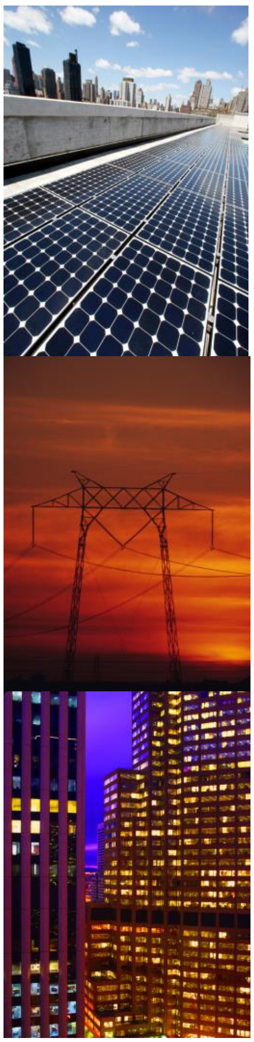
Technical Study Report

New York Control Area Installed Capacity Requirement



For the Period May 2014 to April 2015

December 6, 2013

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.

Table of Contents

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 to provide parameters for establishing NYCA IRM requirements for the following capability year. This year's report covers the period May 2014 to April 2015 (2014 Capability Year).

Results of the NYSRC technical study show that the required NYCA IRM for the 2014 Capability Year is 17.0% under base case conditions.

This study also determined Minimum Locational Capacity Requirements (MLCRs) of 84.7% and 106.9% for New York City (NYC) and Long Island (LI), respectively. In its role of setting the appropriate locational capacity requirements (LCRs), the New York Independent System Operator (NYISO) will consider these MLCRs.

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 for 2014 represents a *0.1% decrease* from the 2013 base case IRM of 17.1%. Table 6-1 shows the IRM impacts of individual study parameters that result in this change. The principle drivers that increased and decreased the required NYCA IRM are:

- Increasing generating unit Equivalent Forced Outage Rates during demand (EFORd's), which *increased* the IRM
- Reduced Special Case Resource (SCR) effectiveness, which *increased* the IRM
- Implementation of a new Multiple Load Shape Model, which *decreased* the IRM
- Updated Neighboring Control Area model, which *decreased* the IRM

Several other study parameter changes impacted the 2014 IRM to a lesser extent. The impact of the sum of all parameter changes – 17 in all – netted a 0.1% IRM decrease.

There are presently six environmental initiatives driven by the State and/or Federal regulators, either in place or are pending, that will affect the operation of most thermal generators in the NYCA, and have the potential to impact future IRM requirements. Compliance with these initiatives could ultimately lead to plant retirements. However, due to the expected timing of e pending regulations, the possible plant retirements are not anticipated to impact IRM requirements in 2014.

This study also evaluated IRM impacts of ten 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 2014 Capability Year is adopted. The 2014 IRM Study also evaluated Unforced Capacity (UCAP) trends. This analysis shows that UCAP margins have steadily decreased over the past six years 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, 2014 through April 30, 2015 (2014 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:

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

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 2014 Capability Year.

The NYISO will implement the final NYCA IRM as determined by the NYSRC, in accordance with the NYSRC Reliability Rules[2], the NYISO Market Services Tariff, and the NYISO Installed Capacity (ICAP) Manual.[3] 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 2014 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 2014 Capability Year (2014 IRM Study) are set forth in NYSRC Policy 5-7[4], *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 NPCC reliability criteria and NERC reliability standards. IRM study procedures include the use of two study methodologies, the *Unified* and the *IRM Anchoring Methodologies.* The above reliability criterion and methodologies are discussed in more detail later in the report. In addition to calculating the NYCA IRM requirement, these methodologies identify corresponding MLCRs for NYC and LI. In its role of setting the appropriate LCRs, the NYISO will utilize the same study methodologies and procedures as in the 2014 IRM Study, and will consider the MLCR values determined in this study. The

[1] For example, if the IRM was 17% and the Forecasted NYCA Peak Load was 35,000 MW, then the ICR would equal 40,950 MW. (1+17%/100)*35,000 or 1.17*35000

[2] http://www.nysrc.org/NYSRCReliabilityRulesComplianceMonitoring.asp

[3] http://www.nyiso.com/public/markets_operations/market_data/icap/index.jsp

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

2014 IRM Study was managed and conducted by the NYSRC Installed Capacity Subcommittee (ICS) and supported by technical assistance from NYISO staff.

A major modeling change for improved representation of generator outage rates was implemented in the 2013 IRM Study and was again utilized for this 2014 IRM Study. This model calculates an "EFORd," which is a better measure of generator performance for reliability studies than previously represented. In addition, two new models were developed and incorporated into the 2014 IRM Study, a Multiple Load Shape Model and a Wind Production Model. These new models are described in the report.

Previous NYCA 2000 to 2013 IRM Study reports can be found on the NYSRC website.[5] Table C-1 in Appendix C provides a comparison of previous NYCA base case and final IRMs for the 2000 through 2013 Capability Years. This table and Figure 8-1 shows 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-R1, *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.*

This NYSRC Reliability Rule is consistent with NPCC Resource Adequacy Design Criteria in Section 5.2 of NPCC Directory 1, *Design and Operation of the Bulk Power System*.

In accordance with NYSRC Rule A-R2, *Load Serving Entity (LSE) Installed Capacity Requirements*, the NYISO is required to establish LSE installed capacity requirements,

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

including locational capacity requirements, in order to meet the statewide IRM Requirements established by the NYSRC for maintaining NYSRC Rule A-R1 above.

3. IRM Study Procedures

The study procedures used for the 2014 IRM Study are described in detail in NYSRC Policy 5-7, *Procedure for Establishing New York Control Area Installed Capacity Requirements*. Policy 5-7 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.

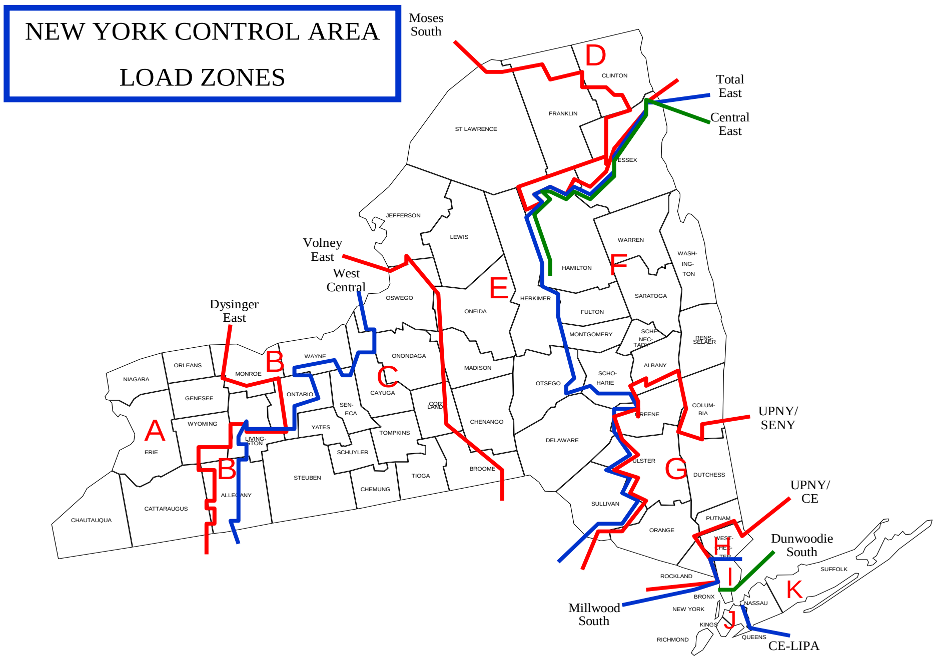
General Electric's Multi-Area Reliability Simulation (GE-MARS) is the primary computer program used for this probabilistic analysis. This program includes detailed load, generation, and transmission representation for eleven NYCA load zones — plus four external Control Areas (Outside World Areas) directly interconnected to the NYCA. The external Control Areas are: Ontario, New England, Quebec, and the PJM Interconnection. The eleven NYCA zones are depicted in Figure 3-1[6]. 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. Note that the area above the curve is more reliable than criteria, and vice versa. This methodology develops a pair of curves, one for NYC (Zone J) and one for LI (Zone K). Appendix A of Policy 5-7 provides a more detailed description of the Unified Methodology.

---

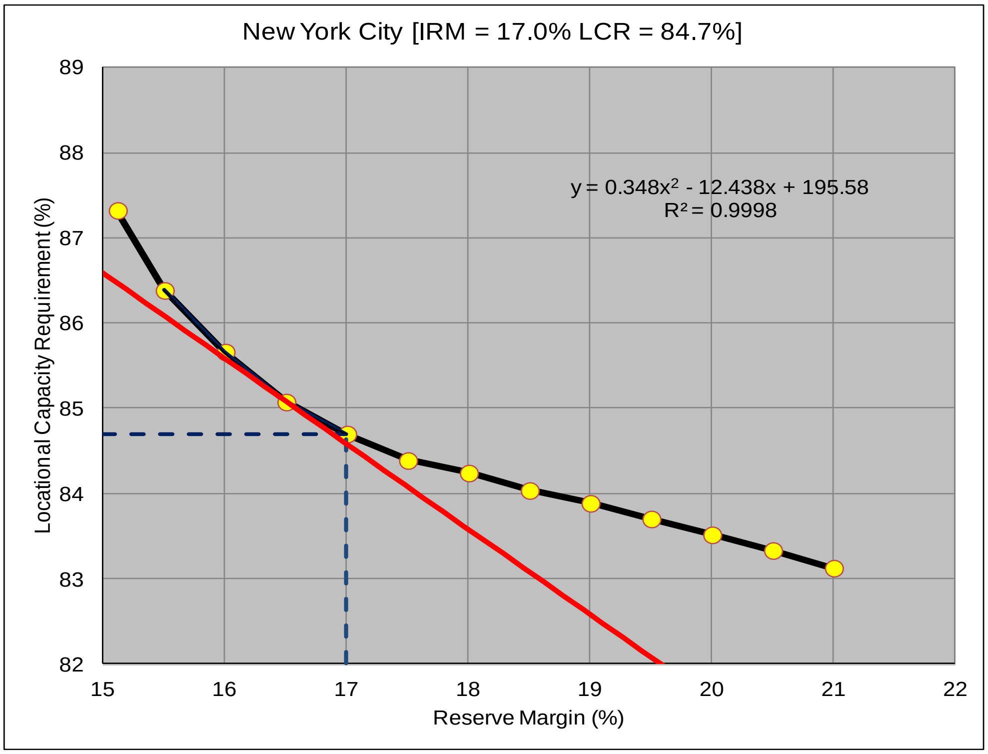
[6] The Federal Energy Regulatory Commission has ordered the creation of a new capacity zone (NCZ) within the NYISO's ICAP market starting in 2014. The NCZ encompasses Load Zones G, H, I, and J. The NCZ was triggered by a NYISO study that identified a deliverability constraint across the UPNY/SENY interface. 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.

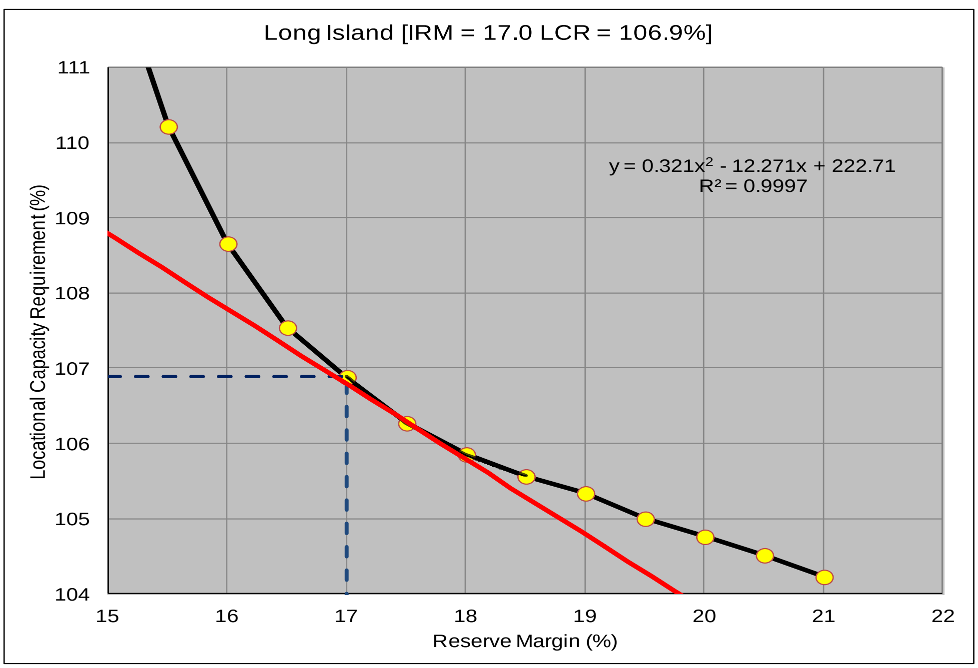
Figure 3-1 NYCA Load Zones



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 5-7 provides a more detailed description of the methodology for computing the Tan 45 inflection point.

Figure 3-2 NYCA Locational Requirements vs. Statewide Requirements





4. Study Results – Base Case

Results of the NYSRC technical study show that the required NYCA IRM is 17.0% for the 2014 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 2014 Capability Year, together with MLCRs of 84.7% and 106.9% 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 MLCRs in this 2014 IRM study to the 2013 IRM Study results (NYC MLCR = 83.7%, LI MLCR = 102.0%), the NYC MLCR increased by 1.0%, while the LI MLCR increased by 4.9%. The NYISO will consider these MLCR results when developing the final NYC and LI LCR values for the 2014 Capability Year.

A Monte Carlo simulation error analysis shows that there is a 95% probability that the above base case result is within a range of 16.8% and 17.2% (see Appendix A.1.1) when obtaining a standard error of 0.023 per unit at 1,000 simulated years. This analysis demonstrates that there is a high level of confidence that the base case IRM value of 17.0% is in full compliance with NYSRC and NPCC reliability rules and criteria.

5. Models and Key Input Assumptions

This section describes the models and related input assumptions for the 2014 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 2013. Appendix A.3 provides more details of these models and assumptions and comparisons of several key assumptions with those used for the 2013 IRM Study.

5.1 Load Model

5.1.1 Peak Load Forecast

A 2014 NYCA summer peak load forecast of 33,655 MW was assumed in the 2014 IRM Study, an increase of 377 MW from the 2013 summer peak forecast used in the 2013 IRM Study. The 2014 load forecast, completed by the NYISO staff in collaboration with the NYISO Load Forecasting Task Force and presented to ICS on October 2, 2013, considered actual 2013 summer load conditions. Use of this 2014 peak load forecast in the 2014 IRM study decreased the IRM by 0.1% compared to the 2013 Study, because the downstate load growth diminished compared to Upstate (Table 6-1). The NYISO will prepare a final 2014 summer forecast in early 2013 for use in the NYISO 2013 Locational Capacity Requirement Study. It is expected that the NYISO's October 2013 summer peak load forecast for 2014 and the final 2014 forecast 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).

The load forecast uncertainty models and data used for the 2014 IRM Study were updated by Consolidated Edison for Zones H, I, and J; Long Island Power Authority (LIPA) for Zone K; and the NYISO. Appendix Section A-3.1 describes these models in more detail. Load forecast uncertainty in the 2013 IRM Study has an effect of increasing IRM requirements by 8.8% as demonstrated in a sensitivity case (Table 7-1). Use of updated LFU models for the 2014 IRM Study decreased the IRM requirement by 0.2% from the 2013 IRM Study (Table 6-1).

5.1.3 Load Shape Model

Load shape models in the past IRM studies assumed a load shape based on a single historical year, 2002. The year 2002 had 13 days where the daily peak load was within 90% of the system peak, more days than in other years during the 1999-2012 year period. Use of the 2002 model therefore exposes the system to a relatively higher risk of LOLE events, which may result in inappropriately high IRM levels. Accordingly, in 2011 and 2012 ICS worked with the NYISO to replace the 2002 load shape with a different load shape that would be more representative of a typical year.

This year ICS concluded that a new feature in GE-MARS that allows for the representation of multiple load shapes be considered for adoption in the 2014 IRM. The new 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 as compared to use of the deterministic single year 2002 model. After extensive testing, the NYSRC approved the Multiple Load Shape Model for use in the 2014 IRM Study. Development of this model is described in paper prepared by the NYISO in Appendix F.

Use of the Multiple Load Shape Model in the 2014 IRM Study results in a 0.9% IRM reduction compared to use of the 2002 load shape model that was used for the 2013 IRM Study.

5.2 Capacity Model

5.2.1 Planned Non-Wind Facilities, Retirements and Reratings

Planned non-wind facilities and retirements that are represented in the 2014 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. Planned non-wind facilities, retirements, and reratings had no impact on IRM compared to the 2013 IRM Study. Appendix A.3.2 shows the ratings of all resource facilities that are included in the 2014 IRM Study capacity model.

5.2.2 Wind Generation

It is projected that by the end of the 2014 summer period there will be a total wind capacity of 1,367 MW participating in the capacity market in New York State. All wind farms are located in upstate New York in Zones A-E. The 2014 summer period wind capacity projection is 217 MW lower than the forecast 2013 wind capacity assumed for the 2013 IRM Study due to projects being canceled.

The 2013 IRM Study base case assumes that the projected 1,367 MW of wind capacity will operate at an 18% 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 2012 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.

The decrease in projected wind capacity from the value of 1,584 MW used in the 2013 IRM Study, to 1,367 MW forecast used for this 2014 IRM study, results in a 0.5% IRM decrease (Table 6-1).

Overall, inclusion of the projected 1,367 MW of wind capacity in the 2014 Study accounts for 3.5% of the 2014 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.

Wind modeling in previous IRM studies was based on 2002 simulated wind plant shapes that were developed for a General Electric wind study several years ago. These wind shapes were based on hourly wind readings taken at a given altitude along with other meteorological information, and a forecast of the hourly electric output of a modern wind turbine. Of the 100+ sites studied, the NYISO has used the output of 33 of these sites around NY to simulate output of installed wind farms.

Over the last several years, the NYISO has collected hourly wind generation output with an installed base that now exceeds 1,600 MW. This allows actual wind production data from NYCA generators to be compared to the simulated data. Functionality was recently added to the GE-MARS model which now allows for the daily wind shape for each day during a simulation year to be modeled randomly. The GE-MARS model allows a single year wind shape to be input for this purpose.

The NYISO conducted analyses using different generation output of different years and load levels, and found small changes in reliability values. Based on a review of these analyses, ICS concluded that the shape for modeling wind generation in the 2014 IRM Study be derived from actual 2012 NYCA wind generation production instead of the simulation method based on 2002 load and wind generation used in previous IRM studies. The NYISO prepared a detailed wind modeling evaluation (Appendix E) that describes these analyses.

5.2.3 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 2014 IRM Study covered the 2008-2012 period. The five-year EFORd calculated for this period slightly exceeded the 2007-2011 average value used for the 2013 IRM Study, causing the IRM to increase by 0.7% (Table 6-1). Figure A-3 of Appendix A depicts NYCA 2003 to 2012 EFORd trends.

In 2010, ICS concluded that development of an improved EFORd model would provide a more accurate measure of generator performance, as well as provide 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. The methodology was first applied for the 2013 IRM study and was used for this 2014 IRM Study.

5.2.4 Emergency Operating Procedures (EOPs)

(1) Special Case Resources (SCRs)

SCRs are ICAP resources that include loads that are capable of being interrupted on demand and distributed generators that may be activated on demand. This study assumes a SCR base case value of 1,195 MW will be registered in July 2014, 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 2014 IRM Study assumed a 63% effectiveness based on recent performance trends. This is down from an 81% effectiveness assumed for the 2013 IRM Study. The resulting effective capacity that was modeled in the 2014 IRM Study is 758 MW.

The 2014 IRM Study determined that for a 17.0% IRM, nine SCR calls would be expected during June-August 2014 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. The 2014 IRM Study assumes 94 MW of EDRP capacity resources will be registered in 2014, a reduction from 2013. This EDRP capacity was discounted to a base case value of 13 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.

The updated SCR and EDRP models used for the 2014 IRM Study resulted in an IRM increase of 0.8% from the 2013 IRM Study (Table 6-1). This increase was primarily caused by reduced SCR effectiveness assumed in the 2014 IRM Study as described earlier. Incorporation of SCRs and EDRP resources in the NYCA capacity model has the combined effect of increasing IRM requirements by 1.3% (Table 7-1).

(3) Other Emergency Operating Procedures

In accordance with NYSRC criteria, the NYISO will implement EOPs as required to minimize customer disconnections. Projected 2014 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 2014.). The updated EOP model, excluding the SCR and EDRP impact noted above, increased the IRM from the 2013 IRM study by 0.1% (Table 6-1).

5.2.5 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, 660 MW HVDC Neptune Cable, Hudson Transmission Partners' 660 MW HVDC, and the 315 MW Linden Variable Frequency Transformer (VFT) are facilities that are represented in the 2014 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 2014 IRM Study incorporates the elections that these facility owners made for the 2014 Capability Year.

5.3 Transmission Model

5.3.1 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-11, 12, and 13. The transfer limits employed for the 2014 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 2014 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 increased the IRM from the 2013 IRM Study by 0.1% (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. In accordance with NYSRC Reliability Rule A-R2, *Load Serving Entity ICAP Requirements,* the NYISO is required to calculate and establish appropriate LCRs. The most recent NYISO study[7] determined that for the 2013 Capability Year, the required LCRs for NYC and LI were 86% and 105%, respectively. A LCR Study for the 2014 Capability Year is scheduled to be completed by the NYISO in January 2014.

The major changes to the NYCA 2014 IRM Study topology from the 2013 Study are:

- Dysinger East dropped from 2,725 MW to 2,650 MW.
- Volney East dynamic limit removed and a singular value of 1,300 MW was used.
- The dynamic limits for the A line plus VFT were increased.

Results from 2014 IRM Study were used to illustrate the impact on the IRM requirement for changes of the base case NYC and LI LCR levels of 84.7% and 106.9%, respectively. Observations from these results include:

(1) Unconstrained NYCA Case

If internal transmission constraints were entirely eliminated, the NYCA IRM requirement could be reduced to 14.5%, 2.5% less than the base case IRM

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

requirement (Table 7-1.) Therefore, relieving NYCA transmission constraints would make it possible to reduce the 2014 NYCA installed capacity requirement by approximately 840 MW.

(2) Downstate New York Capacity Levels

If the NYC and LI LCR levels were each *increased* by 1.0% from the base case values of 84.7% and 106.9%, respectively, the 2014 IRM requirement could be reduced by 0.9% and 0.7%. On the other hand, if the NYC and LI locational installed capacity levels were *decreased* by 1.0%, respectively, the IRM requirement would be required to increase by 2.5% and .9% (see Figure 3-2).

These results illustrate the significant impact on IRM caused by transmission constraints and implementing different LCR levels assuming all other factors being equal.

5.3.2 External Control Area Model

The Outside World Model consists of those Control Areas contiguous with NYCA: Ontario, Quebec, New England, and the PJM Interconnection. 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 during emergency conditions. Representing such interconnection support arrangements in the 2014 IRM Study base case reduces the NYCA IRM requirements by 8.9% (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 2014 IRM Study are listed in Table A-10 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 5-7, a rule is applied whereby an Outside World Area's LOLE cannot be lower than its own LOLE criterion, 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, EOPs are not represented in Outside World Area models.

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.

5.4 Environmental Initiatives

Various environmental initiatives driven by the State and/or Federal regulators are either in place or are pending that will affect the operation of the existing fleet. The United States Environmental Protection Agency (USEPA) has promulgated several regulations that will affect most of the thermal generation fleet of generators in NYCA. Similarly, the New York State Department of Environmental Conservation (NYSDEC) has undertaken the development of several regulations that will apply to most of the thermal fleet in New York.

The control technology retrofit requirements of six environmental initiatives are sufficiently broad in application that certain generator owners may need to address the retirement versus retrofit question. These environmental initiatives are: (i) NYSDEC's Reasonably Available Control Technology for Oxides of Nitrogen (NOx RACT), (ii) Best Available Retrofit Technology (BART) to address regional haze, (iii) Best Technology Available (BTA) for cooling water intake structures, (iv) the USEPA's Mercury and Air Toxics Standards (MATS), (v) either the Cross State Air Pollution Rule (CSAPR) or its predecessor the Clean Air Interstate Rule (CAIR) addressing interstate transport of criteria air pollutants, and (vi) the Regional Greenhouse Gas Initiative (RGGI) program revision. CSAPR is currently under review by the US Supreme Court.

33,200 MW of capacity in the existing NYCA generator fleet will have some level of exposure to the above six environmental initiatives, which could lead to future plant retirements. However, these initiatives are not expected to result in retirements that would impact IRM requirements in 2014.

Appendix B.2 describes the above environmental regulations in more detail.

5.5 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.4.

6. Comparison with 2013 IRM Study Results

The results of this 2014 IRM Study show that the base case IRM result represents a 0.1% decrease from the 2013 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 2013 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 0.1 % IRM decrease from the 2013 Study. Table 6-1 also provides the reason for the IRM change for each study parameter from the 2013 Study.

The principal drivers shown in Table 6-1 that increased the required IRM from the 2013 IRM base case are updated SCR and EDRP models and generating unit EFORd's. The principle drivers that decreased the required IRM from the 2013 IRM base case are a new Multiple Load Shape Model and an updated neighboring control area model. Taking all study assumptions and model changes as a whole, the sum of IRM impacts of parameters that caused an IRM to increase closely balanced the sum of the IRM impacts of parameters that decreased the IRM.

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 (2013 vs. 2014 IRM Study)

Parameter	Estimated IRM Change (%)	IRM (%)	Reasons for IRM Changes
2013 IRM Study – Final Base Case		**17.1**	
2014 Parameters that Increase the IRM			
Updated SCR/EDRP	+0.8		Reduced SCR effectiveness – from 81% to 63%.
Updated Generating Unit EFORd's	+0.7		Increased 5-year EFORd average for NYCA fleet.
Updated DNMC Ratings	+0.5		Downstate to upstate capacity ratio has been reduced.
Retirements	+0.3		Retirements of relatively good performing units in Downstate.
Updated Cable Outage Rates	+0.1		Recent Increase in cable outages.
Updated Non-SCR/EDRP EOPs	+0.1		Less EOP participation.
Mothballed Units Returned to Service	+0.1		Return to service of poor performing units.
Updated Maintenance	+0.1		New Load Shape (2007) stresses system slightly in shoulder months
Total IRM Increase	**+2.7**		
2014 Parameters that decrease the IRM			
New Multiple Load Shape Model	-0.9		New load shapes are less stressful in upper bins (less days near peak).
Updated Neighboring Control Area Models	-0.8		Lower loads in PJM than previously forecast.
Remove Marble River Wind	-0.5		Removal of a poor performing unit that was assumed in 2013 IRM Study.
Updated LFU	-0.2		Zone J unchanged while other zones have less uncertainty.
Updated Topology	-0.2		Increase of transfer limits.
Updated Load Forecast	-0.1		Downstate load growth diminished compared to Upstate.
Use 2012 Wind Shape	-0.1		Recognizes more efficient wind experience.
Total IRM Decrease	**-2.8**		
2014 Parameters that do not change the IRM			
New MARS Version	0		
Updated Study Year	0		
Net Change from 2013 Study		**-0.1**	
2014 IRM Study Final Base Case IRM		**17.0**	

7. 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 three groups of selected sensitivity cases. Many of these sensitivity case results are important considerations when the NYSRC Executive Committee develops the Final NYCA IRM for 2014. A complete summary of the ten 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

Case	Description	IRM (%)	% Change from Base Case	NYC LCR (%)	LI LCR (%)
0	Base Case	17.0		84.7	106.9
Impacts of Major MARS Parameters					
1	NYCA isolated	25.9	+8.9	91.0	115.1
2	No internal NYCA transmission constraints	14.5	-2.5	0	0
3	No load forecast uncertainty	8.2	-8.8	78.4	98.8
4	No wind capacity (1,367 MW)	13.5	-3.5	84.7	106.9
5	No SCRs and EDRPs	15.7	-1.3	83.1	107.4
Impacts of Base Case Assumption and Model Changes					
6	Higher Outside World reserve margins	11.1	-5.9	80.5	101.5
7	Lower Outside World reserve margins	24.4	+7.4	90.0	113.8
8	Retire Cayuga and Dunkirk	16.8	-0.2	84.7	106.9
9	Limit SCRs to five calls per month	17.6	+0.6	85.2	107.5
10	Retire Indian Point 2 and 3[8]				

Sensitivity Cases 1-9 determined the IRM required for meeting the 0.1 days/year LOLE criterion for the sensitivity condition examined. However, for Sensitivity 10, retirement of Indian Point 2 and 3, both units were assumed to be shut down when the NYCA IRM is 17.0%, the base case IRM for the 2014 Capability Year. The LOLE for this sensitivity increased from 0.1 with the units in service to 0.92 with the units shut down. Therefore, New York customers would be expected to experience a service interruption about once

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

per year, ten times the firm load disconnection frequency permitted by the NYSRC Resource Adequacy Reliability Criterion.

8. NYISO Implementation of the NYCA Capacity Requirement

8.1 Translation of NYCA ICAP Requirements to UCAP Requirements

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 trended downward over the 2006-2012 period, despite variations of UCAP requirements. This indicates a lower burden on New York loads over time. Appendix C offers a more detailed explanation.

Figure 8-1 NYCA Reserve Margins