Attachment I

NYISO Responses to Deficiency Letter
Docket No. ER18-1743-000
August 9, 2018

Summary of the Development of the Alternative LCR Methodology

The July 10 Deficiency Letter issued by the Commission in this proceeding directed the NYISO to provide more detailed descriptions and explanations of various aspects of the proposed Alternative LCR Methodology and related amendments to the NYISO Market Administration and Control Area Services Tariff ("Services Tariff") described in the NYISO's June 5, 2018 filing.[1] The NYISO's efforts to develop the Alternative LCR Methodology were undertaken with its stakeholders over a three year span beginning in January of 2015.[2] These efforts culminated with the NYISO's June 5, 2018 filing. Some additional background on this effort is provided below.

The initial impetus for consideration of an alternative approach to determine the Locational Minimum Installed Capacity Requirements ("LCRs")[3] for each Locality within the New York Control Area ("NYCA") arose in 2013 and 2014 when the NYISO implemented the G-J Locality. At that time, the NYISO and its stakeholders began to assess whether the existing methodology used to calculate LCRs for the New York City ("NYC") and Long Island ("LI") Localities would be appropriate to calculate LCRs for the new G-J Locality. The existing methodology is the "Unified Method," which is often referred to as the "Tan 45 Method" and is described in Appendix A of the New York State Reliability Council, L.L.C. ("NYSRC") Policy 5-13.[4]

In implementing the G-J Locality, the NYISO, working with its stakeholders and the NYSRC, developed an additional step to be executed after the Tan 45 Method was used to establish the NYCA Installed Reserve Margin ("IRM") and the NYC and Long Island LCRs. This additional step allowed the NYISO to calculate the G-J Locality requirement without impacting the existing Tan 45 Method used by the NYSRC in setting the IRM. A brief summary of this approach is described in paragraphs 16-17 of the Hall Affidavit.[5]

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[1] New York Independent System Operator, Inc., *Proposed Tariff Revisions to Determine Location Minimum Installed Capacity Requirements*, Docket No.ER18-1743-000 (filed June 5, 2018) ("June 5, 2018 Filing").

[2] The various NYISO presentations that were made to stakeholders, which collectively describe the work conducted by the NYISO, its stakeholders, and consultants that led to the final proposal for the Alternative LCR Methodology are included in this filing as Exhibits 1-39 (in Attachments III and IV).

[3] Capitalized terms not otherwise defined herein shall have the meaning specified in Section 1 of the Open Access Transmission Tariff ("OATT") and Section 2 of the Services Tariff.

[4] New York State Reliability Council, LLC, *Reliability Policy No. 5-13: Procedure for Establishing New York Control Area Installed Capacity Requirements* (approved by Executive Committee May 11, 2018) ("NYSRC Policy 5"): http://www.nysrc.org/pdf/Policies/NYSRC%20POLICY%205-13%20%20Final[3586].pdf.

[5] Attachment II, Affidavit of Wesley Hall, paras. 16-17. ("Hall Affidavit") The NYISO currently provides the detailed description of the steps taken when determining the LCRs in NYISO's Locational Capacity Requirement Calculation Process ("LCR Calculation Process"), which is posted on the NYISO website: http://www.nyiso.com/public/webdocs/markets_operations/market_data/icap/Reference_Documents/LCR_Calculation_Process/LCR%20Calculation%20Process%2012_13_13.pdf. It is unlikely that the current LCR process could be applied to a different configuration of Localities, but the Alternative LCR Methodology being

Despite the addition of steps to allow the LCR calculation to consider the G-J Locality, stakeholder discussions continued to focus on the development of an alternative approach. In its 2013 State of the Market Report,[6] Potomac Economics, the independent Market Monitoring Unit ("MMU"), identified certain potential alternatives to the Tan 45 Method for determining LCRs and presented these alternative approaches to stakeholders at the August 20, 2014 and November 14, 2014 Installed Capacity ("ICAP") Working Group meetings.[7]

In January 2013, prior to the creation of the G-J Locality, Dynegy Danskammer announced the retirement of 537 megawatts,[8] which was removed from NYISO planning studies including the LCR determinations for the 2013-2014 Capability Year. The loss of these Lower Hudson Valley units from Load Zone G caused the LCRs in NYC and Long Island Localities to increase significantly. The NYISO stated in its January 17, 2013 report to the Operating Committee (Attachment III, Exhibit 2) that, despite numerous factors that would tend to reduce the LCR determinations, "[t]he retirement of the Danskammer units is the primary factor increasing the LCR values." The report stated factors causing LCRs to increase – of which the Danskammer exit from the market was the "primary factor" that offset several factors that would tend to reduce the LCRs for NYC and Long Island, such as the addition of the Hudson Transmission Project, improved generator availability, and the reduction of load forecast uncertainty in Long Island. (Attachment III, Exhibit 2, pp 2-3.) Further, the NYSRC IRM report that included the Danskammer units in the base case calculated the lowest feasible LCRs for NYC and Long Island to be 83.7% and 102.0% respectively.[9] Both sets of LCRs were determined using the Tan 45 Method designed explicitly for the NYC and Long Island

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proposed is designed to work consistently notwithstanding the configuration of Localities in the NYCA. See Hall Affidavit paras. 10 and 14.

[6] The Motion to Intervene and Comments of the New York ISO's Market Monitoring Unit filed in this proceeding on July 10, 2018 emphasized (at 3) that starting in 2013, and "for several years" thereafter, the MMU had "documented inefficiencies that result from the existing LCR setting methodology, and recommended the NYISO improve its LCR-setting methodology." The MMU concluded (at 3) that "[a]lthough we recommended certain design elements that were not ultimately adopted by the NYISO, we generally found the NYISO's assessment to be informative and supported the final proposal as a significant improvement over the Tan 45 method, which does not consider cost-minimization as a criterion for the setting of LCRs."

[7] See, *Presentation of Pallas Lee VanSchaick to Installed Capacity Working Group*, 2013 State of the Market Report Recommendation to Enhance Locational Pricing in the Capacity Market (August 20, 2014 and November 14, 2014):http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2014-08-20/Capacity_2013%20SOM__8172014.pdf.

[8] See, Letter to Hon. Jeffrey C. Cohen, Acting Secretary New York Public Service Commission re: Notice of Intent to Retire Dynegy Danskammer, L.L.C. Units 1 – 6, dated January 3, 2013: https://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Planned_Generation_Retirements/Planned_Retirement_Notices/Danskammer_Retirement_Notice.pdf.

[9] See, *New York State Reliability Council, L.L.C. Technical Study Report*, New York Control Area Installed Capacity Requirements for the Period May 2013 Through April 2014, December 7, 2012 ("NYSRC 2013 IRM Study"): http://www.nysrc.org/pdf/Reports/Final%202013%20IRM%20Report%2012-7-12.pdf; and *New York State Reliability Council, L.L.C.*, Filing of Installed Capacity Requirement for the New York Control Area, Docket No. ER13-527-000 (December 27, 2012) ("NYSRC 2013 IRM Filing").

Localities. The Danskammer announced retirement caused the NYC LCR to increase from 83.7% to 86.0% and Long Island's LCR to rise from 102.0% to 105.0%.[10]

The LCRs determination for the 2014-2015 Capability Year continued to model the Danskammer units out of service. This was also the first year an LCR for the G-J Locality was required and an additional step was used with the Tan 45 Method[11] that produced the final LCRs for NYC, Long Island and the G-J Locality that were 85.0%, 107.0% and 88.0%, respectively.[12] When the Danskammer facility's return to service was announced in 2014, after the G-J Locality was implemented into the NYISO Capacity Market, the newly expanded Tan 45 Method for establishing LCRs, with Danskammer units modeled in service, resulted in a 1.5% reduction in the NYC LCR to 83.5%, a 3.5% reduction to 103.5% for Long Island, and a 2.5% increase of the G-J Locality's LCR to 90.5%. (Attachment III, Exhibit 4.) In its report to the Operating Committee the NYISO again pointed to the status of the Danskammer units as a dominant factor in the variability of the LCRs that resulted in an increase to the requirement in the G-J Locality of 408 MW, while New York City and Long Island LCRs combined fell by 372 MW.[13] It is important to note that the NYCA-wide IRM remained unchanged at 117% for these three Capability Years. In fact, in the NYSRC's IRM study that included the return to service of the Danskammer units, it was observed that the addition of these 500 megawatts of supply in the Lower Hudson Valley had no measurable impact on the IRM result. The NYSRC 2015 IRM Study, however, includes sensitivity cases that removed the Danskammer units from the IRM model, which show that the LCRs for NYC and Long Island fell by 2.0 % and 2.6%, respectively with the Danskammer units modeled in service.[14] This sequence of LCR determinations illustrates how LCR outcomes using the Tan 45 Method can vary significantly in relation to

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[10] The actual LCRs applied to the 2012 -2013 Capability Year were 83.0% and 99.0% for NYC and Long Island, respectively (See Attachment III, Exhibit 1), but the NYSRC 2013 IRM Report produced LCRs using the Tan 45 Method with the Danskammer units modeled in service at 83.7% and 102.0% for NYC and Long Island. See, NYSRC 2013 IRM Filing. When the NYISO determined LCRs in January 2013 using the Tan 45 Method and modeling the Danskammer units out-of-service, LCR results increased by 2.3% for NYC and 3% for Long Island. (See Attachment III, Exhibit 2.)

[11] The Tan 45 Method for this 2014 – 2015 Capability Year included for the first time an additional step that is described in the NYISO's LCR Calculation Process. This *post hoc* shifting step allowed the Tan 45 Method, as described in NYSRC Policy 5-13, to stay unchanged for determining the NYCA-wide IRM and LCRs for NYC and Long Island.

[12] NYSRC identified the lowest feasible locational requirements of 84.7% for NYC and 106.9% for LI. See, *NYSRC Technical Study Report*, New York Control Area Installed Capacity Requirements for the Period May 2014 Through April 2015 (December 6, 2013), ("NYSRC 2014 IRM Study"): http://www.nysrc.org/pdf/Reports/2014%20IRM%20Report%20Body%20%20Final%2012-6-13.pdf.

[13] *See*, *NYSRC Technical Study Report*, New York Control Area Installed Capacity Requirements for the Period May 2015 Through April 2016, pp. 2 & 22-23 (December 5, 2014), ("NYSRC 2015 IRM Study"). In the NYSRC 2015 IRM Study Danskammer was modeled in service in the base case.

[14] *Id.* NYSRC 2015 IRM Study identified Minimum Locational Capacity Requirements ("MLCR") of 83.4% for NYC and 103.7% for Long Island for the IRM base case, which included the 500 megawatts associated with the Danskammer units in service. The study, however, also ran parametric and sensitivity analyses to measure the impact of the inclusion of Danskammer in the model on the change of the IRM results from 2014 as well as the change to the 2015 MLCRs for NYC and Long Island. This analysis showed that the inclusion of these 500 megawatts in the IRM database had no impact on the IRM determination, but decreased the NYC and Long Island MLCRs by a combined 373 megawatts. NYSRC 2015 IRM Study, at 22-23. The NYSRC does not produce MLCRs for the G-J Locality because these are calculated by an additional step beyond the Tan 45 Method described in NYSRC's Policy 5.

changes in generator entry and exit assumptions that are highly correlated with the change. Certain stakeholders deemed the increase in the G-J Locality LCR upon the return of the Danskammer units, which are located in Load Zone G, as a concern because the only significant change driving the result was the addition of the Danskammer megawatts (there were no underlying changes that limited the transmission system into the G-J Locality).

In 2015, based on the earlier State of the Market Report recommendations[15] and stakeholder concerns, the NYISO's Operating Committee created a LCR Task Force to address the observed variability of the recent LCR determinations resulting from additional supply returning into the G-J Locality. With the creation of this task force, the Operating Committee explicitly requested that the NYISO lead an effort, coordinated with the ICAP Working Group, to consider alternative processes to calculate LCRs and perform analysis of potential viable enhancements or alternatives to the Tan 45 Method. The first presentation made by the NYISO to the task force highlighted the chance in LCRs observed when the Danskammer units returned to service. (Attachment III, Exhibit 5.) At the January 2016 LCR Task Force meeting, FTI Consulting, an independent consultant engaged by the NYISO, presented the work it conducted in 2015 evaluating potential changes to address these results. This initial effort was terminated because it did not provide stable and predictable results. (Attachment III, Exhibit 9.) At that meeting, the NYISO indicated to stakeholders that it would carefully consider the alternative approaches recommended by Potomac Economics to develop a comprehensive approach to determining LCRs for any Locality. (Attachment III, Exhibit 10.)

In spring 2016, the NYISO engaged GE Energy Consulting ("GE") to assist in developing a comprehensive approach to determining LCRs for any given set of Localities in the NYCA based on minimizing total NYCA capacity costs while meeting the minimum reliability criteria. At the outset, the NYISO established that it would not consider any approach that would require changes to the Tan 45 Method employed by the NYSRC in exercising its authority over calculation of the statewide IRM.[16] Instead the NYISO focused on identifying a solution to the variability in the LCR results that was observed with the addition of capacity in the G-J Locality. (Attachment III, Exhibits 10 and 11.) GE assisted the NYISO in the development of a linear programming optimization tool that iterates with the GE Multi-Area Reliability Simulation Software Program ("GE MARS") to minimize the cost of capacity objective function while achieving the applicable 0.1 days/year loss of load expectation ("LOLE") reliability criterion. (Attachment II, Hall Affidavit at PP 9-12.)

To facilitate this effort, the NYISO and its stakeholders, established the guiding principles for an alternative LCR methodology. Specifically, the new market design should

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[15] See, 2013 State of the Market Report Recommendation to Enhance Locational Pricing in the Capacity Market, dated August 20, 2014: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2014-08-20/Capacity_2013%20SOM__8172014.pdf.

[16] Under the New York State Reliability Council Agreement, the NYSRC has the authority to establish the statewide IRM. Under the Agreement, the NYISO must use the statewide IRM set by the NYSRC and, pursuant its tariffs, determine the minimum NYCA requirement and calculate the minimum LCRs for each Locality within the NYCA. The NYISO has no authority to determine how the NYSRC establishes the statewide IRM. It would take the action of the NYSRC under its Reliability Rules and a revision to NYSRC Policy 5, approved by the NYSRC's Executive Committee, to amend the Tan 45 Method by which the NYSRC sets the IRM.

result in a cost effective and efficient set of capacity requirements by producing lower capacity costs to consumers while continuing to send the appropriate price signals to attract and retain the required investment in resources to maintain a reliable system. The new method should enhance the transparency and the predictability of the LCR determinations by eliminating undue variability. The design should improve the stability of the LCR results and allow them to move appropriately with system changes such as changes to transmission topology and changes to the net cost of new entry ("CONE"), which are indicative of the costs to invest in a new peaking resource within each Locality. Finally, the design should be robust by setting requirements to attract capacity where it provides the reliability benefits to meet the resource adequacy criterion at the lowest costs. A robust design also is one that can consistently be administered with any configuration of Localities in the NYCA and can be modified to incorporate additional constraints that may be deemed necessary in the future. (Attachment III, Exhibit 17.)

Once these design principles were established, the NYISO worked with GE to complete the design in five phases: 1) Proof of Concept – conduct analysis to demonstrate how an economic optimization performs in relation to the design principles; 2) Refine the Methodology – refine the methodology to ensure that the economic optimization is based on sound market and engineering principles; 3) Simulation of Market Outcomes – conduct analyses to ensure the approach produces appropriate outcomes from both a market and reliability perspective; 4) Assessment of Consumer Impacts – compare the short-term, intermediate, and longer-term cost impacts to consumers in each of the three Localities (*i.e.*, J, K, and G-J) and NYCA, of the Alternative LCR Methodology compared to the current methodology; and 5) Implementation – establish a timeline of software and administrative changes to introduce the new approach into the production software and market outcomes. (Attachment III, Exhibit 17.) Given the complexity and importance of this effort, the NYISO and its stakeholders pursued the development of an alternative LCR methodology in a comprehensive and deliberate manner over the course of the following two years.[17]

The NYISO ran over 80 sensitivity analyses assessing both the Tan 45 Method and the Alternative LCR Methodology across two different IRM databases. The NYISO vetted the results of this analysis as well as the refinement of the economic optimization modeling methodology with stakeholders at more than 24 working group and governance committee meetings. At the February 28, 2018 Management Committee meeting, stakeholders approved the market design with 77.5% of the vote affirmatively supporting the Alternative LCR Methodology. As proposed by the NYISO and described in its tariff language, this methodology replaces the Tan 45 Method for calculating LCRs with an economic optimization of LCRs. The optimization uses the Constrained Optimization by Linear Approximation method ("COBYLA"), which executes iterative linear approximations of the constraints and objective functions to find a least cost solution. (Attachment II, Hall Affidavit at P 12.) The GE MARS probabilistic model determines the LOLE constraint function for the system modeled at the NYSRC-determined IRM.[18] Transmission security limits act as reliability-based constraints limiting how low the

[17] This lengthy and transparent stakeholder process is evidenced in the work presented in Exhibits 11-39 provided in Attachments III and IV to this filing.

[18] The methodology utilizes the same approach as the Tan 45 Method in that it uses the IRM MARS database with the IRM set by the NYSRC. Further, each iteration runs 2,500 replications of the MARS model as required by

LCRs in each Locality can be set when achieving the least cost solution. Finally, as the result of its sensitivity analyses, the NYISO used net CONE elasticity curves taken from the ICAP Demand Curve parameters to inform the costs of each iteration of LCRs.

Question 1:

Describe, individually, how the Alternative LCRs Methodology solves for and addresses each of the following requirements: (1) minimize the total cost of capacity at the prescribed level of excess; (2) maintain the loss of load expectation of no more than 0.1 days per year; (3) ensure that transmission security limits are respected. Please provide any studies, exhibits, or other documents that detail the factors that lead to the proposed methodology.

1(1): How the Alternative LCR Methodology minimizes the total cost of capacity at the prescribed level of excess

Response: The Alternative LCR Methodology uses an economic cost minimization algorithm to determine the optimal distribution of capacity within Localities that achieves a least cost solution for procuring the quantity of capacity at the prescribed level of excess ("LOE").[19] GE designed a linear programing optimization to work with GE MARS to solve for the set of LCRs that result in the least cost solution while achieving the 0.1 day/year LOLE. The linear programming optimization model solves the cost minimization function while maintaining the 0.1 day per year LOLE by working with GE MARS iteratively to generate LCR combinations that reduce the cost of capacity at the LOE while not violating any fixed constraints (*e.g.*, LOLE, Transmission Security Limits or LCR Floors, and the IRM).[20] The optimization program stops iterating with GE MARS when the change in the LCRs between two subsequent iterations is less than the user-defined stopping criteria. For example, if the LCRs generated in the 30th iteration were less than the stopping criteria of 0.01% from the 31st iteration, the optimization would stop.

The Alternative LCR Methodology's optimization program is formulated in the following manner:

$$Minimize:$$

$$Cost\ of\ Capacity\ Procurement = \sum_x \left[Q_x + LOE_x\right] \cdot P_x\left(Q_x + LOE_x\right)$$

$$+ \sum_y \left[Q_y + LOE_y - \sum_z LOE_z\right] \cdot P_y\left(Q_y + LOE_y + \sum_z Q_z\right) +$$

the NYSRC to identify LCRs that provide the least cost distribution of capacity resources at the Level of Excess among Localities while maintaining an LOLE of less than 0.1 day per year.

[19] The LOE utilized in establishing the ICAP Demand Curves is further described in Section 5.14.1.2.2 of the Services Tariff.

[20] As discussed further in the response to question 2 below, the optimization model used in the Alternative LCR Methodology is a robust design that will continue to calculate appropriate LCRs for any other configuration of Localities, as well as allow for the elimination or the addition of the defined number of fixed constraints, such as an explicit upper bound on LCRs in each Locality.

$$+\left[Q_{Pool}+LOE_{Pool}-\left(\sum_{x}(Q_x+LOE_x)+\sum_{y}(Q_y+LOE_y)\right)\right]\cdot P_{Pool}(Q_{Pool}+LOE_{Pool})$$

Subject to:

$$LOLE \le 0.1 \text{ days/year}$$
$$Q_{Pool} = \text{NYSRC Approved IRM}$$

$$Q_x \ge Q_{Transmission\ Security\ Floor_x}$$
$$Q_y + Q_z \ge Q_{Transmission\ Security\ Floor_{y+z}}$$

Where x and y are indices used to describe single area capacity localities (x) and multi area capacity localities (y) that contain single area localities. For example, the NYC Locality is wholly contained within the larger G-J Locality. The index z describes the subset of single area localities that are contained within a given multi area locality. Pool is used to describe the total control area – in this application, the NYCA.

The variable Q is the quantity of capacity in each Locality that achieves a 0.1 LOLE result, and is the product of that Locality's non-coincident peak load and the LCR. The LCRs will serve as the decision variables for the cost optimization and will be varied with each iteration to minimize the cost of capacity procurement. The capacity, Q, for each multi area Locality must account for the capacity of the single area Localities contained within them so as not to double count the capacity, and cost, of the smaller Locality. Q_y, then, is the product of the LCR and coincident peak load for the multi-area Locality y, less the product of the LCR and non-coincident peak load for each area z contained within y. For the purposes of the Alternative LCR Methodology, Q_{Pool} is a fixed constraint[21] that is the product of the IRM requirement established by the NYSRC and the coincident peak load for NYCA. The analysis contained within this report fixes the IRM at the current levels and only analyzes the performance of the proposed methodology when solving for the least cost set of LCRs.

$$Q_x = LCR_x \cdot Area_x\ Non\ Coincident\ Peak$$

$$Q_y = \begin{pmatrix} LCR_y \cdot Nested\ Locality_y \\ Coicident\ Peak \end{pmatrix} - \sum_z \begin{matrix} LCR_z \cdot Area_z \\ Non\ Coincident\ Peak \end{matrix}$$

$$Q_{Pool} = IRM \cdot Pool\ Coincident\ Peak$$

[21] As designed the optimization model can solve the objective function while treating IRM as a fixed constraint (*i.e.*, a user-defined input to the model) or as a decision variable that would further minimize the capacity cost by allowing the program to also solve for the variable Q_{Pool}. Since it is the NYSRC that has authority to establish the IRM, the Alternative LCR Methodology treats the IRM as a fixed constraint and, in accordance with the Services Tariff, the NYISO utilizes the IRM to establish the NYCA Minimum Installed Capacity Requirement. The proposed methodology does not modify these steps in any way other than that the NYISO calculates the LCRs using the economic optimization program rather than re-executing the Tan 45 Method with the additional step to determine the G-J Locality LCRs.

P is the price of procuring capacity in each Locality and can be defined either as a single value, or as an elasticity curve that is a function of the LCR. The value of P will most commonly represent the net CONE.

$$P_x(Q_x + LOE_x),\ P_y\left(Q_y + LOE_y + \sum_z Q_z\right),\ P_{Pool}(Q_{Pool} + LOE_{Pool}) =$$

$$Net\ CONE\ or\ other\ Cost\ Elasticity\ Functions$$

LOE is the megawatts added to the applicable minimum capacity requirements. These additional megawatts represent the MW value of the applicable peaking plant utilized in establishing a particular ICAP Demand Curve.[22] This LOE adjustment was incorporated as a variable into the objective function as part of the stakeholder process. (Attachment III, Exhibit 21.) It is a fixed value that will be reset every four years with the quadrennial review of the ICAP Demand Curve parameters. This enhances the optimization because it aligns the costs used in the optimization with the net CONE values that are determined in the ICAP Demand Curve reset process. This allows for the LCRs to be set at a megawatt level that minimizes the cost of capacity at the LOE, which is the capacity market's long run market stasis point.[23]

While the Alternative LCR Methodology is robustly designed in order to be readily modified to capture additional constraints resulting from changes to the system, its cost minimization program is currently subject to three defined fixed constraints: 1) the minimum megawatt constraints on acceptable LCRs (*i.e.*, established transmission security limits); 2) the fixed IRM, as established by the NYSRC; and 3) the 0.1 day/year LOLE, for which the optimization tool iterates with GE MARS, utilizing the GE MARS database that reflects the IRM established by the NYSRC which provides that the combination of IRM and LCRs meets the LOLE criterion. The last two constraints are also currently fixed under the current Tan 45 Method used to calculate LCRs.

The LCR setting process works in conjunction with the twelve-month long process for the NYSRC to set the IRM for the NYCA. The process for setting LCRs recognizes the unique features of this shared process and accommodates NYSRC-mandated constraints within the LCR process such as the NYSRC-set IRM and the IRM Database as initial conditions used in the Alternative LCR Methodology.[24] The Tan 45 Method was developed to achieve a balancing of upstate and downstate capacity requirements without consideration for the creation of additional localities beyond the NYC and Long Island. As a result, the determination of the G-J Locality is performed as a separate calculation after LCRs are calculated for NYC and Long Island rather than in a fully integrated and simultaneous calculation. The Alternative LCR Methodology,

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[22] This megawatt value will be based upon the most recently filed ICAP Demand Curves that is approved by the Commission as part of the NYISO quadrennial ICAP Demand Curve reset process.

[23] See Potomac Economics, LTD, 2017 State of the Market Report, p A-178: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic/meeting_materials/2018-05-16/NYISO%202017%20SOM%20Report__5-07-2018_final.pdf.

[24] These steps in the Alternative LCR Methodology are the same as steps 2 and 3 currently described in the NYISO's LCR Calculation Process: http://www.nyiso.com/public/webdocs/markets_operations/market_data/icap/Reference_Documents/LCR_Calculation_Process/LCR%20Calculation%20Process%2012_13_13.pdf.

however, integrates the LCR calculation for all existing Localities through the introduction of economic efficiency principles. The tool distributes capacity more efficiently based upon the cost of the reliability value for capacity in each Locality (*i.e.*, $/LOLE) using the net CONE curves established for each Locality using parameters developed in in the NYISO's quadrennial ICAP Demand Curve reset process.

Given that the NYSRC establishes the IRM pursuant to its authority under Section 3.03 of the NYSRC Agreement, the Alternative LCR Methodology fixes the IRM in the optimization based on the value set by the NYSRC. If the IRM was allowed to be a decision variable in the optimization, however, it is possible that the Alternate LCR Methodology would find a lower cost solution that would meet the 0.1 LOLE requirement for NYCA, but it would not conform with the current NYSRC rules that mandate the Tan 45 Method be used to determine the IRM. The current NYISO proposal, therefore, aims to find the lowest cost solution within the NYSRC mandated process. Throughout the stakeholder process the NYISO has indicated that it is open to working with the NYSRC to enhance the IRM setting process using the same optimization approach employed in the Alternate LCR Methodology. This is a future enhancement which will be considered in the NYISO project prioritization process based upon stakeholder input and NYSRC direction and approval.

1(2): How the Alternative LCR Methodology maintains the loss of load expectation of no more than 0.1 days per year

Response: The proposed tariff language explicitly requires the Alternative LCR Methodology to identify LCRs that satisfy the 0.1 day/year LOLE criterion. This was a fundamental and absolute design condition for any proposed enhancement to the existing Tan 45 Method used to establish LCRs. The NYISO must comply with the LOLE criterion when it determines the LCRs for NYC, Long Island and the G-J Localities. To meet this primary objective GE developed the economic optimization program as an iterative GE MARS tool to produce LCRs for a defined IRM that meets the LOLE criterion.[25] The economic optimization program works by minimizing the cost of capacity procurement within a set of given constraints that are user defined. As discussed above, the Alternative LCR Methodology introduces the net CONE curves and the transmission security limits ("TSLs") as new constraints used in the modeling to determine the LCRs. It continues to use as the initial conditions for the GE MARS probabilistic model the IRM Database and the IRM, which are established by the NYSRC. These user-defined inputs constrain least-cost solutions and are described in the proposed tariff language as the primary constraints that define the Alternative LCR Methodology. Numerous common inputs and assumptions are found in both the current Tan 45 Method used to calculate LCRs and the economic optimization approach.[26] In the Alternative LCR Methodology, for example, GE MARS is run for each iteration of the optimization to ensure the LOLE is met when the model has found the least cost solution. The probabilistic GE MARS model contains the same inputs and assumptions for both the Tan 45 Method and the Alternative LCR Methodology.[27] Further,

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[25] See Attachment II, Affidavit of Wesley Hall at PP 10, 12-14 and 21.

[26] For example, the User-defined Constraints that are input into the optimization include Load levels, IRM established by the NYSRC, the MARS database used for the IRM Studies including the transmission topology, net CONE curves for each Locality, and Level of Excess megawatts.

[27] The IRM Database is the starting point for both the Tan 45 Method and the Alternative LCR Methodology when calculating LCRs. (Attachment II, Hall Affidavit at PP 13-15.)

each set of LCR combinations evaluated by the optimization tool iteratively runs GE MARS at 2,500 replications[28] producing results from GE MARS simulations that allow the NYISO to confirm that the results meet the LOLE criterion. The optimization stops when the least cost solution is found and a 0.1 day per year LOLE is met using the resulting LCR values. The results are verified by reviewing the GE MARS outcomes for the final iterations to confirm the solution meets the 0.1 day per year LOLE criterion.

In short, the Alternative LCR Methodology directly incorporates the NYISO's proposed tariff requirement that the 0.1 day/year LOLE reliability criterion must be satisfied. There is no cause for concern that this criterion will not be met. Claims made by the Long Island Power Authority "(LIPA") in this proceeding that the Alternative LCR Methodology will result in LOLE violations do not accurately reflect the methodology's design or application.[29]

1(3): How the Alternative LCR Methodology ensures the transmission security limits are respected

Response:_The proposed tariff language addressing the Alternative LCR Methodology explicitly requires that LCRs do not violate identified transmission security limits ("TSL"). Therefore, each TSL acts as a floor below which the optimizer cannot select a LCR value for the least cost solution.

The TSLs are calculated by the NYISO annually by conducting a deterministic transmission security analysis and effectuated within the optimization model as floors on the LCR values that can be produced as the least cost solution. These TSL floors are based upon the final load forecast, N-1-1 import limits into the Localities, and the unavailability of capacity in each Locality. The final load forecast and unavailability of capacity in each Locality will be consistent with the database used to conduct LCR analyses in GE MARS. The NYISO calculates N-1-1 import limits through a deterministic transmission security analysis conducted during the third quarter of the calendar year in parallel with development of the numerous other assumptions used in the IRM and LCR analyses.[30] The NYISO will issue a study report that describes the analysis and identifies the import limits that will be used to determine the final TSLs for the optimization model that acts as a fixed floor when calculating LCRs.

As a practical matter, the optimization tool is designed to recognize any user-defined upper or lower bound on the LCR results. In this case the TSLs are floors on the LCR for each Locality that are defined as fixed constraints in the optimization model that prevent the software from producing, as a feasible least cost result, any combination of LCRs that violates one or more of these user-defined floor values.

[28] The number of GE MARS replications run conforms to the replications used by the NYSRC in its IRM studies. See *NYSRC Technical Study Report*, New York Control Area Installed Capacity Requirements for the Period May 2018 Through April 2019 ("NYSRC 2018 IRM Study"): http://www.nysrc.org/pdf/Reports/2018%20IRM%20Study%20Appendices%20%20Final%2012_08_2017_V2.pdf.

[29] *See, e.g., Protest of the Long Island Power Authority and Power Supply Long Island*, Docket No. ER18-1743-000 (June 26, 2018) ("LIPA Protest") at 2, 4, 10-11.

[30] More detail is provided below regarding how the NYISO establishes the TSLs for the Alternative LCR Methodology.

<u>Please provide any studies, exhibits, or other documents that detail the factors that lead to the proposed methodology.</u>

Response: The NYISO includes in Attachment III and IV (Exhibits 1-39) to this filing all Stakeholder presentations, which include the results of the sensitivity analyses the NYISO conducted with GE to support the development and refinement of the proposed Alternative LCR Methodology.

<u>Question 2</u>:

You state that the Alternative LCRs Methodology is a more transparent, predictable, and robust process than the current methodology. With regard to these objectives, please explain how the Alternative LCRs Methodology:

- *Increases transparency in how LCRs are calculated. In your response, please explain whether, and how, Load Serving Entities are able to independently evaluate and verify the LCRs annually. Please also explain why NYISO's proposal omits from the Tariff (1) the methodology, including the economic optimization algorithm (or a description of it) and any assumptions or inputs that materially affect the calculation of LCRs; and (2) the resulting LCRs.*

<u>i.) How the Alternative LCR Methodology increases transparency in how the LCRs are calculated.</u>

Response: The Alternative LCR Methodology increases transparency because it mitigates the variability that has been observed using the Tan 45 Method with regard to generator entry and exit outcomes, and in turn allows the LCR calculations to appropriately react to transmission and other system changes (*e.g.*, load forecast uncertainty). This was demonstrated in the sensitivity analyses conducted by the NYISO and is illustrated in the comparison of chart shown in Figures e20-1 and e20-2. This will allow Market Participants that participate in the year-long IRM and LCR processes to better understand how changes to the system, as well as any changes to the IRM database and modeling protocols introduced through the NYSRC Installed Capacity Subcommittee annual study work, will impact the calculation of LCRs on a year to year basis.

As discussed above, in the Hall affidavit (Attachment II to this filing) and further illustrated in the numerical examples presented to stakeholders on February 15, 2017 (Attachment III, Exhibit 17), because the Tan 45 Method for determining the joint NYC (Load Zone J) and Long Island (Load Zone K) shift ratio is dependent on the ratio of the excess capacity in each Locality, the Tan 45 Method behaves in a variable and unstable manner when capacity is added to a Locality. As discussed above, this variability was observed when the Danskammer units were modeled out of service and then returned to the market. The resulting variability in LCRs led directly to the creation of the LCR Task Force and ultimately to the market design project to enhance the LCR methodology. Specifically, when capacity was added to the G-J Locality the LCR for that area increased significantly from the prior year's value, while the LCRs for the NYC and Long Island Localities fell. This artifact of the Tan 45 Method was observed when the Danskammer unit returned to service in 2014. (Attachment III, Exhibit 4.) Further, as the numerical examples demonstrate, when capacity is removed from a Locality (*e.g.*, a unit retires), the LCR for that Locality will decrease. (Attachment III, Exhibit 17.) This artifact of the Tan 45 Method was further discussed with stakeholders at the June 1, 2017 and September 28, 2017 ICAP Working Group meetings, at which time the NYISO presented analysis that demonstrated that the Alternative LCR Methodology largely mitigated the issue. (Attachment III, Exhibit 20 and Attachment IV, Exhibit 25.)

Figures e30-1 and e30-2 below, which were shared with stakeholders at the November 15, 2017 Business Issues Committee meeting (also shown in Attachment IV, Exhibit 30), illustrate the variability of results produced with the Tan 45 Method in response to changes in the level of resource supply, while demonstrating that the Alternative LCR Method produces much more stable and predictable results.

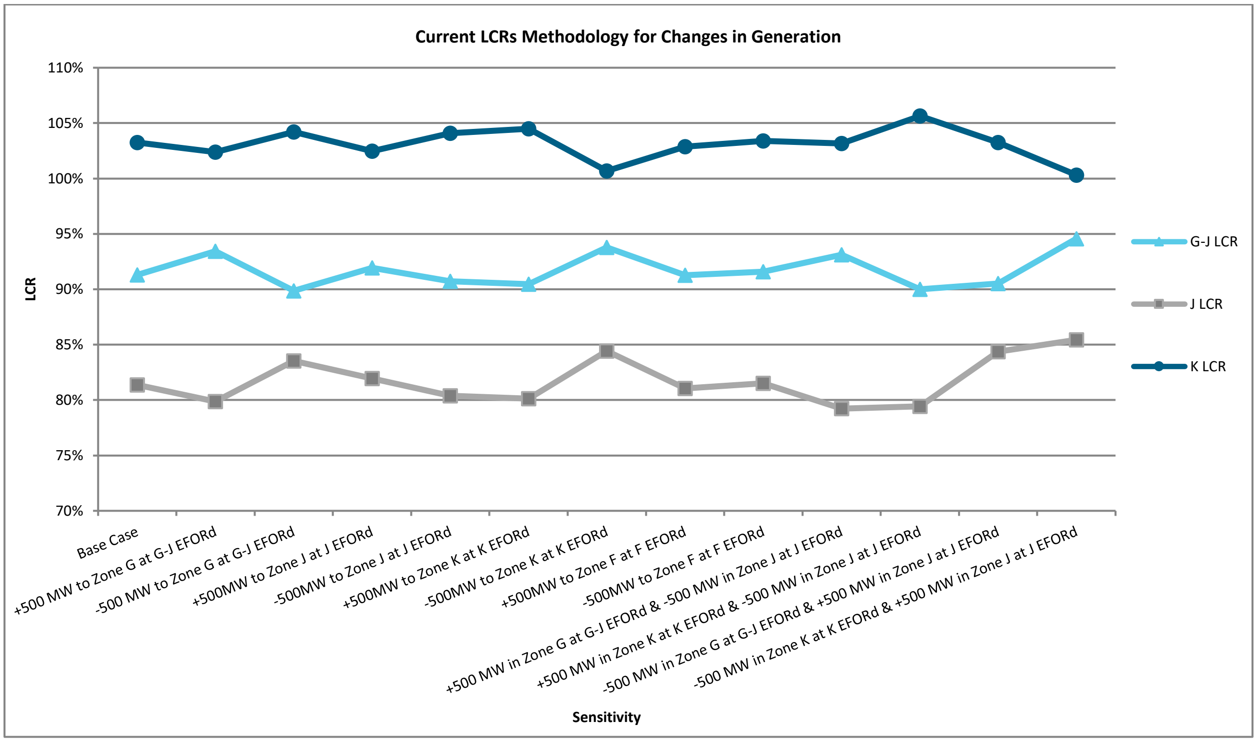


Figure e30-1: Current LCRs Methodology for Changes in Generation

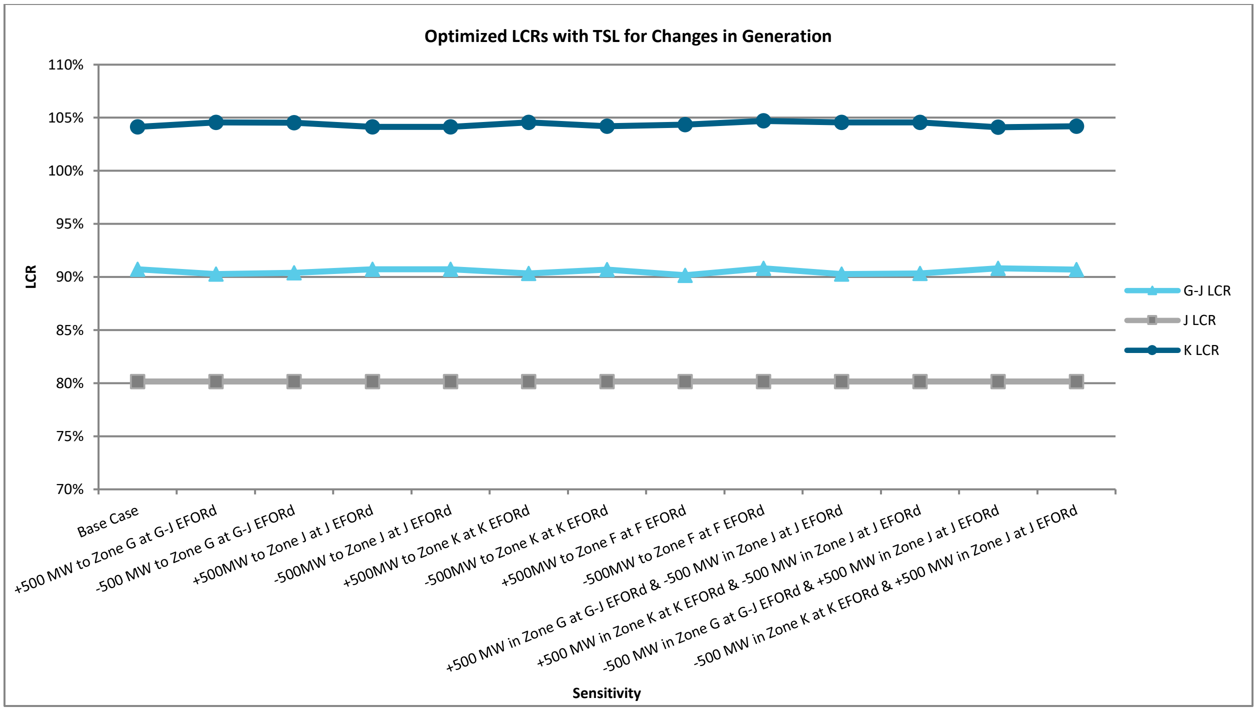
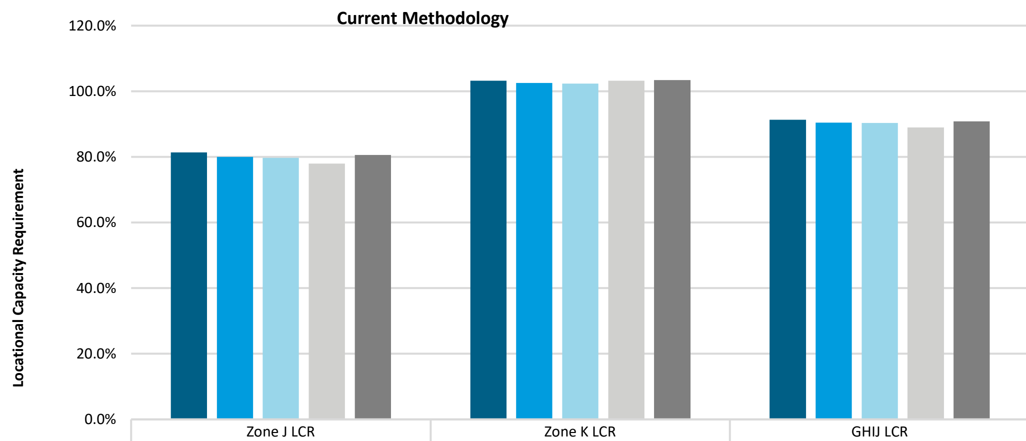


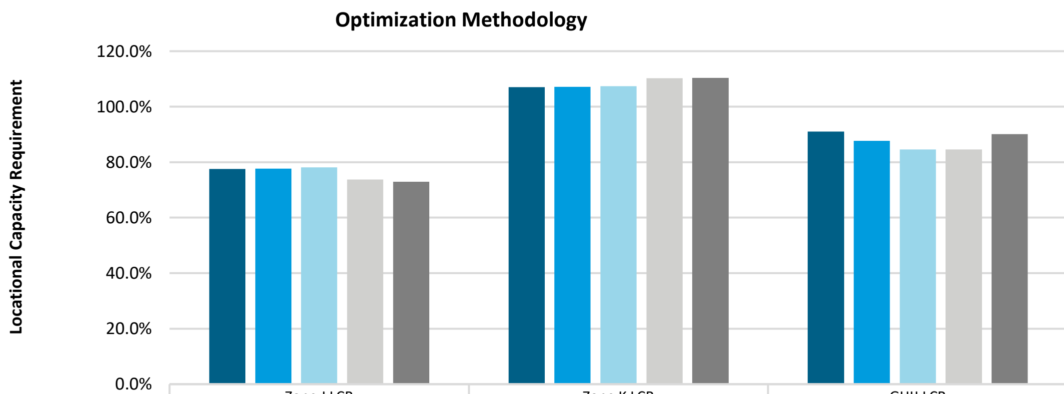
Figure e30-2: Optimized LCRs with TSL for Changes in Generation

This analysis also shows that the Alternative LCR Methodology produces LCR results that move in a manner that makes intuitive sense as transmission topology changes. The NYISO's presentation at the June 1, 2017 ICAP Working Group meeting (Attachment III, Exhibit 20) illustrates how increasing interface limits on UPNY/SENY produces a corresponding change to the G-J Locality's LCR that results in a change to the requirement (in megawatts) that appropriately corresponds to the change in transfer capability. In addition, the same presentation showed that increasing the interface limits on Dunwoodie South results in a corresponding change in the NYC Locality's LCR that, in turn, produces a change to the requirement (in megawatts) that is appropriately sized to the change in the transfer capability. Figures e20-1 and e20-2 below, taken from the June 1, 2017 ICAP Working Group presentation (Attachment III, Exhibit 20) illustrate the Alternative LCR Methodology's responsiveness to transmission topology changes.



	Zone J LCR	Zone K LCR	GHIJ LCR
Base Case solve for 0.100	81.4%	103.2%	91.3%
UPNY-SENY + 500 MW	80.0%	102.5%	90.5%
UPNY-SENY + 1000 MW	79.7%	102.3%	90.3%
Dunwoodie South, UPNY-SENY +1000 MW	78.0%	103.2%	89.0%
Dunwoodie South +1000 MW	80.6%	103.4%	90.8%

Figure e20-1: Current Methodology



	Zone J LCR	Zone K LCR	GHIJ LCR
Base Case solve for 0.100	77.5%	107.0%	91.0%
UPNY-SENY + 500 MW	77.7%	107.2%	87.7%
UPNY-SENY + 1000 MW	78.1%	107.4%	84.6%
Dunwoodie South, UPNY-SENY +1000 MW	73.8%	110.3%	84.6%
Dunwoodie South +1000 MW	72.9%	110.4%	90.1%

Figure e20-2: Optimization Methodology

The addition of the TSLs identified annually by the NYISO as fixed constraints in the optimization is also expected to add to the stability and predictability of the Alternative LCR Methodology. These limits will be calculated in advance of running the economic optimization tool and will be shared with stakeholders in a transparent manner. Stakeholders will have the ability to annually estimate TSLs in October, when updated load forecast, generation availability, and transmission capability data become available. It is not practicable for these parameters to be shared with stakeholders ahead of the LCR calculation because the TSL calculation depends on inputs that could continue to vary throughout the LCR development process.

ii.) Whether, and how, Load Serving Entities are able to independently evaluate and verify the LCRs annually.

Response: Load Serving Entities ("LSEs) and other NYISO stakeholders currently do not independently verify the annual LCR determinations. The Alternative LCR Methodology likewise did not contemplate an independent verification process. Both the IRM and LCR processes are determined based on the NYISO-developed IRM Database, which has not been disclosed to stakeholders because it contains a great deal of Market Participant Confidential Information, such as generator output, generator availability, heat rates and transition rate data.[31]

While the NYISO does not otherwise share the IRM Database, LSEs and interested stakeholders will continue to be able to participate in the NYSRC's and its Installed Capacity Subcommittee's ("ICS") transparent discussion of the various inputs that are developed annually for the IRM, which are then used to form the basis of the LCR study.[32] The NYISO develops and presents to stakeholders the topology that is input into the GE MARS database for use in the IRM study, the LCR study and in the various studies conducted by the NYISO pursuant to its Reliability Planning Process. The topology and other inputs are also reviewed at the Electric System Planning Working Group, ICAP Working Group and the NYSRC Installed Capacity Subcommittee, which is open to participation by Market Participants and other interested parties.

Similar to the transparency with which the NYISO conducted the market design development for this project, the NYISO will present to the ICAP Working Group and the Market Issues Working Group its annual development of the net CONE curves to be used in the Alternative LCR Methodology. These net CONE curves will be based on the results of the ICAP Demand Curve annual update procedures set forth in Section 5.14.1.2.2 of the Services Tariff. Further, as discussed above, the transmission security limits will be developed annually using the transmission security planning requirements and reported to stakeholders prior to use in the Alternative LCR Methodology. Finally, the NYISO will post a public version of the procedure used to develop the LCR values, including the methods used to develop TSLs, Net CONE Curves, and the mechanics of running the optimizer. This is consistent with current practice[33] and will help explain the details of the LCR calculation process to stakeholders thereby allowing them to independently monitor the annual calculations.

The Alternative LCR Methodology should provide a greater opportunity for LSEs to evaluate, anticipate, and better understand the annual LCR determinations because it will: 1) closely align with existing NYISO processes, in conjunction with NYISO's collaborative and transparent work coordinated with NYSRC and its ICS processes, and 2) provide enhanced

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[31] Currently only Con Edison and LIPA are provided a masked version of the GE MARS database used to develop the IRM with the NYSRC. The masked data base does not disclose Confidential Information. At the request of the NYSRC these entities receive this masked version of the GE MARS IRM Database used by the NYSRC from the NYISO for the sole purpose of validating the NYSRC IRM analysis and results.

[32] This is a yearlong process in which the ICS and interested stakeholders review and discuss the various assumptions and system changes that are reflected in the IRM Database and impact the results of NYSRC's Tan 45 Method (*i.e.*, the calculated IRM).

[33] The NYISO's LCR Calculation Process, which is posted on its website, will be updated and reposted as the NYISO implements the Alternative LCR Methodology.

transparency, predictability and stability to the LCR results, as observed across the numerous sensitivity analyses using the Alternative LCR Methodology.

Thus, although neither the Alternative LCR Methodology nor the Tan 45 Method allows disclosure of Confidential Information to LSEs that would allow them to replicate the LCR calculations, there is no question that the Alternative LCR Methodology is more transparent and predictable.

iii.) Why NYISO's proposal omits from the Tariff (1) the methodology, including the economic optimization algorithm (or a description of it) and any assumptions or inputs that materially affect the calculation of LCRs; and (2) the resulting LCRs.

Response: The level of detail included in the proposed tariff revisions is consistent with the Commission's "rule of reason" and with decades of practice in New York. Contrary to LIPA's assertions in this proceeding, the "rule of reason" does not require that the Services Tariff include each and every technical detail of the Alternative LCR Methodology that is "susceptible of specification."[34] Instead, the Commission has traditionally required only that provisions that "significantly" affect the rates and terms of service be filed.[35] The rule of reason has traditionally been interpreted to allow ISOs/RTOs to include technical implementation details and similar information in manuals and other non-tariff documents. The Commission has frequently declined requests that ISOs/RTOs be directed to include technical details in tariffs when doing so would be unduly cumbersome or unnecessarily prevent the ISO/RTO from acting in response to changing circumstances.[36]

The level of detail included in the June 5, 2018 Filing was appropriate because it includes the core components of how the NYISO will set LCRs that significantly affect the rates and terms of service. The proposed tariff language specifies that LCRs will be set "to minimize the total cost of capacity at the prescribed level of excess" using net CONE parameters developed in the ICAP Demand Curve reset process. The proposed tariff language also specifies that the LCRs will be computed to maintain the 0.1 LOLE and not violate the applicable transmission security limits for each Locality.

[34] *See, e.g.,* LIPA Protest at 5, 29-34.

[35] *City of Cleveland v. FERC*, 773 F.2d 1368, 1371 at 1377 (D.C. Cir. 1985).

[36] *See, e.g., Southwest Power Pool*, Inc., 161 FERC ¶ 61,261 at P 50 (2017) (Holding that neither the rule of reason nor Order No. 1000's "transparency principle" required that excessive detail be filed for Commission approval and that it was sufficient for the "basic methodology" to appear in the tariff. The Commission stated that "We find this approach which continues to allow SPP and its stakeholders the flexibility needed in the context of a proactive, dynamic transmission planning process to be reasonable."); *ISO New England, Inc.*, 155 FERC ¶ 61,145 at P 11 (2016) ("[C]onsistent with the rule of reason, the ISO-NE Tariff does not list all of the specific assumptions or methodologies that could impact the ICR [Installed Capacity Requirement] and/or load forecast, as those factors could vary year-by-year and therefore are not "reasonably susceptible to specification."); *Hudson Transmission Partners, LLC v. New York Independent System Operator, Inc.*, 153 FERC ¶ 61,191 at P 94 (2015) (agreeing with NYISO that it was sufficient to include the "conceptual basis and general framework" for a scaling factor in the tariff because "future scaling factor methodologies should reflect the specific characteristics of future UDR projects and the interactions between the system with which each project is interconnection and NYISO.").

The June 5, 2018 Filing added significant detail to Section 5.11.4 of the Services Tariff to describe the Alternative LCR Methodology. Notably, the existing tariff language that sets forth the NYISO process contains no discussion of the Tan 45 Method. It simply states that "[i]n establishing Locational Minimum Installed Capacity Requirements, the ISO will take into account all relevant considerations, including the total NYCA Minimum Installed Capacity Requirement, the NYS Power System transmission Interface Transfer Capability, the election by the holder of rights to Unforced Capacity Deliverability Rights ("UDRs") that can provide Capacity from an External Control Area with a capability year start date that is different than the corresponding ISO Capability Year start date ("dissimilar capability year"), the Reliability Rules and any other FERC-approved Locational Minimum Installed Capacity Requirements."[37]

The proposed tariff revisions contain the appropriate level of detail given that the NYISO's LCR-setting process will need to be able to respond promptly to adjustments that the NYSRC might make to its rules for setting the IRM. While the NYISO works closely with NYSRC on the NYSRC's establishment of the IRM throughout the nearly yearlong process required to complete the IRM studies, it is the NYSRC that determines the IRM and submits it to the Commission for review.[38] The NYISO then determines the LCRs starting with the assumptions and models utilized by the NYSRC in establishing the IRM (*i.e.*, the IRM Database).

The first step of this annual process is conducted by and under the authority of the NYSRC working in conjunction with the NYISO to establish the transmission topology and other input assumptions that will comprise the IRM Database. The NYSRC works with the NYISO through the ICS and its stakeholders beginning each year in January to develop a preliminary base case with a list of approved assumptions. This work is then finalized at the ICS after the summer and an updated load forecast is available. Before this work is presented to the NYSRC for their determination of the IRM, the modeling results are provided to GE to validate the modeling work conducted by the NYISO for the ICS. Changes to the NYSRC final IRM are filed with the Commission for acceptance or approval.[39]. The NYISO uses the IRM, as established by NYSRC, together with the corresponding GE MARS database (*i.e.*, IRM Database) and, after taking into account the final updates to the load forecast, calculates LCRs for NYC, Long Island, and the G-J Localities as described in the Locational Capacity Requirement Calculation Process.

The NYISO does not believe it is appropriate or necessary to attempt to specify all of these technical details and procedural steps into the tariff.

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[37] The NYISO provides a description of the steps taken when determining the LCRs in its Locational Capacity Requirement Calculation Process which is posted on the NYISO website. As discussed above, the posted LCR calculation procedures will be updated and reposted as the NYISO implements the Alternative LCR Methodology: http://www.nyiso.com/public/webdocs/markets_operations/market_data/icap/Reference_Documents/LCR_Calculation_Process/LCR%20Calculation%20Process%2012_13_13.pdf.

[38] The NYISO works closely with the NYSRC and its Installed Capacity Subcommittee to complete the annual IRM Study Report. The NYISO begins work in January through December on this effort and is primarily responsible for developing the IRM Database and executing the Tan 45 process.

[39] NYSRC Agreement § 3.03.

The NYISO's proposed tariff language balances the need for appropriate detail with recognizing the unique features of the collaborative process of setting requirements for the NYISO's Capacity Market. The NYISO's proposed tariff amendments incorporate the economic optimization method by building upon the current tariff language with a significant amount of additional detail to describe the objective function associated with the cost minimization as well as the two new user defined inputs that are being added to the existing process: 1) net CONE curves; and 2) transmission security limits. The NYISO has also clearly established that the 0.1 day per year LOLE must be maintained, as discussed above and in the Hall affidavit. The proposed tariff revisions also clarify that the revised process will rely on the probabilistic modeling recognizing system constraints, which emphasizes that these common features with the current process remain unchanged. Adding further technical details comprised of each facet of the proposed Alternative LCR Methodology beyond the revisions proposed in the NYISO's June 5, 2018 Filing could limit the NYISO's ability to accommodate changes to the NYSRC processes and future system resource and transmission changes. The vast majority of the technical implementation details under the Alternative LCR Methodology are the same as under the Tan 45 Method. Such details have never been included in the tariffs for nearly twenty years and it is neither practicable nor necessary to include them now.

Further, including the LCR results into the tariff has also not been the past practice of the NYISO and is not necessary to implement the Alternative LCR Methodology. As discussed above, the LCR results are produced at the end of a lengthy collaborative process among the NYISO and the NYSRC, which is conducted in open and transparent stakeholder forums at the ICS as well as the NYISO's stakeholder process. In addition, once the NYISO determines the LCRs and shares them with its Operating Committee in January of each year, the NYISO posts the results[40] and immediately implements the LCRs into its preparations for the upcoming Capability Year for its Installed Capacity Market.[41]

In the alternative, if the Commission does not agree that there is sufficient detail in the proposed tariff language's description of the Alternative LCR Methodology, the NYISO believes the inclusion of the formula provided above in the response to Question 1(1), which mathematically describes the objective function of the cost minimization model would adequately describe the Alternative LCR Methodology in its tariffs.

<u>Question 2</u>:

- *[Please explain how the Alternative LCR Methodology i]ncreases predictability in how LCRs are calculated. In your response, please also elaborate on your assertion that LCRs calculated using the Alternative LCRs Methodology "are within the range of*

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[40] The NYISO posts its "Locational Minimum Installed Capacity Requirements Study for the New York Balancing Authority" for the upcoming Capability Year on its website under its Resource Adequacy Planning Documents: http://www.nyiso.com/public/markets_operations/services/planning/documents/index.jsp.

[41] Section 5.13.2 of the Services Tariff requires "[a] Capability Period Auction will be conducted no later than thirty (30) days prior to the start of each Capability Period." In order to accomplish this the NYISO must immediately begin using the LCR's calculated in January as an input into many other required parameters necessary to conduct such auctions. For example, the import right limits setting process and the import rights deliverability assessment needs to commence immediately upon the determination of LCR values.

historic LCRs given comparable system conditions."[42] Please also comment on how NYISO expects the resulting LCRs to impact capacity costs in NYCA and each Locality over the short run and the long run. In doing so, please explain how the LCRs may change in relation to the load being served in each zone(s) within a Locality.

iv.) How the Alternative LCR Methodology increases predictability in how LCRs are calculated

Response: The Alternative LCR Methodology will enhance the transparency and predictability of the LCR determinations by minimizing the instability that has occurred in the current Tan 45 Method with regard to generator entry and exit and is described in the NYISO's numerical examples of the Tan 45 Method and several of its sensitivities evaluated throughout the two year market design effort. (Attachment II, Hall Affidavit at PP 16-19; Attachment III, Exhibits 17 and 20; and Attachment IV, Exhibits 25 and 30.) At the same time, the proposed method will be appropriately sensitive to significant topology changes. (Attachment II, Hall Affidavit at P 20; Attachment III, Exhibits 20 and 21; Attachment IV, Exhibits 25 and 30.) The NYISO will continue to be transparent with stakeholders regarding changes to the transmission topology that are developed for the GE MARS database. Further, significant changes are not expected to occur as frequently as changes in the supply megawatts, which should lead to enhanced stability in year-to-year outcomes. The NYISO ran sensitivities using both the Alternative LCR Methodology and the Tan 45 Method with the 2017/2018 IRM database. The NYISO also calculated LCRs using the Alternative LCR Methodology using the 2018/2019 IRM base case dataset. The results of these sensitivities, as illustrated in Figures e30-1 and e30-2 above, show that the Tan 45 Method provides variable and unstable results when adding or subtracting capacity from a Locality, while the Alternative LCR Methodology has largely mitigated this problem. The results also show that the Alternative LCR Methodology responds to changes in transmission topology in an intuitive and appropriate manner. While the Tan 45 Method does also show changes to LCRs that are directionally intuitive in response to transmission topology changes, the resulting change in the minimum requirements (in megawatts) is much smaller than the increase in transfer capability that was added to the Locality interfaces. These results were presented to the ICAP Working Group at its June 1, 2017, June 29, 2017 and the September 28, 2017 meetings. (See Attachment III, Exhibits 20 and 21, and Attachment IV, Exhibit 25.)

The sensitivities conducted by the NYISO using the Tan 45 Method also illustrate the volatility arising from the Tan 45 Method in response to generation entry or exit and the numerical examples demonstrate how this is an artifact of the resource shifting protocols in this method. Further, in the examples of increasing the transfer capability on the interfaces that define the G-J Locality and the NYC Locality, the Tan 45 Method results mute the LCR movement that should result by allowing into the area more transfers of megawatts that are sited upstream of the relevant interfaces. In comparison, the results produced using the economic optimization for these same sensitivities show much less volatility with regard to generation additions and retirements, but showing an appropriately sized and intuitive shift in LCRs when transmission topology changes occur.

[42] NYISO Transmittal at 3.

<u>v.) Expected impacts of the Alternative LCR Methodology to capacity costs in NYCA over the short run and long run with an explanation of how the LCRs may change in relation to the load being served in each zone within a Locality</u>

Response: The short term and long term cost of capacity shown in the figures below for both the current LCRs and optimized LCRs with the updated TSLs are based on the individual Locality requirements and total capacity that cleared in each Locality. Additionally, the tables include the delta between the cost of capacity for the current and optimized LCRs. Both the short term and long term analyses presented below were conducted using the 2018/19 IRM Database. The impact analysis for the short term consumer impact assumes no changes in generation from the 2017 IRM base case. But for the long term cost impact the analysis looked at two steady state conditions: 1) the long-run equilibrium condition (*i.e.*, LOE conditions utilized in establishing the ICAP Demand Curves); and 2) a historic excess level, which was defined as a percentage of excess above the requirement as observed over the last three Capability Years for each of the existing Localities. The NYISO's cost impact analysis is based on a fixed set of assumptions regarding future supply and demand in the capacity market and is shown for to illustrate potential savings. These results are not intended to be used as forecasts of future prices or savings that may occur in the market.

As shown in Table e38-1 below, in the short term, capacity cost increased in Long Island while it decreased in NYC and GHI regions under the optimized methodology as compared to the current methodology. There was no change in capacity cost for the rest-of-state region ("ROS"). Overall, on a statewide short run basis, capacity costs decreased by approximately $528 million using the Alternative LCR Methodology compared to the current Tan 45 Method.

Table e38-1: 2018 Short Term Cost

Methodology	2018 Short Term Cost of Capacity (million $)				
	LI	NYC	GHI	ROS	Total
Current Methodology	$303	$1,179	$576	$649	$2,706
Optimized Methodology	$553	$668	$308	$649	$2,178
Delta	$251	-$511	-$268	$0	-$528

The long term cost impact for two variants of long-term equilibrium conditions as defined above are shown in Table e38-2and Table e38-3. The long term cost impact using the Alternative LCR Methodology compared to the current Tan 45 Method for the LOE conditions is a decrease of approximately $35 million per year. Similarly, the long term cost impact based on historic excess is a decrease of approximately $34 million per year when using Alternative LCR Methodology compared to the current Tan 45 Method.

Table e38-2: 2018 Long Term Cost at LOE

Methodology	2018 Long Term Cost of Capacity at LOE (million $)				
	LI	NYC	GHI	ROS	Total
Current Methodology	$765	$2,061	$972	$2,017	$5,815
Optimized Methodology	$802	$2,037	$880	$2,060	$5,780
Delta	$37	-$23	-$91	$43	-$35

Table e38-3: 2018 Long Term Cost at Historic Excess

Methodology	2018 Long Term Cost of Capacity at Historic Excess (million $)				
	LI	NYC	GHI	ROS	Total
Current Methodology	$383	$1,121	$521	$551	$2,576
Optimized Methodology	$398	$1,109	$473	$562	$2,542
Delta	$15	-$11	-$48	$11	-$34

The costs presented above use the 2018 load forecast, the 2018-2019 IRM and LCRs, and 2018-2019 ICAP Demand Curve parameters. For the supply assumptions, the analysis assumes that the 2017 supply remains unchanged and that all capacity is purchased at the spot market auction clearing price. As such, the cost of capacity presented is for the 2018-2019 Capability Year, and provides a hypothetical outcome based on the described assumptions in the presentation using both the current Tan 45 Method and the Alternative LCR Methodology. The results of this analysis are intended for informational purposes only and may differ from observed costs if capacity was purchased through other methods (*i.e.*, bilateral contracts or self-supply) or supply conditions differed.

Consumer impact assessments were presented to stakeholders at the October 11, 2017 and November 6, 2017 ICAP Working Group meetings based upon the 2017/18 IRM database. At the February 22, 2018 ICAP Working Group meeting, updated analyses was presented to stakeholders using the 2018/19 IRM database. These presentations are provided in Attachment IV to this filing as Exhibits 26, 29, and 38.

vi.) Explanation of how the LCRs may change in relation to the load being served in each zone within a Locality

Response: LCR results, as calculated by either the Tan 45 Method or the Alternative LCR Methodology, will be impacted by changes in load. Under the Alternative LCR Methodology, which applies a lower bound on the LCRs equal to the applicable transmission security limits, an increase in load in a region will increase the corresponding megawatt floor for generation needed to meet the deterministic N-1-1 transmission security analysis. This assumes the interface limits into the Locality remain constant between the years in which the load growth is forecast. Similarly, a reduction in load in a locality should lower the transmission security limits for the locality. Nevertheless, the costs of capacity as manifest in the net CONE values should be a significant new determinant of LCR values in the Alternative LCR Methodology. Changes in transmission capability and/or load combined with the level of load forecast uncertainty will cause the LCRs to change when using the Alternative LCR Methodology in a manner that is valid and desirable from both a competitive markets and system reliability perspective.

When assessing the impacts of load on the LCRs required to meet the 0.1 day/year LOLE, the GE MARS model is used to conduct a probabilistic evaluation in which load changes would be expected to cause variations to LCRs. However, it is the combined change in the load forecast with the load forecast uncertainty assumptions that needs to be considered as a single combined factor that impacts LCRs required to meet the LOLE. For example, no change in load but an increase in the load forecast uncertainty will result in an increase to overall Locality capacity requirements when using the Alternative LCR Methodology. A similar result can happen using the Tan 45 Method, but because it sets the NYC and Long Island LCRs first, the generation in the G-J Locality can be utilized to serve this increase in effective load. The two-step process used by the Tan 45 Method thereby has the potential to mute to some extent this link between increases in the effective load for NYC and Long Island and corresponding increases in the respective LCRs, while the G-J Locality may see an increase in its LCR despite no change in effective load.

Question 2:

- *[Please explain how the Alternative LCR Methodology i]ncreases robustness in how LCRs are calculated. In your response, please explain to what extent the Alternative LCRs Methodology is sensitive to changes in key assumptions or inputs, such as changes in the ICAP Demand Curve parameters. Furthermore, please describe whether and to what extent the Alternative LCRs Methodology is sensitive to changes in "exogenous factors" such as large generator deactivations, changes in transmission topology, etc. Please describe whether (and how) NYISO reflected the results of its sensitivity analyses into the proposed Alternative LCRs Methodology.*

vii.) How the Alternative LCR Methodology increases robustness in how LCRs are calculated

Response: The Alternative LCR Methodology is a more robust approach for determining the LCRs for a given set of Localities because it will better enable capacity market price signals to reflect the value of additional capacity in the different Localities within the NYCA. The proposed methodology integrates economic efficiency principles by setting LCRs to minimize the cost of satisfying the 0.1 day per year LOLE criterion. The design resolves the issues observed with the Tan 45 Method by evaluating the LOLE impacts of capacity in each region simultaneously and also introduces the net CONE values developed every four years in the NYISO's ICAP Demand Curve reset process into the reliability-based, probabilistic determination of LCRs. This integration and alignment of the two main administrative processes used to set capacity prices – the quadrennial Demand Curve reset process and the annual LCR determinations – allows for a more efficient market that meets the 0.1 day/year LOLE criterion while lowering costs to consumers statewide and incenting investment in areas that is most economic to do so.

The Alternative LCR Methodology is also more robust than the Tan 45 Method because at the outset it was designed to work consistently regardless of the number or configuration of these Localities. This was not the case with the Tan 45 Method for calculating LCRs, because it allowed only the calculation of the Zones J and K LCRs together, requiring the Zones G-J Locality LCR to be calculated subsequently and separately. It is unclear how the Tan 45 Method could be utilized in a consistent manner to determine LCRs if additional Localities were created in the future. As discussed above, the Tan 45 Method of determining the IRM and LCRs was originally developed to distribute megawatts between the NYC and Long Island Localities, as balanced against the IRM. Concerns were raised over utilizing the Tan 45 Method for the methodology when the G-J Locality was created. If a new Capacity locality was created in New York the further extension of the Tan 45 Method to determine the LCR of the new locality would be highly problematic in terms of basic theoretical underpinnings as well as stakeholder acceptance.

Moreover, the Alternative LCR Methodology is designed to be robust in that it can achieve the desired result while also accommodating a wide array of user-defined constraints, such as changing modeling protocols. The work presented by the NYISO and GE throughout the stakeholder process shows that the Alternative LCR Methodology, which is built to work with the IRM Database and maintain compliance with the LOLE criterion, is an improvement over the Tan 45 Method despite the fact that it utilizes the majority of the modeling steps and protocols carried out in the Tan 45 Method. (See stakeholder process work in Attachments III and IV to this filing, Exhibits 1-37). Two changes alone make the Alternative LCR Methodology superior to the current Tan 45 Method: 1) the more stable results from the proposed method relative to changes in the generation supply, and 2) the more appropriate sensitivity to changes to the underlying transmission topology observed with the Alternative LCR Methodology alone make it superior to the existing process. By design the Alternative LCR Methodology achieves these beneficial outcomes while leaving the majority of the separate features of the existing method intact. In essence, the Alternative LCR Methodology benefits from the years of experience in conducting the NYSRC Policy 5. For example, the sensitivity analyses confirmed that the Alternative LCR Method produces intuitive, stable and appropriate LCRs while continuing to rely on certain Policy 5 shifting protocols, such as shifts out of Localities and into areas of excess upstream of Central East.[43] At the same time the new method eliminates the hierarchical shifting

[43] This is a requirement of the NYSRC's Tan 45 Method and while the Alternative LCR Method has the capability to shift to any combination of zones, the NYISO is committed to utilize the underlying IRM Database developed through NYSRC's ICS process and run the probabilistic GE MARS model in a manner consistent with what was

protocols that cause the variability resulting from the change in status of the Danskammer units under the Tan 45 Method. The proposed design avoids the hierarchical shifting and fixed ratio for the simultaneous shift out of NYC and Long Island as well as the *post hoc* shifts to establish the G-J LCR, because it is shifting out of all of the Localities simultaneously to solve the cost optimization objective function and then evaluating these shifts iteratively via 2,500 replications using the GE MARS model. (Attachment III, Exhibit 15.)

In short, the approach taken by the Alternative LCR Methodology is a robust design that builds upon the Tan 45 Method. It aligns the LCR process with the economics of capacity established in the ICAP Demand Curve reset process. It is expected to work consistently with any configuration of Localities and to have the flexibility to address future changes to the underlying system as necessary and/or probabilistic modeling enhancements that are directed by the NYSRC.

viii.) The extent the Alternative LCRs Methodology is sensitive to changes in key assumptions or inputs, such as changes in the ICAP Demand Curve parameters and to what extent the Alternative LCRs Methodology is sensitive to changes in "exogenous factors" such as large generator deactivations, changes in transmission topology.

Response: The Alternative LCR Methodology, which builds upon the existing Tan 45 Method used to establish the IRM, is sensitive to the same key assumptions and inputs that are enumerated in the GE MARS assumption matrix,[44] with the exception that it largely mitigates the variability of LCRs resulting from generator exit and entry assumptions changes that have been observed with the Tan 45 Method as an artifact of its shifting protocols. The NYISO, with GE, conducted over 80 sensitivities to illustrate the comparative assessment of the Tan 45 Method and Alternative LCR Methodology. All of the sensitivities were shared and discussed with stakeholders throughout the process. These sensitivities assisted in evaluating how each methodology responded to both singular and multiple changes in generation within different Localities, increases in transmission capability into the Localities on different interfaces, and also changes to values and assumptions used as the cost in the optimization. These sensitivities were utilized in the valuation of the Alternative LCR Methodology and the enhancements it provided by responding as designed to changes in the system. In particular, the comparative sensitivities confirm that the Alternative LCR Methodology results in more stable LCRs as changes in generation occur, and it provides a greater utilization of increased transmission capability.

In addition to the historical factors that impact the LOLE results from the probabilistic GE MARS modeling,[45] the Alternative LCR Methodology will be responsive to changes in the

used in the IRM, with the sole exception of running the economic optimization software rather than re-execute the Tan 45 Method.

[44] The NYSRC 2013 IRM Study discusses key assumptions starting at page 5 and provides further detail in the appendices.

[45] Many of these factors can be found in the IRM Assumption Matrix, discussed in the annual NYSRC IRM Reports. The relative impacts certain factors may have on the IRM results and the NYC and Long Island LCRs is reported out in the NYSRC's parametric analysis conducted by the NYISO for the ICS and included in the NYSRC's IRM Reports. The list of factors may include, but is not necessarily limited to the list of GE MARS assumptions and inputs, particularly transmission topology, forecasted load and the load forecast uncertainty, historic

net CONE curves for each Locality. As part of the stakeholder process for the Alternative LCR Methodology, the NYISO, with GE, conducted numerous sensitivities testing the output for changes in the treatment of the net CONE inputs for each locality. The sensitivity analyses using the Alternative LCR Methodology has demonstrated that using annually updated net CONE values are expected to produce efficient and stable LCR results. Significant changes in certain drivers of the GE MARS database, such as transmission capability and load combined with load forecast uncertainty, will also appropriately impact the results in both direction of change and megawatt size. These changes to exogenous factors like costs, transmission expansion and load forecasts are desirable from a market design and reliability point of view.

ix.) How the NYISO reflected the results of its sensitivity analyses into the proposed Alternative LCRs Methodology.

Response: The numerous sensitivities that were done throughout the stakeholder process confirm that the Alternative LCR Methodology is a beneficial enhancement over the Tan 45 Method. In particular, this work demonstrates that the optimization largely mitigates variability associated with generator entry and exit that is an artifact of the Tan 45 Method. At the same time the sensitivities show that the proposed method is appropriately sensitive to other system conditions such as transmission topology, load and load forecast uncertainty, and net CONE curves. NYISO's analyses, which evaluated different ways to model the net CONE values, confirmed that the use of sloped elasticity curves was an appropriate feature of the final design. The NYISO also looked at refinements to the objective function by incorporating the level of excess quantities into the final design. Finally, the volume of sensitivity analyses conducted and discussed with stakeholders using multiple IRM databases illustrated that the Alternative Method produces more stable results that fall within the range of the historical LCR values. As a result of this work, it became clear to the NYISO that this enhancement to the method of determining LCRs did not necessitate a redesign of the cost allocation scheme currently in place for the NYISO's Capacity Market. (Attachment IV, Exhibits 27, 30, and 37.)

Question 3:

You state that, in contrast to the current "TAN 45" methodology, the Alternative LCRs Methodology minimizes the total NYCA cost to procure capacity and reduces the volatility of the LCRs due to changes in existing capacity. Please provide a comparison between the Alternative LCRs Methodology and the current "TAN 45" methodology to explain these differences and any other modifications, as well as any similarities between the methodologies.

Response: While there are critical enhancements provided by the Alternative LCR Methodology, the core reliability aspects of the LCR determinations remain the same. That is the LOLE criterion and the IRM established by the NYSRC are maintained in both the current Tan 45 Method and proposed alternative methodology. The GE MARS database used in both methods is also the same. Moreover, the procedures for shifting megawatts out of Localities and into areas of excess upstream of the Total East interface is the same under both methods (*i.e.*, from the Locality into zones of excess that are upstream of the Central East interface). The new

availability of supply resources, historic availability of transmission interfaces and UDRs, changes to system reliability in neighboring control areas and assumptions regarding emergency assistance.

methodology differs in the robustness of its design, which introduces the relative cost of capacity in the Localities into the LCR calculation and is not tied to the shifting ratios established in the Tan 45 Method between the NYC and Long Island Localities. As discussed above, these shifting ratios mathematically drive results and can make the current Tan 45 Method produce highly variable results when there is new generation added or existing generation removed from a Locality. A key difference of the Alternative LCR Methodology is that it shifts megawatts out of all the identified Localities simultaneously rather than the hierarchical order of shifting that is present in the Tan 45 Method.[46] Finally, the Alternative LCR Methodology recognizes that there are many solutions to setting the minimum requirements for capacity procurement that will meet the LOLE criterion and selects the least cost result for the NYCA based upon the LOE conditions used in establishing the ICAP Demand Curves. In contrast, the Tan 45 Method seeks to define a single point solution to meet the LOLE criterion, where this result is largely driven by the as found capacity within the NYC and Long Island Localities, with no consideration of costs.

The NYISO presented several sets of analyses conducted by GE using the Alternative LCR Methodology, which is described in detail throughout this response, in the Hall Affidavit, and the exhibits in Attachments III and IV. The Tan 45 Method is described in detail in the Hall affidavit as well. The results that are provided in the attached presentations clearly illustrate that the Alternative LCR Methodology is an enhancement over the current process in that it provides a robust methodology for the NYISO to administer going forward that will produce more stable and intuitive results.

Question 4:

Please elaborate on the purpose of Transmission Security Limits and how they are determined, as relevant to the proposed Alternative LCRs Methodology. In your response, please use examples to explain how the Transmission Security Limits interact with the LCRs resulting from the economic optimization. Please also comment on whether the Transmission Security Limits can result in LCRs for certain Localities that differ from historic values, and how this could impact reliability in such Localities.

Response: Transmission security limits were included in the Alternative LCR Methodology to ensure that the optimized LCRs would not result in capacity levels that would meet resource adequacy requirements while having an adverse impact on transmission security of the Localities. Consistent with applicable reliability standards for the NYISO that establish criteria for transmission operations of the Bulk Electric System, TSLs represent the ability of the transmission system to support deliveries of energy to the Localities. Transmission security limits for each Locality are input as user-defined constraints within the optimization model which the LCR optimizer respects as constraints when determining the set of least cost LCRs. These constraints establish floors on the LCRs values therefore ensuring the final least cost solution results in capacity levels that additionally meet the transmission security import limitations of the Localities.

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[46] The optimization model simultaneously shifts megawatts out of the three regions associated with the net CONE curves: Load Zones G, H, I, J and K.

The development of the TSLs is an annual process that is expected to begin each summer and conclude prior to the calculation of final LCRs. The development begins with the NYISO Operations department studying the N-1-1 transfer capability into the Localities using applicable design criteria and facility ratings. The analysis will be posted annually by the NYISO in October. This report will detail the transfer capability into each locality (*i.e.*, import limit) and the study assumptions including each interface's limiting element, contingency, and rating.

The transfer capabilities are then utilized in determining the final TSLs for the Localities. The forecasted peak load, transfer capacity into the Locality, and reliability forced outage rate are used to determine the final TSL for each Locality. The use of the forced outage rates provides that the LCR floors account for the average unit availability for each Locality. The forecasted peak load and generator Equivalent Demand Forced Outage Rate ("EFORd") values will be consistent with the values found in the MARS database used to calculate LCRs (i.e., the LCR Database, which is an update of the final IRM Database). The following is an example calculation:

Transmission Security Requirements	Formula	Zone X
Load Forecast (MW)	[A] = Given	12,000
Transmission Security Import Limit (MW)	[B] = Given	1,500
Transmission Security Unforced Requirement (MW)	[C] = [A]-[B]	10,500
Transmission Security Unforced Requirement (%)	[D] = [C]/[A]	87.5%
5 Year EFORd (%)	[E] = Given	8.0%
Transmission Security ICAP Requirement (MW)	[F] = [C]/(1-[E])	11,413
Transmission Security LCR Floor (%)	[G] = [F]/[A]	95.1%

The transmission security limits are then input within the optimization as constraints. Accordingly, the economic optimization solution results in LCRs that are greater than or equal to the specified transmission security limits.[47] Given that the economic optimization seeks to minimize capacity cost, the optimization reduces capacity in the highest cost (*i.e.*, net CONE) Localities until the LCR is equal to the applicable TSL.

Currently, the calculated 2017/2018 and 2018/2019 transmission security limits have been within the historical range of LCRs. Theoretically, the calculation of the TSLs could result in values that are not within the historical range, but this would require large changes to occur in the load, transmission capability into the Locality, or the zonal forced outage rates. The forced outage rates and load tend to slowly trend overtime. Therefore, the results are not expected to result in drastic changes in the TSLs from year to year. On the other hand, if new transmission

[47] An example of this is seen in the sensitivity run on the 2018/19 IRM Database where the optimization sets the NYC LCR equal to the transmission security floor of 79.7%. (Attachment II, Hall Affidavit at P 13 and Attachment IV, Exhibit 32.)

facilities are built to increase the transfer capability into a Locality, the LCR floors could change significantly between years.