Valuing Transmission Security

Issue Discovery Report – Draft

A Report by the
New York Independent System Operator

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Introduction

The New York Independent System Operator (NYISO)'s mission is to maintain power system reliability and competitive markets for New York State in a clean energy future. In support of this mission, the NYISO complies with the reliability rules established by the North American Electric Reliability Corporation (NERC), the Northeast Power Coordinating Council (NPCC) and the New York State Reliability Council (NYSRC). These rules focus on two critical components: resource adequacy and transmission security. The resource adequacy analysis establishes the amount of generation needed to consistently meet customer demand, even amidst outages. Transmission security focuses on avoiding thermal overloads, voltage violations and/or instability during disruptions, such as electric short circuits or unanticipated loss of system elements. The NYISO Installed Capacity (ICAP) market is designed to maintain sufficient capacity to meet the New York Control Area (NYCA) resource adequacy requirements while respecting certain transmission security limitations.

Stakeholders and the Market Monitoring Unit (MMU) have documented inefficiencies in the compensation for capacity resources, especially in the New York City (NYC) Locality (Load Zone J) for the 2023-24 and 2024-25 Capability Years, when Transmission Security Limits (TSLs) (rather than resource adequacy) set the Locality ICAP requirements. This misalignment in market compensation arises when there is a difference between a capacity supplier's contribution to meeting resource adequacy requirements and transmission security requirements. This misalignment is currently occurring and may continue and even increase in the coming years depending on the penetration of Intermittent Power Resources and Energy Storage Resources (ESRs), and as the Champlain Hudson Power Express comes online.

The "Valuing Transmission Security" project seeks to understand whether the ICAP market should explicitly compensate transmission security and explore mechanisms for doing so. The key objectives for any market design change include improving the representation of transmission security needs in the ICAP market, enhancing transparency, promoting reliability-based investments, and achieving economic efficiency. This Issue Discovery Report provides an overview of the issues and stakeholder and MMU concerns with the way transmission security is currently valued in the ICAP market, and various market design approaches to incentivize development of resources that contribute to transmission security.

Ongoing discussions with NYSRC and stakeholders aim to investigate the requirements and assumptions that underly resource adequacy and TSL studies, attempting to bring them closer in alignment. Although this project has not been prioritized for 2025, it might play a crucial role in informing future NYISO ICAP market reforms. It may help ensure that ICAP market signals effectively align both resource adequacy and transmission security needs, thereby enhancing the resilience and reliability of the NYCA power system in the face of increasing energy demand.

I. Resource Adequacy and Transmission Security in the Capacity Market

Two tenets of power system reliability are resource adequacy and transmission security. As defined by the NYSRC, resource adequacy is "the ability of the electric system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements."[1] The NYSRC defines transmission security as "the ability of the electric system to withstand disturbances such as electric short circuits or unanticipated loss of system elements."[2]

The NYISO ICAP market facilitates the sale and purchase of capacity between ICAP suppliers[3] and Load Serving Entities (LSEs).[4] A primary objective is to maintain sufficient generating capacity to meet the New York Control Area's (NYCA) resource adequacy requirements, while respecting transmission security limitations, by providing revenue adequacy for capacity resources. The NYISO ICAP market achieves this objective by setting ICAP requirements that account for resource adequacy needs and transmission security limitations, as explained in detail below.

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[1] See NYSRC Reliability Rule & Compliance Manual, section 3.2.

[2] *Id.*

[3] "Installed Capacity Supplier: An Energy Limited Resource, Generator, Aggregation, Installed Capacity Marketer, Responsible Interface Party, Intermittent Power Resource, Limited Control Run of River Hydro Resource, municipally owned generation, BTM:NG Resource, System Resource or Control Area System Resource that satisfies the ISO's qualification requirements for supplying Unforced Capacity to the NYCA." NYISO MST section 2.12

[4] "Load Serving Entity ("LSE"): Any entity, including a municipal electric system and an electric cooperative, authorized or required by law, regulatory authorization or requirement, agreement, or contractual obligation to supply Energy, Capacity and/or Ancillary Services to retail customers located within the NYCA, including an entity that takes service directly from the ISO to supply its own Load in the NYCA." *Id.*

A. Installed Reserve Margin

The Installed Reserve Margin (IRM) is the capacity above firm system demand (or load) required to provide for equipment forced and scheduled outages and transmission capability limitations. It is used to derive the amount of capacity that must be available to the NYCA to ensure resource adequacy is met and is expressed as a percentage. The IRM resource adequacy study calculates the probabilities of generator unit outages, in conjunction with load and transmission representations. The result of the calculation is termed Loss of Load Expectation (LOLE), which provides a consistent measure of resource adequacy at a given level (MW) of ICAP.

The NYCA IRM is established annually by the NYSRC and is based on the Northeast Power Coordinating Council (NPCC) standard for resource adequacy ("NPCC Resource Adequacy Standard"). The NPCC Resource Adequacy Standard requires the probability of disconnecting firm Load due to a Resource deficiency or LOLE to be, on the average, no more than once in ten years or 0.1 days/year ("0.1 LOLE").

The NYCA minimum ICAP requirement, that is used to set the statewide ICAP requirements for ICAP market auctions, ensures that the NYCA maintains sufficient resources to meet the 0.1 LOLE criteria. This requirement is calculated using the NYCA forecasted peak load and the IRM according to the following formula:

$$NYCA\ Minimum\ ICAP\ Requirement = NYCA\ Forecasted\ Peak\ Load\ x\ (1\ +\ IRM)$$

For each Capability Period, the NYISO calculates the NYCA Minimum Unforced Capacity (UCAP) Requirement by multiplying the NYCA Minimum ICAP Requirement by one (1) minus the NYCA translation factor.[5] The amount of capacity a resource is qualified to supply in the ICAP market, and the capacity payments the resource is paid are based on its marginal resource adequacy contribution, also known as its UCAP contribution.

B. Locational Minimum ICAP Requirements

Due to transmission limitations into certain areas within the NYCA, LSEs serving load in these areas must procure a percentage of their total Minimum UCAP requirement from ICAP Suppliers

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[5] "The NYCA translation factor shall be calculated by taking the quantity one (1) minus a value equal to: (a) the total amount of Unforced Capacity that all resources electrically located in the NYCA are qualified to provide during such Capability Period (as described in Section 4.5 of this ICAP Manual), divided by (b) the sum of the Installed Capacity values used to determine the Unforced Capacity of such resources for such Capability Period." NYISO MST section 5.11.4

electrically located within the constrained areas. The corresponding Minimum ICAP requirement for these areas is called the Locational Minimum Installed Capacity Requirement (LCR). Currently, there are three constrained areas called Localities (NYC or Load Zone J, Long Island (LI) or Load Zone K, and the G-J Locality or Lower Hudson Valley), within the NYCA where LCRs are imposed. LCRs are expressed as a fractional amount or percentage of a Locality's non-coincident peak load and are a portion of the NYCA Minimum ICAP Requirement that must be provided by capacity resources electrically located within a Locality to maintain sufficient energy and capacity in that Locality to meet resource adequacy criteria while maintaining transmission security. The methodology for determining the LCRs are described in the next section.

Prior to 2019, both NYSRC and NYISO used the Tan 45 process[6] to determine the IRM and LCRs, respectively.[7] In 2019, the NYISO introduced the LCR Optimizer to minimize the cost of procuring the capacity within the Localities needed to meet the IRM and 0.1 LOLE criteria. By accounting for locational differences in the cost of constructing new capacity, the LCR Optimizer can identify the combination of LCRs that meet the IRM and 0.1 LOLE criteria at lowest cost.

LCRs developed through the Tan45 process historically resulted in sufficient capacity to meet resource adequacy and respect transmission security criteria. However, with the LCR Optimizer there were possibilities of the optimal LCR values violating the Locality transmission security criteria. The TSL was introduced into the LCR optimizer as a "floor" to maintain sufficient resources in the ICAP Localities to respect transmission security criteria. The TSL floor values establish the minimum capacity procurement requirements for Localities and obviate the need for NYISO to rely on transfer amounts into a Locality that could create transmission security concerns during peak system conditions. The purpose and calculation of the TSL floor values are described in more detail in Section I.C and Section I.D.

C. TSLs: Purpose and Underlying Reliability Criteria

In support of the NYISO's administration of its ICAP market and pursuant to Section 5.11.4 of the NYISO MST, the NYISO determines TSLs that are used in establishing LCRs. The TSLs are incorporated in the LCR Optimizer to determine the LCRs for the ICAP Localities. They take the form of floors, to ensure the LCRs are set at or above the applicable TSL values. The TSL floor values establish minimum capacity procurement requirements for Localities that obviate the need for

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[6] Tan45 process: See pg. 21-23 of Installed-Reserve-Margin-Study-Guide-V22144.pdf

[7] Currently, the NYSRC continues to use the Tan 45 process to calculate the IRM.

NYISO to rely on transfer amounts into a Locality that could create transmission security concerns during peak system conditions.

One of the first steps in determining the TSL floor values is determining the bulk power transfer limit that can be relied upon for each Locality while respecting the applicable NYSRC Reliability Rules.[8] To determine the bulk power transfer limit for the G-J and LI Localities, generation and phase angle regulator schedules for N-1 outage case are developed to maximize the respective Locality import capabilities while maintaining all bulk power system transmission element power flows related to the respective interfaces within Normal ratings (*i.e.*, N-1-0). The NYISO then evaluates NPCC Directory 1[9] and NERC TPL-001[10] criteria contingencies for the N-1 outage case so that all bulk power system transmission element power flows related to the respective interfaces are within applicable Long-Term Emergency (LTE) ratings (*i.e.*, N-1-1).

For the NYC Locality, the bulk power transfer limit is calculated to respect NYSRC Local Reliability Rule G.1-R1.[11] The G.1-R1 Rule states that "[c]ertain areas of the Con Edison system are designed and operated for the occurrence of a second contingency." Consistent with the G.1-R1 Rule, generation and phase angle regulator schedules for the N-1-1 outage cases are developed to maximize the Locality import capability while maintaining all bulk power system transmission element power flows related to the Zone J interface within Normal ratings (*i.e.*, N-1-1-0).[12] NYISO Operations Engineering studies the Bulk Power Transmission Facilities (BPTF) limits using the abovementioned approach and considers those BPTF limits when determining TSL floor values.

D. TSL Floor Value Methodology

The TSL floor value methodology has been updated over the past few years to more closely align with the transmission security assumptions utilized in the transmission security margin

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8 https://www.nysrc.org/wp-content/uploads/2023/07/RRC-Manual-V46-final.pdf

9 https://www.nyiso.com/documents/20142/1403621/03_NPCC_Directory_1_TFCP_rev_20151001_GJD.pdf/f0265921-e7f4-aea0-5d49-67644bc7563f

10 https://www.nerc.com/pa/Stand/Reliability%20Standards/TPL-001-5.pdf

11 https://www.nysrc.org/wp-content/uploads/2023/07/RRC-Manual-V46-final.pdf

12 *See* 2022 Transmission Security Limit (TSL) Report: d708ac68-e7b0-24c2-2384-f4502a9bdee3

analyses conducted as part of NYISO's Reliability Planning Studies.[13] Methodology changes over the past few years include:

- For the 2022 –2023 Capability Year, the TSL floor values methodology was revised to align with the methodology for the transmission security margin assessment used in NYISO 2020 Reliability Needs Assessment (RNA) study.
- For the 2023 –2024 Capability Year, derating factors were added to the TSL floor values methodology to align with the consideration of generator outages in the transmission security margin assessment for the 2022 RNA study.
- For the 2024 –2025 Capability Year, the TSL floor values methodology was updated to capture the impact of LI/NYC net flow assumptions. In addition, the difference in accounting for the offshore wind derating factor was implemented due to the inclusion of an offshore wind resource in the 2024-2025 IRM study.

In general, the current TSL floor calculation methodology consists of the following four steps:

1. Deduct bulk power transfer limit from the peak load forecast to establish the UCAP required to meet the forecasted Locality peak load.
2. Apply the zonal 5-year Equivalent Demand Forced Outage (EFORd) rate to the UCAP requirements to convert into an ICAP requirement.
3. Add Special Case Resource (SCR) MW to reflect that SCRs are not currently counted on for transmission security.
4. Divide the calculated ICAP requirements by the Locality peak load forecast. This number is the TSL floor value expressed as a percentage.

Additionally, adjustments to the TSL floor calculation are made to account for resources whose 5-year EFORd rate are significantly different than their assumed availability in the transmission security margin assessments conducted as part of NYISO's Reliability Planning Studies. For example, offshore wind has an assumed availability of 10% in the Reliability Planning Studies' transmission security assessments. However, its proxy availability factor (used in place of the 5-year EFORd until offshore wind has sufficient operating history) was 37.6% for the 2024-2025 Capability Year. To reflect this difference in assumed availability, an adjustment was made in the calculation of the TSL floor value for any Locality in which offshore wind was assumed for the 2024-

[13] See Appendix for a discussion of the NYISO Reliability Planning Studies

2025 Capability Year. This specific adjustment and complete TSL floor calculation for the 2024 – 2025 Capability Year is shown below.

Table 1: 2024-25 Capability Year TSL Floor Calculation

Transmission Security Limit	Formula	G-J	NYC	LI	Notes
Non-Coincident Load Forecast (MW)	[A] = Given	15,274	11,171	5,080	[1]
Bulk Power Transmission Limit (MW)	[B] = Studied	4,350	2,875	275	[2]
Net Flow Adjustment (MW)*	[N] = Study Assumption	275			[3]
Offshore Wind (MW)	[O] = Given	0	0	37.5	[4]
UCAP Requirement (MW)	[C] = [A]-[B]+[N]+[O]	11,199	8,296	4,843	
UCAP Requirement Floor	[D] = [C]/[A]	73.3%	74.3%	95.3%	
5-Year Derating Factor	[E] = Given	5.40%	2.89%	8.85%	[5]
Special Case Resources (MW)	[F] = Given	526.7	442.4	35.3	[6]
ICAP Requirement (MW)	[G] = ([C]/(1-[E]))+[F]	12,365	8,985	5,348	
ICAP Requirement Floor (%)	[H] = [G]/[A]	81.0%	80.4%	105.3%	

*See Bulk Power Transmission Capability Report for study assumptions and adjustment details
[1] 2024 Fall Load Forecast
[2] Based on 2024 Locality Bulk Power Transmission Capability Report
[3] LI Bulk Power Transmission Limit Adjustment
[4] Difference in Resource Adequacy and Transmission Security UCAP Valuation
[5] 5-year Market EFORd based on the generation mix in the 2024-2025 IRM FB
[6] Modeled SCRs for 2024-2025

E. Issues When TSLs are Binding

The TSL floors were designed to ensure the LCR values, *i.e.*, the minimum amount of ICAP procured within a Locality, do not violate transmission security limitations. The capacity resources in the ICAP market, as mentioned earlier, are compensated for their resource adequacy contributions through their UCAP values. When the TSL floor value for a Locality is lower than the LCR values calculated by the LCR Optimizer, the ICAP requirement for the Locality is driven strictly by resource adequacy criteria. This means both the Locality requirement and resource's compensation are based on resource adequacy.

For the 2023-2024 Capability Year, the NYC and G-J Localities' LCRs were set by their Localities' respective TSL floor values. For the 2024-2025 Capability Year, the LCRs in all Localities were set by their respective TSL floor values. When LCRs are set at the TSL floor values, this indicates that the LCRs are above the minimum amount of capacity needed solely for resource adequacy. Thus, it is the need to preserve local capacity to meet transmission security criteria that is driving the LCR. However, regardless of whether the TSL floor values set the LCRs, capacity resources in the ICAP market are compensated for their resource adequacy contributions according to their resource adequacy-derived UCAP values.

The MMU's 2022 and 2023 State of the Market reports noted that some resource types are currently assumed to contribute less towards transmission security requirements in NYISO's

Reliability Planning Studies than resource adequacy requirements. The MMU notes that differences in these assumptions may lead to inefficient compensation when reflected in the TSL setting process:

- SCRs and Energy Storage Resources (ESRs) are not assumed to contribute to transmission security requirements unless a transmission security violation is observed. If a transmission security violation is observed, SCRs and ESRs may be assessed as potential solutions in the NYISO's Reliability Planning Studies.
- Large resources can increase the transmission security requirement, which is intended to maintain reliability if the largest two generation and/or transmission elements are lost.
- Intermittent resources have a similar or lower resource contribution to transmission security requirements as compared to their resource adequacy contributions.[14]

Other issues may also arise if the TSL floor binds:

- By compensating resources based on their resource adequacy value even when TSL floors are binding, the ICAP market may incentivize entry of capacity resources that do not meet transmission security needs, which may crowd out other capacity resources.
- Locality prices might be too high given the deterministic nature of TSLs. This is because binding TSL-floors lead to higher consumer costs by requiring a larger amount of capacity to be held in higher-priced localities like NYC as opposed to Rest-of-State (areas of NYCA outside the Localities).

II. Market Design Options

There may be multiple ways to explicitly compensate capacity resources for their contribution to maintaining transmission security margins. These include (1) changing the ICAP market structure, (2) changing the ICAP market auction framework, (3) changing the assumptions that go into resource adequacy studies and the transmission security margin assessment, and (4) meeting TSL needs outside of the ICAP market. Through the stakeholder process, NYISO may determine that it should continue the current ICAP market compensation structure or consider

[14] See Appendix for a detailed discussion of the contribution of different resource types to resource adequacy and transmission security

options for addressing the issues mentioned in the previous section, which may include one or multiple of the options described below.

A. Two Products in the ICAP Market

Under this option, the NYISO would separately calculate resource adequacy and transmission security requirements for each Locality, and these would be treated as two separate products in the ICAP market. To implement this option, the NYISO may need to develop two sets of CAFs, demand curves, and requirements for each Capability Period: one based on resource adequacy criteria and the other based on transmission security requirements. This option could reduce market inefficiencies by providing a market-based solution for directly compensating resources for contributing to transmission security. However, it may require developing a new market design, which would be a resource-heavy and lengthy process that may result in an expanded ICAP market structure that may be complicated to implement.

Specifically, under this option, the NYISO would need to restructure the ICAP market auctions and the compensation and settlement of resource payments. NYISO would also need to determine how to design (1) a transmission security demand curve, (2) transmission security-based capacity accreditation methodologies and associated rules, and (3) a new ICAP market auction structure to solve the two products co-optimally, by nesting[15] one requirement within another or by another method. As a result, the Demand Curve Reset process may need to produce two demand curves for each Capability Period, with a different peaking plant for each demand curve or a peaking plant unit that is appropriate for both.

B. MMU State of the Market Recommendations

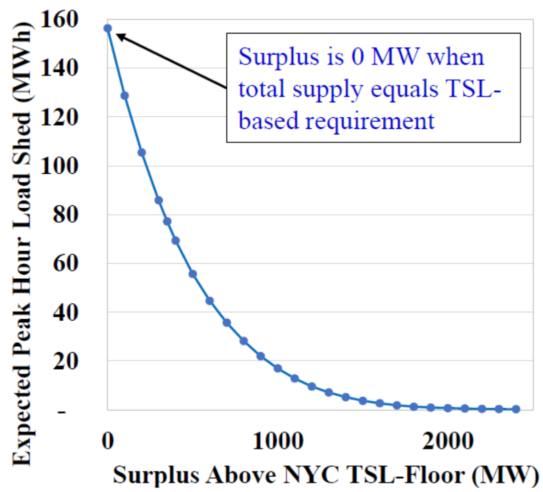
The MMU has provided two State of the Market recommendations related to this option: (1) pay resources for capacity based on requirements they contribute to meeting (State of Market Recommendation #2022-1) and (2) implement sloped demand curves that reflect the marginal value of capacity for transmission security (State of Market Recommendation #2023-4).

In its September 24, 2024, ICAP Working Group presentation, the MMU explained that these two recommendations are complementary and should be adopted together. Currently, the ICAP Demand Curve determines the ICAP Spot Market Auction market-clearing price at the prescribed level-of-

[15] Nesting here refers to solving ICAP market auctions for the lower requirement (out of resource adequacy and transmission security requirements) in a Locality followed by the higher requirement in a hierarchical manner

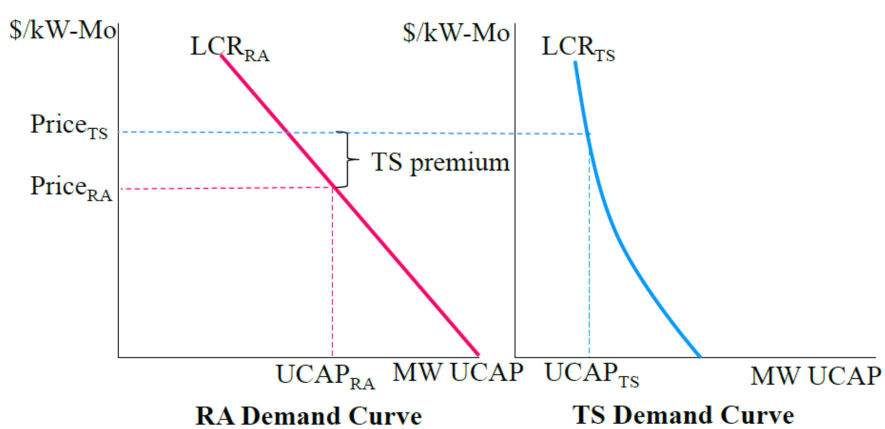
excess and values additional capacity beyond NYCA and Localities' minimum ICAP requirement. The MMU proposes a transmission security-based demand curve shape that reflects the value of additional capacity beyond a Locality's minimum reliability needs to ensure transmission security (*i.e.*, TSLs) as shown below.

Figure 1: Illustration of MMU-recommended Transmission Security Demand Curve[16]



The MMU recommends determining resource adequacy and transmission security prices by using separate demand curves with appropriate shapes and paying each resource based on its contribution to each requirement and the corresponding price.

Figure 2: Illustration of Spot Auction Implementing Both MMU Recommendations[16]



[16] MMU Valuing Transmission Security Recommendations 09_24_2024

A resource would be paid according to the following formula:

$$RA\ UCAP\ MW_x \cdot Price_{RA} + TS\ UCAP\ MW_x \cdot TS\ premium$$

According to the MMU, these recommendations would reduce consumer costs without compromising reliability and would more efficiently signal the locations and types of capacity that improve NYCA system reliability.

C. Two Products, One Price in the ICAP Market

Under this option, NYISO would treat resource adequacy and transmission security as separate products but would not explicitly compensate both requirements in the ICAP market auctions. Instead, the more stringent criteria would determine whether the auction uses transmission security-based parameters, such as demand curves, ICAP requirements, and UCAP values, or resource adequacy based-parameters.

This option could maintain a relatively similar ICAP market administration process to that which exists currently. However, the NYISO would have to consider the following issues: (1) how to design a transmission security demand curve and transmission security-based capacity accreditation methodology and associated rules and (2) how to treat the nesting of capacity if transmission security parameters are used in the auctions for one Locality but not the parent capacity zone of the Locality.

D. Securing Transmission Security through a Separate Market

This option would require addressing transmission security margin requirements for each of the Localities (G-J, NYC and LI) through a separate market. This option would be similar to the 'Two Products in the ICAP Market" option described above, except the NYISO would not need to co-optimize or nest the resource adequacy and transmission security requirements. Therefore, this option would provide one auction for each product, thus reducing the complexity of the ICAP market administration. As with the "Two Products in the ICAP Market" option, the NYISO would need to determine how to design (1) a transmission security demand curve and (2) a transmission security-based capacity accreditation methodologies and associated rules.

E. Meeting Transmission Security Needs Outside of the ICAP Market

Under this option, the ICAP market auction would procure capacity to meet only resource adequacy needs. TSLs would not be incorporated into the ICAP market auction requirement setting process. Additional transmission security-based requirement would only be satisfied through planning process which could result in transmission upgrades and Reliability Must Run contracts. This option addresses the inefficient compensation of certain capacity resource types when TSLs are binding, but it would increase out-of-market actions.

F. Incorporating Transmission Security into Resource Adequacy Analyses

As currently structured, the resource adequacy and transmission security margin analyses model the NYCA system under different conditions. However, it may be possible to reflect transmission security considerations in the resource adequacy assessment and develop requirements that consider both resource adequacy and transmission security simultaneously. This could be done by modifying certain assumptions in the resource adequacy analysis to approximate the conditions that need to be respected to maintain transmission security. One set of assumptions that would likely need to be altered under this approach would be the use of emergency assistance and Emergency Transfer Criteria[17] under below-peak conditions. This approach would need coordination with the NYSRC and could require extensive modeling changes to the resource adequacy models but could preserve the current ICAP market framework and obviate the need for explicit TSLs in the LCR setting process.

If the NYISO proceeds with the more granular capacity zones and seasonal ICAP market framework projects, the application of TSL floors and their calculation might become more complicated and impractical. This is because with a seasonal ICAP market framework, there would be one set of TSL floor values for each season and with more granular capacity zones, a higher number of Localities would mean more TSL floor values for each season.

III. Market Design Objectives and Considerations

If transmission security is explicitly compensated for in the ICAP market or in a separate market, the following market design objectives should be achieved:

- Better representation of planning needs in the ICAP market
- Practical and feasible implementation and long-term administration with the NYISO's available resources
- Maintain market transparency

[17] See Appendix for definition of Emergency Transfer Criteria

- Incenting reliability-based investments
- Economically efficient and robust market design
- Ease of understanding and participation by all market participants in any new ICAP market or auction structure

The following factors should also be considered when selecting a market design:

- Resource requirements for the market design and implementation
- Implementation time
- Changes to ICAP market structure and/or auction processes and corresponding administrative burden and requirements
- Software changes
- Level of complexity
- Magnitude of impact (*e.g.*, consumer impact, financial impact, and reliability impact)
- Price transparency and predictability
- Possibility of hedging for market participants

IV. Conclusion

This Issue Discovery Report highlights how transmission security criteria are incorporated in the current ICAP market construct, how Locality ICAP requirements are determined and how resources are compensated for their resource adequacy contribution in the ICAP market. The report discusses potential options for addressing the issues of inefficient compensation of certain resources when the TSL floors sets the LCRs and the issues and market design considerations for each of these options.

In conjunction with this project, there are ongoing discussions at (1) the Electric System Planning Working Group regarding Reliability Planning Studies Transmission Security margin analysis assumptions, (2) the ICAP Working Group to discuss changes to TSL floor methodology, and (3) with NYSRC to make changes to the IRM resource adequacy study assumptions to address the issues raised by stakeholders and MMU on valuing transmission security in the ICAP market. Although this project has not been prioritized for 2025, the outcome of the 2025 Capacity Market Structure Review project may provide guidance on potential reforms related to valuing transmission security in the ICAP market.

Appendix

A.1. Normal Transfer Criteria

Under normal transfer criteria, adequate facilities are available to supply firm load with the BPTF within applicable normal ratings and limits as follows:

- Pre-contingency line and equipment loadings need to be within normal ratings. Pre-contingency voltages and transmission interface flows need to be within applicable pre-contingency voltage and stability limits
- Post-contingency line and equipment loadings need to be within applicable emergency (Long-Term Emergency (LTE) or Short-Term Emergency (STE)) ratings. Post-contingency voltages and transmission interface flows need to be within applicable post-contingency voltage and stability limits
- All contingencies applied under normal transfer criteria are listed in Table C-1 "NYSRC Operating Transfer Capability Requirements"[18]

Normal Transfer Limit of a transmission line is calculated based on thermal, voltage, and stability testing, considering contingencies, ratings, and limits specified for normal conditions. The normal transfer limit is the lowest limit based of these three maximum allowable transfers

A.2. Emergency Transfer Criteria

In the event that adequate facilities are not available to supply firm load within Normal Transfer Criteria, emergency transfer criteria may be invoked. Under emergency transfer criteria, transfers may be increased up to, but not exceed, emergency ratings and limits as follows:

- Pre-contingency line and equipment loadings may be operated up to LTE ratings for up to four (4) hours, provided the STE ratings are set appropriately. Otherwise, pre-contingency line and equipment loadings must be within normal ratings. Pre-contingency voltages and transmission interface flows must be within applicable pre-contingency voltage and stability limits
- Post-contingency line and equipment loadings within STE ratings. Post-contingency voltages and transmission interface flows within applicable post-contingency voltage and stability limits

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[18] *See* Table C-1 "NYSRC Operating Transfer Capability Requirements"

- All contingencies applied under normal transfer criteria are listed in Table C-1 "NYSRC Operating Transfer Capability Requirements" [18]

Emergency Transfer Limit of a transmission line is calculated based on thermal, voltage, and stability testing, considering contingencies, ratings, and limits specified for emergency conditions. The emergency transfer limit is the lowest limit of these three maximum allowable transfers.

A.3. NYISO Reliability Planning Studies

The NYISO Planning department performs three recurring studies to help NYISO maintain a reliable and resilient power grid, capable of meeting New York's energy needs now and in the future. These are:

- Short-Term Assessment of Reliability studies (STARs): Five-year studies that focuses on addressing reliability needs arising in the first three years of the study period.
- Reliability Needs Assessment studies (RNAs): Biennial studies that identifies long-term reliability needs in years 4 through 10 following the start of the RNA.
- Comprehensive Reliability Plan studies (CRPs): Biennial reports that provides a blueprint for meeting the reliability needs of New York State's bulk electricity grid over a 10-year planning horizon.

These studies are collectively known as "Reliability Planning Studies." The Reliability Planning Studies are based upon applicable NERC, NPCC and NYSRC reliability rules. The NYISO performs Reliability Planning Studies for several reasons, including understanding future reliability risks, maintaining resource adequacy and transmission security, preparing for extreme weather, and coordinating with public policies.

For transmission security planning, the Reliability Planning Studies apply the standards and requirements in NERC TPL-001, NPCC Directory 1, and NYSRC Reliability Rules. The transmission security analysis is a deterministic analysis of credible combinations of system conditions that stress the system. The NYCA system is assessed for its ability to withstand the loss of specified, representative, and reasonably foreseeable design criteria contingencies (N-1, N-1-1, N-1-1-0) at projected customer demand and anticipated transfer levels. Design criteria are applied according to normal transfer criteria.

Some of the key differences between the resource adequacy analysis and the transmission security assessment are as follows:

- The resource adequacy analysis uses emergency transfer criteria, while the transmission security assessment uses normal transfer criteria.
- The resource adequacy analysis considers emergency operation procedures and emergency assistance from neighboring systems, while the transmission security assessment generally does not consider such actions for the identification of reliability needs.
- The resource adequacy analysis probabilistically looks at 8760 hours of a wide range of demand levels, while the transmission security assessment uses a handful of system conditions at different load levels (*e.g.*, summer peak, winter peak, and daytime light load).
- The resource adequacy analysis models resource availability probabilistically, while the transmission security assessment assesses the system in snapshots and models resource availability deterministically.

A.4. Contribution of Different Resource Types to Resource Adequacy and Transmission Security

Resource adequacy and transmission security assessments study the NYCA system under different conditions. As a result, the resource adequacy and the transmission security assessments may identify different resource contributions to meeting resource adequacy and transmission security criteria respectively.

Table 2 shows the comparison of the effective capacity contribution of different resource types in the IRM study and Reliability Planning Studies' resource adequacy and transmission security margin studies.

Table 2: Effective Capacity Contribution of Different Resource Types

PARAMETER	Reliability Studies Resource Adequacy	IRM Study	Reliability Studies Transmission Security Margin
LOAD FORECAST			
Peak Load Forecast	Probabilistic	Probabilistic	Deterministic
RESOURCE TYPES			
Thermal Generators & Large Hydro	Transition Rates representing EFORd during demand periods over the most recent five-year period	Transition Rates representing the EFORd during demand periods over the most recent five-year period	Incorporates the NERC five-year class-average forced outage rate values (EFORd)
Existing and Proposed Land-based Wind Units	Model-based hourly data over the past 5 years (developed by DNV-GL). Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in Monte Carlo process	Actual hourly plant output over the past five years. Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in Monte Carlo process	Dispatch land-based wind (LBW) generation to the following percentage of nameplate capacity: • Summer 5% • Winter 15% • Light Load 10%
Proposed Offshore Wind Units	Model-based hourly data over the past 5 years (developed by DNV-GL). Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in Monte Carlo process	Model-based hourly data over the past 5 years (developed by DNV-GL). Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in Monte Carlo process	Dispatch off-shore wind (OSW) generation to the following percentage of nameplate capacity: • Summer 10% • Winter 20% • Light Load 15%
Existing & Proposed Utility-scale Solar Resources	Program randomly selects from the model-based data shapes covering past 5 years, as developed by DNV-GL	Actual hourly plant output over the past five years. Program randomly selects a solar shape of hourly production over the five years for each model iteration	Utility-scale solar resources are dispatched at the same factor as the BTM solar resources for a given transmission security case
BTM Solar Resources	Past 5 years of 8,760 hourly MW profiles based on sampled inverter data. The MARS random shape mechanism randomly picks one 8,760 hourly shape (of five) for each replication year	BTM Solar is embedded in the modeled load shapes, and there is no separate modeling of the BTM Solar as resources	BTM solar reductions in load forecast are included in the Gold Book (Table I-9d) along with nameplate capacity (Table I-9a)

PARAMETER	Reliability Studies Resource Adequacy	IRM Study	Reliability Studies Transmission Security Margin
Existing Small Hydro Resources (*e.g.*, run of river)	Actual hourly plant output over the past 5 years period. Program randomly selects a hydro shape of hourly production and that is multiplied by their current nameplate rating	Actual hourly plant output over the past five years. Program randomly selects a Hydro shape of hourly production over the five years for each model iteration	Fixed at their 5-year average based on GADS data for production during specific peak or light load hours. Dispatches at: • Summer 40% • Winter 60% • Light Load 55%
Proposed front-of-meter Battery Storage	GE MARS 'ES' model is used. Units are given a maximum capacity, maximum stored energy, and a dispatch window.	GE MARS 'ES' model is used. Units are given a maximum capacity, maximum stored energy, and a dispatch window	As the starting point, modeled at 0 MW output. If a potential transmission security violation is observed, post-processing analysis is performed to understand the nature of the need and how the characteristics of the battery storage resources may address the need
SPECIAL CASE RESOURCES (SCRs)			
Special Case Resources (SCRs)	Modeled as duration-limited resources constrained to be called once in a day, when a loss of load event occurs, for 5 to 7 hours, which is determined based on historical SCR performance in the applicable zone	Modeled as duration-limited resources constrained to be called once in a day, when a loss of load event occurs, for 5 to 7 hours, which is determined based on historical SCR performance in the applicable zone	As the starting point, impact of SCRs is not modeled. If a potential transmission security violation is observed, post-processing analysis is performed to understand the nature of the need and how the characteristics of the SCRs may address the need