UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Grid Resilience in Regional Transmission Organizations and Independent System Operators	**)** **)** **)**	**Docket No. AD18-7-000**

Response of the New York Independent System Operator, Inc.

Pursuant to the order issued in the above-referenced proceeding by the Federal Energy Regulatory Commission ("Commission") on January 8, 2018 ("Grid Resilience Order"),[1] the New York Independent System Operator, Inc. ("NYISO") hereby submits this response to provide information relevant to the questions posed by the Commission. The NYISO shares the Commission's interest in, and concern for, the resilience of the bulk power system. This response: (i) provides an overview of the NYISO's current practices for addressing reliability and resilience of the New York Control Area ("NYCA");[2] and (ii) describes efforts already underway (or being considered) to ensure continued reliable operation and bolster resiliency in response to the evolving nature of the bulk power system in New York.

Technological developments, economics, environmental considerations, and public policies are transforming today's electric grid. This evolving landscape introduces new and changing variables that the NYISO must manage in its operation of, and planning for, the bulk power system in New York. The NYISO is poised to meet the challenges brought about by this

[1] *Grid Resilience in Regional Transmission Organizations and Independent System Operators*, 162 FERC ¶ 61,012 (2018).

[2] Capitalized terms not otherwise defined herein shall have the meaning specified in the NYISO's Market Administration and Control Area Services Tariff ("Services Tariff") and Open Access Transmission Tariff ("OATT").

transformation. The NYISO remains confident in the ability to work collaboratively with its stakeholders to develop and implement the necessary market and procedural enhancements to continue to efficiently and reliably serve New York's energy needs.

The NYISO is undertaking a myriad of initiatives with its stakeholders, aimed at addressing the evolving nature of the electric system in New York. The transmission system is critical to enabling the envisioned transformation of New York's electric system. To this end, the NYISO is embarking this year on a comprehensive re-evaluation of its current planning processes and procedures with its stakeholders. The objective of this effort is to identify enhancements and efficiency improvements to the NYISO's current reliability, economic, and public policy planning processes to help ensure that the NYISO's comprehensive planning process stands ready to facilitate the transmission infrastructure additions and upgrades and other resources necessary to meet the evolving needs of the grid.

The NYISO intends to evaluate with its stakeholders opportunities to leverage competitive wholesale market products and services to bolster the resiliency of New York's bulk power system, especially in critical locations such as New York City. The changing portfolio of resources serving the electric needs of New York will require a careful and comprehensive review of the NYISO's existing market products and operational practices to ensure the continued ability to efficiently and reliably serve New York's electricity requirements. Such initiatives include: (i) re-evaluating the current Ancillary Services products and shortage pricing values; (ii) ensuring that market price signals continue to incentivize resource performance and production consistent with dispatch instructions; (iii) assessing changes to the measurement of capacity supply resource availability to more accurately reflect resource performance during critical operating periods; (iv) evaluating deliverability and performance requirements for

external capacity supply resources; (v) assessing opportunities for enhancements to interregional transaction scheduling and coordination; and (vi) more fully integrating energy storage and distributed energy resources to leverage the capabilities of these emerging resources.

Collaboration among electric industry participants is essential to the development of solutions to these challenges in an effective and equitable manner. The NYISO's shared governance process has a proven track record of success in addressing the challenges and opportunities facing the bulk power system and wholesale energy markets in New York. In recognition of this success, the NYISO respectfully requests that the Commission allow the NYISO to continue to work with its stakeholders in assessing and developing the enhancements necessary to ensure that the wholesale markets, in serving the evolving needs of the electric system, continue to provide significant benefits to the State and its electricity consumers.

I. NYISO RESPONSE

A. Definition of Resilience

The Commission proposes to adopt the following definition of resilience developed by the National Infrastructure Advisory Council:

> The ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event.[3]

The NYISO supports the proposed definition of resilience.

Reliability and resilience are not necessarily separate and distinct concepts in relation to the electric system. Rather, these two concepts are highly intertwined and often indistinguishable. The NYISO shares Commissioner LaFleur's position that resilience is an element of the existing requirements related to maintaining the reliable operation of the bulk

[3] Grid Resilience Order at P 23.

power system.[4] The requirements for reliable operation of the electric system encompass many aspects of resiliency. For example, maintaining reliability encompasses, among other resilience measures: (i) forward-looking design of the system to withstand multiple contingency events (*e.g.*, N-1-1 contingencies) and enable the capability to absorb the impact from the loss of multiple facilities; (ii) advance operational planning by operating the system to meet single contingency events (*i.e.*, N-1 contingencies) thereby ensuring that the failure of one system component will not disrupt the continued operation of the system; (iii) redundancy and rapid recovery in the form of procuring voltage support, regulation service, and operating reserves to assist with responding to unanticipated disturbances that may arise; (iv) emergency preparedness, such as black start capability, coordination of system restoration, and procedures for addressing geomagnetic disturbances; and (v) redundancy in infrastructure design for critical infrastructure and development of business continuity plans to provide for continued operation of critical functions in the event that unplanned disturbances or interruptions arise.

Resiliency that goes beyond traditional measurements of reliability includes measures that could assist in more expeditious recovery from disruptive events. In this way, resiliency is closely linked to the importance of maintaining and expanding interregional interconnections, the building out of a robust transmission system, and the evaluation of additional resources, resource capabilities, and services in critical areas, such as energy storage, that could support rapid recovery from system disturbances.

Resiliency may also include measures for providing incremental reliability above that required to maintain minimum reliable operation of the system. Measures that seek to provide even greater levels of adequacy and security beyond normal operating and planning criteria, such

[4] *Id.* (LaFleur, concurring at 1).

as measures designed to withstand extreme contingency events, should be evaluated. The necessity or reasonableness of implementing measures to provide even greater levels of reliability should be carefully examined in consideration of their benefits and costs.

The NYISO recognizes that differences of opinions persist with respect to the definition of resilience. Additional dialogue regarding concepts for market-based resilience services and practices may be warranted. The Commission could potentially facilitate this dialogue through a technical conference to explore near-term concepts being considered across the diverse regions of the country for bolstering bulk power system resilience.

B. Existing Practices

Appropriate levels of reliability and security are clearly defined in the reliability standards, operating and system planning requirements, and security and infrastructure protection requirements established by the Commission, the North American Electric Reliability Corporation ("NERC"), the Northeast Power Coordinating Council, Inc. ("NPCC"), and the New York State Reliability Council, L.L.C. ("NYSRC"). Together, these entities define a vast array of requirements that the NYISO must abide by in its operating and planning of the bulk power system and administering New York's competitive wholesale markets.

1. System Operations and Market Administration[5]

The NYISO markets are designed to provide proper financial incentives and price signals to ensure the continued reliable operation of the electric system in New York. The NYISO markets inherently value and support elements of resilience that are embedded in maintaining reliability.

[5] This section provides information in response to the following questions set forth in the Grid Resilience Order: (a)-(s) in P 25 and (a)-(d) in P 27.

All resources (without regard to fuel type) that have demonstrated the ability to meet the performance criteria associated with providing a service that the NYISO procures through its markets are eligible to participate in the relevant markets, and compete with other resources. Resources are paid for their reliability and resilience service based on competitive market outcomes.

a. Energy and Ancillary Services Markets

The NYISO administers both Day-Ahead and Real-Time Markets to procure the necessary Energy and Ancillary Services to reliably operate the system and continuously meet the electricity demands of customers, at the lowest overall production cost based on the offers submitted by resources competing to provide service.[6] The NYISO's Day-Ahead and Real-Time Markets each perform a simultaneous co-optimized commitment/dispatch of resources to provide the necessary levels of energy, regulation service, and operating reserves to address all system needs and maintain reliability.

The markets generally secure the transmission system to address single contingency events (*i.e.*, N-1 contingencies).[7] The markets also secure for certain multiple contingency events (*i.e.*, N-1-1 contingencies) to comply with reliability requirements imposed by the NYSRC, as well as operating reserve constraints, which include requirements to meet N-1-1 contingencies.[8] The clearing prices determined by the Day-Ahead and Real-Time Markets

[6] Voltage control and black start service capability are cost-based Ancillary Services that are not procured through competitive markets administered by the NYISO.

[7] Notably, a subset of these single contingency events involve the simultaneous outage of multiple elements. Examples include: (i) the failure of a circuit breaker due to a fault-to-ground may be cleared by the operation of multiple circuit breakers, resulting in the outage of multiple system components; and (ii) the simultaneous phase-to-ground fault of two adjacent transmission circuits on a multiple circuit transmission tower.

[8] For example, the operating reserve constraints modeled in both the Day-Ahead and Real-Time Markets include: (i) 1,300 MW of 30-minute reserves being procured in the Southeastern New York

reflect the costs of securing the system to meet these contingency events. Operation of the system with advanced planning to meet contingency events bolsters resiliency through ensuring that the resources and services necessary to respond to, and quickly recover from, disruptive events are procured and available to system operators.

Since the experiences of the 2013-2014 winter period, the NYISO has revised its operating reserve requirements to: (i) implement a new reserve region for Southeastern New York with an associated 1,300 MW 30-minute operating reserve requirement; and (ii) increase the statewide 30-minute reserve requirement by 655 MW to 2,620 MW.[9] Procurement of operating reserves bolsters system resiliency by providing ready access to additional resource capacity to respond to, and expeditiously recover from, system disturbances.

The Day-Ahead and Real-Time Markets also use "shortage" pricing to reflect appropriate values for services when insufficient capability is available to provide all needed services. Shortage pricing is generally implemented by various demand curves that represent the escalating value of regulation, reserves, and transmission security as the level of resources capable of providing such services decreases. Escalating prices under shortage conditions provides proper economic signals regarding the value of these reliability and resiliency services. Shortage pricing also ensures that resources capable of providing these services are appropriately

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reserve region in order to prepare the system to withstand the next worse contingency following the worst contingency for the UPNY-SENY interface; (ii) a 10-minute reserve requirement of 1,200 MW for the East of Central-East reserve region to rapidly restore flows on the Central East interface to within the applicable Interconnection Reliability Operating Limits ("IROL") following the worst contingency and prepare the system to withstand the next worst contingency; and (iii) a 2,620 MW 30-minute reserve requirement applicable for the statewide (*i.e.*, NYCA) reserve region to prepare the system to withstand the two worst supply contingencies without the need to interrupt delivery of energy to serve load.

[9] Docket No. ER15-1061-000, *New York Independent System Operator, Inc.*, Proposed Tariff Revisions to Ancillary Service Demand Curves and the Transmission Shortage Cost (February 18, 2015); and *New York Independent System Operator, Inc.*, 151 FERC ¶ 61,057 (2015).

compensated in response to actual system conditions. Shortage pricing further provides appropriate incentives for resources committed day-ahead to take necessary actions, including ensuring sufficient fuel supply, to meet their commitments in real-time in order to avoid having to buy-out of their obligations at high shortage pricing levels during periods of system stress. The incentives resulting from shortage pricing are designed to bolster system resilience through improved resource performance and availability during critical operating periods.

b. Capacity Market

The NYISO also administers a capacity market. The capacity market assists with maintaining reliability on a longer-term horizon by ensuring that sufficient resource capability is available to meet peak customer demands, plus a reserve margin. The reserve margin is intended to address potential contingencies and other unanticipated events that may result in the need for additional resource capability to adequately serve system needs.

The NYISO, in coordination with the NYSRC, conducts a technical analysis each year to determine the appropriate level for the capacity market reserve margin. Based on this analysis, the NYSRC determines the level of capacity required NYCA-wide to meet the governing resource adequacy criterion that the probability of an unplanned disconnection of firm load not exceed one occurrence in ten years. Factors that influence the reserve margin value include the load forecast, variability of load due to uncertainties related to weather, historic performance of generation and demand response resources, constraints on the transmission system, and emergency operating procedures that can be deployed during system emergencies. Establishing this reserve mechanism bolsters resiliency by preparing the system to cope with equipment breakdowns, severe weather, or other unplanned events that could affect system reliability.

The capacity market provides price signals indicating the value of resource capability in various locations throughout the State. This is accomplished, in part, through the use of a sloped capacity demand curve (*i.e.*, the ICAP Demand Curve) in the ICAP Spot Market Auction. The basis for pricing underlying the ICAP Demand Curves is the projected net cost to build a new peaking facility in various locations throughout the State where resources need to be located to adequately serve system needs.[10]

The NYISO currently utilizes an ICAP Demand Curve for ensuring statewide resource adequacy, as well as three separate ICAP Demand Curves for the downstate region (*i.e.*, the G-J Locality, New York City and Long Island) where transmission constraints limit power flows and local resources are needed to help ensure system reliability. The establishment of locational capacity requirements and provision of locational price signals serves to bolster system resiliency by seeking to ensure an appropriate distribution of resources throughout the State. The location of resources in manner that reflects system constraints and areas critical to the reliability of the system provides a means of preparation to withstand disruptions and facilitates expedited recovery following disruptive events.

The ICAP Demand Curves are designed to properly value capacity in relation to the applicable minimum requirements needed to ensure reliability (*i.e.*, forecasted peak demands, plus a reserve margin or a minimum amount required to be located within a certain geographic area due to transmission constraints that limit the capability to flow power throughout the State). The ICAP Demand Curves inherently provide for valuation of resilience by recognizing the value of capacity in excess of minimum requirements.

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[10] A peaking unit is defined as the "the unit with technology that results in the lowest fixed costs and highest variable costs among all other units' technology that are economically viable." A peaking plant may consist of one or more units.

In addition to the resilience value of paying for capacity beyond the applicable minimum levels, the estimated cost of constructing a new peaking plant that underlies certain ICAP Demand Curves provides for additional resilience benefits. For the downstate population centers of New York (*i.e.*, the G-J Locality, New York City and Long Island), the projected costs include various components related to improved resilience, such as dual-fuel capability and, in the case of New York City, certain infrastructure hardening costs.

The peaking plant designs underlying the ICAP Demand Curves for each of these downstate areas include dual-fuel capability, which can result in improved generator fuel assurance and availability. This includes both the cost of the necessary infrastructure to store alternative fuel onsite and the cost of obtaining an adequate reserve of such back-up fuel. The cost estimates currently provide for a fuel reserve that is sufficient to accommodate operation on an alternative fuel for 96 hours before needing to be replenished. For New York City, the estimated costs also include additional storm hardening expenses related to raising the site elevation of plants to meet local zoning requirements enacted in response to flooding that occurred as a result of Superstorm Sandy. Including these costs as part of the basis for capacity market pricing provides the necessary price signals for investment in new generation facilities located in these areas to include such resiliency improving measures.

c. Grid Interconnections and Interregional Operations

While the Commission has asked for comments in this docket describing discrete resilience concerns of individual Independent System Operators and Regional Transmission Organizations ("ISOs/RTOs"), it must also recognize the critical importance of maintaining and enhancing grid interconnections. These interconnections support and bolster reliability and

resilience by creating a larger and more diverse resource pool available to meet needs and address unexpected and/or disruptive events ***throughout*** an interconnected region.[11]

The ISO/RTO markets encourage economic interchange with neighboring markets to provide the overall least cost means of serving system needs. The more diverse resource pool available through interregional interconnections provides both economic and resiliency benefits, especially during stressed operating conditions such as sustained heat waves or cold snaps. System operators can also rely on interregional operational processes to request emergency energy assistance, if necessary, to support reliability. These interregional practices bolster the resiliency of the interconnected grid during stressed system conditions and can avoid the need for taking more severe operating actions that may otherwise be needed to support reliability.

The resiliency value of an interconnected grid has been clearly demonstrated during recent periods of system stress. For example, throughout the cold weather event from December 26, 2017 through January 7, 2018, significant levels of economic interchange from NYISO to ISO New England Inc. ("ISO-NE") were scheduled. These energy exports from New York helped to bolster resilience of the Northeast grid by reducing the need for generation facilities in New England to use limited fuel oil supplies and maintaining the availability of New England generation. Additionally, on January 7, 2014, during the stressed system operations of the 2013-2014 winter period, NYISO provided significant levels of emergency energy assistance to PJM Interconnection, L.L.C. ("PJM") for a five-hour period to assist PJM with meeting its system needs in the wake of generator outages and operational constraints.

[11] *See, e.g.*, Docket No. ER17-2073-000, *PJM Interconnection, L.L.C.*, Comments of the New York Independent System Operator, Inc. (July 31, 2017).

Maintaining and protecting existing interconnections between neighboring regions and continually assessing opportunities to improve interregional transaction coordination can bolster the resiliency of the grid throughout an interconnected region. These interconnections foster the opportunity for the Northeast and Mid-Atlantic markets to rely on a broader, more diverse set of resources to meet the overall needs of the region.

d. Operational Practices for Critical Operating Periods and Stressed System Conditions

Consistent with reliability requirements established by the NYSRC, the NYISO has implemented operating practices that bolster the resiliency of the system during stressed conditions. For example, Storm Watch events bolster resilience of the system to serve the needs of the downstate population centers, including New York City, during certain actual or anticipated severe weather conditions (*e.g.*, thunderstorms, hurricanes, tornados and major snowstorms). During these events, the NYISO operates portions of the transmission system serving the downstate load centers in a more conservative fashion by reducing transfer capability into Southeastern New York. This requires the commitment of, and greater reliance on, local supply resources to meet system needs in this region to safeguard against the loss of multiple transmission system facilities that could occur as a result of severe weather conditions.

The NYISO has implemented additional practices and procedures that seek to bolster system performance and resilience. For example, the NYISO performs periodic audits of generation facilities, which includes assessing facility maintenance and, for dual-fuel units, the state of equipment necessary to utilize alternative fuel sources. The NYISO also conducts fuel inventory surveys to provide better awareness of resource fuel availability over time.[12] The

[12] *See* NYISO, *Fuel and Emissions Reporting User's Guide*, available at: http://www.nyiso.com/public/webdocs/markets_operations/documents/Manuals_and_Guides/Guides/User_Guides/GFER_UG.pdf.

NYISO conducts additional fuel inventory inquiries during periods of expected system stress, such as cold snaps, to provide advance knowledge of fuel availability issues that could arise. The NYISO has also improved electric-gas coordination over time through improved coordination, information sharing, and communications with the natural gas pipeline companies and local distribution companies ("LDCs") serving generation resources in New York.

During stressed system conditions, such as heat waves and cold snaps, the NYISO participates in coordinated communications with neighboring systems. Broader coordination and communication across the interconnected grid enhances reliability and resilience through awareness of conditions and events that may be affecting operations in other regions.

Situational awareness of conditions and events that may affect New York's bulk power system has also been enhanced through the implementation of new technologies. For example, new phasor measurement units ("PMUs") have been installed throughout the State, in coordination with Transmission Owners, utilizing funding provided by a Smart Grid Investment Grant from the U.S. Department of Energy ("DOE"). Additionally, in 2014, the NYISO opened its new state-of-the-art primary power control center. Combining cutting-edge technology and innovative system visualization capabilities, the new control center provides system operators improved situational awareness of real-time system conditions.

The NYISO also communicates regularly with natural gas pipelines and LDCs during stressed system conditions to provide for more effective electric-gas coordination and ensure awareness of conditions on each system (*i.e.*, the electric system and the natural gas system) that may have impacts on the other. Additionally, the NYISO coordinates with both generators and transmission owners that have scheduled maintenance outages during periods of expected stressed operating conditions. To the extent necessary, the NYISO seeks to coordinate with

facility owners to reschedule such maintenance to provide for the greatest levels of facility availability as possible.

The NYISO also maintains extensive emergency operating procedures to address a variety of potential emergency conditions that may arise.[13] For purposes of these procedures, an emergency is broadly defined as:

> any abnormal system condition that requires immediate automatic or manual action to prevent or limit loss of transmission facilities or Generators that could adversely affect reliability of the NYS Power System.

These procedures include annual testing requirements to ensure the continued effectiveness, readiness, and capability to execute such procedures. The NYISO also has procedures for addressing other system emergency conditions, such as geomagnetic disturbances,[14] and system restoration in the event of a blackout.[15]

e. Market and Operational Assessments

The NYISO continually assesses New York's electric system to ensure the ongoing reliability and resilience of the system. These include near-term assessments of resource adequacy, longer duration assessments of anticipated system and resource fleet changes, as well as reviews following significant operational events and lessons learned relating thereto.

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[13] *See* NYISO, *Emergency Operations Manual*, available at: http://www.nyiso.com/public/webdocs/markets_operations/documents/Manuals_and_Guides/Manuals/Operations/em_op_mnl.pdf.

[14] *See* NYISO, *Transmission and Dispatching Operations Manual* at Section 4.2.10, available at: http://www.nyiso.com/public/webdocs/markets_operations/documents/Manuals_and_Guides/Manuals/Operations/trans_disp.pdf.

[15] *See* NYISO, *System Restoration Manual*, available at: http://www.nyiso.com/public/webdocs/markets_operations/documents/Manuals_and_Guides/Manuals/Operations/srp_mnl.pdf.

Near- and Mid-Term Resource Assessments

The NYISO conducts seasonal assessments in advance of the summer and winter periods to evaluate the capability of resources to serve the forecasted peak load and operating reserve requirements.[16] These seasonal assessments also evaluate the sufficiency of resource capacity to meet projected load under extreme weather conditions, such as a heat wave or cold snap. As part of the winter seasonal assessments, the NYISO also analyzes the impacts on resource sufficiency from natural gas system contingencies. In fact, the NYISO specifically analyzes whether sufficient resource capacity would be available to serve both forecasted and extreme peak load conditions if all natural gas-fired generation without dual-fuel capability were unavailable to operate.

Longer-Term Market and System Operations Studies

The NYISO conducts market and operational studies of potential significant changes in system conditions over the mid- to longer-term. These studies evaluate system performance under potential future conditions and identify enhancements that may be needed to maintain reliability and bolster system resilience.

For example, in response to the growing deployment of distributed solar generation in New York, the NYISO recently completed an assessment of the potential operational impacts of this ongoing change to the electric system.[17] The study concluded that the NYISO could

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[16] *See, e.g.*, NYISO, *Summer 2017 Capacity Assessment* (presented at the May 31, 2017 NYISO Management Committee meeting), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/mc/meeting_materials/2017-05-31/03_2017%20Summer%20Capacity%20Assessment.pdf; and NYISO, *Winter 2018 Capacity Assessment: Winter Preparedness* (presented at the December 21, 2017 NYISO Management Committee meeting), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/mc/meeting_materials/2017-12-21/04_Winter%20Capacity.pdf.

[17] NYISO, *Solar Impact on Grid Operations: An Initial Assessment* (June 30, 2016), available at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources

maintain reliable operation of the system with the addition of up to 4,500 MW of wind generation and 9,000 MW of solar generation capacity.[18] To do so, however, the assessment noted the need to increase regulation service requirements in New York to reliably serve the increased net-load variability associated with these levels of intermittent wind and solar resources. The study also recommended the incorporation of day-ahead and real-time solar forecasts to improve situational awareness and efficient system operations. The NYISO implemented solar forecasting in 2017.[19]

The NYISO has also undertaken a market study to assess potential system operations and market impacts that could arise under the future state of the grid, as envisioned by New York's Clean Energy Standard ("CES").[20] The CES seeks to achieve a future electric system where 50% of the State's electricity requirements are served by renewable generation.[21] The market

/Special_Studies/Special_Studies_Documents/Solar%20Integration%20Study%20Report%20Final%20063016.pdf.

[18] Currently, there is approximately 1,800 MW of wind generation capacity and approximately 1,000 MW of solar generation capacity installed in New York. The NYISO has also evaluated the impacts of integrating up to 8,000 MW of wind generation capacity in New York. *See*, *e.g.*, NYISO, *Growing Wind* (September 2010), available at: http://www.nyiso.com/public/webdocs/media_room/press_releases/2010/Child_New_York_Grid_Ready_for_More_Wind_093010/GROWING_WIND_-_Final_Report_of_the_NYISO_2010_Wind_Generation_Study.pdf.

[19] In 2008, the NYISO implemented a central forecasting system for wind generation resources that collects real-time meteorological and other data from each wind facility in New York to facilitate the development of more accurate forecasts of generation output for each facility. In 2009, the NYISO became the first grid operator to fully integrate wind generation resources into its economic dispatch system. *See New York Independent System Operator, Inc.*, 123 FERC ¶ 61,267 (2008); and *New York Independent System Operator, Inc.*, 127 FERC ¶ 61,130 (2009).

[20] NYISO, *Integrating Public Policy: A Wholesale Market Assessment of the Impact of 50% Renewable Generation* (December 2017), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-12-20/2017%20Market%20Assessment%20with%2050%20percent%20Renewables,%20Report.pdf.

[21] *See* NYPSC Case No. 15-E-0302, *Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard*, Order Adopting a Clean Energy Standard (issued and effective August 1, 2016.).

assessment highlights the challenges and opportunities presented by this future state. The study also identifies a multitude of potential market and system operations enhancements for discussion with stakeholders over the coming years to ensure the continued reliability and resilience of New York's electric system throughout the transformation envisioned by the State's energy policies.

System Event Reviews and Lessons Learned

The NYISO also regularly conducts after-the-fact reviews of system operations and performance during significant operational events, such as heat waves and cold snaps.[22] These assessments, which the NYISO reviews with its stakeholders, provide an opportunity to identify successes, lessons learned, and opportunities for improving future system operations.

2. System Planning[23]

The NYISO conducts extensive system planning to ensure the reliability and resiliency of the system into the future. System planning consists of annual assessments in accordance with NYSRC and NPCC criteria and requirements, as well as additional evaluations conducted as part of the NYISO's Comprehensive System Planning Process ("CSPP").

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[22] *See, e.g.*, NYISO, *Summer 2017 Hot Weather Operations* (presented at the September 27, 2017 NYISO Management Committee meeting), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/mc/meeting_materials/2017-09-27/04_Hot%20Weather%20Operating%20Conditions.pdf; NYISO, *Winter 2017-2018 Cold Weather Operations* (presented at the January 31, 2108 NYISO Management Committee meeting), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/mc/meeting_materials/2018-01-31/Winter%202018%20Cold%20Weather%20Operating%20Conditions.pdf; and NYISO, *Winter 2013-2014 Cold Weather Overview: Update* (presented at the March 26, 2014 NYISO Management Committee meeting), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/mc/meeting_materials/2014-03-26/Winter%20Operations%20Update.pdf.

[23] This section provides information in response to the following questions set forth in the Grid Resilience Order: (a)-(s) in P 25 and (a)-(d) in P 27.

There are two key design requirements imposed within the NPCC region that result in greater stringency than what would otherwise be required by NERC.[24] The more stringent design requirements are intended to facilitate a more resilient system, and were developed based on lessons learned from past events.

First, the bulk power system in New York is designed for the loss of double-circuit towers and the loss of multiple circuits resulting from the failure of a circuit breaker to operate (*i.e.*, "stuck breaker" contingency). Planning for these design contingencies helps provide for a stronger overall system that is more resilient against storm-related damage and failures within a substation, regardless of the cause of such failure.

Second, New York's bulk power system is designed to withstand these stringent contingency events following a facility outage (*i.e.*, N-1-1 contingency events). This helps to ensure a more flexible and resilient system design for withstanding unexpected and potentially longer duration multiple outage events.

a. Annual Bulk Power System Assessments

The NYISO annually assesses the reliability and resilience of the bulk power system over a five-year planning horizon.[25] The results of these assessments are documented in the NYISO's Area Transmission Review reports.[26] These assessments require the NYISO to evaluate

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[24] *See* NPCC, *Regional Reliability Reference Directory # 1: Design and Operation of the Bulk Power System*, available at: https://www.npcc.org/Standards/Directories/Directory_1_TFCP_rev_20151001_GJD.pdf ("NPCC Directory 1"). The more stringent criteria and requirements apply throughout the NPCC region, which includes New York and the six New England states, as well as the Canadian provinces of Ontario, Québec and the Maritime provinces of New Brunswick and Nova Scotia.

[25] *See* NPCC Directory 1; and NYSRC, *Reliability Rules & Compliance Manual*, available at: http://www.nysrc.org/pdf/Reliability%20Rules%20Manuals/RRC%20Manual%20V41.pdf ("NYSRC Reliability Rules"). In addition to annual reviews, the NYISO is required to conduct comprehensive system assessments at least once every five years.

[26] *See, e.g.*, NYISO, *2016 Interim Area Transmission Review of the New York State Bulk Power Transmission System* (June 1, 2017), available at:

transmission security in response to a single contingency from normal system conditions (*i.e.*, N-1 contingency event),[27] as well as multiple contingencies (*i.e.*, N-1-1 contingency events).[28]

The NYISO is also required to assess the reliability and resilience of the bulk power system for low probability extreme contingencies and extreme system conditions.[29] Extreme contingencies assessed include: (i) loss of an entire substation; (ii) loss of entire generation plants; (iii) loss of all circuits along a transmission right-of-way; and (iv) sudden loss of a fuel delivery system (*e.g.*, natural gas pipeline contingencies). Extreme system conditions typically stress the system's resource availability, thereby placing greater strain on the transmission system due to the need to serve load from more distant generation supply sources. Examples of extreme system conditions assessed include: (i) peak load conditions resulting from extreme weather conditions, such as a heat wave or cold snap (*i.e.*, assessing system reliability and resiliency under 90th percentile peak load forecast conditions); and (ii) potential shortages of fuel supply for generators (*e.g.*, assessing system reliability and resiliency following the loss of all natural gas-fired generators that do not have the capability to operate on an alternative fuel). If the assessment of extreme contingencies or extreme system conditions indicates that there could be serious consequences for system reliability under these scenarios, the NYISO is required to

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http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Reliability-Compliance/2016_NYISO_IntermediateATR_Final.pdf; and NYISO, *2015 Comprehensive Area Transmission Review of the New York State Bulk Power Transmission System* (June 1, 2016), available at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Reliability-Compliance/2015_NYISO_ComprehensiveATR_Final.pdf.

[27] To evaluate the impact of N-1 contingencies, all design criteria contingencies are evaluated, including single element, common structure, stuck breaker, generator, bus fault and high voltage direct current contingencies.

[28] N-1-1 contingency analysis evaluates the ability of the bulk power system to meet design criteria after a critical element has already been lost, following allowable system adjustments.

[29] *See* NPCC Directory 1 at 7; and NYSRC Reliability Rules at 22 and 25.

conduct further evaluations to determine if a change to system design or operating practices is warranted to mitigate the potential impacts of such risks.

In accordance with the requirements of NPCC and the NYSRC, the NYISO also performs annual assessments of resource adequacy to ensure that sufficient resources are available to maintain reliability. These assessments include periodic comprehensive evaluations of resource adequacy over a five-year planning horizon,[30] as well as interim evaluations of resource adequacy over the three-year forward period.[31]

b. The NYISO's Comprehensive System Planning Process

The CSPP provides the framework for identifying and resolving bulk power system needs in New York. The NYISO's CSPP consists of three distinct components: reliability, economic, and public policy planning processes.

The Reliability Planning Process

The reliability planning process is conducted biennially to identify any risks to resource adequacy or transmission security over a forward-looking ten-year planning horizon. If the NYISO identifies a reliability need, it solicits solutions to resolve any such need. The NYISO considers proposals from all resource types (*i.e.*, transmission, generation, and demand response/energy efficiency) on an equivalent basis to assess solutions to resolve an identified need. The reliability planning process strives to achieve market-based solutions whenever

[30] *See, e.g.*, NYISO, *2015 Comprehensive Review of Resource Adequacy* (December 1, 2015), available at: https://www.npcc.org/Library/Resource%20Adequacy/NYCA_2015_Comprehensive_Review_NPCC_RCC_Approved.pdf.

[31] *See, e.g.*, NPCC Reliability Coordinating Committee, *NYISO 2017 Interim Review of Resource Adequacy* (December 5, 2017), available at: https://www.npcc.org/Library/Resource%20Adequacy/NYISO%202017%20Interim%20Review_RCC_2017_12_05.pdf.

possible, rather than relying on regulated solutions to resolve any identified reliability needs. If market-based solutions are insufficient, the NYISO conducts a comparative analysis to identify and select the most cost-effective or efficient regulated transmission solution to resolve the reliability need.

The reliability planning process also assesses, for informational purposes, certain scenarios and sensitivities. This additional analysis helps provide further information regarding potential risks to the reliability and resilience of the bulk power system. Examples of informational scenarios include assessing the reliability and resiliency of the bulk power system under higher than expected load conditions, and the impacts on reliability and resilience from the potential deactivation or retirement of certain generation resources.

The NYISO's most recently conducted Reliability Needs Assessment and subsequent Comprehensive Reliability Plan concluded that New York's bulk power system, as studied, will meet applicable transmission security and resource adequacy requirements over the 2017-2026 period.[32] This assessment concluded that the bulk power system is expected to be capable of meeting peak electric demand over the ten-year study period even if a contingency event, such as the loss of a large generator, were to occur. The plan, however, cautioned that the margin for maintaining reliability over the ten-year study period could narrow or be eliminated based on changes to the assumptions that formed the basis for the assessment. Potential risk factors cited include changes in generator availability, potential deactivation or retirement of generation facilities, delays in implementing proposed generator additions and/or transmission facility

[32] NYISO, *2016 Reliability Needs Assessment* (October 18, 2016), available at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Reliability_Planning_Studies/Reliability_Assessment_Documents/2016RNA_Final_Oct18_2016.pdf; and NYISO, *2016 Comprehensive Reliability Plan* (April 11, 2017), available at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Reliability_Planning_Studies/Reliability_Assessment_Documents/2016CRP_Report_Final_Apr11_2017.pdf.

upgrades and additions reflected in local transmission plans, and higher than forecasted load conditions.

Additional Reliability Assessment Processes

The NYISO continually assesses the reliability and resilience of the bulk power system and the impacts of changes in system conditions over time. In addition to its standard reliability planning process, other procedures exist for evaluating and addressing unexpected reliability needs that may arise. Pursuant to its Generator Deactivation Process, the NYISO evaluates proposed deactivations of generation facilities. The NYISO assesses whether a proposed deactivation could result in a reliability need (transmission security or resource adequacy) over a five-year planning horizon. If a reliability need is identified and must be addressed before the next biennial reliability assessment, the NYISO can solicit and assess solutions, which could include transmission facility upgrades or additions, or, as a last resort, a Reliability Must Run ("RMR") agreement with the deactivating generator to temporarily address the reliability need during the interim period before a longer-term solution can be implemented. The NYISO also can utilize its Gap Solution process, if needed, to address an unanticipated, imminent reliability need arising due to changes in system conditions that must be resolved prior to the next biennial comprehensive reliability assessment.

The Public Policy Planning Process

The public policy planning process is intended to identify potential transmission needs that may be driven by public policy requirements. In certain instances, state and federal policies may desire specific outcomes that are not otherwise served by the NYISO's other planning procedures and market operations. This could, for example, include: (i) the provision of incremental resiliency beyond that necessary to achieve minimum reliability requirements; or (ii)

additional infrastructure to improve energy delivery capability in support of changes in the resource mix that may result from the implementation of certain public policy objectives.

To date, the public policy planning process has identified two transmission needs driven by public policy requirements for further assessment and evaluation by the NYISO. In July 2015, the New York State Public Service Commission ("NYPSC") identified a need for relieving congestion in New York's western region.[33] In October 2017, the NYISO completed its evaluation of the transmission projects submitted in response to this identified need, resulting in the selection of a 345 kV transmission project in western New York.[34] The NYISO currently expects that this project will enter into service in 2022.

The NYPSC identified a second public policy driven transmission need in December 2015. This need seeks alternating current transmission additions to relieve congestion on the UPNY-SENY and Central East interfaces.[35] The transmission additions sought by the NYPSC are intended to increase transfer capability across the UPNY-SENY interface by at least 900 MW and increase transfer capability across the Central East interface by at least 350 MW. The NYISO has completed its viability and sufficiency assessment of projects proposed in response to the need[36] and currently expects complete its evaluation and selection of transmission projects

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[33] NYPSC Case No. 14-E-0454, *In the Matter of New York Independent System Operator, Inc.'s Proposed Public Policy Transmission Needs for Consideration*, Order Addressing Public Policy Requirements for Transmission Planning Purposes (July 20, 2015).

[34] NYISO, *Western New York Public Policy Transmission Planning Report* (October 17, 2017), available at: http://www.nyiso.com/public/webdocs/media_room/press_releases/2017/Child_WNY_PPTN_Report/Western%20New%20York%20Public%20Policy%20Transmission%20Planning%20Report.pdf.

[35] NYPSC Case No. 12-T-0502, *Proceeding on Motion of the Commission to Examine Alternating Current Transmission Upgrades*, Order Finding Transmission Needs Drive by Public Policy Requirements (December 17, 2015).

[36] NYISO, *AC Transmission Public Policy Transmission Need Viability & Sufficiency Assessment* (October 27, 2016), available at:

in 2018. Transmission projects ultimately selected by the NYISO are likely to enter service within five years after selection.

c. Interregional Planning

The NYISO also participates in various interregional system planning studies. Pursuant to the Northeastern ISO/RTO Planning Coordination Protocol, the NYISO, PJM and ISO-NE perform certain interregional planning activities, including periodic interregional system assessments.[37] The most recently completed assessment did not identify a need for any interregional transmission projects.[38]

The NYISO also conducts joint evaluations with planning authorities across the Eastern Interconnection through the Eastern Interconnection Planning Collaborative ("EIPC"). These efforts have included "roll-up" cases to combine the electric system plans of the EIPC members to create a comprehensive Eastern Interconnection-wide model. EIPC has used these models to assess interconnection-wide system reliability for ten-year planning horizons. Certain of these assessments have also evaluated the reliability and resilience of the interconnection-wide system in response to various sensitivities and scenarios, such as heat wave and drought conditions.[39]

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http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Public_Policy_Documents/AC_Transmission_PPTN/NYISO_AC_Transmission_PPTN_VSA_Final_Report.pdf.

[37] Amended and Restated Northeastern ISO/RTO Planning Coordination Protocol, available at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/ipsac/Northeast_Planning_Protocol_FINAL_SIGNED_VERSION.pdf.

[38] ISO-NE, NYISO and PJM, *2015 Northeastern Coordinated System Plan* (April 11, 2016), available at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/ipsac/2015_Northeastern_Coordinated_System_Plan.pdf.

[39] *See, e.g.*, EIPC Steady State Modeling and Load Flow Working Group, *2023 Roll-Up Update and Heat Wave and Drought Scenario* (January 23, 2015), available at: http://nebula.wsimg.com/0ca33e3fbfd7be8f37880ebaaa7146e2?AccessKeyId=E28DFA42F06A3AC21303&disposition=0&alloworigin=1.

EIPC also conducted a study of the interactions between the electric and natural gas systems, including potential impacts to the reliability and resilience of the electric system resulting from disruptions in natural gas supply to natural gas-fired generation resources.[40] In assessing risks to New York's electric system, it was noted that risks are mitigated by the strong presence of dual-fuel capability throughout the State's current natural gas-fired generation fleet and the diversity of natural gas pipelines serving that fleet of resources.

3. Physical and Cyber Security[41]

The NYISO has a comprehensive program for addressing physical and cybersecurity risks. This risk-based program draws from both mandatory NERC Critical Infrastructure Protection ("CIP") standards[42] and other industry standards and guidelines. The NYISO's security posture is premised on continuous evaluation of its assets, vulnerabilities, and threats. The NYISO implements its compliance with mandatory cyber and physical security requirements as part of a layered, "defense-in-depth" strategy that relies on processes, cutting-edge technology, and people to protect its critical infrastructure assets from incursions.

a. Cyber and Physical Security Practices

The CIP standards require that the NYISO conduct an in-depth, risk-based analysis to identify, classify, and protect cyber assets based on their potential impact on electric system reliability. These standards impose holistic security requirements such as access control,

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[40] EIPC and Levitan & Associates, Inc., *Gas-Electric System Interface Study: Existing Natural Gas-Electric System Interfaces* (April 4, 2014), available at: http://nebula.wsimg.com/d28ed8902535b1f517d7a826c79f4421?AccessKeyId=E28DFA42F06A3AC21303&disposition=0&alloworigin=1.

[41] This section provides information in response to the following questions set forth in the Grid Resilience Order: (a)-(s) in P 25 and (a) and (d) in P 27.

[42] *See, e.g.*, *Version 5 Critical Infrastructure Protection Reliability Standards*, 145 FERC ¶ 61,160 (2013).

physical and electronic security perimeters for NYISO assets critical to electric system reliability, recovery plans, well documented change management and information protection programs, protection and isolation of network architecture, security monitoring and alerting, as well as employee training and background checks. Mandatory NERC standards also require incident management programs that support mandatory reporting of cyber and physical security incidents. NERC's physical security standards further require the NYISO to conduct a risk assessment to identify its critical facilities.

b. Industry and Government Collaboration and Coordination

The NYISO is actively engaged in enhancing cyber and physical security practices to address evolving risks by collaborating with various state and federal agencies, other ISOs/RTOs, and other industry partners. This collaboration includes information sharing to enhance situational awareness, and grid security exercises that execute the electric sector's response to simulated cybersecurity and physical security threats and incidents.

At the federal and national level, the NYISO is engaged with the Commission, NERC, the Electricity Information Sharing and Analysis Center, Cybersecurity Risk Information Sharing Program, DOE, Department of Homeland Security, Federal Bureau of Investigation, as well as private vendors and partners such as the Center for Internet Security. The NYISO actively participates in the cyber and physical security policy and standard development activities undertaken by these entities. The NYISO further relies on its collaborative relationships with such entities for classified briefings and real-time cybersecurity information sharing and threat detection.

The NYISO also participates in biennial sector-wide grid security exercises conducted by NERC ("GridEx"). The GridEx events simulate coordinated physical and cybersecurity attacks

to validate the readiness of the electricity sector to respond to such incidents. GridEx is designed to enhance coordination of cyber and physical security resources and practices within the electric industry, improve communication and coordination between the industry and government partners, and support continuous improvement through lessons learned.

On a state level, the NYISO regularly collaborates on security initiatives with a number of state and local agencies, including the Department of Public Service, Division of Homeland Security and Emergency Services, New York State Police, and New York City Police Department SHIELD. Ensuring the continued reliability of electric supply in New York requires a well-coordinated local response to threats to the electric system. In coordination with local, state and federal agencies, electric and gas utilities, and other industry organizations, the NYISO has participated in New York State cybersecurity exercise events. These events walk participants through a facilitated scenario involving an attack on critical infrastructure leading to both cyber and physical consequences for the State's energy delivery systems. These exercises facilitate the testing of incident response plans, identification of opportunities for improvement, and enhanced collaboration and information sharing among State agencies and the industry.

c. Framework for Effective Cyber and Physical Security Standards

As the grid continues to evolve, the risks it faces do as well. The development of cyber and physical security standards to date has appropriately accounted for the rapidly changing nature of risks, threats, and technological advancements. Standards need to provide an appropriate framework that enables, rather than hinders, the continual improvement of security practices in response to the evolving nature of the risks at hand. To do so, standards must avoid being overly prescriptive so as to provide entities, such as the NYISO, the necessary latitude to

identify and assess enterprise-specific risks and develop appropriate and cost-effective controls to mitigate such risks.

C. Ongoing Initiatives and Future Efforts[43]

As the electric sector continues to transform, the markets also must evolve to meet the challenges and opportunities presented by this transformation. The NYISO recognizes and embraces this need for change. Continual reassessment and careful evaluation of the ongoing transformation and its implications for system planning, operations, and market design is fundamental to ensuring the continued success of the NYISO-administered markets.

The NYISO has already identified a variety of initiatives that will seek to develop market and process enhancements to provide the infrastructure, resource performance, situational awareness, and resource integration needed to serve the evolving grid. Several of these initiatives are already underway and others are planned to commence in the near future.

a. Comprehensive System Planning Process Review

The trajectory of transformation in New York envisions a future that involves significantly increased production from solar, onshore and offshore wind resources, and a proactive consumer sector driving increasing levels of distributed generation and shifting historical patterns of energy consumption. The transition to a cleaner, greener, and more integrated grid that relies on both central power stations and distributed resources will require a modernized, upgraded, and expanded transmission system. Well-planned transmission investments will enable resources located in upstate New York to better serve a broader market, particularly the downstate population centers. Transmission upgrades and additions also provide

[43] This section provides information in response to the following questions set forth in the Grid Resilience Order: (n) and (s) in P 25 and (e) in P 27.

other critical benefits, including a more resilient grid, access to more diverse energy resources, and more efficient market competition. Upgraded transmission capability is vital to meeting New York's clean energy goals and efficiently moving power to address regional power needs.

As such, the NYISO will, in coordination with its stakeholders, undertake a comprehensive re-evaluation of its current planning processes (*i.e.*, reliability, economic, and public policy). This assessment is intended to identify potential enhancements to the OATT and improve the overall speed and efficiency of the NYISO's current planning processes. A more efficient transmission planning process is critical to achieving a more robust and resilient transmission system that serves as the catalyst to enable and support the industry's continued transformation.

b. Energy and Ancillary Services Markets Initiatives

Changes in resource performance characteristics, shifts in historical load patterns, increasing variability in load requirements, and changes in the resource fleet highlight the need to ensure that the products and services procured by the NYISO-administered markets, as well as the price signals produced by these markets, remain aligned with changing system needs. Assessments conducted by the NYISO regarding the potential future state of resources serving the grid have identified a variety of opportunities and enhancements to pursue with stakeholders.[44]

In the near term, the NYISO plans to re-evaluate its current suite of Ancillary Services products and assess whether modifications or additions are needed to facilitate a more resilient

[44] *See, e.g.*, NYISO, *Integrating Public Policy: A Wholesale Market Assessment of the Impact of 50% Renewable Generation* (December 2017), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-12-20/2017%20Market%20Assessment%20with%2050%20percent%20Renewables,%20Report.pdf.

and reliable system. As part of this review, the NYISO plans to evaluate with stakeholders the potential resiliency benefits that may be achievable through changes to the level of operating reserves procured through the competitive markets. Similar to the construct currently employed in the capacity market, the NYISO and its stakeholders will assess the potential for implementing a construct that provides appropriate incentives to procure additional operating reserves in excess of the established and recently enhanced minimum requirements.

These efforts will also evaluate the potential need for a separate ramping product or modifications to the current operating reserve products to effectively and efficiently respond to increased net load forecast uncertainty projected under future system conditions with higher levels of intermittent renewable generation and distributed generation resources.

Finally, the NYISO will re-examine its current Ancillary Services shortage pricing levels to determine whether changes are warranted to ensure appropriate price signals as to the value of these services, especially during periods of critical system need.

c. Capacity Market Initiatives

Since the experiences of the 2013-2014 winter period, the NYISO and its stakeholders have generally focused their fuel and performance assurance initiatives on energy market design enhancements that seek to provide proper incentives for improved resource performance. The changing resource mix in New York, increasing reliance on natural gas-fired generation, and growing interdependency on the natural gas system infrastructure underscore the need to reassess capacity market rules. The NYISO will seek to identify potential enhancements to supplement the performance-related energy market improvements that have been implemented in recent years.[45]

[45] *See, e.g.*, Analysis Group, Inc., *Capacity Resource Performance in NYISO Markets: An Assessment of Wholesale Market Operations* (October 2017), available at:

These efforts will include evaluating capacity resource eligibility and performance requirements. The NYISO will also assess potential modifications to its procedures for measuring capacity resource availability to better reflect resource performance and availability during critical operating periods.

d. Fuel Security

The NYISO has evaluated the potential impacts resulting from natural gas supply contingencies, as well as the capability of the natural gas system to provide the supply necessary to operate the State's natural gas-fired generation fleet.[46] These risks are mitigated by the current diversity of resource types in New York, strong presence of dual-fuel capability throughout the State's current natural gas-fired generation fleet, and diversity of natural gas pipelines and LDC systems that serve generators.

Currently, 84% of the State's natural gas-fired generation capacity has dual-fuel capability. This dual-fuel capability provides significant reliability and resilience benefits by affording operational flexibility and resource availability during periods of natural gas supply constraints. This capability also provides a valuable price hedging mechanism to mitigate electricity price spikes during periods of high natural gas prices.

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http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2017-11-06/Analysis%20Group%20Draft%20Capacity%20Resource%20Performance%2010-31-17%20rev.pdf; and NYISO, *Management Response to the Analysis Group's Report* (February 2018), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2018-02-21/Performance%20Assurance%20Management%20Response%20Feb%2021%20MIWG%20FINAL.PDF.

[46] *See, e.g.*, Levitan & Associates, Inc., *NYCA Pipeline Congestion and Infrastructure Adequacy Assessment* (September 2013), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_egcwg/meeting_materials/2013-10-23/Levitan%20Pipeline%20Congestion%20and%20Adequacy%20Report%20Sep13%20-%20Final%20CEII%20Redacted.pdf.

The benefits of dual-fuel capability have been demonstrated during periods of extreme gas price volatility. During the recent cold weather event lasting from December 26, 2017 through January 7, 2018, the price of natural gas in certain areas of New York increased by more than 1,300% in December 2017 compared to the same period in 2016. The year-over-year change in electricity prices during the same period increased by less than a quarter of the spike in natural gas prices.[47] Similar outcomes occurred during the 2013-2014 winter period. The increase in electricity prices between December 2013 and January 2014 was less than half the spike in natural gas prices during the same period.[48] In large part, these outcomes occurred as a result of the existence of dual-fuel capability and the ability of generators with such capability to operate on a lower cost alternative fuel.

Given the importance of, and benefits derived from, dual-fuel capability, the NYISO intends to evaluate with its stakeholders measures to ensure future fuel security. Appropriate levels of fuel security bolster system resilience and help ensure availability of resources to respond to system disturbances and potential constraints that could limit the availability of certain fuel supplies.

e. Distributed Energy Resource Integration

Technological advancements, electricity customer desires, and public policies, such as New York's Reforming the Energy Vision initiative, are producing greater demand for and

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[47] NYISO, *Winter 2017-2018 Cold Weather Operations* (presented at the January 31, 2018 NYISO Management Committee meeting), available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/mc/meeting_materials/2018-01-31/Winter%202018%20Cold%20Weather%20Operating%20Conditions.pdf.

[48] NYISO, *Winter 2013-2014 Cold Weather Operating Performance* (presented at the March 13, 2014 Joint Electric-Gas Coordination Working Group and Market Issues Working Group meeting) at 22, available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2014-03-13/Winter%202013-1014%20NYISO%20Cold%20Snap%20Operations%20EGCW-MIWG.pdf.

adoption of distributed energy resources ("DER"). In February 2017, the NYISO issued its "DER Roadmap" outlining a series of market enhancements the NYISO will pursue over the next three to five years.[49] These enhancements are designed to more fully integrate distributed resources into the NYISO-administered markets and system operations. Effective integration of DER can assist grid operations by improving system resilience and efficiency, energy security, and fuel diversity.

f. Energy Storage Integration and Optimization

The combination of technological advancements, cost reductions, and expanding opportunities to leverage the capabilities of energy storage suggest that the historical paradigm for grid-scale energy storage may be changing. The State has also indicated that it intends to aggressively pursue a significant expansion of energy storage. Addressing these emerging trends requires a re-examination of the market rules to leverage the capabilities of energy storage to assist in meeting reliability and bolstering system resiliency. In 2016, the NYISO, in collaboration with its stakeholders, launched an energy storage integration and optimization initiative.[50] The goal of this effort is to: (i) develop a comprehensive model for energy storage resources to participate in the wholesale markets; and (ii) harness the potential strengths of energy storage in supporting the reliability and bolstering the resilience of New York's bulk power system.

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[49] NYISO, *Distributed Energy Resources Roadmap for New York's Wholesale Electricity Markets* (February 2, 2017), available at: http://www.nyiso.com/public/webdocs/media_room/press_releases/2017/Child_DER_Roadmap/Distributed_Energy_Resources_Roadmap.pdf.

[50] *See, e.g.*, NYISO, *The State of Energy Storage: Energy Storage Resources in New York's Wholesale Electricity Markets* (December 2017), available at: http://www.nyiso.com/public/webdocs/media_room/press_releases/2017/Child-State-of-Storage-Report/State_of_Storage_Report_Final_1Dec2017.pdf.

II. COMMUNICATIONS AND CORRESPONDENCE

Please direct all communications and service in this proceeding to:

Robert E. Fernandez, General Counsel
Raymond Stalter, Director, Regulatory Affairs
*Garrett E. Bissell, Senior Attorney
New York Independent System Operator, Inc.
10 Krey Boulevard
Rensselaer, New York 12144
Telephone: 518-356-6107
Email: gbissell@nyiso.com

*Person designated for receipt of service.

III. CONCLUSION

The NYISO is committed to being a leader in reliability, market design, and technological innovation. Continued success hinges on the ability to deliver on these objectives in close coordination with stakeholders, policymakers, and regulators. The NYISO remains confident in the ability of its shared governance process to develop well-designed market rule changes and process enhancements to propel the wholesale markets forward and continue their delivery of substantial benefits to the State's consumers. The NYISO embraces the challenges and opportunities presented by the ongoing transformation of the electric industry and looks forward to fully engaging in the coordinated collaboration necessary to address these challenges and opportunities.

Respectfully submitted,

/s/ Garrett E. Bissell
Garrett E. Bissell
Senior Attorney
New York Independent System Operator, Inc.
10 Krey Blvd.
Rensselaer, New York 12144
(518) 356-6107
gbissell@nyiso.com

Dated: March 9, 2018

cc: Anna Cochrane
James Danly
Jette Gebhart
Kurt Longo
Daniel Nowak
Larry Parkinson
J. Arnold Quinn
Douglas Roe
Kathleen Schnorf
Gary Will

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary in this proceeding in accordance with the requirements of Rule 2010 of the Rules of Practice and Procedure, 18 C.F.R. §385.2010.

Dated at Rensselaer, NY this 9th day of March, 2018.

/s/ Mohsana Akter

Mohsana Akter
Regulatory Affairs
New York Independent System Operator, Inc
10 Krey Blvd
Rensselaer, NY 12144
(518) 356-7560