

**Draft**  
**December 1, 2007**



**NEW YORK CONTROL AREA  
INSTALLED CAPACITY REQUIREMENTS  
FOR THE PERIOD  
MAY 2008 THROUGH APRIL 2009**

**Technical Study Report**

**New York State Reliability Council, L.L.C.  
Installed Capacity Subcommittee**

**(EC Approval Date)**

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## EXECUTIVE SUMMARY

A New York Control Area (NYCA) Installed Reserve Margin (IRM) Study is conducted annually by the New York State Reliability Council (NYSRC) Installed Capacity Subcommittee to provide parameters for establishing NYCA IRM requirements for the following capability year. This year's report covers the period May 2008 to April 2009 (2008 capability year).

**Results of the NYSRC technical study show that the required NYCA IRM for the 2008 capability year is 15.0% under base case conditions.**

For this base case, the study also determined Minimum Locational Capacity Requirements (MLCRs) of 79% and 94% 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 results satisfy and are consistent with all NYSRC Reliability Rules and Northeast Power Coordinating Council (NPCC) and North American Electric Reliability Corporation (NERC) reliability standards.

The above 2008 base case IRM Study result is 1.0 percentage point less than the base case IRM requirement determined by the 2007 IRM Study. The principle reasons for this reduction in required IRM are:

1. The continued improvement of NYCA generating unit availability,
2. Completion of the Neptune HVdc 660 MW submarine cable connecting Long Island and PJM,
3. Increased transfer capacity of the Dunwoodie-South interface,
4. Improved emergency assistance benefits from interconnections to neighboring Control Areas, primarily due to transmission reinforcements within these Areas, and
5. A reduction of transmission cable outage rates. Table 2 shows the IRM impacts of these factors that have permitted an IRM reduction from the 2007 IRM base case value of 16.0%.

The study also evaluated IRM requirement impacts of several sensitivity cases. These results are depicted in Table 3 and in Appendix B-1. In addition, a confidence interval analysis was conducted to determine the IRM range around the base case IRM that provides a high confidence of meeting the reliability index within the NYSRC resource adequacy criterion.

The base case and sensitivity case 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 2008 capability year.

## INTRODUCTION

This report describes a technical study, conducted by the NYSRC Installed Capacity Subcommittee, for establishing the NYCA IRM for the period of May 1, 2008 through April 30, 2009 (2008 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:

$$\text{ICR} = (1 + \text{IRM}\% / 100) \times \text{Forecasted NYCA Peak Load}$$

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 2008 capability year.

The NYISO will implement the final NYCA IRM as determined by the NYSRC — in accordance with the NYSRC Reliability Rules and the NYISO Installed Capacity manual. 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. These Unforced Capacity and Demand Curve concepts are described later in the report. The schedule for the IRM study is based on the NYISO's timetable for these actions.

The study criteria, procedures, and types of assumptions used for this 2008 IRM Study are in accordance with NYSRC Policy 5-1, *Procedure for Establishing New York Control Area Installed Capacity Requirements*, dated November 14, 2006. The primary reliability criterion used in the IRM study requires, on average, a Loss of Load Expectation (LOLE) of no more than once in 10 years for the NYCA. This NYSRC resource adequacy criterion is consistent with NPCC 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 2008 IRM Study, and will consider the MLCR values determined in this study.

On June 7, 2007 the NYSRC conducted a Resource Adequacy Workshop to provide the NYISO, market participant, and NYS Department of Public Service staffs with a better understanding of probability theory and reliability analysis models, procedures, and assumptions as applied to NYCA IRM studies. Workshop material can be found at [www.nysrc2.org/workshops.asp](http://www.nysrc2.org/workshops.asp).

Previous NYCA 2000 to 2007 IRM Study reports can be found at [www.nysrc2.org/reports.asp](http://www.nysrc2.org/reports.asp). Table B-2 in Appendix B provides a comparison of previous NYCA base case and Final IRMs for the 2000 through 2008 capability years. Definitions of certain terms in this report can be found in the NYSRC Glossary in the *NYSRC Reliability Rules for Planning and Operating the New York State Power System Manual*, at [www.nysrc2.org/NYSRCReliabilityRulesComplianceMonitoring.asp](http://www.nysrc2.org/NYSRCReliabilityRulesComplianceMonitoring.asp).

## **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 the NPCC Resource Adequacy Standard in NPCC Document A-2.

In accordance with NYSRC Rule A-R2, *Load Serving Entity (LSE) Installed Capacity Requirements*, the NYISO is required to establish LSE installed capacity requirements, including locational capacity requirements, in order to meet the statewide IRM Requirements established by the NYSRC for maintaining NYSRC Rule A-R1 above.

The full NYSRC Reliability Rule A-R2 can be found in the NYSRC Reliability Rules Manual on the NYSRC Web site, at [www.nysrc2.org/NYSRCReliabilityRulesComplianceMonitoring.asp](http://www.nysrc2.org/NYSRCReliabilityRulesComplianceMonitoring.asp).

## **IRM STUDY PROCEDURES**

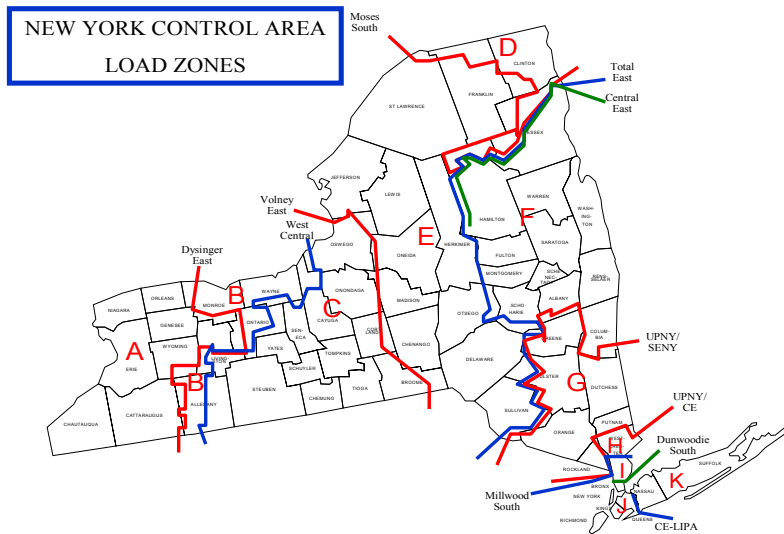
The study procedures used for the 2008 IRM Study are described in detail in NYSRC Policy 5-1, *Procedure for Establishing New York Control Area Installed Capacity Requirements*. Policy 5-1 describes the computer program used for the reliability calculation in addition to the procedures and types of input data and models used for the IRM Study. Policy 5-1 can be found on the NYSRC Web site at [www.nysrc2.org/policies.asp](http://www.nysrc2.org/policies.asp).

This study utilizes a *probabilistic approach* for determining the NYCA IRM requirements. This technique calculates the probabilities of generating 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 Zones — plus four external Control Areas (“Outside World” Areas) directly interconnected to the NYCA. The eleven NYCA zones are depicted in Figure 1 below. GE-MARS calculates LOLE, expressed in days per year, to provide a consistent measure of system reliability.

**Figure 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. All points on these curves meet the NYSRC 0.1 days/year LOLE reliability criterion described above. This methodology develops a pair of curves, one for NYC (Zone J) and one for LI (Zone K). Policy 5-1 provides a more detailed description of the Unified Methodology.

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 multi-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 A-4.1 provides a more detailed description of the methodology for computing the Tan 45 inflection point.

## BASE CASE STUDY RESULTS

Results of the NYSRC technical study show that the required NYCA IRM is 15.0% for the 2008 capability year under base case conditions. Figure 2 depicts the relationship between NYCA IRM requirements and resource capacity in NYC and LI. The points on the NYC and LI curves were calculated using the methodologies described in the previous “IRM

Study Procedures” section. The anchor points on these curves, from which the above base case study results are based, were evaluated using the Tan 45 analysis, also previously described. Accordingly, we conclude that maintaining a NYCA installed reserve of 15.0% for the 2008 capability year, together with MLCRs of 79% and 94% for NYC and LI, respectively, will achieve applicable NYSRC and NPCC reliability criteria for the base case study assumptions shown in Appendix A. The NYISO will consider these MLCRs when developing the final NYC and LI LCR values for the 2008 capability year.

A Monte Carlo simulation error analysis shows that there is a 99.7% probability that the above base case result is within a range of % and % (see Appendix A-2.1). Within this range the statistical significance of the %, 15.0%, and % numbers are a %, 50%, and % probability of meeting the one day in ten reliability index, assuming perfect accuracy of all parameters. The base case IRM value of 15.0% is in full compliance with NYSRC and NPCC reliability rules and criteria.

## MODELS AND KEY INPUT ASSUMPTIONS

This section describes the models and related input assumptions for the 2008 IRM Study. The models represented in the GE-MARS analysis include a Load Model, Capacity Model, Transmission System Model, and Outside World Model. Appendix A provides more details of these models and assumptions.

### Load Model

- Peak Load Forecast:** A 2008 NYCA summer peak load of 33,730 MW was assumed in the study. This load forecast was prepared by the NYISO Staff in October 2007 and is based on actual 2007 summer load conditions. Although the NYISO will prepare a final 2008 summer forecast in early 2008 for use in NYISO locational capacity and other studies, it is expected that both forecasts will be similar.
- Load Shape Model:** The 2008 IRM Study was performed using a load shape based on 2002 actual values. The 2002 load shape was compared to load shapes from 1999 through 2006. The conclusion reached in this recent analysis was that the load shape used for this year’s study should be the same as in the 2006 and 2007 IRM Studies, i.e., the 2002 load shape is best suited for the 2008 IRM Study.
- 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 and economic conditions. Recognizing the unique LFU of individual NYCA areas, the LFU model is subdivided into four areas: Zone I, Zone J (NYC), Zone K (LI), and Zones A-G (the rest of New York State). Recognizing LFU in the base case increases IRM requirements by 7.3% (see Table 3).

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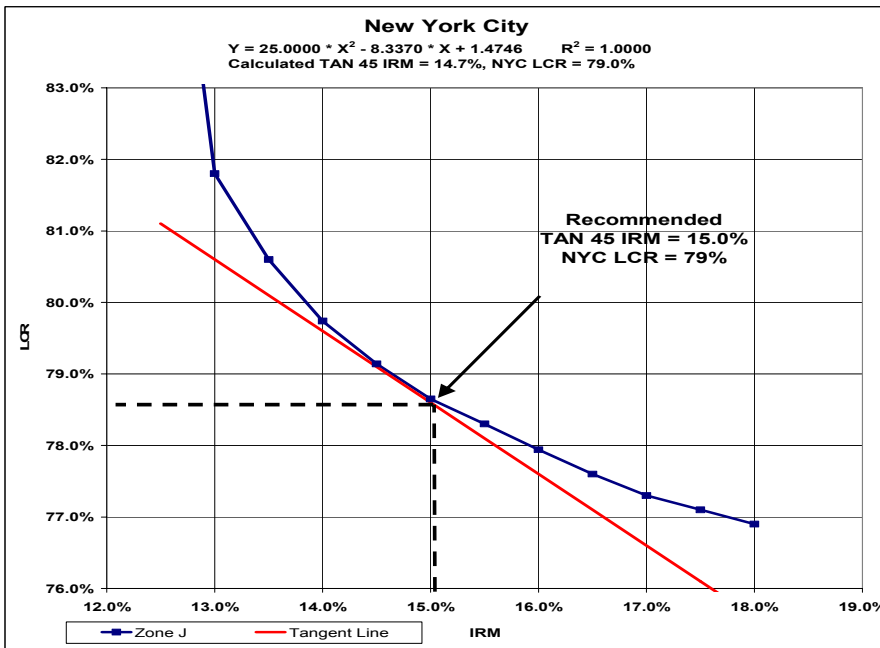
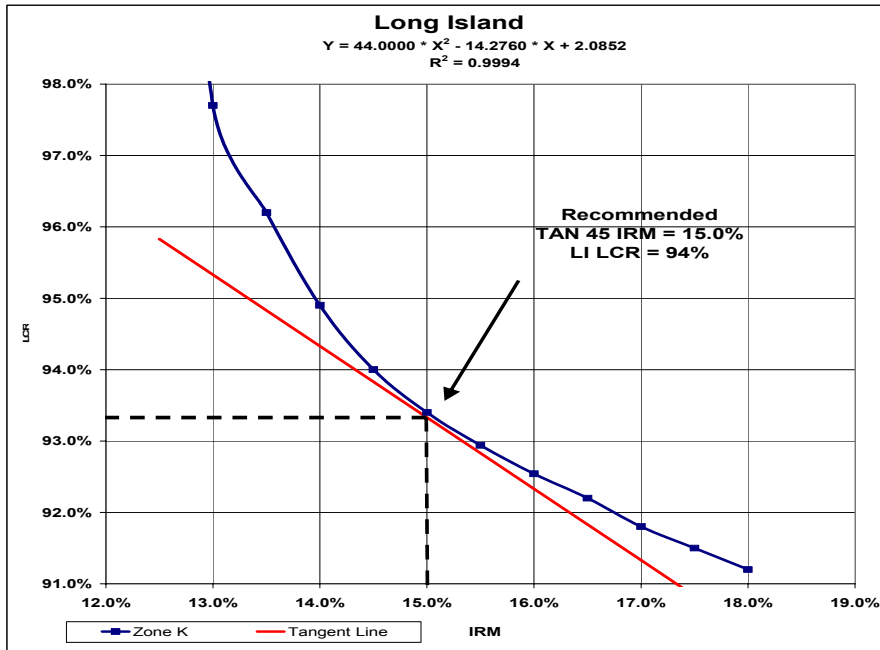
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Figure 2

NYCA Locational ICAP Requirements vs. Statewide ICAP Requirements



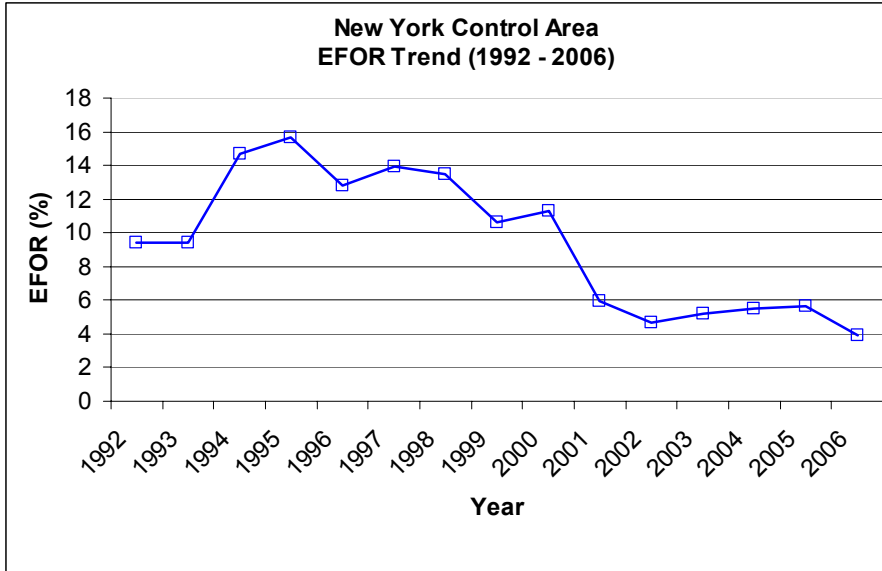
## Capacity Model

The capacity model in MARS incorporates the several considerations, as discussed below:

- **Resource Facility Ratings:** The rating for each existing and planned resource facility in the capacity model is based on its Dependable Maximum Net Capability (DMNC). The source of DMNC ratings for existing facilities is seasonal tests required by procedures in the NYISO Installed Capacity Manual. Appendix A shows the new resource facilities that are included in the 2008 IRM Study capacity model.
- **Resource Capacity 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 on demand” (EFORd) for each unit represented. Outage data is received by the NYISO from generator owners based on specific 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 2008 IRM Study covered the 2002–2006 period.

Generating unit availability performance has stabilized over the past six years. As depicted in Figure 3 below, the NYCA average annual EFOR during the 2001-2006 period have been consistently in the range of 4 to 6%. This is a substantial improvement from the 9 to 16% EFOR range experienced during the prior nine years. Improvement of generating unit availability has permitted the required IRM to be reduced by 1.1% since the 2005 capability year, that is, without this improvement the required 2008 IRM base case would have been 16.1% instead of 15.0%.

Figure 3



- **Generating Unit Ambient Deratings:** Gas turbine and combined cycle capacity deratings are modeled using ambient temperature correction curves. Deratings of generating units affected by extreme temperature and humid summer conditions are recognized in this model. Based on its review of historical 2006 and 2007 data, the NYISO staff has updated the simple cycle combustion turbine derate model to include what is termed the bias. The NYISO plans to extend this analysis in the future to include other capacity limited resources. Although this analysis indicates a bias at design temperatures, it also shows an approximate one-third reduction from the 2007 IRM Study, in the amount of correction occurring at higher temperatures. The net effect of replacing the 2007 IRM Study's combustion turbine derate model with this year's updated model is a slight reduction in LOLE. A NYISO report on this analysis, *Adjusting for the Overstatement of the Availability of the Combustion Turbine Capacity in Resource Adequacy Studies*, dated October 22, 2007, can be found at [www.nyiso.com](http://www.nyiso.com).

- **Emergency Operating Procedures:**

-- **Special Case Resources (SCRs).** SCRs are ICAP resources that include loads that are capable of being interrupted — and distributed generation that may be activated on demand. This study assumes 1,323 MW of SCR capacity resource capacity in July and August (and lesser amounts during other months), limited to a maximum of four SCR calls per month in July and August for NYS Department of Environmental Conservation-limited generation. The above SCR capacity was discounted to a base case value of 1205 MW (reflecting past performance) for the 2008 Study.

-- **Emergency Demand Response Programs (EDRP).** 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 2008 Study assumes 430 MW of EDRP capacity resources will be registered in 2008. This EDRP capacity was discounted to a base case value of 193.5 MW (reflecting past performance) and is implemented in the study in July and August (and less 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.

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-- **Other Emergency Operating Procedures.** The NYISO will implement EOPs as required to minimize customer disconnections. If a 15.0% IRM is maintained, firm load disconnections due to inadequate resources will not occur more than once in every ten years on average — in accordance with NYSRC and NPCC criteria. (Refer to Appendix B, Table B-2, for the expected use of SCRs, EDRP, voltage reductions, and other EOPs during 2008, assuming an IRM of 15.0%.)

- **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 NYISO calculates the actual UDR award based on the performance characteristics of the facility and other data. LIPA's 330 MW HVdc Cross Sound Cable and 660 MW HVdc Neptune Cable are facilities that are represented in the 2008 Study as having UDR capacity rights. LIPA currently has the option on an annual basis of selecting the MW quantity of UDRs (ICAP) it plans on utilizing for capacity contracts over these facilities, with any remaining capability on the cable to be used to support emergency assistance and counted towards reducing locational and IRM requirements.

### Transmission System Model

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A detailed transmission system model is represented in the GE-MARS study. The transmission system topology, which includes the eleven NYCA zones and four Outside World Areas, along with transfer limits, is shown in Figure A-9 in Appendix A. A notable addition in the 2008 IRM Study transmission model is LIPA's Neptune HVdc submarine cable which was energized during the summer of 2007. This cable connects Long Island and PJM and has a 660 MW rating. In addition to this new HVdc cable, improvements in the transfer capability of the Dunwoodie-South interface and the reconductoring of the NUSCO 1385 submarine cables offer increased ability of the system to transfer capacity (and energy) when needed. A fuller description of these improvements can be found in Appendix A.

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GE-MARS is capable of determining the impact of transmission constraints on NYCA LOLE. This study, as with previous GE-MARS studies, reveals that the transmission system into NYC and LI is constrained and can impede the delivery of emergency capacity assistance required to meet load within these zones. The NYSRC has two reliability planning criteria that recognize transmission constraints: (1) the NYCA IRM requirement considers transmission constraints into NYC and LI, and (2) minimum LCRs must be maintained for both NYC and LI (See NYSRC Resource Adequacy Reliability Criteria section).

The impact of transmission constraints on NYCA IRM requirements depends on the level of resource capacity in NYC and LI. 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 (*Locational Installed Capacity Requirements Study*, dated February 16, 2007, at [www.nyiso.com](http://www.nyiso.com)) determined that for 2007 capability year, the required LCRs for NYC and LI were 80% and 99%, respectively. As previously discussed, Figure 2 depicts the relationship between NYCA IRM requirements and resource capacity in NYC and LI for the base case. This figure shows that the IRM requirement can be impacted significantly depending on the level of capacity within these zones, particularly to the right of the "anchor point" of the curve where the IRM requirement rises much faster than the locational installed capacity levels are reduced. For base case assumptions, the anchor point in Figure 2 results in the base case IRM requirement of 15.0% and MLCRs for NYC and LI MLCR of 79% and 94%, respectively.

Results from this study illustrate the impact on the IRM requirement for changes of LCR level assumptions from the base case. Observations from these results include:

- **Unconstrained NYCA Case** – If internal transmission constraints were entirely eliminated the NYCA IRM requirement could be reduced to 12.6%, 2.4 percentage points less than the base case IRM requirement (see Figure 2).
- **Downstate NY Capacity Levels** – If the NYC and LI LCR levels were *increased* from the base case results to 82% and 98%, respectively, the IRM requirement would be reduced by 2.0 percentage points, to 13.0%. Similarly, if the NYC and LI locational installed capacity levels were *decreased* to 77% and 91%, respectively, the IRM requirement would increase by about 3.0 percentage points, to 18.0% (see Figure 2).

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

### **Outside World Model**

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The Outside World Model consists of Control Areas in Ontario, Quebec, New England, and PJM. NYCA reliability can be improved and IRM requirements can be reduced by recognizing available emergency assistance support from these neighboring interconnected control areas — in accordance with control area agreements during emergency conditions. Assuming such interconnection support arrangements in the base case reduces the NYCA IRM requirements by approximately 4.0 percentage points (see Table 3). A model for representing neighboring control areas, similar to that applied in previous IRM studies, was utilized in his study.

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 capacity support. For this purpose, from Policy 5-1, 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. Table 1 below compares the base case NYCA 2008 IRM with lower NYCA IRM requirements assuming (1) each Outside World Area is represented by its planned 2008 IRMs and (2) each Outside World Area’s IRM for maintaining its LOLE criteria. The table also compares NYCA LOLEs for the base case and both scenarios.

**Table 1**  
**Impacts of Alternate Outside World Scenarios on NYCA IRM and LOLE**

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| <b>Outside Area IRMs</b>                                  | <b>Required NYCA IRM</b> | <b>NYCA LOLE at NYCA Base Case IRM (15%)</b> |
|---|--------------------------|--|
| All Outside Areas at their base case IRMs                 | 15.0%                    |  |
| All Outside Areas at their planned 2008 IRMs              |                          |  |
| All Outside Areas with IRMs that meet their LOLE Criteria |                          |  |

Another consideration for developing models for the Outside World Areas is to recognize internal transmission constraints within the Outside World Areas that may limit emergency

assistance to the NYCA. This recognition is considered 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 of the Outside World Areas – New England and PJM – are each represented as multi-areas. This level of granularity better captures the impacts of transmission constraints within these areas, particularly on their ability to provide emergency assistance to the NYCA.

Limitations across the Northport-Norwalk Harbor cable were modeled as a function of the availability of Norwalk Harbor generation. Limitations from Eastern PJM system across the Con Edison Hudson-Farragut, Linden-Gothels interconnections, and the new HVdc Neptune cable inertia, were modeled as a function of the availability of Northern New Jersey generation including Linden, Hudson, and Bergen.

## COMPARISON WITH 2007 IRM STUDY RESULTS

The results of this 2008 IRM study show that the base case IRM result has decreased 1.0 percentage point compared to the 2007 IRM Study. Table 2 below compares the estimated IRM impacts of changing certain several key study assumptions from the 2007 Study. The estimated % IRM change for each parameter was calculated from the results of a parametric analysis. These results were grouped and then normalized such that the sum of the +/- % changes totals the 1.0 percentage point IRM reduction from the 2007 Study. The primary drivers that have reduced IRM requirements from the 2007 capability year are:

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- (1) The continued improvement of NYCA generating unit availability (see Table 2, Updated Generating Unit EFORs),
- (2) Completion of the Neptune HVdc 660 MW submarine cable connecting Long Island and PJM (included in updated NYS Transmission Topology in Table 2),
- (3) Increased transfer capacity of the Dunwoodie-South interface (included in Updated NYS Transmission Topology in Table 2, see also Transmission System Model section),
- (4) Improved emergency assistance benefits from interconnections to neighboring control areas, primarily due to transmission reinforcements within these Areas (see Updated Outside World Model in Table 2), and
- (5) A reduction of transmission cable outage rates (see Updated Cable Outage Rates in Table 2).

**Table 2**

### Parametric IRM Impact Comparison with 2007 Study

| Parameter   | Estimated IRM Change (%) | IRM (%)      |
|---|--------------------------|--------------|
| <b>Previous 2007 Study – Base Case IRM Result</b> |                          | <b>16.0</b>  |
| Updated SCR and EDRP Capacity & Other EOPs        | + 0.3                    |              |
| New Units and Retirements                         | 0.0                      |              |
| Updated Load Model                                | 0.0                      |              |
| Updated Maintenance Schedule                      | 0.0                      |              |
| Updated GT Capacity Temperature Correction Model  | 0.0                      |              |
| Updated Outside World Model                       | -0.2                     |              |
| Updated Generating Unit EFORs                     | -0.3                     |              |
| Updated Cable Outage Rates                        | - 0.3                    |              |
| Updated NYS Transmission Topology                 | - 0.5                    |              |
|   |                          |              |
| <b>Net Change from 2007 Study</b>                 |                          | <b>- 1.0</b> |
|   |                          |              |
| <b>2008 Study – Base Case IRM Result</b>          |                          | <b>15.0</b>  |

### 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 3 shows IRM requirement results and related NYC and LI locational capacities for several selected sensitivity cases. Sensitivity results are important input when the NYSRC Executive Committee develops the final NYCA 2008 IRM. A complete summary of all sensitivity case results are shown in Appendix B, Table B-1. Table B-1 also includes a description and explanation of each sensitivity case. Due primarily to time and resource constraints, there was no attempt to re-evaluate the “anchor point” or require each of the sensitivity case MLCR results to be consistent with base case MLCR results.

**Table 3**

**Selected Sensitivity Case Results  
NYCA IRM Requirements and Related Locational Capacities**

| <b>Case</b> | <b>Case Description</b>                             | <b>IRM (%)</b> | <b>% Change from Base Case</b> | <b>NYC LCR (%)</b> | <b>LI LCR (%)</b> |
|-------------|---|----------------|--------------------------------|--------------------|-------------------|
| 0           | Base Case   | 15.0           | --                             | 79.0               | 94.0              |
| 1           | NYCA Isolated                                       | 19.0           | +4.0                           | 81.9               | 97.2              |
| 2           | Decrease tie ratings on 5 upstate interfaces by 10% | 15.1           | +0.1                           | 79.1               | 94.1              |
| 3           | No Load Forecast Uncertainty                        | 7.7            | -7.3                           | 73.8               | 88.1              |
| 4           | No SCRs or EDRPs                                    | 15.2           | +0.2                           | 78.0               | 94.4              |
| 5           | No Internal NYS Transmission System Constraints     | 12.6           | - 2.4                          | *                  | *                 |
| 6           | Decrease NYCA EFOR to match lowest 5 yr value       | 12.0           | +3.0                           | 76.9               | 95.0              |
| 7           | Increase NYCA EFOR to match highest 5 yr value      | 16.2           | -2.8                           | 78.9               | 96                |

\* Locational capacities are not relevant for this case.

## **NYISO IMPLEMENTATION OF THE NYCA IRM REQUIREMENT**

### **NYISO Translation of NYCA Capacity Requirements to Unforced Capacity**

The NYISO values capacity sold and purchased in the market in a manner that considers the forced outage ratings of individual units — Unforced Capacity or “UCAP”. To maintain consistency between the rating of a unit (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, and is not a reduction of actual installed resources. Therefore, no degradation in reliability is expected. The NYISO employs a translation methodology that converts UCAP requirements to ICAP in a manner that assures compliance with NYSRC Resource Adequacy Rule A-R1. The conversion to UCAP provides financial incentives to decrease the forced outage rates while improving reliability.

### **NYISO Implementation of a Spot Market Auction based on a Demand Curves**

Effective June 1, 2003 the NYISO replaced its monthly Capacity Deficiency Auction with a monthly Spot Market Auction based on three FERC-approved Demand Curves. Demand Curves are developed for Zones J, K, and the rest of NYCA. The existence of Demand Curves does not impact the determination of IRM requirements by the NYSRC.



# Appendix A

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## **NYCA** Installed Capacity Requirement Reliability Calculation Models **and** Assumptions

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**Description of the GE-MARS Program;  
Load, Capacity, Transmission, and  
Outside World Models; and Assumptions**

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## A-1 Introduction

Appendix A provides details of the modeling and assumptions for the NYCA IRM study covered in this report.

The reliability calculation process for determining the NYCA IRM requirement utilizes a probabilistic approach. This technique calculates the probabilities of outages of generating units, in conjunction with load and transmission models, to determine the number of days per year of expected capacity shortages. The General Electric Multi-Area Reliability Simulation (GE-MARS) is the primary computer program used for this probabilistic analysis. The result of the calculation for “Loss of Load Expectation” (LOLE) provides a consistent measure of system reliability. The various models used in the NYCA IRM calculation process are depicted in Figure A-1 on the following page.

Table A-1 lists the study parameters in the Figure A-1 models, the source for the study assumptions, and where in Appendix A the assumptions are described. Finally, section A-5 compares the assumptions used in the 2007 and 2008 IRM reports.

**Table A-1 (Refer to Figure A-1)**

Details on Study Modeling

**Internal NYCA Modeling:**

| Figure A-1 Box No. | Name of Parameter              | Description  | Source                                     | Reference   |
|--------------------|--------------------------------|--|--|---|
| 1                  | GE-MARS                        | <del>General Electric Multi-Area Reliability Simulation Program</del>                              |  | <del>Section A-2</del>                                    |
| 2                  | 11 Zones                       | Load areas   | Fig. A-3                                   | NYISO Accounting & Billing Manual                         |
| 3                  | Zone Capacity Models           | -Generator Models for each generating unit in Zone.<br>-Generating Availability.<br>-Unit Ratings. | GADS Data 2007 “Gold Book”                 | <del>Section A-5.3</del>                                  |
|                    | Emergency Operating Procedures | Reduces load during emergency conditions to maintain operating reserves.                           | NYISO                                      | <del>Section A-5.4</del>                                  |
| 4                  | Zone Load Models               | Hourly loads   | NYCA load shapes.<br>NYISO peak forecasts. | <del>Section A-5.2</del><br>33,730 MW NYISO Oct. forecast |
| 5                  | Load Uncertainty Model         | Account for forecast uncertainty due to weather and economic conditions.                           | Historical Data                            | <del>Section A-5.1.1</del>                                |
| 6                  | Transmission Capacity Model    | Emergency transfer limits of transmission interfaces between Zones.                                | NYISO transmission studies                 | <del>Section A-5.5</del>                                  |

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**External Control Area Modeling:**

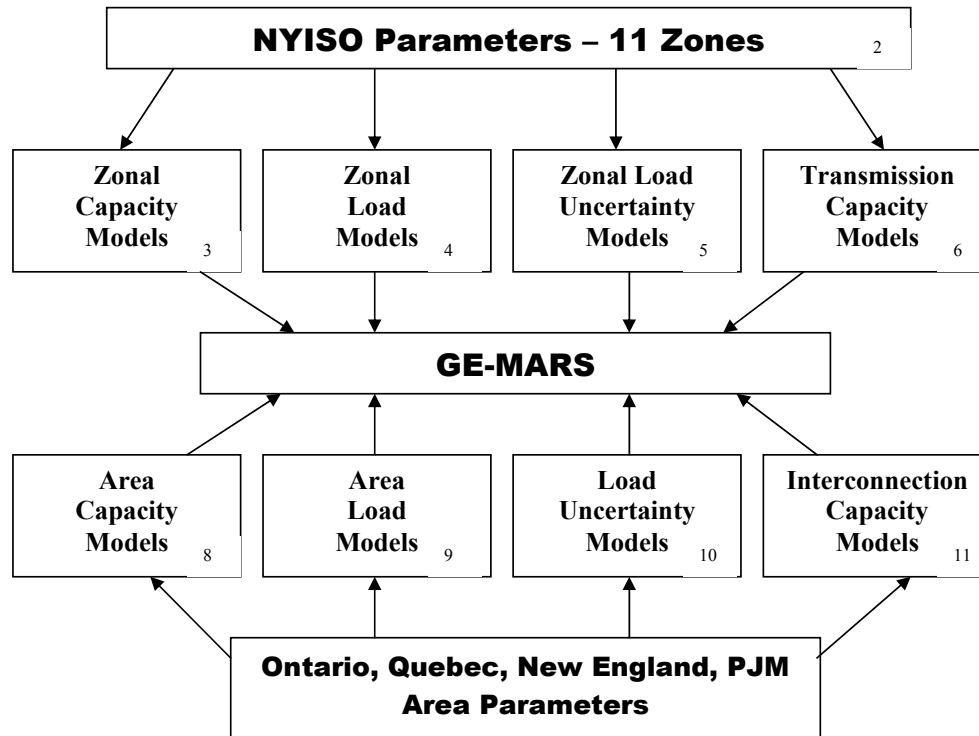
|    |   |   |                                    |   |
|----|---|---|------------------------------------|---|
| 7  | Ont., Quebec, NE, PJM control area Parameters | See the following items 8-11.   |                                    |   |
| 8  | External Control Area Capacity Models         | Generator Models in neighboring control areas                               | Supplied by External Control Areas | <del>Section A-5.7</del> Deleted: See page 35 |
| 9  | External Control Area Load Models             | Hourly Loads  | Same as above                      | <del>Section A-5.7</del> Deleted: See page 35 |
| 10 | External Control Area Load Uncertainty Models | Account for forecast uncertainty due to weather and economic conditions     | Supplied by External Control Areas | <del>Section A-5.7</del> Deleted: See page 36 |
| 11 | Interconnection Capacity Models               | Emergency transfer limits of transmission interfaces between control areas. | Supplied by External Control Areas | <del>Figure A-10</del> Deleted: See page 34   |

\* “2007 Load & Capacity Data” Report issued by the NYISO.

**Figure A-1**

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**NYCA ICAP Modeling**



## **A-2 Computer Program Used for Reliability Calculations**

As the primary probabilistic analysis tool used for establishing NYCA IRM requirements, the GE-MARS program includes a detailed load, generation, and transmission representation for 11 NYCA Zones, as well as the four external Control Areas (Outside World Areas) interconnected to the NYCA (see Sections A-3 and A-5.6 for a description of these Zones and Outside World Areas).

A sequential Monte Carlo simulation forms the basis for GE-MARS. The Monte Carlo method provides a fast, versatile and easily expandable program that can be used to fully model many different types of generation, transmission and demand-side options.

GE-MARS calculates the standard reliability indices of daily and hourly LOLE (days/year and hours/year) and Loss of Energy Expectation (LOEE in MWh/year). The use of sequential Monte Carlo simulation allows for the calculation of time-correlated measures such as frequency (outages/year) and duration (hours/outage). The program also calculates the need for initiating Emergency Operating Procedures (EOPs), expressed in days/year (see Section A-5.3).

In addition to calculating the expected values for the reliability indices, GE-MARS also produces probability distributions that show the actual yearly variations in reliability that the NYCA could be expected to experience. In determining NYCA reliability, there are several types of randomly occurring events that must be taken into consideration. Among these are the forced outages of generating units and transmission capacity. Monte Carlo simulation models the effects of such random events. Deviations from the forecasted loads are captured by the use of a load forecast uncertainty model.

Monte Carlo simulation approaches can be categorized as “non-sequential” and “sequential”. A non-sequential simulation process does not move through time chronologically or sequentially, but rather considers each hour to be independent of every other hour. Because of this, non-sequential simulation cannot accurately model issues that involve time correlations, such as maintenance outages, and cannot be used to calculate time-related indices such as frequency and duration.

Sequential Monte Carlo simulation (used by GE-MARS) steps through the year chronologically, recognizing the status of equipment is not independent of its status in adjacent hours. Equipment forced outages are modeled by taking the equipment out of service for contiguous hours, with the length of the outage period being determined from the equipment’s mean time to repair. Sequential simulation can model issues of concern that involve time correlations, and can be used to calculate indices such as frequency and duration. It also models transfer limitations between individual areas.

Because the GE-MARS Program is based on a sequential Monte Carlo simulation, it uses state transition rates, rather than state probabilities, to describe the random forced outages of the thermal units. State probabilities give the probability of a unit being in a given capacity state at any particular time, and can be used if one assumes that the unit’s capacity state for a given hour is independent of its state at any other hour. Sequential Monte Carlo simulation recognizes the fact that a unit’s capacity state in any given hour is dependent on a given state in previous hours and influences its state in future hours. It thus requires additional information that is contained in the transition rate data.

For each unit, a transition rate matrix is input that shows the transition rates to go from each capacity state to each other capacity state. The transition rate (TR) from state A to state B is defined as the number of transitions from A to B per unit of time in state A:

$$TR (A \text{ to } B) = \frac{\text{(Number of Transitions from A to B)}}{\text{(Total Time in State A)}}$$

Table A-2 shows the calculation of the state transition rates from historic data for one year. The Time-in-State Data shows the amount of time that the unit spent in each of the available capacity states during the year; the unit was on planned outage for the remaining 760 hours. The Transition Data shows the number of times that the unit transitioned from each state to each other state during the year. The State Transition Rates can be calculated from this data. For example, the transition rate from state 1 to state 2 equals the number of transitions from 1 to 2 divided by the total time spent in state 1:

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$$TR (1 \text{ to } 2) = (10 \text{ transitions}) / (5000 \text{ hours}) = 0.002$$

**Table A-2**  
Example of State Transition Rates

| Time-in-State Data |     |       |
|--------------------|-----|-------|
| State              | MW  | Hours |
| 1                  | 200 | 5000  |
| 2                  | 100 | 2000  |
| 3                  | 0   | 1000  |

| Transition Data |          |    |    |
|-----------------|----------|----|----|
| From State      | To State |    |    |
|                 | 1        | 2  | 3  |
| 1               | 0        | 10 | 5  |
| 2               | 6        | 0  | 12 |
| 3               | 9        | 8  | 0  |

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| State Transition Rates |          |       |       |
|------------------------|----------|-------|-------|
| From State             | To State |       |       |
|                        | 1        | 2     | 3     |
| 1                      | 0.000    | 0.002 | 0.001 |
| 2                      | 0.003    | 0.000 | 0.006 |
| 3                      | 0.009    | 0.008 | 0.000 |

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From the state transition rates for a unit, the program calculates the two important quantities that are needed to model the random forced outages on the unit: the average time that the unit resides in each capacity state, and the probability of the unit transitioning from each state to each other state.

Whenever a unit changes capacity states, two random numbers are generated. The first is used to calculate the amount of time that the unit will spend in the current state; it is assumed that the time in a state is exponentially distributed, with a mean as computed from the transition rates. This time in state is added to the current simulation time to calculate when the next random state change will occur. The second random number is combined with the state transition probabilities to determine the state to which the unit will transition when it leaves its current state. The

program thus knows for every unit on the system, its current state, when it will be leaving that state, and the state to which it will go next.

Each time a unit changes state, as a result of random state changes, the beginning or ending of planned outages, or mid-year installations or retirements, the total capacity available in the unit's area is updated to reflect the change in the unit's available capacity. This total capacity is then used in computing the area margins each hour.

- **A-2.1 Error Analysis**

An important issue in using Monte Carlo simulation programs such as GE-MARS is the number of years of artificial history (or replications) that must be created to achieve an acceptable level of statistical convergence in the expected value of the reliability index of interest. The degree of statistical convergence is measured by the standard deviation of the estimate of the reliability index that is calculated from the simulation data.

The standard deviation has the same physical units (e.g., days/year) as the index being estimated, and thus its magnitude is a function of the type of index being estimated. Because the standard deviation can assume a wide range of values, the degree of convergence is often measured by the standard error, which is the standard deviation of the estimated mean expressed as a per unit of the mean.

Convergence can also be expressed in terms of a confidence interval that defines the range in which you can state, with a given level of confidence that the actual value falls within the interval. For example, a range centered on the mean of three standard deviations in each direction (plus and minus) defines a confidence interval of 99.7%.

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For this analysis, the Base Case required 277 replications to converge to a daily LOLE for NYCA of 0.090 days/year with a standard error of 0.05 per unit, which corresponded to an IRM of 15.0 % as shown in Figure A-2. For a % confidence interval (plus and minus three standard deviations about the mean), the IRMs that would result in a NYCA LOLE of 0.075 days/year and 0.105 days/year were computed. The resulting IRM values of % and % define the % confidence interval. The statistical significance of the 15.0%, % and % numbers are a 0.15%, 50% and 99.85% probability of meeting the one in ten criterion, assuming perfect accuracy in all parameters. It should be recognized that a 15.0% IRM, with a 50% probability of meeting the one in ten LOLE criterion, is in full compliance with the NYSRC Resource Adequacy rules and criteria (see Base Case Study Results section).

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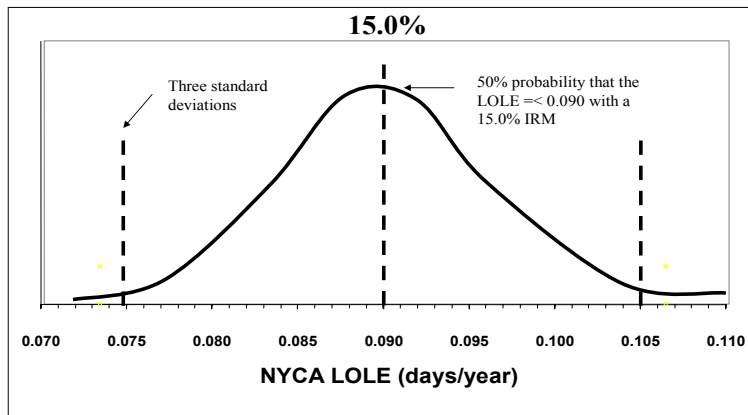
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Figure A-2

## Confidence Interval

Based on a Standard Error of 0.05



### A-3 - Representation of the NYCA Zones

Figure A-2 on the following page depicts the NYCA Zones represented in GE-MARS.

### A-4 - Conduct of the GE-MARS Analysis

The study was performed using version 2.83 of the GE-MARS software program. This is the same version as was used in the 2007 IRM study.

The current base case is the culmination of the individual changes made to last year's base case. Each change, however, is evaluated individually against last year's base case. The LOLE results of each of these pre-base case simulations are reviewed to confirm that the reliability impact of the change is reasonable and explainable.

General Electric was asked to review the input data for errors. They have developed a program called "Data Scrub" which processes the input files and flags data that appears to be out of the ordinary. For example, it can identify a unit with a forced outage rate significantly higher than all the others in that size and type category. If something is found, the ISO reviews the data and either confirms that it is correct as is, or institutes a correction. The results of this data scrub are shown in [Table A-3](#):

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**Table A-3**  
**GE Data Scrub**

|   | <u>Issue</u>   | <u>Disposition</u>   |
|---|--|--|
| 1 | Units with Zero EFORds   | Identified as hydro units where derate is applied separately   |
| 2 | Large Units with High EFORds   | Units identified. Investigation revealed high EFORds is correct according to GADS data.                  |
| 3 | EFORd > 90% for Small Unit   | Unit identified as correctly having large EFORd.   |
| 4 | Planned Outage > 25 Weeks  | Maintenance scheduled reviewed and found correct. Unit identified was small and not in critical locality |
| 5 | Incorrect limit on K - SWCT interface                                    | Correct limit inserted   |
| 6 | Record length for UNT-DERT table too long to be read                     | Data fit to readable length.   |
| 7 | Load multipliers for UNT-DERT decrements must be entered as 'less than'. | Multipliers changed from "less than or equal to' to 'less than'.   |

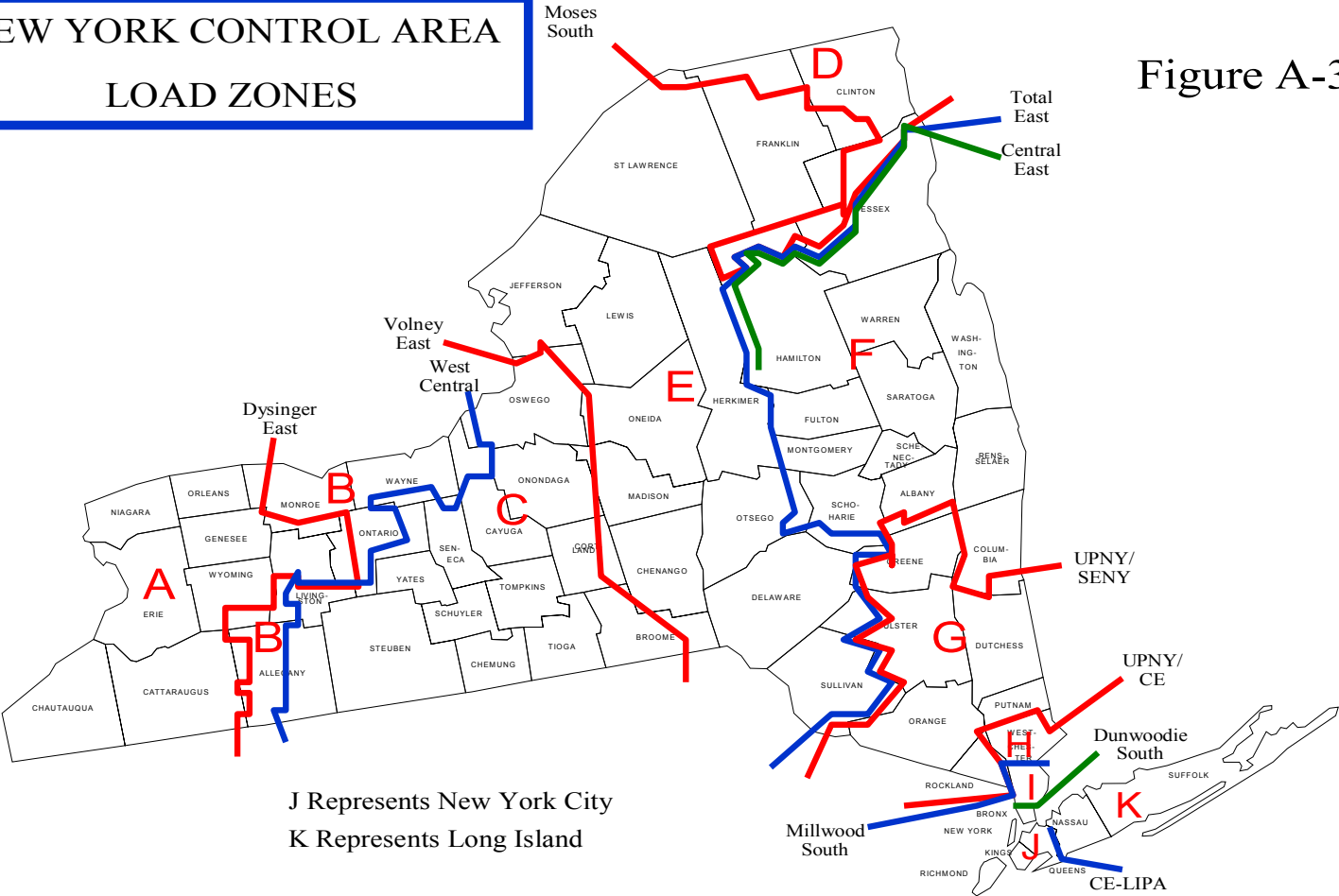
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**NEW YORK CONTROL AREA  
LOAD ZONES**

Figure A-3



J Represents New York City  
K Represents Long Island

The top three summer peak loads of all Areas external to NYCA are aligned to be on the same days as that of NYCA, even though they may have historically occurred at different times. This is a conservative approach, using the assumption that peak conditions could be the result of a wide spread heat wave. This would result in reducing the amount of assistance that NYCA could receive from the other Areas.

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#### • A-4.1 - Methodology

This year's study continued to use the Unified Methodology that simultaneously provides a basis for the NYCA installed reserve requirements and locational installed capacity requirements. The following describes how the tangent 45 inflection point is calculated:

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The IRM/LCR characteristic consists of two constituents; 1) a curve function ("the knee of the curve", and 2) straight line segments at the asymptotes. The curve function is represented by a quadratic (second order) curve which is the basis for the Tangent 45 inflection point calculation. Consideration of IRM/LCR point pairs remote to the "knee of the curve" may impact the calculation of the quadratic curve function used for the Tangent 45 calculation. The procedure for determining the best fit curve function used for the calculation of the Tangent 45 inflection point to define the basecase requirement is based on the following criteria summarized below:

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- 1) Start with all points on IRM/LCR Characteristic
- 2) Develop regression curve equations for all different point to point segments
- 3) Rank all the regression curve equations based on the following:
  - Sort regression equations with highest R2
  - Ensure calculated IRM is within the selected point pair range, i.e. if the curve fit was developed between 14% and 18% and the calculated IRM is 13.9%, the calculation is invalid
  - Ensure the *calculated* IRM and corresponding LCR do not violate the 0.1 criteria
  - Check result to ensure consistent with visual inspection methodology used in past years studies.

This approach produced a quadratic curve function with R<sup>2</sup> correlation equaling 1.0000 as the basis for the Tangent 45 calculation. The above methodology was adopted by the NYSRC Executive Committee at the November 7, 2007 meeting and will be incorporated into the next Policy 5 revision.

#### A-5 - Input Data and Models

##### • A-5.1 - Base Case Modeling Assumptions

Table A-4 summarizes the major assumptions used in the 2008 Study:

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**Base Case Modeling Assumptions for 2008 NYCA IRM Study**

| Parameter                             | 2007 Study Modeling Assumptions  | 2008 Study Modeling Assumptions  | Described in following section |
|---------------------------------------|--|--|--------------------------------|
| <b>NYCA Load Model</b>                |  |  |                                |
| Peak Load                             | October forecast: <ul style="list-style-type: none"> <li>• 33,544 MW for NYCA</li> <li>• 11,775 MW for Zone J</li> <li>• 5,478 MW for Zone K</li> </ul>                                  | October forecast: <ul style="list-style-type: none"> <li>• 33,730 MW for NYCA,</li> <li>• 11,955 MW for Zone J</li> <li>• 5,460 MW for Zone K</li> </ul>                                     | Section A-5.2                  |
| Load Shape Model                      | 2002 Load Shape  | 2002 Load Shape  | Section A-5.2                  |
| Load Uncertainty Model                | Statewide and zonal model updated to reflect current data.   | Statewide and zonal model updated to reflect current data.   | Section A-5.2                  |
| <b>Capacity Resources</b>             |  |  |                                |
| Generating Unit Capacities            | Updated DMNC test values.  | Updated DMNC test values per 2007 Gold Book.   | Section A-5.3                  |
| New Generation Units                  | Gold Book (table III) units plus: <ul style="list-style-type: none"> <li>• Prattsburgh Wind Farm - 79.5 MW (10/06)</li> <li>• Flat Rock Wind Power (phase 2) - 100 MW (12/06)</li> </ul> | Gold Book (table III) units plus <ul style="list-style-type: none"> <li>• Prattsburgh Wind Park - 55 MW (11/07)</li> <li>• Gilboa unit 2 uprate of 30 MW (6/07).</li> </ul>                  | Section A-5.3                  |
| Wind Generation Resources             | Derived from hourly wind data with average Summer Peak Hour capacity factor of 11.4%   | Derived from hourly wind data with average Summer Peak Hour capacity factor of approximately 11 %.   | Section A-5.3                  |
| Retirements                           | <ul style="list-style-type: none"> <li>• Huntley 65 &amp; 66 (165 MW)</li> <li>• Lovett 5 (176.2 MW)</li> <li>• Lovett 3 (46.8 MW)</li> </ul>  | <ul style="list-style-type: none"> <li>• Lovett 3, 4, 5 (404.8 MW)</li> <li>• Russell Station (236.4 MW)</li> <li>• Huntley 65 &amp; 66 (165 MW)</li> <li>• Ogdensburg (76.7 MW).</li> </ul> | Section A-5.3                  |
| <b>Availability &amp; Maintenance</b> |  |  |                                |
| Forced & Partial Outage Rates         | 5-year (2001-05) GADS data. (Those units with less than five years data will use available representative data.)   | 5-year (2002-06) GADS data. (Those units with less than five years data will use available representative data.)   | Section A-5.3                  |
| Planned Outages                       | Based on schedules received by NYISO & adjusted for history.   | Based on schedules received by NYISO & adjusted for history.   | Section A-5.3                  |
| Summer Maintenance                    | Continue with approximately 150 MW after reviewing last year's data.   | Continue with approximately 150 MW after reviewing last year's data.   | Section A-5.3                  |
| Gas Turbines Ambient Derate           | Derate expanded to include combustion turbine portion of combined cycle units.   | The derate model was updated after analyzing historical performance.   | Section A-5.3                  |

| <b>Parameter</b>  | <b>2007 Study Modeling Assumptions</b>   | <b>2008 Study Modeling Assumptions</b>  | <b>Described in following section</b>  |
|---|--|---|--|
| Non-NYPA Hydro Capacity Modeling                              | 45% derating.  | 45% derating.   | Section A-5.3                          |
| <b>Emergency Operating Procedures (EOPs) &amp; Assistance</b> |  |   |  |
| Special Case Resources  | <ul style="list-style-type: none"> <li>• 1080 MW sold;</li> <li>• modeled as 994 MW.</li> </ul>  | <ul style="list-style-type: none"> <li>• 1323 MW sold;</li> <li>• modeled as 1205 MW.</li> </ul>  | Section A-5.3                          |
| EDRP Resources  | <ul style="list-style-type: none"> <li>• 507 MW registered;</li> <li>• modeled as 228 MW</li> </ul>  | <ul style="list-style-type: none"> <li>• 430 MW registered;</li> <li>• modeled as 193.5 MW</li> </ul>   | Section A-5.3                          |
| External Capacity   | 3085 MW total: <ul style="list-style-type: none"> <li>• 1000 from HQ,</li> <li>• 730 from NE,</li> <li>• 1300 from PJM,</li> <li>• 55 from Ontario.</li> </ul> | 2,921 MW total: <ul style="list-style-type: none"> <li>• 1200 from HQ,</li> <li>• 50 from NE,</li> <li>• 1300 from PJM,</li> <li>• 205 from Ontario,</li> <li>• 166 MW from Cedars</li> </ul>   | Based on NYISO forecast. Section A-5.3 |
| Emergency Operating Procedures                                | 2122 MW load relief including SCRs and EDRPs   | 2302 MW load relief including SCRs and EDRPs (counted at their effective value).  | Section A-5.4                          |
| <b>Transmission System Model</b>                              |  |   |  |
| Interface Limits  | Based on 2006 Operating Study, 2006 Operations Engineering Voltage Studies, 2006 Comprehensive Planning Process, and additional analysis.                      | Based on 2007 Operating Study, 2007 Operations Engineering Voltage Studies, 2007 Comprehensive Planning Process, and additional analysis.   | Section A-5.5                          |
| New Transmission Capability                                   | None Known   | <ul style="list-style-type: none"> <li>• Introduction of Millwood Capacitor bank,</li> <li>• Neptune line including EGC to Newbridge to Ruland Road.</li> <li>• Mott Haven substation.</li> <li>• NUSCO 1385 cable reconductoring.</li> <li>• Completion of Bethel to Norwalk 345Kv.</li> </ul> | Section A-5.5.                         |
| Transmission Cable Forced Outage Rate                         | All existing Cable EFORs updated on LI and NYC to reflect 5 year history.  | All existing Cable EFORs updated on LI and NYC (based on 2002-2006 availability with adjustment to NUSCO cable due to reconductoring).  | Section A-5.5.                         |
| Unforced Capacity Deliverability Rights (UDRs)                | Dummy zone in NY attached to zone K and NE with 330 MW tie and 330 MW of NE units in dummy zone (for CSC).   | LIPA has notified the NYISO that the amount of UDR's for the Neptune Cable and Cross Sound Cable is confidential data.  | Per transmission owner notification.   |
| <b>Other Modeling Considerations</b>                          |  |   |  |
| GE-MARS computer Model Version                                | Version 2.83   | Version 2.83  | Section A-2                            |

| Parameter                 | 2007 Study Modeling Assumptions                                 | 2008 Study Modeling Assumptions | Described in following section |
|---------------------------|---|---------------------------------|--------------------------------|
| Outside World Area Models | Updated models for PJM and NE to include zonal representations. | Updated models.                 | Section A-5.7                  |

• **A-5.2 NYCA Load Model**

○ **Methodology for Determining the Summer IRM Peak Load Forecast**

Prior to 2007, the load forecast used to develop GE-MARS runs was based on the most recent Load and Capacity (Gold Book) report, which is released in April or May of the current year. The Gold Book uses load data from the previous summer. This means that the forecast used for the IRM study had always been over one year old. Beginning last year with the 2007 IRM Study, the Executive Committee of the NYSRC requested a forecast for the IRM study year to be prepared after the most recent summer. This meant advancing the schedule for the installed capacity (ICAP) forecast, normally not released until January of the next year.

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The procedure for preparing the ICAP forecast is detailed in the NYISO Load Forecasting Manual and authorized by the FERC under the NYISO tariff. It calls for a joint effort by the NYISO and participating transmission organizations in the NYISO's Load Forecasting Task Force (LFTF). In particular, the ICAP forecast is based in large part on data provided by the Transmission Owners (TOs). For the IRM forecast however, it is not possible to obtain all load data, complete the weather normalization process, and produce a forecast to meet the IRM schedule according to the procedures detailed in the manual. To meet the request of the NYSRC, the NYISO and TOs use as much data and results as possible from the TOs. To further aid this process, the NYISO also requests an expedited updated economic forecast from Moody's Economy.com. This economic forecast is now provided in August one month earlier than in previous studies.

Using these abbreviated methods, the NYISO and the TOs jointly produced and reviewed a forecast in September 2007 they recommended for use in the 2008 IRM study. This forecast was based upon weather-normalized peaks load in 2007 for each of the TOs, NYPA, and other NY municipalities for the hour of the NYISO coincident peak. The 2008 forecast was produced by applying regional load growth factors (RLGFs) to each TO's weather-normalized peak. Where possible, the RLGFs were based upon new economic forecasts prepared by the TOs. Otherwise, the most recent data from Economy.com is used to adjust the RLGFs used in the prior ICAP forecast.

The final result is a peak load forecast based upon the most recent data available for the IRM study that maintains the schedule for the IRM study, as shown in Table A-4.

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Table A-5

**2008 NYCA Area Peak Load Forecast**

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**Summary of 2006 & 2007 Results**

| Transmission District | 2006 Weather Adjusted MW | 2007 RLGf - Forecast | 2007 ICAP Forecast - MW | 2007 Weather Adjusted MW | MW Over/ Under | 2007 RLGf - Actual |
|-----------------------|--------------------------|----------------------|-------------------------|--------------------------|----------------|--------------------|
| Central Hudson        | 1,177                    | 1.0240               | 1,205                   | 1,200                    | -5             | 1.0195             |
| Con-Edison            | 13,408                   | 1.0168               | 13,633                  | 13,608                   | -25            | 1.0149             |
| LIPA                  | 5,256                    | 1.0126               | 5,322                   | 5,312                    | -10            | 1.0107             |
| Niagara Mohawk        | 6,719                    | 1.0000               | 6,718                   | 6,705                    | -13            | 0.9979             |
| NYPA                  | 534                      | 1.1020               | 588                     | 587                      | -1             | 1.0993             |
| NYSE&G                | 3,177                    | 1.0125               | 3,217                   | 3,211                    | -6             | 1.0107             |
| O&R                   | 1,095                    | 1.0330               | 1,132                   | 1,130                    | -2             | 1.0320             |
| RG&E                  | 1,626                    | 1.0035               | 1,632                   | 1,629                    | -3             | 1.0018             |
| <b>NYCA Total</b>     | <b>32,992</b>            | <b>1.0138</b>        | <b>33,447</b>           | <b>33,382</b>            | <b>-65</b>     | <b>1.0118</b>      |

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**2008 Forecast  
for NYSRC Installed Reserve Margin Study**

| Transmission District | 2007 Weather Adjusted MW | 2008 RLGF     | NYSRC 2008 Forecast - MW | Difference in MW | 2008 Gold Book Forecast |
|-----------------------|--------------------------|---------------|--------------------------|------------------|-------------------------|
| Central Hudson        | 1,200                    | 1.0190        | 1,223                    |                  |                         |
| Con-Edison            | 13,608                   | 1.0170        | 13,839                   |                  |                         |
| LIPA                  | 5,312                    | 1.0081        | 5,355                    |                  |                         |
| Niagara Mohawk        | 6,705                    | 0.9979        | 6,691                    |                  |                         |
| NYPA                  | 587                      | 1.0000        | 587                      |                  |                         |
| NYSE&G                | 3,211                    | 1.0107        | 3,245                    |                  |                         |
| O&R                   | 1,130                    | 1.0250        | 1,158                    |                  |                         |
| RG&E                  | 1,629                    | 1.0018        | 1,632                    |                  |                         |
| <b>NYCA</b>           | <b>33,382</b>            | <b>1.0104</b> | <b>33,730</b>            | <b>-141</b>      | <b>33,871</b>           |

| Locality Peaks | NYSRC 2008 Forecast - MW | Difference in MW | 2008 Gold Book Forecast |
|----------------|--------------------------|------------------|-------------------------|
| New York City  | 11,955                   | -20              | 11,975                  |
| Long Island    | 5,460                    | -25              | 5,485                   |

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o **Load Shape Analysis**

The 2008 IRM study was performed using a load shape based on 2002 actual values. The 2002 load shape was compared to load shapes from 1999 through 2006. The conclusion reached this year was the same as in previous years - that the 2002 load shape is best suited for the IRM study.

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o **Zonal Load Distribution**

From 1995 to 2000, the peak loads increased faster downstate than upstate. But since 2000, the zonal shares have been virtually constant. Table A-6 presents load trends from 1995 to 2006. The chart shows the three-year moving average of each region's share of coincident peak demand. There is no discernible trend since 2000. The peak load share upstate is holding steady at 50%. The zonal share is also sensitive to the hour of the peak. A peak later in the day will tend to increase the share in Zone J and decrease it in the upstate zones. But the hour of the peak changes randomly from year to year, making it more difficult to identify trends with respect to this factor.

**Table A-6**

**Relative Zonal Shares of Coincident Peak Demand**

| Three-Year Moving Average of Shares |     |     |     |     |
|-------------------------------------|-----|-----|-----|-----|
| Year                                | J   | K   | J-K | A-I |
| 1995                                | 32% | 13% | 46% | 54% |
| 1996                                | 32% | 13% | 46% | 54% |
| 1997                                | 33% | 14% | 47% | 53% |
| 1998                                | 33% | 14% | 47% | 53% |
| 1999                                | 34% | 15% | 49% | 51% |
| 2000                                | 34% | 15% | 50% | 50% |
| 2001                                | 34% | 15% | 50% | 50% |
| 2002                                | 34% | 16% | 50% | 50% |
| 2003                                | 34% | 16% | 50% | 50% |
| 2004                                | 34% | 16% | 50% | 50% |
| 2005                                | 34% | 16% | 50% | 50% |
| 2006                                | 34% | 16% | 50% | 50% |

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• **A-5.1.1 Zonal Load Forecast Uncertainty**

For 2008, new load forecast uncertainty models were provided by Consolidated Edison (Con Edison) (for Zones H, I and J) and LIPA (for Zone K). Additional models were developed by the NYISO for Zones A-G. The results of these models are presented in Table A-7. Each row represents the probability that a given level of load will occur, on a per-unit basis, by zone. These results are presented graphically in Figure A-4.

**Table A-7**

**2008 Load Forecast Uncertainty Models**

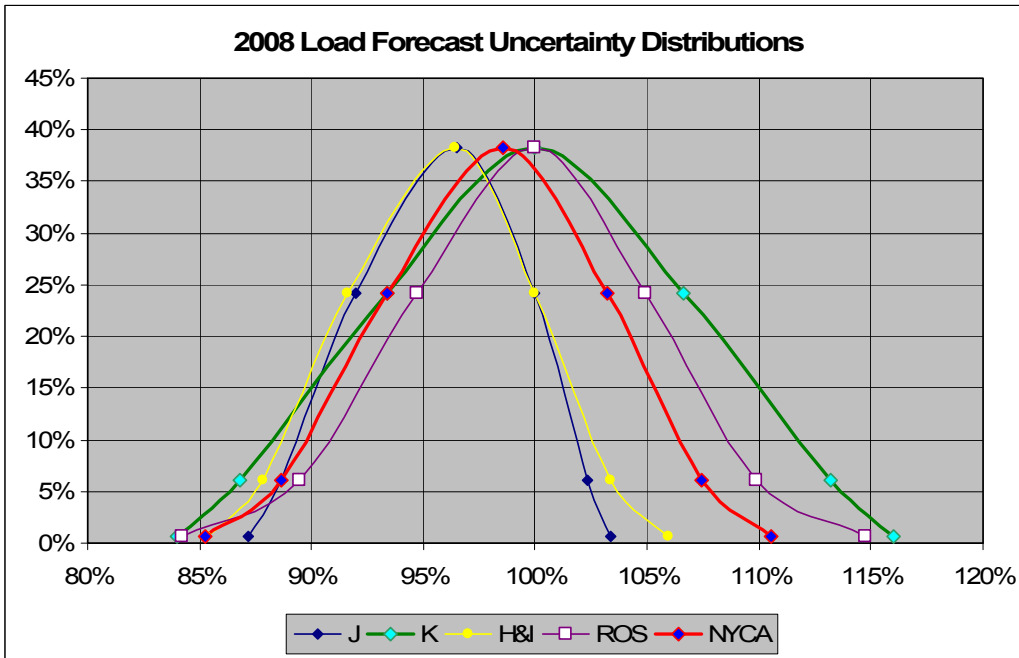
| Multiplier | Zones H & I | Zone J | Zone K | NYCA Net |
|------------|-------------|--------|--------|----------|
| 0.0062     | 0.853       | 0.871  | 0.839  | 0.841    |
| 0.0606     | 0.878       | 0.886  | 0.868  | 0.894    |
| 0.2417     | 0.916       | 0.919  | 0.934  | 0.947    |
| 0.3830     | 0.964       | 0.964  | 1.000  | 1.000    |
| 0.2417     | 1.000       | 1.000  | 1.066  | 1.049    |
| 0.0606     | 1.033       | 1.023  | 1.131  | 1.098    |
| 0.0062     | 1.059       | 1.033  | 1.160  | 1.147    |

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Figure A-4

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The Con Edison (Zone J) model reflects the fact that the load forecast used for Zone J has a 1 in 3 instead of 1 in 2 probability of occurrence. The LI (Zone K) model is only marginally different than that used in 2007. The approach developed in 2006 for the remaining zones is maintained in the IRM 2008 study. The models for Zones A to I were developed by estimating weather response equations, taking care to examine the behavior both below and above design conditions.

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This work was reviewed by the LFTF. The weather response equations were used to estimate uncertainty distributions for these zones, and to assess the load forecast uncertainty models provided to the NYISO by Con Edison and LIPA.

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**A-5.3 NYCA Capacity Model**

**2007 "Gold Book" Changes:**

The capacity model input to GE-MARS incorporates the several types of resource capacity used to serve load in the NYCA. The following were changes made to the existing capacity shown in Table III-2 of the "2007 Load and Capacity Data" (also known as "The Gold Book"):

**Retirements:**

|                    |          |        |
|--------------------|----------|--------|
| ○ Huntley 65 & 66  | 165 MW   | Zone A |
| ○ Lovett 3, 4, & 5 | 404.8 MW | Zone G |
| ○ Russell Station  | 236.4 MW | Zone B |
| ○ Ogdensburg       | 76.7 MW  | Zone E |

- **New Units: (Units installed during 2007)**
  - Gilboa Station Unit 2 uprate 30 MW Zone F
- **Planned Units for 2008:**
  - (These units had a signed interconnection agreement by August 1, 2007.)
  - Prattsburgh Wind Park 55 MW Zone B

The section below describes how each resource type is modeled in GE-MARS.

○ **Generating Units:**

The capacity model includes all NYCA generating units, including new and planned units, as well as units that are physically outside New York State. This model requires the following input data:

○ **Unit Ratings:**

With the exception of wind units, the rating for each generating unit is based on its Dependable Maximum Net Capability (DMNC). The source of DMNC ratings are seasonal tests required by procedures in the NYISO Installed Capacity Manual. Wind units are rated at their nameplate, or full rated value, in the model. The 2007 NYCA Load and Capacity Report, issued by the NYISO, is the source of those generating units and their ratings included on the capacity model.

○ **Unit Performance:**

With the exception of wind units, performance data for generating units in the model includes forced and partial outages, which are modeled by inputting a multi-state outage model that is representative of the “equivalent demand forced outage rate” (EFORd) for each unit represented. Generation owners provide outage data to the NYISO using Generating Availability Data System (GADS) data in accordance with the NYISO Installed Capacity Manual. The NYSRC is continuing to use a five-year historical period for the 2008 IRM Study. (See Figure A-5)

The multi-state model for each unit is derived from five years of historic events if it is available. For units with less than five years of historic events, the available years of event data collected since the inception of the NYISO is used if it appears to be reasonable. For the remaining units NERC class-average data is used.

The unit forced outage states for the majority of the large steam units were obtained from the five-year average NERC-GADS outage data collected by the NYISO for the years 2002 through 2006. This hourly data represents the availability of the units for all hours. From this, full and partial outage states and the frequency of occurrence were calculated and put in the required format for input to the GE-MARS program.

Following an analysis of generating unit ambient deratings (see below), the Market Monitoring Unit of the NYISO informed the NYSRC that owners of certain downstate units totaling approximately 580 MW had incorrectly reported their GADS forced outage data. As a result, the EFORds of these particular units in the 2008 IRM Study capacity model were replaced by NERC five-year class average EFORds.

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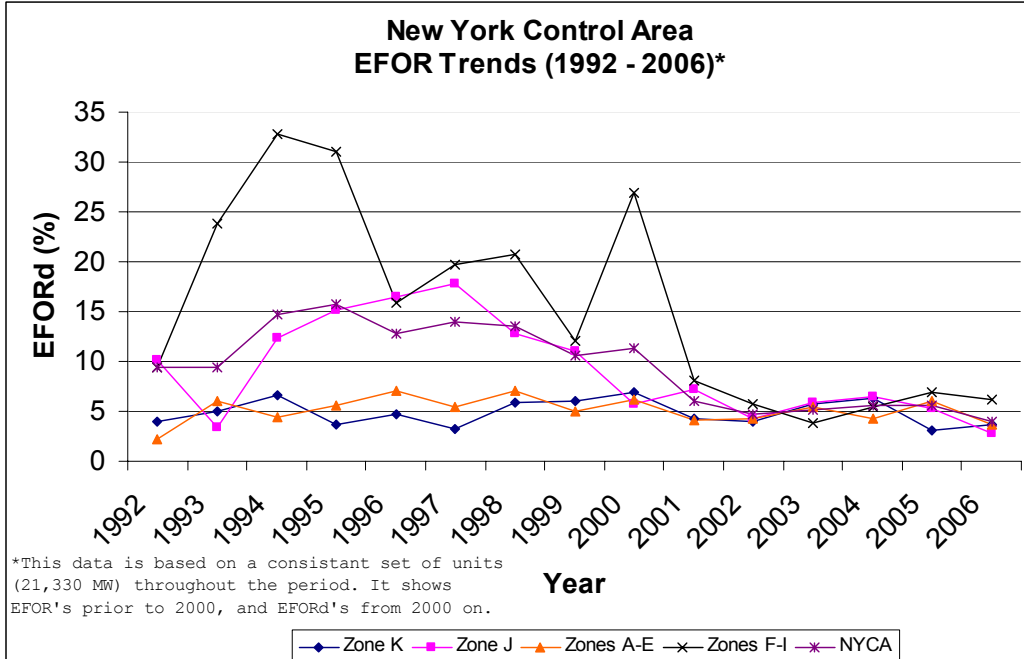
A second performance parameter to be modeled for each unit is scheduled maintenance. This parameter includes both planned and maintenance outage components. The planned outage component is obtained from the generator owners, and where necessary, extended so that the scheduled maintenance period equals the historic average using the same five year period used to determine EFORd averages. Figure A-6 provides a graph of scheduled outage trends over the 1993 through 2006 period for the NYCA generators.

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Wind generators are modeled as an hourly load modifier. The output of the unit varies between 0 and the DMNC value based on wind data collected near the Plant sites during 2002. The 2002 hourly wind data corresponds to the 2002 hourly load shape also used in the model. Characteristics of this data indicate an overall 30% capacity factor with a capacity factor of approximately 11% during the summer peak hours.

Figure A-5

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Figure A-5 provides a graph of Equivalent Forced Outage Rates under Demand (EFORD). The graph presents unit weighted averages for four areas within the NYCA along with a NYCA total aggregate

○ **Equivalent Availability:**

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The equivalent availability factor accounts for forced, partial, scheduled, and maintenance outages. Figure A-6, which is based on NERC-GADS data for New York units, shows that there is a continued trend of improved reliability.

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Figure A-7 provides NERC-GADS data industry-wide. The continued improved availability is similar to that experienced in the NYCA.

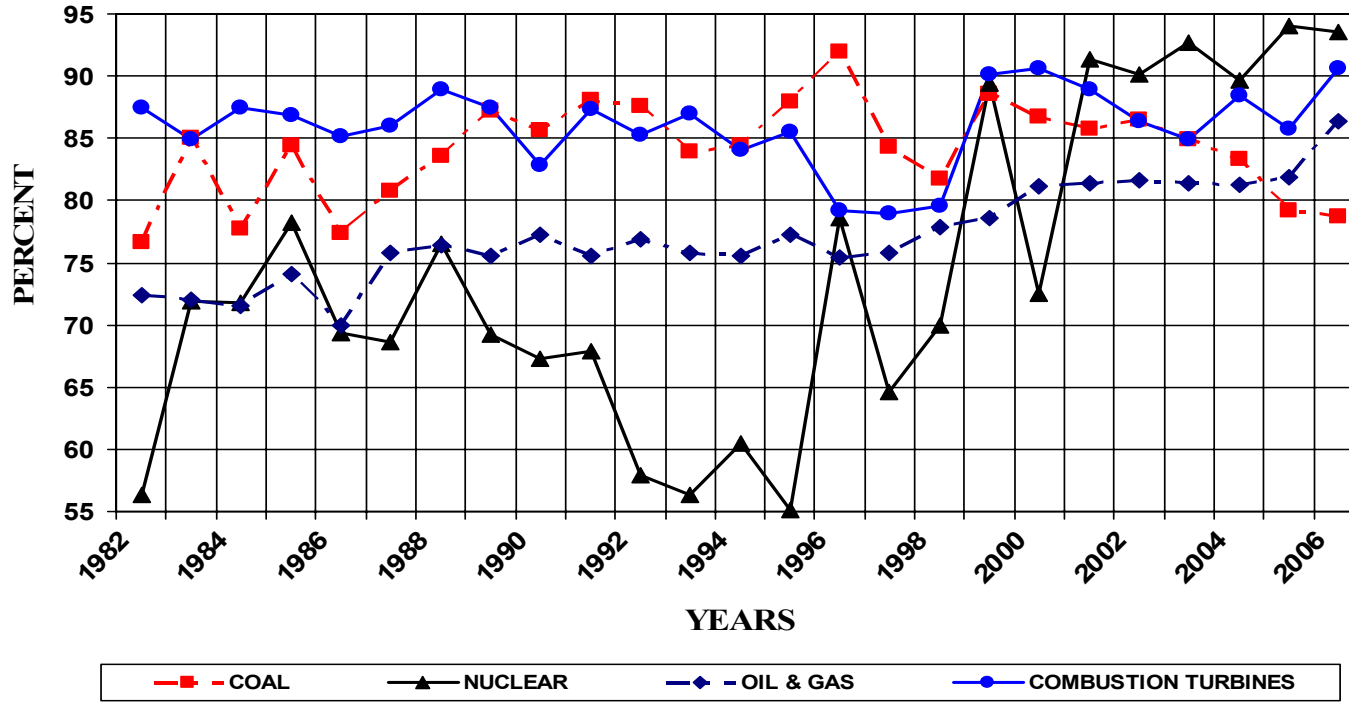
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### Figure A-6 NYCA EQUIVALENT AVAILABILITY

BASED ON NERC-GADS DATA FROM 1982 - 2006  
ANNUAL WEIGHTED AVERAGES FOR NUCLEAR, COAL, OIL & GAS, AND COMBUSTION TURBINES



### Figure A-7 NERC EQUIVALENT AVAILABILITY

BASED ON NERC-GADS DATA FROM 1982 - 2006  
ANNUAL WEIGHTED AVERAGES FOR NUCLEAR, COAL, OIL, GAS, AND COMBUSTION TURBINES

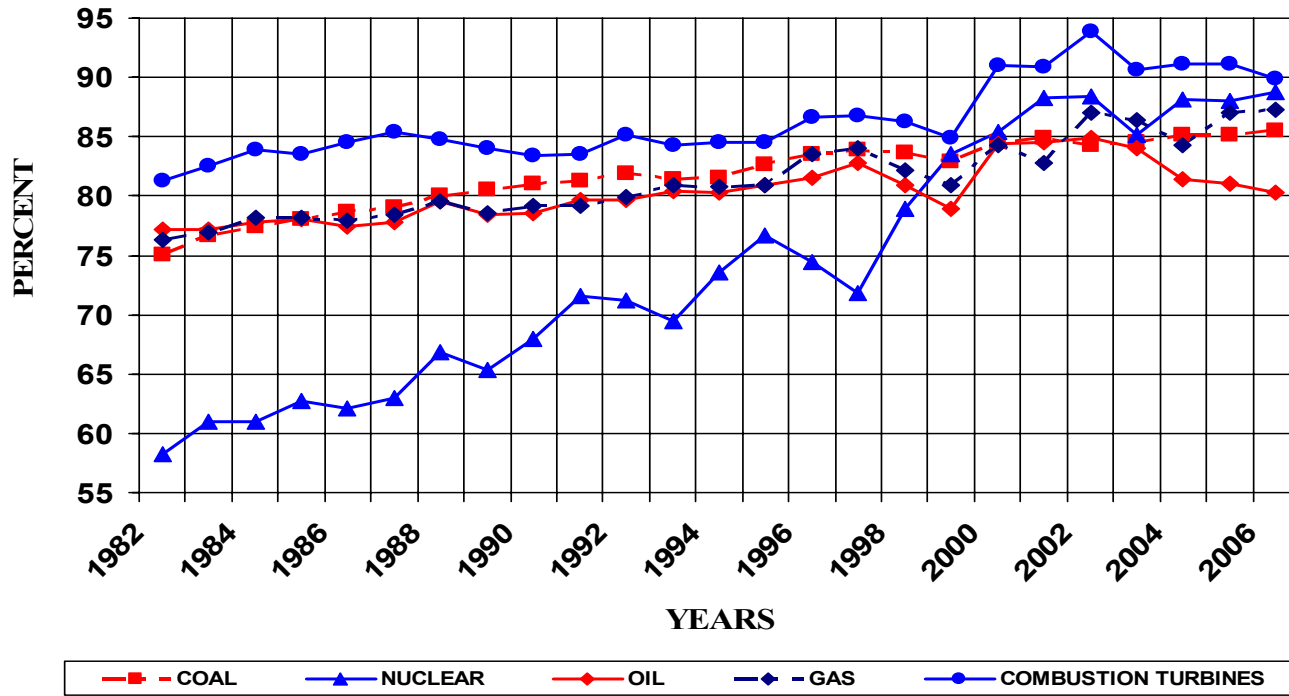


Figure A-8

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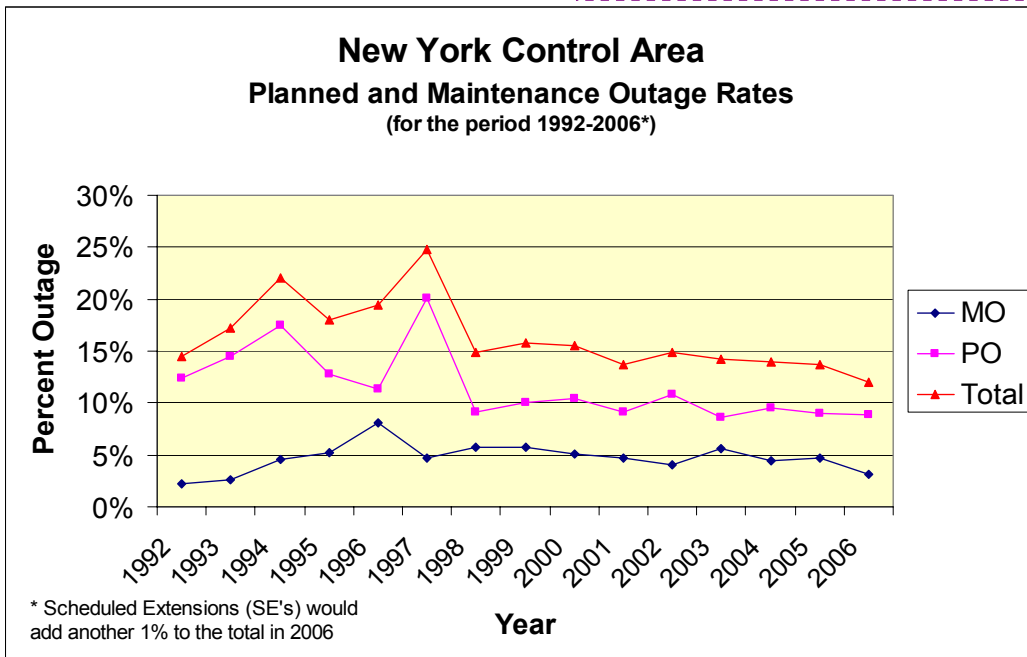


Figure A-8 shows the historic percentage of planned and maintenance outage hours for the years 1992 through 2006.

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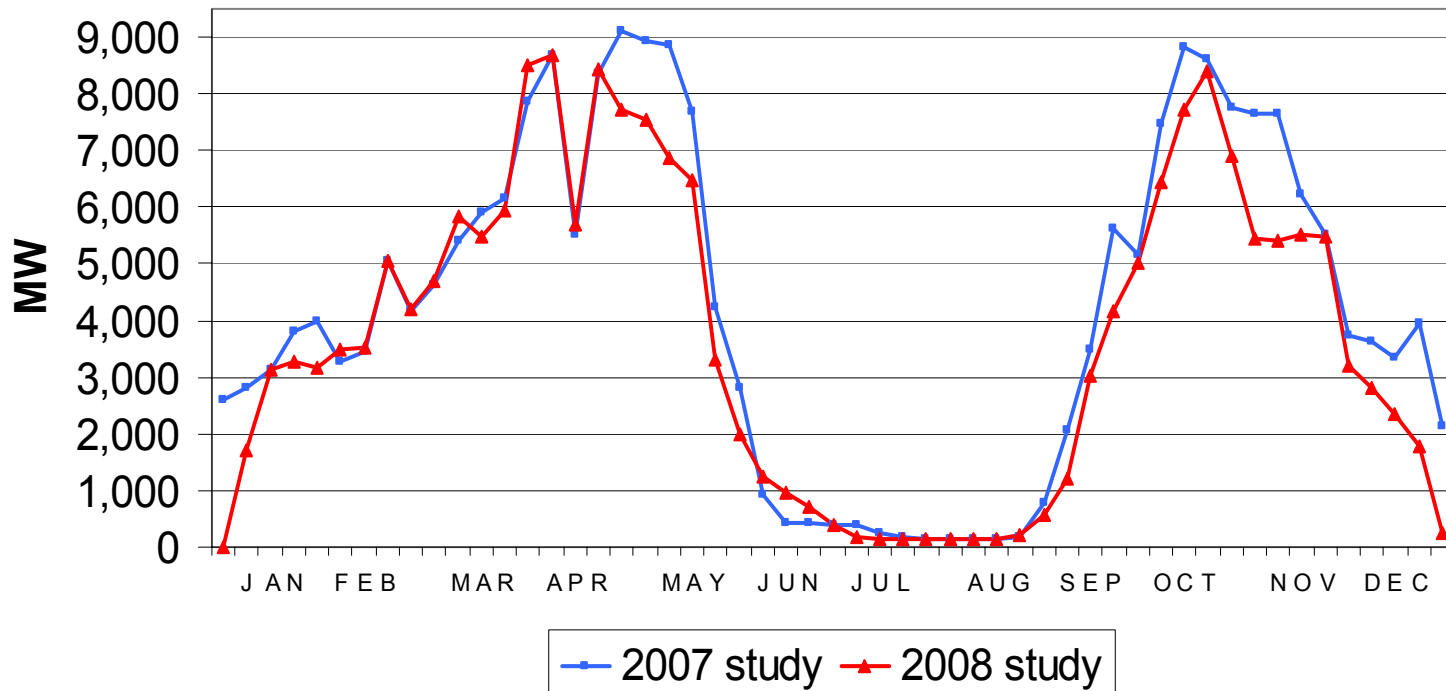
Figure A-9 shows the amount of capacity assumed to be scheduled out in the 2007 and 2008 studies.

The planned outages in the current study over the 2008 summer period are approximately 150 MW.

Figure A-9

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### Scheduled Maintenance For NYCA Generation (IRM Studies)



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o **Combustion Turbine Units:**

Operation of combustion turbine units at temperatures above DMNC test temperature results in reduction in output. These reductions in gas turbine and combined cycle capacity output are captured in the GE-MARS model using deratings based on ambient temperature correction curves. Based on its review of historical 2006 and 2007 data, the NYISO staff has concluded that the existing combined cycle temperature correction curves are still valid and appropriate. These temperature corrections curves, provided by the Market Monitoring Unit of the NYISO, show unit output versus ambient temperature conditions over a range starting at 60 degrees F to over 100 degrees F. Because generating units are required to report their DNMC output at peak or "design" conditions (an average of temperatures obtained at the time of the transmission district previous four like capability period load peaks), the temperature correction for the combustion turbine units is derived for and applied to temperatures above transmission district peak loads.

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Review of the simple cycle combustion turbine data, however, has led the NYISO to introduce to the model what is termed a bias. The NYISO plans to extend this analysis in the future to include other capacity limited resources. Although this analysis indicates a bias at design temperatures, it also shows an approximate 1/3rd reduction from the 2007 IRM study, in the amount of correction occurring at higher temperatures. The net effect of replacing the 2007 IRM Study's simple cycle combustion turbine derate model with this year's updated model is a slight reduction in LOLE. An NYISO report on this analysis, *Adjusting for the Overstatement of the Availability of the Combustion Turbine Capacity in Resource Adequacy Studies*, dated October 22, 2007, can be found at [www.nyiso.com](http://www.nyiso.com).

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The derate does not affect all units because many of the new units are capable of generating up to 88 or 94 MW but are limited by permit to 79.9 MW, so they are not impacted by the temperature derating in obtaining an output of 79.9 MW. About one quarter of the existing 3,700 MW of simple cycle Combustion Turbines fall into this category.

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The accuracy of temperature corrections for all combustion turbines will continue to be evaluated as operational data becomes available.

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o **Hydro Units:**

The Niagara and St. Lawrence hydroelectric projects are modeled with a probability capacity model based on historic water flows and unit performance. The remaining 1,040 MW of hydro facilities are simulated in GE-MARS with a 45% hydro derate model, representing deratings in accordance with recent historic hydro water conditions.

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o **Special Case Resources (SCRs) and Emergency Demand Response Program (EDRP)**

Special Case Resources (SCRs) are loads capable of being interrupted, and distributed generators, rated at 100 kW or higher, that are not directly telemetered. SCRs are ICAP resources that only provide energy/load curtailment when activated in accordance with the NYISO Emergency Operating Manual.

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The Emergency Demand Response Program (EDRP) is a separate 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.

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GE-MARS models SCRs and EDRPs as EOP steps and will activate these steps to minimize the probability of customer load disconnection. Both GE-MARS and NYISO operations only activate EOPs in zones where they are capable of being delivered.

For this year's study the NYISO has recommended that SCRs be modeled as a 1,323 MW EOP step, discounted to 1205 MW in July and August (and further discounted in other months proportionally to the monthly peak load). Prior to this study year, the discount was applied to all zones equally. Now, with the obtainment of historic zonal performance, the discount varies on a zonal basis. Of the 1205 MW of SCRs modeled, 110 MW are generators that may be subject to DEC emission restrictions. Because of these restrictions, those units were modeled to only be available in the summer months for a total of approximately 30 hours. SCR Numbers for 2008 are net of retirements of Holtsville and Wading River truck mounted diesel generating units.

EDRPs are modeled as a 193.5 MW EOP step in July and August (and they are also further discounted in other months) with a limit of five calls per month. This EOP is discounted based on actual experience from the forecast registered amount of 430 MW.

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o **External Installed Capacity from Contracts**

An input to the study is the amount of NYCA installed capacity that is assumed located outside NYCA. Some of this capacity is grandfathered. The balance of the contracts are based on a NYISO forecast that reflects historical contracts and current contractual activity.

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o **Transactions**

The NYISO has recommended that the following inter-area capacity transactions to be modeled in this study:

The base case assumes the following summer external ICAP: 205 MW from Ontario, 1200 MW from HQ, 50 MW from New England, 166 MW from Cedars and 1300 MW from PJM. This totals 2,921 MW of expected summer external ICAP.

All firm sales are modeled as listed in the 2007 Gold Book for the year 2008.

In calculating the IRM, all sales are subtracted from the Installed capacity. Purchases are not included.

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• **A-5.4 Emergency Operating Procedures (EOPS)**

There are many steps that the system operator can take in an emergency to avoid disconnecting load. The steps listed in Table A-8 were provided by the NYISO based on experience.

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interface tie limits have been developed such that the transmission model closely resembles the standard eleven-Zone NYCA model. The interface tie limits employed are developed from emergency transfer limits calculated from various transfer limit studies performed at the NYISO and refined with additional analysis specifically for the GE-MARS representation. The new topology and interface limits are shown in Figure A-10.

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The interface tie limits used in the 2007 IRM study were reviewed to assess the need to update the transfer limits and topology resulting from the changes to a multi area representation for PJM and New England and to reflect results from more recent studies. The Summer 2006 and 2007 Operating Study Reports, the 2004, 2005 and 2006 Area Transmission Reviews, the Reliability Needs Assessment (RNA) in the 2007 Comprehensive Reliability Planning Process, and SRIS reports were reviewed to update the transfer limits. Databases from the 2008 RNA were also used.

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When the results in the above reports were not sufficient to make an assessment, additional analysis was done with these databases, and/or other studies were performed and/or referenced. Transmission Owner input and study results were also utilized. Input from neighboring regions on internal constraints was also evaluated.

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### o Changes in Topology and Interface Groupings

The most significant change in the topology was the implementation of a new interface between PJM and Long Island to reflect the operation of the new PJM to Long Island Neptune DC tie. In addition, two new interface groupings were created, the first being a grouping of ties from PJM East to G and J to reflect simultaneous limits arising from PJM East internal constraints. Another grouping is the addition of the PJM-LI tie with the recent LI SUM to capture internal limits of the LI system for exports from western Long Island to NYC and Westchester. These internal limits are a function of generator availability and DC line flow. Appropriate Nomograms were developed as per Table A-9

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### o Changes in Thermally Limited Interfaces

The interface limit for I to J was increased from 3700 MW to 3925 Mw based on recent studies performed by Con Edison and the NYISO. This increase in limit was due to an increase in ratings, using MVA ratings for the limiting circuits, and better flow balancing of the circuits comprising the interface. With the advent of the modified UPNY / SENY Grouping and the new New England to New York Interface Grouping, the New England to SENY grouping was removed and the individual limits on Rest of NE to F and Rest of Connecticut to G were raised to their individual thermal limits.

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o **Cable Interfaces**

Failure rates for overhead lines and underground cables are similar but the repair time for an underground cable is much longer. Therefore, forced transmission outages are included in the GE-MARS model for the underground cable system from surrounding Zones entering into New York City and Long Island. 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 individual make-up of each interface, which includes failure rates and repair times for the cable, and for any transformer and/or phase angle regulator on that particular cable.

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For the Con Edison system, the transition rates were calculated based on five year historical failures of their entire system of underground cables, transformers, and phase angle regulators that are the three major components of the cable interface system into New York City. The failure rates and repair rates for transformers, and phase angle regulators were calculated by voltage classification, and the cables' failure rates and repair rates were calculated by voltage classification and on a per-mile basis. Typically, the larger the cable and equipment population included in the study, the better the results are in predicting the future performance of the underground electric system.

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Once a failure rate and a repair time are created for each component, they are combined to form a single cable system model for each cable. Each single cable system model is then combined together with the other single cable system models that make-up that particular interface to obtain a composite interface model. This provides a conservative estimated transition rate for each of the three cable interfaces into New York City.

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The EFORD calculated from the transition rates of the three transmission interfaces into New York City reveal a slight decrease in the availability of all three interfaces. The weighted average EFOR for all six cables improved from 2.22% to 2.08% while the weighted average for the three internal cables (not including Neptune HVDC cable) worsened from 1.32% to 1.45%

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o **Interconnection Support during Emergencies**

Base case assumptions considered the full capacity of transfer capability from external Control Areas (adjusted for grandfathered contracts and estimated external capacity purchases) in determining the level of external emergency assistance.

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**Table A-9**

**Interface Limit Changes for 2008 IRM**

| Interface Name   |        | 2007 Limit           | 2008 Limits, Base Case  | Comments   |
|--|--------|----------------------|---|--|
| <b>PJM Interfaces</b>  |        | <b>Three Area</b>    | <b>Maintain Three Area, RECO Load Treatment</b>                                 | <b>PJM studies on load deliverability and assessment at NYISO request last year.</b>                           |
|  |        |                      |   |  |
| PJM Cent to East   | +<br>- | 6000<br>6000         | 6500<br>6500  | PJM Update   |
| PJM East to G  | +      | 500                  | 500   | Reflects Internal PJM Constraints For simultaneous and RECO load   |
|  | -      | 2000                 | 2000  | Review of Limits in New York   |
| PJM East to J  | +      | 600 – 1200, PJM unit | 600 – 1200, PJM unit sensitive  | Reflects Internal PJM Constraints and NYC Constraints  |
|  | -      | 0                    | 0   | No Change  |
| PJM East to K  | +      |                      | 660 MW  | Modeled  |
|  | -      |                      | 660 MW  | Both Directions  |
| Joint PJM to G and J   | +      |                      | 1500  | Reflects Internal PJM Constraints, Simultaneous and RECO load  |
|  | -      |                      | 2000  |  |
| <b>New England Interfaces</b>  |        | <b>Five Area</b>     | <b>Maintain Five Area Representation</b>  |  |
| Northport Tie  |        | 286,143, 0           | 286, 200  | Update Unit Nomogram by 200 MW ie, drops to 200 MW both NWLK Units Out   |
| <b>New York Interfaces</b>   |        | <b>Eleven Area</b>   | <b>Maintain Eleven Area Representation</b>                                      |  |
| Astoria West   | +      |                      | 200, 30 Unit Sensitive  | Lock out of 3 GTs if AW units avail.   |
| LI Sum,K-J   | -      | 530, 420             | 576, 486  | Joint Con Edison and LIPA Update   |
| Joint with PJM-LI Neptune HVDC   |        |                      | 306, Neptune Zero Flow 576, Neptune Full into LI<br>No impact on K to J modeled | PJM to LI DC Out or reduced flow, Add PJM-LI interface-into grouping with LI sum for a new-interface grouping. |
| Unit Sensitivity   |        |                      | Reduction of LI-Sum and K to J  | LI Unit Nomogram, Units Lumped for Simplification.   |
| I into J   | +      | 3700                 | 3925  | Updated Ratings, Power Flow Analysis with MVA ratings, and improved flow balancing                             |
| Simultaneous J Import  |        |                      | Sum of All Previous Ties into J   | Interface is for monitoring  |
| <b>Updates to Transfer Limits to Reflect Hudson Valley Voltage Studies</b> |        |                      |   |  |
| UPNY / SENY Group  | +      |                      |   | Study results indicate that the new Cap bank at Millwood with  |
|  | -      |                      |   | NYC and PJM system changes   |
| UPNY / CE  | +      |                      |   | Results in no need to update   |

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|           | - |  |  |                                 |
| DS/Y49Y50 |   |  |  | No change for DS/Y49Y50 in 2008 |

A) **Astoria West** - Unit Sensitive Model, Four Astoria West GTs are in a Separate Area, with a unit sensitive limit combined with a load level of 10,250 in Zone J:

1) Starts at 200 MW, reduces to 30 MW for the following Condition Sets:

a) All Three NYPA CC Units are available and two or three out of Astoria 3,4,5. This gives Four Condition sets for the combinations.

B) **LI Sum DC Tie** – Implemented to capture limitations on flows from Western Long Island to Zones I and J when the PJM to LI DC tie is out of service or flows are limited to less than full rating. An interface grouping is constructed to represent this simultaneous limitation.

$$LI\_Sum\_DC\_Tie = I \text{ to } K + J \text{ to } K + .4 K \text{ to } PJM\_East$$

Derivation of 0.4 coefficient: Analysis was performed to determine the transfer limit at the DC at full output and zero output and a linear relationship was assumed:

$$(576 \text{ MW} - 306 \text{ MW}) / 660 \text{ MW} = 0.4$$

Limits developed for this grouping are effective only for the Long Island west direction. When flows are from PJM to Long Island, the flows on K to J and K to I can be higher than 306, up to the present 576 MW limit.

C) **Dynamic Transfer Limit for Western LI export limit that is dependent on Western Long Island Generation availability.** Since there are over twenty units ranging in size from 14 MWs to 195 MWs in Western Long Island, only the large units are included in the Unit Status List (greater than 100 MW).

From study results, reducing Barrett, Far Rockaway and Glenwood generation by 429 MWs leads to a 393 MW reduction in the Western LI export limit and a reduction in the K to J (Jamaica Export) limit of 160 MW, giving a ratio of approximately .91 and .37, respectively. The reduction occurs primarily with deliveries to Valley Stream and then to Jamaica, so the focus is on units affecting this area. Since Far Rockaway 4 (110 MW) is downstream of Valley stream, its impact is assumed to be one for one.

Impacts Interface K to J (Jamaica Export) and LISUM). Begin at 486 MW, LISUM 576 MW

Grouping the Units to minimize number of dynamic transfer limit tables:

a) Grouping: BARS01, BARS02  
One Unavailable Reduce by 72 MW, 179 MW Two Unavailable Reduce

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by 144 MW, 353 MW

- b) ~~FROCS4 always Unavailable, then combined with:  
BARS01,BARS02 Unavailability, Reduce Only K to J  
One Unavailable Reduce by 182 MW,  
Two Unavailable Reduce by 254 MW~~

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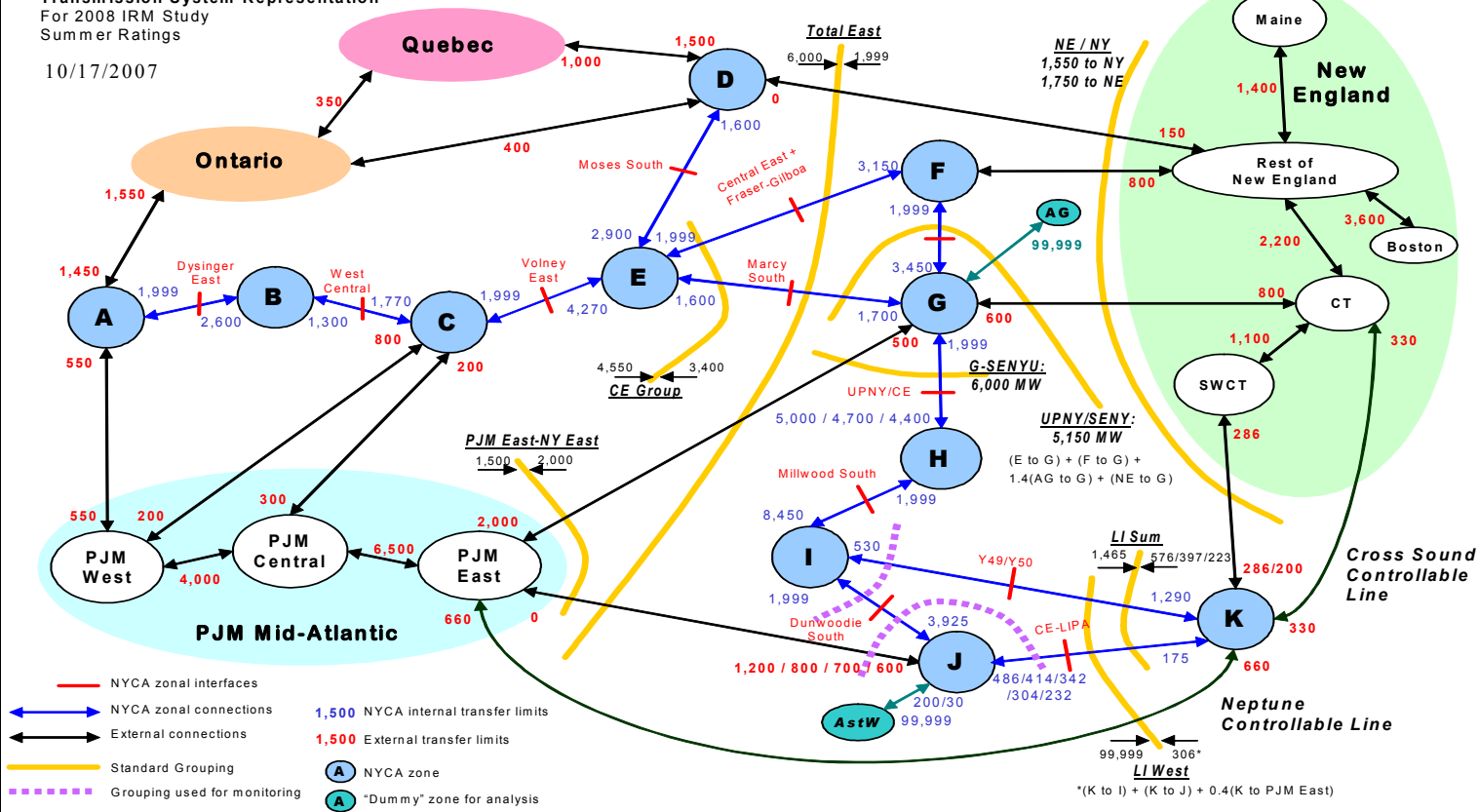
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Figure A-10

**New York Control Area**  
Transmission System Representation  
For 2008 IRM Study  
Summer Ratings

10/17/2007



NYSC - NYCA Installed Capacity Requirement for the Period May 2008 through April 2009



• **A-5.6 Locational Capacity Requirements**

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

These locational ICAP requirements, recognized by NYSRC Reliability Rule A-R2 and monitored by the NYISO, supplement the statewide IRM requirement. This report using the unified methodology determines the minimum locational requirements for different levels of installed reserve. The NYSRC chooses the IRM to be used for the coming year and the NYISO chooses the final value of the locational requirements to be met by the LSEs.

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• **A-5.7 Outside World Load and Capacity Models**

NYCA reliability largely depends on emergency assistance from its interconnected Control Areas in NPCC and PJM, based on reserve sharing agreements with the Outside World Areas. Load and capacity models of the Outside World Areas are therefore represented in the GE-MARS analyses. The load and capacity models for New England, Ontario, PJM, and Quebec are based on data received from the Outside World Areas, as well as NPCC sources.

The primary consideration for developing the final load and capacity models for the Outside World Areas is to avoid over-dependence on the Outside World Areas for emergency capacity support. For this purpose, a rule is applied whereby either an Outside World Area’s LOLE cannot be lower than 0.100 days/year LOLE, or its isolated LOLE cannot be lower than that of the NYCA. In other words, the neighboring Areas are assumed to be equally or less reliable than NYCA. Another consideration for developing models for the Outside World Areas is to recognize internal transmission constraints within the Outside World Areas that may limit emergency assistance to the NYCA. This recognition is considered implicitly for those Areas that have not supplied internal transmission constraint data.

The year 2002 is used in this study for both the NYCA and the Outside World Area load shapes. In order to avoid over-dependence from emergency assistance, the three highest summer load peak days of the Outside World Areas’ are modeled to match the same load sequence as NYCA.

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For this study both New England and PJM continue to be represented as multi-area models, based on data provided by these Control Areas.

The EOPs were removed from the Outside World Areas to avoid the difficulty in modeling the sequence and coordination of implementing them. This is a conservative measure.

The assistance from East Central Area Reliability Council (ECAR) and the Maritime Provinces was not considered, therefore, limiting the emergency assistance to the NYCA from the immediate neighboring control areas. This consideration is another measure of conservatism added to the analyses.

The load forecast uncertainty model for the outside world model was supplied from the external Control Areas.

**Modeling of the neighboring Control Areas in the base case in accordance with Policy 5-1 is as follows:**

**Table A-10**

**Reserve Margin Modeling in Neighboring Control Areas**

| <b>Area</b>  | <b>Reserve Margin</b> | <b>LOLE</b>         |
|--------------|-----------------------|---------------------|
| NYCA         | 15.0%                 | 0.090 Days per year |
| Hydro Quebec | 30.5%*                | 0.264 Days per year |
| Ontario      | 14.0%                 | 0.120 Days per year |
| PJM-MA       | 11.4%                 | 0.697 Days per year |
| NEPOOL       | 8.7%                  | 7.473 Days per year |

\*This is the summer ratio, the winter ratio is 2.7%

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# Appendix B

## Details **of** Study Results

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## B-1 - Introduction

Appendix B provides details of the GE-MARS case results referenced in the body of this report. This includes results of the anchor point case and various sensitivities cases, as well as an analysis of emergency operating procedures for the anchor point case required IRM. A history of the IRM values are given below in Table B-1.

## B-2 - Historical IRMs

Table B-1

### NYCA Historical IRM and LCR Information

| <u>Capability</u><br><u>Year</u> | <u>Base Case IRM</u><br><u>Developed by</u><br><u>NYRC-ICS For</u><br><u>NYCA</u> | <u>NYCA IRM</u><br><u>Final Approved by</u><br><u>NYSRC-EC</u> | <u>LCR for NYC</u><br><u>Final Approved by</u><br><u>NYISO-OC*</u> | <u>LCR for LI</u><br><u>Final Approved by</u><br><u>NYISO-OC*</u> |
|----------------------------------|---|--|--|---|
| 2000                             | 15.5%   | 18.0%  | 80%  | 107%  |
| 2001                             | 17.1%   | 18.0%  | 80%  | 98%   |
| 2002                             | 18.0%   | 18.0%  | 80%  | 93%   |
| 2003                             | 17.5%   | 18.0%  | 80%  | 95%   |
| 2004                             | 17.1%   | 18.0%  | 80%  | 99%   |
| 2005                             | 17.6%   | 18.0%  | 80%  | 99%   |
| 2006                             | 18.0%   | 18.0%  | 80%  | 99%   |
| 2007                             | 16.0%   | 16.5%  | 80%  | 99%   |
| 2008                             | 15.0%   | TBD  | TBD  | TBD   |

\* The NYISO Operating Committee

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### B-3 - Base Case and Sensitivity Case Results

Table B-1 summarizes the 2008 capability year IRM requirements under anchor point case assumptions, as well as under a range of assumption changes from this case. The base case utilized the computer simulation, reliability model, and assumptions described in Appendix A. The sensitivity cases determined the extent of how the anchor point case required IRM would change for assumption modifications, either one at a time, or in combination. The methodology used to conduct the sensitivity cases was to start with the base case results of 15% NYCA, 79% NYC, and 94% LI reserve margins. Capacity is then added or removed from all zones in NYCA until the NYCA LOLE approaches criteria.

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Table B-2

#### Description & Explanation of 2008 Sensitivity Cases

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| Case No.   | Description & Explanation   | %IRM  | % LCRs       |             |
|--|---|-------|--------------|-------------|
|  |   |       | Zone J (NYC) | Zone K (LI) |
| <b>Transmission Sensitivities</b>                  |   |       |              |             |
| T1   | <b>No Internal NYCA Transmission Constraints (“Free-Flowing” System)</b>  | 12.6% | N.A.         | N.A.        |
|  | This case represents the “Free-Flow” NYCA case where internal transmission constraints are eliminated and measures the impact of transmission constraints on statewide IRM requirements. See the “Base Case – NYCA Transmission Constraints” section of the report. |       |              |             |
| T2   | <b>Remove Neptune Cable</b>   | 17.6% | 80.8%        | 96.1%       |
|  | This case shows the impact on NYCA reliability if the new Neptune cable project is not available.   |       |              |             |
| T3   | <b>Reduce transmission limits of Dysinger East, West Central, Volney East Moses South and Central East by 10% in the positive direction.</b>  | 15.1% | 79.1%        | 94.1%       |
|  | This case addresses concern of how much help downstate can get from upstate.  |       |              |             |
| T4   | <b>NUSCO re-conductoring project delayed past 2008 summer.</b>  | ___%  | ___%         | ___%        |
|  | This case looks at the potential of not getting emergency assistance from NEPOOL to Long Island if the cable is not in service.   |       |              |             |
| <b>Assistance From Outside World Sensitivities</b> |   |       |              |             |
| A1   | <b>NYCA Isolated (No Emergency Assistance or Non-UDR Capacity from Outside World Areas)</b>   | 19.0% | 81.9%        | 97.2%       |

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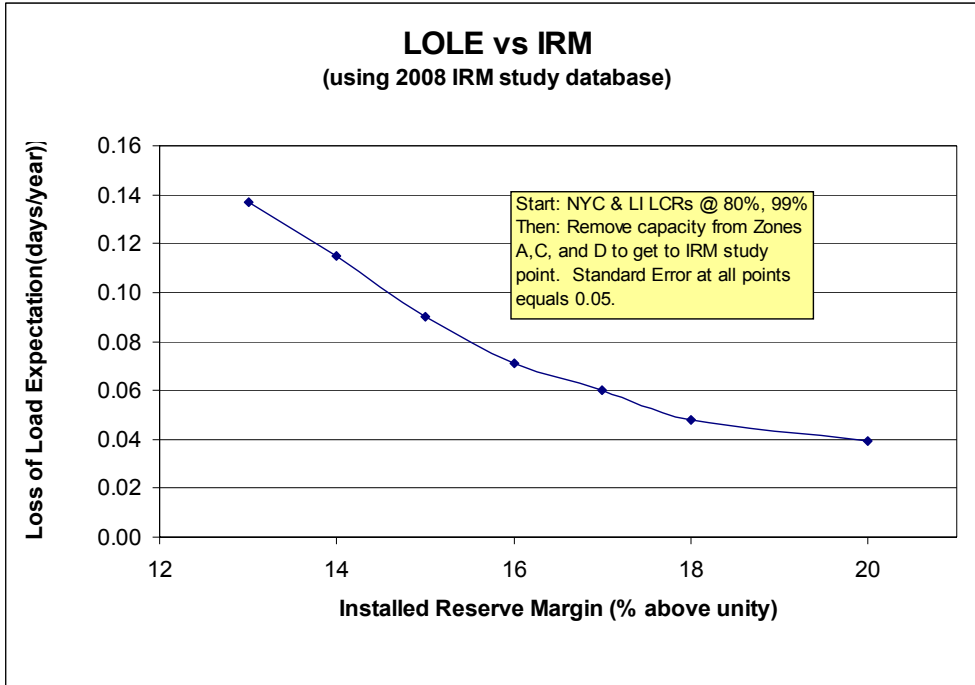
| Case No.  | Description & Explanation  | %IRM         | % LCRs       |              |
|---|--|--------------|--------------|--------------|
|   |  |              | Zone J (NYC) | Zone K (LI)  |
|   | This case examines a scenario where the NYCA system is isolated and receives no emergency assistance from neighboring control areas (New England, Ontario, Quebec, and PJM). See the "Base Case Results – Interconnection Support during Emergencies" section of the report.                     |              |              |              |
| <b>A2</b>   | <b>Each External Control Area's 2008 Load and Capacity as presently projected</b>  | <b>14.8%</b> | <b>78.9%</b> | <b>93.9%</b> |
|   | Examines the case where the external Control Areas are modeled as being more reliable than in the base case and can provide additional assistance to NYCA.   |              |              |              |
| <b>A3</b>   | <b>Each external Control Area's IRM is at the level required to meet its LOLE criterion.</b>   | <b>___%</b>  | <b>___%</b>  | <b>___%</b>  |
|   | Similar to Case A2 but the external Areas would probably be less reliable than in A2 and would be able to provide less assistance to NYCA.   |              |              |              |
| <b>A4</b>   | <b>Enhanced NEPOOL system (Assumes latest ISO-NE Regional Plan)</b>  | <b>___%</b>  | <b>___%</b>  | <b>___%</b>  |
|   | This case would probably show that NYCA would get less assistance from NEPOOL.   |              |              |              |
| <b>Generation Unit Availability Sensitivities</b> |  |              |              |              |
| <b>G1</b>   | <b>Increase EFORDs from Base Case (represented by assuming the maximum annual EFORDs during the 2002-06 period)</b>  | <b>16.2%</b> | <b>78.9%</b> | <b>95.0%</b> |
|   | This shows the impact if the NYCA units are very unreliable.   |              |              |              |
| <b>G2</b>   | <b>Decrease EFORDs from Base Case (represented by assuming the minimal annual EFORDs during the 2002-2006 period)</b>  | <b>12.0%</b> | <b>76.9%</b> | <b>91.6%</b> |
|   | This shows the impact if the NYCA units are very reliable.   |              |              |              |
| <b>G3</b>   | <b>Represent IP 2 as unavailable the entire year instead of using the 2002-06 average EFORD (on maintenance).</b>  |              |              |              |
|   | This shows the impact of the removal of IP 2 either by regulations or operational problems.  |              |              |              |
| <b>Load Sensitivities</b>                         |  |              |              |              |
| <b>L1</b>   | <b>No Load Forecast Uncertainty</b>  | <b>7.7%</b>  | <b>73.8%</b> | <b>88.1%</b> |
|   | This scenario represents "perfect vision" for 2008 peak loads, assuming that the forecast peak loads for NYCA have a 100% probability of occurring. The results of this evaluation help to quantify the effects of weather and, to a smaller degree, economic uncertainties on IRM requirements. |              |              |              |
| <b>L2</b>   | <b>Assume the actual 2008 peak load will be the 0.8 percentile load represented in the Base Case load forecast uncertainty distribution model</b>  | <b>9.2%</b>  | <b>74.8%</b> | <b>89.3%</b> |
|   | Assumes that there is no load forecast uncertainty and that the actual load will be high.  |              |              |              |

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| Case No.  | Description & Explanation   | %IRM                       | % LCRs       |             |
|---|---|----------------------------|--------------|-------------|
|   |   |                            | Zone J (NYC) | Zone K (LI) |
| L3  | <b>Assume the actual 2008 peak load will be the 0.2 percentile load represented in the Base Case load forecast uncertainty distribution model</b> | 4.1%                       | 71.2%        | 85.2%       |
| Assumes that there is no load forecast uncertainty and that the actual load will be low.  |   |                            |              |             |
| <b>Emergency Operating Procedure Sensitivity</b>  |   |                            |              |             |
| EP1   | <b>No SCRs or EDRPs</b>   | 15.2%                      | 78.0%        | 94.4%       |
| Special Case Resources (SCRs), like traditional central generation stations, can be used to satisfy the NYCA IRM requirement, while Emergency Demand Response Program (EDRP) suppliers represent voluntary resources which are available – in addition to those resources which satisfy the NYCA IRM. The intention of this sensitivity case is to demonstrate the impact of replacing traditional central generation facilities with SCRs and of removing EDRP suppliers. Eliminating SCRs from the study results in a lower IRM because the forced outage rates associated with SCRs are higher than the average system forced outage rates. Conversely, removing EDRPs causes an increase in IRM because the EDRP suppliers provide benefits from their status as voluntary resources. The base case IRM study models an effective value of EDRP based on the historic performance from a given set of registered suppliers. The net effect of the SCRs and EDRP suppliers tends to have an offsetting effect for this particular study year. See the “Base Case Results – SCR and EDRP” sections of the report. |   |                            |              |             |
| <b>Environmental Initiative Sensitivities</b>   |   |                            |              |             |
| EN1   | <b>HEDD Scenario</b>  | ___%                       | ___%         | ___%        |
| This case assumes that the environmental restrictions appearing the 2007 RNA report for the year 2009 are modeled in this study for the year 2008.  |   |                            |              |             |
| EN2   | <b>RGGI Scenario</b>  | ___%                       | ___%         | ___%        |
| This case assumes that the environmental restrictions appearing the 2007 RNA report for the year 2010 are modeled in this study for the year 2008.  |   |                            |              |             |
| <b>Miscellaneous LOLE Sensitivities</b>   |   |                            |              |             |
| M1  | <b>IRM vs. LOLE curve (with LOLE of Base Case IRM @ 0.1)</b>  | <b>See Graph M1 below.</b> |              |             |
| This is in response to Executive Committee Action Item #82.5  |   |                            |              |             |
| M2  | <b>Monte Carlo 99.7% confidence level, including use of a 0.05 standard error.</b>  | ___% low                   | ___% high    |             |
| This would show the impact of a run with many more replications.  |   |                            |              |             |
| M3  | <b>LOLE for Monte Carlo convergence at a standard error of 0.025</b>  | ___% low                   | ___% high    |             |
| A more severe test than case M2.  |   |                            |              |             |
| M4  | <b>Combine Sensitivities A-3 and G-1</b>  | ___%                       | ___%         | ___%        |



Graph M1



In all cases, it was assumed that the EOPs are implemented as required to meet the 0.1days/year criterion. In the base case, the study shows that approximately 1.5 remote voltage reductions per year would be implemented to meet the once in 10 years disconnection criterion. The expected frequency for each of the EOPs for the Base Case is provided in Table B-2.

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**Table B-3**

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**Implementation of Emergency Operating Procedures\***  
Anchor Point Case Assumptions (IRM = 15.0 %)

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| <u>Emergency Operating Procedure</u> | <u>Expected Implementation (Days/Year)</u> |
|--------------------------------------|--|
| Require SCRs                         | <u>5.9</u>                                 |
| Require EDRPs                        | <u>5.0</u>                                 |
| 5% manual voltage reduction          | <u>4.7</u>                                 |
| 30 minute reserve to zero            | <u>2.4</u>                                 |
| 5% remote control voltage reduction  | <u>1.5</u>                                 |
| Voluntary load curtailment           | <u>1.2</u>                                 |
| Public appeals                       | <u>1.1</u>                                 |
| Emergency purchases                  | <u>1.1</u>                                 |
| 10 minute reserve to zero            | <u>1.0</u>                                 |
| Customer disconnections              | 0.1  |

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\* See Appendix A, Table A-2

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| Relative Zonal Shares of Coincident Peak Demand  |                 |                               |
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| 2008 Load Forecast Uncertainty Models  |                 |                               |
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Three Area

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Maintain Three Area, RECO Load Treatment

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PJM studies on load deliverability and assessment at NYISO request last year.

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