The New York Independent System Operator's 2015 Comprehensive Review of Resource Adequacy

Covering the New York Control Area for the Period 2016 – 2020

Report 2.0

Approved by the RCC

December 1, 2015

Caution and Disclaimer

Executive Summary

The 2015 Comprehensive Review of Resource Adequacy covers the time period of 2016 through 2020. The New York Independent System Operator (NYISO) has prepared this Comprehensive Review to comply with the Reliability Assessment Program established by the Northeast Power Coordinating Council (NPCC). This Comprehensive Review is based upon the NYISO's most recent reliability planning process under Attachment Y of its Open Access Transmission Tariff approved by the Federal Energy Regulatory Commission. The results were reflected in the 2014 Reliability Needs Assessment and the 2014 Comprehensive Reliability Plan, which was approved by the NYISO's Board of Directors in July 2015. The NYISO will commence its next reliability planning process in January 2016. This assessment follows the resource adequacy guidelines outlined in NPCC's Regional Reliability Reference Directory No. 1, Appendix D[1] and supersedes the 2012 Comprehensive Review of Resource Adequacy approved by the Reliability Coordinating Committee (RCC) on November 7, 2012.

The 2015 Comprehensive Review demonstrates that New York will meet the NPCC resource adequacy criterion of not more than one unplanned disconnection of firm load in ten years, or 0.1 days/year, on average under a Base Forecast of future system electric loads.

Major Findings

This Comprehensive Review sets forth the NYISO findings, that under the conditions studied, shown in the table below the planned NYCA system will result in the New York bulk power system meeting all applicable reliability criteria over the 2016 through 2020 study period. These findings confirm that the initially identified Reliability Needs in the 2014 RNA are resolved and no additional solutions are required. This review highlights a number of risks which include narrowing capacity margins that make long-term bulk power system reliability vulnerable to reduction in available resources or any failure to timely implement Transmission Owners' Local Transmission Owner Plans.

[1] http://www.npcc.org/documents/regStandards/Directories.aspx

Major Assumptions

Table ES-1 lists the major assumptions modeled in this review. Table ES-2 lists the Loss of Load Expectation (LOLE) results.

Table ES-1 Model Assumptions

Model Assumptions	
Assumption	**Description**
Adequacy Criterion	NPCC Loss of Load Expectation (LOLE) requirement of not more than one unplanned disconnection of firm load in ten years, or 0.1 days/year, on average
Reliability Model	GE MARS Program (Version 3.18)
Load Model	Based on forecast from the 2014 Load and Capacity Data Report, which includes reductions for energy efficiency and behind-the-meter solar PV. Behind-the-meter solar forecasted at 553 MW for 2020 11 zones modeled
Load Uncertainty	Historical Basis Weather and economic conditions are factored in the analysis Multiple load shapes (2006, 2002, and 2007) used in load forecast uncertainty bins in GE MARS program
Generating Capacity Additions	1,996 MW
Generating Capacity Retirements	341.3 MW
Unit Availability	Based on NERC GADS data (EFORd calculation) and five-year unit history
Topology	As defined by the 2014 Reliability Needs Assessment (RNA) with modifications dictated by the assessment of future transmission system conditions. Emergency transfer limits at transmission interfaces between NYISO zones modeled
Emergency Operating Procedures	EOPS that reduce load during emergency conditions to maintain operating reserves modeled
External Control Areas	Load and Capacity fixed for the 2016 through 2020 study years Areas adjusted to between 0.1 LOLE and 0.15 LOLE

Table ES-2 LOLE Results

2015 Comprehensive Review LOLE Results					
Year	2016	2017	2018	2019	2020
Projected Resources	42,816	42,507	42,507	42,507	42,507
	Base Load Forecast				
NYCA Base Load Forecast	34,412	34,766	35,111	35,454	35,656
LOLE Results	0.02	0.03	0.04	0.05	0.05
	High Load Forecast				
NYCA High Load Forecast	35,160	35,691	36,202	36,697	37,057
LOLE Results	0.03	0.06	0.08	0.10	0.14

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1. Introduction

The New York Independent System Operator (NYISO) was formed in 1997 and commenced operations in 1999. The NYISO is a not-for-profit organization that manages New York's bulk electricity grid, administers the state's competitive wholesale electricity markets, provides system and resource planning for state's bulk power system, and works to advance the technology serving the power system. The organization is governed by an independent Board of Directors and a governance structure made up of committees with market participants and stakeholders.

The NYISO is also the regional Reliability Coordinator for the New York Balancing Authority Area of the Northeast Power Coordinating Council. As the Reliability Coordinator, the NYISO is responsible to conduct reliability studies and provide results to NPCC demonstrating that the New York bulk power system complies with NPCC reliability criteria as defined in NPCC's Regional Reliability Reference Directory No. 1, Design and Operation of the Bulk Power System.

The NYISO submits the 2015 Comprehensive Review of Resource Adequacy covering the period 2016 through 2020 to satisfy NPCC requirements. The review follows the guidelines as specified in Appendix D of NPCC's Regional Reliability Reference Directory No. 1.

1.1 Previous Comprehensive Review

The Reliability Coordinating Committee (RCC) approved the 2012 New York Comprehensive Review of Resource Adequacy in November 2012. The findings of that review demonstrated that New York would meet the NPCC Resource Adequacy Design Criterion for the period studied under the base case load and resource conditions.

1.2 Comparison of Load and Resources with Previous Review

1.2.1 Demand Forecast

The electricity forecast is based on projections of New York's economy performed by Moody's Analytics in January 2014. The forecast includes detailed projections of employment, output, income and other factors for twenty three regions in New York State.

In June 2008, the New York Public Service Commission issued its Order regarding the Energy Efficiency Portfolio Standard. This proceeding set forth a statewide goal of a cumulative energy reduction of about 26,900 GWh. The NYISO estimates the peak demand impacts to be about 5,500 MW. This goal is expected to be achieved by contributions from a number of state agencies, power authorities and utilities, as well as from federal codes and building standards.

Table 1-1 Comparison of Peak Load Forecasts and Capacity Resources from Previous Review

Comparison of Peak Load Forecasts and Capacity Resources with the 2012 Comprehensive Review					
Year	2016	2017	2018	2019	2020
2015 Comprehensive Review – Capacity Resources	42,816	42,507	42,507	42,507	42,507
2012 Comprehensive Review – Capacity Resources	42,361	42,361	N/A	N/A	N/A
Delta	455	146	N/A	N/A	N/A
2015 Comprehensive Review – Base Forecast	34,412	34,766	35,111	35,454	35,656
2012 Comprehensive Review – Base Forecast	34,345	34,550	N/A	N/A	N/A
Delta	67	216	N/A	N/A	N/A

2. Resource Adequacy Criterion

2.1 Statement of Resource Adequacy Criterion

The NYISO adheres to the NPCC resource adequacy criterion[2], which reads:

> "The probability (or risk) of disconnecting firm load due to resource deficiencies shall be, on average, not more than one day in ten years as determined by studies conducted for each Resource and Planning Coordinator Area. Compliance with this criterion shall be evaluated probabilistically, such that the loss of load expectation (LOLE) of disconnecting firm load due to resource deficiencies shall be, on average, no more than 0.1 day per year. This evaluation shall make due allowance for demand uncertainty, scheduled outages and de-ratings, forced outages and de-ratings, assistance over interconnections with neighboring Planning Coordinator Areas, transmission transfer capabilities, and capacity and/or load relief from available operating procedures."

The NYISO also adheres to the New York State Reliability Council (NYSRC) resource adequacy criterion (A-R1), which reads:

> *"The NYSRC shall establish the Installed Reserve Margin (IRM) requirement for the NYCA such that the probability (or risk) of disconnecting any firm load due to resource deficiencies shall be, on average, not more than once in ten years. Compliance with these criteria shall be evaluated probabilistically, such that the loss of load expectation (LOLE) of disconnecting firm load due to resource deficiencies shall be, on average, no more than 0.1 day per year. This evaluation shall make due allowance for scheduled outages and de-ratings, forced outages and de-ratings, assistance over interconnections with neighboring control areas, NYS Transmission System transfer capability, and capacity and/or load relief from available operating procedures."*

[2] See NPCC Directory #1 at http://www.npcc.org/documents/regStandards/Directories.aspx

The NYSRC criterion is consistent with the NPCC criterion. In addition, NYSRC imposes Installed Capacity Requirements on NYCA Load Serving Entities (LSE) (A-R2), as follows:

> "LSEs shall be required to procure sufficient resource capacity for the entire NYISO defined obligation procurement period so as to meet the state-wide IRM requirement determined from A-R1. Further, this LSE capacity obligation shall be distributed so as to meet locational ICAP requirements, considering the availability and capability of the NYS Transmission System to maintain the A-R1 reliability requirements."

This means that New York State Transmission System capability limitations shall not prevent NYISO from meeting the NYSRC resource adequacy criterion.

2.2 Application of the Criteria

NYSRC uses these criteria to establish the appropriate NYCA installed reserve requirements. According to these criteria, not more than one unplanned disconnection of firm load can occur in a ten year period. However, before a load disconnection will occur, a series of emergency operating procedures (EOP's) will be invoked. These are aimed at either reducing load or increasing capacity. Table 2-1 lists the operating procedures and their respective effect.

Table 2-1 Emergency Operating Procedures

Emergency Operating Procedures			
Step	**Procedure**	**Effect**	**MW**
1	Special Case Resources	Load Relief	1189
2	Emergency Demand Response	Load Relief	86
3	5% Manual Voltage Reduction	Load Relief	62
4	30 Minute Reserve to Zero	Allow Operating Reserve to decrease to largest unit capacity	655
5	5% Remote Voltage Reduction	Load Relief	441
6	Voluntary Industrial Curtailment	Load Relief	122
7	General Public Appeals	Load Relief	88
8	Emergency Purchases	Increase Capacity	Varies
9	10 Minute Reserve to Zero	Allow 10 Minute Reserve to decrease to Zero	1310
10	Customer Disconnection	Load Relief	As Needed

2.3 Capacity Resources to Meet Criteria

The current approved Installed Reserve Margin[3] requirement for the May 1, 2015 through April 30, 2016 Capability Year is 17.0%. This value is based upon an annual Installed Reserve Margin

[3] Capitalized terms are defined in the NYISO's Tariffs, Agreements and Procedures.

study report adopted by the NYSRC[4] completed in December, 2014. Should the reserve margin requirement remain constant over the Comprehensive Review period, the NYCA would have a minimum excess capacity of 789 MWs under base load forecast to meet the current Installed Reserve Margin requirement. Table 2-2 shows the resources necessary to meet the current reserve margin if it were to be extended to cover the five-year study period for this Comprehensive Review.

Table 2-2 Capacity Resources to Meet Current Criteria

Capacity Resources to meet current IRM @ 17.0%					
Year	**2016**	**2017**	**2018**	**2019**	**2020**
	Base Load Forecast				
NYCA Load Forecast	34,412	34,766	35,111	35,454	35,656
Resources for 17.0%	40,262	40,676	41,080	41,481	41,718
Total Resources	42,816	42,507	42,507	42,507	42,507
Excess Resources	2,554	1830	1427	1025	789
	High Load Forecast				
NYCA Load Forecast	35,160	35,691	36,202	36,697	37,057
Projected Resources for 17.0%	41,137	41,758	42,356	42,935	43,357
Total Resources	42,816	42,507	42,507	42,507	42,507
Excess Resources	1,678	748	150	-429	-850

2.4 Planning Coordinator Criterion

The NYCA criterion is the same as the NPCC criterion.

2.5 Resource Adequacy Studies Since the 2012 Review

The Comprehensive System Planning Process[5] (CSPP) is the NYISO's biennial ten-year planning process 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. In addition, the CSPP provides for cost allocation and cost recovery in certain circumstances for regulated reliability and economic transmission projects, as well as the coordination of interregional planning activities.

The RPP consist of two studies:

1) The Reliability Needs Assessment (RNA): The NYISO performs a biennial study in which it 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

[4] http://www.nysrc.org/NYSRC_NYCA_ICR_Reports.asp
[5] See Attachment Y of the NYISO Open Access Tariff (OATT)

NYISO identifies Reliability Needs, if any, in compliance with applicable Reliability Criteria. The RNA report is reviewed by NYISO stakeholders and approved by the Board of Directors.

2) The Comprehensive Reliability Plan (CRP): After the RNA is complete, the NYISO requests the submission of market-based solutions to satisfy the Reliability Need. The NYISO also identifies a Responsible TO and requests that the Responsible TO submit a regulated backstop solution, and provides that any interested entities may submit alternative regulated solutions to address the identified Reliability Needs. Prior to providing its response to the RNA, each Responsible TO will present any updates in its LTP that impact a Reliability Need identified in the RNA. If major system changes occur after the lock down date of the RNA base case, and these changes meet the base case inclusion rules, the NYISO next updates the CRP base case and determines whether the Reliability Needs identified in the RNA persist. The NYISO analyzes the viability and sufficiency of the proposed solutions to satisfy the identified Reliability Needs and evaluates and selects the more efficient or cost-effective transmission solution from among proposed transmission solutions to the identified Reliability Need. In the event that market-based solutions do not materialize to meet a Reliability Need in a timely manner, the NYISO triggers regulated solution(s) to satisfy the need. The NYISO develops the CRP for the ten year Study Period that sets forth its findings regarding the proposed solutions. The CRP is reviewed by NYISO stakeholders and approved by the Board of Directors.

2.5.1 Summary of 2014 RNA (September 2014)

Under base case assumptions, the 2014 RNA identified transmission system security violations beginning in 2015 and resource adequacy violations beginning in 2019 and increasing through 2024. For transmission security, there were four primary regions with Reliability Needs identified: Rochester, Western & Central New York, Capital Region, and the Lower Hudson Valley and New York City. These Reliability Needs were generally driven by then-recent and proposed generator deactivations, combined with load growth. The New York transmission owners developed plans through their respective local transmission planning processes to construct transmission projects to meet not only the needs identified in the prior Reliability Planning Process, but also any additional needs occurring since then. Those transmission projects were included in the 2014 RNA base case. The NYISO identified the Reliability Needs in the 2014 RNA even with the inclusion of those transmission projects in the base case, or determined that the needs existed until the in-service date of certain projects.

In addition, the 2014 RNA analyzed risks to the Bulk Power Transmission Facilities under certain sensitivities and scenarios to assist developers and stakeholders to propose market-based and regulated reliability solutions as well as to inform policy makers in formulating state policy. The 2014 RNA analysis included a sensitivity that included completion of the Dunkirk facility fuel conversion project, and scenarios to address recent experiences in the NYISO operations, which revealed potential future reliability risks caused particularly by generation retirements, fuel unavailability, or other factors that could limit energy production during the extreme winter weather. The findings under the sensitivity and scenario conditions are:

- *Dunkirk Fuel Conversion Project*: The 2014 RNA concluded that the availability of Dunkirk after the fuel conversion project in 2016 would resolve thermal transmission security violations in the Buffalo and Binghamton areas, but would not resolve the resource adequacy needs identified in 2019 and thereafter.

- *High (econometric) Load Forecast*: The 2014 RNA concluded that resource adequacy violations would occur as soon as 2017.

- *Indian Point Energy Center Plant Retirement*: The 2014 RNA concluded that reliability violations would occur in 2016 if the Indian Point Plant retired at the latter of the two units' current license expiration dates in December 2015.

- *Zonal Capacity at Risk*: The 2014 RNA concluded that for year 2015, removal of up to 2,500 MW in Zones A through F, 650 MW in Zones G through I, 650 MW in Zone J, or 550 MW in Zone K would result in a NYCA resource adequacy violation.

- *Transmission Security under 90/10 Forecasted Load*: The 2014 RNA concluded that the 90/10 forecast for the statewide coincident summer peak was on average approximately 2,400 MW higher than the baseline 50/50 forecast. This higher load would have resulted in the earlier occurrence of the reliability needs identified in the base case as well as the occurrence of new violations in the same four primary regions. In addition, based on the assumptions applied in this analysis, beginning in 2017 there would be insufficient resources to meet the minimum 10-minute operating reserve requirement of 1,310 MW. Starting in 2020, there would be insufficient resources to meet the modeled 90/10 peak load under pre-contingency conditions.

- *Stressed Winter Scenario*: The winter of 2013-2014 experienced five major cold snaps, including three polar vortex events that extended across much of the country. The NYISO set a new winter peak load of 25,738 MW, while neighboring ISOs and utilities concurrently set record winter peaks during the month of January. Compounding the impact from high load conditions, unexpectedly high generation derates and gas pipeline constraints occurred simultaneously due to the extreme winter weather. In the extreme case in which the NYISO assumes that NYCA is unable to receive any emergency assistance from neighboring areas, it would take a loss of capacity in excess of 7,250 MW due to energy production constraints under extreme winter conditions to cause a resource adequacy violation in 2015.

In addition to the 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 discussed pending changes in environmental regulations that affect long term power system planning and highlighted the impacts of various environmental drivers on resource availability.

2.5.2 Summary of 2014 CRP (July 2015)

The 2014 Comprehensive Reliability Plan (CRP) completed the 2014 Reliability Planning Process (RPP). The NYISO initiated the CRP after the NYISO Board approved the 2014 Reliability Needs Assessment (RNA) in September 2014. The 2014 RNA report identified resource adequacy needs in Southeast New York (SENY) beginning in 2019 and bulk transmission security needs in four regions starting in 2015. Subsequent to the RNA approval and prior to the start of the CRP, the New York Transmission Owners (TOs) updated their local transmission owner plans (LTPs), which included many components such as facilities, demand response programs, and operating procedures. Also, certain generation owners provided status changes that included generators returning to service, withdrawal of a notice of intent to mothball, and a restoration to full capacity operation. These changes include approximately 1,000 MW of resources returning at critical locations in SENY in response to new and existing market signals, and additional capacities located outside of SENY. The NYISO incorporated these updates into the CRP base case.

The 2014 CRP determined that the New York bulk power system will meet all applicable reliability criteria over the 2015 through 2024 study period, and confirmed that the Reliability Needs initially identified in the 2014 RNA were resolved. The NYISO concluded that there were sufficient resources such that the New York Control Area (NYCA) will be in compliance with the resource adequacy criterion for the ten-year study period. With the inclusion of the TOs' local transmission plan updates and the returning generation capacities, the previously-identified transmission security violations will be resolved from 2018 through 2024. Between 2015 through 2017, pending completion of their local transmission upgrades, certain TOs plan to utilize local operating procedures, up to an including load shedding, if necessary to resolve the identified transmission security violations.

The CRP findings are summarized below:

- **Finding One – Resource Adequacy**

There are sufficient resources in the CRP base case to meet the resource adequacy criterion for the entire ten year study period. Absent new resources, the capacity margins diminish as the load grows over the study period such that there is a very small capacity margin in 2024, the tenth year of the Study Period. However, the Reliability Needs will be revisited in the next Reliability Planning Process beginning in January 2016.

- **Finding Two – Transmission Security and Adequacy**

When the LTP and generation updates are considered, the New York bulk power system meets applicable reliability criteria throughout the study period, but operating procedures will be necessary to resolve potential overloads for years 2015 through 2017. In the Rochester and Syracuse areas, the violations will be resolved with permanent solutions identified in the most recent TO local transmission plans scheduled to be completed by summer 2017 in Rochester and the end of 2017 in the Syracuse area. In the interim, local operating procedures (up to and including load shedding) will be implemented, if required, to prevent overloads.

- **Finding Three – Plan Risk Factors**

In addition to base case assumption uncertainties identified in the 2014 RNA, there are other risk factors that could adversely affect the implementation of the plan and hence system reliability over the ten-year planning horizon. If any of these risks occur, the NYISO will evaluate the impact, considering all other appropriate system changes, to determine whether a Gap Solution is needed to address an imminent threat to reliability if it occurs before the next Reliability Planning Process can address it. These factors, which require ongoing review and assessment, include:

1. <u>Completion of Transmission Owner Local Transmission Plans:</u> The TOs' local transmission plans are a critical cornerstone of the overall CRP. Delays in the siting of the LTP facilities, such as those experienced by the Rochester Gas and Electric (RG&E) Rochester Area Reliability Project (RARP), which was included in the 2012 CRP, introduce uncertainty to the Reliability Planning Process and expose the bulk power system to unnecessary risk, including but not limited to load shedding.

2. <u>Change to System Performance</u>: The aging generation infrastructure may lead to more frequent and longer outages as well as increasing costs, which may drive more aging generation into retirement.

3. <u>Change to System Load Level</u>: The high load, or 90/10, forecast for the statewide coincident summer peak is on average approximately 2,400 MW

higher than the baseline 50/50 forecast modeled in the base case. A higher-than-forecasted load level could expose the system to potential reliability issues, including greater levels of load shedding in the interim operating procedures in some localized areas of the state.

4. Change to System Resources: Substantial uncertainties exist in the next ten years that will impact the system resources. These uncertainties include, but are not limited to:

    a. If expected capacity resources do not materialize, additional transmission security violations may arise as early as year 2016 in western NY, and NYCA resource adequacy violations may occur in later years. The 2014 CRP base case includes approximately 2,000 MW of additional resources, of which 950 MW of expected capacity resources are not in-service yet.

    b. If additional generating units become unavailable or retired beyond those already contemplated in the 2014 RNA, the reliability of the NYCA bulk power system could be adversely affected. The NYISO recognizes that there are numerous risk factors related to the continued financial viability and operation of generating units. Depending on the units affected, the NYISO may need to take swift actions to maintain reliability. The sensitivity and scenarios performed as part of the RNA and CRP demonstrated that retirements of generators in particular areas of the state, including Western & Central New York, the Capital Region, and Southeast New York, could accelerate resource adequacy needs, transmission security violations, and reduce transmission transfer capabilities.

    c. The R.E. Ginna Nuclear Power plant may retire within the ten year study period. On February 13, 2015, RG&E filed at NYPSC an executed RSSA that it enters into with Ginna Nuclear Power Plant, LLC (GNPP), and GNPP filed the agreement with FERC. The agreement would provide reliability support services from the plant with a term from April 1, 2015 to September 30, 2018, subject to earlier termination as well as possible extension into 2020. The CRP assumes Ginna is in-service for the entire study period. A change in status of the plant could impact transmission security and statewide resource adequacy. The uncertainty associated with Ginna highlights the importance of timely completion of a transmission solution in the Rochester area.

    d. Capacity resources could decide to offer into other markets and, therefore, not be available to the NYCA. Accordingly, the NYISO will continue to monitor imports, exports, generation and other infrastructure.

5. Natural Gas Coordination: While there are efforts underway to enhance planning and communication between the electric and gas sectors, New York's reliance on natural gas as the primary fuel for electric generation justifies continued vigilance about the status of the natural gas system. Presently ongoing studies and efforts focus on: (i) improving communication and coordination between the sectors; (ii) addressing market structure enhancements, such as the closing time of the natural gas markets; (iii) providing for back-up fuel (primarily distillate oil) assurance to generation; and (iv) addressing the electric system reliability impact of the sudden catastrophic loss of gas.

6. Federal and State Environmental Regulations: Building on the 2014 RNA, which qualitatively reviewed the impacts of federal and state environmental regulations upon operation of the Bulk Power Transmission Facilities, the 2014 CRP highlights the potential risks to system reliability posed by implementation of environmental regulations. The regulatory programs with the largest reliability risk potential are: (i) facility specific operational limitations; (ii) the Cross State Air Pollution Rule (CSAPR) cap and trade program for NOx and SO2; (iii) the Mercury and Air Toxics Standards (MATS) for hazardous air pollutants from new and existing coal and oil-fired units; (iv) Clean Power Plan, which is the proposed USEPA greenhouse gas standards for existing sources; and (v) the revised ozone National Ambient Air Quality Standard (NAAQS).

3. Resource Adequacy Assessment

3.1 Base Load Forecast Results

Assessment results for the Base Load forecast are summarized in Table 3-1. No LOLE violations occur during the study period. Assuming the current IRM value is maintained for the Study Period, Table 3-1 also summarizes the amount of excess capacity resources during the Study Period.

Table 3-1 Base Load Forecast Results

Base Load Forecast LOLE Results					
Year	**2016**	**2017**	**2018**	**2019**	**2020**
Base Load Forecast	34,412	34,766	35,111	35,454	35,656
Resources for 17%	40,262	40,676	41,080	41,481	41,718
Projected Resources	42,816	42,507	42,507	42,507	42,507
Delta	2,554	1830	1427	1025	789
LOLE Results	0.02	0.03	0.04	0.05	0.05

3.2 High Load Forecast Results

The high peak load forecast excludes the projected energy efficiency reductions included in the Base Case. Assessment results for the High Load forecast are summarized in Table 3-2. An LOLE violation would occur in 2020.

Table 3-2 High Load Forecast Results

High Load Forecast LOLE Results					
Year	**2016**	**2017**	**2018**	**2019**	**2020**
High Load Forecast	35,160	35,691	36,202	36,697	37,057
Resources for 17%	41,137	41,758	42,356	42,935	43,357
Projected Resources	42,816	42,507	42,507	42,507	42,507
Delta	1,678	748	150	-429	-850
LOLE Results	0.03	0.06	0.08	0.10	0.14

3.3 Impact of Load and Resource Uncertainties

Some uncertainty exists relative to forecasting NYCA loads for any given year. This uncertainty is incorporated in the base case model by using a load forecast probability distribution that is sensitive to different weather and economic conditions. See Appendix A-1.2. Only existing resources and those that have met certain inclusion rules in the NYISO's procedures are modeled. Existing resources are those listed in the 2014 Load and Capacity Data Report.[6] Table 3-3 lists generating units that met criteria for inclusion in the study period.

Table 3-3 Unit Additions

Generation Addition			
Unit	**MW**	**Zone**	**Status**
Selkirk	347.7	F	Notice of Intent to Mothball Withdrawn
Dunkirk	435.0	A	Coal to gas conversion planned
Binghamton BOP	41.3	C	Returned to Service
Danskammer	493.6	G	Returned to Service
Astoria 20	177	J	Returned to Service
Ravenswood 3-3	31.7	J	Returned to Service
Ravenswood 3-4	-33.1	J	Notice of Intent to Mothball
Bowline 2	557.4	G	Intent to return to full capacity (additional 374.4 MW)
Con Ed	125.0	J	Case 12-E0503, NYPSC order effective Nov 4, 2013[7]
Total Incremental	**1995.6**		

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

[7] Total expected load reduction in the PSC Order includes another 60 MW of NYSERDA on-going efforts, which is included separately in the load forecast used in the 2014 RNA and CRP.

4. Resource Capacity Mix

4.1 Gas Infrastructure Adequacy Assessment

As the plentiful low cost gas produced in the Marcellus Shale makes its way into New York, the amount of electrical demand supplied and energy produced by this gas have steadily increased. The benefits of this shift in the relative costs of fossil fuels include reduced emissions, improved generation efficiency, and lower electricity prices. These benefits, however, are accompanied by a reduction in overall fuel diversity in NYCA. This reduction in fuel diversity has led to the Eastern Interconnection Planning Collaborative (EIPC) gas and electric infrastructure study and FERC proceedings addressing gas and electric system communications, and market coordination, all of which are intended to improve the knowledge base for electric and gas system planners, operators, and policy makers.

The NYISO has recently completed a study that examined the ability of the regional natural gas infrastructure to meet the reliability needs of New York's electric system. Specifically the study provided a detailed review of New York gas markets and infrastructure, assessed historic pipeline congestion patterns, provided an infrastructure and supply adequacy forecast and examined postulated contingency events. Importantly, the study concluded there will be no unserved gas demand for generation on the interstate gas pipeline systems throughout the next five years, even with the retirement of Indian Point and related replacement of that generation with 2,000 MW of new capacity in the Lower Hudson Valley.

The study did not examine the impact of intra-state pipeline deliverability constraints on the LDC systems. The study did document increasing congestion on key pipelines in New York resulting from increased gas demand in New England and to a lesser degree by in- state demand increases for generation. Gas fired generators located on constrained pipeline segments may continue to experience gas supply curtailments over the study horizon. Gas pipeline expansions under construction and planned will materially increase delivery capability and result in reduced delivery basis and future interruptions. The market for gas supply forward contracts has already made significant adjustment to recognize the future completion of these projects. The price difference between Henry Hub and the NYC represented by the Transco NY 6 delivery point has disappeared except for a small number of incidences in the winter months. Moreover, New York is fortunate to have dual fuel capability installed at the majority of its gas fired generators.

The NYISO conducted surveys in October 2012 and October 2013 to verify dual fuel capability. Based on the October 2013 survey results, it was determined that of 18,011 MW (Summer DMNC) dual fuel generators reported in the 2013 Gold Book, 16,983 MW have permits that allow them to operate on oil. In addition, there were 2,505 MW (Summer DMNC) oil-only generators reported in the 2013 Gold Book; based on the October 2013 Survey results, this has increased to 2,579 MW (Summer DMNC). Thus, the summer capability of oil and dual fuel units with oil permits totals 19,562 MW. These oil and dual fuel facilities represent a strong fleet of resources that can respond to delivery disruptions on the gas pipeline system during both summer and winter seasons.

4.2 Loss of Gas Supply Assessment

Loss of Gas Supply Assessment was conducted as part of the NYISO 2013 Area Transmission Review (ATR). The findings of the assessment are summarized below.

Natural gas-fired generation in NYCA is supplied by various networks of major gas pipelines, as described in Appendix O of the 2013 ATR. NYCA generation capacity has a balance of fuel mix which provides operational flexibility and reliability. Several generation plants have dual fuel capability. Based on the NYISO 2013 Gold Book, 8% of the generating capacity is fueled by natural gas only, 47% 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 2018 50/50 forecast of the coincident peak load. The power flow base case was developed by assuming all gas-only units and dual-fuel units that do not have a current license to operate with the alternative fuel are not available due to a gas supply shortage. The total reduction in generating capacity was 4,251 MW; however, only 2,777 MW had to be redispatched due to the modeling assumptions in the base case. N-1 and N-1-1 thermal and voltage analysis was performed using the TARA program monitoring bulk system voltages and all 115 kV and above elements for post contingency LTE thermal ratings.

No thermal or voltage violations are observed in addition to those already identified for the summer peak conditions for this extreme system condition. The only stability issue noted for this gas shortage scenario was an undamped response to a single-line to ground stuck breaker fault at Marcy on the Marcy – Volney 345kV line. Possible mitigation would be to balance the VAr flow from each plant at the Oswego complex or redispatching the Oswego complex.

The capacity of 2014-2015 winter is summarized in Table 6-1 below. In the event that NYCA loses gas-only units, the remaining capacity is sufficient to supply the load. However, in the extreme case that NYCA loses gas-only units, and simultaneously the oil inventory of all dual-fuel units has been depleted, a total capacity of 16,879 MW would be unavailable. As the consequence of such an extreme event, the remaining generation would not be sufficient to supply NYCA load.

4.3 Ongoing Efforts

The NYISO has been working with stakeholders and other industry groups to identify and address fuel adequacy concerns. Most notably, the Electric Gas Coordination Working Group (EGCWG) and EIPC are actively studying related issues. The efforts are summarized in this section.

At EGCWG, the efforts are focusing on gas-electric coordination issues within NYCA. The NYISO retained Levitan & Associates (LAI) to prepare the following reports:

- “Fuel Assurance Operating and Capital Costs for Generation in NYCA” (Task 1)
- The “NYCA Pipeline Congestion and Infrastructure Adequacy Assessment” (Task 2)

The final study reports have been completed and are posted on the NYISO website.

At EIPC, six Participating Planning Authorities (PPAs) were actively involved in the Gas-Electric System Interface Study, which included ISO-NE, NYISO, PJM, IESO, TVA, and MISO (includes the Entergy system). The efforts focused on gas-electric coordination issues in the region across the six PAs. The study had four targets:

1. Develop a baseline assessment that includes description of the natural gas-electric system interface(s) and how they impact each other.

2. Evaluate the capability of the natural gas system(s) to supply the individual and aggregate fuel requirement from the electric power sector over a five and ten year study horizon.

3. Identify contingencies on the natural gas system that could adversely affect electric system reliability and vice versa.

4. Review operational and planning issues and any changes in planning analysis and operations that may be impacted by the availability or non-availability of dual fuel capability at generating units.

All four study targets are complete and the final report was delivered to the Department of Energy (DOE) in July 2015.

4.4 Environmental Impacts

The 2014 RNA identified new environmental regulatory programs that could impact the operation of the Bulk Power Transmission Facilities. These state and federal regulatory initiatives cumulatively will require considerable investment by the owners of New York’s existing thermal power plants in order to comply. The following programs were reviewed in the 2014 RNA:

a) *NOx RACT*: Reasonably Available Control Technology (Effective July 2014);

b) *BART*: Best Available Retrofit Technology for regional haze (Effective January 2014);

c) *MATS*: Mercury and Air Toxics Standard for hazardous air pollutants (Effective April 2015, 2016, 2017);

d) *MRP*: Mercury Reduction Program for Coal-Fired Electric Utility Steam Generating Units – Phase II reduces Mercury emissions from coal fired power plants in New York (Effective January 2015);

e) *CSAPR*: Cross State Air Pollution Rule for the reduction of SO2 and NOx emissions in 28 Eastern States. The U.S. Supreme Court has upheld the CSAPR as promulgated by USEPA. The Supreme Court remanded the rule to the District Circuit Court of Appeals for further proceedings. USEPA has implemented Phase I effective January 2015;

f) *RGGI*: Regional Greenhouse Gas Initiative Phase II cap reductions started January 2014. The Program design will be reviewed by the RGGI states in 2016;

g) *CO2 Emission Standards*: NSPS effective June 2014, Existing Source Performance Standards become effective in 2022;

h) *RICE*: NSPS and NESHAP – New Source Performance Standards and Maximum Achievable Control Technology for Reciprocating Internal Combustion Engines (Effective July 2016), however, the exemption for use of non-compliant engines in energy markets has been remanded back to USEPA; and

i) *BTA*: Best Technology Available for cooling water intake structures (Effective upon Permit Renewal).

Table 4-1 summarizes the impact of the new environmental regulations. Approximately 33,800 MW of New York nameplate generating capacity may be affected to some extent by these regulations. Compliance plans are in place for NOx RACT, BART, and RGGI. Reviewing publicly available information from USEPA and USEIA, most generators affected by MATS and MRP have demonstrated operations with emission levels consistent with the new regulations. BTA determinations are the result of extensive studies and negotiations. In many cases, BTA determinations have not resulted in decisions requiring conversion to closed cycle cooling systems, although cooling water intake system improvements may be required. These determinations are made on a plant specific schedule. The Indian Point Nuclear Plant BTA determination is the subject of an extensive hearing and Administrative Law Judge determination process that will continue through 2017.

Table 4-1 Impact of Environmental Regulation

Program	Status	Compliance Deadline	Approximate Nameplate Capacity
NOx RACT	In Effect	July 2014	27,100 MW (221 Units)
BART	In Effect	January 2014	8,400 MW (15 Units)
MATS	In Effect	April (2015/2016/2017)	10,300 MW (23 Units)
MRP	In Effect	January 2015	1,500 MW (6 Units)
CSAPR	In Effect	January 2015	26,300 MW (160 Units)
RGGI	In Effect	In Effect	25,800 MW (154 Units)
BTA	In Effect	Upon Permit Renewal	16,400 MW (34 Units)

Table 4-2 Summary of Significant Operational Impacts Due to Environmental Regulations

Program	Status	Significant Operational Impacts	Future Operations Potentially Impacted	Capacity (MW)
NOx RACT	July 2014	Three NYC NOx bubbles	Arthur Kill, Astoria Gas Turbines, Astoria, Narrows, Gowanus, Ravenswood	5,300
BART	In Effect	Emission Caps	Oswego 5 & 6: limited number of days for operations at peak	1,600
MATS/MRP	April (2015/2016/2017)	Oil use limits	Astoria, Ravenswood, Northport, Barrett, Port Jefferson, Bowline, Roseton, Oswego	8,800
CSAPR	Uncertain	Cost increases	Uncertain	
RGGI	In Effect	Cost increase up to $10/MWH	All Coal Units	1,450
BTA	Permit Renewal	Potential retirements or capacity factor limits	Indian Point, Bowline, Huntley	3,200

4.5 Mechanism to Mitigate Risk

The 2014 Comprehensive Reliability Plan contained the following recommended actions:

- *Monitor and Track Potential New Developments:* The energy industry is in transition. Economic conditions, governmental programs and environmental regulations are changing quickly, resulting in financial stresses that may lead to the loss of resources or, alternatively, could positively affect system conditions. New market-based generation projects under study in the NYISO's interconnection process could increase the narrow long-term reliability margin if such capacity comes into service during the study period. The NYISO will monitor and track these issues and consider their potential impacts on future system reliability. If a threat to reliability appears to be imminent, the NYISO can investigate the need to trigger a Gap Solution if it occurs before the next biennial Reliability Planning Process has a chance to address the need, in accordance with established procedures, as set forth in Attachment Y of the NYISO OATT.

- *Monitor and Track Transmission Owner Plans:* The New York TOs need to complete the projects identified in their LTPs on schedule and as planned. Local transmission projects that are identified to maintain reliability should be sited and constructed without further delay to minimize reliance on the interim operating procedures in the Rochester and Syracuse areas. The NYISO will continue to monitor the completion of the identified projects and, more generally, the statuses of those plans associated with the reliability needs initially identified in the RNA and assess the state of the system to determine if violations would occur.

- *Continue Coordination with the New York State Public Service Commission (PSC):* System planning activities, such as those encompassed by the New York Energy Highway Blueprint, will need to be considered within the NYISO Comprehensive System Planning Process. In addition, the State of New York is presently considering expanding and extending a variety of clean energy programs that may increase deployment of renewable generation and distributed energy resources. These initiatives could positively affect reliability, but are not explicitly recognized in the 2014 CRP analyses. The NYISO will continue to monitor and participate in other planning activities including, but not limited to, NYPSC proceedings considering Reforming the Energy Vision (REV), Alternating Current Transmission Upgrades, Clean Energy Fund, Indian Point Reliability Contingency Plan, and individual proceedings on generation retirement and repowering.

- *Monitor Changes that could Impact Risk Factors*: The NYISO planning processes include steps that actively monitor and address the potential impacts of additional system changes and known risk factors. New market-based generation projects under study in the NYISO's interconnection process could increase the long-term capacity margin if such projects come into service during the Study Period.

Appendices

A. Resource Reliability Model

A-1 Load Model

A-1.1 Description of Load Model

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 this period. 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 consumption is influenced by weather conditions over an entire year, which is much less variable than peak-producing conditions.

The electricity forecast is based on projections of New York's economy performed by Moody's Analytics in January 2014. The forecast includes detailed projections of employment, output, income and other factors for twenty three regions in New York State.

Econometric forecasts were developed for zonal energy using monthly data from 2000 through 2013. For each zone, the NYISO estimated an ensemble of econometric models using population, households, economic output, employment, cooling degree days and heating degree days. Each member of the ensemble was evaluated and compared to historic data. 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 Con Edison and LIPA, which were used in combination with the forecasts the NYISO developed for Zones A through G.

In June 2008, the New York Public Service Commission issued its Order establishing the Energy Efficiency Portfolio Standard. This proceeding set a statewide goal of a cumulative energy reduction of about 26,900 GWh. The NYISO estimates the peak demand impacts to be about a 5,500 MW reduction. Achieving this goal is expected to come from contributions from a number of state agencies, power authorities and utilities, as well as from federal codes and building standards. The EEPS energy efficiency programs have been modified and continued in the New York State Clean Power Plan. The NYISO develops a projection of the impact on annual energy and seasonal peaks due to state energy policy goals, which include energy efficiency and behind the meter solar PV.

The summer and 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 Edison 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 2000 through 2013. The 2014 summer peak forecast was matched to coincide with the 2014 ICAP forecast.

In addition to the baseline forecast, the NYISO has high and low forecasts for each zone, representing an 80% confidence interval, using the baseline forecast as the midpoint, with the high and low forecasts based on extreme weather assumptions.

A-1.2 Load Forecast Uncertainty

Some uncertainty exists relative to forecasting NYCA loads for any given year. This uncertainty is incorporated in the base case model by using a load forecast probability distribution that is sensitive to different weather and economic conditions. Recognizing the unique Load Forecast Uncertainty (LFU) of individual NYCA areas, the LFU model is subdivided into four areas: Zones H and I, Zone J (NYC), Zone K (LI), and Zones A-G (the rest of New York State).

The process followed in this and in previous years is for the Transmission Owners in Zones H, I, J, and K to provide Load Forecast Uncertainty (LFU) models to the Installed Capacity Subcommittee (ICS) for the TOs' respective Transmission Districts. The NYISO develops an LFU model for the rest of the state. As a matter of practice, the NYISO develops its own estimates of LFU for Zones H, I, J, and K, and compares its results to those of the Transmission Owners.

A-1.3 Demand Response

Special Case Resources (SCRs) constitute electric loads functioning as a Capacity Resource by reducing consumption when called upon. SCRs are deployed for forecast or actual reserve shortages or other emergency conditions. The NYISO's Emergency Demand Response Program Resources are voluntary emergency resources deployed for forecast or actual reserve shortages or other emergency conditions. EDRP resources are modeled in the NYISO's probabilistic resource adequacy planning studies. This assessment held projected levels of Special Case Resources constant from 2016 through 2020. The inclusion of Special Case Resources in this manner is an appropriate assumption for planning purposes as these resources can be added or removed with short lead times and are driven by market conditions.

A-2 Supply Side Resources

A-2.1 Resource Ratings

The capacity ratings for thermal units are based on their Dependable Maximum Net Capability (DMNC) test results. The source of DMNC ratings are seasonal tests required by procedures detailed in the NYISO Installed Capacity Manual. Wind and solar units are rated at their nameplate, or full rated value, in the model.

The NYCA Load and Capacity Report, issued by the NYISO, is the source of those generating units and their ratings included on the capacity model. The procedure for verifying unit ratings through DMNC testing is detailed in Section 4.2 of the "NYISO Installed Capacity Manual."

Table A-1 Capacity by Type and GWh

	Capacity (MW)	Capacity (%)	Generation (% GWH)
Gas	3,226	9	6
Oil	2,564	7	0
Gas & Oil	17,627	46	35
Coal	1,495	4	3
Nuclear	5,418	14	32
Hydro	4,272	11	18
Hydro – Pumped Storage	1,406	4	1
Wind	1,463	4	3
Solar	32	0	0
Other	476	3	2

A-2.2 Unavailability Factors

Performance data for thermal generating units in the model includes forced and partial outages, which are modeled by utilizing a multi-state outage model that is representative of the "equivalent demand forced outage rate" (EFORd) for each unit represented. Generation owners provide outage data to the NYISO using the Generating Availability Data System (GADS) data in accordance with the NYISO Installed Capacity Manual.

The multi-state model for each unit is derived from five years of historic events if available. For units with less than five years of historic events, the NYISO uses available event data collected in the years since its inception if the data appear to be reasonable. For the remaining units, the NERC class-average availability data is used for the type, size and model of each unit. The unit forced outage states for the majority of the large steam units were obtained from the five-year average NERC-GADS outage data collected by the NYISO for the years 2007 through 2011. This hourly data represents the availability of the units for all hours. From this, full and partial outage states and the frequency of occurrence were calculated for input to the GE-MARS program.

Table A-2 Five-Year Weighted EFORd Values

Unit Type	Five-Year Weighted EFORd (%)
Coal	4.3
Combined Cycle	3.7
Combustion Turbine	11.4
Gas	8.8
Jet Engine	11.2
Nuclear	2.7
Oil	7.8

Wind and solar generators are modeled as hourly load modifiers. The output of the unit varies between zero and the nameplate value based on hourly data collected near the plant sites. For wind units, production data from 2013 is used. Characteristics of this data indicate an overall 30% capacity factor with a capacity factor of approximately 14% during the summer peak hours. For solar units, the data is from 2013 hourly readings indicating a summer peak hour capacity factor of approximately 47%.

Planned and scheduled maintenance outages are also modeled. The planned outage component is obtained from the generator owners. If units do not have scheduled maintenance, a default maintenance period is modeled by using the unit's historic maintenance outages. These schedules are rounded up to the nearest week in MARS.

Operation of combustion turbine units at temperatures above DMNC test temperature results in reduction of output. These reductions in gas turbine and combined cycle capacity output are captured in the GE-MARS model using derates based on ambient temperature correction curves. Based on the review of historical data, the NYISO has concluded that the existing combined cycle temperature correction curves are still valid and appropriate. These manufacturer temperature correction curves show unit output versus ambient temperature conditions over a range starting at 60 degrees F to over 100 degrees F.

The Niagara and St. Lawrence hydroelectric projects are modeled with a probability capacity model based on historic water flows and unit performance. The run-of-river hydro facilities are simulated in GE-MARS with a 45% hydro derate for the summer peak months, representing derates in accordance with recent historic water conditions.

A-2.3 Purchase and Sale Representation

An input to the study is the amount of NYCA installed capacity that is assumed located outside NYCA. Only grandfathered capacity sales contracts are modeled in these analyses. This equates to a total of 2,170 MW of summer external capacity – 1,080 MW from PJM and 1,090 MW from Hydro Quebec.

In addition, the external capacity representation also includes Unforced Capacity Deliverability Rights (UDRs). These rights allow the owner of an incremental controllable transmission project to extract locational capacity benefit derived by the NYCA from the project. The owner of UDR facility rights designates how they will be treated by the NYISO in resource adequacy studies on an annual basis.

LIPA's 330 MW HVDC Cross Sound Cable, the 660 MW HVDC Neptune Cable, Con Ed's 315 MW Linden VFT, and the 660 HTP (Hudson Transmission Partners) cable are facilities that are represented as having UDR rights. Remaining transmission capacity beyond that identified by the owners as 'in use' for locational capacity benefit is modeled as available to support emergency assistance.

All firm net sales are modeled as listed in the 2014 Gold Book.

A-2.4 Unit Retirements

Table A-3 presents the list of retired and proposed unit retirements assumed in the study. A total of 341.3 MW are scheduled to be retired. For study purposes those units were modeled as retired.

Table A-3 Unit Retirements – Actual and Proposed

Unit	Area	Retired Units	Proposed Retirements
Ravenswood 3-4	J	33.1	Notice of Intent to Mothball
Cayuga 1	C	154.1	July 2017
Cayuga 2	C	154.1	July 2017
Total		341.3	

A-3 External Control Areas

NYCA reliability relies to an extent on emergency assistance from its interconnected control areas in NPCC and PJM, based on reserve sharing agreements with those areas, which are referred to as Outside World Areas. Load and capacity models of the Outside World Areas are therefore represented in the GE MARS analyses. The load and capacity models for New England, Ontario, PJM, and Quebec are based on data received from the Outside World Areas, as well as NPCC sources.

The primary consideration for developing the final load and capacity models for the Outside World Areas is to avoid over-dependence on the Outside World Areas for emergency capacity support. For this purpose, a rule is applied whereby either an Outside World Area's LOLE cannot be lower than 0.1 days/year LOLE, or its isolated LOLE cannot be lower than that of the NYCA. In other words, the neighboring Areas are assumed to be equally or less reliable than NYCA. Another consideration for developing models for the Outside World Areas is to recognize internal transmission constraints within the Outside World Areas that may limit emergency assistance to the NYCA. This recognition is considered implicitly for those Areas that have not supplied internal transmission constraint data.

The multiple load shape feature in GE MARS was used in this study for both the NYCA and the Outside World Area load shapes. Load shapes were prepared for years 2002, 2006, and 2007. In order to avoid over-dependence from emergency assistance, the three highest summer load peak days of the Outside World Areas are modeled to match the same load sequence as NYCA.

For this study, both New England and PJM continue to be represented as multi-area models, based on data provided by these Control Areas. In addition, the capacity of the external areas was further modified such that the LOLE value of each Area was a minimum value of 0.1 and capped at a value of 0.15 through the Study Period.

The Emergency Operating Procedures were removed from the Outside World Areas to avoid the difficulty in modeling the sequence and coordination of implementing them. This is a conservative measure because it assumes the unavailability of such procedures in modeling the combined systems.

Emergency assistance from Reliability First Corporation (RFC) was not modeled, with the exception of PJM-Mid Atlantic. Also, emergency assistance from the Maritime Provinces was not considered. These assumptions limit the emergency assistance to the NYCA from the immediate neighboring control areas. This consideration is another measure of conservatism added to the analyses.

The load forecast uncertainty models for the outside world model were supplied by the external Control Areas.

A-4 Variable and Limited Energy Resources

The assumed capacity on-peak for variable resources such as wind, solar, and run-of river hydro included in this assessment is determined using an expected capability for each resource class based upon unit historic operating data. Hourly unit output data is collected for the Run-of-River hydro resources over the summer peak hours (2 – 5 p.m.) during the June 1 through August 31 time period. Analysis of this data has resulted in a de-rate factor of 45% to account for the uncertainty in the amount of water available at peak. The hourly data for wind and solar resources shows summer peak hour capacity factors of approximately 14% and 45%, respectively. Biomass and landfill gas resources are modeled with the unit's rated capability and an associated forced outage rate.

A-5 Demand Side Resources

Special Case Resources are modeled using the most recent registration numbers and then held constant over the review period. Each resource registered is tested once per capability period to demonstrate that the resource is capable of responding to a demand call and to determine its level of load reduction attainable. For this study, SCR resources were rated by using the ACL (Average Coincident Load) method. An SCR derate factor is then applied which captures three different performance derates: 1) the translation factor between the ACL and CBL (Customer Base Load) methods; 2) the ECV (Effective Capacity Value); and 3) the fatigue factor. Currently, all three factors equal 0.95 for a net 0.855 SCR derate factor.

A-6 Modeling of All Resources

Details were covered above in Section A-2 above

A-7 Other Assumptions

A-7.1 NYCA Topology

The NYCA is divided into 11 Zones. The boundaries between Zones and between adjacent control Areas are called interface ties. These ties are used in the GE-MARS model to allow and limit the assistance among NYCA Zones and adjacent control Areas.

While the NYCA transmission system is not explicitly modeled in the GE MARS program, a transportation algorithm is utilized with limits on the interface ties between the Areas and Zones represented in the model. Interface tie groupings and dependent interface tie limits have been developed such that the transmission model closely resembles the standard eleven-Zone NYCA model. The interface tie limits employed are developed from emergency transfer limits calculated from various transfer limit studies performed at the NYISO and refined with additional analysis specifically for the GE-MARS representation.

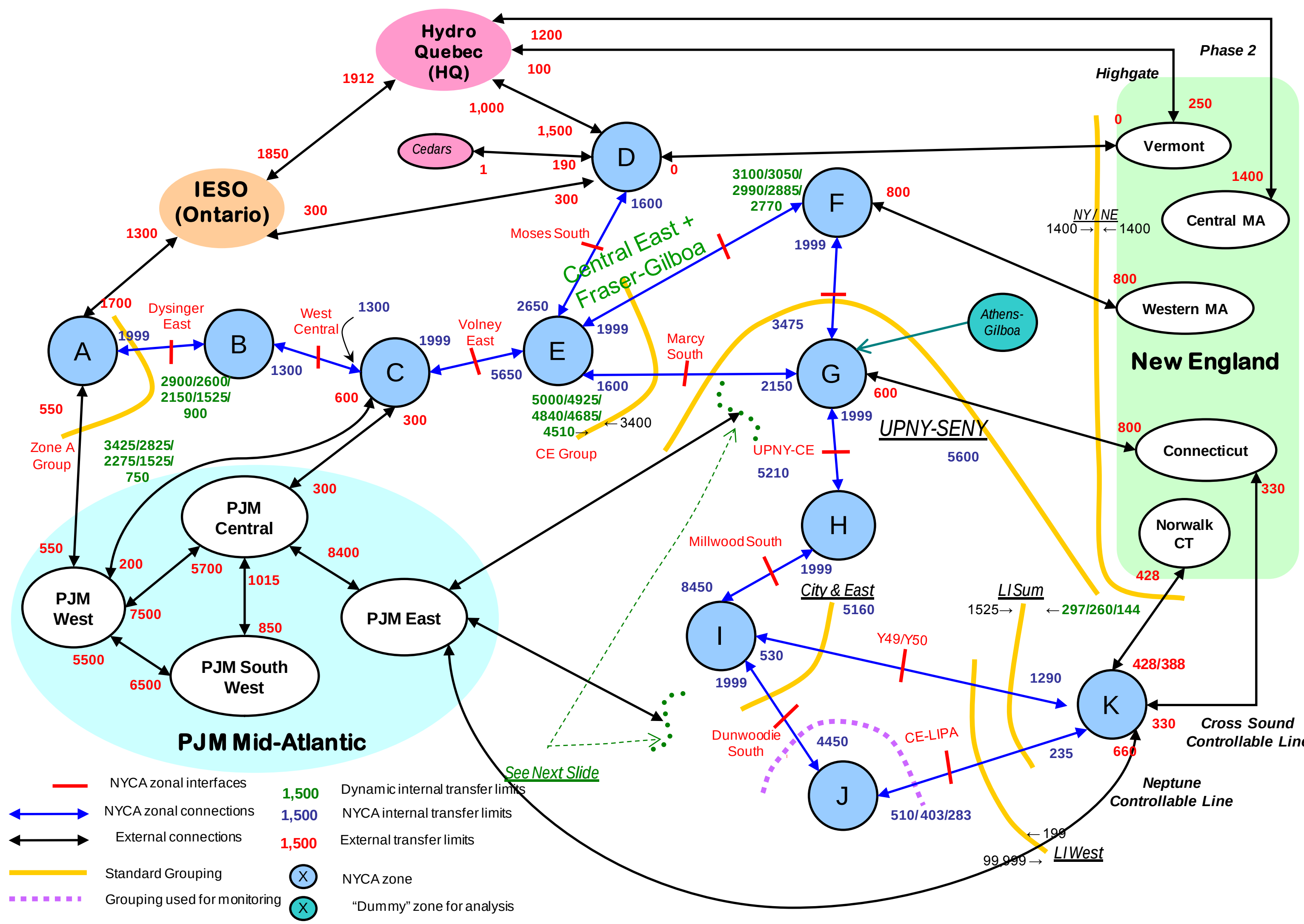
A-7.2 External Representation

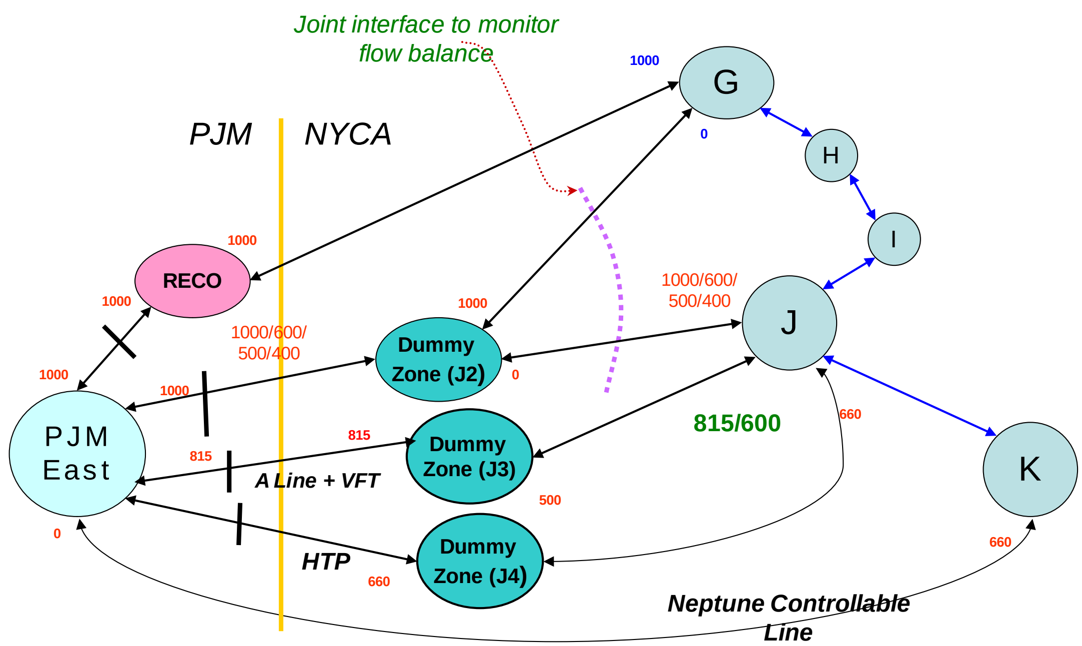
The topology used in the MARS model is represented in Figures A-1 and A-2. The internal transfer limits modeled are the summer emergency ratings derived from the 2014 RNA Power Flow cases. The external transfer limits are developed from the NPCC

CP-8 Summer Assessment MARS database with changes based upon the RNA Base Case assumptions.

A-7.3 Locational Capacity Requirements

The GE-MARS model used in NYCA resource adequacy studies provides an assessment of the adequacy of the NYCA transmission system to deliver assistance from one Zone to another for meeting load requirements. Previous studies have identified transmission constraints into certain Zones that could impact the LOLE of these Zones, as well as the state-wide LOLE. To minimize these potential LOLE impacts, these Zones require a minimum portion of their NYCA ICAP requirement, i.e., locational ICAP, which shall be electrically located within the Zone in order to maintain sufficient energy and capacity in that Zone and that NYSRC Reliability Rules are met. The minimum Locational ICAP requirements are currently applicable to three transmission-constrained Zones: New York City, Long Island, and Zones G-J. The minimum Locational ICAP requirements are normally expressed as a percentage of each Zone's annual peak load.


Hydro Quebec (HQ)
IESO (Ontario)
Cedars
Phase 2
Highgate
Vermont
Central MA
Western MA
New England
Connecticut
Norwalk CT
NY / NE
Athens-Gilboa
Central East + Fraser-Gilboa
Moses South
Dysinger East
West Central
Volney East
Marcy South
CE Group
Zone A Group
UPNY-CE
UPNY-SENY
Millwood South
City & East
LI Sum
Y49/Y50
Dunwoodie South
CE-LIPA
LI West
Cross Sound Controllable Line
Neptune Controllable Line
PJM Central
PJM West
PJM South West
PJM East
PJM Mid-Atlantic
See Next Slide
NYCA zonal interfaces
NYCA zonal connections
External connections
Standard Grouping
Grouping used for monitoring
Dynamic internal transfer limits
NYCA internal transfer limits
External transfer limits
NYCA zone
"Dummy" zone for analysis



(PJM East to RECO) + (PJM East to J2) + (PJM East to J3) + (PJM East to J4) = 3075 MW