Technical Study Report

New York Control Area Installed Capacity Requirement

For the Period May 2020 to April 2021

DRAFT 10-24-19

December 6, 2019

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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NOTE: Appendices A, B, C and D are included in a separate document.

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,[1] 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 2020 through April 2021 (2020 Capability Year).

Results of the NYSRC technical study show that the required NYCA IRM for the 2020 Capability Year is 19.0% under base case conditions. This IRM satisfies the NYSRC and Northeast Power Coordinating Council (NPCC) reliability criteria of a Loss of Load Expectation (LOLE) of no greater than 0.1 days per year. The base case, along with other relevant factors, will be considered by the NYSRC Executive Committee on December 6, 2019 for its adoption of the Final NYCA IRM requirement for the 2020 Capability Year.

This study also determined corresponding *preliminary* Locational Capacity Requirements (LCRs) of 84.0% and 102.0% for the New York City and Long Island localities, respectively. In accordance with its responsibility of setting the LCRs, the New York Independent System Operator, Inc. (NYISO) will calculate and approve *Final LCRs* for all NYCA localities using a separate process using the NYSRC approved Final IRM that also adheres to NYSRC Reliability Rules and policies.

The 19.0% IRM base case value for the 2020 Capability Year represents a *2.2% increase* from the 2019 base case IRM of 16.8%. Table 6-1 shows the IRM impacts of individual updated study parameters that result in this change. In summary:

- There are *seven parameter drivers* that in combination *increased* the 2020 IRM from the 2019 base case by 3.0%. Of these seven drivers, the principal driver is an updated load forecast uncertainty model which increased the IRM by 1.2%. Another driver, an improved representation of the interconnected external Areas, increased the IRM by 0.7%.
- *Three parameter drivers* in combination *decreased* the IRM from the 2019 base case by 0.8%. Most of this decrease – 0.6% – is attributed to an updated NYPA transmission system topology.

[1] A Capability Year begins on May 1 and ends on April 30 of the following year.

The complete parametric analysis showing the above and other results can be found in Section 6 in this report.

This study also evaluated IRM impacts of several sensitivity cases. The results of these sensitivity cases are discussed in Section 7 and summarized in Table 7-1.

The base case IRM and sensitivity case results, along with other relevant factors, will be considered by the NYSRC Executive Committee in adopting the Final NYCA IRM requirement for 2020. NYSRC Policy 5-14 describes the Executive Committee process for establishing the Final IRM.

In addition, a confidence interval analysis was conducted to demonstrate that there is a high confidence that the base case 19.0% IRM will fully meet NYSRC and NPCC resource adequacy criteria that require a Loss of Load Expectation (LOLE) of no greater than 0.1 days per year.

The 2020 IRM Study also evaluated Unforced Capacity (UCAP) trends. UCAP is the manner by which the NYISO values installed capacity – considering the forced outage ratings of individual generating units. This analysis shows that required UCAP margins, which steadily decreased over the 2006-2012 period to about 5%, have remained fair steady since then (see Table 8-1).

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, 2020 through April 30, 2021 (2020 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:

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

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 2020 Capability Year.

The NYISO will implement the Final NYCA IRM as determined by the NYSRC, in accordance with the NYSRC Reliability Rules,[2] NYSRC Policy 5-14, *Procedure for Establishing New York Control Area Installed Capacity Requirement*;[3] the NYISO Market Administration and Control Area Services Tariff; and the NYISO Installed Capacity (ICAP) Manual.[4] The NYISO translates the required IRM to a UCAP basis. These values are also used in a Spot Market Auction based on FERC-approved Demand Curves. The schedule for conducting the 2020 IRM Study was based on meeting the NYISO's timetable for conducting this auction.

The study criteria, procedures, and types of assumptions used for the study for establishing the NYCA IRM for the 2020 Capability Year (2020 IRM Study) are set forth in NYSRC Policy 5-14. The primary reliability criterion used in the IRM study requires a Loss of Load Expectation (LOLE) of no greater than 0.1 days per year for the NYCA. This NYSRC resource adequacy criterion is consistent with the Northeast Power Coordinating Council (NPCC) resource adequacy criterion. IRM study procedures include the use of two reliability study methodologies: the *Unified Methodology* and the *IRM Anchoring Methodology.* NYSRC reliability criteria and IRM study methodologies and models are described in Policy 5-14 and discussed in detail later in this report.

The NYSRC process for determining the IRM also identifies *preliminary* Locational Capacity Requirements (LCRs) for the New York City and Long Island localities. The LCR values determined in this 2020 IRM Study are considered preliminary because the NYISO, using a separate process –

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

in accordance with NYISO tariff and procedures, while adhering to NYSRC Reliability Rules and NYSRC Sections 3.2 and 3.5 of Policy 5-14 – is responsible for setting *final* LCRs. For its determination of LCRs for the 2020 Capability Year, the NYISO will continue utilizing an economic optimization methodology.

The 2020 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 year 2000 to year 2019, can be found on the NYSRC website.[5] Appendix C, Table C.1 provides a record of previous NYCA base case and final IRMs for the 2000 through 2019 Capability Years. Figure 8-1 and Appendix C, Table C.2, show UCAP reserve margin trends over previous years. Definitions of certain terms in this report can be found in the Glossary (Appendix D).

A separate analysis from the IRM study process covered in this report assesses "resource adequacy" of the NYCA for several years into the future. This assessment determines whether the NYSRC resource adequacy reliability criterion, as defined in Section 2 below, is maintained over the study period; and if not, identifies reliability needs or compensatory capacity requirements.

2. NYSRC Resource Adequacy Reliability Criterion

The required reliability level used for establishing NYCA IRM Requirements is dictated by Requirement 1.1 of NYSRC Reliability Rule A.1, *Establishing NYCA Statewide Installed Reserve Margin Requirements,* which states:

> *Probabilistically establish the IRM requirement for the NYCA 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 allowances for demand uncertainty, scheduled outages and de-ratings, forced outages and de-ratings, assistance over interconnections with neighboring control areas, NYS Transmission System emergency transfer capability, and capacity and/or load relief from available operating procedures.*

The above NYSRC Reliability Rule is consistent with NPCC's Resource Adequacy criterion in NPCC Directory 1, *Design and Operation of the Bulk Power System*. This criterion is interpreted to mean that planning reserve margins, or the IRM, needs to be high enough that involuntary load shedding due to inadequate resources would occur only once in ten years, or 0.1 loss of load events per year. This criterion has been widely accepted by most electric power systems in North

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

America for reserve capacity planning. In New York, use of the LOLE criterion of 0.1 day per year has provided an acceptable level of reliability for many years.

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

3. IRM Study Procedures

The study procedures used for the 2020 IRM Study are described in detail in NYSRC Policy 5-14, *Procedure for Establishing New York Control Area Installed Capacity Requirements*. Policy 5-14 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 as follows: 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.[7] The GE-MARS program is described in detail in Appendix A, Section A.1.

Prior to the 2016 IRM Study, the IRM base case and sensitivity analyses were simulated using only weekday peak loads rather than evaluating all 8,760 hours per year in order to reduce computational run times. However, the 2016 IRM Study determined that the difference between

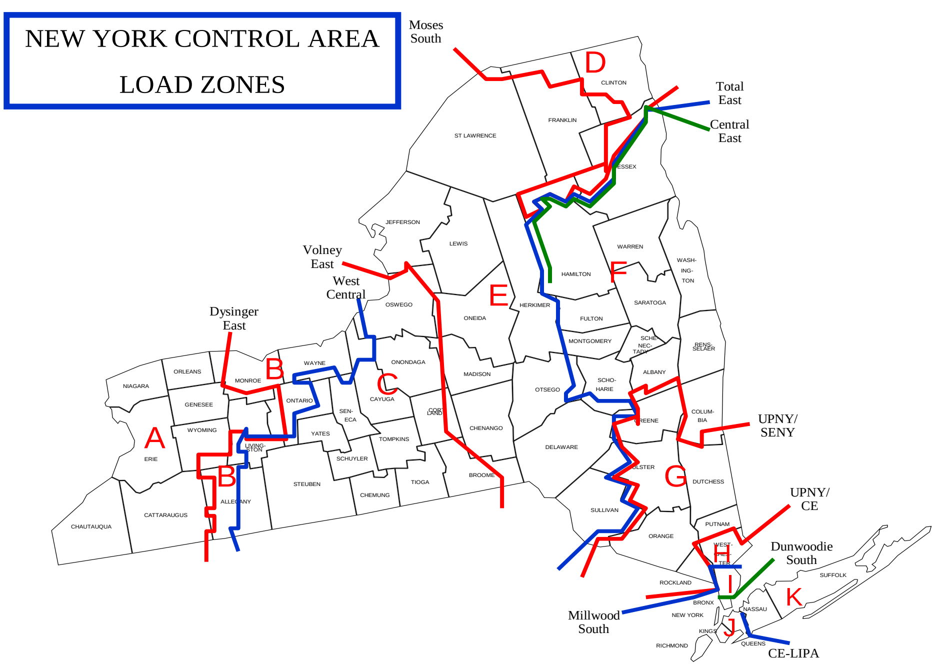
[6] The Federal Energy Regulatory Commission ordered the creation of a capacity zone within the NYISO's ICAP market encompassing Load Zones G, H, I, and J (the "G-J Locality"). The creation of the G-J Locality did not impact the current Unified and IRM Anchoring Methodologies and NYSRC's calculation of the NYCA IRM that is discussed in this report. The NYISO establishes the LCR for the G-J Locality in addition to the J and K Localities.

[7] A change was adopted for the 2019 IRM Study – which also applies to this study – to target the New York Balancing Area ("NYBA") to meet the LOLE criterion instead of NYCA, with the difference being that NYCA includes dummy zones for which MARS occasionally calculates loss of load events despite not containing load. The use of NYBA with the removal of dummy zones was recommended by the NYISO and GE and approved by ICS.

study results using the daily peak hour versus the 8,760-hour methodologies would be significant. Therefore, the base case and sensitivity cases in the 2016 IRM Study and all later studies, including this 2020 IRM Study, were simulated using all hours in the year.

Using the GE-MARS program, a procedure is utilized for establishing NYCA IRM requirements (termed the *Unified Methodology*) which establishes a relationship between NYCA IRM and preliminary LCRs, as illustrated in Figure 3-2. All points on these curves meet the NYSRC 0.1 days/year LOLE reliability criterion described in Section 2. Note that the area above the curve is more reliable than the criterion, and the area below the curve is less reliable. This methodology develops a pair of curves for two zones with locational capacity requirements, New York City (NYC), Zone J; and Long Island (LI), Zone K. Appendix A of NYSRC Policy 5-14 provides a more detailed description of the Unified Methodology.

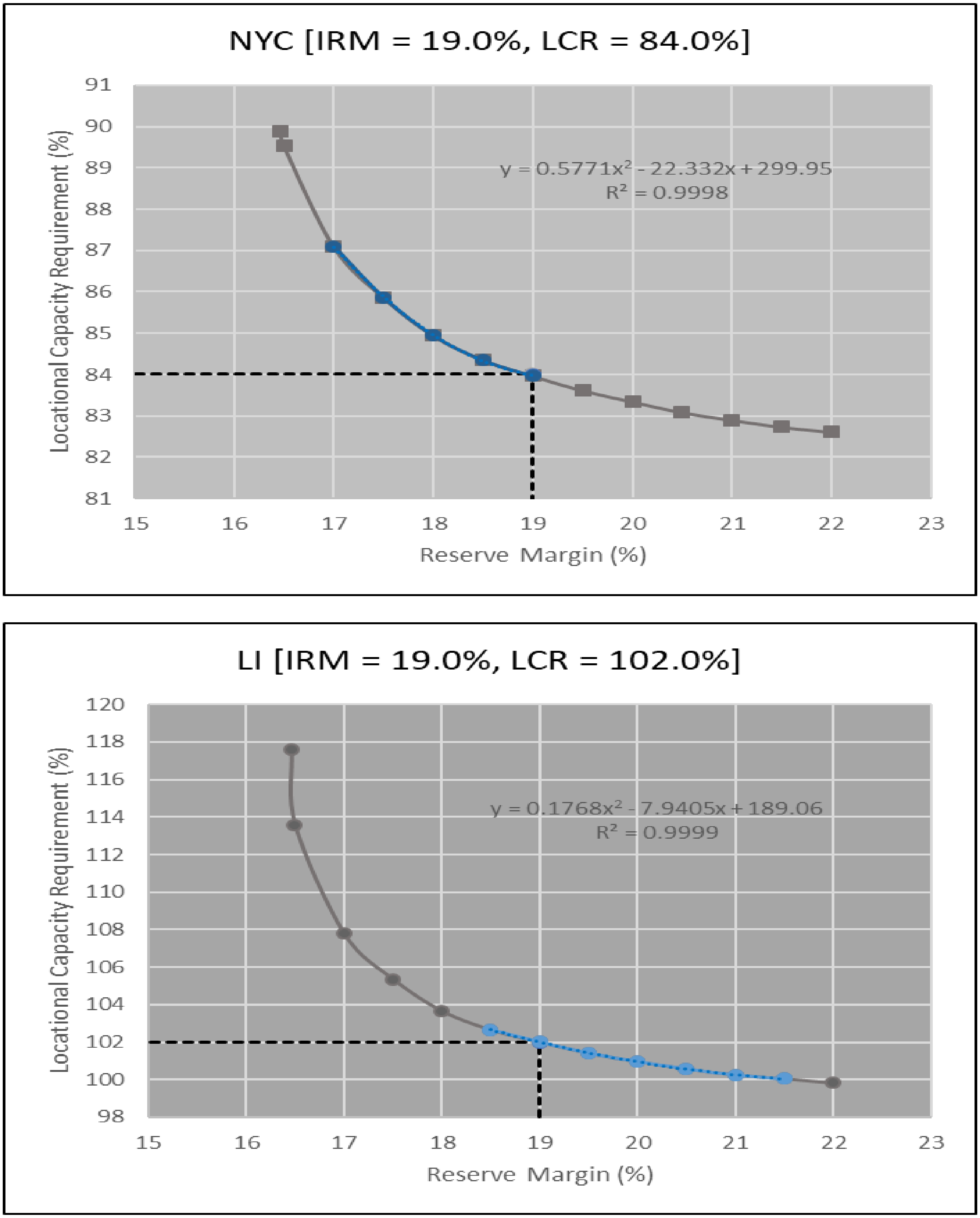
Figure 3-1 NYCA Load Zones



Base case NYCA IRM requirements and related preliminary LCRs for Zones J and K 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 NYSRC Policy 5-14 provides a more detailed description of the methodology for computing the Tan 45 inflection point.

Figure 3-2 Relationship Between NYCA IRM and Preliminary Locational Capacity Requirements



4. Study Results – Base Case

Results of the NYSRC technical study show that the required NYCA IRM is 19.0% for the 2020 Capability Year under base case conditions. Figure 3-2 on page 8 depicts the relationship between NYCA IRM requirements and preliminary LCRs in NYC and LI.

The tangent points on these curves were evaluated using the Tan 45 analysis described in Section 3. Accordingly, maintaining a NYCA IRM of 19.0% for the 2020 Capability Year, together with corresponding preliminary LCRs of 84.0% and 102.0% 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 preliminary LCRs in this 2020 IRM Study to 2019 IRM Study results (NYC LCR= 82.7%, LI LCR=101.5%), the preliminary 2020 NYC LCR increased by 1.3%, while the preliminary LI LCR increased by 0.5%.

In accordance with NYSRC Reliability Rule A.2, *Load Serving Entity ICAP Requirements,* the NYISO is responsible for separately calculating and establishing the final LCRs. The most recent NYISO LCR study,[8] dated January 17, 2019, determined that for the 2019 Capability Year, the final LCRs for NYC and LI were 82.8% and 104.1%, respectively. An LCR Study for the 2020 Capability Year is scheduled to be completed by the NYISO in January 2020. The NYISO utilizes an economic optimization algorithm for calculating LCRs that minimizes the total cost of NYCA capacity. This study utilizes the same base case database used by the NYSRC for calculating the NYCA IRM[9], while respecting the NYSRC-approved IRM and NYSRC's 0.1 days/year LOLE reliability criterion and required study procedures in NYSRC Policy 5-14.

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 0.025 per unit or less at 2,750 simulated years. This analysis demonstrates that there is a high level of confidence that the base case IRM value of 19.0% is in full compliance with the one day in 10 years LOLE criterion in NYSRC Reliability Rule A.1.

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

[9] This database may be updated for base case assumption changes that occur after the IRM study is completed.

5. Models and Key Input Assumptions

This section describes the models and related base case input assumptions for the 2020 IRM Study. The models represented in the GE-MARS analysis include a *Load Model, Capacity Model, Transmission Model, and Outside World Model*. A *Database Quality Assurance Review* of the 2020 base case assumptions is also addressed in this section. The input assumptions for the final base case were approved by the Executive Committee on October 11, 2019. Appendix A, Section A.3 provides more details of these models and assumptions and comparisons of several key assumptions with those used for the 2020 IRM Study.

5.1 The Load Model

5.1.1 Peak Load Forecast

The NYCA peak load forecast is based upon a model that incorporates forecasts of economic drivers, end use and technology trends, and normal weather conditions. A 2020 NYCA summer peak load forecast of 32,169 MW was assumed in the 2020 IRM Study, a decrease of 319 MW from the 2019 summer peak forecast used in the 2019 IRM Study. This "Fall 2020 Summer Load Forecast" was prepared for the 2020 IRM Study by the NYISO staff in collaboration with the NYISO Load Forecasting Task Force and presented to the ICS on October 2, 2019. The 2020 forecast considered actual 2019 summer load conditions. A 2019 "normalized" peak load[10] was determined to be 32,299 MW, 130 MW higher than the Fall 2020 Load Forecast, showing a continued forecast NYCA peak load decline. (See Table 5-1 below for additional details.) The NYISO expects the NYCA peak load to continue to gradually decrease into the future because of energy efficiency trends and the integration of DERs.

Table 5-1: Comparison of 2019 and 2020 Actual and Forecast Coincident Peak Summer Loads (MW)

	Fall 2019 Forecast	2019 Actual	2019 Normalized	Fall 2020 Forecast	Forecast Change
Zones A-I	15,557	14,188	15,519	15,441	-116
Zones J&K	16,931	16,215	16,780	16,728	-203
NYCA	32,488	30,403	32,299	32,169	-319

Use of the Fall 2020 Load Forecast and an updated load shape in the 2020 IRM Study resulted in an IRM increase of 0.3% compared to the 2019 IRM Study (Table 6-1). The

[10] The "normalized" 2019 peak load reflects an adjustment of the actual 2019 peak load to account for the load impact of actual weather conditions, demand response programs, and muni self-generation.

NYISO will prepare a Final 2020 summer load forecast at the end of 2019 that will be used for the NYISO's calculation of Locality LCRs for 2020.

5.1.2 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 conditions. Recognizing the unique load forecast uncertainty (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).

These LFU models are meant to measure the load response to weather at high peak-producing temperatures as well as other factors such as the economy. However, economic uncertainty is relatively small compared to temperature uncertainty one year ahead. Thus, the LFU is largely based on the slope of load vs. temperature, or the weather response of load. If the weather response of load increases, the slope of load vs. temperature will increase, and the upper-bin LFU multipliers (Bins 1-3) will increase. The new LFU multipliers included summer 2018 data which was not included in prior LFU models. In general, the load response to weather in 2018 was steeper than it was in previous hot summers.

The summer 2018 weekday base load in most areas declined relative to earlier years. This decline was larger than the decline in summer peak load over the same time period. Thus, the slope of load vs. weather has recently increased, resulting in larger LFU multipliers in the upper bins. This has resulted in higher LFU impacts on the IRM then in previous years. This is demonstrated by a sensitivity case that shows that the modeling of LFU in the 2020 IRM Study has an effect of increasing IRM requirements by 9.1% (Table 7-1, Case 3), as compared to a range of 7.2% to 7.9% in the previous three IRM studies.

5.1.3 Load Shape Model

A feature in GE-MARS that allows for the representation of multiple load shapes was utilized for the 2020 IRM Study. This multiple load shape feature enables a different load shape to be assigned to each of seven load forecast uncertainty bins. ICS has established criteria for selecting the appropriate historical load shapes to use for each of these load forecast uncertainty bins. For this purpose, a combination of load shape years 2002, 2006, and 2007 were selected by ICS as representative years for the 2020 IRM Study. The load shape for the year 2007 was selected to represent a typical system load shape over the 1999 to 2017 period. The load shape for 2002 represents a flatter load shape, i.e., 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 load duration curves were reviewed as part of the 2020 IRM Study. These curves were examined for the period 2002 through 2018. It was observed that the year 2012 was similar to the year 2007, the year 2013 was similar to 2006, and the year 2018 was similar to the year 2002. As a result of this review, the ICS decided to continue the use of the current three load shapes.

5.2 The Capacity Model

5.2.1 Conventional Resources: Planned New Capacity, Retirements, Deactivations, and Behind the Meter Generation

Planned conventional generation facilities that are represented in the 2020 IRM Study are shown in Appendix A, Section A.3.2. 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 its 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.

A planned new generating unit located in Zone G, Cricket Valley Energy Center, having a capacity of 1,020 MW, is included in the 2020 IRM Study. Also included are the retirements of Cayuga Unit 1 (151 MW) and two small units (totaling 5 MW), in addition to the deactivation of the Indian Point 1 nuclear unit (1,016 MW).

A "BTM:NG," or behind the meter net generation program resource, for the purpose of this study contributes its full capacity while its entire host load is exposed to the electric system. Two BTM:NG resources with a total resource capacity of 144.1 MW and a total host load of 50.5 MW, included in 2019 IRM Study, are also included in this study. The resource capacity of these BTM:NG facilities is included in the NYCA capacity model, while their host loads are included in the NYCA 2020 summer peak load forecast used for this study.

The NYISO has identified several state and federal environmental regulatory programs that could potentially impact operation of NYS Bulk Power System. The NYISO analysis concluded that these environmental initiatives would not result in NYCA capacity reductions or retirements that would impact IRM requirements during the 2020 Capability Year. The analysis further identified those regulations that could potentially act in the future to limit the use of existing resources and the those that will require the addition of new non-emitting resources. For more details, see Appendix A, Section B.2.

5.2.2 Renewable Resources

Intermittent types of renewable resources – *wind*, *solar,* and *energy storage* – are becoming an increasing component of the NYCA generation mix. These intermittent resources are included on the MARS capacity model as described below. These resources, plus the existing 4,253 MW of hydro facilities, will account for a total of 6,202 MW of NYCA renewable resources in 2020.

It is projected that during the 2020 summer period there will be a total *wind capacity* of 1,892 MW participating in the capacity market in New York State. This reflects no new planned wind capacity additions since the 2019 summer period. All wind farms are presently located in upstate New York in Zones A-E.

GE-MARS allows the input of multiple years of wind data. This multiple wind shape model randomly draws wind shapes from historical wind production data. The 2020 IRM Study used available wind production data covering the years 2014 through 2018. For any new wind facilities, zonal hourly wind shape averages or the wind shapes of nearby wind units will be modeled.

Overall, inclusion of the projected 1,892 MW of wind capacity in the 2020 IRM Study accounts for 3.5% of the 2020 IRM requirement (Table 7-1, Case 4). This relatively high IRM impact is a direct result of the relatively 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 Appendix A, Table A.7.

In 2020, 20 MW of new *solar capacity* in Riverhead will be added to the NYS Bulk Power System (BPS), bringing the total BPS solar capacity in NYCA to 51.5 MW. Actual hourly solar plant output over the 2014-18 period is used to represent solar shape for existing units, while new solar units are represented by zonal hourly averages or nearby units.

An *energy storage* resource will be added to the BPS in 2020 in the form of a 5 MW battery storage unit in Montauk.

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 2020 IRM Study covered the 2014-2018 period.

The weighted average five-year EFORd for NYCA thermal and large hydro generating units calculated for the 2014-18 period is slightly higher than the 2013-17 average value used for the 2019 IRM Study. This increase in average forced outage rates increased the 2020 IRM by 0.3% compared to the 2019 IRM Study (Table 6-1). Appendix A, Figure A.4 depicts NYCA EFORd trends from 2005 to 2018.

5.2.4 Emergency Operating Procedures (EOPs)

(1) Special Case Resources (SCRs)

SCRs are loads capable of being interrupted and distributed generators that are rated at 100 kW or higher. SCRs are ICAP resources that provide load curtailment only when activated when as needed in accordance with NYISO emergency operating procedures. GE-MARS represents SCRs as an EOP step, which is activated to avoid or to minimize expected loss of load. SCRs are modeled with monthly values based on July 2019 registration. For the month of July, the forecast SCR value for the 2020 IRM Study base case assumes that 1,282 MW will be registered, with varying amounts during other months based on historical experience. This is 27 MW lower than that assumed for the 2019 IRM Study. The number of SCR calls in the 2019 Capability Year for the 2020 IRM base case was limited, as in previous studies, to five calls per month.

The SCR performance model is based on discounting registered SCR values to reflect historical availability. The SCR model used for the 2020 IRM Study is based on a recent analysis of performance data for the 2012-18 period. This SCR determined a SCR model value of 872 MW – 30 MW lower than determined for the 2019 Study – with an overall performance factor of 68.2%. This is 0.8% lower than the performance factor used the 2019 IRM Study (refer to Appendix A, Section A.3.7 for more details). Although the SCR performance factor is slightly lower than assumed for the 2019

Study, the projected decrease of SCR capacity resulted in a net IRM decrease of 0.1% compared to the 2019 IRM Study (Table 6-1).

Incorporation of SCRs in the NYCA capacity model has the effect of increasing the IRM by 2.8% (Table 7-1, Case 5). This increase is because the overall availability of SCRs is lower than the average statewide resource fleet availability. The 2020 IRM Study also determined that for the base case, approximately ___ SCR calls would be expected during the 2020 Capability Period.

(2) Emergency Demand Response Program (EDRP)

The EDRP is a separate EOP step from the SCR Program that 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 2020 IRM Study assumes that 6 MW of EDRPs will be registered in 2020, about the same amount assumed in the 2019 IRM Study. However, EDRP capacity used for the 2020 IRM Study was discounted to a base case value of only one MW to reflect past performance. This value is implemented in the study in July 2019 and proportional to monthly peaks loads in other months, while being limited to a maximum of five EDRP calls per month. Because of the very small EDRP capacity represented in 2020 IRM Study, it has virtually no impact on the IRM.

Both SCRs and EDRP are included in the Emergency Operating Procedure (EOP) model. Unlike SCRs, EDRPs are not ICAP suppliers and, therefore, are not required to respond when called upon to operate.

(3) Other Emergency Operating Procedures

In addition to SCRs and the EDRP, the NYISO will implement several other types of EOPs, such as voltage reductions, as required, to avoid or minimize customer disconnections. Projected 2019 EOP capacity values are based on recent actual data and NYISO forecasts. Refer to Appendix B, Table B.2 for projected EOP frequencies for the 2020 Capability Year assuming the 19.0% base case IRM.

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 provide locational capacity benefits. Non-locational capacity, when coupled with a UDR to deliver capacity to a Locality, can be used to satisfy locational capacity requirements. The owners of the UDRs elect whether they will utilize their capacity deliverability rights. This decision determines how this transfer capability will be represented in the MARS model. 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 2019 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 they plan 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 2020 IRM Study incorporates the confidential elections that these facility owners made for the 2020 Capability Year.

5.3 The Transmission Model

A detailed NYCA 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 A, Figure A.12. The transfer limits employed for the 2020 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 transmission model assumptions included in the 2020 IRM Study are listed in Table A.8 in the Appendix which reflects changes from the model used for the 2019 IRM Study. These topology changes are as follows:

- An update to the UPNY-SENY Interface Group
- An update to the Jamaica Ties (from Zone J to Zone K)
- An update to the UPNY-Con Edison Interface (from Zone G to Zone H)
- The Cedars bubble merged into the Hydro-Quebec bubble.

The above 2020 IRM Study topology changes are primarily driven by addition of the Cricket Valley Energy Center and deactivation of the Indian Point 2 nuclear unit**.**

Forced transmission outages based on historic performance are represented in the GE-MARS model for the underground cables that connect New York City and Long Island to surrounding zones. The GE-MARS model uses transition rates between operating states for each interface, which were calculated based on the probability of occurrence from the historic failure rates and the time to repair. Transition rates into the different operating states for each interface were calculated based on the circuits comprising each interface, including failure rates and repair times for the individual cables, and for any transformer and/or phase angle regulator associated with that cable. The TOs provided updated transition rates for their associated cable interfaces. Updated cable outage rates assumed in the 2020 IRM Study had no IRM impact on the 2020 IRM compared with the 2019 IRM Study (Table 6-1).

As in all previous IRM studies, forced outage rates for overhead transmission lines were not represented in the 2020 IRM Study. Historical overhead transmission availability was evaluated in a study conducted by ICS in 2015, *Evaluation of the Representation of Overhead Transmission Outages in IRM Studies*, which concluded that representing overhead transmission outages in IRM studies would have no material impact on the IRM (see www.nysrc.org/reports).

The impact of NYCA 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 on IRM, if internal NYCA transmission constraints were eliminated, the required 2020 IRM could decrease by 2.2% (Table 7-1, Case 2).

5.4 The Outside World Model

The Outside World Model consists of four interconnected external control areas contiguous with NYCA: Ontario, Quebec, New England, and the PJM Interconnection (PJM). NYCA reliability is improved and IRM requirements can be reduced by recognizing available emergency capacity assistance support from these neighboring interconnected control areas, in accordance with control area agreements governing emergency operating conditions.

For the 2020 IRM Study, two Outside World Areas, New England and PJM, are each represented as multi-area models—i.e., 13 zones for New England and five zones for the PJM Interconnection. These zonal representations align with these Control Areas' own models that they use for their own reserve margin studies. Another consideration for developing models for the four Outside World Areas is to recognize internal transmission constraints within those Areas that may limit emergency assistance (EA) into the NYCA. This recognition is explicitly considered through direct multi-area modeling of well-defined external area "bubbles" and their internal interface constraints. The model's representation explicitly requires adequate data in order to accurately model transmission interfaces, load areas, resource and demand balances, load shape, and coincidence of peaks among the load zones within these Outside World Areas.

Representing external interconnection support in IRM studies significantly reduces IRM requirements. For the past five IRM studies, EA has reduced IRM requirements in the range of 8.0 to 8.7%.[11] This is a higher EA benefit than used by other NPCC member systems for their IRM analyzes. To examine whether NYCA IRM studies are overly depending on EA for reducing IRM requirements, in 2019 ICS conducted an analysis of the IRM study's Outside Area Model to review its compliance with a NYSRC Policy 5 objective that "interconnected external Areas shall be modeled to avoid NYPA's overdependence on external areas for emergency assistance." To meet this objective, Policy 5 requires that: (1) an external Control Area's LOLE assumed in an IRM study cannot be lower than its own LOLE criterion, and (2) its reserve margin can be no higher than the area's minimum requirement.

In previous IRM studies, for the purpose of developing the Outside World Model, loads in external areas were scaled proportional to existing load to meet the LOLE criterion with reserve margins adjusted as necessary to be no higher than the area's minimum requirement. After considering several options, ICS approved a new method in which load is instead scaled proportional to excess capacity in each load zone of each external Area to meet the LOLE criterion and reserve margins and adjusted, if needed, to be no higher than the area's minimum IRM requirement. This method has a two-fold impact on assistance to NYCA. First, the overall level of reserves in the external Areas to support EA to NYCA is reduced. Second, the external Area load zones with excess capacity are generally positioned closer to the NYCA load zones, and thus reduces the EA further. Therefore, ICS concluded that this updated model better meets the Policy 5 objective to avoid overdependence on external areas for EA than previous Outside World Models, and therefore approved this new model for use in the 2020 IRM Study.[12]

During 2020 Hydro-Quebec is expected to wheel 300 MW of capacity through NYCA to New England. In addition, the 2020 IRM study continues to limit EA to a maximum of 3,500 MW as applied in the 2018 and 2019 IRM Studies[13].

Utilizing the improved Outside Area Model, while including the Hydro-Quebec wheel to New England and continuing to represent the 3,500 MW EA limit described above, reduces the NYCA IRM by 7.5% (Table 7-1, Case 1). This is 0.7% less than the interconnection benefit determined in the 2019 IRM Study.

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[11] See 2015 to 2019 IRM Study reports at www.nysrc.org/reports3.html.

[12] See the white paper, *Evaluation of External Area Modeling in NYCA IRM Studies*, for a description of this analysis, at http://www.nysrc.org/reports3.html.

[13] The 2018 IRM Study report, pages 17-18, describes this EA limit and its derivation. See www.nysrc.org/reports3.html.

5.5 Database Quality Assurance Review

It is critical that the database 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 two TOs for their review. Also, certain confidential data are reviewed by two independent NYSRC consultants as required.

The NYISO, GE, and TO reviews found a few 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 for the 2020 IRM Study input data is shown in Appendix A, Section A.4.

6. Parametric Comparison with 2019 IRM Study Results

The results of this 2020 IRM Study show that the base case IRM result represents an 2.2% increase from the 2019 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 2019 IRM 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 IRM impact of each parameter in this analysis was normalized such that the net sum of the -/+ % parameter changes total the 2.2% IRM increase from the 2019 IRM Study. Table 6-1 also provides the reason for the IRM change for each study parameter from the 2019 IRM Study.

There are seven parameter drivers that in combination *increased* the 2020 IRM from the 2019 base case value by 3.0%. Of these drivers, the principal driver is an updated LFU model which increased the IRM by 1.2%. Section 5.1.2 describes the reasons for this rather large increase in the IRM.

Three parameter drivers in combination *decreased* the IRM from the 2019 base case by 0.8%. The largest decrease, 0.6%, is attributed to topology changes in the 2020 IRM Study.

The parameters in Table 6-1 are discussed under *Models and Key Input Assumptions.*

Table 6-1: Parametric IRM Impact Comparison– 2019 IRM Study vs. 2020 IRM Study

Parameter	Estimated IRM Change (%)	IRM (%)	Reasons for IRM Changes
2019 IRM Study – Final Base Case		**16.8**	
2020 IRM Study Parameters that increased the IRM			
Update Load Forecast Uncertainty	+1.2		Higher weather uncertainty
Improved External Area Model	+0.7		Less emergency assistance available using improved external area model plus Hydro-Quebec wheel
Updated Load Forecast & Load Shape Model	+0.3		
Run of River Shapes	+0.3		Five-year average dropped a wet year (2013) and added a dry year (2018)
Generator Transition Rates	+0.3		Increase in forced outage rates n all zones except LI
DMNC Updates	+0.1		DMNC rating testing resulted in less Downstate capacity relative to Upstate
Update Non-SCR EOPs	+0.1		23 less MW of EOP steps than in 2019 study
Total IRM Increase	**+3.0**		
2020 IRM Study Parameters that decreased the IRM			
Topology Changes	-0.6		Improvements in UPNY/SENY and Zone K to Zone J interfaces in updated model
SCR Update	-0.1		Decreased SCR enrollment improves zonal average EFORds
Update Wind Shapes	-0.1		The year added to the 5-year window (2018) had better performance than the dropped year (2013)
Total IRM Decrease	**-0.8**		
2020 IRM Study Parameters that did not change the IRM			
NYCA Capacity Additions & Retirements	0		
2020 Maintenance	0		
Update Cable Transition Rates	0		
New Solar Unit	0		
EDRP Update	0		
Net Change from 2019 Study		**+2.2**	
2020 IRM Study – Final Base Case		**19.0**	

7. Sensitivity Case Study

In addition to calculating the IRM using base case assumptions, sensitivity analyses are run as part of an IRM study to determine IRM outcomes using different assumptions than in the base case. Sensitivity studies provide a mechanism for illustrating "cause and effect" of how some performance and/or operating parameters and study assumptions can impact reliability. Certain sensitivity studies serve to inform the NYSRC Executive Committee when determining the Final IRM of how the IRM may be affected by reasonable deviations from selected base cases assumptions. The methodology used to conduct sensitivity cases starts with the base case IRM results and adds or removes capacity from all NYCA zones until the NYCA LOLE approaches 0.1 days/year.

Table 7-1 shows the IRM requirements for 11 sensitivity cases. Because of the lengthy computer run time and manpower needed to perform a full Tan 45 analysis in IRM studies[14], this method was applied for only select cases as noted in the table. It should be recognized that some accuracy is sacrificed when a Tan 45 analysis is not utilized.

Sensitivity Cases 1 through 5 in Table 7-1 illustrate how the IRM would be impacted if certain major IRM study parameters were not represented in the IRM base case. Two of these cases – assuming that load forecast uncertainty (Case 3) and emergency assistance from neighboring Control Areas (Case 1) were not represented in the study – show particularly significant IRM impacts. These parameters and their IRM impacts are discussed in Sections 5.1.2 and 5.4, respectively.

The next set of cases – Cases 6 through 11 – illustrate the IRM impacts of changing certain base case assumptions. Five of these cases assume that select planned new resource additions or retirements are either delayed to 2021 or advanced to 2020. Included in these sensitivity cases are accompanying topology changes that could also impact the IRM. The remaining case, Case 9, shows the IRM impact assuming that the SCR model were to utilize different event data than assumed for the base case.

Appendix B, Table B-1 includes a more detailed description and explanation of each sensitivity case.

[14] The Tan 45 method is described in Section 3.

Table 7-1: Sensitivity Cases – 2020 IRM Study

Case	Description	IRM (%)	% Change from Base Case
0	2020 Base Case IRM	19.0	0
	IRM Impacts of Key MARS Study Parameters		
1	NYCA isolated, i.e., no emergency assistance	26.5	+7.5
2	No internal NYCA transmission constraints	16.8	-2.2
3	No load forecast uncertainty, i.e., 100% probability that forecast peak load will occur	9.9	-9.1
4	No wind capacity	15.5	-3.5
5	No SCRs	16.2	-2.8
	IRM Impacts of Base Case Assumption Changes		
6	Indian Point Unit 2 remains in service[15] (Tan 45 analysis)	18.8	-0.2
7	Remove the planned Cricket Valley 1,020 MW unit from the base case[16] (Tan 45 analysis)	19.7	+0.7
8	Retire the Somerset 686 MW unit[17]	18.7	-0.3
9	Model SCRs utilizing event performance data only[18]	19.0	0
10	HQ to NY 80 MW EDR Project included[19]	18.9	-0.1
11	Remove Indian Point Unit 3 from service[20] (tan 45 analysis)	19.3	+0.3

8. 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.

[15] The base case assumes that this unit will be deactivated in 2020.
[16] The base case assumes that this unit will be installed in 2020. The UPNY/CE interface group was adjusted for this case as appropriate.
[17] This unit is not presently scheduled to retire until 2021.
[18] This is an alternate to the base case SCR model which utilizes a mix of event and test performance data.
[19] This project is not presently scheduled for completion until 2021.
[20] This unit is not presently scheduled to retire until 2021. Removal of this unit in 2020 increases the UPNY/CE transfer capability by 250 MW.

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.1**: R1. The conversion to UCAP provides financial incentives to decrease the forced outage rates while improving reliability.

The increase in wind resources raises the IRM because wind capacity has a relatively 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 required UCAP margins, which steadily decreased over the 2006-2012 period to about 5%, and then have remained fairly steady since. Appendix C provides details of the ICAP to UCAP conversion process used for this analysis

Figure 8-1 NYCA Reserve Margins