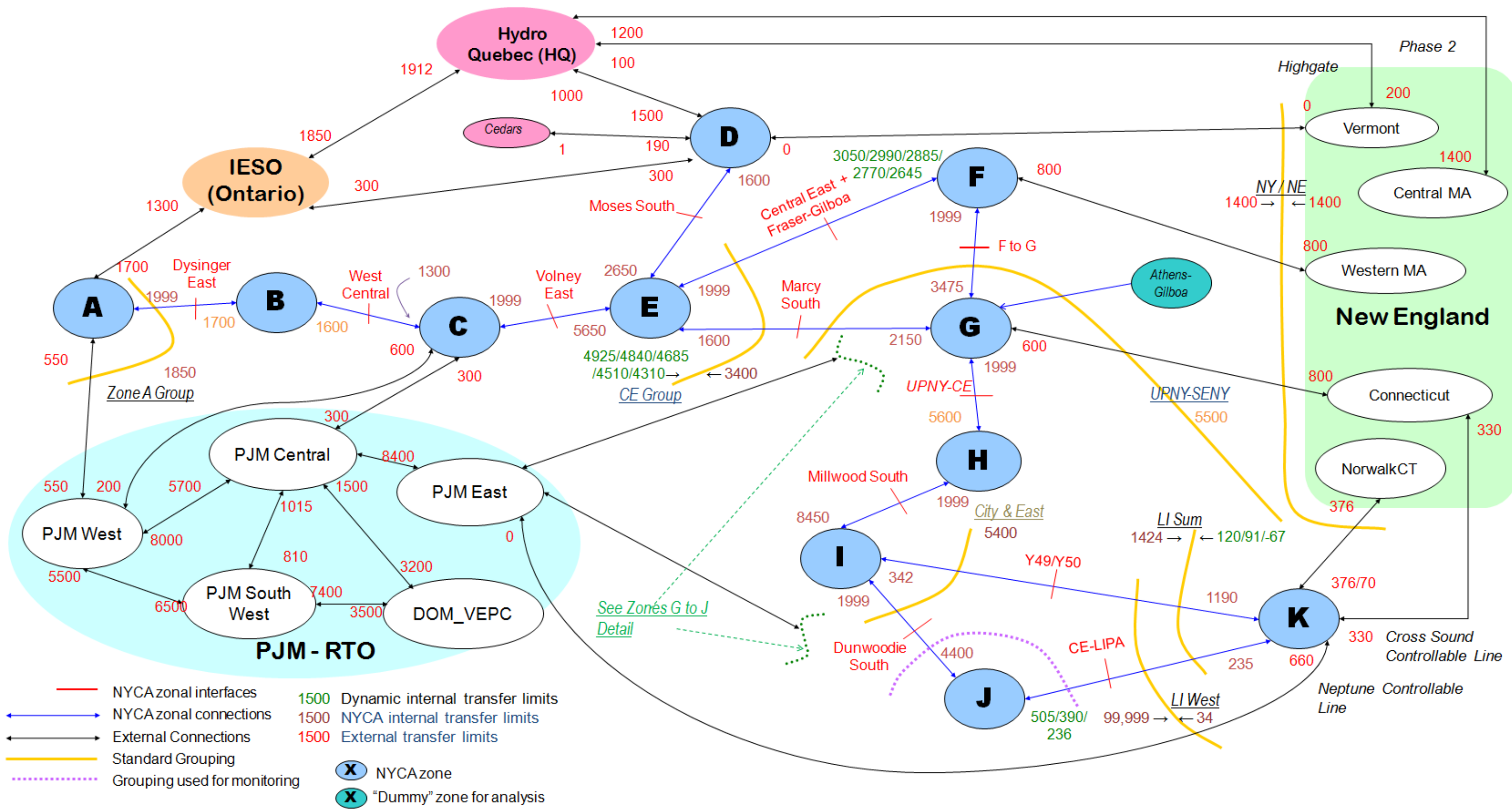


Figure 5-3: 2016 RNA Final Topology Year 2 to 10 (2018-2026)

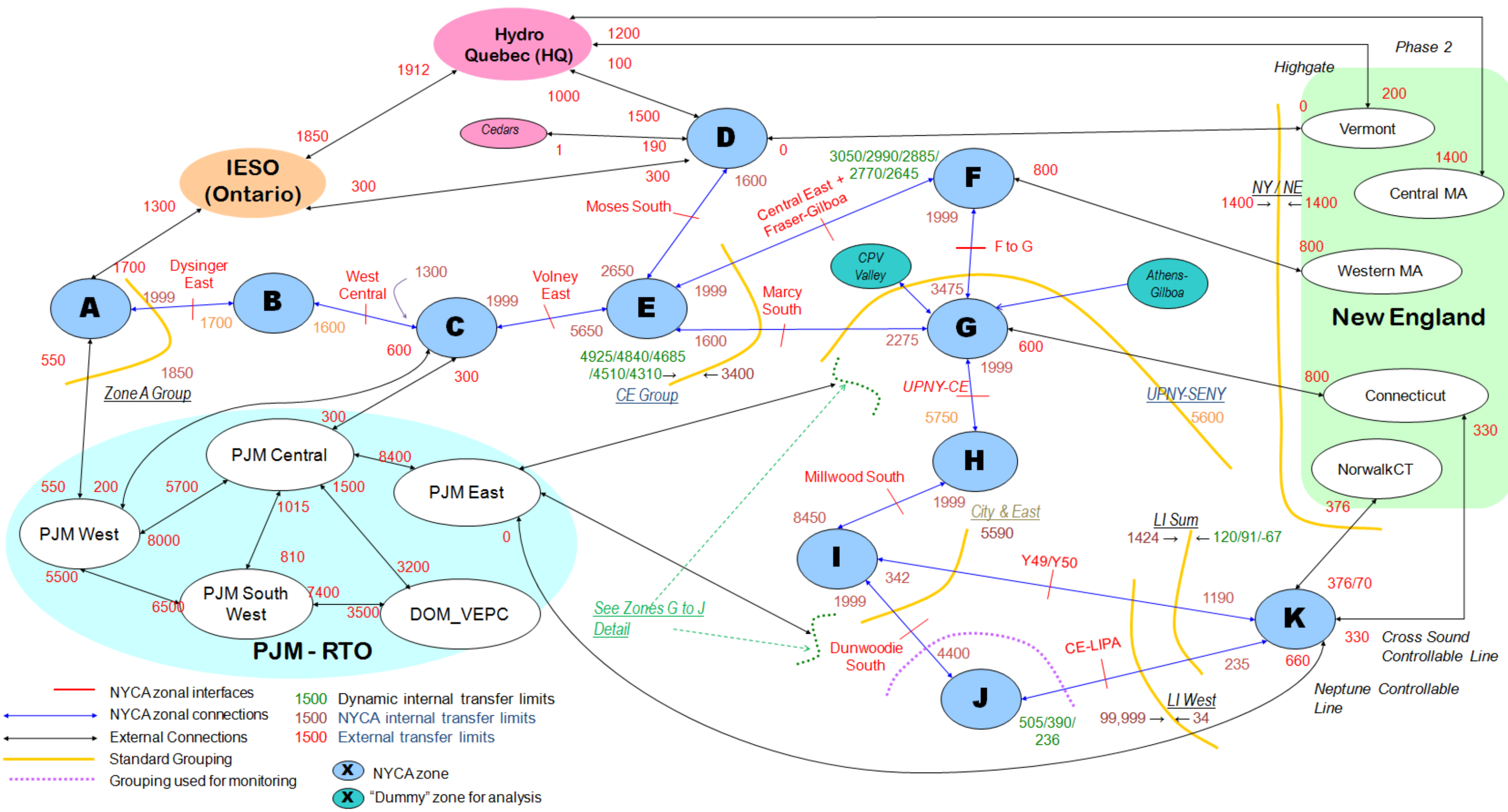
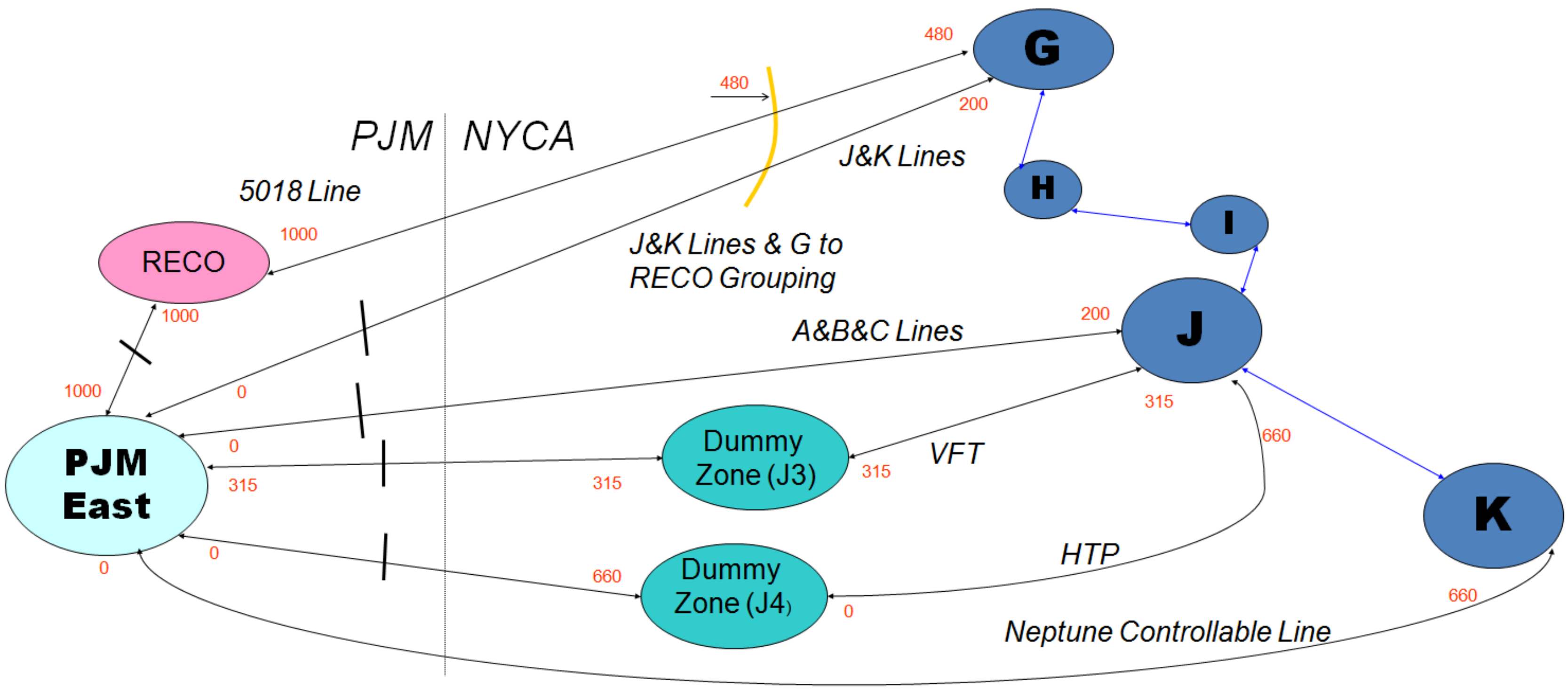


Figure 5-4: 2016 RNA Final Topology Zones G to J, Year 1 to 10 (2017 to 2026)



(PJM East to RECO) + (PJM East to J) + (PJM East to J3) + (PJM East to J4) + (PJM East to G) Grouped Interface Limited to 2,000 MW

The results of the 2016 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 for both the preliminary and final are presented in **Table 5-8**.

Table 5-8: NYCA Resource Adequacy Measure (in LOLE)

Case	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Preliminary Base Case	0.04	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.04
NYCA Free Flow*	0.04	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.04

*all NYCA internal transfer limits are removed

Case	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Preliminary Base Case	0.04	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.04
Final Base Case	0.04	0.03	0.04	0.02	0.03	0.03	0.03	0.04	0.04	0.05

The decrease in NYCA LOLE from 2017 to 2018 results from the CPV Valley Energy Center entering into service, while the drop from 2019 to 2020 results from capacity currently sold to New England assumed to be returning to the New York market. The very small difference in the LOLE between the Base Case and free flow case indicates a lack of binding interfaces in NYCA.

6. Scenarios

6.1. Introduction

The NYISO, in conjunction with stakeholders and Market Participants, develops 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 following scenarios were evaluated as part of the 2016 RNA, with an identification of the type of assessment performed:

- High Load (Econometric) Forecast – Resource Adequacy Only
- Zonal Capacity at Risk – Resource Adequacy Only
- Indian Point Energy Center (IPEC) Retirement assessment – Resource Adequacy Only
- No Coal – Resource Adequacy Only
- No Nuclear – Resource Adequacy Only
- Capacity Currently Sold Forward to External Control Areas will Continue to Sell in Remaining Years of Study Period – Resource Adequacy Only
- Transmission security assessment using a 90/10 load forecast – Transmission Security Only
- Western Public Policy Transmission Needs – Transmission Security Only

6.2. Resource Adequacy Scenarios LOLE Results

The results of the Resource Adequacy scenarios are summarized in the following sections and also in the **Table 6-3**, below.

6.2.1. High Load (Econometric) Forecast

The RNA Base Case forecast includes impacts associated with projected energy reductions coming from statewide energy efficiency and retail PV programs. The High Load Forecast Scenario excludes these energy efficiency program impacts from the peak forecast, resulting in the econometric forecast levels, and is shown in **Table 4-1**, above, with the delta shown in the **Table 6-1** below. This results in a higher peak load in 2026 than the Base Case forecast by 2,962 MW. Given that the peak load in the econometric forecast is higher than the Base Case, the probability of violating the LOLE criterion increases and violations also occur sooner.

Table 6-1: High Load vs. Baseline Summer Peak Forecast

Year	NYCA HighLoad	NYCA Baseline	Delta HighLd-Baseline
2017	34,533	33,363	1,170
2018	34,922	33,404	1,518
2019	35,243	33,477	1,766
2020	35,487	33,501	1,986
2021	35,747	33,555	2,192
2022	36,005	33,650	2,355
2023	36,261	33,748	2,513
2024	36,497	33,833	2,664
2025	36,745	33,926	2,819
2026	37,018	34,056	2,962

6.2.2. Zonal Capacity at Risk

The zones-at-risk assessments identify a maximum level of capacity that can be removed without causing NYCA LOLE 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 analysis 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 Base Case LOLE does not exceed the 0.10 criterion over the ten-year Study Period. Scenario analyses were performed to determine the reduction in zonal capacity (*i.e.,* the amount of capacity in each zone that could be lost) which would cause the NYCA LOLE to exceed 0.10 in each year from 2017 through 2026. The NYISO reduced zonal capacity to determine when violations occur in the same manner as the compensatory MW are added to mitigate resource adequacy violations, but with the opposite impact. The zonal capacity at risk analysis is summarized in **Table 6-2**, below.

Table 6-2: 2016 RNA Zonal Capacity at Risk (MW)

Load Zones	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Zone A	1,100	850	850	1,100	1,050	1,050	950	950	900	850
Zone B[1]	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR
Zone C	1,400	1,450	1,450	2,000	1,900	1,800	1,700	1,550	1,500	1,250
Zone D[1]	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR
Zone E[1]	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR
Zone F	1,400	1,450	1,450	2,050	1,950	1,850	1,700	1,550	1,500	1,250
Zone G	1,150	1,350	1,300	1,650	1,600	1,500	1,400	1,300	1,250	1,050
Zone H	1,150	1,350	1,300	1,650	1,550	1,550	1,400	1,300	1,250	1,000
Zone I[1]	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR	EZR
Zone J	950	1,050	1,000	1,150	1,150	1,100	1,050	1,000	950	850
Zone K	750	800	800	900	850	800	750	650	600	500

[1] EZR = Exceeds Zonal Resources

Zonal Groups	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Zones A-F	1,500	1,500	1,450	2,100	1,950	1,900	1,700	1,550	1,500	1,250
Zones G-I	1,150	1,350	1,300	1,650	1,600	1,550	1,400	1,300	1,250	1,000

6.2.3. Indian Point Energy Center Plant Retirement

The second of two nuclear operating licenses for the Indian Point Energy Center ("IPEC") expired in 2015. Because its owners submitted license renewal applications on a timely basis, IPEC remains in operation duringits ongoing license renewal processes. This scenario studied the impacts if the IPEC instead deactivated. Significant violations of resource adequacy criteria would occur immediately in 2017 if the IPEC deactivated at the beginning of 2017.

The IPEC has two base-load units (totaling 2,060 MW) located in Zone H in Southeastern New York, an area of the State that is subject to transmission constraints that limit transfers in that area. Southeastern New York, with the IPEC in service, currently relies on transfers to augment existing capacity. Consequently, load growth or loss of generation capacity in this area would aggravate those constraints.

The transmission security analysis findings for this 2016 RNA were not expected to be materially worse than in previous studies, such as the 2014 RNA. Prior studies demonstrated that the resource adequacy violations were more severe than the transmission security results; therefore, the 2016 RNA performed only a resource adequacy assessment, as shown in **Table 6-3**.

With IPEC out of service, the NYCA LOLE would be 0.21 days per year in 2017. The LOLE violation continues in each year of the Study Period and reaches an LOLE of 0.22 days per year in 2026, which is substantially higher than the 0.1 days per year criteria.

Compared with the 2014 RNA, the resulting LOLE violations are lower, but continue to substantially exceed the LOLE requirement should the Indian Point Plant deactivate.

6.2.4. No Coal

This scenario assesses the retirement of the last coal plant in New York State, which would represent the loss of approximately 687 MW of capacity. This scenario caused a relatively small increase in NYCA LOLE as shown in **Table 6-3**.

6.2.5. No Nuclear

This scenario assesses the retirement of all of the remaining nuclear plants in New York State (in addition to Ginna and FitzPatrick being modeled as retired in the

Base Case). This scenario resulted in a relatively large increase in LOLE, as shown in **Table 6-3**.

6.2.6. Continued Forward Sales to External Control Areas

This assessment was performed with current capacity sales to New England being held constant from 2018 to the end of the Study Period. **Table 6-3** below details the NYCA LOLE results. This assessment does not address the impacts on major transmission interface transfer capabilities caused by the capacity sales to New England.

Table 6-3: 2016 RNA Resource Adequacy Scenarios NYCA LOLE Results

Scenario	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Base Case	0.04	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.04
Capacity Continuing to Sell	0.04	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.07
No Coal	0.06	0.07	0.07	0.04	0.05	0.05	0.06	0.06	0.06	0.07
High Load Forecast	0.09	0.10	0.11	0.10	0.12	0.13	0.15	0.17	0.20	0.24
Retirement of IPEC Gen.	0.21	0.14	0.14	0.12	0.13	0.14	0.16	0.17	0.18	0.20
No Nuclear	0.36	0.27	0.27	0.22	0.23	0.24	0.26	0.27	0.29	0.32

6.3. Transmission Security Scenario Results

6.3.1. 90/10 Load Forecast

The 90/10 peak load forecast represents an extreme weather condition (*e.g.*, hot summer day). **Table 6-4** provides a summary of the 90/10 coincident peak load forecast through the ten-year Study Period compared to the baseline forecast on a year-by-year basis.

Table 6-4: 90/10 Peak Load Forecast NYCA versus Baseline Forecast (MW)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Baseline Peak Load Forecast	33,363	33,404	33,477	33,501	33,555	33,650	33,748	33,833	33,926	34,056
90/10 Peak Load Forecast	35,708	35,766	35,857	35,892	35,960	36,067	36,180	36,278	36,385	36,532
Difference	2,345	2,362	2,380	2,391	2,405	2,417	2,432	2,445	2,459	2,476

The transmission security violations identified in the preliminary RNA Base Case, occurring primarily in Western and Central New York and Long Island, are exacerbated under 90/10 coincident peak load conditions; also, additional overloaded facilities occur in the same regions. **Table 6-5** provides a summary of the contingency pairs that result in the highest thermal overload on BPTF elements. This table shows that increased load growth across the state exacerbates the violations identified in the preliminary RNA Base Case. In the second contingency column, “N/A” corresponds to a violation occurring under N-1 conditions and “Base Case” corresponds to a violation under an N-1-0 conditions.

Table 6-5: 2016 RNA 90/10 Transmission Security Thermal Violations

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	2017 Flow (MVA)	2021 Flow (MVA)	2026 Flow (MVA)	First Contingency	Second Contingency
A/ONT	N.Grid	Packard-Beck (BP76) 230	489	587	587	608	590	590	Niagara-Packard (#62) 230	TWR Niagara 230
A	NYSEG	Stolle-Gardenville (#66) 230	474	478	478	485	487	491	TWR Huntley 230	N/A
						569	565	569	Packard-Huntley (#77) 230	SB Packard 230
A	N. Grid	Packard-Huntley (#77) 230	556	644	746			649	SB Packard 230	N/A
						740	719	731	Stolle-Gardenville (#66) 230	SB Packard 230
						605	583	594	Packard-Huntley (#78) 230	Base Case
A	N. Grid	Packard-Huntley (#78) 230	556	644	746	738	714	726	Packard-Huntley (#77) 230	Bus Fault Stolle 230
						606	583	597	Packard-Huntley (#77) 230	Base Case
A	N.Grid	Niagara-Packard (#61) 230	627	717	847	877	859	877	Stolle-Gardenville (#66) 230	TWR Packard 230
								628	Niagara-Packard (#62) 230	Base Case
A	N.Grid	Niagara-Packard (#62) 230	627	717	847			855	TWR Niagara 230	N/A
						917	915	946	Beck-Packard (BP76) 230	TWR Niagara 230
C/B	NYPA, RG&E, N. Grid	Clay-Pannell (#1) 345	1195	1195	1195	1450	1365	1431	Robinson-Stolle (#65) 230	SB Clay 345
C/B	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345	1195	1195	1195	1452	1367	1433	Robinson-Stolle (#65) 230	SB Clay 345
C	NYSGE	Oakdale 345/115 2TR	428	556	600	661	672	708	Fraser 345/115 TR2	SB Oakdale 345
						441	432	455	Oakdale 345/115 3TR	Base Case
C	NYSGE	Oakdale 345/115 3TR	428	556	600	577	572	592	SB Oakdale 345	N/A
						602	608	630	Watercure-Oakdale (#31) 345	Oakdale 345/115 2TR
								445	Oakdale 345/115 2TR	Base Case
C	NYSGE	Hillside 230/115 BK3	231	294	336	304	316	328	Robinson-Stolle (#66) 230	Bus Fault Hillside 230
						243	255	256	Hillside 230/115 BK4	Base Case
C	N. Grid	Elbridge 345/115 1TR	470	557	717			559	SB Lafayette 345	N/A
						570	658	675	Clay-Pannell (PC-1)345	SB Clay 345
							497	486	Packard-Huntley (#77) 230	Base Case
C	N. Grid	Clay-Woodard (#17) 115 (Clay-Euclid)	220	252	280	286	275	293	Clay-Lockheed Martin (#14)	SB Lafayette 345
						281	322	339	Oakdale-Fraser (#32) 345	SB Lafayette 345
C	N. Grid	Clay-Lockheed Martin (#14) 115 (Clay-Wetzel)	220	252	280		283	298	Oakdale-Fraser (#32) 345	SB Lafayette 345
						266	261	272	Clay-Woodard (#17) 115	SB Oswego 345
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	137			Clay-Teall (#11) 115	SB Dewitt 345
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116	120	145	137			Clay-Dewitt (#13) 345	SB Oswego 345
C	N. Grid	Lighthouse Hill-Clay (#7) 115	108	108	108			113	Clay 345/115 2TR	SB Clay 345
E	NYPA	Fraser 345/115 BK2	305	386	420	438	437	441	Lafayett-Clarks Corners (4-46) 345	SB Fraser 345
						420	456	471	Oakdale-Fraser (#32) 345	SB Lafayette 345
E	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	142			Bus Fault Porter 115	N/A
						159	126	126	Oswego-Elbridge-Lafayett (#17) 345	Bus Fault Porter 115
						151	131	156	Dewitt 345/115 TR2	Bus Fault Porter 115
						130			Porter-Oneida (#7) 115	Base Case
E	N. Grid	Porter-Oneida (#7) 115 (Power-W. Utica)	116	120	145	143	130		Porter-Yahnundasis (#3) 115	SB Oswego 345
						132	133	132	Oakdale-Fraser (#32) 345	SB Lafayette 345
K	LIPA	Shore Rd-Lake Success (#367) 138	249	430	612		440	436	Barrett-Valley Stream (#291) 138	Shore Rd-Lake Success (#368) 138
K	LIPA	Shore Rd-Lake Success (#368) 138	249	430	612		441	437	Barrett-Valley Stream (#291) 138	Shore Rd-Lake Success (#367) 138
K	LIPA	East Garden City-Valley Stream (#262) 138	211	291	504	337	336	352	Barrett-Valley Stream (#292) 138	Barrett-Valley Stream (#291) 138

6.3.2. Western New York Public Policy Transmission Need

On July 20, 2015, the New York State Public Service Commission (PSC) issued an order identifying the relief of congestion in Western New York, including access to increased output from the Niagara hydroelectric facility and additional imports of renewable energy from Ontario, as a Public Policy Transmission Need for which the NYISO must solicit and evaluate proposed solutions. For this Western New York Public Policy Transmission Need, a sufficient project must obtain full output from Niagara, while reliably maintaining certain levels of simultaneous imports from Ontario. On November 1, 2015, the NYISO issued a solicitation for proposed solutions of all types (transmission, generation, and demand side) and received 15 proposals from a total of eight developers—12 transmission-only proposals, one hybrid transmission and generation proposal, and two generation-only proposals. On May 31, 2016, the NYISO issued the Western New York Public Policy Transmission Need Viability & Sufficiency Assessment, identifying 10 viable and sufficient projects to address the public policy need and also recommending certain non-bulk transmission facility upgrades to fulfill the objectives of the public policy. The PSC has received public comments and will issue an order regarding whether there continues to be a need for transmission driven by public policy requirements such that the NYISO should evaluate and select a transmission solution.

To evaluate the effects of a potential Western New York Public Policy Transmission Project on the transmission security findings for this RNA, the transmission constraints in the Niagara area were relaxed in the preliminary RNA Base Case for study years 2021 and 2026. As shown in **Table 6-6**, a Western New York Public Policy Transmission Need project would resolve the overloads on Stolle-Gardenville (#66) 230 kV, Packard-Huntley (#77) 230 kV, Clay-Pannell (#1) 345 kV, Clay-Pannell (#2) 345 kV, and Oakdale (2TR) 345/115 kV.

Table 6-6: 2016 RNA Transmission Security Thermal Violations for Western Public Policy

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	2017 Flow (MVA)	2021 Flow (MVA)	2026 Flow (MVA)	First Contingency	Second Contingency
A	NYSEG	Stolle-Gardenville (#66) 230	474	478	478	N/A			Packard-Gardenville (#182) 115	TWR Packard-Huntley 230
A	N. Grid	Packard-Huntley (#77) 230	556	644	746	N/A			Stolle-Gardenville (#66) 230	SB Packard 230
C/B	NYPA, RG&E, N. Grid	Clay-Pannell (#1) 345	1195	1195	1195	N/A			Stolle-Gardenville (#66) 230	SB Clay 345
C/B	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345	1195	1195	1195	N/A			Stolle-Gardenville (#66) 230	SB Clay 345
C	NYSGE	Oakdale 345/115 2TR	428	556	600	N/A			Packard-Huntley (#77) 230	SB Oakdale 345
C	N. Grid	Elbridge 345/115 1TR	470	557	717	N/A		569	Pannell-Clay (#1) 345	SB Clay 345
C	N. Grid	Clay-Lockheed Martin (#14) 115 (Clay-Wetzel)	220	252	280	N/A		255	Clay-Woodard (#17) 115	SB Lafayette 345
C	N. Grid	Clay-Woodard (#17) 115 (Clay-Euclid)	220	252	280	N/A		255	Clay-Lockheed Martin (#14) 115	SB Lafayette 345
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	N/A			Clay-Teall (#11) 115	SB Dewitt 345
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	N/A			Clay-Dewitt (#13) 345	Oswego-Lafayette (#17) 345
E	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	N/A			Stolle-Gardenville (#66) 230	Porter Bus D 115
E	N. Grid	Porter-Oneida (#7) 115 (Power-W. Utica)	116	120	145	N/A			Porter-Yahnundasis (#3) 115	SB Oswego 345
K	LIPA	East Garden City-Valley Stream (#262) 138	211	291	504	N/A	302	316	Barrett-Valley Stream (#292) 138	Barrett-Valley Stream (#291) 138

7. Impacts of Environmental Regulations

7.1. Regulations Reviewed for Impacts on NYCA Generators

There are several environmental regulatory programs that could impact the operation of the BPTF. These state and federal regulatory initiatives cumulatively may require considerable investment by the owners of New York's existing thermal power plants in order to comply. If the owners of those plants have to make considerable investments, the cost of the investments could impact whether they remain in the NYISO's markets and potentially affect the reliability of the BPTF. The purpose of this section is to review the status of the environmental regulatory programs, so that the risks can be properly represented and balanced in the context of the Resource Adequacy and Transmission Security analysis and results contained in this report. The following environmental regulatory programs are reviewed in the 2016 RNA:

a) *MATS*: Mercury and Air Toxics Standard for hazardous air pollutants (effective April 2015)

b) *CSAPR*: Cross-State Air Pollution Rule for the reduction of SO_2 and NO_X emissions in 28 Eastern States (Additional Phase 2 reductions proposed for 2017)

c) *RGGI*: Regional Greenhouse Gas Initiative 2016 Program Review is currently underway (CO_2 emission cap reductions beyond the existing program are currently being evaluated)

d) *Clean Power Plan:* New Source Performance Standards would have become effective October 2015 with final emissions limits for existing units beginning in 2022. However, the Supreme Court of the United States stayed the effectiveness of the CPP pending resolution of judicial challenges to the regulation.

e) *RICE*: NSPS and NESHAP – New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines

f) *DG Rule*: New York State Department of Environmental Conservation (NYSDEC) proposed rule to lower emissions from small generators (potentially effective in 2018)

g) *NYC Residual Oil Elimination*: Phase out of residual oil usage in New York City (NYC) utility boilers

h) *BTA: Best Technology Available for cooling water intake structures (effective* upon Permit Renewal)

The NYISO has estimated that as much as 27,500 MW in the existing fleet (72% of 2015 Summer Capacity) will have some level of exposure to the above-referenced environmental regulations.

7.1.1. Mercury and Air Toxics Standards (MATS)

The United States Environmental Protection Agency (EPA) Mercury and Air Toxics Standards (MATS) will limit emissions of mercury and air toxics through the use of Maximum Achievable Control Technology (MACT) for Hazardous Air Pollutants (HAP) from coal and oil fueled steam generators with a nameplate capacity of 25 MW or more. MATS directly affects three coal-fired units in the NYCA, representing 978 MW of nameplate capacity. Compliance requirements began in April 2015, but Reliability Critical Units (RCU) can apply for an extension through April 2017. One coal-fired unit in New York applied for an extension of the compliance deadline to April 2017. The remainder of the New York coal fleet installed emission control equipment and achieved compliance by April 2015.

The heavy oil-fired units have implemented a compliance strategy that relies on cleaner mix of fuels. Given the current outlook for the continued attractiveness of natural gas compared to heavy oil, it is anticipated that compliance can be achieved by dual fuel units through the use of natural gas to maintain fuel ratios that are specified in the regulation. *Note*: The MATS regulation provides for an exemption for units that use oil for less than ten percent of heat input annually over a three year period, and less than 15 percent in any given year. The regulation provides for an exemption from emission limits for units that limit oil use to less than the amount equivalent to an eight percent capacity factor over a two year period.

7.1.2. Cross-State Air Pollution Rule (CSAPR)

The CSAPR established emission caps and an allowance trading system to limit SO_2 and NO_X emissions from fossil fuel fired EGUs for units with 25 MW of nameplate capacity or more. Affected generators need one allowance for each ton emitted for SO_2 and NO_X in a year and NOx during the Ozone Season (OS NO_X). *Note*: The Ozone Season is May 1 to September 30.

The EPA has established a budget for each type of allowance for each affected state. The rule restricts interstate trading of allowances by establishing trading limits for each allowance system, which are 118%, 118%, and 121% of the respective (SO_2, NO_X and OS NO_X) state budgets. If the allowance trading limit is exceeded, those generators that exceeded their respective contributions to the budget will need to match their emissions in excess of the budget amounts with three allowances for each ton emitted.

In New York, CSAPR affects 157 units, representing 23,100 MW of nameplate capacity. The Supreme Court of the United States upheld the CSAPR regulation and the EPA made the rule effective January 1, 2015. Since the rule was finalized in 2012, two National Ambient Air Quality Standards for SO_2 and Ozone have been promulgated. The EPA has recognized these new standards, unit retirements, and/or changes in load and fuel forecasts in an updated proposal to reduce the Ozone Season NO_X Budget for New York by 58% beginning in 2017. Similarly, proposed budgets in New Jersey and Pennsylvania were significantly reduced by 77% and 74%, respectively. The structure of this rule creates uncertainty in the cost of production; however, it is expected that there will be a sufficient supply of allowances available in other affected states to allow compliance. The final CSPAR Update Rule is scheduled for release in the fall of 2016, and the NYISO will continue to study its impact on the reliability of the electric system.

7.1.3. Regional Greenhouse Gas Initiative (RGGI)

The Regional Greenhouse Gas Initiative (RGGI) is a multi-state, market-based power sector initiative that established a cap on CO_2 emissions from most fossil fueled units of 25 MW or more beginning in 2009. Under RGGI, one allowance is required for each ton of CO_2 emitted during a three-year compliance period. Phase II of the RGGI program became effective January 1, 2014 and further reduced the CO_2 emission cap by 45% to 91,000,000 tons for 2014. Phase II applied annual emission cap reductions of 2.5% per year with a cap of 78,175,215 tons by 2020. The actual quantity of allowances available for auction was further reduced to 56,283,807 tons to account for the carry forward allowance bank from the first phase of the program. After 2020, the emission cap reductions will be based upon the ongoing 2016 RGGI program review.

Under RGGI, a key provision to keep the allowance and electricity markets functioning is the provision of a Cost Containment Reserve (CCR). If demand exceeds supply at predetermined trigger prices, an additional 10,000,000 allowances will be added to the market. Trigger prices are set to rise to $10/ton in 2017 and escalate at 2.5% annually thereafter. Trigger prices were exceeded in 2014 and 2015. With the current bank of allowances held in reserve, the planned scheduled auctions, and the availability of the CCR allowances, it appears that the current program design will not negatively impact electric system reliability as long as the existing fleet of non-emitting units is not significantly reduced.

Leading up to the 2016 RNA, there have been several announcements of pending retirements of non-emitting nuclear generating stations within the RGGI region. The loss of these facilities will lead to significant increases in CO_2 emissions and will quickly erode the current bank of allowances.

The RGGI states are currently engaged in a Program Review looking beyond 2020 with a special focus on identifying program changes that may be necessary to make RGGI compatible with the EPA's Clean Power Plan (CPP). The RGGI states are considering changes in the cap, the rate of change of the cap, and the use of the CCR, as well as the criteria for expanded trading of allowances with other states.

7.1.4. Clean Power Plan

The EPA promulgated regulations to limit CO_2 emissions from existing power plants greater than 25 MW starting in 2022. The rule seeks to reduce national power sector CO_2 emissions by 32% compared to the baseline year of 2005. The rule provides several approaches among which states can choose to design their State Plans. Specifically, states can choose to include new units, mass caps, technology-based emission rates standards, state emission rates, or state specific plans. Recently, in February 2016, the Supreme Court of the United States stayed the implementation of the CPP, which effectively put on hold all further compliance obligations on the states. In May 2016, the Circuit Court of Appeals of the District of Columbia announced that it will hear the appeal of EPA's CPP final rule in September 2016. The New York State Department of Environmental Conservation has indicated that it will continue to formulate a state implementation plan notwithstanding the stay of the rule. The RGGI states have expressed the intent to only examine mass based compliance with the CPP. While this approach may ultimately provide a reliable system, an analysis of rate based approaches may show reduced reliability risks with an expanded portfolio of options for responding to the loss of non-emitting resources or important transmission facilities. The NYISO will continue to perform analyses of the CPP's impact on reliability as the rule undergoes judicial review.

7.1.5. RICE: NSPS and NESHAP

In January 2013, the EPA finalized two new rules that apply to engine powered generators typically used as emergency generators. The new rules were designed to allow older emergency generators that do not meet the EPA's rules and emission limits to comply. The first rule allowed generators to operate in demand response programs by limiting operations in non-emergency events to less than 100 hours per year when (i) a North American Electric Reliability Corporation (NERC) Alert Level 2 is declared or (ii) an electric system incurs a voltage or frequency deviation of five percent (5%) or more below the standard voltage or frequency. However, on March 1, 2015, the DC District Court struck this provision. Subsequently, the EPA finalized National Emission Standards for Hazardous Air Pollutants (NESHAP), and New Source Performance Standards (NSPS), for Reciprocating Internal Combustion Engines (RICE). The final rule does not contain the proposed exemptions for older higher emitting generators.

To participate in the demand response programs, emergency generators in New York State are required to have a NYSDEC Title V permit if located at a Major Source, a NYSDEC State Facilities Permit if located at an Area Source, or otherwise a NYSDEC registration. Each of these permits or registrations will have its unique set of limitations.

Some of the affected generators also participate in the NYISO's Special Case Resource (SCR) or Emergency Day-ahead Response (EDRP) Programs, which adds risks to the system reliability if the operations of these generators are constrained by the emission regulations.

7.1.6. Proposed NYSDEC Part 222 DG Rule

The NYSDEC proposed Part 222 rules to control emissions of NO_X and particulate matter (PM10 and 2.5) from engine driven generators that participate in the demand response programs. The proposed rules will apply to all such generators above 150 kW in New York City and above 300 kW in the remainder of the State not already covered by a Title V Permit containing stricter NOx and PM limits. Depending on their specific types, it appears that engines purchased since 2005 and 2006 should be able to operate within the proposed limits. Older engines can be retrofitted with emission control packages, replaced with newer engines, or cease participation in the demand response programs. The proposed rule is generally comparable to rules already in place in a number of other states within the Ozone Transport Region. NYSDEC's estimated compliance schedule is still developing but currently contemplates compliance in mid-2018. Based on the survey of demand response providers, the NYISO estimates that 100-200 MW of demand response program resources may be impacted by this proposed rule.

7.1.7. NYC Residual Oil Elimination

NYC has undertaken a program to eliminate the use of residual fuel oil in Electric Generating Units (EGUs). The program will become effective in 2020. Approximately 3,100 MW of affected generators will need to switch to #2 or #4 fuel oil when oil burning is required to comply with NYSRC Loss of Gas rules. The switch will increase production costs; however, the supplies of #2 fuel oil for direct use or for blending to produce #4 are more widely available.

7.1.8. Best Technology Available (BTA)

The EPA proposed a new Clear Water Act Section 316 b rule providing standards for the design and operation of power plant cooling systems. This rule will be implemented by NYSDEC, 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 NYSDEC, the NYISO has estimated that approximately 4,300 MW of nameplate capacity could be required to undertake major system retrofits, including closed cycle cooling systems. One high profile application of this policy is the Indian Point nuclear power plant, for which water discharge permit and water quality certification under the Clean Water Act remain pending at the NYSDEC. **Table 7-1** shows the current status of for BTA determinations.

Table 7-1: NYSDEC BTA Determinations (as of July 2016)

Plant	Status
Arthur Kill	**BTA in place**
Astoria	**BTA in place**
Barrett	**Permit drafting underway with equipment enhancements**
Bowline	**BTA in place, 15% Cap. Factor**
Brooklyn Navy Yard	**BTA Decision made, installing upgrades**
Cayuga	**BTA Decision made, install screens**
East River	**BTA in place**
FitzPatrick	**BTA studies being evaluated**
Ginna	**BTA studies being evaluated**
Indian Point	**Hearings, BTA Decision 2018 at the earliest**
Nine Mile Pt 1	**BTA studies being evaluated**
Northport	**BTA determination made, permit issued, equipment upgrades underway**
Oswego	**Lower priority for NYSDEC, leaning towards 15% Cap. Factor**
Port Jefferson	**BTA in place**
Ravenswood	**BTA in place**
Roseton	**In hearings**
Somerset	**BTA equipment upgrades identified.**

The owners of Bowline have accepted a limit on the duration of operation of the plant as their compliance method. NYSDEC's BTA Policy allows units to operate with 15% capacity factor averaged over a five-year period, provided that impingement goals are met and the plant is operated in a manner that minimizes entrainment of aquatic organisms.

7.2. Summary of Environmental Regulation Impacts

Table 7-2 summarizes the impact of the new environmental regulations. Approximately 32,400 MW of nameplate capacity may be affected to some extent by these regulations.

Table 7-2: Impact of New Environmental Regulations

Program	Status	Compliance Deadline	Approximate Nameplate Capacity (MW)
MATS	In effect	April 2015/2016/2017	1,000
CSAPR	In effect	January 2015 and 2017	23,100
RGGI	In effect	In effect	23,200
NYC #6 Elimination	In Permitting	2020	3,100
BTA	In effect	Upon permit Renewal	4,300

Using publicly available information from the EPA and the U.S. Energy Information Agency, the NYISO further identified potential operational impacts from the environmental regulations.

- *MATS/MRP Program*: Given the current outlook for the continued attractiveness of natural gas compared to heavy oil, it is anticipated that compliance can be achieved by dual fuel units through the use of natural gas to maintain fuel ratios that are specified in the regulation.
- *RGGI:* The impact of RGGI may increase the operating cost of fossil fueled units.

8. Fuel Adequacy

8.1. Gas Infrastructure Adequacy Assessment

High volumes of low-cost natural gas continues to be produced in the Marcellus and Utica Shale areas and remains the least costly fuel source for generation in the New York electric markets. As a result, the amount of electrical energy produced by natural gas continues to increase. The benefits of this shift in the relative costs of fossil fuels include reduced emissions from displaced coal and oil, improved generation efficiency, and lower electric energy prices. The trend, however, results in a higher reliance on gas pipelines and a reduction in overall fuel diversity in New York as other generation resources become uneconomic. The 2014 Regional EIPC Study findings for study year 2018 reported that there is inadequate gas pipeline infrastructure to meet all gas-fired generation needs during cold weather operations but that electric reliability can be met with the current levels of dual-fuel capability.

Every fall, the NYISO issues a seasonal fuel adequacy survey to Generation Asset Owners requesting expected dual-fuel capability, the level of gas transportation service, starting alternative fuel inventories, and arrangements for alternative fuel replenishments. The NYISO also independently tracks the permitting status of generating units to confirm dual-fuel capability. Based on these data sources, the 2016 Gold Book reported dual-fuel capability of 18,211 MW (Summer DMNC) and oil-only capability of 2,578 MW (Summer DMNC). Thus, the summer capability of oil and dual-fuel units with oil permits totals 20,789 MW. These oil and dual-fuel facilities represent a fleet of resources that can respond to delivery disruptions on the gas pipeline system during both summer and winter seasons.

8.2. Loss of Gas Supply Assessment

A loss of gas supply assessment was conducted as part of the NYISO 2015 Comprehensive Area Transmission Review (CATR). The findings of the assessment are summarized below.

Natural gas-fired generation in NYCA is supplied by various networks of major gas pipelines. NYCA generation capacity has a balance of fuel mix which provides operational flexibility and reliability, and several generation plants have dual fuel capability. Based on the 2015 Gold Book, 10% of the generating capacity is fueled by natural gas only, 46% by oil and natural gas, and the remainder is fueled by oil, coal, nuclear, hydro, wind, and other.

The loss of gas supply assessment was performed using the winter 2020 baseline (50/50) forecast of the coincident peak load. The study model for a gas fuel shortage uses the winter peak demand level assuming that all NYCA gas-only units, dual-fuel units that lack permits to burn oil, and other units that do not have the capability to burn their alternative fuel (such as those that do not store any in their tanks) are not available. The total reduction in generating capacity is 10,003 MW. **Table 8-1** provides a summary of the winter peak load and total capacity assuming the loss of gas supply.

Table 8-1: Loss of Gas Supply Winter Peak Load and Capacity Minus Gas Units

	Comprehensive Review: 2015 Forecast for Winter 2020
Peak Load (MW)	24,575
Total Capacity (MW)	44,748
Loss of Gas Supply Capacity (MW)	10,003
Total Remaining Capacity (MW)	34,745

The steady state analysis shows no thermal or voltage violations for this scenario. For the dynamic analysis, all contingencies evaluated are stable and damped.

8.3. Summary of Other Ongoing NYISO efforts

The NYISO has been working with stakeholders and other industry groups to identify and address gas-electric coordination issues and improvements. These groups include the NYISO Electric Gas Coordination Working Group (EGCWG), the Northeast Gas-Electric Operating Committee, and the IRC Gas-Electric Task Force. Recent coordination improvements include:

Operator Awareness

- Northeast interstate pipeline system in the NYISO Control Room with enhanced posting of gas Operational Flow Orders
- Web based fuel inventory application

Coordination

- Continued quarterly infrastructure maintenance coordination
- Market Mitigation & Analysis generation site visits
- New York State Reliability Council Minimum Oil Burn Rules

- FERC Order 809 electric and gas nomination timing coordination
- FERC Order 787 Code of Conduct communication enhancements
- Improvements in reference level developments reflective of actual fuel costs
- Increased market reserve requirements and enhanced shortage pricing

9. 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 detailed analysis of historic congestion can be found on the NYISO website:
http://www.nyiso.com/public/markets_operations/services/planning/documents/index.jsp

10. Observations and Recommendations

This 2016 Reliability Needs Assessment (RNA) assesses both the transmission and resource adequacy and the transmission security of the New York Control Area (NYCA) bulk power transmission system from year 2017 through 2026, the "Study Period" of this RNA.

This 2016 Reliability Needs Assessment finds two transmission security related Reliability Needs in portions of the Bulk Power Transmission Facilities (BPTF) beginning in 2017:

- the New York State Electric & Gas Corp. (NYSEG) Oakdale 345/115 kV transformer, and
- the Long Island Lighting Company d/b/a Long Island Power Authority (LIPA) East Garden City to Valley Stream 138 kV line.

This 2016 Reliability Needs Assessment finds that resource adequacy criteria is met throughout the Study Period.

From the transmission and 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 ten-year Study Period. This is mainly attributable to the decrease in the summer peak baseline load forecast of approximately 2,300 MW in 2021 as compared with the 2014 Reliability Needs Assessment. When recent and planned capacity deactivations are included in the calculation, the net statewide surplus increased by approximately 3,000 MW as compared with the 2014 Reliability Needs Assessment and about 975 MW as compared with the 2014 Comprehensive Reliability Plan (see **Table E-1**).

The 2016 Reliability Needs Assessment has identified two transmission security related Reliability Needs in portions of the Bulk Power Transmission Facilities. Specifically, **Table E-2** and **Figure E-1** show that the identified transmission security issues occur in Long Island and Western New York beginning in 2017.

In Long Island, the East Garden City to Valley Stream 138 kV line could not be secured within applicable thermal ratings when another 138 kV line is out-of-service (also known as an "N-1-1" condition). The power flow on this facility is driven by the combination of LIPA load in western Long Island and the scheduled 300 MW wheel between ConEdison and LIPA. This overload has now been identified as a result of no longer reducing the wheel following an outage, for which ConEdison's contractual portion of Y50 is assumed to be delivered to ConEdison, thus reducing the portion of western Long Island load that is capable of being served through the overloaded facility from generating sources in eastern Long Island.

The Oakdale 345/115 kV transformer also could not be secured within applicable thermal ratings under certain transmission line outage conditions. This overload was noted in the 2014 Reliability Needs Assessment as well. At that time, NYSEG provided an update to their Local Transmission Owner Plans that included a third Oakdale transformer and reconfiguration of the Oakdale 345 kV substation. NYSEG's planned in-service date was 2018, which met the inclusion rules and therefore addressed the Reliability Need identified in the 2014 Reliability Needs Assessment. However, as part of the 2016 Gold Book reporting process, NYSEG updated the in-service date to the winter of 2021, which does not meet the inclusion rules for this 2016 Reliability Needs Assessment Base Case. Without this project in the Base Case, the Oakdale transformer remains overloaded.

The two transmission security related Reliability Needs listed in **Table E-2** will be eligible for the NYISO to solicit solutions if those Reliability Needs remain unresolved by further updates to Local Transmission Owner Plans. Following such a solicitation by the NYISO, developers may submit market-based solutions and alternative regulated solutions for evaluation as part of the 2016 Comprehensive Reliability Plan.

As a backstop to market-based solutions, the NYISO employs a process to define responsibility should the market fail to provide an adequate solution to an identified Reliability Need. The Responsible Transmission Owners for the identified Reliability Needs, NYSEG and LIPA, will be tasked to develop detailed regulated backstop solutions for evaluation for inclusion in the 2016 Comprehensive Reliability Plan.

Given the limited time between the identification of the transmission security related Reliability Needs in this Reliability Needs Assessment report and their occurrence in 2017, the use of demand response and operating procedures, including load shedding under emergency conditions, may be necessary to maintain reliability during peak load periods until permanent solutions can be put in place. Accordingly, the Responsible Transmission Owners will present at the Electric System Planning Working Group (ESPWG) and at the Transmission Planning Advisory Subcommittee (TPAS) any updates to their LTPs that impact the Reliability Needs identified in the 2016 Reliability Needs Assessment, including their proposed operating procedures pending completion of their permanent solutions, for review and acceptance by the NYISO and consideration in the 2016 Comprehensive Reliability Plan.

In addition, the 2016 Reliability Needs Assessment provides analysis of risks to the Bulk Power Transmission Facilities under certain scenarios to assist stakeholders and developers in developing and proposing market-based and regulated reliability solutions, as well as policy makers to formulate state policy.

Scenarios are variations on the Reliability Needs Assessment Base Case to assess the impact of possible changes in key study assumptions, such as higher load forecast (*i.e.,* not including the benefits of retail solar photovoltaic ("solar PV", or "behind-the-meter solar PV") and of the energy efficiency programs), capacity retirements or sales (*e.g.,* all nuclear units retire, remaining coal units deactivate*, etc.*), and additional transmission build-outs (*e.g.,* transmission driven by public policy) which, if they occurred, could change the timing, location, or degree of violations of applicable Reliability Criteria on the NYCA system during the Study Period.

As demonstrated in the 2016 Reliability Needs Assessment scenarios, a higher load level or additional retirement of capacity (nuclear, *etc.*) 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: (i) units interconnecting to the bulk power transmission system; (ii) the development and installation of local transmission facilities; (iii) additions, mothballs or retirement of generators; (iv) the status of mothballed/retired facilities; (v) the continued implementation of New York State energy efficiency, solar PV installations, clean energy standards, and similar programs; (vi) participation in the NYISO demand response programs; and (vii) the impact of new and proposed environmental regulations on the existing generation fleet.

Appendices

2016 RNA

Appendices A – D

FINAL

October 18, 2016

Appendix A – 2016 Reliability Needs Assessment Glossary

Term	Definition
10-year Study Period	10-year period starting with the year after the study is dated and projecting forward 10 years. For example, the 2016 RNA covers the 10-year Study Period of 2017 through 2026.
Adequacy	Encompassing both generation and transmission, adequacy refers to the ability of the bulk power system to supply the aggregate requirements of consumers at all times, accounting for scheduled and unscheduled outages of system components.
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.
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.
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 (Directory #1).
Best Available Retrofit Technology (BART)	NYS DEC regulation, required for compliance with the federal Clean Air Act, applying to fossil fueled electric generating units built between August 7, 1962 and August 7, 1977. Emissions control of SO_2, NOx and PM may be necessary for compliance. Compliance deadline is January 2014.
Best Technology Available (BTA)	NYS DEC policy establishing performance goals for new and existing electricity generating plants for Cooling Water Intake Structures. The policy would apply 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.
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.

Term	Definition
Capability Period	The Summer Capability Period lasts six months, from May 1 through October 31. The Winter Capability Period runs from November 1 through April 30 of the following year.
Capacity	The capability to generate or transmit electrical power, or the ability to reduce demand at the direction of the NYISO.
Capacity Resource Integration Service (CRIS)	CRIS is the service provided by NYISO to interconnect the Developer's Large Generating Facility or Merchant Transmission Facility to the New York State Transmission System in accordance with the NYISO Deliverability Interconnection Standard, to enable the New York State Transmission System to deliver electric capacity from the Large Generating Facility or Merchant Transmission Facility, pursuant to the terms of the NYISO OATT.
Class Year	The group of generation and merchant transmission projects included in any particular Annual Transmission Reliability Assessment (ATRA), in accordance with the criteria specified for including such projects in the assessment.
Clean Air Interstate Rule (CAIR)	USEPA rule to reduce interstate transport of fine particulate matter (PM) and ozone. CAIR provides a federal framework to limit the emission of SO_2 and NOx.
Clean Energy Fund (CEF)	A statewide program ordered by the NYPSC that mandates that 50 percent of all electricity consumed in New York by 2030 comes from clean and renewable energy sources.
Comprehensive Reliability Plan (CRP)	A biennial study undertaken by the NYISO that evaluates projects offered to meet New York's future electric power needs, as identified in the Reliability Needs Assessment (RNA). The CRP may trigger electric utilities to pursue regulated solutions or other developers to pursue alternative regulated solutions to meet Reliability Needs, if market-based solutions will not be available by the need date. It is the second step in the Reliability Planning Process (RPP).
Comprehensive System Planning Process (CSPP)	A transmission system planning process that is comprised of three components: 1) Local transmission owner planning; 2) Compilation of local plans into the Reliability Planning Process (RPP), which includes developing a Comprehensive Reliability Plan (CRP); 3) Channeling the CRP data into the Congestion Assessment and Resource Integration Study (CARIS)

Term	Definition
Congestion Assessment and Resource Integration Study (CARIS)	The third component of the Comprehensive System Planning Process (CSPP). The CARIS is based on the Comprehensive Reliability Plan (CRP).
Congestion	Congestion on the transmission system results from physical limits on how much power transmission equipment can carry without exceeding thermal, voltage and/or stability limits determined to maintain system reliability.
Contingencies	Contingencies are individual electrical system events (including disturbances and equipment failures) that are likely to happen.
Cross-State Air Pollution Rule (CSARP)	This USEPA rule requires the reduction of power plant emissions that contribute to exceedances of ozone and/or fine particle standards in other states.
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. The DMNC test determines the amount of Installed Capacity used to calculate the Unforced Capacity that the Resource is permitted to supply to the NYCA.
Electric System Planning Work Group (ESPWG)	A NYISO governance working group for Market Participants designated to fulfill the planning functions assigned to it. The ESPWG is a working group that provides a forum for stakeholders and Market Participants to provide input into the NYISO's Comprehensive System Planning Process (CSPP), the NYISO's response to FERC reliability-related Orders and other directives, other system planning activities, policies regarding cost allocation and recovery for regulated reliability and/or economic projects, and related matters.
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 715	Annual report that is required by transmitting utilities operating grid facilities that are rated at or above 100 kilovolts. 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 unanticipated loss of capacity due to the breakdown of a power plant or transmission line. It can also mean the intentional shutdown

Term	Definition
	of a generating unit or transmission line for emergency reasons.
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. 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.
Gold Book	Annual NYISO publication of its Load and Capacity Data Report.
Installed Capacity (ICAP)	A Generator or Load facility that complies with the requirements in the Reliability Rules and is capable of supplying and/or reducing the demand for Energy in the NYCA for the purpose of ensuring that sufficient Energy and Capacity are available to meet the Reliability Rules. The Installed Capacity requirement, established by the New York State Reliability Council (NYSRC), includes a margin of reserve in accordance with the 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.
Interconnection Queue	A queue of transmission and generation projects that have submitted an Interconnection Request to the NYISO to be interconnected to the New York State Transmission System. All projects must undergo three studies – a Feasibility Study (unless parties agree not to perform it), a System Reliability Impact Study (SRIS) and a Facilities Study – before interconnecting to the grid.
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.
Local Transmission Owner Planning Process (LTPP)	The first step in the Comprehensive System Planning Process (CSPP), under which transmission owners in New York's electricity markets provide their local transmission plans for consideration and comment by interested parties.
Loss of load expectation (LOLE)	LOLE establishes the amount of generation and demand-side resources needed - subject to the level of the availability of those resources, load uncertainty, available transmission system transfer capability and emergency operating procedures - to minimize the probability of an involuntary loss of firm electric load on the bulk electricity grid. The state's bulk electricity grid is designed to meet an

Term	Definition
	LOLE that is not greater than one occurrence of an involuntary load disconnection in 10 years, expressed mathematically as 0.1 days per year.
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.
Market Monitoring Unit	A consulting or other professional services firm, or other similar entity, retained by the NYISO Board pursuant to ISO Services Tariff Section 30.4.6.8.1, Attachment O - Market Monitoring Plan.
Market Participant	An entity, excluding the ISO, that produces, transmits, sells, and/or purchases for resale Capacity, Energy and 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.
Mercury and Air Toxics Standards (MATS)	The rule applies to oil and coal fired generators and establishes limits for HAPs, acid gases, mercury (Hg), and particulate matter (PM). Compliance is required by March 2015, with extensions to 2017 for reliability critical units.
Mercury Reduction Program for Coal-Fired Electric Utility Steam Generating Units (MRP)	NYSDEC regulation of mercury emissions from coal-fired electric utility steam generating units with a nameplate capacity of more than 25 MW producing electricity for sale.
National Ambient Air Quality Standards (NAAQS)	Limits, set by the EPA, on pollutants considered harmful to public health and the environment.
New York Control Area (NYCA)	The area under the electrical control of the NYISO. It includes the entire state of New York, and is divided into 11 zones.
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

Term	Definition
	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)	A not-for-profit entity that develops, maintains, and, from time-to-time, updates the Reliability Rules which shall be complied with by the New York Independent System Operator ("NYISO") and all entities engaging in electric transmission, ancillary services, energy and power transactions on the New York State Power System.
North American Electric Reliability Corporation (NERC)	A not-for-profit organization that develops and enforces reliability standards; assesses reliability annually via 10-year and seasonal forecasts; monitors the bulk power system; and educates, trains, and certifies industry personnel. NERC is subject to oversight by the FERC and governmental authorities in Canada.
Northeast Power Coordinating Council (NPCC)	A not-for-profit corporation responsible for promoting and improving the reliability of the international, interconnected bulk power system in Northeastern North America.

Term	Definition
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	Order No. 1000 is a Final Rule that reforms the FERC electric transmission planning and cost allocation requirements for public utility transmission providers. The rule builds on the reforms of Order No. 890 and provides for transmission planning to meet transmission needs driven by Public Policy Requirements, interregional planning, opens transmission development for new transmission needs to non-incumbent developers, and provides for cost allocation and recovery of transmission upgrades.
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.
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 fueled 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.
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

Term	Definition
	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.
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.
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.
Reliability Need	A condition identified by the NYISO in the RNA as a violation or potential violation of Reliability Criteria.
Reliability Needs Assessment (RNA)	A biennial study which evaluates the resource adequacy and transmission system adequacy and security of the New York bulk power system over a ten year Study Period. Through this evaluation, the NYISO identifies Reliability Needs in accordance with applicable Reliability Criteria.
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.
Renewable Portfolio Standard (RPS)	Proceeding commenced by order of the NYDPS in 2004 which established the goal to increase renewable energy used in New York State to 30% of total New York energy usage (equivalent to approximately 3,700 MW of capacity) by 2015.
Responsible Transmission Owner (Responsible TO)	The Transmission Owner(s) or TOs designated by the NYISO, pursuant to the NYISO RPP, to prepare a proposal for a regulated solution to a Reliability Need or to proceed with a regulated solution to a Reliability Need. The Responsible TO will normally be the Transmission Owner in whose Transmission District the NYISO identifies a Reliability Need.
Security	The ability of the power system to withstand the loss of one or more elements without involuntarily disconnecting firm load.
Special Case Resources (SCR)	A NYISO demand response program designed to reduce power usage by businesses and large power users qualified to participate in the

Term	Definition
	NYISO's ICAP market. Companies that sign up as SCRs are paid in advance for agreeing to cut power upon NYISO request.
State Environmental Quality Review Act (SEQRA)	NYS law requiring the sponsoring or approving governmental body to identify and mitigate the significant environmental impacts of the activity/project it is proposing or permitting.
Study Period	The 10-year time period evaluated in the RNA.
System Reliability Impact Study (SRIS)	A study, conducted by the NYISO in accordance with Applicable Reliability Standards, to evaluate the impact of a proposed interconnection on the reliability of the New York State Transmission System.
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)	An identified group of Market Participants that advises the NYISO Operating Committee and provides support to the NYISO Staff in regard to transmission planning matters including transmission system reliability, expansion, and interconnection
Unforced Capacity Delivery Rights (UDR)	Unforced capacity delivery rights are rights that may be granted to controllable lines to deliver generating capacity from locations outside the NYCA to localities within NYCA.
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 entitled: "Reliability Planning Process Manual," 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:

1. Local Transmission Planning Process (LTPP),
2. Reliability Planning Process (RPP),
3. Congestion Assessment and Resource Integration Study (CARIS), and
4. 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.

Security is an operating and deterministic concept. This means that possible events are identified as having significant adverse reliability consequences, and the system is planned and operated so that the system can continue to serve load even if these events occur. Security requirements are sometimes referred to as N-1 or N-1-1. N is the number of system components. An N-1 requirement means that the system can withstand single disturbance events (*e.g.*, generator, bus section, transmission circuit, breaker failure, double-circuit tower) without violating thermal, voltage and stability limits or before affecting service to consumers. An N-1-1 requirement means that the Reliability Criteria apply after any critical element such as a generator, a transmission circuit, a transformer, series or shunt compensating device, or a high voltage direct current (HVDC) pole has already been lost. Generation and power flows can be adjusted by the use of 10-minute operating reserve, phase angle regulator control, and HVDC control and a second single disturbance is analyzed.

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. 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.

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 B-1 below summarizes the CSPP and **Figure B-2** summarizes the RPP process.

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

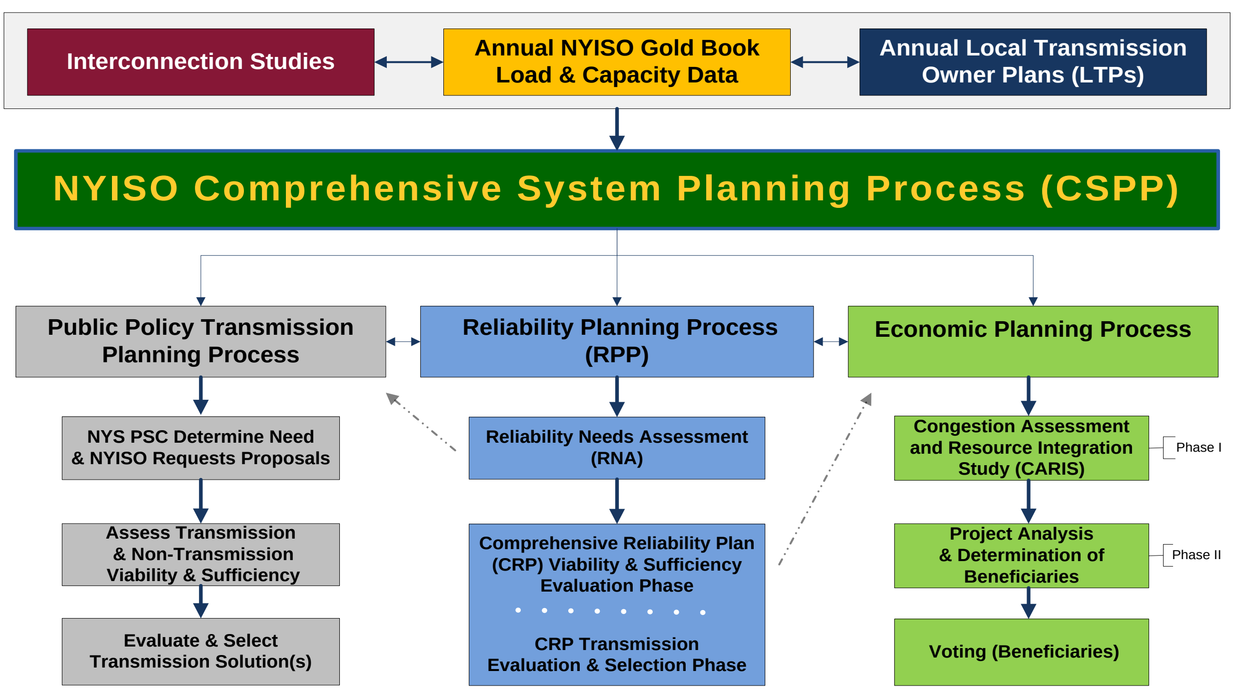
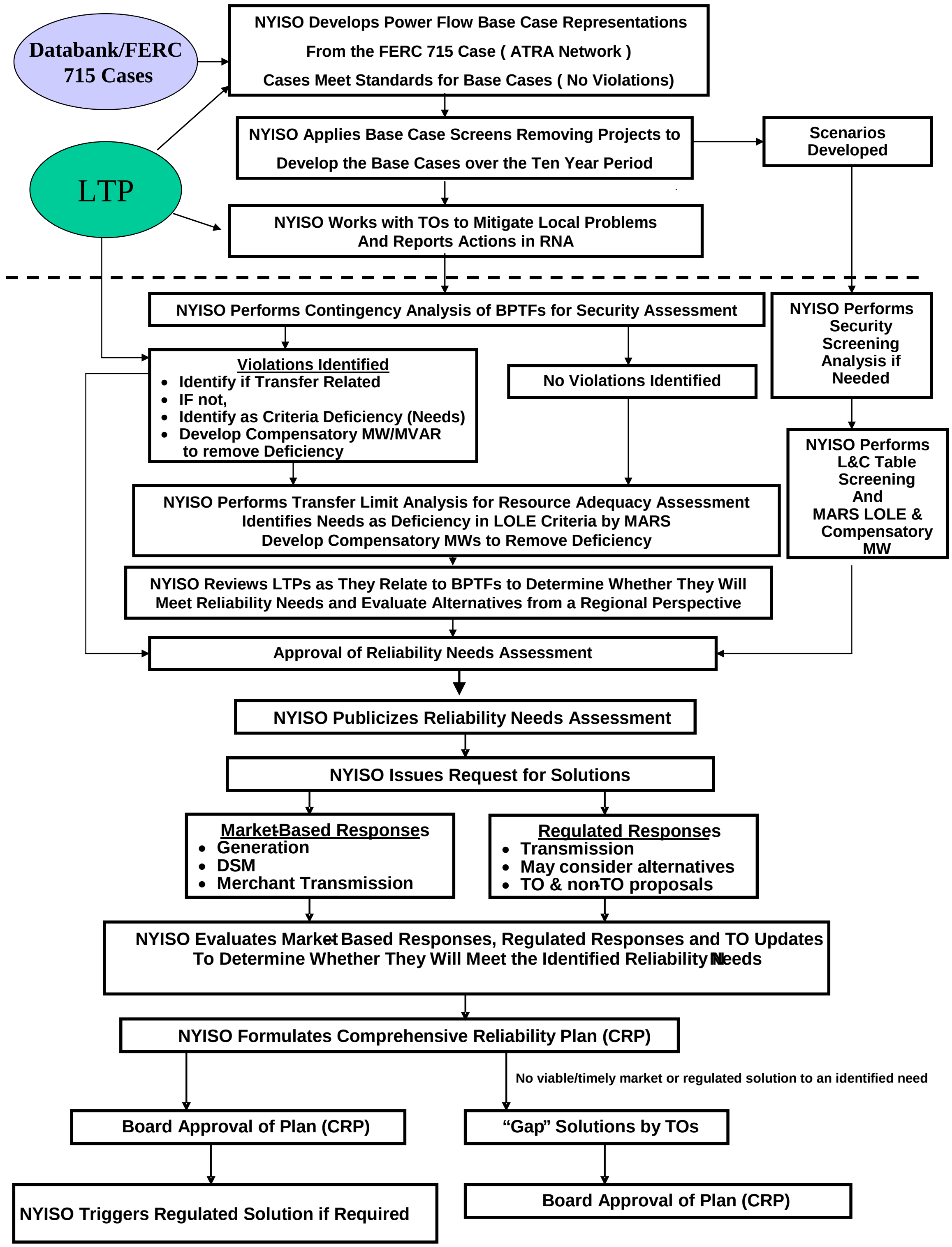


Figure B-2: NYISO Reliability Planning Process (RPP)



Appendix C - Load and Energy Forecast 2016-2026

C-1. Summary

In order to perform the 2016 RNA, a forecast of summer and winter peak demands and annual energy requirements was produced for the years 2016 – 2026. The electricity forecast is based on projections of New York's economy performed by Moody's Analytics in August 2015. 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. Table C-1 provides a summary of key economic and electric system growth rates from 2005 to 2026.

Table C-1: Summary of Economic & Electric System Growth Rates – Actual & Forecast

	Average Annual Growth			
	2005-2010	2010-2015	2016-2021	2021-2026
Total Employment	0.11%	1.57%	0.57%	0.34%
Gross State Product	0.98%	1.98%	1.56%	1.47%
Population	0.36%	0.39%	0.31%	0.29%
Total Real_Income	1.74%	2.53%	1.21%	1.36%
Weather Normalized Summer Peak	-0.37%	0.47%	0.12%	0.30%
Weather Normalized Annual Energy	-0.18%	-0.20%	-0.31%	-0.02%

C-2. Historic Overview

The New York Control Area (NYCA) is a summer peaking system and its summer peak has grown faster than annual energy and winter peak over the period from 2005 to 2015 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.

Table C-2 reports the NYCA historic seasonal peaks and annual energy growth since 2005. 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 2005 to 2015.

Table C-2: 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
2005	167,207	163,015	32,075	33,068	2005-06	24,947	24,770
2006	162,237	163,413	33,939	32,992	2006-07	25,057	25,030
2007	167,339	166,173	32,169	33,444	2007-08	25,021	25,490
2008	165,613	166,468	32,432	33,670	2008-09	24,673	25,016
2009	158,777	161,908	30,844	33,063	2009-10	24,074	24,537
2010	163,505	161,513	33,452	32,458	2010-11	24,654	24,452
2011	163,330	162,628	33,865	33,019	2011-12	23,901	24,630
2012	162,843	163,458	32,547	33,106	2012-13	24,658	24,630
2013	163,493	163,473	33,956	33,502	2013-14	25,738	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
	-0.34%	-0.19%	-0.30%	0.05%		-0.67%	-0.22%

C-3. Forecast Overview

Table C-3 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.

Table C-3: 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
2005	70,269	19,984	54,007	22,948	167,208	11,792	4,237	10,810	5,236	32,075
2006	67,805	19,152	53,096	22,185	162,238	12,555	4,499	11,300	5,585	33,939
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	66,182	18,764	52,483	21,953	159,382	11,745	4,482	11,695	5,438	33,360
2017	66,162	18,643	52,152	21,756	158,713	11,801	4,485	11,696	5,381	33,363
2018	66,116	18,574	52,077	21,664	158,431	11,844	4,489	11,717	5,354	33,404
2019	66,040	18,473	51,873	21,713	158,099	11,878	4,495	11,756	5,348	33,477
2020	65,964	18,380	51,594	21,762	157,700	11,906	4,495	11,760	5,340	33,501
2021	65,894	18,212	50,889	21,908	156,903	11,925	4,499	11,761	5,370	33,555
2022	65,833	18,144	50,688	22,120	156,785	11,944	4,507	11,785	5,414	33,650
2023	65,772	18,086	50,526	22,411	156,795	11,960	4,517	11,807	5,464	33,748
2024	65,730	18,043	50,373	22,654	156,800	11,975	4,527	11,830	5,501	33,833
2025	65,694	17,993	50,219	22,873	156,779	11,989	4,536	11,851	5,550	33,926
2026	65,675	17,956	50,066	23,080	156,777	12,002	4,552	11,907	5,595	34,056
2005-15	-0.5%	-0.4%	-0.1%	-0.5%	-0.3%	-0.3%	-0.3%	-0.4%	-0.2%	-0.3%
2016-26	-0.1%	-0.4%	-0.5%	0.5%	-0.2%	0.2%	0.2%	0.2%	0.3%	0.2%
2005-10	-1.3%	-0.4%	0.4%	0.0%	-0.4%	0.1%	1.6%	0.7%	2.2%	0.8%
2010-15	0.3%	-0.4%	-0.6%	-0.9%	-0.2%	-0.6%	-2.2%	-1.5%	-2.5%	-1.4%
2016-21	-0.1%	-0.6%	-0.6%	0.0%	-0.3%	0.3%	0.1%	0.1%	-0.3%	0.1%
2021-26	-0.1%	-0.3%	-0.3%	1.0%	0.0%	0.1%	0.2%	0.2%	0.8%	0.3%

C-4. Forecast Methodology

The NYISO methodology for producing the long-term forecasts for the Reliability Needs Assessment consists of the following steps.

Econometric forecasts were developed for zonal energy using monthly data from 2002 through 2015. For each zone, the NYISO estimated an ensemble of econometric models using economic output, employment, cooling degree days, and heating degree days. 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 which best represented recent history and the regional growth for that zone. The NYISO also received and evaluated forecasts from Consolidated Edison and PSEG-LIPA for Zones H, I, J and K, which were used in combination with the forecasts the NYISO developed for Zones A through G.

The summer & winter non-coincident and coincident peak forecasts for Zones H, I, J, and K were derived from the forecasts submitted to the NYISO by Con-Ed and LIPA. For the remaining zones, the NYISO derived the summer and winter coincident peak demands from the zonal energy forecasts by using average zonal weather-normalized load factors from 2008 through 2015. The 2016 summer peak forecast was matched to coincide with the 2016 ICAP forecast.

C-4.1. Demand Side Management

The New York State Public Service Commission (NYPSC) initiated a Clean Energy Fund, which includes the NY-Sun Initiative, as a mean to achieve reductions in annual electric energy and summer peak demand for the foreseaable future. The Clean Energy Fund supersedes the Energy Efficiency Portfolio Standard, which was in effect from 2008 through 2015 (with some carry-over of unspent EEPS funds).

Guided by the programatic content and authorized spending for the Clean Energy Fund, the NYISO developed individual energy and demand forecasts for

- energy efficiency impacts,
- building codes and appliance standards,
- distributed generation, and
- behind-the-meter solar photovoltaic (PV).

The NYISO considered the following factors in developing the 2016 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.;
- The actual rates of implementation of EEPS based on data received from the New York State Department of Public Service Staff;
- 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 impacts of these programs were developed, zonal level forecasts were produced by adjusting the econometric forecast to arrive at the base case forecast.

Figure C-1: 2016 Gold Book Zonal Energy Forecast Growth Rates - 2016 to 2026

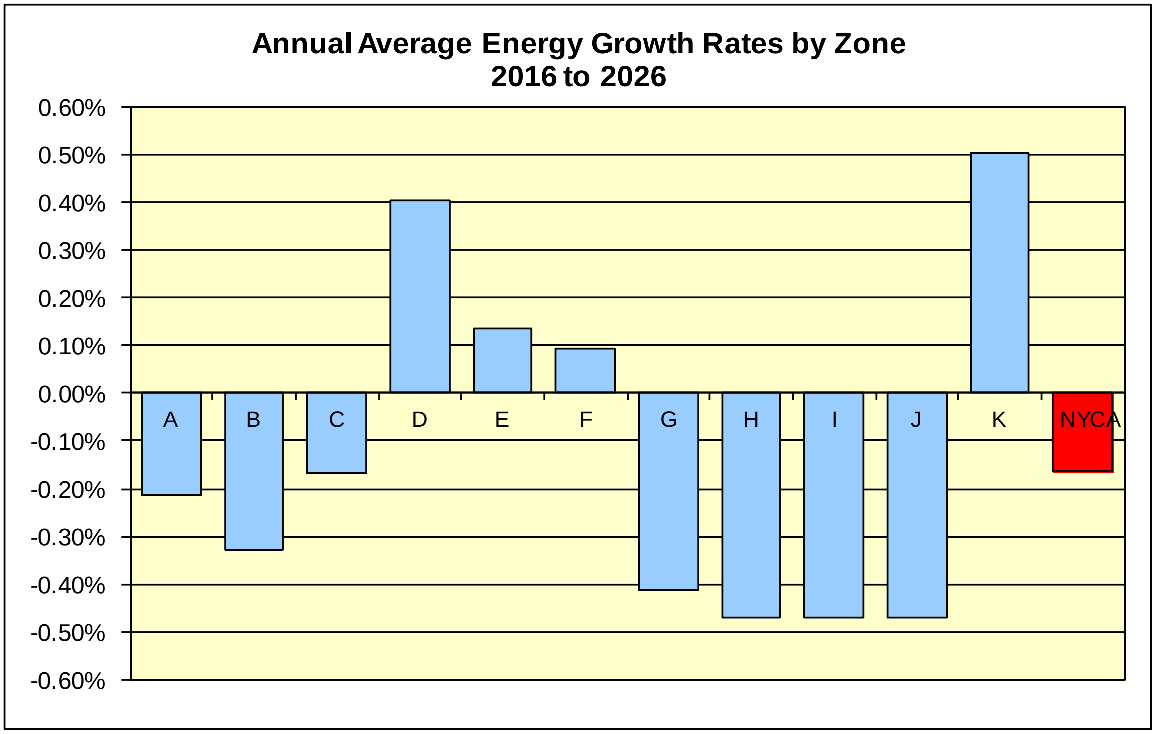


Figure C-2: Gold Book Summer Peak Demand Zonal Forecast Growth Rates - 2016 to 2026

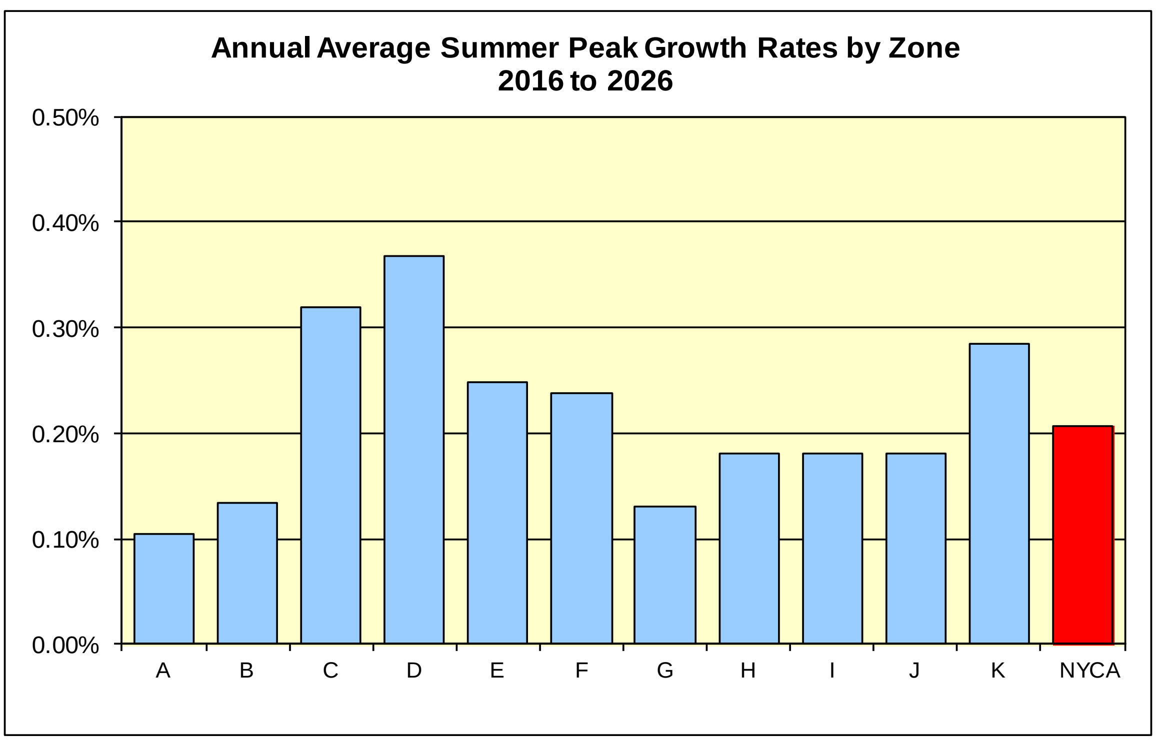


Table C-4: Annual Energy by Zone – Actual & 2016 Gold Book Baseline Forecast (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2005	16,498	10,227	17,568	6,593	7,594	11,789	10,924	2,625	6,435	54,007	22,948	167,208
2006	15,998	10,003	16,839	6,289	7,339	11,337	10,417	2,461	6,274	53,096	22,185	162,238
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	15,651	9,858	16,027	4,458	8,063	12,125	9,812	2,769	6,183	52,483	21,953	159,382
2017	15,587	9,823	15,986	4,525	8,091	12,150	9,748	2,751	6,144	52,152	21,756	158,713
2018	15,525	9,790	15,942	4,594	8,105	12,160	9,690	2,749	6,135	52,077	21,664	158,431
2019	15,475	9,760	15,899	4,622	8,115	12,169	9,624	2,738	6,111	51,873	21,713	158,099
2020	15,442	9,726	15,860	4,629	8,128	12,179	9,580	2,722	6,078	51,594	21,762	157,700
2021	15,411	9,698	15,836	4,631	8,129	12,189	9,530	2,687	5,995	50,889	21,908	156,903
2022	15,384	9,665	15,814	4,633	8,139	12,198	9,497	2,676	5,971	50,688	22,120	156,785
2023	15,362	9,629	15,798	4,635	8,140	12,208	9,467	2,667	5,952	50,526	22,411	156,795
2024	15,343	9,594	15,783	4,637	8,152	12,221	9,451	2,658	5,934	50,373	22,654	156,800
2025	15,330	9,561	15,772	4,639	8,162	12,230	9,426	2,651	5,916	50,219	22,873	156,779
2026	15,322	9,538	15,761	4,641	8,172	12,241	9,416	2,642	5,898	50,066	23,080	156,777

Table C-5: Summer Coincident Peak Demand by Zone – Actual & 2016 Gold Book Baseline Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2005	2,726	1,923	2,897	768	1,314	2,164	2,236	592	1,409	10,810	5,236	32,075
2006	2,735	2,110	3,128	767	1,435	2,380	2,436	596	1,467	11,300	5,585	33,939
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	2,680	1,992	2,810	535	1,352	2,376	2,290	656	1,536	11,695	5,438	33,360
2017	2,684	1,997	2,828	543	1,358	2,391	2,293	656	1,536	11,696	5,381	33,363
2018	2,688	2,003	2,841	551	1,363	2,398	2,293	658	1,538	11,717	5,354	33,404
2019	2,692	2,006	2,855	554	1,367	2,404	2,291	660	1,544	11,756	5,348	33,477
2020	2,695	2,009	2,867	555	1,371	2,409	2,290	660	1,545	11,760	5,340	33,501
2021	2,697	2,011	2,874	555	1,374	2,414	2,294	660	1,545	11,761	5,370	33,555
2022	2,700	2,013	2,880	555	1,377	2,419	2,299	660	1,548	11,785	5,414	33,650
2023	2,702	2,015	2,886	555	1,379	2,423	2,304	662	1,551	11,807	5,464	33,748
2024	2,704	2,017	2,891	555	1,382	2,426	2,309	665	1,553	11,830	5,501	33,833
2025	2,706	2,018	2,896	555	1,384	2,430	2,314	665	1,557	11,851	5,550	33,926
2026	2,708	2,019	2,901	555	1,386	2,433	2,320	668	1,564	11,907	5,595	34,056

Table C-6: Winter Coincident Peak Demand by Zone – Actual & 2016 Gold Book Baseline Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2005-06	2,450	1,544	2,700	890	1,266	1,886	1,663	515	955	7,497	3,581	24,947
2006-07	2,382	1,566	2,755	921	1,274	1,888	1,638	504	944	7,680	3,505	25,057
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	24,658
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	2,334	1,573	2,623	653	1,320	1,868	1,575	529	914	7,510	3,546	24,445
2017-18	2,338	1,577	2,639	663	1,326	1,880	1,577	529	914	7,510	3,540	24,493
2018-19	2,341	1,582	2,651	673	1,330	1,886	1,577	530	915	7,524	3,548	24,557
2019-20	2,344	1,584	2,665	676	1,334	1,890	1,575	532	919	7,549	3,549	24,617
2020-21	2,346	1,587	2,675	678	1,338	1,894	1,575	532	919	7,551	3,575	24,670
2021-22	2,349	1,589	2,682	678	1,341	1,898	1,577	532	919	7,552	3,599	24,716
2022-23	2,351	1,590	2,688	678	1,344	1,901	1,581	532	921	7,567	3,637	24,790
2023-24	2,353	1,591	2,693	678	1,346	1,905	1,584	534	923	7,581	3,661	24,849
2024-25	2,355	1,593	2,698	678	1,349	1,908	1,588	536	924	7,596	3,697	24,922
2025-26	2,356	1,594	2,703	678	1,351	1,910	1,591	536	926	7,610	3,726	24,981
2026-27	2,358	1,595	2,707	678	1,353	1,913	1,595	538	931	7,646	3,755	25,069

Table C-7: Behind-the-Meter Solar PV and 2016 RNA Base Case Annual Energy by Zone – (GWh)

2016 Gold Book Behind the Meter Solar PV Energy Forecast

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2016	55	34	77	6	46	159	148	15	26	110	377	1,053
2017	89	43	124	9	67	220	201	17	30	139	511	1,450
2018	104	66	159	13	90	278	274	17	33	171	562	1,767
2019	126	86	194	16	110	336	343	20	37	202	597	2,067
2020	151	111	231	20	126	379	416	22	41	230	628	2,355
2021	177	138	269	24	143	418	489	22	44	261	647	2,632
2022	204	167	306	27	160	452	558	24	47	283	654	2,882
2023	230	194	340	30	176	481	621	26	50	315	661	3,124
2024	252	218	370	32	190	503	674	26	54	346	669	3,334
2025	270	238	394	34	201	520	717	29	58	375	676	3,512
2026	285	254	412	34	211	533	752	31	61	405	683	3,661

2016 RNA Baseline Forecast With SPV

2016	15,706	9,892	16,104	4,464	8,109	12,284	9,960	2,784	6,209	52,593	22,330	160,435
2017	15,676	9,866	16,110	4,534	8,158	12,370	9,949	2,768	6,174	52,291	22,267	160,163
2018	15,629	9,856	16,101	4,607	8,195	12,438	9,964	2,766	6,168	52,248	22,226	160,198
2019	15,601	9,846	16,093	4,638	8,225	12,505	9,967	2,758	6,148	52,075	22,310	160,166
2020	15,593	9,837	16,091	4,649	8,254	12,558	9,996	2,744	6,119	51,824	22,390	160,055
2021	15,588	9,836	16,105	4,655	8,272	12,607	10,019	2,709	6,039	51,150	22,555	159,535
2022	15,588	9,832	16,120	4,660	8,299	12,650	10,055	2,700	6,018	50,971	22,774	159,667
2023	15,592	9,823	16,138	4,665	8,316	12,689	10,088	2,693	6,002	50,841	23,072	159,919
2024	15,595	9,812	16,153	4,669	8,342	12,724	10,125	2,684	5,988	50,719	23,323	160,134
2025	15,600	9,799	16,166	4,673	8,363	12,750	10,143	2,680	5,974	50,594	23,549	160,291
2026	15,607	9,792	16,173	4,675	8,383	12,774	10,168	2,673	5,959	50,471	23,763	160,438

Table C-8: Behind-the-Meter Solar PV and 2016 RNA Base Case Summer Peak Demand Forecast by Zone – (MW)

2016 Gold Book Behind the Meter Solar PV Summer Peak Demand Forecast

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2016	10	6	15	2	9	31	30	3	6	25	121	258
2017	14	7	20	2	13	41	37	5	8	43	173	363
2018	16	10	24	2	14	47	46	5	10	52	195	421
2019	18	12	28	3	16	52	54	5	11	62	210	471
2020	21	15	33	3	18	57	63	5	12	69	222	518
2021	24	18	37	4	20	62	71	7	13	78	231	565
2022	27	21	41	4	23	66	80	7	14	89	234	606
2023	30	24	45	4	25	69	87	7	16	101	237	645
2024	32	27	48	5	26	72	93	7	18	114	240	682
2025	34	29	51	5	28	74	98	10	20	128	243	720
2026	36	31	53	5	29	75	101	10	21	139	247	747

2016 RNA Baseline Forecast With SPV

2016	2,690	1,998	2,825	537	1,361	2,407	2,320	659	1,542	11,720	5,559	33,618
2017	2,698	2,004	2,848	545	1,371	2,432	2,330	661	1,544	11,739	5,554	33,726
2018	2,704	2,013	2,865	553	1,377	2,445	2,339	663	1,548	11,769	5,549	33,825
2019	2,710	2,018	2,883	557	1,383	2,456	2,345	665	1,555	11,818	5,558	33,948
2020	2,716	2,024	2,900	558	1,389	2,466	2,353	665	1,557	11,829	5,562	34,019
2021	2,721	2,029	2,911	559	1,394	2,476	2,365	667	1,558	11,839	5,601	34,120
2022	2,727	2,034	2,921	559	1,400	2,485	2,379	667	1,562	11,874	5,648	34,256
2023	2,732	2,039	2,931	559	1,404	2,492	2,391	669	1,567	11,908	5,701	34,393
2024	2,736	2,044	2,939	560	1,408	2,498	2,402	672	1,571	11,944	5,741	34,515
2025	2,740	2,047	2,947	560	1,412	2,504	2,412	675	1,577	11,979	5,793	34,646
2026	2,744	2,050	2,954	560	1,415	2,508	2,421	678	1,585	12,046	5,842	34,803

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 the development of the transfer limits to be implemented in the Multi-Area Reliability Simulation (MARS) model. A comprehensive assessment of the transmission system is conducted through a series of steady-state power flow, transient stability, and short circuit studies.

The MARS model was used 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.*, 2017 to 2026) (See Section 5.2.4 of this report). The MARS model was also used to evaluate selected scenarios (See Section 6 of this report).

D-1 2014 RNA Assumption Matrix

D-1.1 Assumption Matrix for Resource Adequacy Assessment

2016 RNA Resource Adequacy Assumptions Matrix				
#	Parameter	2017 IRM Model Assumptions	Basis for IRM Recommendation	2016 RNA Assumptions
Load Parameters				
1	Peak Load Forecast (Preliminary Base Case – Parametric & Sensitivities)	2016 Gold Book NYCA: 33,363 MW NYC: 11,795 MW LI: 5,422 MW G-J: 16,313 MW	Gold Book Forecast is used for Preliminary Base Case parametric study and sensitivity cases	2016 Gold Book The GB 2016 baseline load contains the impact (reduction) of behind- the -meter solar at the time of NYCA peak. The behind the meter solar impact MW are added back to the NYCA zonal loads in order to model solar resources discretely.
3	Load Shape (Multiple Load Shape)	Bin 1: 2006 Bin 2: 2002 Bins 3-7: 2007	ICS Recommendation.	Same
4	Load Forecast Uncertainty	Zonal Model to reflect current data with input from Con Ed and LIPA.	Cool weather patterns mean LFU does not need to be revisited.	Same
Generation Parameters				
1	Existing Generating Unit Capacities	2016 Gold Book values. Use min (DMNC vs. CRIS) capacity value	2016 Gold Book publication	Same, but adjusted for RNA inclusion rules
2	Proposed New Units (Non- Renewable)	MW of new or returning non- wind resources	2016 Gold Book publication and generator notifications	Inclusion Rules Applied
3	Retirements and Mothballed units	MW retirements or mothballs reported	NYSRC Policy 5 guidelines on retirement or mothball disposition in IRM studies.	Inclusion Rules and TB185 Applied
4	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 (2011-2015)	Same
5	Planned Outages	Based on schedules received by the NYISO and adjusted for history	Updated schedules	Same

2016 RNA Resource Adequacy Assumptions Matrix				
#	**Parameter**	**2017 IRM Model Assumptions**	**Basis for IRM Recommendation**	**2016 RNA Assumptions**
6	Summer Maintenance	Nominal YY MWs – divided equally between upstate and downstate	Review of most recent data	Same
7	Combustion Turbine Derates	Derate based on temperature correction curves provided	Operational history indicates the derates are in-line with manufacturer's curves	Same
8	Existing and Proposed New Wind Units	MW Wind Capacity	Renewable units based on RPS agreements, interconnection Queue, and ICS input.	Inclusion Rules Applied
9	Wind Shape	Actual hourly plant output over the period 2012-2015. New units may have wind readings taken at or near the site	NYISO to prepare paper on new functionality of the GE MARS program to randomly select an annual wind shape from multiple years of production data	Probabilistic model will be incorporated based on five years of input shapes with one shape per iteration year being randomly selected in Monte Carlo process
10	Solar Resources	31.5 MW metered solar capacity. Model chooses from 4 years of production data output covering the period 2012-2015. New units may use a nearby plant or utilize solar readings taken at or near the site	Concepts in the paper referenced in Item No. 9 may also apply to solar modeling to treat solar as if it were resource on the system. GE MARS program can randomly select a solar shape from multiple years of production data	For the metered solar probabilistic model will be incorporated based on production data shapes with one shape per iteration year being randomly selected in Monte Carlo process. The large projection of increasing solar installations over the ten year period require a discrete model with some level of detailed hourly performance. A probabilistic model of the solar shapes similar to the wind shapes will be developed.
11	Small Hydro Resources	Derate by yy%	Review of five years of unit production data over the years 2011 to 2015	Same
12	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)	Same
Transaction - Imports / Exports				
1	Capacity Purchases	Grandfathered amounts: PJM – 1080 MW	Grandfathered Rights, ETCNL, and other awarded long-term rights including 20 MW CRIS	Modeled as explicit contracts

2016 RNA Resource Adequacy Assumptions Matrix				
#	**Parameter**	**2017 IRM Model Assumptions**	**Basis for IRM Recommendation**	**2016 RNA Assumptions**
		HQ – 1090 MW HQ TO 1110 MW All contracts modeled as equivalent contracts	potentially awarded to HQUS	
2	Capacity Sales	Long Term firm sales Summer yyy MW	These are long-term contracts filed with FERC	Modeled as equivalent contracts sold from ROS surplus zones
3	FCM Sales	Xxxx MW	Sensitivity based on Examination of Neighbor's FCM auction results	What is currently sold is modeled as equivalent contracts sold from ROS surplus zones
4	New UDRs	No new UDR projects	Existing UDR elections are made by August 1st and will be incorporated into the model	Same
Topology				
1	Interface Limits	All changes reviewed and commented on by TPAS	Based on 201x: Operating Study, Operations Engineering Voltage Studies, Comprehensive Planning Process, and additional analysis including interregional planning initiatives	Developed by review of previous studies and specific analysis during the RNA study process
2	New Transmission	Identified	Based on TO provided models and NYISO review	Based on TO- provided firm plans and NYISO review. *Note:* Inclusion Rules applied to the Leeds - Hurley 345 kV Series Compensation System Deliverability Upgrade
3	Cable Forced Outage Rates	All existing Cable EFORs updated for NYC and LI to reflect most recent five-year history	Based on TO analysis	Update used

2016 RNA Resource Adequacy Assumptions Matrix				
#	**Parameter**	**2017 IRM Model Assumptions**	**Basis for IRM Recommendation**	**2016 RNA Assumptions**
Emergency Operating Procedures				
1	Special Case Resources	July 2016 – MW based on registrations and modeled as aaa MW of effective capacity. Monthly variation based on historical experience (Calls Limited to 5/month.)*	Those sold for the program discounted to historic availability. Summer values calculated from July 2016 registrations	2016 Gold Book with effective capacity modeled
2	EDRP Resources	July 2016 bb MW registered model as MW in July and proportional to monthly peak load in other months. Limit to five calls per month	Those sold for the program discounted to historic availability. Summer values calculated from July 2016 registrations and forecast growth.	2016 Gold Book with effective capacity modeled
3	Other EOPs	MW of non-SCR/non-EDRP resources	Based on TO information, measured data, and NYISO forecasts	Same
External Control Areas				
1	PJM	Load and Capacity data provided by PJM/NPCC CP-8	Initial review performed by the NPCC CP-8 WG prior to Policy 5 changes. NYISO to prepare white paper on external EOPs	As per RNA Procedure
2	ISONE	Load and Capacity data provided by ISONE/NPCC CP-8 Data may be adjusted per NYSRC Policy 5	Initial review performed by the NPCC CP-8 WG prior to Policy 5 changes.	As per RNA Procedure
3	HQ	Load and Capacity data provided by HQ/NPCC CP-8 Data may be adjusted per NYSRC Policy 5 See	Initial review performed by the NPCC CP-8 WG prior to Policy 5 changes.	As per RNA Procedure
4	IESO	Load and Capacity data provided by IESO/NPCC	Initial review performed by the NPCC CP-8 WG prior to Policy 5 changes.	As per RNA Procedure

2016 RNA Resource Adequacy Assumptions Matrix				
#	**Parameter**	**2017 IRM Model Assumptions**	**Basis for IRM Recommendation**	**2016 RNA Assumptions**
		CP-8 data may be adjusted per NYSRC Policy 5		
5	Reserve Sharing	All NPCC Control Areas indicate that they will share reserves equally among all members	Per NPCC CP-8 WG	Same
Miscellaneous				
1	MARS Model Version	Version 3.20	Per benchmark testing and ICS recommendation	Version 3.20
2	Environmental Initiatives	No estimated impacts based on review of existing rules and retirement trends	Review of existing regulations and rules.	Same

D-1.2 Assumption Matrix for Transmission Security Assessment

Parameter	2016 RNA Transmission Security Studies Modeling Assumptions	Source
Peak Load	NYCA baseline coincident summer peak forecast, which already includes EE and DG (including solar) reductions	2016 Gold Book
Load model	ConEd: voltage varying	2016 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, 2016 FERC 715 filing
Inter-area interchange schedules	Consistent with ERAG MMWG interchange schedule	2016 FERC 715 filing, MMWG
Inter-area controllable tie schedules	Consistent with applicable tariffs and known firm contracts or rights	2016 FERC 715 filing
In-city series reactors	Consistent with ConEdison operating protocol (All series reactors in-service for summer)	2016 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	2016 FERC 715 filing
Switched shunts	Allowed to adjust pre-contingency; fixed post-contingency	2016 FERC 715 filing
Fault current analysis settings	Per Fault Current Assessment Guideline	NYISO Fault Current Assessment Guideline
Model Version	Power flow: PSS/E v33.5.2, PSS/MUST v11.0, TARA v810a	
	Dynamics: PSS/E v33.5.2	
	Short Circuit: ASPEN v12.4	

D-2 RNA Power Flow Base Case Development and Thermal Transfer Limit Results

D- 2.1 Development of RNA Power Flow Base Cases

The base cases used in analyzing the performance of the transmission system were developed from the 2016 FERC 715 filing power flow case library. The load representation in the power flow model is the summer peak load forecast reported in the 2016 Gold Book Table 1-2a baseline forecast of coincident peak demand. The system representation for the NPCC Areas in the base cases is from the 2015 Base Case Development (BCD) libraries compiled by the NPCC SS-37 Base Case Development working group. The PJM system representation was derived 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) 2015 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 2016 RNA Base Case. The RNA Base Case inclusion rules, set forth in the Reliability Planning Process Manual are:

1. TO LTPs for non-BPTF facilities and NYPA transmission plans for non-BPTF, which are reported to the NYISO as firm transmission plans, will be included.
2. Regulated BPTF projects not in-service or not under construction, including TO LTPs, will be included if:
    a. the project is: (i) triggered in the RPP; (ii) has been selected in PPTPP; (iii) approved by beneficiaries under CARIS; or (iv) part of a TO LTP or the NYPA transmission plans, and
    b. the project is expected to be in-service within 3 years or other reasonable time frame based on the nature of the project, and
    c. the project has an application that has been deemed complete for a certificate under Article VII of the New York Public Service Law or other major regulatory approval, if required, and
    d. the project has an approved System Reliability Impact Study ("SRIS"), or an approved System Impact Study ("SIS") (as applicable), if required, and
    e. the project is making reasonable progress under the applicable planning process of Attachment Y of the OATT.
3. Market based BPTF projects not in-service or not under construction will be included if:
    a. the project is expected to be in-service within 3 years or other reasonable time frame based on the nature of the project, and
    b. the project has an approved SRIS, or an approved SIS (as applicable), if required, and
    c. the project has an application that has been deemed complete for a certificate under Article VII of the New York Public Service Law or other major regulatory approval, if required, and
    d. the project has an executed contract with a credit worthy entity for at least half of the project capacity.
4. BPTF projects that are in-service will be included.
5. BPTF projects under construction will be included if:
    e. the project is expected to be in-service within 3 years or other reasonable time frame based on the nature of the project, and
    f. the project is making reasonable progress toward entering service by its project in-service date.

6. Generators currently in an outage state or that intend to enter such a state, will be modeled as of the effective date of entering that outage state as indicated in **Table D2-1**, below.

Table D2-1: Modeling of Generators in Outage States

Generator Outage State	Modeling in RNA
Forced Out	In-service
Inactive Reserve	In-service
ICAP Ineligible Forced Outage	Out-of-service, unless the owner has provided NYISO a positive indication* that the unit will be returning to service other than pursuant to an RMR agreement or RSSA**
Noticed intent to mothball or retire to the NYPSC or to the NYISO	Out-of-service
Operating in accordance with an RMR agreement or RSSA	Out-of-service
In a Mothball Outage or mothballed under the pre-May 1, 2015 rules	Out-of-service, unless the owner has provided NYISO a positive indication* that the unit will be returning to service other than pursuant to an RMR agreement or RSSA**
Retired	Out-of-service
* Positive indications that a unit will be returning to service include, but not limited to, the following: • Commenced Repair as defined in MST Section 2.3, or indications of repair evidenced by items such as, but not limited to: (i) a repair plan including schedule, (ii) a list of permits required with indications of active status, (iii) invoices for material, or (iv) contracts for construction. • Indications of restart are evidenced by items such as, but not limited to: (i) visible site activity, (ii) labor arrangements, (iii) fuel supply arrangements, or (iv) unit testing. ** If such positive indication is provided to the NYISO, the unit will be modeled in the year of its return in the Study Period.	

Specifically, the 2016 RNA Base Case does not include all projects currently listed on the NYISO's interconnection queue or those shown in the 2016 Gold Book. It includes only those which met the screening requirements for inclusion, as shown in the **Table 4-3** of this report.

The generation deactivation assumptions are reflected in Table 4-4 of this Report. The firm transmission plans included in 2016 RNA Base Case are listed in **Table D2-2** below.

Table D2-2: Firm Transmission Plans included in 2016 RNA Base Case

Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to (2)	Year	Nominal Voltage in kV Operating	Design	# of ckts	Thermal Ratings (4) Summer	Winter	Project Description / Conductor Size
CHGE	Todd Hill	Fishkill Plains	5.26	In-Service	2015	115	115	1	1167	1433	Rebuild line with 1033 ACSR
LIPA	Randall Ave	Wildwood	N/A	In-Service	2015	138	138	-	150 MVAR	150 MVAR	Dynamic Reactive Support System (DRSS)
NGRID	Luther Forest	North Troy	-18.30	RETIRED	2015	115	115	1	937	1141	605 ACSR
NGRID	Luther Forest	Eastover Road (New Station)	17.50	In-Service	2015	115	115	1	937	1141	Luther Forest-North Troy Loop (0.9 miles new 1113 kcmil ACSR)
NGRID	Eastover Road (New Station)	North Troy	2.60	In-Service	2015	115	115	1	937	1141	Luther Forest-North Troy Loop (0.9 miles new 1113 kcmil ACSR)
NGRID	Eastover Road (New Station)	North Troy	2.60	In-Service	2015	115	115	1	916	1118	Battenkill-North Troy Loop (0.9 miles new)
NGRID	Battenkill	North Troy	-22.39	RETIRED	2015	115	115	1	916	1118	605 ACSR
NGRID	Battenkill	Eastover Road (New Station)	21.59	In-Service	2015	115	115	1	937	1141	Battenkill-North Troy Loop (0.9 miles new)
NGRID	Gardenville	Homer Hill	-65.69	In-Service	2015	115	115	2	584	708	New Five Mile substation
NGRID	Gardenville	Five Mile Rd (New Station)	58.30	In-Service	2015	115	115	2	129MVA	156MVA	New Five Mile substation
NGRID	Five Mile Rd (New Station)	Homer Hill	8.00	In-Service	2015	115	115	2	221MVA	270MVA	New Five Mile substation
NGRID	Homer City	Stolle Road	-204.11	In-Service	2015	345	345	1	1013	1200	New Five Mile substation
NGRID	Homer City	Five Mile Rd (New Station)	151.11	In-Service	2015	345	345	1	1013	1200	New Five Mile substation
NGRID	Five Mile Rd (New Station)	Stolle Road	53.00	In-Service	2015	345	345	1	1013	1200	New Five Mile substation
NGRID	Sawyer 230kV	Sawyer 23kV	-	In-Service	2015	230/23	230/23	1	-	-	Addition of Overcurrent relays
NGRID	Clay	Clay	xfmr	In-Service	2015	345/115	345/115	1	478MVA	590MVA	Replace TB1 transformer & reconfigure Clay 345 kV for TB2 transformer
NGRID	Five Mile Rd (New Station)	Five Mile Rd (New Station)	xfmr	In-Service	2015	345/115	345/115	-	478MVA	590MVA	New Five Mile substation
NYPA	Gilboa	Gilboa	GSU	In-Service	2015	345/17	345/17	1	325 MVA	325 MVA	Replacement of Blenheim-Gilboa GSU #2
NYPA	Niagara	Niagara	Auto Transformer	In-Service	2015	345/230	345/230	1	697 MVA	717 MVA	Replacement of Niagara AT# 4
NYPA	Massena	Massena	Auto-Transformer	In-Service	2015	765/230	765/230	1	936 MVA	1296 MVA	Replacement of Massena 765/230 kV Auto-Transformer Bank #2
NYSEG	Goudey	AES Westover	Reconfiguration	In-Service	2015	115	115	-	N/A	N/A	Substation separation
NYSEG	Jennison	AES Oneonta	Reconfiguration	In-Service	2015	115	115	-	N/A	N/A	Substation separation
NYSEG	Coopers Corners	Coopers Corners	Shunt Reactor	In-Service	2015	345	345	1	200 MVAR	200 MVAR	Shunt Reactor Installation
NYSEG	Homer City	Watercure Road	-177.00	In-Service	2015	345	345	1	1549	1552	2156 ACR
NYSEG	Watercure Road	Mainesburg	26.00	In-Service	2015	345	345	1	1549	1552	2156 ACR
NYSEG	Mainesburg	Homer City	151.00	In-Service	2015	345	345	1	1549	1552	2156 ACR
RGE	Station 69	Station 69	Cap Bank	In-Service	2015	115	115	1	20 MVAR	20 MVAR	Capacitor Bank (DOE)
RGE	Mortimer	Station 251	1	In-Service	2015	115	115	2	1396	1707	New 115 kV Line
RGE	Station 251	Station 33	0.98	In-Service	2015	115	115	2	1396	1707	New 115 kV Line
RGE	Station 42	Station 23	Phase Shifter	In-Service	2015	115	115	1	253 MVA	285 MVA	Phase Shifter
RGE	Station 251 (New Station)	Station 251 (New Station)	xfmr	In-Service	2015	115/34.5	115/34.5	2	30 MVA	33.8 MVA	Transformer
CHGE	Pleasant Valley	Todd Hill	5.53	S	2016	115	115	1	917	1282	Rebuild line with 1033 ACSR
ConEd	Rock Tavern	Sugarloaf	11.80	S	2016	345	345	1	1971 MVA	2390 MVA	2-1590 ACSR
ConEd	Goethals	Linden Co-Gen	-1.50	S	2016	345	345	1	2500	2500	Feeder Separation
ConEd	Goethals	Linden Co-Gen	1.50	S	2016	345	345	1	1250	1250	Feeder Separation
ConEd	Goethals	Linden Co-Gen	1.50	S	2016	345	345	1	1250	1250	Feeder Separation

Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to (2)	Year	Nominal Voltage in kV Operating	Design	# of ckts	Thermal Ratings (4) Summer	Winter	Project Description / Conductor Size
ConEd	East 13th Street	East 13th Street	Reconfiguration	S	2016	345	345		N/A	N/A	Reconfiguration
NGRID	New Scotland	Long Lane	4.22	In-Service	2016	115	115	1	600	600	20.5% Series Reactor #7 Unionville
NGRID	New Scotland	Feura Bush	4.08	S	2016	115	115	1	600	600	12.5% Series Reactor #9 Unionville
NGRID	Clay	GE	6.52	In-Service	2016	115	115	1	220MVA	268MVA	reconductor 4/0 CU & 477 ACSR with 795ACSR (line#14)
NGRID	Huntley	Huntley	-	S	2016	230	230	1			Install two 100MVAR cap banks
NGRID	Packard	Huntley 77	-	S	2016	230	230	1			1.5% series reactor
NGRID	Packard	Huntley 78	-	S	2016	230	230	1			1.5% series reactor
NGRID	Packard	Huntley 77	-	S	2016	230	230	1	556 MVA	680 MVA	Conductor Clearance Upgrade to STE Rating
NGRID	Edic 345 kV	Edic 345 kV	Reconfiguration	W	2016	345	345	1	-	-	Create new bay by adding 2 new 345kV breakers, reconnect transformer
NGRID/NYSEG	Homer City	Five Mile Rd (New Station)	-151.11	S	2016	345	345	1	1013	1200	New Piercebook Station (First Energy)
NGRID/NYSEG	Homer City	Farmers Valley	120.00	S	2016	345	345	1	1013	1200	New Piercebook Station (First Energy)
NGRID/NYSEG	Farmers Valley	Five Mile Rd (New Station)	31.00	S	2016	345	345	1	1013	1200	New Piercebook Station (First Energy)
NYPA	Moses	Moses	Cap Bank	In-Service	2016	115	115	1	100 MVAR	100 MVAR	Cap Bank Installation to Replace Moses Synchronous Condensers
NYPA	Marcy	Coopers Corners	Series Comp	S	2016	345	345	1	1776 MVA	1793 MVA	Installation of Series Compensation on UCC2-41
NYPA	Edic	Fraser	Series Comp	S	2016	345	345	1	1793 MVA	1793 MVA	Installation of Series Compensation on EF24-40
NYPA	Fraser	Coopers Corners	Series Comp	S	2016	345	345	1	1494 MVA	1793 MVA	Installation of Series Compensation on FCC33
NYPA	Niagara	Niagara	GSU	S	2016	115/13.8	115/13.8	1	250 MVA	250 MVA	Replacement of Niagara GSU #5
NYPA	Massena	Massena	Auto-Transformer	In-Service	2016	765/230	765/230	1	936 MVA	1296 MVA	Replacement of Massena 765/230 kV Auto-Transformer Bank #1
NYSEG	Wood Street	Katonah	11.70	W	2016	115	115	1	1079	1310	convert 46kV to 115kV
NYSEG	Elbridge	State Street	14.50	W	2016	115	115	1	250 MVA	305 MVA	1033 ACSR
NYSEG	Fraser	Coopers Corners	21.80	S	2016	345	345	1	2500	3000	ACCR 1742-T9 Reconductor
NYSEG	Stephentown	Stephentown	xfmr	W	2016	115/34.5	115/34.5	1	37 MVA	44MVA	Transformer #2
NYSEG	Eelpot Road	Eelpot Road	xfmr	W	2016	115/34.5	115/34.5	2	59.2MVA	66.9MVA	Transformer #2
O & R	Harings Corner (RECO)	Tappan (NY)	-	W	2016	69	69	1	1096	1314	Three-way switch station
O & R	Ramapo	Sugarloaf	16.00	S	2016	345	345	1	3030	3210	2-1590 ACSR
O & R	Sugarloaf	Sugarloaf	xfmr	S	2016	345/138	345/138	1	562 MVA	562 MVA	Transformer
O & R	O&R's Line 26	Sterling Forest	xfmr	S	2016	138/69	138/69	1	214 MVA	214 MVA	Transformer
ConEd	East 13th Street	East 13th Street	Reconfiguration	S	2017	345	345		N/A	N/A	Reconfiguration
NGRID	Mohican	Battenkill	14.2	S	2017	115	115	1	933	1140	Replace 14.2 miles of conductor w/min 1033.5 ACSR
NGRID	Mohican	Luther Forest	34.47	S	2017	115	115	1	937	1141	Replace 14.2 miles of conductor w/min 795 kcmil ACSR 26/7
NGRID	Menands	State Campus	5.00	S	2017	115	115	1	744	744	Replace 3.2 miles of 4/0 Cu conductor with 795kcmil ACSR 26/7
NGRID	Wolf Rd	Menands	4.54	S	2017	115	115	1	808	856	Replace 2.1 miles of 4/0 Cu conductor with 795kcmil ACSR 26/7
NGRID	Edic	Marcy Nanocenter	1.3	S	2017	115	115	2	556MVA	680MVA	New Circuit to Customer Station (MVEdge)
NGRID	Clay	Dewitt	10.24	W	2017	115	115	1	220MVA	268MVA	Reconductor 4/0 CU to 795ACSR
NGRID	Clay	Teall	12.75	W	2017	115	115	1	220 MVA	268MVA	Reconductor 4/0 CU to 795ACSR
NGRID	Eastover Road	Eastover Road	xfmr #2	S	2017	230/115	230/115	1	381MVA	466MVA	New/2nd 230-115 kV Transformer
NGRID	Edic	Edic	xfmr	S	2017	345/115	345/115	2	505MVA	603MVA	Add Transformer for MVEdge (TR#5&#6)
NYPA	Cumberland Head	Gordon Landing	1.63	W	2017	115	230	1	1147	1316	Replacement of PV-20 Submarine Cable
NYSEG	Wood Street	Carmel	1.34	W	2017	115	115	1	775	945	477 ACSR
NYSEG	Elbridge	State Street	14.50	W	2017	115	115	1	1255	1531	Reconductor 336.4 ACSR to 1194 KCM
NYSEG	Willet	Willet	xfmr	W	2017	115/34.5	115/34.5	1	39 MVA	44 MVA	Transformer #2
NYSEG	Gardenville	Gardenville	xfmr	S	2017	230/115	230/115	1	200 MVA	225 MVA	NYSEG Transformer #3 and Station Reconfiguration
RGE	Station 33	Station 262	2.97	W	2017	115	115	1	2008	2409	Underground Cable
RGE	Station 262	Station 23	1.46	W	2017	115	115	1	2008	2409	Underground Cable
RGE	Station 80	Station 80	-	S	2017	345	345				Station 80 Reconfiguration (GRTA)
RGE	Station 23	Station 23	xfmr	W	2017	15/11.5/11.	15/11.5/11.	2	75 MVA	84 MVA	Transformer
RGE	Station 23	Station 23	xfmr	W	2017	115/34.5	115/34.5	2	75 MVA	84 MVA	Transformer
RGE	Station 122 (Station upgrade)	Station 122 (Station upgrade)	xfmr	S	2017	345/115	345/115	3	494 MVA	527 MVA	Transformer Replacement and Station Reconfiguration (GRTA)

Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to (2)	Year	Nominal Voltage in kV Operating	Design	# of ckts	Thermal Ratings (4) Summer	Winter	Project Description / Conductor Size
CHGE	Hurley Avenue	Leeds	Series Compensation	S	2018	345	345	1	2336	2866	21% Compensation
ConEd	Greenwood	Greenwood	Reconfiguration	S	2018	138	138		N/A	N/A	Reconfiguration
NGRID	Oneida	Porter	Reactor	S	2018	115	115	1	-		Install reactor on Line #7; 6%
NGRID	Porter	Yahnundasis	Reactor	S	2018	115	115	1	-		Install reactor on Line #3;8%
NGRID	Battenkill	Eastover Road	-22.72	S	2018	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Battenkill	Schaghticoke (New Station)	14.31	S	2018	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Schaghticoke (New Station)	Eastover Road	8.41	S	2018	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Mohican	Luther Forest	-34.47	S	2018	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Mohican	Schaghticoke (New Station)	28.13	S	2018	115	115	1	937	1141	New Schaghticoke Switching Station
NGRID	Luther Forest	Schaghticoke (New Station)	6.34	S	2018	115	115	1	1280	1563	New Schaghticoke Switching Station
NGRID	Gardenville	Erie	0.30	S	2018	115	115	1	648	846	Replace 400CU and 636AL with 795 ACSR
NGRID	Gardenville 115 kV	Gardenville 115 kV	-	S	2018	-	-	-	-	-	Rebuild of Gardenville 115 kV station to full breaker and a half
NYPA	Moses	Moses	Cap Bank	W	2018	115	115	1	100 MVAR	100 MVAR	Cap Bank Installation to Replace Moses Synchronous Condensers
NYSEG	Falls Park	Klinekill (Line 630) circuit 1		S	2018	34.5	34.5		36MVA	49MVA	
NYSEG	Falls Park	Klinekill (Line 630) circuit 2		S	2018	34.5	34.5		36MVA	49MVA	
NYSEG	Windham	-	Cap Bank	S	2018	115	115	1	5.4 MVAR	5.4 MVAR	Capacitor bank
NYSEG	Falls Park	Schodack(NG)		S	2018	115	115	1	129MVA	156MVA	Tap to interconnect NG Line 14
NYSEG	Falls Park	Churchtown		S	2018	115	115	1	129MVA	156MVA	Tap to interconnect NG Line 14
NYSEG	Falls Park 115/34.5kV Substation			S	2018	115/34.5	115/34.5				Tap to interconnect NG Line 14
NYSEG	Falls Park	Falls Park	xfmr	S	2018	115/34.5	115/34.5	1	53MVA	59	Transformer #1
NYSEG	Flat Street	Flat Street	xfmr	W	2018	115/34.5	115/34.5	2	40MVA	45.2MVA	Transformer #2
NYSEG	Watercure Road	Watercure Road	xfmr	S	2018	345/230	345/230	1	426 MVA	494 MVA	Transformer
O & R	North Rockland (New Station)	Lovett	xfmr	S	2018	345/138	345/138	1	562 MVA	562 MVA	Transformer
O & R/ConEd	Ladentown	Buchanan	-9.5	S	2018	345	345	1	3000	3211	2-2493 ACAR
O & R/ConEd	Ladentown	North Rockland (New Station)	5.5	S	2018	345	345	1	3000	3211	2-2493 ACAR
O & R/ConEd	North Rockland (New Station)	Buchanan	4	S	2018	345	345	1	3000	3211	2-2493 ACAR
RGE	Station 67	Station 418	3.5	W	2018	115	115	1	1255	1255	New 115kV Line
RGE	Station 262	Station 262	xfmr	S	2018	115/34.5	115/34.5	1	56 MVA	63 MVA	Transformer
ConEd	Rainey	Corona	xfmr/Phase shifter	S	2019	345/138	345/138	1	268 MVA	320 MVA	xfmr/Phase shifter
NGRID	Spier	Rotterdam (#2)	-32.74	S	2019	115	115	1	1168	1416	New Lasher Rd Switching Station
NGRID	Spier	Lasher Rd (New Station) (#2)	21.69	S	2019	115	115	1	1168	1416	New Lasher Rd Switching Station
NGRID	Lasher Rd (New Station)	Rotterdam	11.05	S	2019	115	115	1	2080	2392	New Lasher Rd Switching Station
NGRID	Spier	Luther Forest (#302)	-34.21	S	2019	115	115	1	916	1070	New Lasher Rd Switching Station
NGRID	Spier	Lasher Rd (New Station) (#302)	21.72	S	2019	115	115	1	916	1118	New Lasher Rd Switching Station
NGRID	Lasher Rd (New Station)	Luther Forest	12.49	S	2019	115	115	1	990	1070	New Lasher Rd Switching Station
NGRID	Dunkirk	Dunkirk	-	S	2019	115	115	1			Add second bus tie breaker
NYPA	Niagara	Rochester	-70.20	W	2019	345	345	1	2177	2662	2-795 ACSR
NYPA	Niagara	Station 255 (New Station)	66.40	W	2019	345	345	1	2177	2662	2-795 ACSR
NYPA	Station 255 (New Station)	Rochester	3.80	W	2019	345	345	1	2177	2662	2-795 ACSR
NYPA	Dysinger Tap	Rochester	-44.00	W	2019	345	345	1	2177	2662	2-795 ACSR
NYPA	Dysinger Tap	Station 255 (New Station)	40.20	W	2019	345	345	1	2177	2662	2-795 ACSR
NYPA	Station 255 (New Station)	Rochester	3.80	W	2019	345	345	1	2177	2662	2-795 ACSR
NYSEG	Meyer	Meyer	xfmr	S	2019	115/34.5	115/34.5	2	59.2MVA	66.9MVA	Transformer #2
RGE	Station 168	Mortimer (NG Trunk #2)	26.4	S	2019	115	115	1	145 MVA	176 MVA	Station 168 Reinforcement Project
RGE	Station 168	Elbridge (NG Trunk # 6)	45.5	S	2019	115	115	1	145 MVA	176 MVA	Station 168 Reinforcement Project
RGE	Station 255 (New Station)	Rochester	3.80	W	2019	345	345	1	2177	2662	2-795 ACSR
RGE	Station 255 (New Station)	Station 255 (New Station)	xfmr	W	2019	345/115	345/115	1	400 MVA	450 MVA	Transformer
CHGE	St. Pool	High Falls	5.61	S	2020	115	115	1	1010	1245	1-795 ACSR
CHGE	High Falls	Kerhonkson	10.03	S	2020	115	115	1	1010	1245	1-795 ACSR
CHGE	Modena	Galeville	4.62	S	2020	115	115	1	1010	1245	1-795 ACSR
CHGE	Galeville	Kerhonkson	8.96	S	2020	115	115	1	1010	1245	1-795 ACSR
NGRID	Gardenville	Dunkirk	20.5	S	2020	115	115	2	1105	1346	Replace 20.5 miles of 141 and 142 lines
RGE	Station 255 (New Station)	Station 418	9.60	W	2020	115	115	1	1506	1807	New 115kV Line
RGE	Station 255 (New Station)	Station 23	11.10	W	2020	115	115	1	1506	1807	New 115kV Line
RGE	Station 255 (New Station)	Station 255 (New Station)	xfmr	W	2020	345/115	345/115	2	400 MVA	450 MVA	Transformer
O & R	Montvale (RECO)	-	Cap Bank	S	2022	69	69	1	32 MVAR	32 MVAR	Capacitor bank

D-2.2 Emergency Thermal Transfer Limit Analysis

The NYISO performed analyses of the RNA Base Cases to determine emergency thermal transfer limits for the key interfaces to be used in the MARS resource adequacy analysis. **Table D2-3** reports the emergency thermal transfer limits for the RNA base system conditions:

Table D2-3: Emergency Thermal Transfer Limits

Interface	2017		2021	
Dysinger East	1700	1	1700	1
Volney East	5650	2	5650	2
Moses South	2650	3	2650	3
Central East MARS	4425	4	4475	4
F to G	3475	5	3475	5
UPNY-SENY MARS	5500	6	5600	6
I to J	4400	7	4400	7
I to K (Y49/Y50)	1190	8	1190	8

Limiting Facility		Rating	Contingency
1	Packard - Huntley 230kV (77)	746	Niagara - Packard 230kV Packard 230/115kV BK 3 Packard - Huntley 230kV (78)
2	Oakdale - Fraser 345kV	1380	Edic - Fraser 345kV
3	Marcy 765/345kV T2 transformer	1971	Marcy 765/345kV T1
4	Porter - Rotterdam 230kV (30)	560	Porter - Rotterdam 230kV (31)
5	New Scotland-Leeds 345kV	1724	New Scotland-Leeds 345kV
6	Leeds-Pleasant Valley 345 kV	1725	Athens-Pleasant Valley 345 kV
7	Mott Haven-Rainey 345 kV	786	Pre-disturbance
8	Shore Rd - Glenwood So 138 kV	358	Sprain Brook - E.G.C. 345 kV (Y49)

Table D2-4: Dynamic Limit Tables

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

* 9 Mile Point 1, 9 Mile Point 2, 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	LI Sum	120	91	-67
	CE-LIPA (towards Zone J)	505	390	236

Year	Interface	Northport Units	
		All available	Any out
All	Norwalk CT to K (NNC)	70	369

D-3 2016 RNA MARS Model Base Case Development

The system representation for PJM, Ontario, New England, and Hydro Quebec modeled in the 2016 RNA Base Case was developed from the NPCC CP-8 2014 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 the year 10 (2026). The external area model was then frozen for the remaining study years (2017–2026). Because the load forecast in the NYCA continues to increase for the years 2017–2026, the LOLE for each of the external areas can experience increases despite the freeze of external loads and capacity.

The topology used in the MARS model preliminary RNA Base Case is represented in **Figures D-1**, **D-2**, and **D-3**. The topology used for the final RNA Base Case resource adequacy results is located in Figures 5-2 to 5-4 in the body of the report. The changes in the NYCA topology from the preliminary to the final RNA Base Case reflect LIPA's ratings re-calculation. The internal transfer limits modeled are the summer emergency ratings derived from the RNA Power Flow cases discussed above. The external transfer limits are developed from the NPCC CP-8 Summer Assessment MARS database with changes based upon the RNA Base Case assumptions.

Figure D-1: MARS Preliminary Base Case Topology for Year 1 (2017)

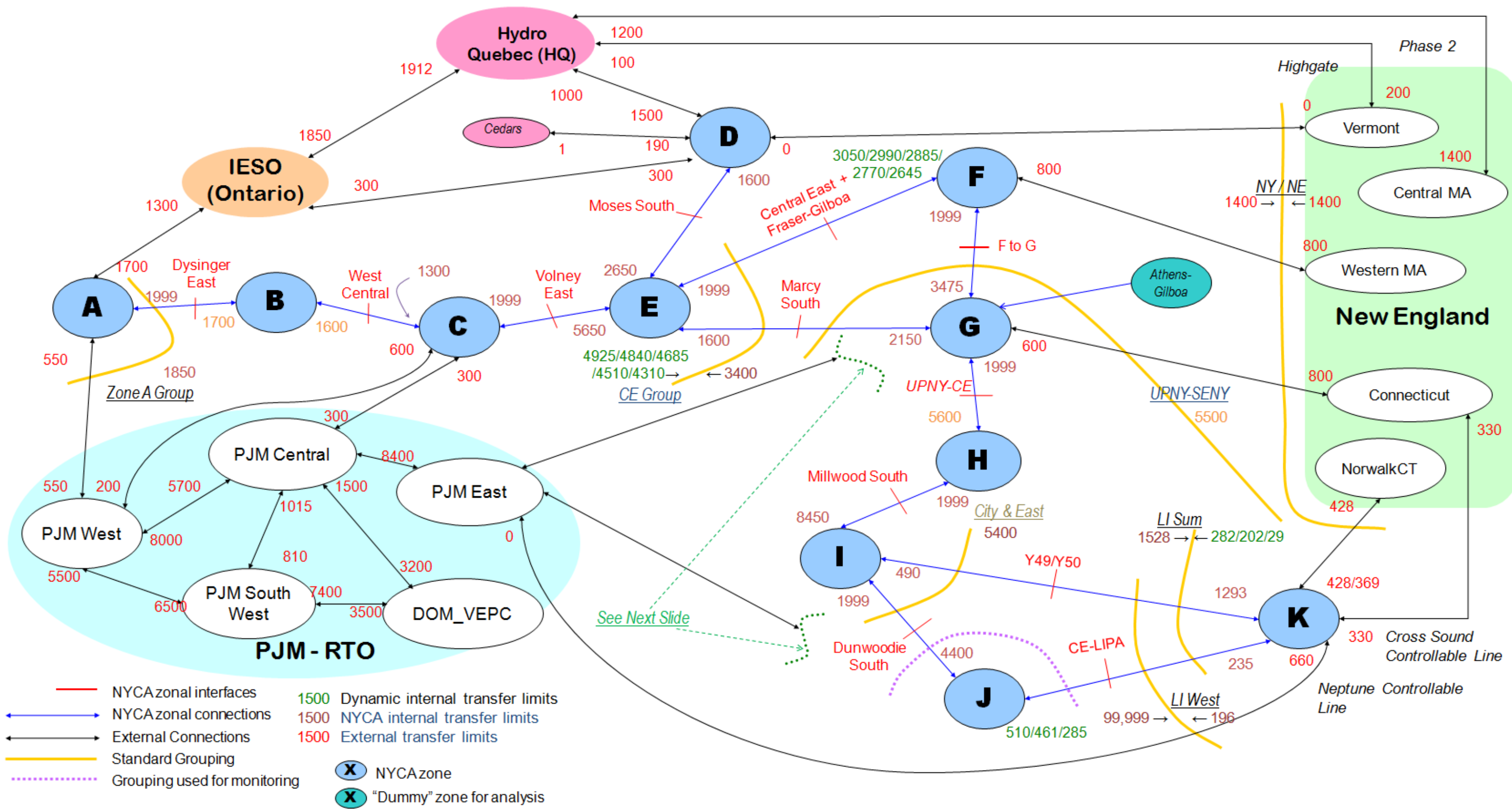


Figure D-2: NYCA MARS Preliminary Base Case Topology for Year 2 through 10 (2018-2026)

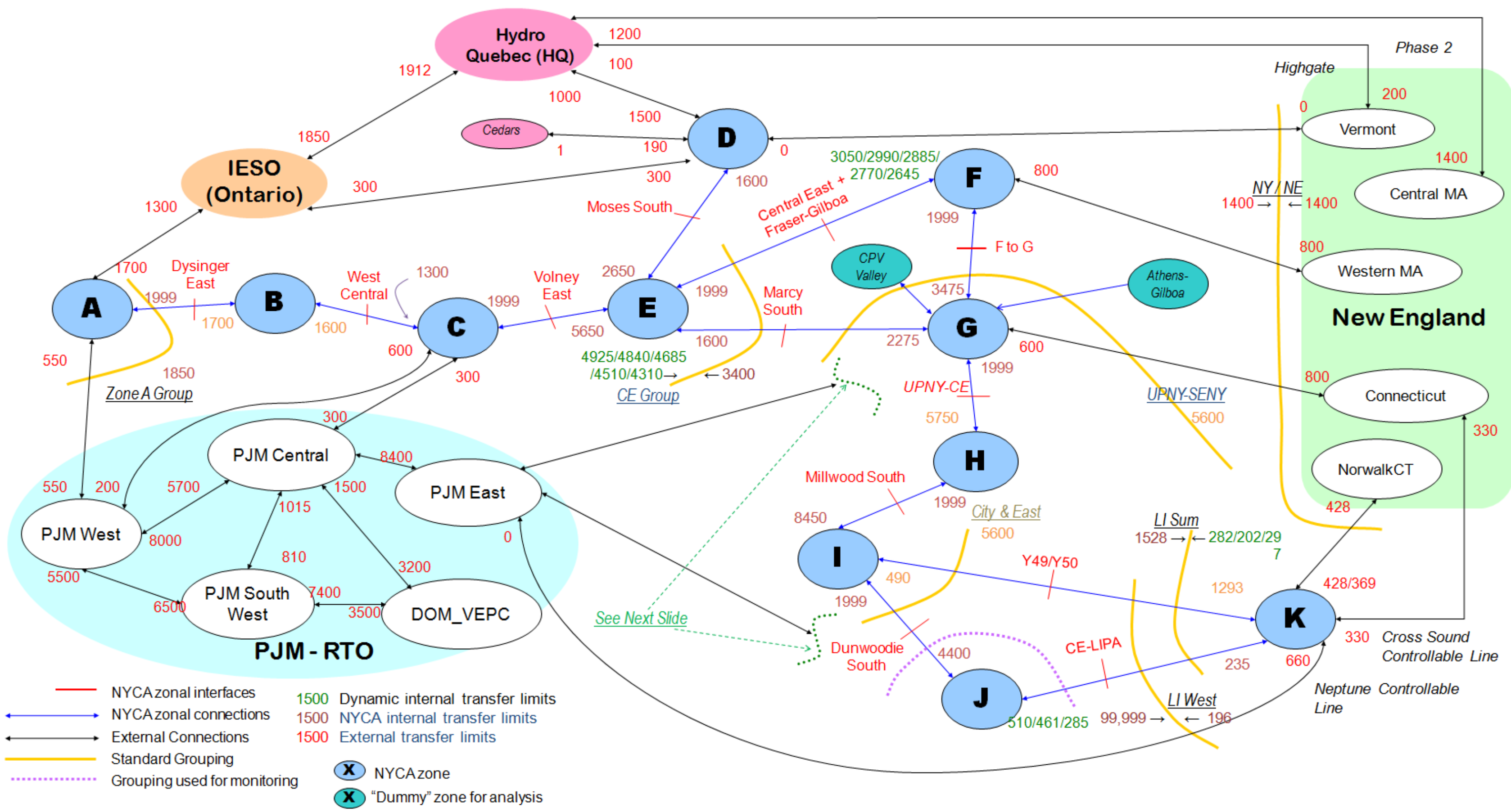
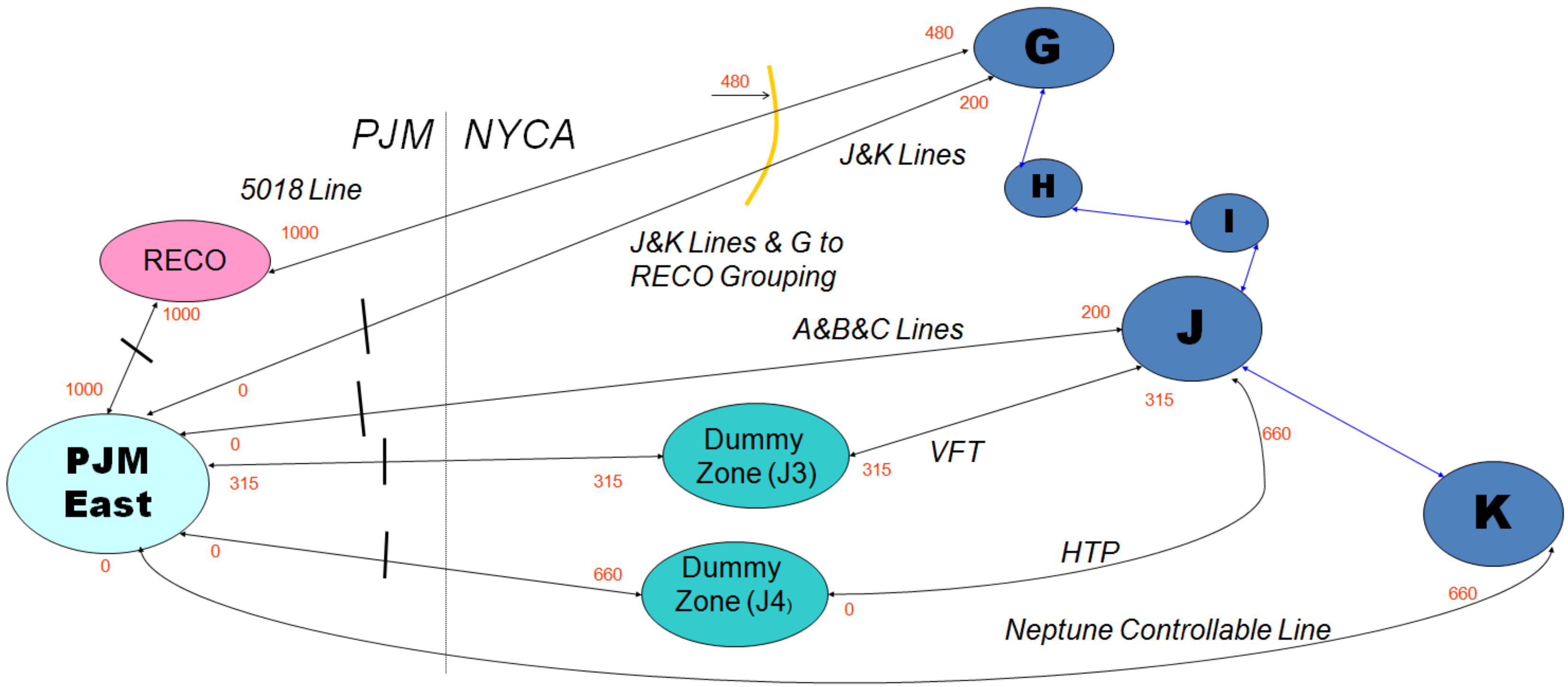


Figure D-3: PJM SENY Detail MARS Topology for Year 1 through 10 (2017-2026)



(PJM East to RECO) + (PJM East to J) + (PJM East to J3) + (PJM East to J4) + (PJM East to G) Grouped Interface Limited to 2,000 MW

D-4 Short Circuit Assessment

Table D-4 provides the results of NYISO's short circuit screening test. Individual breaker assessment (IBA) is required for any breakers whose rating is exceeded by the maximum fault current. Either NYISO or the Transmission Owner may complete the IBA.

Table D-4: 2014 RNA Fault Current Analysis Summary Table

Substation	Nominal kV	Lowest Rated Circuit Breaker	TO Number	2016 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
Academy	345	63	2	32.9	N	N
ADIRONDACK	230	25	5	9.4	N	N
AES SOMERSET	345	40	4	17.5	N	N
ALPS	345	40	5	17.6	N	N
AST-EAST-E	138	63	2	56.7	N	N
AST-EAST-W	138	63	2	56.7	N	N
AST-WEST-N	138	45	2	44.3	N	N
AST-WEST-S	138	45	2	44.3	N	N
AstoriaAnnex	345	63	7	46.7	N	N
ATHENS	345	48.7	5	34.7	N	N
BARRETT2	138	57.8	3	48.7	N	N
BAYONNE 345	345	50	2	24.6	N	N
BOONVILLE	115	29.7	5	10.8	N	N
BOWLINE 2	345	40	6	28.0	N	N
BOWLINE1	345	40	6	28.2	N	N
BRKHAVEN	138	37	3	26.8	N	N
BUCHAN N	345	63	2	30.2	N	N
BUCHAN S	345	63	2	39.7	N	N
BUCHANAN	138	40	2	15.7	N	N
C.ISLIP	138	38.9	3	28.2	N	N
CANANDAIGUA	230	40	4	6.4	N	N
CARLE PL	138	63	3	41.2	N	N
CHASES LAKE	230	40	5	8.9	N	N
CLARKS CNRS	115	40	4	17.4	N	N
CLARKS CNRS	345	40	4	11.4	N	N
CLAY	115	44.4	5	37.1	N	N
CLAY	345	49	5	31.4	N	N
COOPERS CRN	345	40	4	19.0	N	N
COOPERS CRN4	115	22.636	4	20.1	N	N
COOPERS CRN8	115	22.636	4	20.1	N	N

Substation	Nominal kV	Lowest Rated Circuit Breaker	TO Number	2016 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
CORONA N.	138	63	2	56.3	N	N
CORONA S.	138	63	2	56.3	N	N
DEWITT	115	63	5	28.6	N	N
DEWITT	345	39.9	5	18.3	N	N
DUFFY AVE	345	63	3	8.5	N	N
Duley	230	40	7	7.3	N	N
DUN NO	138	40	2	34.6	N	N
DUN SO	138	40	2	30.7	N	N
DUNKIRK	230	29.5	5	9.6	N	N
DUNWOODIE	345	63	2	51.4	N	N
E 13 ST	138	63	2	47.7	N	N
E FISHKILL	115	40	9	24.7	N	N
E FISHKILL	345	50	2	40.7	N	N
E15ST 46	345	63	2	54.8	N	N
EASTOVER	230	50	5	10.7	N	N
EASTOVER N	115	50	5	24.8	N	N
EASTVIEW	138	63	2	37.1	N	N
EDIC	345	40	5	32.7	N	N
EGC PAR	345	63	7	25.6	N	N
EGC-1	138	80	3	70.4	N	N
EGC-2	138	80	3	70.4	N	N
ELBRIDGE	115	63	5	26.6	N	N
ELBRIDGE	345	39.9	5	15.7	N	N
ELWOOD 1	138	63	3	38.4	N	N
ELWOOD 2	138	63	3	38.1	N	N
FARRAGUT	345	63	2	60.5	N	N
FITZPATRICK	345	37	7	38.0	Y	N
FIVE MILE RD	115	39.7	5	12.8	N	N
FIVE MILE RD	345	40	5	5.8	N	N
FR KILLS	138	40	2	36.1	N	N
FR KILLS	345	63	2	27.2	N	N
FRASER	115	40	4	18.8	N	N
FRASER	345	40	4	19.1	N	N
FREEPORT	138	63	3	35.9	N	N
GARDEN (NM)	34.5	21	5	13.8	N	N
GARDEN BS3	115	39.9	5	33.3	N	N
GARDEN BS4	115	39.9	5	33.4	N	N
GARDEN BS5-7	115	39.9	5	33.5	N	N

Substation	Nominal kV	Lowest Rated Circuit Breaker	TO Number	2016 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
GARDEN BS6-8	115	39.9	5	33.5	N	N
GARDENVILLE1	230	30.859	5	18.8	N	N
GILBOA 345	345	50	7	25.1	N	N
GLNWD NO	138	63	3	45.1	N	N
GLNWD SO	138	63	3	44.6	N	N
GOETHL N	345	63	2	29.6	N	N
GOETHL S	345	63	2	29.6	N	N
GOW N	345	63	2	28.3	N	N
GOW S	345	63	2	28.3	N	N
GREENLWN	138	63	3	29.1	N	N
HAUPAGUE	138	63	3	22.0	N	N
High Sheldon	230	40	4	10.0	N	N
HILLSIDE #4	115	21.0555	4	18.2	N	N
HILLSIDE #8	115	21.0555	4	18.2	N	N
HILLSIDE 230	230	28.6	4	13.7	N	N
HILLSIDE#4	34.5	21.6842	4	17.8	N	N
HOLBROOK	138	57.8	3	48.6	N	N
HOLTSGT-NYPA	138	63	3	53.4	N	N
HUNTLEY 68	230	31.8	5	17.1	N	N
HUNTLEY 70	230	31.8	5	17.1	N	N
HURLEY	345	40	9	19.0	N	N
HURLEY AVE	115	37.867	9	18.9	N	N
INDEPENDENCE	345	41.9	5	36.2	N	N
JAMAICA	138	63	2	49.7	N	N
LADENTOWN	345	63	6	41.4	N	N
LAFAYETTE	345	40	5	17.3	N	N
LCST GRV	138	63	3	39.7	N	N
LEEDS	345	36.6	5	35.4	N	N
LHH WHITE	115	38.1	5	10.5	N	N
LKSUCS P	138	63	3	32.4	N	N
MARCY 345	345	63	7	32.0	N	N
MARCY 765	765	63	7	9.7	N	N
MASSENA 765	765	63	7	8.1	N	N
MEYER	34.5	21.6842	4	10.9	N	N
MEYER	115	18.888	4	10.7	N	N
MEYER	230	40	4	7.0	N	N
MIDDLETN TAP	345	63	7	19.9	N	N
MILLR PL	138	63	3	14.7	N	N

Substation	Nominal kV	Lowest Rated Circuit Breaker	TO Number	2016 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
MILLWOOD	138	40	2	19.4	N	N
MILLWOOD	345	63	2	45.6	N	N
MOTT HAVEN	345	63	2	50.0	N	N
NEWBRID	138	80	3	69.1	N	N
NEWBRIDG	345	57.3	3	8.6	N	N
NIAGARA 345	345	63	7	33.1	N	N
NIAGRA E 115	115	50	7	36.8	N	N
NIAGRA E 230	230	63	7	53.5	N	N
NIAGRA W 115	115	50	7	26.8	N	N
NIAGRA W 230	230	63	7	53.5	N	N
NMP#1	345	50	5	40.2	N	N
NMP#2	345	50	5	40.8	N	N
NRTHPRT1	138	63	3	59.8	N	N
NRTHPRT1-2	138	63	3	59.9	N	N
NRTHPRT2	138	63	3	59.9	N	N
NRTHPRT3	138	63	3	44.3	N	N
NRTHPRT4	138	63	3	44.2	N	N
NSCOT 77B	345	38.8	5	31.5	N	N
NSCOT 99B	345	38.8	5	31.5	N	N
NSCOT33	115	63	5	46.6	N	N
NSCOT77	115	63	5	46.6	N	N
NSCOT99	115	63	5	46.6	N	N
OAKDALE	34.5	22.9543	4	19.4	N	N
OAKDALE	115	40	4	26.8	N	N
OAKDALE 345	345	40	4	12.5	N	N
OAKWOOD	138	57.8	3	28.2	N	N
ONEIDA EAST	115	28.4	5	14.9	N	N
ONEIDA WEST	115	28.4	5	14.9	N	N
OSWEGO	345	40.6	5	31.4	N	N
OSWEGO M3	115	40	5	21.1	N	N
PACKARD 2&3	230	47.8	5	39.6	N	N
PACKARD 4&5	230	47.8	5	39.6	N	N
PACKARD 6	230	47.8	5	39.7	N	N
PACKARD NRTH	115	63	5	29.0	N	N
PACKARD STH	115	63	5	24.9	N	N
Patnode	230	63	7	9.2	N	N
PILGRIM	138	63	3	59.5	N	N
PLATTSBURGH	115	25	7	17.0	N	N

Substation	Nominal kV	Lowest Rated Circuit Breaker	TO Number	2016 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
PLEASANT VAL	115	38.012	9	28.0	N	N
PLEASANT VAL	345	63	2	41.9	N	N
PORTER	115	55.5	5	41.3	N	N
PORTER	230	21	5	19.5	N	N
PT JEFF	138	63	3	32.1	N	N
PVILLE-1	345	63	2	22.0	N	N
PVILLE-2	345	63	2	22.2	N	N
RAINEY	345	63	2	56.7	N	N
RAMAPO	345	63	2	46.8	N	N
REYNOLDS	345	40	5	14.9	N	N
REYNOLDS RD	115	43	5	38.1	N	N
RIVERHD	138	63	3	17.4	N	N
RNKNKOMA	138	63	3	36.5	N	N
ROBINSON RD.	34.5	21.8944	4	16.9	N	N
ROBINSON RD.	115	37.8639	4	18.5	N	N
ROBINSON RD.	230	43	4	14.0	N	N
ROCK TAV	115	43.203	9	25.8	N	N
ROCK TAVERN	345	63	9	35.0	N	N
Roseton	345	63	9	37.2	N	N
ROSLYN	138	63	3	30.9	N	N
ROTTERDAM66H	230	39.9	5	13.6	N	N
ROTTERDAM77H	230	23.6	5	13.5	N	N
ROTTERDAM99H	230	23.2	5	13.6	N	N
RULND RD	138	63	3	45.8	N	N
Ryan	230	40	7	10.4	N	N
S OSWEGO	115	39.2	5	20.6	N	N
S RIPLEY	230	40	5	10.3	N	N
S013A	115	40	8	18.1	N	N
S080 345kV	345	40	8	16.5	N	N
S080 922	115	40	8	16.0	N	N
S082 B2	115	40	8	34.6	N	N
S082 B3	115	40	8	34.5	N	N
S122	345	40	8	15.9	N	N
S122 925	115	40	8	32.4	N	N
S255	115	40	8	20.2	N	N

Substation	Nominal kV	Lowest Rated Circuit Breaker	TO Number	2016 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
S255	345	40	8	16.3	N	N
SB TR N7	138	63	2	27.0	N	N
SB TR S6	138	63	2	29.2	N	N
SCHUYLER	115	36	5	15.4	N	N
SCRIBA	345	48.3	5	43.1	N	N
SCRIBA C	115	40	5	10.4	N	N
SCRIBA D	115	40	5	10.3	N	N
SHORE RD	345	63	3	28.0	N	N
SHORE RD1	138	57.8	3	48.3	N	N
SHORE RD2	138	57.8	3	48.3	N	N
SHOREHAM1	138	52.2	3	27.7	N	N
SHOREHAM2	138	52.2	3	27.7	N	N
SILLS RD1	138	63	3	31.7	N	N
SMAH	138	40	237	27.3	N	N
SPRN BRK	345	63	2	52.7	N	N
ST LAWRN 115	115	46.3	7	40.8	N	N
ST LAWRN 230	230	33.1	7	31.9	N	N
STOLLE	115	23.9068	4	15.5	N	N
STOLLE ROAD	230	40	4	13.3	N	N
STOLLE ROAD	345	40	4	4.7	N	N
STONEYRIDGE	230	40	4	7.1	N	N
STONY CREEK	230	40	4	8.9	N	N
SUGLF 345TAP	345	63	9	27.5	N	N
SYOSSET	138	63	3	34.1	N	N
TEALL	115	40	5	25.9	N	N
TERMINAL	115	28.4	5	17.0	N	N
TREMNT11	138	63	2	42.9	N	N
TREMNT12	138	63	2	42.8	N	N
TX9	138	50	2	13.4	N	N
VALLEY	115	40	5	8.4	N	N
VERNON E	138	63	2	43.9	N	N
VERNON W	138	63	2	34.8	N	N
VLY STRM1	138	63	3	53.7	N	N
VLY STRM2	138	63	3	53.9	N	N
VOLNEY	345	44.8	5	34.5	N	N
W 49 ST	345	63	2	51.8	N	N
WADNGRV1	138	56.4	3	25.8	N	N
WATERCURE230	230	40	4	13.7	N	N

Substation	Nominal kV	Lowest Rated Circuit Breaker	TO Number	2016 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
WATERCURE345	345	40	4	9.1	N	N
WATKINS	115	40	5	8.7	N	N
Wethersfield	230	40	4	8.7	N	N
WHAV	138	40	6	30.7	N	N
WILDWOOD	138	63	3	27.6	N	N
WILLIS 230	230	33.1	7	12.4	N	N
WOOD ST.	115	40	4	20.0	N	N
WOODARD	115	35.7	5	15.5	N	N
YAHNUNDASIS	115	25.1	5	10.5	N	N

Table D-5 provides the results of NYISO's IBA for FitzPatrick 345kV.

Table D-5: NYISO IBA for 2016 RNA Study

Bus Number	Bus	Breaker	Interrupting Breaker Capacity (A)	Maximum Interrupting Fault Duty (A)	Breaker Overstressed
147830	FITZPATRICK	10052	37000	4177	NO
147830	FITZPATRICK	10042	37000	32840	NO

D-6 Transmission Security Violations of the 2014 RNA Base Case

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
A	N. Grid	Packard-Huntley (#77) 230	556	644	746	STOLLRD - GARDENVILL 230 66	PACKARD 230/115 3TR	100.31	-	-
A	N. Grid	Packard-Huntley (#77) 230	556	644	746	STOLLRD - GARDENVILL 230 66	SB:PA230_R3230	100.27	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	LN:115:182N	T:77&78	106.37	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	LN:115:182S	T:77&78	105.9	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	LN:115:180	T:77&78	104.32	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 77 230	SB:PA230_R3230	103.56	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 77 230	PACKARD 230/115 3TR	103.54	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 77 230	SB:PA230_R0306	103.51	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 78 230	SB:PA230_R3430	101	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 78 230	PACKARD 230/115 4TR	100.95	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 78 230	SB:PA230_R506	100.93	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 78 230	SB:HUNT230_R1302	100.69	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 78 230	PACKARD - HUNTLEY 230 77	100.67	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 78 230	T:77&78	100.67	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 77 230	SB:HUNT230_R1502	100.65	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 78 230	OE:PACK_77	100.65	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 77 230	PACKARD - HUNTLEY 230 78	100.62	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 77 230	T:77&78	100.62	-	-
A	NYSEG	Stolle-Gardenville (#66) 230	474 534	478 615	478 705	N10 PACKARD - HUNTLEY 77 230	OE:PACK_78	100.58	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#1) 345	1195 1301	1195 1501	1195 1685	STOLLRD - GARDENVILL 230 66	SB:CLAY345_R20	103.2	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#1) 345	1195 1301	1195 1501	1195 1685	STOLLRD - GARDENVILL 230 66	PANL - CLAY 345 2	102.05	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#1) 345	1195 1301	1195 1501	1195 1685	STOLLRD - GARDENVILL 230 66	SB:CLAY345_R935	101.61	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#1) 345	1195 1301	1195 1501	1195 1685	N10 PACKARD - HUNTLEY 77 230	SB:CLAY345_R20	100.85	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#1) 345	1195 1301	1195 1501	1195 1685	N10 PACKARD - HUNTLEY 78 230	SB:CLAY345_R20	100.19	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345	1195 1301	1195 1501	1195 1685	STOLLRD - GARDENVILL 230 66	SB:CLAY345_R10	103.34	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345	1195 1301	1195 1501	1195 1685	STOLLRD - GARDENVILL 230 66	PANL - CLAY 345 1	102.19	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345	1195 1301	1195 1501	1195 1685	STOLLRD - GARDENVILL 230 66	SB:CLAY345_R945	101.76	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345	1195 1301	1195 1501	1195 1685	N10 PACKARD - HUNTLEY 77 230	SB:CLAY345_R10	100.99	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345	1195 1301	1195 1501	1195 1685	N10 PACKARD - HUNTLEY 78 230	SB:CLAY345_R10	100.32	-	-
B/C	NYPA, RG&E, N. Grid	Clay-Pannell (#2) 345	1195 1301	1195 1501	1195 1685	STOLLRD - GARDENVILL 230 66	SB:PANN345_3808	100.12	-	-
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	CLAY - DEW 345 13	OS - EL - LFYTE 345 17	108.9	-	-
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	CLAY - DEW 345 13	T:17&11	108.73	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	OS - EL - LFYTE 345 17	CLAY - DEW 345 13	107.7	-	-
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	OS - EL - LFYTE 345 17	SB:CLAY345_R925	105.83	-	-
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	CLAY - TEAL 10 115	SB:DEWI345_R220	103.19	-	-
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	CLAY - TEAL 10 115	SB:DEWI345_R915	103.18	-	-
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	CLAY - TEAL 10 115	SB:DEWI345_R130	103.17	-	-
C	N. Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116 220	120 252	145 280	CLAY - TEAL 10 115	DEWITT 345/115 2TR	100.61	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	CLAY - TEAL 11 115	SB:DEWI345_R220	106.69	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	CLAY - TEAL 11 115	SB:DEWI345_R915	106.68	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	CLAY - DEW 3 115	SB:DEWI345_R220	106.67	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	CLAY - TEAL 11 115	SB:DEWI345_R130	106.66	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	CLAY - DEW 3 115	SB:DEWI345_R915	106.65	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	CLAY - DEW 3 115	SB:DEWI345_R130	106.64	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	CLAY - DEW 3 115	DEWITT 345/115 2TR	104.01	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	CLAY - TEAL 11 115	DEWITT 345/115 2TR	103.32	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	DEWITT 345/115 2TR	CLAY - TEAL 11 115	102.64	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	DEWITT 345/115 2TR	SB:CLAY115_R865	101.27	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	DEWITT 345/115 2TR	SB:CLAY115_R110	101.06	-	-
C	N. Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116 220	120 252	145 280	CLAY - DEW 345 13	OS - EL - LFYTE 345 17	100.52	-	-
C	NYSGE	Oakdale 345/115 2TR	428	556	600	N10 PACKARD - HUNTLEY 77 230	SB:OAKD345_31-B322	101.77	102.75	107.24
C	NYSGE	Oakdale 345/115 2TR	428	556	600	N10 PACKARD - HUNTLEY 78 230	SB:OAKD345_31-B322	100.77	102.78	107.26
C	NYSGE	Oakdale 345/115 2TR	428	556	600	STOLLRD - GARDENVILL 230 66	SB:OAKD345_31-B322	101.12	102.6	106.5
C	NYSGE	Oakdale 345/115 2TR	428	556	600	ROBINSON - STOLLRD 230 65	SB:OAKD345_31-B322	-	100.48	105.73
C	NYSGE	Oakdale 345/115 2TR	428	556	600	NIAGARA - ROBINSON 345 64	SB:OAKD345_31-B322	-	-	101.8
C	NYSGE	Oakdale 345/115 2TR	428	556	600	FRASER 345/115 2TR	SB:OAKD345_31-B322	-	-	101.39
D	N. Grid	Porter-Oneida (#7) 115 (Power-W. Utica)	116	120	145	PORTER - YAHNUNDASIS 115	SB:OSWE_R985	102.74	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
D	N. Grid	Porter-Oneida (#7) 115 (Power-W. Utica)	116	120	145	STOLLRD - GARDENVILL 230 66	B:PORTER115C	100.27	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	B:PORTER115D	115.94	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	PORTER - ONEIDA 115	SB:OSWE_R985	113.64	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	N10 PACKARD - HUNTLEY 78 230	B:PORTER115D	113.06	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	N10 PACKARD - HUNTLEY 77 230	B:PORTER115D	112.57	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	PORTER - ONEIDA 115	110.22	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	DEWITT 345/115 2TR	B:PORTER115D	110.06	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	ROBINSON - STOLLRD 230 65	B:PORTER115D	107.66	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	N10 PACKARD - HUNTLEY 78 230	PORTER - ONEIDA 115	107.41	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	OSWEGO - VOLNEY 345 12	B:PORTER115D	107.22	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	N10 PACKARD - HUNTLEY 77 230	PORTER - ONEIDA 115	107.21	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	PORTER - ONEIDA 115	SB:DEWI345_R915	107.16	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	PORTER - ONEIDA 115	SB:DEWI345_R220	107.14	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	PORTER - ONEIDA 115	SB:DEWI345_R130	107.13	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	OS - EL - LFYTE 345 17	B:PORTER115D	106.72	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLAY - INDEPNC 345 26	B:PORTER115D	106.08	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	N10 PACKARD - HUNTLEY 78 230	SB:OSWE_R985	105.93	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	NIAGARA - ROBINSON 345 64	B:PORTER115D	105.88	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	N10 PACKARD - HUNTLEY 77 230	SB:OSWE_R985	105.68	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	OSWEGO 345/115 1TR	B:PORTER115D	105.25	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	LN:115:182S	B:PORTER115D	104.97	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	GEN:9MIPT2_LOG08	B:PORTER115D	104.92	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	LN:115:182N	B:PORTER115D	104.8	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLAY - TEAL 11 115	B:PORTER115D	104.53	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLAY 345/115 1TR	B:PORTER115D	104.47	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	GEN:OSWEGO 6	B:PORTER115D	104.43	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	GEN:OSWEGO 5	B:PORTER115D	104.4	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	GEN:KINTIGH_LOG01	B:PORTER115D	104.19	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	PTR TRMNL 115	PTR SCHLR 115	104.03	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	DEWITT 345/115 2TR	PORTER - ONEIDA 115	103.97	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	Porter - Boonville 1 115	B:PORTER115D	103.88	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	PTR WATKINS 115	B:PORTER115D	103.65	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	EDIC - FRASER 345 EF24-40	B:PORTER115D	103.48	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLAY - 9MI1 8 345	B:PORTER115D	103.15	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	ELBRIDGE 345/115 1TR	B:PORTER115D	103.14	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	OS - EL - LFYTE 345 17	SB:CLAY345_R925	103.02	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLAY - DEW 345 13	B:PORTER115D	102.98	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	VE08:L/O OAKDALE-FRASER 345 32	B:PORTER115D	102.9	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	GEN:ESYR	B:PORTER115D	102.81	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	GEN:9MIPT1	B:PORTER115D	102.5	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	PTR SCHLR 115	PTR TRMNL 115	102.42	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	FARRAGUTW - E13ST 345 48/Q35M	B:PORTER115D	102.2	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	ROBINSON - STOLLRD 230 65	PORTER - ONEIDA 115	101.99	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLAY 345/115 2TR	B:PORTER115D	101.93	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:DEWI345_R915	101.78	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:DEWI345_R130	101.77	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:DEWI345_R220	101.77	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	OS - EL - LFYTE 345 17	CLAY - DEW 345 13	101.76	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	OSWEGO - VOLNEY 345 12	PORTER - ONEIDA 115	101.59	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLARKS CORNERS 345/115 BK1	B:PORTER115D	101.43	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLARKS CORNERS 345/115 BK2	B:PORTER115D	101.43	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:FRAS345_32-3362	101.26	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLAY - DEW 345 13	OS - EL - LFYTE 345 17	101.04	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:OSWE_R935	100.99	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:FRAS345_B1-3262	100.99	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	VE08:L/O OAKDALE-FRASER 345 32	100.99	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:OSWE_R965	100.98	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	DEWITT 345/115 2TR	100.95	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	OS - EL - LFYTE 345 17	PORTER - ONEIDA 115	100.91	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	OS - EL - LFYTE 345 17	100.78	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:OAKD345_B3-3222	100.66	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLAY - INDEPNC 345 26	PORTER - ONEIDA 115	100.62	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:OAKD345_32-B222	100.61	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	CLAY - DEW 345 13	T:17&11	100.53	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	SB:LAFAYETTE_VE10	100.46	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	LN:115:182S	SB:OSWE_R985	100.39	-	-

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	1st Contingency	2nd Contingency	2017 Flow (%)	2021 Flow (%)	2026 Flow (%)
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	NIAGARA - ROBINSON 345 64	PORTER - ONEIDA 115	100.31	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	STOLLRD - GARDENVILL 230 66	T:17&11	100.3	-	-
D	N. Grid	Porter-Yahnundasis (#3) 115 (Port-Kelsey)	116	120	145	LN:115:182N	SB:OSWE_R985	100.25	-	-
K	LIPA	East Garden City-Valley Stream (#262) 138	226	285	310	138-291	138-292	105.31	107.12	115.58
K	LIPA	East Garden City-Valley Stream (#262) 138	226	285	310	138-291	5 :VST NEW1	105.29	107.1	115.57
K	LIPA	East Garden City-Valley Stream (#262) 138	226	285	310	138-292	138-291	105.05	106.36	114.78