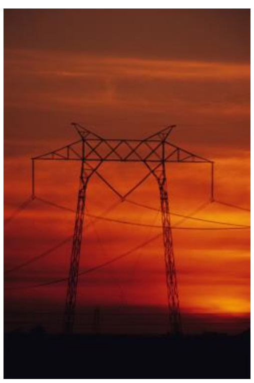
Technical Study Report

New York Control Area Installed Capacity Requirement

For the Period May 2016 to April 2017



Draft 10/23/15

December 4, 2015

New York State Reliability Council, LLC
Installed Capacity Subcommittee

About the New York State Reliability Council

The New York State Reliability Council (NYSRC) is a not-for-profit corporation responsible for promoting and preserving the reliability of the New York State power system by developing, maintaining and, from time to time, updating the reliability rules which must be complied with by the New York Independent System Operator and all entities engaging in electric power transactions on the New York State power system. One of the responsibilities of the NYSRC is the establishment of the annual statewide Installed Capacity Requirement for the New York Control Area.

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EXECUTIVE SUMMARY

A New York Control Area (NYCA) Installed Reserve Margin (IRM) Study is conducted annually by the New York State Reliability Council (NYSRC) Installed Capacity Subcommittee (ICS). ICS has the overall responsibility of managing studies for establishing NYCA IRM requirements for the following capability year, including the development and approval of all modeling and database assumptions to be used in the reliability calculation process. This year's report covers the period May 2016 through April 2017 (2016 Capability Year).

Results of the NYSRC technical study show that the required NYCA IRM for the 2016 Capability Year is 17.0% under base case conditions.

This study also determined corresponding Locational Capacity Requirements (LCRs) of 80.9% and 102.6% for New York City and Long Island, respectively. In accordance with its responsibility of setting the final LCRs, the New York Independent System Operator (NYISO) will later determine appropriate LCRs for the New York City and Long Island zones using a separate calculation process in accordance with NYISO tariff and procedures.

These study results satisfy and are consistent with NYSRC Reliability Rules, Northeast Power Coordinating Council (NPCC) reliability criteria, and North American Electric Reliability Corporation (NERC) reliability standards.

The 17.0% IRM base case value for 2016 represents a *0.3% decrease* from the 2015 base case IRM of 17.3%. Table 6-1 shows the IRM impacts of individual updated study parameters that result in this change. There are four parameter drivers that in combination *increased* the 2016 IRM from the 2015 base case. Of these, the most significant drivers are the modeling of all hours in the reliability simulation in MARS instead of only peak hours, which increased the IRM by 0.4%; and updated Ontario, New England, and Quebec interconnected area models, which increased the IRM by 0.3%.

Four other parameter drivers collectively *decreased* the IRM. Of these, the most significant drivers are an updated PJM model, which decreased the IRM by approximately 0.5%, and updated generating unit EFORds, which decreased the IRM by 0.4%.

This study also evaluated IRM impacts of several sensitivity cases. These results are summarized in Table 7-1 and in greater detail in Appendix B, Table B.1. In addition, a confidence interval analysis was conducted to demonstrate that there is a high confidence that the base case 17.0% IRM will fully meet NYSRC and NPCC resource adequacy criteria.

The base case and sensitivity case IRM results, along with other relevant factors, will be considered in a separate NYSRC Executive Committee process in which the Final NYCA IRM requirement for the 2016 Capability Year is adopted. The 2016 IRM Study also evaluated Unforced Capacity (UCAP) trends. This analysis shows that UCAP margins, having steadily decreased over the 2006-2010 period, have since stabilized. This UCAP trend is despite variations in IRM requirements and increases in low capacity factor wind generation.

1. Introduction

This report describes a technical study, conducted by the NYSRC Installed Capacity Subcommittee (ICS), for establishing the NYCA Installed Reserve Margin (IRM) for the period of May 1, 2016 through April 30, 2017 (2016 Capability Year). This study is conducted each year in compliance with Section 3.03 of the NYSRC Agreement which states that the NYSRC shall establish the annual statewide Installed Capacity Requirement (ICR) for the NYCA. The ICR relates to the IRM through the following equation:

$$\text{ICR} = \left(1 + \frac{\text{IRM Requirement (\%)}}{100}\right) * \text{Forecasted NYCA Peak Load}$$

The base case and sensitivity case study results, along with other relevant factors, will be considered by the NYSRC Executive Committee for its adoption of the Final NYCA IRM requirement for the 2016 Capability Year.

The NYISO will implement the Final NYCA IRM as determined by the NYSRC, in accordance with the NYSRC Reliability Rules[1], the NYISO Market Services Tariff, and the NYISO Installed Capacity (ICAP) Manual.[2] The NYISO translates the required IRM to an Unforced Capacity (UCAP) basis. These values are also used in a Spot Market Auction based on FERC-approved Demand Curves. The schedule for conducting the 2016 IRM Study was based on meeting the NYISO's timetable for these actions.

The study criteria, procedures, and types of assumptions used for the study for establishing the NYCA IRM for the 2016 Capability Year (2016 IRM Study) are set forth in NYSRC Policy 5-9[3], *Procedure for Establishing New York Control Area Installed Capacity Requirement*. The primary reliability criterion used in the IRM study requires a Loss of Load Expectation (LOLE) of no greater than 0.1 days/year for the NYCA. This NYSRC resource adequacy criterion is consistent with Northeast Power Coordinating Council (NPCC) reliability criteria and National Electric Reliability Corporation (NERC) reliability standards. IRM study procedures include the use of two study methodologies: the *Unified Methodology* and the *IRM Anchoring Methodology.* The above reliability criterion and methodologies are described in Policy 5-9 and discussed in more detail later in the report.

In addition to calculating the NYCA IRM requirement, the above methodologies identify corresponding LCRs for New York City (NYC) and Long Island (LI). In its role of setting the final LCRs, the NYISO will utilize the IRM value approved by the NYSRC. The LCR values

[1] http://www.nysrc.org/NYSRCReliabilityRulesComplianceMonitoring.asp
[2] http://www.nyiso.com/public/markets_operations/market_data/icap/index.jsp
[3] http://www.nysrc.org/policies.asp

determined in this NYSRC study are indicative of the final LCR values that will be later calculated by the NYISO using a separate calculation process in accordance with its tariff and procedures.

The 2015 IRM Study included a major modeling change whereby all hours are considered in the IRM simulation rather that only daily peak hours as represented in previous IRM studies. This study also included major parametric changes in the PJM model which led to a significant reduction in the PJM LOLE compared to the 2015 Study. This change permits increased emergency assistance to NYCA for avoiding loss of load.

The 2015 IRM Study was managed and conducted by the NYSRC Installed Capacity Subcommittee (ICS) and supported by technical assistance from NYISO staff.

Previous IRM Study reports, from 2000 to 2015, can be found on the NYSRC website.[4] Table C-1 in Appendix C provides a record of previous NYCA base case and final IRMs for the 2000 through 2015 Capability Years. Table C-2 and Figure 8-1 show UCAP reserve margin trends over previous years. Definitions of certain terms in this report can be found in the Glossary (Appendix D).

2. NYSRC Resource Adequacy Reliability Criterion

The acceptable LOLE reliability level used for establishing NYCA IRM Requirements is dictated by the NYSRC Reliability Rule A.1, *Statewide Installed Reserve Margin Requirements,* which states:

> *The NYSRC shall establish the 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 this criterion shall be evaluated probabilistically, such that the loss of load expectation (LOLE) of disconnecting firm load due to resource deficiencies shall be, on average, no more than 0.1 day per year. This evaluation shall make due allowance for demand uncertainty, scheduled outages and deratings, forced outages and deratings, assistance over interconnections with neighboring control areas, NYS Transmission System emergency transfer capability, and capacity and/or load relief from available operating procedures.*

[4] http://www.nysrc.org/reports3.asp

This NYSRC Reliability Rule is consistent with NPCC Resource Adequacy Design Criteria in Section 3.0 of NPCC Directory 1, *Design and Operation of the Bulk Power System*.

In accordance with NYSRC Reliability Rule A.2, *Load Serving Entity (LSE) Installed Capacity Requirements*, the NYISO is required to establish LSE installed capacity requirements, including locational capacity requirements, to meet the statewide IRM Requirement established by the NYSRC for maintaining NYSRC Reliability Rule A.1 above.

3. IRM Study Procedures

The study procedures used for the 2016 IRM Study are described in detail in NYSRC Policy 5-9, *Procedure for Establishing New York Control Area Installed Capacity Requirements*. Policy 5-9 also describes the computer program used for reliability calculations and the types of input data and models used for the IRM Study.

This study utilizes a *probabilistic approach* for determining NYCA IRM requirements. This technique calculates the probabilities of generator unit outages, in conjunction with load and transmission representations, to determine the days per year of expected resource capacity shortages.

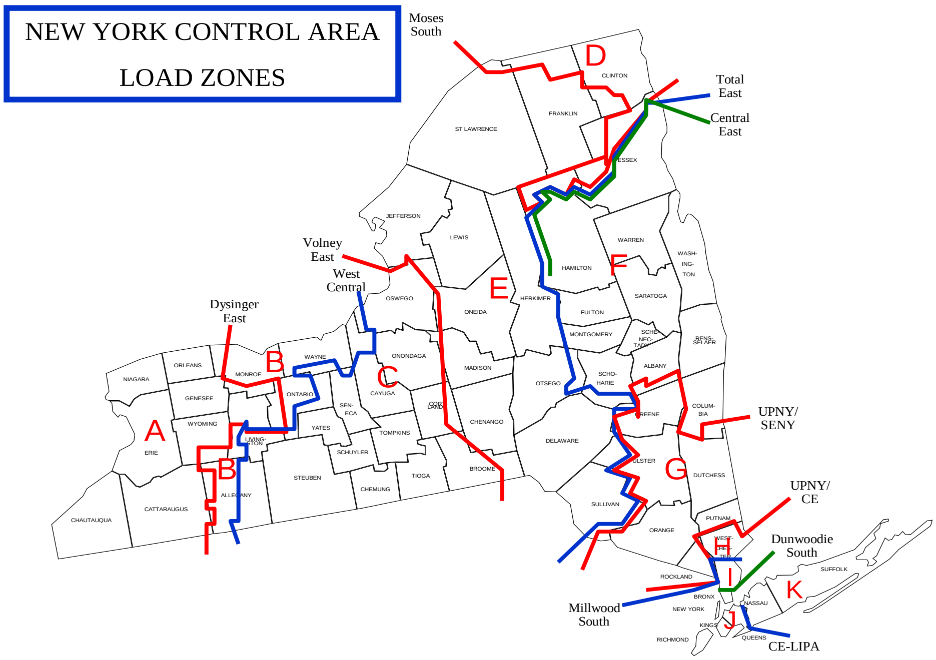
General Electric's Multi-Area Reliability Simulation (GE-MARS) is the primary computer program used for this probabilistic analysis. This program includes detailed load, generation, and transmission representation for eleven NYCA load zones — plus four external Control Areas (Outside World Areas) directly interconnected to the NYCA. Up through this year's IRM study, only weekday peak loads were represented in the reliability simulation. In this 2016 IRM Study all hours are represented. The external Control Areas are: Ontario, New England, Quebec, and the PJM Interconnection. The eleven NYCA zones are depicted in Figure 3-1.[5] GE-MARS calculates LOLE, expressed in days per year, to provide a consistent measure of system reliability. The GE-MARS program is described in detail in Appendix A.1.

Using the GE-MARS program, a procedure is utilized for establishing NYCA IRM requirements (termed the *Unified Methodology)* which establishes a graphical relationship between NYCA IRM and MLCRs, as illustrated in Figure 3-2. All points on these curves meet the NYSRC 0.1 days/year LOLE reliability criterion described above.

[5] The Federal Energy Regulatory Commission has ordered the creation of a new capacity zone (NCZ) within the NYISO's ICAP market starting in 2014. The NCZ encompasses Load Zones G, H, I, and J. The NCZ was triggered by a NYISO study that identified a deliverability constraint across the UPNY/SENY interface. The creation of the NCZ does not impact the current Unified and IRM Anchoring Methodologies and NYSRC's calculation of the NYCA IRM that is discussed in this report.

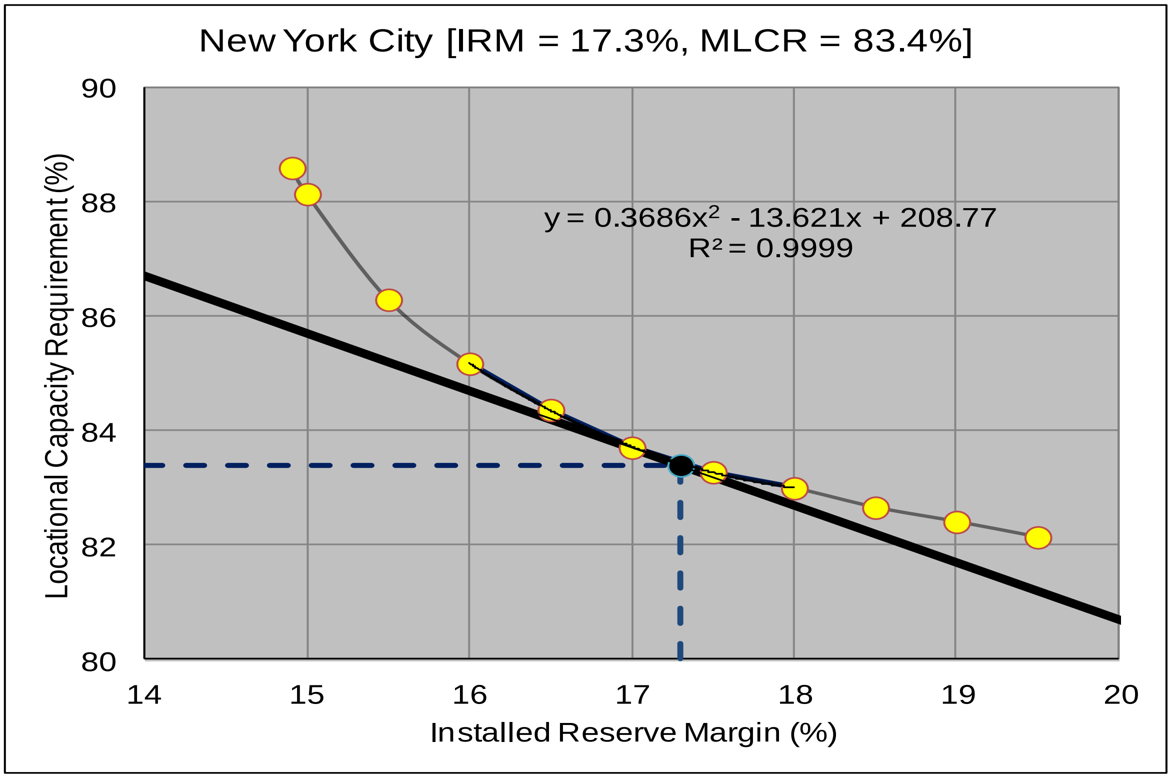
Note that the area above the curve is more reliable than criteria, and the area below the curve is less reliable. This methodology develops a pair of curves, one for NYC (Zone J) and one for LI (Zone K). Appendix A of Policy 5-9 provides a more detailed description of the Unified Methodology.

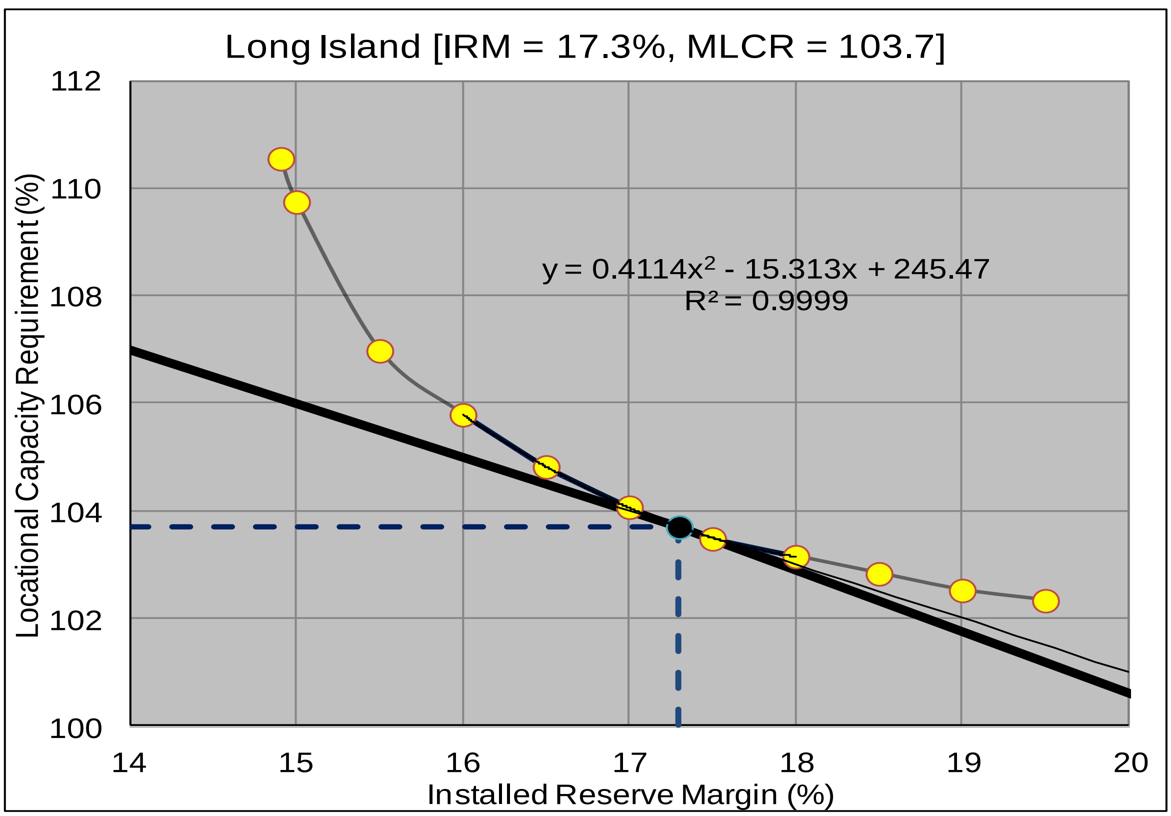
Figure 3-1 NYCA Load Zones



Base case NYCA IRM requirements and related MLCRs are established by a supplemental procedure (termed the *IRM Anchoring Methodology*) which is used to define an *inflection point* on each of these curves. These inflection points are selected by applying a tangent of 45 degrees (Tan 45) analysis at the bend (or "knee") of each curve. Mathematically, each curve is fitted using a second order polynomial regression analysis. Setting the derivative of the resulting set of equations to minus one yields the points at which the curves achieve the Tan 45 degree inflection point. Appendix B of Policy 5-9 provides a more detailed description of the methodology for computing the Tan 45 inflection point.

Figure 3-2 NYCA Locational Requirements vs. Statewide Requirements (to be replaced)





4. Study Results – Base Case

Results of the NYSRC technical study show that the required NYCA IRM is 17.0% for the 2016 Capability Year under base case conditions. As described above, Figure 3-2 depicts the relationship between NYCA IRM requirements and resource capacity in NYC and LI.

The tangent points on these curves were evaluated using the Tan 45 analysis. Accordingly, it can be concluded that maintaining a NYCA installed reserve of 17.0% for the 2016 Capability Year, together with corresponding LCRs of 80.9% and 102.6% for NYC and LI, respectively, will achieve applicable NYSRC and NPCC reliability criteria for the base case study assumptions shown in Appendix A.3.

Comparing the LCRs in this 2016 IRM study to the 2015 IRM Study results (NYC LCR= 84.7%, LI LCR=103.4%), the NYC MLCR decreased by 3.8%, while the LI MLCR decreased by 0.8%.

In accordance with NYSRC Reliability Rule A.2, *Load Serving Entity ICAP Requirements,* the NYISO is required to separately calculate and establish final LCRs. The most recent NYISO study[6] determined that for the 2015 Capability Year, the required LCRs for NYC and LI were 83.5% and 103.5%, respectively. An LCR Study for the 2016 Capability Year is scheduled to be completed by the NYISO in January 2016.

A Monte Carlo simulation error analysis shows that there is a __% probability that the above base case result is within a range of __% and __% (see Appendix A.1.1) when obtaining a standard error of __ per unit at ___ simulated years. This analysis demonstrates that there is a high level of confidence that the base case IRM value of ___% is in full compliance with NYSRC Reliability Rule A.1 and reliability criteria in NPCC Directory 1.

5. Models and Key Input Assumptions

This section describes the models and related input assumptions for the 2016 IRM Study. The models represented in the GE-MARS analysis include a *Load Model, Capacity Model, Transmission System Model, and Outside World Model*. Potential IRM impacts of pending environmental initiatives are also addressed. The input assumptions for the base case were based on information available as of October 2015. Appendix A.3 provides more details of these models and assumptions and comparisons of several key assumptions with those used for the 2015 IRM Study.

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[6] *Locational Installed Capacity Requirements Study, http://www.nyiso.com/public/markets_operations/services/planning/planning_studies*

5.1 Load Model

5.1.1 Peak Load Forecast

A 2016 NYCA summer peak load forecast of 33,378 MW was assumed in the 2016 IRM Study, a decrease of 209 MW from the 2015 summer peak forecast used in the 2015 IRM Study. The 2016 load forecast, completed by the NYISO staff in collaboration with the NYISO Load Forecasting Task Force and presented to ICS on September 29, 2015, considered actual 2015 summer load conditions. Use of this 2016 peak load forecast in the 2016 IRM study increased the IRM by 0.1% compared to the 2015 Study. This is because the downstate load growth increased compared to Upstate (Table 6-1). The NYISO will prepare a final 2016 summer forecast in early 2016 for use in the NYISO 2016 Locational Capacity Requirement Study. It is expected that the 2016 summer peak load forecast used for this study and the final NYISO forecast for 2016 will be similar.

5.1.2 Load Forecast Uncertainty (LFU)

It is recognized that 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 conditions. Recognizing the unique LFU of individual NYCA areas, separate LFU models are prepared for four areas: New York City (Zone J), Long Island (Zone K), Westchester (Zones H and I), and the rest of New York State (Zones A-G).

An NYISO examination of the LFU models used for the 2015 IRM Study indicated that updates of these models were not required for the 2016 IRM Study. Appendix Section A-3.1 describes these models in more detail. Modeling of load forecast uncertainty in the 2016 IRM Study has an effect of increasing IRM requirements by 8.5% as demonstrated in a sensitivity case (Table 7-1).

A feature in GE-MARS that allows for the representation of multiple load shapes, adopted for the 2014 IRM Study, was utilized for the 2015 and 2016 IRM Studies. This multiple load shape feature enables a different load shape to be assigned to each of the load forecast uncertainty bins. Part of the effort of implementing this model was to establish criteria for selecting the appropriate historical load shapes to use for each of the seven load forecast uncertainty bins. ICS concluded that an acceptable approach would be to select a combination of load shape years 2002, 2006, and 2007. The load shape for the year 2007 was selected to represent a typical system load shape over the 1999 to 2012 period. The load shape for 2002 represents a flatter load shape, a shape that has numerous daily peaks that are close to the annual peak. The load shape for 2006 represents a load shape with a small number of days with peaks that are significantly above the remaining daily peak loads. The combination of these load shapes on a weighted basis represents an expected probabilistic LOLE result.

The GE-MARS versions used for the 2015 and 2016 IRM Studies included a daily peak load feature that enhances the logic for calculating the daily LOLE index. In the previous GE-MARS versions the LOLE index was calculated using the base load shape's daily peak hours for all bins. The enhanced MARS version instead calculates the LOLE index using the daily peak hour for each load shape in each bin.

5.1.3 Planned Non-Wind Facilities, Retirements and Reratings

Planned non-wind facilities and retirements that are represented in the 2016 IRM Study are shown in Appendix A.3. The rating for each existing and planned resource facility in the capacity model is based on its Dependable Maximum Net Capability (DMNC). In circumstances where the ability to deliver power to the grid is restricted, the value of the resource is limited to it Capacity Resource Interconnection Service (CRIS) value. The source of DMNC ratings for existing facilities is seasonal tests required by procedures in the NYISO Installed Capacity Manual. Appendix A.3.2 shows the ratings of all resource facilities that are included in the 2016 IRM Study capacity model.

5.1.4 Wind Generation

It is projected that during the 2016 summer period there will be a total wind capacity of 1,455 MW participating in the capacity market in New York State. All wind farms are located in upstate New York in Zones A-E. The 2016 summer period wind capacity projection is two MW less than the wind capacity assumed for the 2016 IRM Study.

Over the last several years, the NYISO has collected hourly wind generation output. Functionality is included in the GE-MARS model which allows for the daily wind shape for each day during a simulation year to be modeled randomly. The present GE-MARS version allows only a single year wind shape to be input for this purpose. Although it had been the practice in the past two IRM studies to use the previous year's calendar year's hourly plant output as the basis for the wind shape model, an analysis indicated that the actual 2014 wind output substantially exceeded the actual 2012 and 2013 wind output and actual 2015 summer wind output. It was concluded that the 2013 wind shape – the same used for the 2015 IRM Study – would serve as a better representative of wind conditions over the 2012-2015 period, and therefore should be used for the 2016 IRM Study.

The 2016 IRM Study base case assumes that the projected 1,455 MW of wind capacity will operate at a 14% capacity factor during the summer peak period. This assumed capacity factor is based on an analysis of actual hourly wind generation data collected for wind facilities in New York State during the June through August 2013 period between the hours of 2:00 p.m. and 5:00 p.m. This test period was chosen because it covers the time during which virtually all of the annual NYCA LOLE occurrences are distributed.

Overall, inclusion of the projected 1,455 MW of wind capacity in the 2016 Study accounts for 3.6% of the 2016 IRM requirement (Table 7-1). This relatively high IRM impact is a direct result of the very low capacity factor of wind facilities during the summer peak period. The impact of wind capacity on *unforced capacity* is discussed in Appendix C.3, "Wind Resource Impact on the NYCA IRM and UCAP Markets." A detailed summary of existing and planned wind resources is shown in Figure A-7 of Appendix A.

A new GE-MARS version was recently made available that includes a feature that allows input of multiple years of wind data, an improvement over the present model. Although this new model has not yet been sufficiently tested and accepted for use in the 2016 IRM Study base case, the new model was used for a sensitivity case (see Table 8-1). Results of this sensitivity case show that use of this wind shape feature would have the effect of _____ the IRM by ____. After additional testing, this new MARS feature will be considered for use in the 2017 IRM Study.

5.1.5 Generating Unit Availability

Generating unit forced and partial outages are modeled in GE-MARS by inputting a multi-state outage model that represents an equivalent forced outage rate during demand periods (EFORd) for each unit represented. Outage data used to determine the EFORd is received by the NYISO from generator owners based on outage data reporting requirements established by the NYISO. Capacity unavailability is modeled by considering the average forced and partial outages for each generating unit that have occurred over the most recent five-year time period – the time span considered for the 2016 IRM Study covered the 2010-2014 period. The average NYCA five-year EFORd calculated for this period is less than the 2009-2013 average value used for the 2015 IRM Study, causing the IRM to decrease by 0.4% (Table 6-1). Figure A-4 of Appendix A depicts NYCA 2005 to 2014 EFORd trends.

In 2010, ICS concluded that development of an improved EFORd model would provide a more accurate measure of generator performance then used in previously IRM studies, as well as providing a metric that was aligned with what is used in the capacity markets. An independent consulting firm was retained by the NYISO in 2011 to assist in developing this method. This methodology has been successively applied for all studies since the 2013 IRM Study.

5.1.6 Emergency Operating Procedures (EOPs)

(1) Special Case Resources (SCRs) [Will be revised]

SCRs are ICAP resources that include demand response (DR) resources that are capable of being interrupted as needed and distributed generators that may be activated also as needed. This study assumes a SCR base case value of 1,254 MW will be registered in July 2016, with varying amounts during other months based on historical experience.

The SCR performance model is based on an analysis of historical SCR load reduction performance which is described in Section A-3.7 of Appendix A. Due to the possibility that some of the potential SCR program capacity may not be available during peak periods, projections are discounted for the base case based on previous experience with these programs, as well as any operating limitations. The 2016 IRM Study assumed a __% SCR effectiveness based on recent performance trends. This is slightly up from a __% SCR effectiveness assumed for the 2015 IRM Study. The resulting effective SCR capacity that was modeled in the 2016 IRM Study is 961 MW. The updated SCR model used for the 2016 IRM Study resulted in an IRM decrease of 0.1% from the 2015 IRM Study (Table 6-1). Incorporation of SCR resources in the NYCA capacity model has effect of increasing IRM requirements by 2.2% (Table 7-1).

The 2016 IRM Study determined that for the 17.0% base case IRM, __ SCR calls would be expected during the June-August 2016 period.

(2) Emergency Demand Response Program (EDRP)

The EDRP allows registered interruptible loads and standby generators to participate on a voluntary basis – and be paid for their ability to restore operating reserves after major emergencies have been declared. The 2016 IRM Study assumes 75 MW of EDRP capacity resources will be registered in 2016, an 11 MW a reduction from 2015. The 2016 EDRP capacity was discounted to a base case value of 12 MW reflecting past performance. This value is implemented in the study in July and proportional to monthly peaks loads in other months, while being limited to a maximum of five EDRP calls per month. Both SCRs and EDRP are included in the Emergency Operating Procedure (EOP) model. Unlike SCRs, EDRP are not ICAP suppliers and therefore are not required to respond when called upon to operate.

(3) Other Emergency Operating Procedures

In accordance with NYSRC criteria, the NYISO will implement EOPs as required to minimize customer disconnections. Projected 2016 EOP capacity values are based on recent actual data and NYISO forecasts. (Refer to Table B-5 of Appendix B for the expected use of SCRs, EDRP, voltage reductions, and other types of EOPs during 2016.). Unforced Capacity Deliverability Rights (UDRs).

5.1.7 Unforced Capacity Deliverability Rights (UDRs)

The capacity model includes UDRs which are capacity rights that allow the owner of an incremental controllable transmission project to extract the locational capacity benefit derived by the NYCA from the project. Non-locational capacity, when coupled with a UDR, can be used to satisfy locational capacity requirements. The owner of UDR facility rights designates how they will be treated by the NYSRC and NYISO for resource adequacy studies. The IRM modeling accounts for both the availability of the resource that is identified for each UDR line as well as the availability of the UDR facility itself.

LIPA's 330 MW High Voltage Direct Current (HVDC) Cross Sound Cable, LIPA's 660 MW HVDC Neptune Cable, Hudson Transmission Partners 660 MW HVDC Cable, and the 315 MW Linden Variable Frequency Transformer are facilities that are represented in the 2016 IRM Study as having UDR capacity rights. The owners of these facilities have the option, on an annual basis, of selecting the MW quantity of UDRs it plans on utilizing for capacity contracts over these facilities. Any remaining capability on the cable can be used to support emergency assistance which may reduce locational and IRM requirements. The 2016 IRM Study incorporates the confidential elections that these facility owners made for the 2016 Capability Year.

5.2 Transmission Model

5.2.1 Internal Transmission Model

A detailed transmission system model is represented in the GE-MARS topology. The transmission system topology, which includes eleven NYCA zones and four Outside World Areas, along with transfer limits, is shown in Appendix Figures A-12, 13, and 14. The transfer limits employed for the 2016 IRM Study were developed from emergency transfer limit analysis included in various studies performed by the NYISO, and from input from Transmission Owners and neighboring regions. The transfer limits are further refined by additional assessments conducted specifically for this cycle of the development of the topology. The assumptions for the transmission model included in the 2016 IRM Study are listed in the Tables A-8 and A-9 of Appendix A and described in detail in Appendix A.3.3.

Forced outages based on historic performance are represented in the IRM study for the underground cables that connect New York City and Long Island to surrounding zones are represented in the GE-MARS model. The GE-MARS model uses transition rates between operating states for each interface, which are calculated based on the probability of occurrence from the failure rate and the time to repair. Transition rates into the different operating states for each interface are calculated based on the circuits comprising each interface, which includes failure rates and repair times for the individual cables, and for any transformer and/or phase angle regulator associated with that particular cable. Updated cable outage rates in the 2016 IRM Study had no impact on the IRM compared to the 2015 IRM Study (Table 6-1).

The impact of transmission constraints on NYCA IRM requirements depends on the level of resource capacity in any of the downstream zones from a constraining interface, especially in the NYC and LI zones J and K. To illustrate the impact of transmission constraints, if there were no transmission constraints, the required IRM in 2016 would decrease by 2.9% (Table 7-1). The major changes to the NYCA 2016 IRM Study topology from the 2015 Study are:

[ADD INSERT]

5.2.2 Outside World Model

The Outside World Model consists of those interconnected external control areas contiguous with NYCA: Ontario, Quebec, New England, and the PJM Interconnection (PJM). NYCA reliability can be improved and IRM requirements reduced by recognizing available emergency capacity assistance support from these neighboring interconnected control areas, in accordance with control area agreements governing emergency operating conditions. Representing such interconnection support arrangements in the 2016 IRM Study base case reduces the NYCA IRM requirements by ___% (Table 7-1). A model for representing neighboring control areas, similar to previous IRM studies, was utilized in this study. The assumptions for the Outside World Model included in the 2016 IRM Study are listed in Table A-9 of Appendix A.

The primary consideration for developing the base case load and capacity assumptions for the Outside World Areas is to avoid overdependence on these Areas for emergency assistance support. For this purpose, from Policy 5-9, a rule is applied whereby an Outside World Area's LOLE cannot be lower than its own LOLE criterion, i.e., 0.1 days/year, its isolated LOLE cannot be lower than that of the NYCA, and its IRM can be no higher than that Area's minimum requirement. In addition, Policy 5-9 does not allow EOPs to be represented in Outside World Area models because of the uncertainties associated with the performance and availability of these resources.

Another consideration for developing models for the Outside World Areas is to recognize internal transmission constraints within those Areas that may limit emergency assistance into the NYCA. This recognition is considered either explicitly, or through direct multi-area modeling providing there is adequate data available to accurately model transmission interfaces and load areas within these Outside World Areas. For this study, two Outside World Areas – New England and the PJM Interconnection – are each represented as multi-areas, i.e., 13 zones for New England and four zones for the PJM Interconnection. Such granularity better captures the impacts of transmission constraints within these areas, particularly on their ability to provide emergency assistance to the NYCA.

[PJM-SENY Topology discussion insert, including Con Ed-PSEG wheel]

5.3 Environmental Initiatives [to be replaced]

Several environmental initiatives driven by the NYS and/or federal regulators are either presently in place or are pending that will affect the operation of most of the existing NYCA thermal generator fleet. These regulatory initiatives will require substantial investment and operating costs, in addition to changes in operating methods and emission levels for New York's existing thermal power plants in order to comply with these new regulatory requirements. However, these initiatives are not expected to result in NYCA capacity reductions or retirements that would increase LOLE or IRM requirements during the 2015 Capability Year.

5.4 Database Quality Assurance Reviews

It is critical that the data base used for IRM studies undergo sufficient review in order to verify its accuracy. The NYISO, General Electric (GE), and two New York Transmission Owners (TOs) conducted independent data quality assurance reviews after the preliminary base case assumptions were developed and prior to preparation of the final base case. Masked and encrypted input data was provided by the NYISO to the transmission owners for their reviews.

The NYISO, GE, and TO reviews found several minor data errors, none of which affected IRM requirements in the preliminary base case. The data found to be in error by these reviews were corrected before being used in the final base case studies. A summary of these quality assurance reviews is shown in Appendix A.

6. Comparison with 2015 IRM Study Results

The results of this 2016 IRM Study show that the base case IRM result represents a 0.3% decrease from the 2015 IRM Study base case value. Table 6-1 compares the estimated IRM impacts of updating several key study assumptions and revising models from those used in the 2015 Study. The estimated percent IRM change for each parameter was calculated from the results of a parametric analysis in which a series of IRM studies were conducted to test the IRM impact of individual parameters. The results of this analysis were normalized such that the net sum of the -/+ % parameter changes total the 0.3% IRM decrease from the 2015 Study. Table 6-1 also provides the reason for the IRM change for each study parameter from the 2015 Study.

The principal drivers shown in Table 6-1 that *increased* the required IRM from the 2015 IRM base case are the representation of all hours in the MARS simulation, instead of only peak hours. These parameter changes increased the IRM by 0.4% and 0.3%, respectively. The principle drivers that *decreased* the required IRM from the 2015 IRM base case are an updated PJM model and updated EFORd's. These parameter changes decreased the IRM by 0.5% and 0.4%, respectively that *decreased* the required IRM from the 2015 IRM base case. The parameters in Table 6-1 are discussed under *Models and Key Input Assumptions*. A more detailed description of these changes and their IRM impacts can be found in Table B-6 of Appendix B.

Table 6-1: Parametric IRM Impact Comparison – 2015 vs. 2016 IRM Study

Parameter	Estimated IRM Change (%)	IRM (%)	Reasons for IRM Changes
2015 IRM Study – Final Base Case		**17.3**	
2016 IRM Study Parameters that Increased the IRM			
All Hours in simulation instead of only peak hours	+0.4		Increase in 'off peak' LOLE events
Updated IESO, NE and Quebec models	+0.3		Less assistance from the new external models
Updated load forecast (Gold Book)	+0.1		Downstate load growth higher than upstate
Non-SCR EOPs	+0.1		Slightly lower voltage response
Total IRM Increase	**+0.9**		
2016 IRM Study Parameters that Decreased the IRM			
Updated PJM model (4-zone model)	-0.5		Increased planned installed reserve.
Updated generating unit EFORd's	-0.4		Five-year average performance improved
Updated SCRs	-0.1		Performance improvement
Updated large hydro model	-0.1		Improved hydro availability
Updated topology & generation additions	-0.1		Slight improvement of transmission and resource capability downstate
Total IRM Decrease	**-1.2**		
2016 IRM Study Parameters that do not change the IRM			
Updated Solar Shape	0		
Updated Sales	0		
Updated Cable Outage Rates	0		
Change Study Year	0		
Updated DMNC	0		
2013 Wind Shape Model* (Same as for 2015 IRM Study)	0		
Net Change from 2015 Study		**-0.3**	
2016 IRM Study – Final Base Case		**17.0**	

7.0 Sensitivity Case Study Results

Determining the appropriate IRM requirement to meet NYSRC reliability criteria depends upon many factors. Variations from the base case will, of course, yield different results. Table 7-1 shows IRM requirement results and related NYC and LI locational capacities for selected sensitivity cases. NYSRC Executive Committee members may consider one or more of these sensitivity case results, in addition to the base case IRM, when the Committee develops the Final NYCA IRM for 2015. A complete summary of the twelve sensitivity case results shown in Table 7-1 is depicted in Table B-1 of Appendix B. Table B-1 also includes a description and explanation of each sensitivity case. Because of the lengthy computer run time and manpower needed to utilize the Tan 45 method in IRM studies (see Section 3), this method was not applied for the sensitivity studies in Table 7-1.

Table 7-1: Sensitivity Cases – 2015 IRM Study

Case	Description	IRM (%)	% Change from Base Case	NYC MLCR (%)	LI MLCR (%)
0	Base Case	17.0	0	80.9	102.6
	Impacts of Major MARS Parameters				
1	NYCA isolated				
2	No internal NYCA transmission constraints	14.1	-2.9	N.A.	N.A.
3	No load forecast uncertainty	8.5	-8.5	70.2	94.0
4	No wind capacity	13.4	-3.6	76.2	101.6
5	No SCRs	14.8	-2.2	74.0	101.7
	Impacts of Base Case Assumption and Model Changes from Base Case				
6	Assume 2015 IRM Study SCR 0.855 derate adjustment factor	17.1	+0.1	76.3	101.7
7a	Forward Capacity Market Sales to NE of 135 MW				
7b	Forward Capacity Market Sales to NE of 405 MW				
8	Multiple years of wind shape data (new MARS feature)				
9	Model Marble River Wind (assumes CRIS rights awarded)				
10	PJM sensitivity (scope TBD)				
11	Retire Indian Point 2 and 3[7]	17.0	N.A.	N.A.	N.A.

[7] See the Section 7, "Sensitivity Case Study Results" section for details of this case.

Sensitivity Cases 1-10 determined the IRM and LCRs required for meeting the 0.1 days/year LOLE criterion for the sensitivity condition assumed. However, for Sensitivity Case 11, Indian Point 2 and 3 were assumed to shut down in 2016 when the NYCA IRM is 17.0% (the base case IRM for the 2016 Capability Year). The LOLE for this sensitivity increased from 0.1 days/year with both Indian Point both units in service, to 0.62 days/year with both units shut down. Therefore, if Indian Point was to close, New York customers would be expected to experience service interruptions at a rate about six times that permitted by the NYSRC Resource Adequacy Reliability Criterion.

7. NYISO Implementation of the NYCA Capacity Requirement

The NYISO values capacity sold and purchased in the market in a manner that considers the forced outage ratings (UCAP) of individual units. To maintain consistency between the DMNC rating of a unit translated to UCAP and the statewide ICR, the ICR must also be translated to an unforced capacity basis. In the NYCA, these translations occur twice during the course of each capability year, prior to the start of the summer and winter capability periods.

Additionally, any LCRs in place are also translated to equivalent UCAP values during these periods. The conversion to UCAP essentially translates from one index to another; it is not a reduction of actual installed resources. Therefore, no degradation in reliability is expected. The NYISO employs a translation methodology that converts ICAP requirements to UCAP in a manner that ensures compliance with NYSRC Resource Adequacy Rule A-R1. The conversion to UCAP provides financial incentives to decrease the forced outage rates while improving reliability.

The increase in wind resources increases the IRM because wind capacity has a much lower peak period capacity factor than traditional resources. On the other hand, there is a negligible impact on the need for UCAP. Figure 8-1 below illustrates that UCAP reserve margins, having trended downward during the 2006-2010 period, has since stabilized. This indicates a generally lower burden on New York loads over the 2006 to 2014 time period. Appendix C provides details of the ICAP to UCAP conversion process used for this analysis.

Figure 7-1 NYCA Reserve Margins (to be replaced)