# AC Transmission Public Policy Transmission Plan

A Report from the New York Independent System Operator

April 8, 2019

**NYISO BOARD OF DIRECTORS' DECISION**

**ON**

**APPROVAL OF AC TRANSMISSION PUBLIC POLICY TRANSMISSION PLANNING REPORT AND SELECTION OF PUBLIC POLICY TRANSMISSION PROJECTS**

**APRIL 8, 2019**

## EXECUTIVE SUMMARY

Today we select two transmission projects that will benefit New York State's electric consumers by enabling the delivery of environmentally desirable power required to meet state energy goals, relieving uneconomic congestion, and replacing aging infrastructure while enhancing New York State's already high standard of system reliability. Our action constitutes one of the most significant decisions by the Board of Directors ("Board") in the nearly twenty-year history of the New York Independent System Operator, Inc. ("NYISO").

We are making these selections in accordance with the requirements of the NYISO's Public Policy Transmission Planning Process ("Public Policy Process") located in Attachment Y of the NYISO's Open Access Transmission Tariff ("OATT"). Pursuant to this process, the NYISO is responsible for selecting the more efficient or cost-effective transmission solution from among competing projects to address a transmission need driven by a public policy requirement ("Public Policy Transmission Need") identified by the New York Public Service Commission ("NYPSC").

There have been no large-scale, high-voltage, alternating current ("AC") transmission facilities constructed in New York State in over thirty years. This has resulted in an aging and congested transmission infrastructure that cannot adequately accommodate the state's future energy goals, including the requirement that 50% of the state's load be served by renewable resources by 2030 and the additional goals currently being discussed in connection with New York State's Green New Deal. Both New York State and the NYPSC identified the need to expand the state's AC transmission capability to deliver additional power from generating facilities located in upstate New York, including important renewable resources, to the population centers located downstate. As part of the NYISO's initial Public Policy Process, the NYPSC identified the Public Policy Transmission Needs to increase Central East transfer capability by at least 350 MW ("Segment A") and UPNY/SENY transfer capability by at least 900 MW ("Segment B") to provide additional capability to move power from upstate to downstate New York (together, the "AC Transmission Needs").

NYISO staff solicited solutions to the AC Transmission Needs and received a number of well-developed, high-quality proposals. NYISO staff and its consultants performed detailed studies and analyses to determine which solutions were viable and sufficient to meet the identified needs and then evaluated their performance across a wide range of quantitative and qualitative metrics established in the OATT. NYISO staff detailed the results of their analyses and their recommendations for project ranking and selection in a Public Policy Transmission Planning Report for the AC Transmission Needs ("AC Transmission Report").

NYISO stakeholders and developers were provided numerous opportunities to review and provide input to NYISO staff and the Board concerning the AC Transmission Report and its conclusions. In addition, the NYISO's Market Monitoring Unit ("MMU") reviewed the projects recommended for selection to identify their impact on the NYISO-administered markets. The Board reviewed all of this input and performed its own independent review of the AC Transmission Report. The Board directed that NYISO staff perform certain additional studies and analyses and update the report and the recommendations for project ranking and selection accordingly. The modifications to the report were then subject to further review and comment by stakeholders, developers, and the MMU.

The Board arrived at its decision only after detailed review and deliberation concerning the AC Transmission Report, stakeholders' and developers' comments, and the analysis of the market impacts provided by the MMU. The OATT establishes the metrics that the NYISO considers in ranking projects and selecting the more efficient or cost-effective transmission solutions, but does not establish a specific formula or weighting of the metrics. Rather, we must use our independent judgment, informed by all the input we received, to evaluate the totality of each project's performance across all of the selection metrics. The Board carefully considered hundreds of pages of data, studies, and comments to determine the more efficient or cost-effective solutions for New York.

For the reasons outlined below, we approve the revised AC Transmission Report and its recommendations for project rankings and selections. Specifically, we select the Double-Circuit project (T027) proposed jointly by North America Transmission ("NAT") and the New York Power Authority ("NYPA") as the more efficient or cost-effective transmission solution to address Segment A of the AC Transmission Needs. We also select the New York Energy Solution project (T019) proposed jointly by Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid") and the New York Transco, LLC ("Transco") as the more efficient or cost-effective transmission solution to address Segment B of the AC Transmission Needs. The anticipated in-service date for Projects T027 and T019 is December 2023. The estimated cost of the combined projects including a 30% contingency is $1,230 million. The developers of the selected projects may recover their project costs through the NYISO's OATT in rates accepted by the Federal Energy Regulatory Commission ("FERC" or "Commission").

## BACKGROUND

*AC Transmission Needs*

The NYISO Public Policy Process was accepted by the Commission in accordance with Order No. 1000 as the means to address Public Policy Transmission Needs in New York. The AC Transmission Needs identified by the NYPSC drew upon extensive analysis performed by the NYISO and others concerning the benefits of expanding transmission capability to move power from upstate to downstate New York, including addressing persistent congestion, enabling the delivery of environmentally desirable power, enhancing system reliability, and replacing aging infrastructure.

In 2008, the NYISO and the New York Transmission Owners jointly began the State Transmission Assessment and Reliability Study ("STARS") to address aging transmission and generation infrastructure in New York and to identify cost-effective incremental transmission upgrades. The STARS findings informed Governor Andrew Cuomo's 2012 Energy Highway Blueprint, which called for the development of over 1,000 MW of new AC transmission upgrades to move power from upstate to downstate. As a result, in November 2012, the NYPSC initiated the "Examine Alternating Current Transmission Upgrades" proceeding, which highlighted the need to relieve congestion and replace aging infrastructure. In a series of NYPSC orders and technical conferences over the subsequent years, the NYPSC sought and evaluated, with the NYISO's assistance, proposals from transmission owners and other developers to increase transmission transfer capability.

On August 1, 2014, the NYISO commenced its first Public Policy Process cycle. The NYISO solicited and submitted to the NYPSC potential transmission needs. On December 17, 2015, the NYPSC issued an order identifying the AC Transmission Needs to provide additional transmission capacity to move power from upstate to downstate New York, which the NYPSC determined would produce a number of valuable benefits for New York. The NYPSC also requested that certain developers participating in its AC transmission proceeding submit their project proposals for consideration by the NYISO in the Public Policy Process.

*NYISO Evaluation of Proposed Solutions and Draft AC Transmission Report*

On February 29, 2016, the NYISO issued a solicitation for solutions to the AC Transmission Needs. Developers submitted sixteen projects. Of these, the NYISO determined that seven Segment A proposals and six Segment B proposals were viable and sufficient to address the AC Transmission Needs. On October 27, 2016, the NYISO issued the AC Transmission Viability and Sufficiency Assessment and filed it with the NYPSC for its consideration and action. On January 24, 2017, the NYPSC issued an order confirming the AC Transmission Needs and determining that the NYISO should evaluate and select transmission solutions.

NYISO staff, in coordination with its independent consultant, Substation Engineering Company ("SECO"), conducted a detailed evaluation and ranked each project based on its performance across the metrics established in Section 31.4.8.1 of the OATT. These quantitative and qualitative metrics include the project's capital cost, cost per MW, expandability, operability, performance, property rights and routing, schedule, metrics identified by the NYPSC (*e.g.*, replacement of aging infrastructure), and other metrics (*e.g.*, production cost savings, Location-Based Marginal Pricing ("LBMP") savings, Installed Capacity ("ICAP") savings, and emissions savings). NYISO staff used a number of scenarios and sensitivities to evaluate the proposed projects' performance across these metrics.

NYISO staff developed a draft AC Transmission Report that detailed the results of its analysis and proposed ranking of the projects. The draft report recommended selection of NAT/NYPA's Segment A Project T027 and their Segment B Project T029 as the more efficient or cost-effective transmission solutions. The report was reviewed with developers and then with stakeholders and developers in a series of joint Electric System Planning Working Group ("ESPWG") and Transmission Planning Advisory Subcommittee ("TPAS") meetings. The report was revised and clarified based on stakeholder and developer feedback. In addition, the MMU reviewed and evaluated the impact of the proposed projects on the NYISO-administered markets. The Business Issues Committee and Management Committee subsequently reviewed and recommended Board approval of the draft AC Transmission Report by affirmative advisory votes of 76.33% and 80.0%, respectively. Pursuant to Section 31.4.11.2 of the OATT, NYISO staff then submitted the draft AC Transmission Report to the Board on June 19, 2018, for its review and action.

*Board Review and Revisions to Draft AC Transmission Report*

The Board exercised its discretion under the ISO Agreement[1] to provide interested parties with the opportunity to submit comments and to make oral presentations for the Board's consideration prior to its taking action on the draft AC Transmission Report.[2] Based on the input received and the Board's independent review of the report, the Board directed NYISO staff to conduct certain additional studies and analyses. The Board then concluded that certain modifications should be made to the draft report.

The Board agreed with the draft AC Transmission Report recommendation that NAT/NYPA's Project T027 is the more efficient or cost-effective transmission solution for Segment A.[3] However, based on the additional studies and analyses, the Board concluded that the more efficient or cost-effective transmission solution for Segment B is National Grid/Transco's Project T019, rather than NAT/NYPA's Project T029.[4] The Board determined that Project T019 demonstrated superior performance across a broader range of metrics when compared to Project T029 and the other proposed Segment B projects, including, significantly, providing additional transfer capability across the UPNY/SENY transmission interface.[5]

Accordingly, the Board directed NYISO staff to revise the draft AC Transmission Report, including the project rankings and recommended selections. The modifications were reflected in an Addendum contained in the revised AC Transmission Report. As required by the OATT, the Board directed that the draft report be returned to the Management Committee for further

[1] ISO Agreement Section 5.07 ("The ISO Board also may review any matter, complaint, or Committee action on its own motion.")

[2] At its July 2018 meeting, the Board heard oral presentations concerning the draft AC Transmission Report by NAT/NYPA, National Grid/Transco, and NextEra. National Grid/Transco also provided additional written comments at the oral presentation.

[3] Project T027 includes a new 86-mile double-circuit line between the Edic and New Scotland 345 kV substations and the addition of a new Princetown 345 kV switchyard to connect to Rotterdam. The double-circuit line will use rights-of-way currently occupied by the Porter-Rotterdam 230 kV lines that will be decommissioned as part of the project.

[4] Project T019 includes, among other things, a new double-circuit 345/115 kV line from a new Knickerbocker 345 kV switching station to the existing Pleasant Valley Substation, including a rebuild of the Churchtown 115 kV switching station, an upgrade of the existing Pleasant Valley 345/115 kV Substation, and 50% series compensation on Knickerbocker to Pleasant Valley 345 kV line.

[5] The Board described its proposed modifications in its December 27, 2018, Summary of Proposed Modifications to Draft AC Transmission Public Policy Transmission Planning Report and Proposed Selections.

comments.[6] The Board is required to consider the Management Committee comments, including comments regarding the MMU's evaluation, prior to making a final determination concerning a revised report.

*Additional Review and Input by Developers, Stakeholders, and MMU*

Before providing the revised AC Transmission Report to the Management Committee, NYISO staff presented the revised report at two joint ESPWG/TPAS meetings to provide additional opportunities for stakeholders and developers to review and comment on the modifications. Following the initial stakeholder review of the revised draft report, the NYISO was informed of an impedance modeling error included in the NAT/NYPA and National Grid/Transco Segment B proposals that affected the calculated transfer capability of those projects. NAT/NYPA and National Grid/Transco each subsequently provided corrected data for their projects. The NYISO staff assessed the impact of the corrected impedance data on the transfer limit calculations and other affected metrics and then further revised the report to reflect the findings.

In addition, NYISO staff provided the revised draft report to the MMU to update its evaluation of the impact of the recommended projects on the NYISO-administered markets. The MMU concluded that, under a scenario that did not take into account state policy initiatives, the recommended projects would have a benefit-cost ratio of 0.74. However, with renewable resources such as wind and solar added upstate to meet the state Clean Energy Standard and expected generator retirements, the recommended projects would have a benefit-cost ratio well in excess of 1.0. The MMU also recognized that its assessment does not take account of certain unquantifiable benefits that would result from the projects.

At the February 27, 2019, Management Committee meeting, NYISO staff reviewed the revised AC Transmission Report with stakeholders and developers, and the MMU reviewed its evaluation of the report. Stakeholders and developers were permitted to provide comments on the revised draft report at the ESWPG/TPAS meetings and to provide comments to the Management Committee. These comments were submitted to the Board and publicly posted on the NYISO's website.[7] In addition, NAT/NYPA and National Grid/Transco made oral presentations concerning the revised draft report to the Board on March 18, 2019. NYISO staff and the Board reviewed and carefully considered this input.

## BOARD DECISION

We appreciate the significant work that developers dedicated to developing and proposing their projects. The Board's extensive deliberations in this Public Policy Process reflect the quality of the proposals and the involvement of all of the developers in the stakeholder and Board processes. We also acknowledge the hard work performed by NYISO staff in administering the Public Policy Process for the AC Transmission Needs and the participation of the other stakeholders, the MMU, and the NYPSC, including the extensive time and resources they have dedicated and the valuable feedback they have provided.

[6] OATT Section 31.4.11.2.

[7] https://www.nyiso.com/management-committee-mc-?meetingDate=2019-02-27

*Board Responsibilities*

The Board is responsible in the Public Policy Process for reviewing and taking action on a Public Policy Transmission Planning Report, including the rankings of the proposed transmission solutions and the selection of the more efficient or cost-effective transmission solution to address a Public Policy Transmission Need.

The OATT does not establish a specific formula or weighting of metrics for the NYISO to identify the more efficient or cost-effective transmission project. It is important to understand that the NYISO's selection metrics may not equate to the least cost solution. Rather, the NYISO carefully assesses and ranks each proposed project's total performance across all of the numerous qualitative and quantitative metrics contained in the tariff using a range of scenarios and sensitivities. The NYISO then solicits and considers input from developers, stakeholders, and other interested parties concerning its analysis and recommendations and presents the results in the Public Policy Transmission Planning Report.

The Board then exercises its independent judgment in evaluating the report. The Board may approve the report or propose modifications, including determining not to select a project if warranted. If the Board modifies the report, it must review the Management Committee's comments concerning the modifications prior to making a final determination concerning the revised draft report.

*Board Approval of AC Transmission Report, Project Ranking, and Project Selection*

Based upon our review, consideration, and extensive deliberations concerning the AC Transmission Report, stakeholders' and developers' comments, and the MMU's market impact analysis, we approve the AC Transmission Report, its project rankings, and the selection of NAT/NYPA's Project T027 for Segment A and National Grid/Transco's Project T019 for Segment B. The developers of the selected projects may recover their project costs through the NYISO's OATT in rates accepted by FERC.

We agree with the conclusion of the AC Transmission Report that NAT/NYPA's Project T027 and National Grid/Transco's Project T019 are the more efficient or cost-effective transmission solutions to address the Segment A and Segment B AC Transmission Needs, respectively, based on their total performance across the various selection metrics.

Although Project T027 has higher costs relative to some other Segment A projects, it replaces the greatest amount of aging infrastructure among the Segment A projects and provides the highest Central East interface transfer capability among all of the 345 kV Segment A projects. Considering the proposed infrastructure replacements, Project T027 will not only add more efficient and cost-effective new transmission facilities, but will also obviate the need to incur a significant amount of transmission refurbishment costs. Additional benefits provided by Project T027's double-circuit 345 kV design include increased production cost savings, excellent operability and expandability, and a lower electromagnetic field compliance risk due to the double-circuit design.

Project T019 also has higher costs relative to certain Segment B projects, but demonstrates superior performance across a broad range of metrics. Importantly, Project T019 provides for additional transfer capability across the UPNY/SENY transfer interface, the primary objective of the transmission need. Project T019's greater transfer capability results in the lowest cost per MW ratio, highest production cost savings, greatest $CO_2$ reductions, and highest Installed Capacity savings of the Segment B projects. In addition, the series compensation component of the project provides performance benefits through greater operational flexibility and increased use of the UPNY/SENY interface. The project also has the most resilient foundation and structure design, resulting in significant benefits to the operability of the transmission system during extreme weather events.

Finally, the Board has concluded that selecting Projects T027 and T019 would not have an adverse impact on the competitiveness of the NYISO-administered markets. Rather, the addition of the selected transmission facilities will reduce persistent uneconomic transmission congestion and enhance wholesale market competition by providing additional infrastructure to permit resources located upstate to compete to fulfill customer needs in the NYISO-administered markets.

*Assessment of Comments on AC Transmission Report*

NAT/NYPA argue that we should instead select their Project T029 for Segment B. They assert that the combination of Projects T027+T029 is superior to Projects T027+T019 based on their assessment of certain quantitative measures, such as production cost savings and capacity savings, compared against the project cost estimates. We disagree. For the reasons discussed in the AC Transmission Report, Project T019 demonstrates superior performance across the range of both quantitative and qualitative metrics, including project transfer capability, operability, and total performance.

NAT/NYPA argue that Project T019 has a higher cost and has a greater risk of cost increases than Project T029. While cost is an important factor, neither FERC's Order No. 1000 nor the NYISO OATT require cost to be the overriding factor in determining the more efficient or cost-effective transmission solution. In this case, as detailed above, Project T019 does have higher estimated cost relative to certain Segment B projects, but it demonstrates superior performance across a broad range of metrics that warrants the project cost.

In addition, the NYISO accounted for the potential cost increase risks identified by NAT/NYPA in its evaluation of Project T019. The potential for subsynchronous resonance issues resulting from Project T019's use of series compensation will be addressed in the NYISO's interconnection process. The NYISO was not required to complete the interconnection studies prior to selection, but did give due consideration to the interconnection information available at the time of selection. The NYISO also performed additional analysis to evaluate the potential need for and cost of upgrades or mitigation measures related to Project T019's series compensation. This analysis indicated that the magnitude of any upgrades or mitigation measures that might be required would be well within the project's 30% cost contingency.

All Segment B projects will result in degradation of New York-to-New England transfers, so the cost estimates for all of the projects included a cost of $30M to address any network upgrade facilities that may be required. Issues concerning the visual impacts of the number and height of structures are most properly addressed in the NYPSC siting process. Finally, based on NYISO staff's and the MMU's review, the 475 MW increase in the SENY locational 30-minute reserve requirement associated with Project T019 is not expected to be impactful.

NAT/NYPA also assert that the NYISO inaccurately determined that Project T019 provides greater production cost savings because it did not model upgrades for terminal equipment for NAT/NYPA's Projects T029 and T030. Again, we disagree. The NYISO correctly modeled NAT/NYPA's projects. Unlike Project T019, the NAT/NYPA proposals did not specify terminal upgrades, and the data they provided clearly indicated the use of original ratings limited by terminal equipment.

NAT/NYPA argue that the production cost savings are mainly driven by the increase on Central East transfer capability provided by the Segment A project. However, it was necessary to evaluate the combined production cost benefits of both the Segment A and Segment B projects. The NYPSC's need determination contemplated that the AC Transmission Needs should only be addressed if both Segments A and B are built.[8] The congestion benefits provided by Segment A to Central East would be diminished if Segment B did not alleviate the downstream constraints associated with the UPNY/SENY interface.

We also reject NAT/NYPA's arguments concerning ICAP cost savings. Project T019 will provide 400 to 500 MW of greater transfer capability compared to the other Segment B projects. Accordingly, ICAP cost savings from Project T019 are greater than the other Segment B projects as demonstrated by the separate and distinct calculation methodologies employed by the NYISO and the MMU. NAT/NYPA's assertion that the NYISO should have re-run the ICAP cost savings calculation to correct for the impedance data error is unpersuasive because, while it is difficult to predict the precise amount of these future benefits, Project T019 would have relatively higher savings than the other Segment B projects in all cases due to Project T019's higher transfer capability.

Further, we do not agree with NAT/NYPA's argument that the NYISO acted inconsistent with its past practice in considering certain resilience benefits or that the resilience benefits for Project T019 are not substantiated. The NYISO appropriately considered resilience as a feature of Operability. Furthermore, the NYPSC's December 17, 2015, order establishing the AC Transmission Needs identified enhancing resilience/storm hardening as one of the benefits driving the transmission need. NAT/NYPA's comparison to the Western New York Public Policy Transmission Need and the wooden poles associated with the selected Empire State Line project is inapt because the NYPSC did not identify such benefits for the Western New York need. In addition, the NYISO reasonably concluded, with input from SECO, that Project T019 would provide greater resilience benefits than Project T029. Directly embedded pole foundations, such as those used by NAT/NYPA's Project T029, may be designed to withstand similar loads as drilled shaft concrete foundations, such as those used by Project T019. However, the NYISO staff and consultants reasonably determined that Project T019 provided the greater combined resilience benefits of heavy duty structures, drilled shaft concrete foundations, and a greater number of dead-

[8] NYPSC Case No. 12-T-0502, *et al., Order Finding Transmission Needs Driven by Public Policy Requirements* (December 17, 2015), Appendix B, at 2, Evaluation Criteria 8 and 9.

end structures. Furthermore, both Projects T019 and T029 include a longitudinal broken wire to be applied to the load cases. While Project T029 is designed to a slightly higher extreme wind case, the NYISO reasonably concluded that the higher ice loading combined with appropriate wind loading proposed by Project T019 would provide greater benefit.

NAT/NYPA argue that Project T019's series compensation level of 50% is not optimized for future system conditions. The NYISO staff and consultants, however, acted appropriately in performing their evaluation based on what developers proposed, rather than attempting to determine the optimized sizing for series compensation. NAT/NYPA also assert that series compensation can be added in the future to their Projects T029 and T030 to increase the transfer limits if needed. The NYISO, however, correctly assessed Projects T029 and T030 as proposed by NAT/NYPA, which did not include series compensation. The NYISO did consider the expandability of all proposed projects and determined that the proposed design of all three projects (*i.e.*, T019, T029 and T030) provides sufficient space at the Knickerbocker substation for future expansion, which could include series compensation or other facilities not yet considered.

NAT/NYPA also assert that some scenarios (*e.g.*, social cost of carbon) are inconsistent with other scenarios and should not be considered. In addition, several stakeholders, including the Independent Power Producers of New York, the City of New York, Multiple Intervenors, and NAT/NYPA question the NYISO's use of a "G-J Locality Elimination" sensitivity, arguing that it should not be considered as it is flawed and based on unreasonable assumptions. We do not agree. The NYISO's tariff permits it to evaluate the proposed Public Policy Transmission Projects under various system conditions, scenarios, and sensitivities. With regard to the G-J Locality Elimination scenario, the Addendum makes clear that the mere examination of this scenario should not be construed as advocating for or against the G- J locality nor a commentary on potential ICAP market rules for creating or eliminating localities. Instead, this potential scenario was one of many under which the performance of the proposed projects was evaluated, and it was not accorded significant weight in the Board's project selection decisions.

Hudson Valley residents[9] argue that we should re-examine the justification for selecting any AC Transmission Public Policy Transmission Project. They cite the MMU's benefit cost ratio ("B/C Ratio") of 0.74 for Project T019 in the baseline case and conclude that the Board should not select a project with a ratio of less than 1.0. Additionally, they argue that the MMU's higher B/C ratio of 1.52 in the CES+Retirement scenario is based on faulty assumptions, particularly the level of off-shore wind resources modeled, and should be discounted entirely. We find these arguments unpersuasive. Although the B/C Ratio provides important guidance, the Board considers the full range of quantitative and qualitative metrics in project selection, and is not limited to selecting a project only if it exceeds a B/C Ratio of 1.0. In addition, while there remains significant uncertainty concerning how New York's policy objectives will be met given evolving state policies and technological advances, the CES+Retirement scenario provides a reasonable outlook for considering how new transmission projects would perform under state policies they are designed to facilitate.

[9] Town of Clinton, Town of Milan, Milan Hall Farm, Walnut Grove Farm, Farmers and Families of Claverack, Farmers and Families for Livingston, Pamela Lovinger, and Town of Livingston.

Finally, various developers and stakeholders have identified elements of the Public Policy Process that may benefit from further enhancement or clarification to improve the efficiency and transparency of the process, including providing for additional consultation with the Board throughout the process. The Board is aware that the process has been lengthy and could benefit from further enhancements to improve efficiency and transparency. NYISO staff will review lessons learned through the AC Transmission Needs process with stakeholders and is separately performing an extensive review of the Comprehensive System Planning Process. We direct NYISO staff to consider the suggestions raised by stakeholders and developers as part of these reviews, and to keep the Board apprised of its progress.

# # #

# AC Transmission Public Policy Transmission Planning Report Addendum

A Report by the
New York Independent System Operator

April 8, 2019

# Table of Contents

## Executive Summary for Addendum

NYISO staff submitted the draft AC Transmission Public Policy Transmission Planning Report ("Draft Report") to the NYISO Board of Directors ("Board") for its review and action. The Draft Report summarized NYISO staff's analysis and recommendations concerning proposed solutions to address the AC Transmission Public Policy Transmission Needs identified by the New York Public Service Commission ("PSC"), which includes the need to increase Central East transfer capability by at least 350 MW ("Segment A") and UPNY/SENY transfer capability by at least 900 MW ("Segment B").

In the Draft Report, NYISO staff recommended that the Board select as the more efficient or cost effective solution to address the AC Transmission Needs the Segment A project (T027) proposed jointly by North American Transmission ("NAT") and New York Power Authority ("NYPA") and the Segment B project (T029) also proposed by NAT and NYPA.

The Board provided interested parties with the opportunity to submit comments and to make oral presentations for the Board's consideration prior to its taking action concerning the Draft Report. Based on this input and the Board's independent review of the Draft Report, the Board directed NYISO staff to conduct certain additional studies and analyses.

The Board proposes to modify the Draft Report to reflect the results of the additional studies and analyses as well as the Board's conclusions regarding certain information provided in the Draft Report. These modifications are contained in this Addendum to the Draft Report ("Revised Report"). As described in the Board memorandum, the Board has determined that the more efficient or cost effective solution for Segment A is project T027. The Board also concluded that for Segment B, the more efficient or cost effective solution is project T019, which was jointly proposed by Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid") and the New York Transco, LLC ("Transco"). Based on the estimated project schedules, the in-service date established for the purposes of the Development Agreements for the selected projects is December 2023.

After conducting additional analyses at the Board's request, considering the import of those analyses in conjunction with information in the Draft Report, NYISO staff supports the Board's project selections for both Segments A and B.

In accordance with the NYISO's tariff, the Revised Report will be returned to the Management Committee for further comment. Following the Board's consideration of these comments, the Board will make its final determination on the Revised Report and the selection of the Public Policy Transmission Projects to address the AC Transmission Needs.

# A1. Transfer Limit Analysis

Transfer limit analysis evaluates the amount of power that can be transferred across a defined transmission interface while observing applicable reliability criteria. The results of transfer limit analysis are used in the evaluation of metrics such as Cost per MW, Operability, and Performance, as well as for determining ICAP benefits.

As described in Section 3.2.1 of the Draft Report, the NYISO evaluated the transfer limits of the UPNY/SENY interface based on the criteria set forth by the NYPSC Order for Segment B. The UPNY/SENY interface is critical to the New York State transmission system as it represents the collection of transmission lines on which all power flows from Upstate New York to Southeast New York. UPNY/SENY is historically limited by the thermal capability of the individual transmission lines; therefore, the NYISO performed various thermal transfer analysis.

The Board identified aspects of the transfer limit methodologies and results that warranted further scrutiny, and therefore requested additional analysis to assess whether and, if so, how alternate approaches should be factored in the selection process. This section describes additional transfer analysis based on the 2016 Reliability Planning Process power flow case with the updates detailed in Section 3.2.1 of the Draft Report.

Following the initial stakeholder review of the Revised Report, the NYISO was informed of a modeling error included in the NAT/NYPA and National Grid/Transco Segment B proposals. Specifically, the impedance data submitted for the New Scotland – Knickerbocker 345 kV line and the Knickerbocker – Alps 345 kV line was transposed for each project. NAT/NYPA and National Grid/Transco each provided corrected data for their respective projects. The NYISO assessed the impact of the impedance data correction on the calculated transfer limits and on affected metrics, as reflected in the following sections.

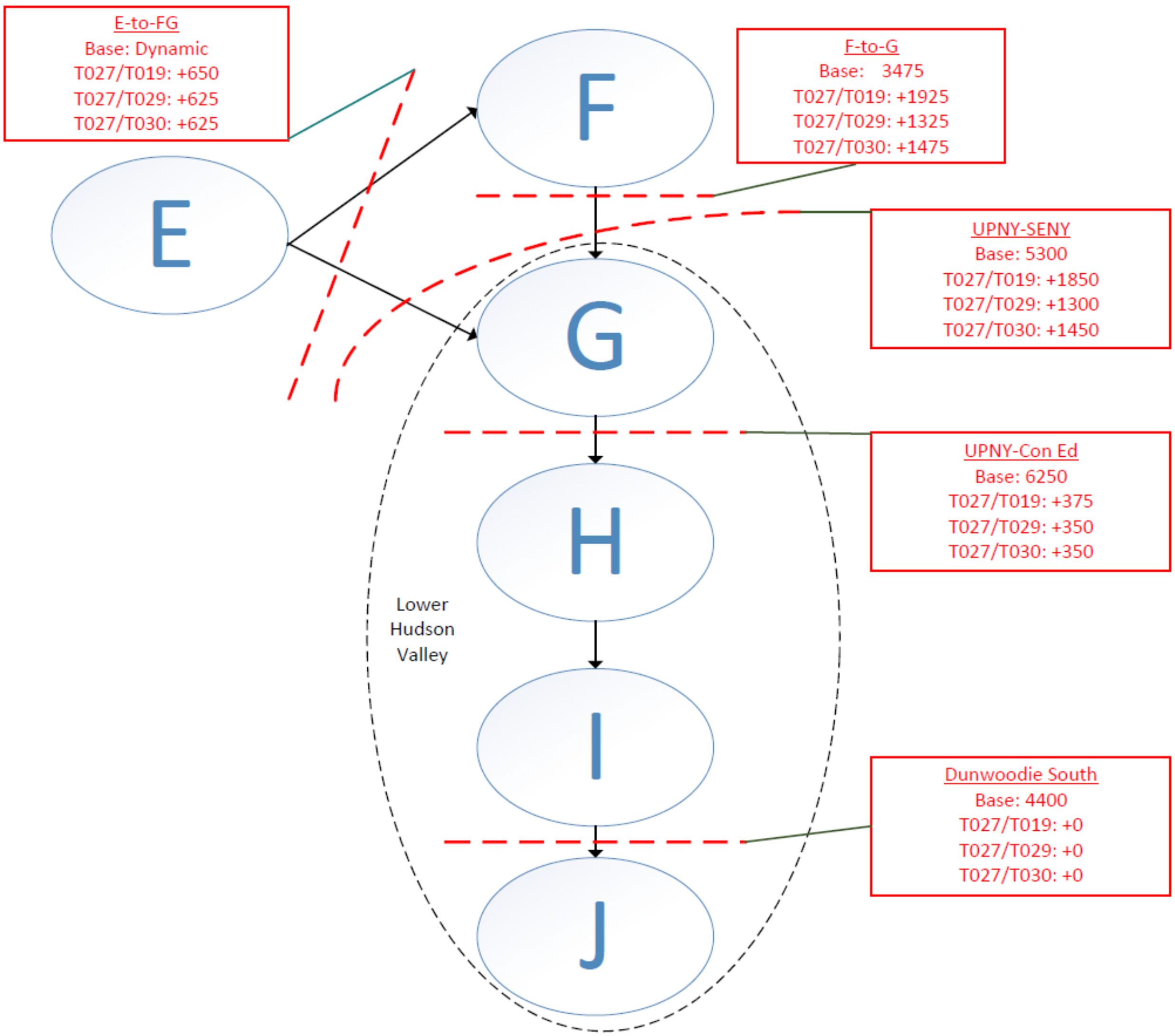
## A1.1. UPNY/SENY Transfer Limits for N-1 Emergency Transfer Criteria

The calculation of Emergency Transfer Limits is necessary to support a number of the requests from the Board further described in this Addendum. Emergency Transfer Criteria are defined by the New York State Reliability Council to allow transfers to be increased up to higher short-term emergency (15-minute) ratings for post-contingency conditions. Emergency Transfer Criteria may be invoked in the event that adequate facilities are not available to supply firm load within Normal Transfer Criteria. The use of Emergency Transfer Criteria is critically important for the operation of the New York bulk power system in that it allows the transmission system to be operated to higher ratings during emergency or stressed system conditions in order to supply firm load and to avoid the need for load relief measures. Therefore, Emergency Transfer Criteria limits are utilized in resource adequacy analysis, including the evaluation of loss of load expectation (LOLE) for system planning and the calculation of the Installed Reserve Margin (IRM) and Locational Capacity Requirements (LCRs) for the capacity market.

Figure A-1 depicts the N-1 Emergency Transfer Criteria limits for the T019 project and the T029 project assuming that T027 is the project selected for Segment A. The limits reflect adjustments for the impedance data correction described in Section A1. Specifically, the correction impacted the UPNY/SENY limit. For T019, the incremental UPNY-SENY emergency transfer capability decreased from the previously calculated level of 2,100 MW to 1,850 MW. For T029, the data correction caused the incremental emergency transfer capability to increase from 1,150 MW to 1,300 MW. T030 provides an additional 150 MW of emergency transfer capability compared to T029, for a total incremental increase of 1,450 MW. These changes together reduce the emergency transfer differential between T019 and the other Segment B projects from 950 MW to a range of 400 MW to 550 MW.

The additional emergency transfer capability provided by the T019 project relative to the other Segment B projects constitutes a material benefit to the operability and performance of the transmission system and capacity savings for the market as described in Sections A3, A4, and A6 of this Addendum.

**Figure A-1: Incremental UPNY/SENY N-1 Emergency Transfer Capability**




* T027/T029 is representative of all other Segment B projects

### A1.2. Alternate Dispatch Methodology to Determine Transfer Limits

Transfer limits can be highly sensitive to generation dispatch depending on the transmission project design. To derive the original incremental UPNY/SENY N-1-1 thermal transfer capability shown in Table 3-18 of the Draft Report, certain Capital Zone (Zone F) and Hudson Valley Zone (Zone G) generators were restricted to be dispatchable only within a small range.[1] This small range is to mimic the typical dispatch in resource adequacy reliability models.

As requested by the Board, the NYISO staff evaluated the impact of generation dispatch on the N-1-1 transfer capability by utilizing the dispatch methodology established for calculating transmission security-based floors used by the alternative Locality Capacity Requirement (LCR) optimization process. As part of the calculation of LCRs, a Transmission Security Limit (TSL) is calculated for the Zones G-J, the Zone J, and the Zone K localities to represent the N-1-1 transmission transfer capability into each locality. Each TSL is then used to calculate a percentage floor for each LCR. Each LCR floor is then input to the optimizer simulation to prevent the optimizer from reducing the capacity below adequate levels for each locality.

The assumptions for calculating the LCR TSLs recognize that: (1) in actual operations the NYISO can re-dispatch a reasonable amount of generation in support of increasing the transmission security limits, and (2) the NYISO should expect to meet transmission security limits by procuring the required amount of ICAP resources within each of the localities in order for the NYISO to be capable of operating the New York State transmission system in the Normal Transfer Criteria state.[2] As such, the following assumptions are used:

a) Individual generators are limited in re-dispatch between a minimum of 50% and a maximum of 100% of their Dependable Maximum Net Capability ("DMNC") value. The minimum DMNC value of 50% represents an average level of physical minimum generation levels.

b) All applicable NERC, NPCC, and NYSRC contingencies under N-1-1 design criteria for Normal Transfer Criteria are evaluated. The transfer level associated with the most limiting N-1-1 contingency combination is the TSL.

[1] Athens: 970-1000 MW, Gilboa: 565-585 MW, Cricket Valley: 1010-1050 MW, CPV Valley: 650-680 MW, Danskammer: 200-230 MW, Roseton: 554-584 MW, and Bowline: 547-577 MW.

[2] Normal Transfer Criteria, as defined by the New York State Reliability Council, require that pre-contingency circuit loading is within normal (24-hour) ratings and post-contingency circuit loading is within applicable emergency (typically 4-hour) ratings for all design criteria contingencies. Design criteria contingencies include multiple-element contingencies such as stuck breakers and double-circuit towers.

#### A1.2.1. Revised UPNY/SENY Transfer Limits for Normal Transfer Criteria

Applying the Alternate Dispatch (LCR TSL) methodology, Table A-1 shows the UPNY/SENY Normal Transfer Criteria transfer limits under various outage conditions (N-1 and N-1-1) for the pre-project case and the post-project cases for each Segment B project in combination with the NAT/NYPA T027 Segment A project. The limits reflect adjustments for the impedance data correction described in Section A1. The UPNY/SENY TSL for each case is highlighted in red.

**Table A-1: UPNY/SENY Normal Transfer Criteria Limits**

| Maintenance Outage | No Outage | CPV - Rock Tavern 345 kV Line | Marcy - Coopers Corners 345 kV Line | Roseton - East Fishkill 345 kV Line | Athens-Pleasant Valley 345 kV Line | Knickerbocker-Pleasant Valley 345 kV Line |
|---|---|---|---|---|---|---|
| Pre-Project | 5,050 | 4,450 | 4,425 | 3,975 | 3,450 | - |
| T027+T019 | 7,150 | 6,600 | 6,475 | 5,375 | 4,875 | 4,725 |
| T027+T022 | 6,650 | 6,050 | 6,025 | 5,000 | 4,750 | 4,775 |
| T027+T023 | 6,600 | 6,025 | 5,975 | 4,975 | 4,700 | 4,725 |
| T027+T029 | 6,600 | 6,000 | 5,975 | 5,425 | 4,700 | 4,725 |
| T027+T030 | 6,750 | 6,175 | 6,100 | 5,575 | 4,800 | 4,725 |
| T027+T032 | 6,575 | 6,000 | 5,900 | 4,975 | 4,675 | 4,775 |

The Draft Report addresses the N-1-1 limits in Section 3.3.5.2 and in Table 3-18. The results shown above using the alternate dispatch methodology indicate that, for all projects, the minimum N-1-1 Normal Transfer Criteria limits for the UPNY/SENY interface range from 4,675 MW to 4,750 MW. These findings indicate that the UPNY/SENY N-1-1 Normal Transfer Criteria limits are not a distinguishing factor among the proposed projects. Section A2 further describes the cost-per-MW metric that utilizes the "no outage" (*i.e.,* N-1) results.

#### A1.2.2. Revised UPNY/SENY Transfer Limits for N-1-1 Emergency Transfer Criteria

Applying the Alternate Dispatch (LCR TSL) methodology, Table A-2 shows the UPNY/SENY N-1-1 Emergency Transfer Criteria transfer limits for the pre-project case and the post-project cases for each proposed Segment B project in combination with the NAT/NYPA T027 Segment A project. The limits reflect adjustments for the impedance data correction described in Section A1. The lowest limit for each project is highlighted in red.

**Table A-2: UPNY/SENY Emergency Transfer Criteria N-1-1 Limits**

| Maintenance Outage | CPV - Rock Tavern 345 kV Line | Marcy - Coopers Corners 345 kV Line | Roseton - East Fishkill 345 kV Line | Athens-Pleasant Valley 345 kV Line | Knickerbocker-Pleasant Valley 345 kV Line |
|---|---|---|---|---|---|
| Pre-Project | 4,850 | 5,025 | 4,500 | 3,900 | - |
| T027+T019 | 7,125 | 6,950 | 6,950 | 5,650 | 5,425 |
| T027+T022 | 6,725 | 6,450 | 6,150 | 5,375 | 5,475 |
| T027+T023 | 6,725 | 6,400 | 6,100 | 5,350 | 5,425 |
| T027+T029 | 6,725 | 6,400 | 6,100 | 5,350 | 5,425 |
| T027+T030 | 6,850 | 6,550 | 6,275 | 5,500 | 5,425 |
| T027+T032 | 6,700 | 6,400 | 6,125 | 5,300 | 5,475 |

The results indicate that, for all projects, the N-1-1 Emergency Transfer Criteria limits for the UPNY/SENY interface range from 5,300 MW to 5,425 MW using the alternate generation dispatch methodology. These findings indicate that the UPNY/SENY N-1-1 Emergency Transfer Criteria limits are not a distinguishing factor among the proposed projects.

## A2. Cost per MW

As reflected in Section 3.3.3 of the Draft Report, the NYISO calculated the Cost per MW ratio metric by dividing the independent cost estimates, provided by the NYISO independent consultant Substation Engineering Company (SECO), for Segment B by the incremental MW value of transfer capability. Given the revised transfer limits calculated at the request of the Board, as discussed above, the NYISO staff recalculated the Cost per MW ratio metric. The incremental increase for UPNY/SENY is based on the revised "no outage" (N-1) Normal Transfer Criteria transfer limits described in Section A1.2.1 of this addendum.

Table A-3 reports the Cost per MW ($M/MW) ratio based on the updated transfer limits. The results reflect adjustments for the impedance data correction described in Section A1.

**Table A-3: Cost per MW Ratio**

| Project | Segment B Independent Cost Estimate (2018 $M) | Incremental UPNY/SENY (MW) | **Cost per MW** |
|---|---|---|---|
| T027+T019 | $479 | 2,100 | **0.228** |
| T027+T022 | $373 | 1,600 | **0.233** |
| T027+T023 | $424 | 1,550 | **0.274** |
| T027+T029 | $401 | 1,550 | **0.259** |
| T027+T030 | $419 | 1,700 | **0.246** |
| T027+T032 | $536 | 1,525 | **0.351** |

The results show that T019 has the lowest Cost per MW ratio of all the Segment B projects.

# A3. Operability

As reflected in Section 3.3.5 of the Draft Report, the NYISO considered how the proposed Public Policy Transmission Projects affect flexibility in operating the system, such as dispatch of generation, access to operating reserves, access to ancillary services, or the ability to remove transmission facilities for maintenance. The NYISO also considered how the proposed projects may affect the cost of operating the system, such as how they may affect the need for operating generation out of merit for reliability needs, reduce the need to cycle generation, or provide more balance in the system to respond to system conditions that are more severe than design conditions.

The Board requested the NYISO staff to further examine how certain design aspects of the proposed projects could be beneficial to the future operation of the grid under more extreme conditions such as high impact storms or significant generation retirements that could otherwise strain the system. This section describes additional assessments of resilience, generator deactivations, and operating reserve.

## A3.1. Resilience Benefits

The resilience of the electric power system is an important consideration in evaluating the operability of proposed transmission projects. FERC has proposed a working definition of resilience as "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."

A meaningful measure of grid resilience is the ability of New York State's electric power system to withstand extreme storm events. The power system in New York is a collection of individual components that includes high voltage transmission lines, generation resources, and important substation equipment. The resilience of the New York State's power system is dependent, in part, on each individual facility component's ability to "withstand the disruptive event." It is sometimes difficult to clearly assess the resilience benefits of an individual facility component's system design, but it is reasonable to invest in incremental improvements above minimally accepted criteria in order to protect the system from the potential catastrophic events.

With a focus on New York State's transmission system resilience, there have been occurrences of extreme disruptive storm events, which have included hurricanes, tornados, windstorms, coastal flooding, and ice storms. As an example, an ice storm in January 1998 was particularly impactful, in which a series of storms swept across the northeastern part of North America, causing 770 transmission structures to collapse.[3] About 110,000 customers were affected in northeastern New York due to the loss of 230 kV and 115 kV lines in this area, and major tie lines with neighboring systems were lost for several weeks.

#### A3.1.1. Transmission Line Structural Design

SECO evaluated the transmission line structural design for all of the proposals relative to the ice and wind loading requirements defined by the National Electric Safety Code (NESC).[4]

All proposals meet minimum NESC standards, but the National Grid/Transco T019 Segment B proposal includes heavier duty structures mounted on drilled-shaft concrete foundations where other proposals use direct embedded poles with crushed rock backfill foundations for tangent pole applications (shown in Figure A-2 and Figure A-3). The concrete foundations of T019 cost approximately two and a half times as much compared to the direct embedded rock foundations, but provide greater resilience to significantly heavier wind and ice loadings. In addition, T019 utilizes more dead-end structures compared to the other Segment B proposals, with an average distance of approximately one mile between dead-end structures. This more resilient design would mitigate cascading structure failures if they occur.

**Figure A-2: Drilled Shaft Construction**

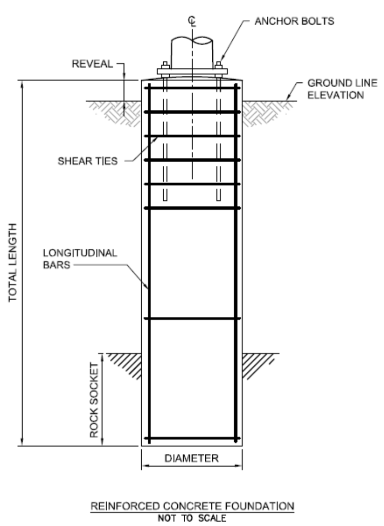
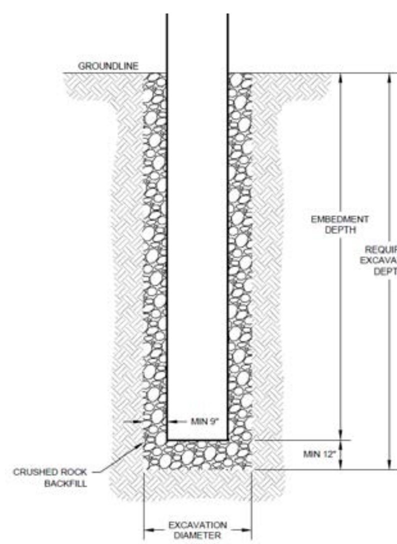



**Figure A-3: Direct Embedded Pole Construction**




[3] NERC 1998 System Disturbances Report: https://www.nerc.com/pa/rrm/ea/System%20Disturbance%20Reports%20DL/1998SystemDisturbance.pdf

[4] SECO Report Section 4.11.2.7

NextEra's T022/T023 project design proposes to install full length concrete poles as opposed to the multi-piece steel poles proposed by other developers. This design also provides greater resilience to ice loading, but the direct embedded foundations proposed by NextEra result in lesser resilience to wind than T019. There is also significantly more incremental work involved in the installation of full length concrete poles as opposed to multi-piece steel poles. For example, there would be additional labor required to rig and set concrete poles which could have length up to 135 feet and weigh up to 62,000 pounds. By contrast, steel poles are constructed in segments, typically with three segments no longer than 50 feet each, and weighing up to 16,000 pounds.

While the costs of the enhanced structures for projects T019 and T022/T023 are higher, it is important to appropriately recognize the incremental resilience benefit to withstand reasonable icing and wind events. The Board has concluded that this benefit should be more prominently reflected in the Operability metric and project ranking.

#### A3.1.2. Resilience Benefits of Increased Transmission Capability

The NYISO has long advocated that maintaining and improving transmission capability within New York State will improve the reliability and resilience of the transmission grid during stressed system conditions and disruptive events. Stressed conditions and disruptive events can occur because of many different factors; examples include extreme storm conditions (*e.g.*, Superstorm Sandy) which can result in a large number of bulk electric system transmission outages or during events when critical supply resources are forced out of service or otherwise unavailable (e.g. fuel shortage events).

Maintaining and improving electric transmission system capability is generally viewed as supportive of promoting grid resilience. In comments responsive to the FERC resilience docket, the NYISO stressed the importance of maintaining and protecting existing interconnections between neighboring systems, as well as continually assessing opportunities to improve interregional transaction coordination serves to bolster resilience throughout an interconnected region. These interconnections foster the opportunity to rely on a broader, more diverse set of resources to meet the overall needs of an interconnected region. The more diverse resource pool available through interregional interconnections provides both economic and resilience benefits, especially during stressed operating conditions such as sustained heat waves or cold snaps.

In New York, there are a limited number of transmission corridors available to build new transmission projects in support of improving the state's transmission capability. Given the limited potential for new transmission projects in the future, the additional emergency transfer capability provided by the T019 project would materially improve the transmission system into the Southeast New York area. The Board has concluded that the additional transfer capability provided by T019 should be reflected as a benefit in the Operability metric and in the project ranking.

### A3.2. Ability to Accommodate Generator Deactivations

The Board requested further evaluation of how the increase in UPNY/SENY transfer capability resulting from the Segment B projects could accommodate additional generation deactivations within the Lower Hudson Valley, if they occur, while maintaining reliability. As part of each Reliability Needs Assessment, the NYISO performs a "zonal capacity at risk" scenario. The zonal capacity at risk assessment identifies a maximum level of capacity in megawatts that can be removed from a given zone without causing loss of load expectation (LOLE) reliability criterion violations.[5] A small megawatt amount is indicative of a transmission constrained zone that is reliant upon intra-zonal generation, while a large megawatt amount is indicative of a zone that has a significant import capability and/or significant surplus generation. Accordingly, the NYISO performed this analysis for the National Grid/Transco T019 project and the NAT/NYPA T029 project, each in combination with the NAT/NYPA T027 Segment A project, to determine for each project how much generation could deactivate within Zone G while maintaining reliability under the postulated future system conditions. The T029 project results are also representative of other Segment B projects with the exception of T019, though T030 would produce slightly higher results than T029 in the CES+Retirement scenario. Table A-4 summarizes the results, which reflect adjustments for the impedance data correction described in Section A1.

**Table A-4: Maximum MW Capacity Removal from Zone G in 2030**

| Project | Baseline Case | CES+Retirement Scenario |
|---|---|---|
| T027+T019 | 1,400 | 2,750 |
| T027+T029 | 1,400 | 2,250 |

Under both the baseline case and the CES+Retirement scenario system conditions, the UPNY/SENY interface is not a binding constraint before removal of generation, even without the AC Transmission projects. This means that the UPNY/SENY interface limit does not affect the resource adequacy of the system before removal of generation from Zone G. By comparison, the UPNY/ConEd interface is the most binding in the system for resource adequacy under all study conditions before

[5] The megawatt amounts are reported as "perfect capacity", which is capacity that is not derated (*e.g.*, due to ambient temperature or unit unavailability) and not tested for impacts to interface limits.

removal of generation. This means that the additional UPNY/ConEd transfer capability provided by each Segment B project is beneficial to the resource adequacy of the system. As discussed in Section A4, the Performance metric also recognizes the potential benefits of future system improvements that could be made to mitigate the impact of voltage limitations of the UPNY/ConEd interface.

For the baseline case, in which there are not significant generation projects added upstate, there is not enough surplus generation upstate to serve the Zone G load once 1,400 MW of generation is removed from Zone G. At that point, the LOLE violation occurs before the UPNY/SENY interface becomes binding. Therefore, no additional resource adequacy benefit for Zone G would be realized from additional UPNY/SENY transfer capability under baseline system conditions.

For the CES+Retirement scenario, there are three primary differences in system conditions compared to the baseline: (1) additional energy efficiency measures equating to a peak load decrease of approximately 2,300 MW statewide in 2030, (2) additional renewable generation primarily located upstate (see details in Table 3-4 of the Draft Report), and (3) the retirement of all coal generation and approximately 3,500 MW of older gas turbines in New York City and Long Island. Under these postulated system conditions, more capacity can be removed from Zone G compared with the baseline analysis because of the reduced peak load and additional renewables, particularly an additional 1,000 MW of utility-scale solar in Zone G. When removing capacity from Zone G with the AC Transmission projects in place, the UPNY/SENY interface begins to bind at a certain point because of the flow of power from the additional renewables upstate, and therefore additional UPNY/SENY transfer capability could be beneficial if a large number of generator retirements were to occur in Zone G.

In summary, an increase to the UPNY/SENY transfer limit does not provide an improvement in resource adequacy under the baseline system conditions which assumes no generation retirements occur, but such additional capability would be beneficial under the CES+Retirement scenario system conditions if Zone G generator retirements were to exceed approximately 2,250 MW. This analysis would indicate a benefit to the T019 project in a future scenario where the New York system is impacted by large upstate renewable additions and the potential for Zone G generation retirements. The Board concluded that this benefit should be reflected as a benefit in the Operability metric and in the project ranking.

### A3.3. Impact on SENY 30-Minute Reserve Requirement

In calculating the revised transfer limits at the request of the Board, as discussed above, the potential impact of these transfer limits on the locational reserve requirement for Southeast New

York (SENY) was evaluated. For the calculation of the SENY locational reserve requirement, limits for the UPNY/SENY transfer capability need to be determined under both N-1-1 and N-1 criteria as follows:

a) For the N-1 criteria UPNY/SENY limit, all applicable NERC, NPCC, and NYSRC contingencies assuming Normal Transfer Criteria are used.

b) For the N-1-1 criteria UPNY/SENY limit, all applicable NERC, NPCC, and NYSRC contingencies assuming Emergency Transfer Criteria are used.

c) Individual generators are limited in re-dispatch between a minimum of 50% and a maximum of 100% of their DMNC value.

d) The difference between these N-1 and N-1-1 UPNY/SENY limits represents the expected level of locational operating reserves needed for the SENY locality that would have to be procured in the NYISO day-ahead and real-time energy and ancillary services markets.

This analysis was performed for the Segment B projects, each in combination with the NAT/NYPA T027 Segment A project, with the results shown in Table A-5. The results reflect adjustments for the impedance data correction described in Section A1.

**Table A-5: SENY Reserve Requirement**

| Project | N-1 Normal | N-1-1 Emergency | Reserve Requirement |
|---|---|---|---|
| Pre-Project | 5,050 | 3,900 | 1,150 |
| T027+T019 | 7,150 | 5,425 | 1,725 |
| T027+T022 | 6,650 | 5,375 | 1,275 |
| T027+T023 | 6,600 | 5,350 | 1,250 |
| T027+T029 | 6,600 | 5,350 | 1,250 |
| T027+T030 | 6,750 | 5,425 | 1,325 |
| T027+T032 | 6,575 | 5,300 | 1,275 |

The present-day Southeast New York (SENY) locational reserve requirement is 1,300 MW. The pre-project result from this analysis is 150 MW less, which can be attributed to various differences in the system model such as the addition of Cricket Valley and the retirement of the Athens special protection system.

The analysis demonstrates that every Segment B project would result in some level of increase in the SENY reserve requirement, but the National Grid/Transco T019 project would require approximately 475 MW of additional 30-minute reserves compared to other Segment B projects. The T019 project provides a higher normal transfer limit with all lines in (N-1) compared to the other projects, but maintains approximately the same emergency transfer limit under the critical outage (N-1-1), thus necessitating a greater amount of generation redispatch to transition from an N-1 normal state to an N-1-1 emergency state.

The New York Control Area total 30 minute reserve requirement of 2,620 MW would not change as a result of the transmission projects. Given that reserve suppliers located in SENY typically provide the majority of the New York Control Area reserve requirement of 2,620 MW, the 475 MW increase in SENY locational reserve requirement associated with the T019 project is not expected to be impactful.

## A4. Performance

The Board requested NYISO staff investigate whether there are potential performance benefits associated with the series compensation capability included with T019. NYISO staff provided the Board with information related to how the proposed series compensation can provide certain operational benefits from improved utilization of the UPNY/SENY interface through NYISO actions directing the operational status of the series compensation. Specifically, the NYISO can direct the proposed series compensation to be switched in or out of service in response to reliability or market conditions.

The NYISO has realized similar performance benefits, both from a grid reliability and energy market operations perspective, by directing the operational status of the existing series compensation on the Marcy-South transmission corridor during certain transmission outage scenarios and during the different seasonal market operating conditions.

As an example, in the fall of 2017, the NYISO implemented operational actions using the operational control provided by the Marcy-South series compensation in response to observed seasonal market operating conditions:

a) During the Summer Capability Period, the Marcy-South Series Capacitors will normally remain in service to facilitate improved utilization of the New York transmission system. This action increases the UPNY/SENY transfer capability, which tends to reduce UPNY/SENY congestion that is typically more limiting than other transmission system constraints.

b) During the Winter Capability Period, the Marcy-South Series Capacitors will normally be out of service (bypassed) to facilitate improved utilization of the New York transmission system. This action increases the Central-East transfer capability, which tends to reduce Central-East congestion that is typically more limiting than other transmission system constraints.

While the NYISO does not expect to bypass the series compensation for T019 for long durations such as seasonal capability periods, the NYISO expects that operational benefits will be realized by the capability to control Segment B power flows by directing the operational status of the series compensation for T019 in a manner similar to the current use of the Marcy-South series compensation.

The improved controllability of UPNY/SENY power flows by the T019 project will allow the NYISO more flexibility in addressing grid reliability needs, and can result in improved utilization of the overall transmission system as compared to the other proposed projects. This operational capability is expected to result in lower overall energy costs and provide benefit to consumers during certain transmission outage conditions or under certain market operating conditions. Furthermore, the utilization of the UPNY/ConEd interface could be further increased if future system improvements mitigate the voltage limitations. Voltage limitations can potentially be addressed in a variety of ways without needing to build additional transmission lines.

The Board has concluded that T019's improved control of power flows and increased utilization of the UPNY/SENY interface should be reflected as a benefit in the Performance metric and in the project ranking.

## A5. Production Cost

As reflected in Section 3.3.7 of the Draft Report, the NYISO calculated the system production cost savings that could be realized for the proposed projects. The savings for each project is calculated as the difference between the pre-project and post-project results over the duration of a project's study period. The study period begins with the estimated in-service date and extends 20 years. Entries with a dollar value are listed in 2018 millions of dollars. The discount rate used to calculate present value is 6.988% consistent with the 2017 CARIS Phase 1 database. The NYISO used scenarios to distinguish projects and to measure the robustness of project performance.

The Board requested additional production cost analysis to study the potential impact of incorporating carbon pricing in the NYISO's wholesale market on the relative cost effectiveness of Segment B projects.

### A5.1. Social Cost of Carbon Sensitivity

The additional simulations were performed using the CES+Retirement case with $CO_2$ emissions priced at the social cost of carbon as defined by the New York State Department of Public Service (DPS). Each of the project proposals were modeled in combination with the NAT/NYPA T027 Segment A project. Two sets of simulations were conducted, one set for T019 because the project is electrically distinct from other Segment B projects, and the second set for T029 since it is electrically comparable to T022, T023, and T032.[6]

The methodology and carbon costs employed in this analysis mirror those being utilized in the carbon pricing market designs that are being discussed at NYISO's Integration Public Policy Task Force (IPPTF). As in the Brattle work for IPPTF, hourly external transactions (MWh) with neighboring control areas (*e.g.*, PJM, ISO-NE) from the relevant base case are frozen or locked in the social cost of carbon cases, consistent with NYISO's Carbon Pricing Straw Proposal. This treatment makes the economics of external generator dispatch and transactions unaffected by a carbon adder. Absent this treatment, there would be a material increase in imports because New York generation, with its market offers now including a carbon adder, would become appreciably more expensive than external resources.

[6] Simulations were not performed for T030 because in all CES+Retirement cases it underperforms T029 in production cost savings.

This "freezing of external transactions" was effected in the production cost modeling by running cases without the social cost of carbon and then locking the hourly interface flows (within a +/- 20 MW bandwidth) when running the case with the social cost of carbon. For example, for the CES+Retirement case, the NYISO ran the 20-year simulation and extracted the hourly interface flows. The NYISO then modeled these interface flows in its production cost simulation (allowing the flows to be 20 MW higher or lower), incorporated the social cost of carbon, and then re-ran the case.

The NYISO utilized the social cost of carbon assumed in the IPPTF analysis for study years 2023-2030, and escalated these values by four percent annually for study years 2031-2042. Table A-6 presents the assumed costs in $ per ton of $CO_2$:

**Table A-6: Social Cost of Carbon Assumptions**

| Year | Social Cost of Carbon (nominal, $/ton) | Year | Social Cost of Carbon (nominal, $/ton) | Year | Social Cost of Carbon (nominal, $/ton) |
|---|---|---|---|---|---|
| 2023 | $52.74 | 2030 | $69.32 | 2037 | $91.22 |
| 2024 | $55.07 | 2031 | $72.09 | 2038 | $94.87 |
| 2025 | $57.48 | 2032 | $74.98 | 2039 | $98.66 |
| 2026 | $59.96 | 2033 | $77.98 | 2040 | $102.61 |
| 2027 | $62.52 | 2034 | $81.09 | 2041 | $106.71 |
| 2028 | $65.17 | 2035 | $84.34 | 2042 | $110.98 |
| 2029 | $66.54 | 2036 | $87.71 | | |

Total production costs for the New York Control Area (NYCA) consist of internal NYCA generation costs and the net cost of transactions with New York's neighbors. Internal generation costs are comprised of fuel, variable operation and maintenance, start-up and emission allowance costs for SOx, NOx, and $CO_2$.[7]

Savings associated with carbon-related production costs were substantially higher for both T019 and T029 in the social cost of carbon case as one would expect due to the higher per-ton costs. However, as illustrated, these incremental savings were attenuated due to reduced savings in fuel and variable operation and maintenance costs for both T019 and T029. These off-setting effects can be attributed to changes in the pattern of inter-control area flows, and to differences in the New York commitment and dispatch between the original, RGGI-only cases and the social cost of carbon case.

The overall production cost savings for T019 increases by $111M as a result of including the

[7] SOx and NOx costs are negligible relative to the other components of production costs and are therefore not discussed further.

social cost of carbon. This includes a decrease of $221M in carbon-related costs, an increase of $73M in fuel and variable operation and maintenance, a decrease of $10M in start-up costs, and an increase of $47M in costs related to the net interchange with neighboring control areas.

The overall production cost savings for T029 increases by $71M as a result of including the social cost of carbon. This increase can be disaggregated into a decrease in carbon-related costs of $201M, an increase in fuel and variable operation and maintenance costs of $86M, an increase in start-up costs of $2M, and an increase in costs related to the net interchange of $42M.

Table A-7 summarizes the results for the original case and the social cost of carbon case. The results reflect adjustments for the impedance data correction described in Section A1.

**Table A-7: Production Cost Savings**

| CES+ Retirement Scenario | Capital Costs | Original RGGI Program Only | | Social Cost of Carbon Sensitivity | |
|---|---|---|---|---|---|
| | | Production Cost Savings | Production Cost Savings / Capital Costs | Production Cost Savings | Production Cost Savings / Capital Costs |
| T027+T019 | $1,230 | $1,080 | 0.878 | $1,191 | 0.968 |
| T027+T022 | $1,123 | $1,076 | 0.958 | $1,147 | 1.021 |
| T027+T023 | $1,174 | $1,076 | 0.917 | $1,147 | 0.977 |
| T027+T029 | $1,113 | $1,076 | 0.967 | $1,147 | 1.031 |
| T027+T030 | $1,131 | $1,012 | 0.895 | N/A | N/A |
| T027+T032 | $1,286 | $1,076 | 0.837 | $1,147 | 0.892 |

In summary, this analysis shows that while there were incremental increases in the production cost savings for both studied projects (and by extension, all relevant Segment B projects), the inclusion of the social cost of carbon did not alter the comparative system costs of projects with regard to production cost savings to capital cost ratio.

## A6. ICAP Benefits

The Board asked NYISO staff to update and conduct further analysis to evaluate whether particular projects are likely to produce additional Installed Capacity ("ICAP") cost savings relative to the other proposed projects. As more fully described in Section 3.3.8 of the Draft Report and summarized below, the original analysis relied upon the optimization tool developed by the NYISO to set optimal locational capacity requirements (LCRs) for use in its capacity markets. While the prior methodology to calculate ICAP benefits was not materially altered, the NYISO did incorporate additional constraints to the optimization (*i.e.*, transmission security limits) to more closely align the benefit estimation procedure with the optimization tool's use in NYISO's capacity market operations. Also, while the original analysis estimated and presented a range of benefits for a representative combination of Tier 1 and Tier 2 project combinations, this supplemental assessment constructed specific estimates for all Segment B projects in combination with the T027 Segment A proposal.

In addition, the NYISO performed this assessment for both a reference case in which all existing capacity localities are retained and a sensitivity in which the G-J locality is eliminated and a new H-J locality is created. It is important to understand that the assumptions and findings of the "G-J elimination" sensitivity should not be construed as advocating for or against the elimination of the G-J locality nor a commentary on potential ICAP market rules for eliminating localities. This sensitivity simply reports the estimated capacity benefits for all Segment B projects under a defined set of assumptions if the locality were to be eliminated once a proposed AC Transmission project enters into service.

Following completion of the further ICAP analysis, the NYISO was informed of a modeling error for projects T019, T029, and T030 as described in Section A1. Certain data inconsistencies were also identified as described in Section A6.2. As further described in this section, the data inconsistencies and the impedance error have an impact on the numerical calculations, but do not affect the ultimate conclusions for the ICAP benefit metric.

### A6.1. Optimization Procedure for Estimating ICAP Benefits

The NYISO's optimization tool was accepted by FERC in 2018 to replace the TAN45 methodology for establishing LCRs for each locality in the NYISO's capacity market. It minimizes ICAP costs by iteratively adjusting the megawatt requirements for each of the capacity zones, while observing emergency transfer criteria interface limits, transmission security limits for each locality and the LOLE reliability criterion of 0.1 days per year, and pricing capacity using a set of Net CONE cost curves. The NYISO has leveraged the tool here in order to estimate how future ICAP costs may be impacted by the proposed transmission projects.

Other than the inclusion of the transmission security limits in the optimization tool, the actual benefit calculations mirror those used in the original analyses, including the use of the same Net CONE curves. For each project combination and sensitivity studied, the NYISO ran the optimizer simulations for four sample years (*i.e.,* 2025, 2030, 2035 and 2040) and calculated the annual capacity benefit as the pre-project costs less the post-project costs. A 20-year time-series of savings was then constructed using the simple average of the four savings values. Consistent with the Draft Report, the annual values were escalated by 1.92% to reflect growth in the Net CONE curves and then discounted by 6.988% to calculate a 20-year stream in 2018 dollars.

Consistent with the original analysis, the NYISO calculated the impact on ICAP costs using alternate assumptions on the clearing price. In one case, the clearing price is set at Net CONE beginning with the first year of the study period (2023) and extending through the end of the study period (2042). In the second case, clearing prices are assumed to more realistically gradually converge to Net CONE through the course of the study from current levels (approximately 33% of Net CONE in 2018).

The NYISO extended the prior capacity market analysis to study all Segment B projects in combination with the T027 Segment A project proposal. As a practical matter, all Segment B projects, other than T019, are electrically similar with regard to resource adequacy analysis. Therefore, the study work was limited to estimating the ICAP benefits for T027+T019 and T027+T029 which served as the proxy for all other Segment B projects.

### A6.2. Transmission Security Limits

Transmission Security Limits (TSLs) can be viewed as hard floors for each locality's LCR and are modelled as additional constraints in the optimization to respect all applicable reliability planning criteria in setting the LCRs. The TSLs utilized in this estimation were calculated consistent with the LCR TSL process described in Section A1.2. The TSLs were used to establish the LCR floors for use in the optimization. For each locality and each year in the study case, the LCR floors (%) shown in Table A-8 were calculated as the locality megawatt limit as a percentage of the locality peak forecast load.

**Table A-8: Transmission Security LCR Floors Used in the Optimization Tool**

| | | Transmission Security Floors | | | |
|---|---|---|---|---|---|
| | | J | K | GHIJ | HIJ |
| Base | 2025 | 80.79% | 103.65% | 86.88% | 68.95% |
| | 2030 | 81.00% | 103.86% | 87.37% | 70.02% |
| | 2035 | 81.88% | 104.08% | 88.07% | 71.25% |
| | 2040 | 82.72% | 104.28% | 88.74% | 72.42% |
| T019 | 2025 | 80.79% | 103.65% | 78.09% | 60.85% |
| | 2030 | 81.00% | 103.86% | 78.80% | 62.13% |
| | 2035 | 81.88% | 104.08% | 79.76% | 63.60% |
| | 2040 | 82.72% | 104.28% | 80.68% | 65.00% |
| T029 | 2025 | 80.79% | 103.65% | 78.61% | 59.84% |
| | 2030 | 81.00% | 103.86% | 79.30% | 61.15% |
| | 2035 | 81.88% | 104.08% | 80.24% | 62.64% |
| | 2040 | 82.72% | 104.28% | 81.15% | 64.07% |

Following completion of the additional analysis, an inconsistency was identified in the EFORd values used in the calculation of the LCR floors for the G-J and J localities in years 2030, 2035 and 2040. This inconsistency resulted in the use of slightly lower floors in the optimizer tool. An inconsistency was also identified in the load values used in the calculation of the Transmission Security Floors for the K locality, which resulted in the use of slightly higher floors in the optimizer tool. The impacts of these corrections on the ICAP benefit findings are described in Section A6.3.

### A6.3. Scenarios

In this extended analysis, the NYISO studied two scenarios: a baseline case, and a second case in which the capacity zones are reconstituted due to pending changes to the resource mix and the construction of the AC Transmission projects. The baseline case reflects the load, resource, and topology assumptions incorporated in the baseline case for the production cost analysis. This treatment is consistent with the assumptions used in the original ICAP benefit analysis.

There are two modifications in the second scenario. First, in the pre-project cases an H-J locality is created as UPNY/ConEd (G-to-H) emerges as a binding interface following the retirement of the Indian Point Energy Center. Secondly, in the post-project cases, the G-J locality is eliminated as UPNY/SENY no longer binds after the AC Transmission projects are placed in service. Given that Net CONE curves are not currently available for an H-J locality, the NYISO utilized the Net CONE for the G-J locality and adjusted the curves to reflect capacity available in the H-J locality.

Utilizing the optimization tool, the NYISO developed a range of ICAP benefit estimates for each of the Segment B projects in combination with the T027 proposal. These estimates do not account for the impedance data correction previously described. The estimated 20-year benefits in the "Existing Localities" scenario for T019 range from $744M to $1,040M compared to a range from $584M to $816M for all other Segment B projects. For the "G-J Elimination" scenario, the T019 benefits range between $1,385M and $1,936M compared to $1,327M and $1,856M for all other Segment B projects.

The inconsistencies in EFORd and load data described in Section A6.2 have a minor effect on the optimizer results. First, the EFORd and load data utilized in the MARS/Optimization tool were unaffected; only the LCR floors were affected by the inconsistencies. The inconsistency for J in the "Existing Localities" case did not impact the overall capacity benefit metric evaluation since the revised floors would not have been binding in the simulation. The inconsistency for G-J in the "Existing Localities" case did not impact the overall capacity benefit metric evaluation as the revised savings for T019 and T029 were impacted minimally, resulting in approximately $4M less incremental savings (<2% of the total incremental savings) for T029 relative to T019 over the 20-year evaluation period. The inconsistencies for the G-J and J localities in the "G-J Elimination" case did not impact the overall capacity benefit metric evaluation as the revised savings for T019 and T029 were impacted minimally, resulting in approximately $0.7M more incremental savings (<1% of the total incremental savings) for T029 relative to T019 over the 20-year evaluation period.

As described in Section A1.1, the impedance data correction provided to the NYISO for projects T019, T029, and T030 impacts the UPNY/SENY emergency transfer limits for those projects, resulting in a differential ranging from 400 MW to 550 MW greater transfer capability for T019 compared to the other Segment B projects rather than the previously calculated 950 MW. This reduced differential would have a corollary effect on the ICAP savings differential between the projects. Nevertheless, the additional increase of 400 MW to 550 MW to the interface that defines the G-J locality is significant, and therefore T019 still offers significantly greater capacity savings than the other Segment B projects. It is also important to note that the separate ICAP savings calculation performed by the Market Monitoring Unit (MMU) described in Section A6.4 is not affected by the impedance data correction. The MMU results, which also indicate significant savings from T019, will continue to be the lower bound of the ICAP savings metric.

### A6.4. Market Monitoring Unit's Findings

The NYISO's MMU performed an independent assessment of the capacity benefits of the proposed AC Transmission projects. The MMU has provided a memorandum detailing its methodology and estimates (provided in Appendix G). In short, the MMU's methodology is distinct from the optimizer approach outlined above and is designed to capture two segments of capacity benefits for transmission projects: avoided investment costs and enhanced reliability benefits. The former is derived from the reduced compensatory megawatts required to maintain a reliable system (at 0.1 LOLE); and the latter is derived from the lower LOLE (less than 0.1) with the transmission project in place.

The MMU estimated 20-year capacity benefits, shown in Table A-9, for the T027+T019 and T027+T029 project combinations for both the baseline case and the CES+Retirement case as modeled in the NYISO's production cost analyses.[8] The MMU impacts are less than those developed utilizing the optimization tool and are particularly driven by the project's impacts on the UPNY/ConEd interface limits (rather than UPNY/SENY). The table below summarizes the MMU's results.

**Table A-9: ICAP Savings from MMU Method**

| Case (20-year savings, 2018 $M) | T027+T019 | T027+T029 |
|---|---|---|
| Baseline Case | $237 | $218 |
| CES+Retirement Case | $592 | $523 |

### A6.5. Summary Conclusions

The NYISO developed a range of capacity benefit estimates for each of the Segment B projects in combination with the T027 proposal utilizing the modeling data originally provided by the developers of projects T019 and T029. For T019, the estimated benefits for the 20-year study period range from $744M to $1,936M; for all other Segment B projects, the estimated benefits range from $584M to $1,856M. Due to the changes in transfer limits resulting from the impedance data correction received after the analysis was complete, the estimates for T019 would be somewhat lower and the estimates for the other Segment B projects would be somewhat higher. The MMU's assessment yielded savings in range of $237M to $592M for T019, and $218M to $523M for all other Segment B projects.

Notwithstanding the impedance data correction, the additional increase of 400-550 MW of emergency transfer capability provided by T019 would be a significant benefit to the G-J locality.

[8] The MMU also estimated 45-year savings but for purposes of comparison, only the 20-year values are reported here.

Accordingly, T019 still offers greater capacity savings than all of the other Segment B projects. The MMU's assessment, which is unaffected by the impedance data correction, indicated additional ICAP savings associated with T019 ranging from $19M to $69M.

While it is difficult to predict the precise amount of these future benefits, under either the NYISO or the MMU methodology, the T019 project clearly produces the highest level of expected ICAP cost savings among the proposed Segment B projects. The Board has concluded that ICAP savings should be considered in the project ranking.

## A7. Interconnection Studies

The Public Policy Transmission Planning Process considers the status and results of the interconnection studies in evaluating and selecting the more efficient or cost-effective project. All of the AC Transmission projects are currently under evaluation in the NYISO's Transmission Interconnection Procedures under Attachment P to the NYISO's tariff. The Board requested further investigation of two interconnection issues that were outstanding at the time the Draft Report was issued: potential subsynchronous resonance due to series compensation, and the feasibility of a Middletown transformer upgrade. This section describes updates to the two issues.

### A7.1. Potential Subsynchronous Resonance Issue

Subsynchronous resonance (SSR) is a phenomenon that occurs between a series-compensated transmission line and the shaft system of a thermal generator unit. The series-compensated line can cause the network's natural frequencies to fall into the sub-synchronous frequency range (0-60 Hz) which can interact with the resonant frequencies of the turbine shaft system and cause serious damage to the turbine shaft. A generator that is connected near a highly series-compensated transmission line can be at considerable risk for undamped subsynchronous oscillations. A generator does not have to be radially connected to a series-compensated transmission line before SSR occurs, though the risk for generators in an interconnected network is typically less than in a radial system. The SSR phenomenon can be studied by performing frequency scanning of the network to calculate the driving point impedance, as seen from the neutral of the generator, and comparing the resonant frequencies with those of the turbine shaft system.

The National Grid/Transco T019 Segment B proposal introduces a potential risk of SSR that may be caused by interactions between the proposed 50% series compensation and nearby synchronous generators. As part of the System Impact Study conducted for T019 (NYISO Interconnection Queue #543) under Attachment P of the NYISO Open Access Transmission Tariff, Burns & McDonnell conducted an SSR screening study to identify any potential SSR problems that the proposed series capacitors may cause to nearby generators. A review of subsynchronous control interaction was not performed as a part of the screening study. While an initial draft of the screening study submitted by National Grid/Transco indicated that the proposed series compensation would not present a material SSR risk, the final screening study for the System Impact Study indicated that SSR could potentially be an issue. The study identified the potential for SSR between the Empire combined cycle plant (also known as Besicorp) and the project's Knickerbocker-Pleasant Valley series compensation. The Facilities Study for the project will include further screening analysis with other nearby generators and detailed electromagnetic transient studies of any potential resonant conditions. If potential resonant conditions are found, additional network upgrade facilities will also be identified in the Facilities Study.

The NYISO engaged ABB to independently develop and estimate costs for conceptual mitigation solutions to resolve the potential SSR issues identified in the Burns & McDonnell SSR screening study for the National Grid/Transco T019 Segment B project. The ABB report, included as Appendix B, documents a review of various mitigation measures and provides high-level cost estimates.

The NYISO requested ABB to evaluate five mitigation options under two scenarios: (1) SSR occurs only at the Empire plant, and (2) SSR occurs at Empire, Athens, and Cricket Valley plants. ABB estimates that if SSR mitigation is required only at the Empire plant, ABB estimates that costs for mitigations would range from $565,000 to $1,300,000. If SSR mitigation is required at Empire, Athens, and Cricket Valley, ABB estimates that costs would range from $1,860,000 to $4,875,000. ABB provides the pros and cons of each of the five mitigation options. ABB does not recommend and did not provide cost estimates for the option involving resonant blocking filters given that this option is not standard within the industry.

ABB notes that the risk for SSR and the nature of any potential SSR issue is inconclusive based on the current information. ABB also advises that before any mitigation option can be selected, additional analysis is necessary to confirm whether or not there is a risk of SSR and, if so, the precise nature of the SSR issue. Specifically, ABB identifies some concerns with regard to the risk of torsional interaction. Torsional interaction occurs when the effects of an electrical resonance properly align in frequency with a mechanical torsional mode of a machine. ABB states that the risk for torsional interaction is not limited to a radial connection between the machine and the series capacitor, but can occur anytime that the electrical damping becomes negative so long as 1) the mechanical mode aligns with the negative electrical damping; and 2) the electrical damping is sufficiently negative to overcome the mechanical damping. It is assumed that any additional studies to identify the potential for SSR associated with T019, and any necessary mitigation measures, will be addressed through the NYISO interconnection processes.

The ABB Report indicates that any potential SSR issue resulting from the series compensation associated with T019 can be mitigated in a cost effective manner. The need for, and design of, the appropriate mitigation measures will be determined during the remaining portion of the interconnection process and design phase for T019. Therefore, the Board has concluded that T019's series compensation and the potential associated risk of SSR should not negatively affect the project's ranking.

### A7.2. Middletown Transformer

The NAT/NYPA T029 and T030 Segment B proposals include replacement of the existing Orange & Rockland Middletown 345/138 kV 562 MVA transformer with a larger 720 MVA transformer. As part of the System Impact Study conducted for T029 (NYISO Interconnection Queue #559) under Attachment P of the NYISO Open Access Transmission Tariff, Orange & Rockland conducted a physical feasibility analysis for the proposed Middletown transformer. O&R identified a potential need for additional Network Upgrade Facilities (NUFs) at the Middletown substation, the Middletown – Shoemaker 138 kV line, and Shoemaker 138 kV substation and raised concerns related to the space required for the proposed transformer, permitting, and outage coordination.

In response to O&R's concerns, SECO conducted a site visit with O&R at the Middletown substation on August 13, 2018 to perform an independent physical feasibility evaluation and environmental assessment of the proposed replacement of the Middletown transformer. SECO determined that the larger transformer would fit inside the Middletown substation, which is assessed to be capable of holding a transformer with a depth of up to 60 feet. Additional equipment at Middletown Substation will have to be replaced and/or relocated. SECO determined the installation of the proposed transformer is physically feasible without impacting the nearby wetlands.

The NUFs associated with the Middletown transformer replacement identified in the System Impact Study will be further evaluated in the Facilities Study and will be refined with respect to equipment, design detail and cost, as applicable.

As indicated in the transfer capability assessment, it was found that the UPNY/SENY N-1-1 Normal and Emergency Transmission Security Limits are not a distinguishing factor among the proposed Segment B projects. It was also found that the Middletown transformer would not provide significant incremental benefits under the studied outage conditions when considering the alternate generation dispatch methodology.

# A8. Summary of Board Revisions

Transfer Capability Assessment:

- The Board views that the additional transfer capability provided by T019 constitutes a material benefit as compared to the other proposed projects which will allow for opportunities to leverage additional benefits from future upgrades to New York's transmission infrastructure.
- The additional transfer capability of the T019 project will materially improve the bulk power system's resilience, alleviate constraints between upstate resources and downstate load centers, and allow for greater operational flexibility as compared to the other proposed Segment B projects. The Board has concluded that the additional transfer capability provided by T019 should be reflected as a grid resilience benefit in the Operability metric.
- The Board requested further evaluation of how the Segment B projects could accommodate additional generation deactivations within Lower Hudson Valley if they occur while maintaining reliability because of the associated increase in UPNY/SENY transfer capability. This analysis indicates a significant benefit from the T019 project in a future scenario where the New York system is impacted by large upstate renewable additions and potential generation retirements.
- The Board has concluded that the increased transfer capability associated with the T019 project should be reflected as a material benefit in the Operability and Performance metrics as the project provides additional flexibility in operating the system under design and extreme conditions, and provides better utilization of the UPNY/SENY interface. With the best Cost per MW, T019 achieves this transfer capability more cost effectively than the other Segment B projects.

Installed Capacity Cost Savings Benefits:

- The Board views relative installed capacity cost savings as an appropriate consideration when comparing overall project performance and relative project ranking. While it is difficult to predict the precise amount of these future benefits, NYISO staff, along with the MMU, have each calculated a reasonable order of magnitude estimate of ICAP savings at the Board's request.

- While the estimated calculated savings differ, what is common across the NYISO and MMU methodologies and scenarios is that T019 consistently produces the highest level of ICAP cost savings among the proposed projects. This is a significant finding, which the Board concludes should be considered in the project ranking.

Grid Resilience Benefits:

- The T019 project foundations and structures are designed to specifications that exceed minimum engineering standards. While the cost associated with the enhanced structures is higher, the design provides incremental resilience benefits that are not provided by other proposed projects.
- The Board views the potential benefits of storm hardened transmission facility designs and the ability to withstand heavier ice accumulation loadings and limit cascading structure failures as providing meaningful resilience benefits as compared to the alternate proposed projects. The Board concludes that the incremental resilience benefit of the T019 structural design should be reflected more prominently in the Operability metric and in the project ranking.

Structure Heights:

- Considering the language provided in the PSC Order establishing the AC Transmission need, as well as an understanding of the Article VII siting process, the Board concludes that the PSC, not the NYISO, would address the visual impacts resulting from the number and height of structures used by Developers and that the PSC will determine how to modify projects to address these issues in Article VII siting proceedings.
- Accordingly, the Board has concluded that structure height, as a risk to project siting, should not be used to differentiate between project rankings.

Series Compensation Issues and Related Operational Benefits:

- The Board is satisfied that any potential SSR or related issues resulting from the series compensation can be mitigated in a cost effective manner. The need for, and design of, the appropriate mitigation measures will be determined during the remaining portion of the interconnection process and design phase for T019. Therefore, the Board concluded that the series compensation and the potential associated risk of SSR should not negatively affect T019's ranking.

- Additionally, the Board asked NYISO staff whether there are potential operational benefits associated with the series compensation capability included with T019. NYISO staff provided the Board with information related to how the proposed series compensation can provide certain operational benefits from improved utilization of the UPNY/SENY interface through NYISO actions directing the operational status of the series compensation. The Board has concluded that T019's improved control of Segment B power flows should be reflected as a benefit in the Performance metric.

Production Cost Analysis / Carbon Pricing Sensitivity:

- The Board requested additional production cost analysis to study the potential impact of incorporating carbon pricing in the NYISO's wholesale market on the relative cost effectiveness of Segment B projects.
- The analysis found that while there were increases in the production cost savings for all Segment B projects, the inclusion of the social cost of carbon did not alter the comparative ranking of projects with regard to production cost savings to capital cost ratio.

Middletown Transformer:

- In response to concerns voiced by the facility owner, the NYISO conducted site visits and additional analysis to determine that there were no appreciable barriers to accommodating the upgrade to the Middletown substation proposed by NAT/NYPA.
- Using the alternate dispatch methodology for the transfer limit analysis documented in this Addendum, it is found that the benefits provided by the proposed transformer upgrade are minimal and not a significant distinguishing factor among the Segment B projects.

Project Synergy and Diversity Considerations:

- The Draft Report included a synergy cost savings that might be realized if a single to developer conducted the work to build both segments. The conservative 5% was provided by the NYISO independent consultant (SECO) to represent shared common services. The Board asked NYISO staff and SECO to also consider whether having a diversity in project developers (*i.e.*, different developer for Segments A and B) could have benefits outside costs. SECO opined that having different developers for each segment could bring qualitative benefits, such as diversity of financing risks of the projects and the availability of additional resources to support project development.

- Subsequently, the Board has concluded that while cost savings may be realized from synergies of a common developer to Segments A and B, there are also diversity benefits that may be realized.

## A9. Revised Ranking

Based on consideration of all the evaluation metrics for efficiency or cost effectiveness, and having given due weight to metrics according to input from the NYISO Board and subsequent conclusions reached by the Board, the NYISO has determined the following revised ranking of the Segment B projects.

**Table A-10: Segment B Overall Ranking**

| Ranking | Project ID | Developer Name | Project Name |
|---|---|---|---|
| 1 | T019 | National Grid / Transco | New York Energy Solution Seg. B |
| 2 | T029 | North America Transmission / NYPA | Segment B Base |
| 3 | T023 | NextEra Energy Transmission New York | Enterprise Line: Segment B-Alt |
| 4 | T022 | NextEra Energy Transmission New York | Enterprise Line: Segment B |
| 5 | T030 | North America Transmission / NYPA | Segment B Enhanced |
| 6 | T032 | ITC New York Development | 16NYPP1-1B AC Transmission |

In consideration of the conclusions described in Section A8, T019 is ranked first among the Segment B projects. Based on the estimated project schedules, the in-service date established for the purposes of the Development Agreements for the selected Segment A and Segment B projects is December 2023. Critical comparisons of the Segment B projects and the resulting ranking are summarized below:

- T019 has the highest incremental UPNY/SENY transfer capability, resulting in the lowest cost per MW ratio, highest production cost savings, highest $CO_2$ emissions savings, and highest ICAP savings of the Segment B projects. The series compensation component of the project provides performance benefits through greater operational flexibility and utilization of the UPNY/SENY interface. The project also has the most resilient foundation and structure design resulting in significant benefits for the operability of the transmission system during extreme weather events.

- T029 is estimated to have the second-lowest capital costs among the Segment B projects. However, the project achieves less production cost savings than T019 and has a higher Cost per MW ratio. T029 also has a less resilient foundation and structure design than T019.

- T023's capital costs are estimated to be slightly more than T029 with comparable electrical performance and comparable replacement of aging infrastructure, therefore T023 is ranked lower than T029. T023 would retire additional aging lattice transmission structures compared to T022 resulting in a more resilient design overall.

- T022 is estimated to have the lowest capital costs of the Segment B projects with comparable electrical performance as the other Segment B projects, with the exception of T019. However, T022 proposes the least amount of aging infrastructure replacement among Segment B projects.
- T030 is more expensive because of an additional conductor (triple-bundle rather than double-bundle), however the additional conductor actually results in less production cost savings in the CES+Retirement scenario while only achieving slightly greater emergency transfer capability compared to T029. As such, T030 has the lowest production cost savings of the Segment B projects and would not have materially higher ICAP savings.
- T032 is the most expensive Segment B project with numerous inherent siting risks in the design, as identified in the Draft Report, with no material incremental performance benefits. T032 has the lowest production cost benefit/cost ratio and the highest cost-per-MW ratio.

# Additional Appendices

### Appendix G – Market Monitoring Unit Memo Re: Estimating Capacity Benefits

### Appendix H – ABB Subsynchronous Resonance Mitigation Cost Estimation Report

# NYISO Board of Directors' Summary of Proposed Modifications to Draft AC Transmission Public Policy Transmission Planning Report and Proposed Selections

**December 27, 2018**

## Introduction

NYISO staff submitted the draft AC Transmission Public Policy Transmission Planning Report ("Draft Report") to the NYISO Board of Directors ("Board") on June 19, 2018 for its review and action. The Draft Report summarized NYISO staff's analysis and recommendations concerning proposed solutions to address the AC Transmission Public Policy Transmission Needs identified by the New York Public Service Commission ("PSC"), which include the need to increase Central East transfer capability by at least 350 MW ("Segment A") and UPNY/SENY transfer capability by at least 900 MW ("Segment B").

In the Draft Report, NYISO staff recommended that the Board select as the more efficient or cost effective solution to address the AC Transmission Needs the Segment A Project T027 proposed jointly by North American Transmission ("NAT") and New York Power Authority ("NYPA") and the Segment B Project T029 also proposed by NAT and NYPA.

The Board provided interested parties with the opportunity to submit comments and to make oral presentations for the Board's consideration prior to its taking action on the Draft Report. Based on this input and the Board's independent review of the Draft Report, the Board directed NYISO staff to conduct certain additional studies and analyses.

After careful consideration of the initial Draft Report, comments provided by interested parties, and the additional analyses performed by NYISO staff, the Board concludes that the more efficient or cost effective solution for Segment A is Project T027. The Board also concludes that the most efficient or cost effective solution for Segment B is Project T019, which was jointly proposed by Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid") and the New York Transco, LLC ("Transco"). The Board has directed that the Draft Report be modified accordingly.

The additional analyses and the Board's conclusions are summarized below and are detailed in an Addendum to the Draft Report prepared by NYISO staff ("Revised Report"). In accordance with the NYISO's tariff, the Revised Report is being returned to the Management Committee for further review and comment. Following the Board's consideration of these comments, the Board will make its final determination on the Revised Report and the selection of the Public Policy Transmission Projects to address the AC Transmission Needs.

## BACKGROUND

### A. Board's Role in Approving Public Policy Transmission Planning Report and Selecting Public Policy Transmission Project

Section 31.4 of the NYISO's Open Access Transmission Tariff ("OATT") establishes the requirements for the NYISO's Public Policy Transmission Planning Process ("Public Policy Process") by which the NYISO addresses transmission needs that are driven by public policy requirements identified by the PSC. Pursuant to these requirements, NYISO staff develops a draft Public Policy Transmission Planning Report that sets forth its analyses and recommendations concerning proposed solutions to address a Public Policy Transmission Need. The draft report is submitted to the Electric System Planning Working Group ("ESPWG") and Transmission Planning Advisory Subcommittee ("TPAS") for stakeholders' review and comment and then forwarded to the Business Issues Committee and Management Committee for discussion and an advisory vote. Following the Management Committee vote, the draft report, with stakeholder input, is forwarded to the Board for its review and action.

The Board is ultimately responsible for selecting the more efficient or cost effective solution to address a Public Policy Transmission Need in accordance with the selection metrics established in the tariff. Section 31.4.11.2 of the OATT establishes the process for the Board's review and action on the Draft Report. Specifically, the "Board may approve the Public Policy Transmission Planning Report as submitted or propose modifications on its own motion, including a determination not to select a Public Policy Transmission Project to satisfy a Public Policy Transmission Need." If the Board proposes any changes to the report, "the revised report shall be returned to the Management Committee for comment." Furthermore, "[t]he Board shall not make a final determination on a revised report until it has reviewed the Management Committee comments, including comments regarding the Market Monitoring Unit's evaluation."

### B. AC Transmission Process

In accordance with the OATT, NYISO staff developed the Draft Report, which summarized staff's analyses and recommendations based on its evaluation of proposed solutions to address the AC Transmission Public Policy Transmission Needs identified by the PSC. NYISO staff recommended as the more efficient or cost effective solutions to address the AC Transmission Needs (i) Segment A Project T027 proposed jointly by NAT/NYPA and (ii) Segment B Project T029 also proposed by NAT/NYPA.

NYISO staff reviewed the Draft Report with stakeholders at ESPWG/TPAS meetings and then forwarded the Draft Report first to the Business Issues Committee and then to the Management Committee for their review and advisory votes. On June 26, 2018, the Management Committee conducted an advisory vote on the Draft Report. The Management Committee approved the motion with 80% of the vote in favor (with abstentions) and Con Edison, National Grid, and Orange & Rockland voting against the motion.

NYISO staff then submitted the Draft Report to the Board for its review and action. Along with the Draft Report, NYISO staff provided the Board with the comments submitted by stakeholder and developers during the committee process. In addition, the Board invited stakeholders and developers to submit additional comments and to make oral presentations for the Board's consideration. At its July 2018 meeting, the Board heard oral presentations by NAT/NYPA, National Grid/Transco, and NextEra. National Grid/Transco also provided additional written comments at the oral presentations.

## OVERVIEW OF MODIFICATIONS TO THE DRAFT REPORT

After careful consideration of the initial Draft Report, the comments and oral presentations provided by developers and stakeholders, and the additional analyses provided by NYISO staff, the Board has determined that certain changes are required to the Draft Report. The Board agrees that, as recommended in the initial Draft Report, the more efficient or cost effective solution for Segment A is Project T027. However, with respect to Segment B, the Board reaches a different conclusion than that recommended in the initial Draft Report.

The Board finds that the more efficient or cost effective transmission solution for Segment B is Project T019 rather than Project T029. The grounds for this conclusion are summarized below, and supporting data and analyses are included in the Addendum to the Revised Report.

### Transfer Capability

In evaluating Segment B projects, the Board concludes that Project T019's additional transfer capability drives superior performance across a number of important selection metrics. As described in the Draft Report, transfer limits significantly impact metrics such as Cost-per-MW and Operability, as well as estimated Installed Capacity cost savings, among others. The Board directed NYISO staff to conduct additional analyses related to the calculation of transfer limits for each of the proposed projects and to evaluate the resulting impact on key metrics, as discussed below.

Project T019 provides significantly greater transfer capability across the Upstate New York to Southeast New York ("UPNY/SENY") transmission interface as compared to all other

Segment B projects. This additional transfer capability provides several important benefits, as described below.

Project T019 provides important benefits by alleviating, to a greater extent than any other Segment B project, constraints that limit the economic flow of power between upstate resources the downstate load centers. In addition, Project T019's incremental transfer capability across the UPNY/SENY transmission interface will significantly improve grid resilience grid during stressed system conditions and disruptive events. Further, the Project T019's superior transfer capability will provide for greater future operating flexibility, particularly for managing generator outages or retirements in the Lower Hudson Valley. This will improve grid resilience and support the continued evolution of New York's energy landscape.

The additional transfer capability provided by Project T019 will make the greatest use of the Segment B corridor now, and it will allow New York to realize even greater benefits under a variety of future system conditions. The Board concludes that the Performance metric should take into account the increased utilization of the Segment B corridor and the additional benefits that a project would provide in the future if downstream limitations are alleviated, which potentially could be achieved without significant additional transmission development.

Evaluating the transfer limits assuming all facilities in service (N-1), NYISO staff produced a supplemental calculation of the Cost-per-MW ratio, which is contained in the Addendum. Based on the independent cost estimates provided by the NYISO independent consultant Substation Engineering Company (SECO), for each project and the revised transfer limits, the recalculated results continue to show that Project T019 has the lowest Cost-per-MW ratio of all Segment B projects.

The Board requested further evaluation of the extent to which each of the Segment B projects could accommodate additional generation retirements within the Lower Hudson Valley, should they occur, while maintaining reliability. Project T019 performs best among Segment B projects in this analysis as a result of its greater transfer capability. Under certain scenarios examined, Project T019 would accommodate significant additional generation retirements from the Lower Hudson Valley as compared to other Segment B projects. The Board views this to be a significant benefit that should be recognized under the Operability metric and impact project ranking.

This aspect of the Board's rationale for selecting Project T019 for Segment B is similar to its rationale for selecting Project T027 for Segment A. The superior transfer capabilities of these projects provide significant benefits that exceed those offered by the other proposed projects. The Board concludes that it is critically important to maximize the transmission capacity of these important rights-of-way at this juncture, especially when considering that no major AC transmission infrastructure has been developed in New York in over 30 years.

### Installed Capacity Cost Savings

In the Draft Report, estimated Installed Capacity cost savings were identified for purposes of supporting a Board decision to select a project, rather than to differentiate among specific projects. The Draft Report provided estimated capacity cost savings for projects in Tier 1 and 2. NYISO staff did not evaluate the capacity benefits for Project T019, however, as it was initially classified as a Tier 3 project.

The Board views relative Installed Capacity cost savings as an appropriate and important consideration, among others, when comparing overall project performance. The Board notes that Installed Capacity costs are identified as a potential selection metric in the NYISO tariff. Therefore, the Board asked NYISO staff to conduct further analysis evaluating whether particular Segment B projects, including T019, are likely to produce greater Installed Capacity cost savings relative to the other proposed projects.

The additional analysis indicates that Project T019's configuration provides the potential for materially greater Installed Capacity cost savings than the competing projects. While it is difficult to predict these future cost savings with precision, NYISO staff, with assistance from GE, calculated reasonable estimates using the "optimizer" tool accepted by FERC for purposes of calculating Locational Minimum Installed Capacity Requirements (LCRs). These estimates show that T019's incremental Installed Capacity savings range from $160 million to $224 million over 20 years as compared to other proposed projects. The NYISO's Market Monitoring Unit ("MMU"), Potomac Economics, developed an estimate using a different methodology indicating incremental Installed Capacity cost savings associated with T019 ranging from $19 million to $69 million. The MMU emphasized that its calculation methodology is sensitive to various assumptions and noted that the expected cost savings is likely to be higher.

While the estimates vary under different calculation methodologies and scenarios, Project T019 has been shown to consistently produce the highest level of Installed Capacity cost savings among the proposed Segment B projects. This is a significant finding that is important to consumers. The Board therefore concludes that it should be considered in the project ranking.

### Resilience Benefits

*Value of Structures that Exceed Minimum Standards*

The foundations and structures proposed for Project T019 are designed to specifications that exceed minimum engineering standards. The Draft Report recognized that benefit under the Operability metric.

The Board asked NYISO staff to provide further information on how the design of these structures provides additional resilience benefits. These benefits include the ability of the towers to withstand a higher level of icing and wind storm events. The structures proposed by Project

T019 could potentially avoid, or mitigate the extent of, catastrophic tower collapses, including cascading structure failures, such as those experienced in the 1998 ice storm in northern New York. The Board is particularly cognizant of the importance of resilience and the need to prepare the electric grid for extreme weather events and other contingencies.

While the cost associated with the structures is higher, the design provides benefits that are not provided by any other proposed project. The Board concludes that the incremental benefit of this design should be recognized more prominently in the Operability metric and in the project ranking.

*Value of Additional Transfer Capability*

Improving transmission capability within New York State has the additional benefit of improving the resilience of the transmission grid during stressed system conditions and disruptive events. These events can occur because of many different factors; examples include extreme storm conditions which can result in a large number of bulk electric system transmission outages or during events when critical supply resources are forced out of service or otherwise unavailable.

Therefore, the Board has concluded that the resilience benefit of the additional transfer capability provided by Project T019 should be reflected in the Operability metric and in the project ranking.

**Structure Height**

The Draft Report considered structure height to differentiate among projects. The Board acknowledges that the risk of obtaining siting approval is an appropriate metric for the NYISO to consider in accordance with its tariff. However, the Board views structure height as a siting issue that is more appropriately addressed through the Article VII siting process.

This finding is consistent with statements made by the PSC in its Order finding a Public Policy Transmission Need. In its December 17, 2015 order establishing the AC Transmission Needs, the PSC stated that "[a]s to structure heights, the Commission will not mandate criteria to be applied by the NYISO . . . ." Instead, the PSC stated that "all proposers of transmission solutions should be aware as they prepare their submissions that minimization of structure heights will be an important issue in the siting review process so applicants should be careful not to lock themselves into designs that could not later be approved." Moreover, the PSC said that "a change in structure types and structure heights of the types contemplated may have local, site specific visual impacts" that would be addressed by the Commission and the Staff in the Article VII siting process. Finally, with respect to visual impacts from a reduction in the total number of structures used, the PSC determined that "the NYISO would not have sufficient information to determine such impacts and the Commission does not want to convert the NYISO process into a siting process. Those matters will be further addressed by the Commission in the Article VII siting cases."

Taken together, these statements are consistent with the view that the PSC, not the NYISO, should address the visual impacts resulting from the number and height of structures used by developers and that the PSC will determine whether to require modifications to address these issues in Article VII siting proceedings. Accordingly, the Board concludes that structure height as a risk to project siting should not be used to differentiate among projects.

**Series Compensation**

National Grid and Transco proposed a series compensation element as part of Project T019. The Draft Report identified a potential for subsynchronous resonance ("SSR") caused by the interaction of the proposed series compensation and nearby synchronous generators. The Draft Report indicated this to be a potential risk to project completion.

National Grid and Transco submitted an initial screening study that indicated that the proposed series compensation would not present a material SSR risk. However, a subsequent System Impact Study for T019 completed in the NYISO's interconnection process found that SSR potentially could be an issue.

In light of these preliminary study results and related stakeholder comments, the Board requested that NYISO staff conduct further analysis to examine potential mitigation measures for SSR risk and the estimated cost of such measures. NYISO staff engaged ABB to perform an independent assessment that concluded that potential SSR issues caused by the series compensation feature of T019 can be mitigated through cost effective upgrades. ABB identified a range of viable mitigation approaches, the most costly of which was approximately $5 million.

Based on the ABB assessment, the Board is satisfied that any potential SSR issues resulting from the series compensation can be adequately mitigated in a cost effective manner. The need for, and design of, the appropriate mitigation measures will be determined in the interconnection process and design phase for T019. The Board therefore concludes that series compensation and the potential for SSR should not negatively impact T019's ranking.

The Board also asked NYISO staff whether there are potential operational benefits associated with the series compensation capability of Project T019. NYISO staff advised that series compensation provides an improved level of control of Segment B power flows. Specifically, the NYISO can direct the proposed series compensation to be switched in or out of service in response to grid reliability needs or to provide for more efficient use of the New York State transmission system, which can result in lower overall energy market costs and provide benefit to consumers. The NYISO has realized similar operational benefits, both from a grid reliability and energy market administration perspective, by directing the switching of the existing series compensation on the Marcy-South transmission lines based on expected summer and winter seasonal congestion patterns. The Board concludes that this benefit should be reflected in the Operability metric for T019.

**Production Cost Analysis / Carbon Pricing**

In the Draft Report, Project T019 produced incremental production cost savings of $50M over Project T029. The Board asked NYISO staff to perform additional production cost analyses to evaluate the potential impact of incorporating carbon pricing in the NYISO's wholesale market on the relative cost-effectiveness of the proposed Segment B projects.

NYISO staff evaluated Segment A Project T027 in combination with the proposed Segment B projects under a carbon pricing scenario.[1] NYISO staff's analysis found that while there were increased production cost savings offered by all relevant Segment B projects, with Project T019 demonstrating a marginal $3M increase in production cost savings, the inclusion of the social cost of carbon did not alter the comparative ranking of projects with regard to production cost savings relative to capital cost.

**Middletown Transformer**

Project T029 and Project T030 included as part of their proposals the replacement of an existing transformer at Orange and Rockland's (O&R's) Middletown substation with a new transformer with higher ratings.

O&R expressed concerns over the physical feasibility of this upgrade. O&R also identified a potential need for additional Network Upgrade Facilities at the Middletown substation, the Middletown – Shoemaker 138 kV line, and Shoemaker 138 kV substation and raised concerns related to the space required for the proposed transformer, permitting, and outage coordination.

In response to O&R's concerns, the Board asked NYISO staff to conduct additional review on the feasibility issues surrounding the proposed transformer replacement. NYISO staff directed SECO to conduct a site visit to perform an independent physical feasibility evaluation and environmental assessment. O&R was present at the site visit. SECO determined that the larger transformer would fit in the existing available space in the Middletown substation. SECO also determined that the installation of the proposed transformer is physically feasible without impacting the nearby wetlands.

[1] Simulations were not performed for T030 (North America Transmission/NYPA) because in all CES cases it underperforms T029 in production cost savings.

SECO noted that additional equipment at Middletown Substation would have to be replaced and/or relocated. Any additional upgrades associated with the Middletown transformer replacement identified in the system impact study would have be further evaluated in the Facilities Study. This study would refine upgrades identified with respect to equipment, design detail and cost, as applicable. It was additionally found that the Middletown transformer would not provide significant incremental UPNY/SENY transfer capability benefits under transmission outage conditions when considering the alternate generation dispatch methodology described in the Addendum. On balance, the proposed Middletown transformer replacement was not a material factor in the Board's selection.

**Synergy v. Diversity**

The Draft Report considers the potential impact of cost savings in the event that the same developer constructs both Segment A and Segment B. This is consistent with the PSC Order that indicated that such savings "may be considered" in such event. NYISO staff sought input, reflected in the Draft Report, from its independent consultant on the categories of costs that may experience savings. Based on this data, NYISO used a value of 5% potential synergy savings.

The Board asked staff to consider whether having a *diversity* of project developers (*i.e.*, different developer for Segments A and B) could provide benefits unrelated to project costs. NYISO staff evaluated the issue and sought input from its consultant. While NYISO staff was unable to quantify a dollar value associated with diversity, NYISO's consultant indicated that having different developers for each segment could bring qualitative benefits, such as diversifying financing risks of the projects and increasing the availability of additional resources to support project development. The Board concludes that such qualitative benefits are relevant to the Board's selection.

**Additional Observations**

The Board notes the additional conclusions from the Draft Report:

- Project T019 produces the greatest incremental voltage transfer limits across the Central East and UPNY/Con Ed interfaces.
- Project T019 has the lowest UPNY/SENY Cost-per-MW.
- Project T019 produces the greatest baseline production cost savings.
- Project T019 produces the greatest production cost savings for the CES+Retirement scenario.
- Project T019 produces greater $CO_2$ reductions.
- Project T019 produces the greatest 20-year incremental energy flow across UPNY/SENY and Central East interfaces.

**Conclusion and Next Steps**

Based upon the additional analysis and due diligence and careful examination of various findings in the original Draft Report, the Board concludes that Project T019 demonstrates superior performance across a broader range of metrics when compared to T029 and all other Segment B projects. This superior performance warrants the estimated additional costs of Project T019 compared to other Segment B projects, and this Project T019 will best serve the interest of New York ratepayers.

The significant distinguishing factor among the proposed Segment B projects is Project T019's additional transfer capacity across the UPNY-SENY transmission interface, which drives superior performance across a number of important metrics. The Board finds this especially compelling in recognition that Segment B of the AC Transmission Public Policy Transmission Need was focused specifically on increasing the transfer capability of this critical transmission interface.

Therefore, the Board concludes that Project T019 is the more efficient and cost effective Segment B project. Final selection of the projects will only occur after stakeholders have had the opportunity to comment on the revised report and the Board has had the opportunity to consider those comments.

Over the past six months, the Board has considered inputs from a number of sources including the Draft Report; the developers' proposals; assessments by several independent consultants including GE, SECO, and ABB; oral and written stakeholder comments; and input from the independent MMU, Potomac Economics. The Board has diligently weighed these inputs against the various metrics set forth in the NYISO tariffs and exercised its judgment on a wide variety of engineering, operational, economic, and other issues. Recognizing the NYISO's dual roles as transmission system operator and wholesale market administrator, this Board's challenge is to select the more efficient or cost effective transmission projects to address New York State's public policy needs. Subject to consideration of further comments from stakeholders and the MMU, the Board has identified the two projects that will best serve the interests of New York's electric consumers well into the future.

Attached to this memo is the Revised Report. The Addendum to the Revised Report reflects the Board's proposed changes to the recommendations in the Draft Report and details the additional analysis described above. Pursuant to Section 31.4.11.2 of the OATT, the Revised Report will be returned to the Management Committee for further comment. Following the Board's consideration of these comments, the Board will make its final determination on the Revised Report and the selection of the Public Policy Transmission Projects to address the AC Transmission Needs.

# # #

# AC Transmission Public Policy Transmission Planning Report

A Report by the
New York Independent System Operator

Initial Report
June 19, 2018

# Table of Contents

# Executive Summary

This report presents the results of the Public Policy Transmission Planning Process administered by the New York Independent System Operator (NYISO) for the AC Transmission Public Policy Transmission Needs. The New York State Public Service Commission (PSC) issued an order on December 17, 2015 identifying the AC Transmission Public Policy Transmission Needs. The following report represents the culmination of a multi-year joint effort by the NYISO, PSC, Developers, and stakeholders to address transmission needs associated with the Central East and Upstate New York/Southeast New York (UPNY/SENY) interfaces. The NYISO conducted extensive evaluations of the proposed viable and sufficient transmission projects and recommends the ranking and selection of the more efficient or cost-effective transmission solutions to the AC Transmission Public Policy Transmission Needs as described herein.

The NYISO commenced the Public Policy Transmission Planning Process for the first time by soliciting proposed transmission needs driven by Public Policy Requirements from NYISO's stakeholders and other interested parties. The NYISO filed the proposed transmission needs for consideration by the PSC, which, upon considering various comments submitted, issued an order that found significant benefits could be achieved by relieving the transmission constraints along the Central East and UPNY/SENY corridors. The PSC, therefore, adopted the AC Transmission Public Policy Transmission Needs ("AC Transmission Needs") specifically consisting of two segments: Segment A (Central East interface) and Segment B (UPNY/SENY interface). A key objective is to utilize existing rights-of-way to increase Central East transfer capability by at least 350 MW and UPNY/SENY transfer capability by at least 900 MW. Further details of the AC Transmission Needs are provided in Section 2.

The NYISO performed analysis to identify the specific transmission constraints in the transmission system in Central, Eastern, and Southeastern New York. Following review of the baseline analysis and discussions with stakeholders and prospective Developers, the NYISO issued a solicitation for solutions to address the AC Transmission Needs. The NYISO conducted the Viability and Sufficiency Assessment to address the needs, and identified thirteen viable and sufficient projects. Details of the proposed projects are provided in Section 3.

Following the PSC's review of the Viability and Sufficiency Assessment and consideration of public comments, the PSC issued an order confirming the AC Transmission Needs. Upon issuance of the order confirming the need for transmission, the NYISO immediately commenced a detailed evaluation of each viable and sufficient transmission proposal with the assistance of its independent consultant, Substation Engineering Company (SECO).

In determining which of the viable and sufficient proposed transmission projects are the more efficient or cost-effective solutions to satisfy the AC Transmission Needs, the NYISO considered the metrics set forth in the tariff and ranked each proposed project based on the its performance under these metrics. These metrics include capital costs, cost per MW, expandability, operability, performance, property rights and routing, risks to siting and operation, development schedule, and other metrics such as production cost savings, locational based marginal price (LBMP) savings, emissions savings, and congestion.

A core concept of the NYISO's evaluation and selection process is the use of an independent consultant to review each proposed project and apply a consistent methodology across all projects for establishing cost estimates, schedule estimates, and routing assessments. Utilizing detailed project information provided by the Developers, SECO developed independent capital cost and schedule estimates considering material and labor cost by equipment, engineering and design work, permitting, site acquisition, procurement and construction work, and commissioning needed for the proposed project. SECO's cost estimates for the proposed transmission projects range from $491 million to $863 million for Segment A projects and $373 million to $536 million for Segment B projects, with schedules ranging from 52 months to 55 months for Segment A projects and 47 months to 51 months for Segment B projects following the NYISO's selection.

As part of the AC Transmission proceedings, the PSC identified benefits from avoiding refurbishment costs by retiring aging transmission infrastructure and utilizing the right-of-way for new, upgraded transmission. In 2015, The Brattle Group estimated that, if no new transmission were built, the refurbishment of the Porter – Rotterdam 230 kV lines (Segment A corridor) and two 115 kV lines from Knickerbocker to Pleasant Valley (Segment B corridor) would cost $560 million and $279 million (both in 2015 $), or $839 million in total. The retirement of these aging transmission facilities is included in all project proposals. Therefore, the avoided refurbishment cost for these lines is not a distinguishing factor between projects, but should be recognized as a significant benefit provided by the selected projects.

A key objective of the AC Transmission Needs is to increase Central East and UPNY/SENY transfer capability. Each project's efficiency in achieving this objective is measured in a number of ways utilizing power flow and production cost simulations under a variety of system dispatches and conditions. To determine the cost effectiveness of each project, the NYISO compared these electrical results to SECO's independent capital cost estimate for each project. Further, the increased transfer capability and relief of these New York transmission constraints would result in production cost savings of as much as $337 million for the baseline system assumptions, and $1,129 million for the Clean Energy Standard (CES) + generation retirement scenario over the first 20 years of a project being in-service. The achieved savings may vary for each transmission project depending on the project design and system conditions in the future. The NYISO also assessed the potential capacity procurement savings that may be realized if the AC Transmission Needs are addressed. Although the NYISO continues to refine its capacity savings metric and did not use it to rank projects, the potential range of capacity savings of $550 to $850 million supports the recommendation for selection of a project to meet the transmission needs consistent with NYISO's competitive markets and the interests of consumers.

The NYISO also considers qualitative metrics such as expandability, operability, performance, and the risks associated with each project. The NYISO considered how the proposed projects affect flexibility in operating the system, such as dispatch of generation, access to operating reserves, access to ancillary services, and the ability to remove transmission for maintenance. Certain projects afford greater expandability opportunities through substation design and transmission line configurations, while other projects offer greater operability of the system through improved performance under outage conditions or better integration of facilities with the overall system.

A two-step process was used to rank the Segment A and Segment B projects, as detailed in Section 4. Projects in each segment were first analyzed individually, and then compared against each other to identify the major performance and risk differences as distinguishing factors. Metrics analyzed in this step include independent cost estimates, duration estimates, transfer capability, operability, expandability, property rights, replacement of aging infrastructure, and risks to project siting and operation. In the second step, the NYISO compared combinations of Segment A and Segment B projects based on consideration of all the evaluation metrics for efficiency or cost effectiveness. Cost savings were considered for synergies that may be realized for Segment A and Segment B projects proposed by the same developers. Improved system efficiency or cost effectiveness was also considered due to the combined electrical characteristics regardless of whether the projects are proposed by the same developers or not. The NYISO then used the combination to inform the numerical ranking in each Segment. **Table E-1** shows the project ranking in each Segment.

**Table E-1: Overall Ranking**

| Segment | Ranking | Project ID | Developer Name | Project Name |
|---|---|---|---|---|
| A | 1 | T027 | North America Transmission / NYPA | Segment A Double Circuits |
| | 2 | T028 | North America Transmission / NYPA | Segment A Enhanced |
| | 3 | T018 | National Grid / Transco | New York Energy Solution Seg. A |
| | 4 | T021 | NextEra Energy Transmission New York | Enterprise Line: Segment A |
| | 5 | T031 | ITC New York Development | 16NYPP1-1A AC Transmission |
| | 6 | T026 | North America Transmission / NYPA | Segment A Base |
| | 7 | T025 | North America Transmission / NYPA | Segment A + 765 kV |
| B | 1 | T029 | North America Transmission / NYPA | Segment B Base |
| | 2 | T030 | North America Transmission / NYPA | Segment B Enhanced |
| | 3 | T022 | NextEra Energy Transmission New York | Enterprise Line: Segment B |
| | 4 | T019 | National Grid / Transco | New York Energy Solution Seg. B |
| | 5 | T023 | NextEra Energy Transmission New York | Enterprise Line: Segment B-Alt |
| | 6 | T032 | ITC New York Development | 16NYPP1-1B AC Transmission |

Based on consideration of all the evaluation metrics for efficiency or cost effectiveness, together with input from stakeholders and the New York State Department of Public Service (DPS), the NYISO staff recommends that the NYISO Board of Directors select the Segment A Double-Circuit proposal (T027) proposed jointly by North America Transmission/NYPA, and the Segment B Base proposal (T029) also proposed by North America Transmission/NYPA, as the more efficient or cost-effective transmission solutions to satisfy the AC Transmission Public Policy Transmission Needs. Figure E-1 shows the geographic map of T027 and T029.

Major components of T027 include a new 86-mile double-circuit line between the Edic and New Scotland 345 kV substations, and the addition of a new Princetown 345 kV switchyard to connect to Rotterdam. The double-circuit line will utilize rights-of-way currently occupied by the Porter-Rotterdam 230 kV lines that will be decommissioned as part of the project. The benefits provided by the double-circuit 345 kV design include significant increases in Central East transfer capability, increased production cost savings, and excellent operability and expandability. T027 also has lower electromagnetic field (EMF) risk due to the double-circuit design.

**Figure E-1: Map of T027 and T029**

Among all Segment A proposals, T027 proposes the highest total mileage of aging infrastructure replacement. Considering the infrastructure replacements proposed by T027, this project will not only add efficient and cost-effective new transmission facilities, but will also obviate the need for a significant amount of transmission refurbishment costs. Therefore, the overall quantitative and qualitative benefits of T027 warrant the higher cost of that project relative to some other Segment A proposals.

Major components of T029 include a new Knickerbocker 345 kV switching station on the existing New Scotland to Alps 345 kV line, and a new 345 kV line from Knickerbocker to Pleasant Valley. The project includes various modifications to the 115 kV system between Greenbush and Pleasant Valley to allow for use of existing rights-of-way to accommodate the 345 kV line. T029 has the second lowest cost of the Segment B projects and provides similar UPNY/SENY transfer capability and production cost savings, while demonstrating excellent operability. Moreover, T029 is assessed to have the lowest siting risk due to the lower increases in structure height compared to other projects; in fact, more than half of its new structures will be lower than existing structure heights along the right-of-way.

The combination of T027 and T029 is estimated to cost $856 million, taking into account a 5% discount for cost efficiency synergies of having a single developer for both projects. Assuming a 30% contingency factor of $257 million, the combined projects are estimated to cost $1,113 million. The projects are expected to provide combined production cost savings and capacity procurement savings in a range of $881 million to $1,979 million depending on future system conditions. Combining the production cost savings and ICAP savings for T027+T029, the savings over capital cost ratio is 0.8 to 1.1 for the baseline, and 1.5 to 1.8 for the CES + Retirement scenario. Moreover, the projects would also result in savings from avoided aging transmission refurbishment costs estimated to total $839 million.

Based on the project schedule for T027 and T029 estimated by SECO, the in-service date for the selected projects is April 2023 if there is no major delay in siting. Following the approval of this report and selection of the projects by the Board of Directors, the NYISO will tender Development Agreements to the Developers of the selected transmission projects.

# 1. The Public Policy Transmission Planning Process

The Public Policy Transmission Planning Process (PPTPP) is the newest component of the NYISO's Comprehensive System Planning Process and considers transmission needs driven by Public Policy Requirements in the local and regional transmission planning processes. The Public Policy Transmission Planning Process was developed in consultation with NYISO stakeholders and the New York State Public Service Commission (PSC), and was approved by the Federal Energy Regulatory Commission (FERC) under Order No. 1000.[1] At its core, the Public Policy Transmission Planning Process provides for the NYISO's evaluation and selection of transmission solutions to satisfy a transmission need driven by Public Policy Requirements. The process encourages both incumbent and non-incumbent transmission developers to propose projects in response to an identified need.

The NYISO is responsible for administering the Public Policy Transmission Planning Process in accordance with Attachment Y to its Open Access Transmission Tariff (OATT). Consistent with its obligations to regulate and oversee the electric industry under New York State law, the PSC has the primary responsibility for the identification of transmission needs driven by Public Policy Requirements.

A Public Policy Transmission Planning Process cycle typically commences every two years following the posting of the draft Reliability Needs Assessment study results, and consists of four core steps—(1) the identification of a Public Policy Transmission Need, (2) developers proposing solutions to satisfy the identified Public Policy Transmission Need, (3) an evaluation of the viability and sufficiency of the proposed Public Policy Transmission Projects and Other Public Policy Projects, and (4) a comparative evaluation of the viable and sufficient projects for the NYISO Board of Directors to select the more efficient or cost-effective Public Policy Transmission Project that satisfies the Public Policy Transmission Need, if the PSC confirms that there is a need for transmission. The selected Public Policy Transmission Project is eligible for cost allocation and cost recovery under the NYISO's tariffs.

---

[1] *See New York Indep. Sys. Operator, Inc.*, Order on Compliance Filing, 143 FERC ¶ 61,059 (April 18, 2013); *New York Indep. Sys. Operator, Inc.*, Order on Compliance Filing, 148 FERC ¶ 61,044 (July 17, 2014); *New York Indep. Sys. Operator, Inc.,* Order on Compliance Filing, 151 FERC ¶ 61,040 (April 16, 2015); *New York Indep. Sys. Operator, Inc.,* Order on Compliance Filing, 155 FERC ¶ 61,037 (April 18, 2016); *New York Indep. Sys. Operator, Inc.*, Order on Compliance Filing, 162 FERC ¶ 61,107 (February 15, 2018). *See also New York Indep. Sys. Operator, Inc.*, Acceptance of Compliance Filings in Docket Nos. ER13-102-012, ER13-102-013 and ER13-102-014 (June 5, 2018)(granting final acceptance to NYISO regional planning compliance filings).

## 1.1 Identification of a Public Policy Transmission Need

For each cycle of the Public Policy Transmission Planning Process, the NYISO begins the process by inviting stakeholders and interested parties to submit proposed transmission needs driven by Public Policy Requirements. A Public Policy Requirement includes an existing federal, state, or local law or regulation, or a new legal requirement that the PSC establishes after public notice and comment under New York State law.

Following the submission of proposals, the NYISO posts all submittals on its website and provides those submissions, including any proposal from the NYISO, to the PSC. The NYISO separately provides any submission that proposes the identification of transmission needs driven by Public Policy Requirements within the Long Island Transmission District to the Long Island Power Authority (LIPA). The PSC and LIPA, as applicable, consider the proposals in order to identify any Public Policy Transmission Needs, and the PSC determines whether the NYISO should solicit solutions to any of the identified needs.

## 1.2 Solicitation for Proposed Solutions

After the PSC determines that a Public Policy Transmission Need or a transmission need solely within the Long Island Transmission District driven by a Public Policy Requirement should be evaluated and considered by the NYISO for selection and regional cost allocation, the NYISO solicits proposed solutions that Developers believe will satisfy the identified need. Developers have 60 days to propose their solutions and must provide specific Developer qualification and project information as detailed in Attachment Y to the OATT, the Public Policy Transmission Planning Process Manual, and the NYISO's solicitation.

Under the Public Policy Transmission Planning Process, proposed solutions fall into two categories—(i) Public Policy Transmission Projects and (ii) Other Public Policy Projects. A Public Policy Transmission Project is a transmission project or a portfolio of transmission projects proposed by a qualified Developer to satisfy an identified Public Policy Transmission Need and for which the Developer seeks to be selected by the NYISO for purposes of allocating and recovering the project's costs under the NYISO OATT. An Other Public Policy Project is a non-transmission project (*i.e.*, generation or demand-side projects) or a portfolio of transmission and non-transmission projects proposed by a Developer to satisfy an identified Public Policy Transmission Need. The NYISO will determine whether an Other Public Policy Project is viable and sufficient to meet a Public Policy Transmission Need. However, an Other Public Policy Project is not entitled to cost allocation and recovery under the NYISO OATT.

### 1.3 Evaluation for Viability and Sufficiency

In the first phase of analysis, the NYISO evaluates each proposed solution to the Public Policy Transmission Need to determine whether it is viable and sufficient. The NYISO assesses all resource types on a comparable basis within the same general timeframe. Under the viability evaluation, the NYISO considers a Developer's qualification and the project information data to determine whether the project is technically practicable, whether there is the ability to obtain the necessary rights-of-way within the required timeframe, and whether the Developer could complete the project within the required timeframe. Under the sufficiency evaluation, the NYISO evaluates the degree to which each proposed solution independently satisfies the Public Policy Transmission Need, including any specific criteria established by the PSC in its order identifying the need. After completing the viability and sufficiency evaluations, the NYISO presents the assessment to stakeholders, interested parties, and the PSC for review and comments.

Following the NYISO's presentation of the Viability and Sufficiency Assessment, the Public Policy Transmission Planning Process requires the PSC to review the assessment and issue an order. If the PSC concludes that there is no longer a transmission need driven by a Public Policy Requirement, the NYISO will not perform an evaluation, or make a selection of, a more efficient or cost-effective transmission solution for that planning cycle. If the PSC modifies the transmission need driven by a Public Policy Requirement, the NYISO will restart its Public Policy Transmission Planning Process as an out-of-cycle process. This out-of-cycle process begins with the NYISO's solicitation of Public Policy Transmission Projects to address the modified Public Policy Transmission Need. The NYISO evaluates the viability and sufficiency of the proposed Public Policy Transmission Projects. The NYISO then evaluates the viable and sufficient Public Policy Transmission Projects for purposes of selecting the more efficient or cost-effective transmission solution to the modified Public Policy Transmission Need.

### 1.4 Evaluation for Selection as the More Efficient or Cost-Effective Solution

Once the PSC determines that there continues to be a transmission need driven by a Public Policy Requirement, the NYISO evaluates the proposed Public Policy Transmission Projects. The NYISO only considers those Public Policy Transmission Projects that it determined to be viable and sufficient and that have provided the required notifications to proceed with the evaluation for selection as the more efficient or cost-effective solution to the identified need.

The NYISO's selection is based on the totality of its evaluation of the eligible projects using the pre-defined metrics set forth in Attachment Y of the OATT and others set by the PSC and/or in consultation with stakeholders. The NYISO uses the project information provided by the Developer at the start of the process, in addition to any other information available to the NYISO. In performing its evaluation, the NYISO and its an independent consultant, reviews the reasonableness and comprehensiveness of the information submitted by the Developer for each project that is eligible for selection to be measured against the specific evaluation metrics (*see* Section 3.2, below).

In determining which of the eligible proposed regulated Public Policy Transmission Projects is the more efficient or cost-effective solution to satisfy the Public Policy Transmission Need, the NYISO considers each project's total performance under all of the selection metrics. The NYISO may develop scenarios that modify certain assumptions to evaluate the proposed Public Policy Transmission Projects under differing system conditions. The NYISO considers and ranks each proposed solution based on its performance under the metrics. Based upon its evaluation of each viable and sufficient Public Policy Transmission Project, the NYISO staff recommends in the draft Public Policy Transmission Planning Report what project is the more efficient or cost-effective solution to satisfy the Public Policy Transmission Need, if any. After the draft report is reviewed through the collaborative governance process and by the Market Monitoring Unit, the NYISO Board of Directors may approve the report, including whether to select a Public Policy Transmission Project, or propose modifications.

### 1.5 Identifying a Cost Allocation Methodology for the Public Policy Transmission Need

Under the Public Policy Transmission Planning Process and consistent with FERC's directives under Order No. 1000, a regulated transmission project that is selected as the more efficient or cost-effective solution to satisfy an identified Public Policy Transmission Need will be eligible to receive cost allocation and recovery under the OATT. The Public Policy Transmission Planning Process contains an approved load ratio share cost allocation methodology, and a multi-step process for identifying any alternative methodology. This process is designed to provide flexibility in prescribing a methodology that would allocate the costs of a selected Public Policy Transmission Project consistent with the Public Policy Requirement driving the identified transmission need and roughly commensurate with the derived benefits. In allocating the costs of the selected Public Policy Transmission Project, the NYISO will use the default methodology under Attachment Y to the OATT or an alternative methodology proposed in this process and accepted by FERC. The cost allocation methodology eventually accepted by the Commission has no bearing on the NYISO's selection of the more efficient or cost-effective transmission project to meet the Public Policy Transmission Need.

# 2. AC Transmission Public Policy Transmission Needs

## 2.1 Identification of AC Transmission Public Policy Transmission Needs

The NYISO issued a letter on August 1, 2014, inviting stakeholders and interested parties to submit proposed transmission needs driven by Public Policy Requirements to the NYISO on or before September 30, 2014.[2] On October 3, 2014, the NYISO filed the proposed needs for consideration with the PSC.[3] These proposed needs had two common and recurring themes: (i) increase transfer capability between upstate and downstate, and (ii) mitigate transmission constraints in Western New York to facilitate full output from the Niagara hydroelectric power plant and imports from Ontario. The PSC issued notices soliciting public comments on the proposed needs on November 12, 2014, and numerous parties submitted comments.[4]

Prior to the NYISO's solicitation of proposed transmission needs driven by Public Policy Requirements, the PSC initiated the Alternating Current Transmission Upgrades proceedings to consider whether to address the persistent transmission congestion that exists at the Central East and Upstate New York/Southeast New York (UPNY/SENY) electrical interfaces on the New York State Transmission System.[5] In those proceedings, the PSC sought and received in January 2013 numerous proposed projects to address the PSC's public policy objective with the intent of increasing transfer capability by approximately 1,000 MW based upon the recommendation of the Governor's Energy Highway Task Force. In response to the 2014 State of the State Address encouraging utilities and transmission developer to build solely within existing rights-of-way corridors, the PSC afforded the opportunity for revisions to the proposals, and four entities proposed 22 revised proposals.

---

[2] The NYISO's letter can be obtained at the following link: http://www.nyiso.com/public/markets_operations/services/planning/planning_studies/index.jsp.

[3] The proposed needs and the NYISO's submission of the needs can be obtained at the following link: http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=14-E-0454&submit=Search.

[4] The notices seeking comments were issued under PSC Case Nos. 12-T-0502, *et al*., and PSC Case No. 14-E-0454, and the comments can be obtained from the Department of Public Service website: http://www.dps.ny.gov/.

[5] The UPNY/SENY interface represents a collection of transmission on which power flows from upstate New York to southeast New York, and is comprised of: two 345 kV lines from Utica to south of the Catskills (commonly known as "Marcy South"); three 345 kV lines from Athens to Kingston and Pleasant Valley, in addition to underlying 115 kV lines (commonly known as "Leeds South"); and one 345 kV line from Connecticut to Pleasant Valley (commonly known as "Pleasant Valley-Long Mountain").

Following the PSC's receipt and review of comments in response to the NYISO's invitation for proposed transmission needs driven by Public Policy Requirements, the PSC continued its efforts in the Alternating Current Transmission Upgrades comparative proceedings and sought to coordinate its comparative evaluation of proposed projects with the NYISO's Public Policy Transmission Planning Process. During the period in which the PSC was considering comments, the PSC requested that the NYISO perform analysis of the 22 proposed projects proposed in the PSC's proceedings. On July 6, 2015, DPS posted the Trial Staff Interim Report with the initial results of the NYISO's evaluation, and the NYISO, on July 20, 2015, presented the initial results at a technical conference hosted by New York State Department of Public Service (DPS) in the Alternating Current Transmission Upgrades proceedings.

Thereafter, due to public information that the CPV Valley Energy Center—a 680 MW generation facility that would interconnect to the New York State Transmission System at Dolson Avenue Substation—received its financing and would commence construction, DPS requested the NYISO to update its analysis to consider the effects of the CPV Valley Energy Center. On September 22, 2015, DPS issued its Trial Staff Final Report, containing the results of the NYISO's analysis, and a companion motion recommending that the Commission find that there are transmission needs driven by Public Policy Requirements to move power from upstate to downstate over the Central East and UPNY/SENY interfaces.

Following presentation of the Trial Staff Final Report at a technical conference in October 2015, the PSC issued an order, on December 17, 2015, identifying numerous public policies[6] that, taken

[6] The PSC identified that, as it relates to the AC Transmission Needs, it is the public policy of the state to: reduce transmission congestion so that large amounts of power can be transmitted to regions of New York where it is most needed; to reduce production costs through congestion relief; reduce capacity resource costs; to improve market competition and liquidity; to enhance system reliability, flexibility, and efficiency; to improve preparedness for and mitigation of impacts of generator retirements; enhance resiliency/storm hardening; to avoid refurbishment costs of aging transmission; to take better advantage of existing fuel diversity; to increase diversity in supply, including additional renewable resources; to promote job growth and the development of new efficient generation resources Upstate; to reduce environmental and health impacts through reductions in less efficient electric generation; to reduce costs of meeting renewable resource standards; to increase tax receipts from increased infrastructure investment; to enhance planning and operational flexibility; to obtain synergies with other future transmission projects; and to relieve gas transportation constraints. December 2015 Order at pp 66-67. In addition, the Commission found that the 2015 State Energy Plan (containing the New York's Energy Highway Blueprint), Section 6-104(1) of the New York Energy Law that requires the State Energy Planning Board to adopt a State Energy Plan, and Section 6-104(5)(b) of the New York Energy Law constitute Public Policy Requirements. *See id.* at pp 67-68.

together, constitute Public Policy Requirements driving transmission needs associated with the Central East and UPNY/SENY interfaces on the New York State Transmission System (collectively, "AC Transmission Needs").[7] The PSC distinguished the transmission needs based on each affected system—*i.e.*, Central East (Segment A) and UPNY/SENY (Segment B), and described the transmission needs on the two segments as follows:

**SEGMENT A**

Edic/Marcy to New Scotland; Princetown to Rotterdam

Construction of a new 345 kV line from Edic or Marcy to New Scotland on existing right-of-way (primarily using Edic to Rotterdam right-of-way west of Princetown); construction of two new 345 kV lines or two new 230 kV lines from Princetown to Rotterdam on existing Edic to Rotterdam right-of-way; decommissioning of two 230 kV lines from Edic to Rotterdam; and related switching or substation work at Edic or Marcy, Princetown, Rotterdam and New Scotland.

**SEGMENT B**

Knickerbocker to Pleasant Valley

Construction of a new double circuit 345 kV/115 kV line from Knickerbocker to Churchtown on existing Greenbush to Pleasant Valley right-of-way; construction of a new double circuit 345 kV/115 kV line or triple circuit 345 kV/115 kV/115 kV line from Churchtown to Pleasant Valley on existing Greenbush to Pleasant Valley right-of-way; decommissioning of a double-circuit 115 kV line from Knickerbocker to Churchtown; decommissioning of one or two double-circuit 115 kV lines from Knickerbocker to Pleasant Valley; construction of a new tap of the New Scotland-Alps 345 kV line and new Knickerbocker switching station; and related switching or substation work at Greenbush, Knickerbocker, Churchtown and Pleasant Valley substations.

Upgrades to the Rock Tavern Substation Terminal Equipment

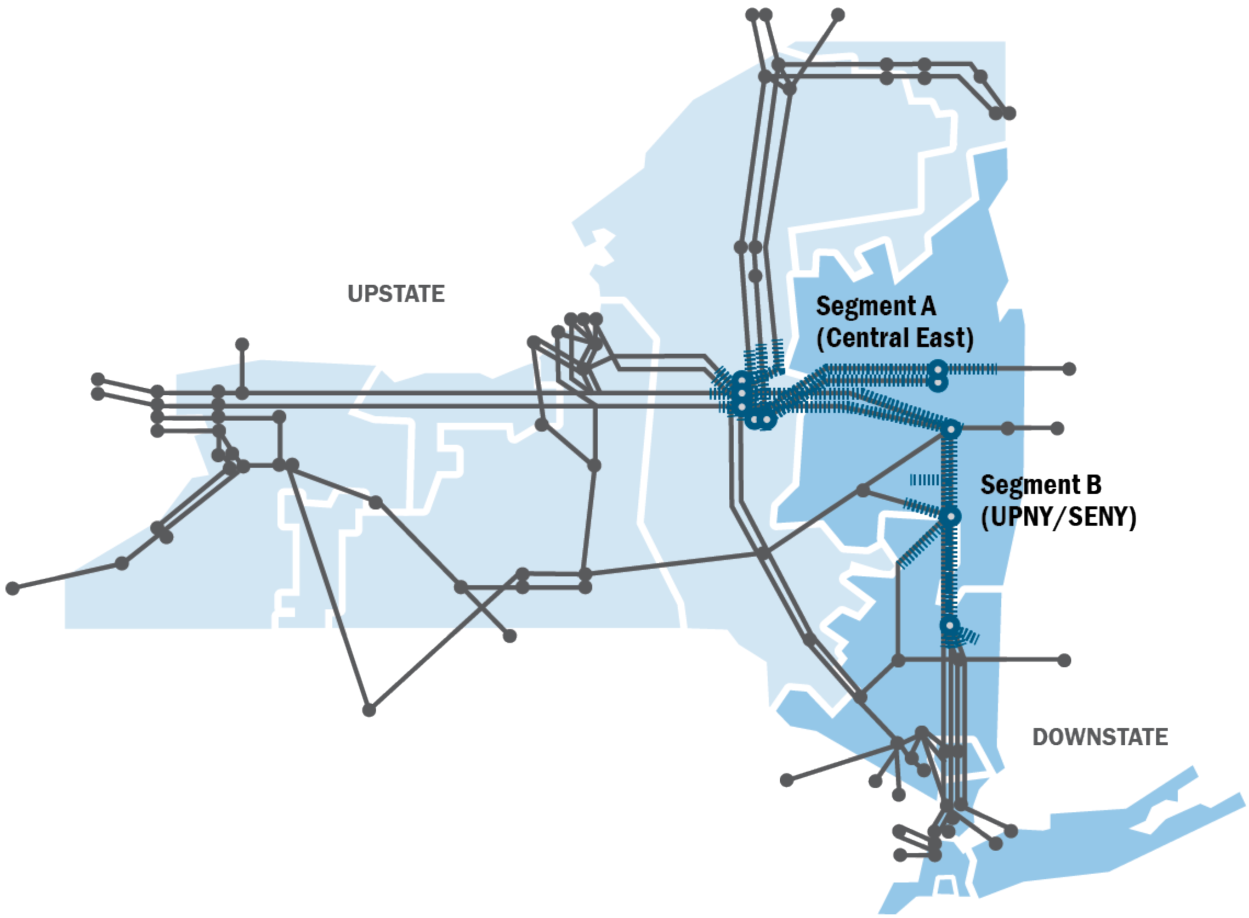
New line traps, relays, potential transformer upgrades, switch upgrades, system control upgrades and the installation of data acquisition measuring equipment and control wire needed to handle higher line currents that will result as a consequence of the new Edic/Marcy to New Scotland; Princetown to Rotterdam and Knickerbocker to Pleasant Valley lines.

[7] *See* December 2015 Order, at p 68 & Appendix A.

Shoemaker to Sugarloaf

Construction of a new double circuit 138 kV line from Shoemaker to Sugarloaf on existing Shoemaker to Sugarloaf right-of-way; decommissioning of a double circuit 69 kV line from Shoemaker to Sugarloaf; related switching or substation work at Shoemaker, Hartley, South Goshen, Chester, and Sugarloaf.[8]

**Figure 2-1: AC Transmission Public Policy Transmission Needs**




The PSC referred the AC Transmission Needs to the NYISO for solicitation and evaluation of proposed solutions under the NYISO's Public Policy Transmission Planning Process for potential selection in the regional transmission plan for purposes of cost allocation under the OATT. The PSC

[8] December 2015 Order, at Appendix A. With respect to the upgrades to the Rock Tavern substation terminal equipment and the Shoemaker-Sugarloaf facilities, the PSC stated that "all developers should include the upgrade costs in their bids at the same level, and the upgrade costs should not be used as a distinguishing factor between bids." *Id.* at p 62.

also prescribed specific evaluation criteria in Appendix B of the December Order, which are set forth in Appendix C of this report, for the NYISO to consider, to the extent feasible, in its evaluation and selection process.

In addition, the PSC identified that the cost allocation methodology for the AC Transmission Needs would be based on a "beneficiaries pay" approach that would allocate the 75 percent of the project costs to economic beneficiaries of reduced congestion and the remaining 25 percent of the project costs across the state based upon load-ratio share.[9] The PSC noted that this methodology will allocate approximately 90 percent of the transmission project's cost to ratepayers in the downstate region. The PSC requested the NYISO to apply its expertise and design a more granular cost allocation among downstate entities consistent with the prescribed methodology.

### 2.2 Development of Solutions

The NYISO made a presentation at a combined meeting of the Transmission Planning Advisory Subcommittee (TPAS) and Electric System Planning Working Group (ESPWG) on February 5, 2016 to review the PSC's December 2015 Order and the nature of the resulting AC Transmission Needs.[10] The NYISO then established sufficiency criteria in accordance with the criteria set by the PSC in its December 2015 Order, and made available baseline models and associated Power flow results to aid interested parties in developing project proposals.[11] The PSC specifically prescribed in its December 2015 Order that, in order for a proposed Public Policy Transmission Project or Other Public Policy Project to be considered sufficient by the NYISO, it must satisfy, at a minimum, the following criteria:

- Proposed solutions to Segment A (Central East) must provide at least a 350 MW increase to the Central East interface transfer capability in accordance with Normal Transfer Criteria as defined by the New York State Reliability Council (NYSRC) Reliability Rules.

---

[9] *Id.* at p 69 & Appendix D.

[10] The NYISO presentation is posted on its website under meeting materials at the following link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_espwg/meeting_materials/2016-02-05/03_AC%20Transmission_PPTN.pdf.

[11] The baseline study cases for the AC Transmission Needs were the same system representation used by the NYISO to perform the evaluation directed by DPS for the Trial Staff Final Report in the Alternating Current Transmission Upgrades proceedings. The baseline study cases were available to all developers, subject to satisfactorily completing a Critical Energy Infrastructure Information (CEII) request, and the base line results are publicly available on the NYISO website at: http://www.nyiso.com/public/markets_operations/services/planning/planning_studies/index.jsp

- Proposed solutions to Segment B (UPNY/SENY) must provide at least a 900 MW increase to the UPNY/SENY interface transfer capability in accordance with Normal Transfer Criteria as defined by the NYSRC Reliability Rules.

Additionally, a sufficient Public Policy Transmission Project must meet the following criteria, as set forth by the December 2015 Order:

- Proposed solutions to Segment A (Central East) must include all project components included in Segment A, as described in the December 2015 Order.
- Proposed solutions to Segment B (UPNY/SENY) must include all project components included in Segment B, as described in the December 2015 Order.
- No acquisition of new permanent transmission rights-of-way, except for *de minimis* acquisitions that cannot be avoided due to unique circumstances; however, the transfer or lease of existing transmission right-of-way property or access rights from a current utility company owner to a Developer shall not be considered such an acquisition.
- No crossing of the Hudson River, either overhead, underwater, in riverbed, or underground, or in any other way by any component of the transmission facility.
- For those Public Policy Transmission Projects that were also evaluated in the Alternating Current Transmission Upgrades proceedings, the December 2015 Order required that the cost estimate must not exceed the level estimated by the Trial Staff for the project, unless the developer can demonstrate that upward estimates are necessary to correct errors or omissions made by Trial Staff for the components that were added or adjusted by Trial Staff.

For each proposed Public Policy Transmission Project, the PSC required the sponsoring developer to submit at least two project cost estimates. The first cost estimate required the developer to presume that "all prudently incurred costs will be recovered and there will be no sharing of cost overruns."[12] The second cost estimate was required to reflect an 80/20 incentive regime, where if there are actual cost overruns, "the developer shall bear 20% of the cost over-runs, while ratepayers shall bear 80% of those costs[, but if] actual costs come in below a bid, then the developer should retain 20% of the savings," provided that the developer would not seek incentives

[12] December 2015 Order, at Appendix C.

from FERC above the base return-on-equity otherwise approved.[13]

On February 29, 2016, the NYISO issued a solicitation for proposed solutions of all types (transmission, generation, and demand side) to the AC Transmission Needs. Following the issuance of the solicitation, the NYISO received numerous questions from interested developers seeking clarification on the process and the AC Transmission Needs. The NYISO issued a public Frequently Asked Questions (FAQ) document on March 30, 2016, and updated it on April 13, 2016, summarizing the questions and providing responses.[14]

As a result of the solicitation, the NYISO received a total of 16 proposals consisting of both Public Policy Transmission Projects and an Other Public Policy Project. The list of the proposed projects submitted to the NYISO and considered in the Viability and Sufficiency Assessment are included in **Table 2-1**, below.

[13] *Id.*

[14] The AC Transmission Public Policy Transmission Needs FAQ document is available at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Public_Policy_Documents/AC_Transmission_PPTN/AC-Transmission_PPTN_FAQ_2016-04-13.pdf.

**Table 2-1: Proposed Projects**

| Developer | Project Name | Project ID | Category | Type | Location (County/State) |
|---|---|---|---|---|---|
| National Grid/Transco | New York Energy Solution Segment A | T018 | PPTP | AC | Segment A |
| National Grid/Transco | New York Energy Solution Segment A | T019 | PPTP | AC | Segment B |
| NextEra Energy Transmission New York | Enterprise Line: Segment A | T021 | PPTP | AC | Segment A |
| NextEra Energy Transmission New York | Enterprise Line: Segment B | T022 | PPTP | AC | Segment B |
| NextEra Energy Transmission New York | Enterprise Line: Segment B-Alt | T023 | PPTP | AC | Segment B |
| North America Transmission / NYPA | Segment A + 765 kV | T025 | PPTP | AC | Segment A |
| North America Transmission / NYPA | Segment A Base | T026 | PPTP | AC | Segment A |
| North America Transmission / NYPA | Segment A Double Circuit | T027 | PPTP | AC | Segment A |
| North America Transmission / NYPA | Segment A Enhanced | T028 | PPTP | AC | Segment A |
| North America Transmission / NYPA | Segment B Base | T029 | PPTP | AC | Segment B |
| North America Transmission / NYPA | Segment B Enhanced | T030 | PPTP | AC | Segment B |
| ITC New York Development | 16NYPP1-1A AC Transmission | T031 | PPTP | AC | Segment A |
| ITC New York Development | 16NYPP1-1B AC Transmission | T032 | PPTP | AC | Segment B |
| AvanGrid | Connect New York Recommended | T033 | PPTP | HVDC | Segments A and B |
| AvanGrid | Connect New York Alternative | T034 | PPTP | HVDC | Segments A and B |
| GlidePath | Distributed Generation Portfolio | OPP004 | OPPP | Gen | Orange, Ulster, Putnam, Greene, NY |
| PPTP = Public Policy Transmission Project<br>OPPP = Other Public Policy Project | | | Gen = Generation<br>AC = Alternating Current Transmission<br>HVDC = High-Voltage Direct Current Transmission | | |

## 2.3 Viability and Sufficiency Assessment

Through the second and third quarters of 2016, the NYISO assessed the viability and sufficiency of all proposed projects. In conducting its viability and sufficient assessment, the NYISO performed a comparable transfer limit analysis of each project in the same manner as the baseline analysis.[15] Consistent with the PSC's direction that Segment A proposals depend on a Segment B proposal being in place, the NYISO combined each Segment A proposal with each developer's Segment B counterpart proposal. If there was at least one combined case that increased the Central East transfer limit by at least 350 MW, the Segment A proposal met the Central East sufficiency criterion.

The NYISO presented a draft AC Transmission Public Policy Transmission Needs Viability and Sufficiency Assessment to stakeholders at the joint ESPWG/TPAS on September 26, 2016. After receiving and addressing comments from stakeholders, the NYISO posted on its website the final Viability and Sufficiency Assessment report on October 27, 2016 and filed the same at the PSC in Case No. 14-E-0454 and the Alternative Current Transmission Upgrades proceedings on October 28, 2016.[16] The assessment is included in this report as Appendix B.[17]

In the AC Transmission Public Policy Transmission Needs Viability and Sufficiency Assessment, the NYISO determined the following projects are viable and sufficient to satisfy the AC Transmission Needs:

T018: National Grid / Transco – New York Energy Solution Segment A

T019: National Grid / Transco – New York Energy Solution Segment B

T021: NextEra Energy Transmission New York – Enterprise Line: Segment A

T022: NextEra Energy Transmission New York – Enterprise Line: Segment B

---

[15] On July 29, 2016, the NYISO notified stakeholders and interested parties that although it had acted diligently in administering the current process, it would extend the 2014 cycle of the Public Policy Transmission Planning Process beyond two years as permitted by the OATT. *See* OATT Section 31.4.1.

[16] The NYISO's filing can be obtained at the following link:

http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=12-t0502&submit=Search+by+Case+Number.

[17] The NYISO's "AC Transmission Public Policy Transmission Needs Viability and Sufficiency Assessment" can be obtained at the following link:

http://www.nyiso.com/public/markets_operations/services/planning/planning_studies/index.jsp.

T023: NextEra Energy Transmission New York – Enterprise Line: Segment B Alt.

T025: North America Transmission / NYPA – Segment A + 765 kV

T026: North America Transmission / NYPA – Segment A Base

T027: North America Transmission / NYPA – Segment A Double Circuit

T028: North America Transmission / NYPA – Segment A Enhanced

T029: North America Transmission / NYPA – Segment B Base

T030: North America Transmission / NYPA – Segment B Enhanced

T031: ITC New York Development – 16NYPP1-1A AC Transmission

T032: ITC New York Development – 16NYPP1-1B AC Transmission

Together with the AC Transmission Public Policy Transmission Needs Viability and Sufficiency Assessment, the NYISO filed a more granular cost allocation methodology consistent with the prescribed methodology set forth in the December 2015 Order for the PSC's consideration.

### 2.4 Confirmation of Need for Transmission

On January 24, 2017, following consideration of public comments, the PSC issued an order confirming the AC Transmission Needs.[18] The January 2017 Order stated that "[t]he Commission agrees that persistent congestion on the Central East and UPNY/SENY interfaces continues to contribute to higher energy costs for downstate customers and to limit the accessibility of renewable resources located upstate," and that the Clean Energy Standard (CES) "further heightens the public policy need for transmission constraint relief and cross-state power flows" allowing renewable resources to be delivered to downstate load centers.[19] Based on the "various economic and public policy benefits," the PSC directed the NYISO to proceed with its evaluation and selection of the proposed transmission solutions deemed viable and sufficient solution that will satisfy the AC Transmission Needs.

---

[18] *Proceeding on Motion of the Commission to Examine Alternating Current Transmission Upgrades*, Order Addressing Public Policy Transmission Need for AC Transmission Upgrades, PSC Case Nos. 12-T-0502, *et al.*, (January 24, 2017) ("January 2017 Order").

[19] *Id.* at pp 18-19.

The January 2017 Order also adopted the NYISO's analysis of the recommended cost allocation methodology that the PSC identified as a part of the AC Transmission Public Policy Requirements/Public Policy Transmission Needs in its December 2015 Order.[20] In response to the PSC's adoption of the NYISO's recommended cost allocation methodology, the NYISO filed, and the FERC accepted, the AC Transmission Cost Allocation methodology.[21]

## 2.5 Local Transmission Plan Updates and PSC-Directed Upgrades

The PSC, in its December 2015 Order, ordered Orange and Rockland Utilities, Inc. (O&R) and Central Hudson Gas and Electric Corporation (Central Hudson) respectively to upgrade the Shoemaker to Sugarloaf 138 kV facilities and the terminal upgrades at Rock Tavern 345 kV Substation, as part of Segment B project proposals. In its order confirming the AC Transmission Needs, the PSC determined that the costs of the additional Segment B upgrades should not be a distinguishing factor among project proposals. Accordingly, the NYISO did not include, for each Segment B project, the cost for the additional upgrades for the purpose of evaluation and selection.

[20] *Id.* at p 21. The Commission also reiterated the appropriateness of certain incentives to ensure accurate cost estimates, and encouraged developers to pursue the cost-containment incentives before the Federal Energy Regulatory Commission (FERC) in their rates. *See id.*

[21] *See New York Indep. Sys. Operator, Inc.*, 161 FERC ¶ 61,160 (November 16, 2017). The AC Transmission Cost Allocation methodology is contained in Section 31.8 of Attachment Y to the OATT.

# 3. Evaluation for Selection of the More Efficient or Cost-Effective Solution

Upon issuance of the January 2017 Order confirming the need for transmission, the NYISO commenced a detailed evaluation of each viable and sufficient transmission proposal with the assistance of its independent consultant, Substation Engineering Company (SECO). This section of the report details the NYISO's evaluation and the results.

## 3.1 Overview of Proposed Viable and Sufficient Solutions

The NYISO determined that 13 transmission solutions are viable and sufficient. All proposed projects utilize the existing rights-of-way as required by the PSC order. The locations of the proposed projects are shown in Figure 2-1. A brief description and high-level diagram of each of the 13 viable and sufficient projects is provided below, while a detailed description of all project elements is provided in Appendix G of this study report.

### 3.1.1 Segment A Projects

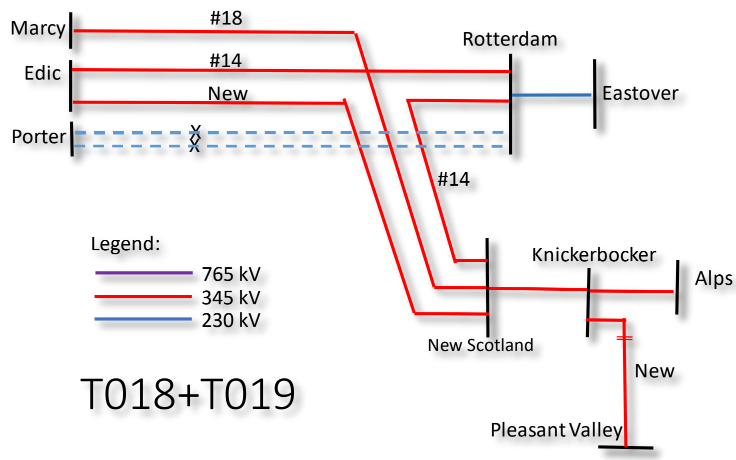
#### T018: National Grid/Transco - NYES Segment A

National Grid/Transco's NYES Segment A Proposal includes the following components:

- A new 345 kV line of approximately 87 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation. The New Scotland 345kV Substation will be upgraded and expanded
- Two new 345 kV lines of approximately five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired
- Two new 345/115 kV autotransformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard
- One new 345/230 kV autotransformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV switchyard
- One new 135 MVAR capacitor bank connected to the new Rotterdam 345 kV switchyard
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-1 shows the one-line diagram of T018 (together with components of T019).

**Figure 3-1: High-Level Diagram of T018+T019**



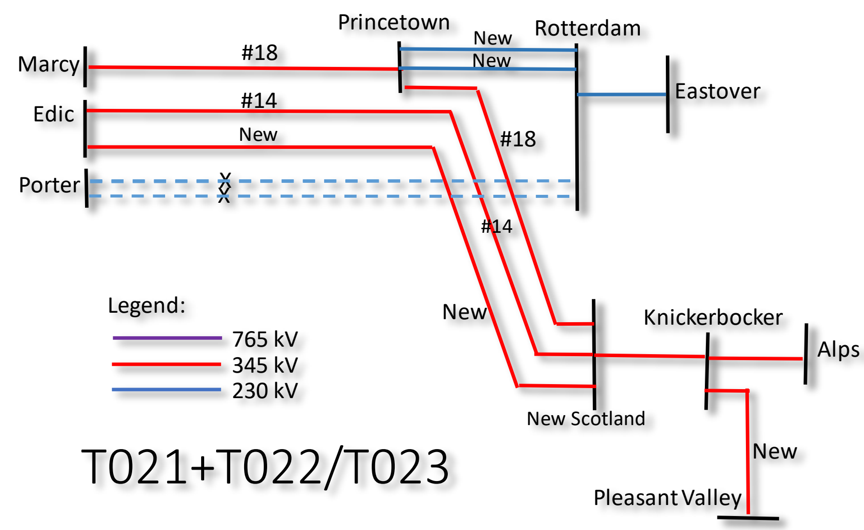

#### T021: NextEra - Enterprise Line Segment A

NextEra's Enterprise Segment A Proposal includes the following components:

- A new 345 kV line of approximately 86 miles (83.4 miles 345 kV line and 2.6 miles double circuit 345/115 kV line) from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation
- Rebuild 2.6 miles of existing Rotterdam-New Scotland 115 kV line circuit #13
- A new breaker-and-a-half 345/230 kV Princetown Substation, located near the existing Rotterdam 230 kV substation. The substation will include two 345/230 kV auto-transformers
- Two new 345 kV circuits each approximately four miles in length to loop the existing Marcy – New Scotland 345 kV circuit #18 into Princetown 345/230 kV substation
- Two new one mile 230 kV lines from Princetown-Rotterdam
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-2 shows the one-line diagram of T021 (together with components of T022/T023).

**Figure 3-2: High-Level Diagram of T021+T022/T023**




#### T025: NAT/NYPA - Segment A + 765 kV

The NAT/NYPA Segment A +765 kV Proposal consists of the following components:

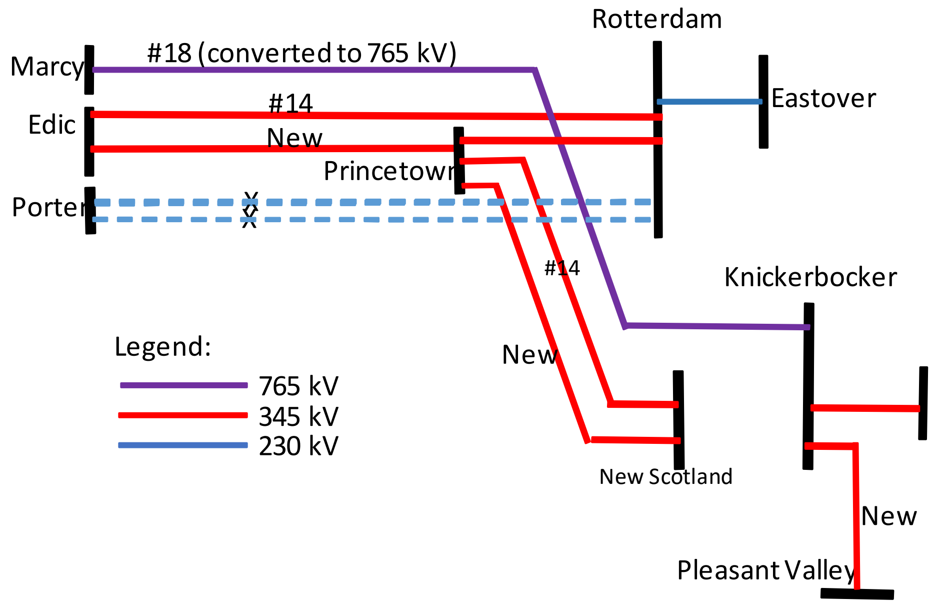
- A new 345 kV line of approximately 86 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation
- Two new 345 kV lines of approximately five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired
- Two new 345/115 kV lower impedance transformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard. One new 345/230 kV transformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV switchyard
- A new Princetown 345kV switchyard by tapping the newly proposed Edic-New Scotland lines and Rotterdam-New Scotland transmission lines
- Convert the Marcy – New Scotland and New Scotland – Knickerbocker 345 kV transmission lines to 765 kV operation as Marcy – Knickerbocker 765 kV (with no connection at New Scotland)
- Switching station or substation work at Knickerbocker with two new 2000 MVA 765/345 kV

transformers at Knickerbocker

- Terminal upgrades at Edic and Marcy 345 kV substations
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-3 shows the one-line diagram of T025 (together with components of T029/T030).

**Figure 3-3: High-Level Diagram of T025+T029/T030**




**T026: NAT/NYPA - Segment A Base**

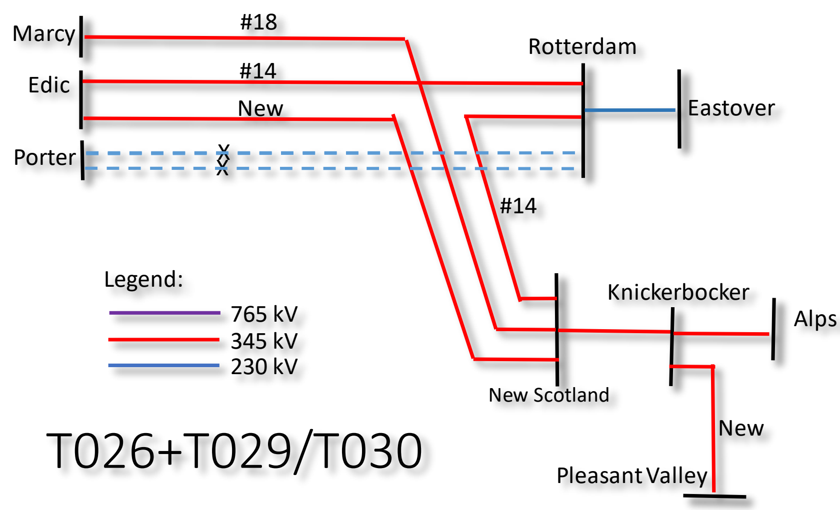
NAT/NYPA Segment A Base Proposal consists of the following components:

- A new 345 kV line of approximately 86 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation
- Two new 345 kV lines of approximately five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired
- Two new 345/115 kV transformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard. One new 345/230 kV transformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV switchyard

- Terminal upgrades at Edic and Marcy 345kV substations
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-4 shows the one line diagram of T026 (together with components of T029/T030).

**Figure 3-4: High-Level Diagram of T026+T029/T030**




#### T027: NAT/NYPA - Segment A Double-Circuit

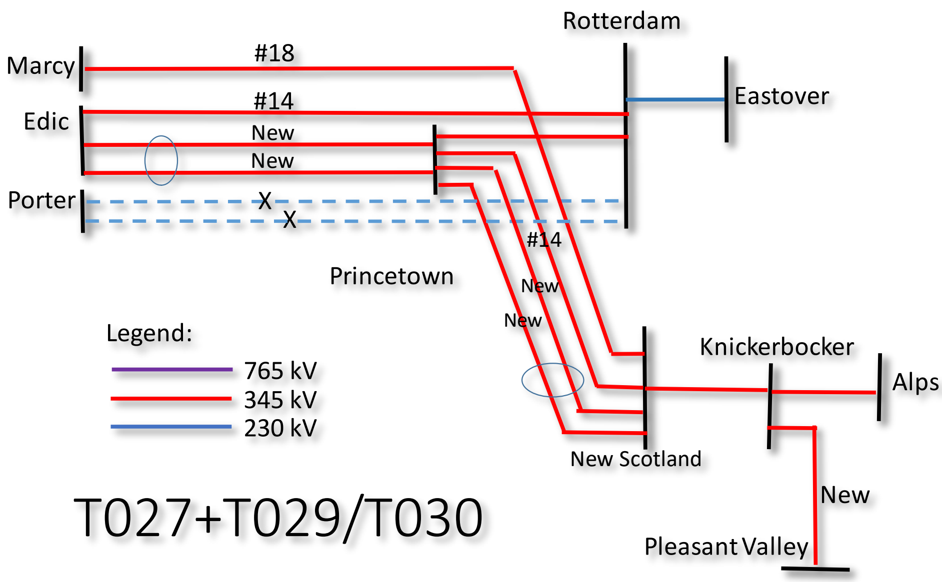
NAT/NYPA Segment A Double Circuit Proposal consists of the following components:

- A new 345 kV double circuit line of approximately 86 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation
- Two new 345 kV lines of approximately five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired
- Two new 345/115 kV lower impedance transformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard. One new 345/230 kV transformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV switchyard
- Rebuild approximately six miles of the Rotterdam to New Scotland 345 kV transmission line to accommodate the new double-circuit line beginning from Princetown junction
- Remove the Rotterdam to New Scotland 115 kV transmission line

- A new Princetown 345 kV switchyard by tapping the newly proposed Edic-New Scotland lines and Rotterdam-New Scotland transmission lines
- Terminal upgrades at Edic and Marcy 345 kV substations
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-5 shows the one-line diagram for T027 (together with components of T029/T030).

**Figure 3-5: High-Level Diagram of T027+T029/T030**




#### T028: NAT/NYPA - Segment A Enhanced

The NAT/NYPA - Segment A Enhanced Proposal consists of the following components:

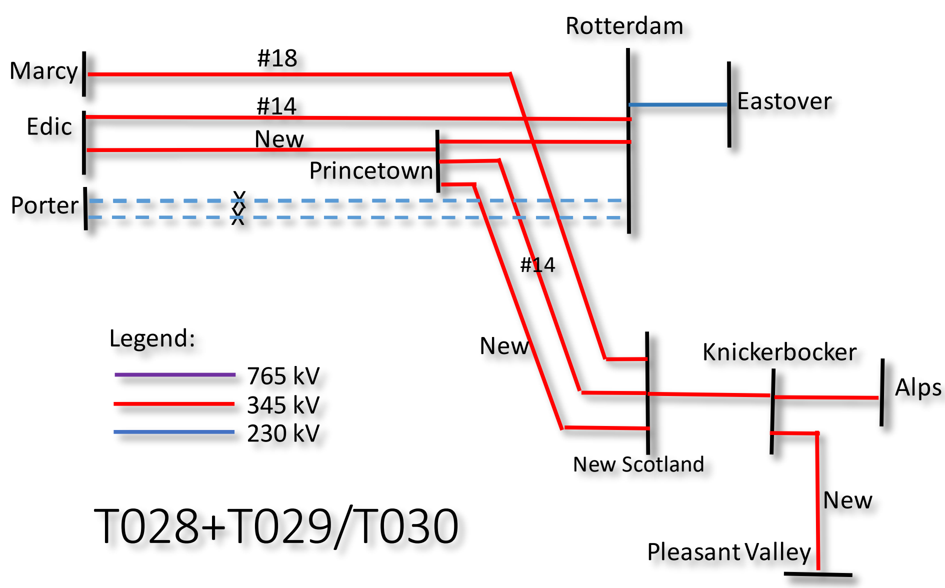
- A new 345 kV line of approximately 86 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation
- Two new 345 kV lines of approximately five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired
- Two new 345/115 kV lower impedance transformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard. One new 345/230 kV transformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV

switchyard

- A new Princetown 345 kV switchyard by tapping the newly proposed Edic-New Scotland lines and Rotterdam-New Scotland transmission lines
- Terminal upgrades at Edic and Marcy 345 kV substations
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-6 shows the one-line diagram of T028 (together with components of T029/T030).

**Figure 3-6: High-Level Diagram of T028+T029/T030**



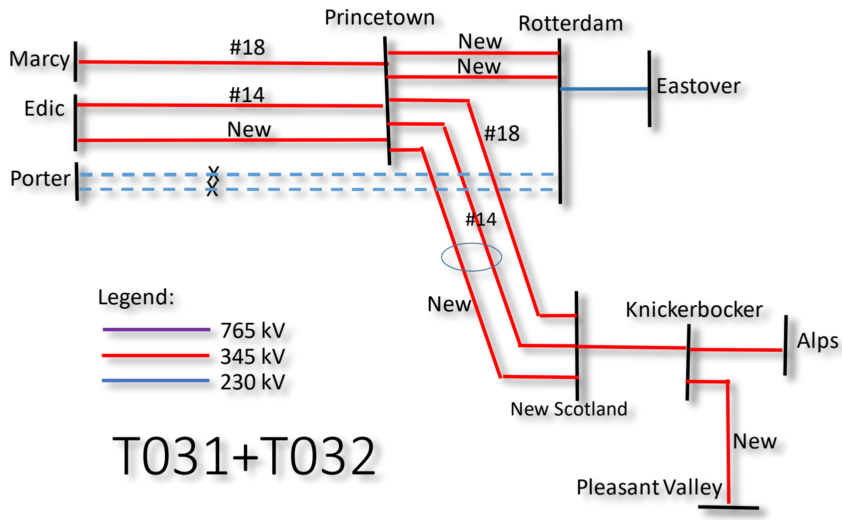

#### T031: ITC - 16NYPP1-1A AC Transmission Segment A

The ITC Segment A Proposal consists of the following components:

- A new Princetown 345 kV switching station tapping the existing Marcy to New Scotland 345 kV #18 line and Edic to New Scotland 345 kV #14 line
- A new Edic – Princetown – New Scotland 345 kV line, rebuilding line #14 between Princetown and New Scotland and sharing the common tower structures with the new line
- A new Rotterdam 345 kV substation with two new 345/230 kV transformers
- Two new Princetown to Rotterdam 345 kV lines of approximately 5.2 miles single circuit
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31.

Figure 3-7 shows the one-line diagram of T031 (together with components of T032).

**Figure 3-7: High-Level Diagram of T031+T032**




### 3.1.2 Segment B Projects

All Segment B projects include the common upgrades required by the PSC in its December 2015 Order, which ordered Orange and Rockland Utilities, Inc. (O&R) and Central Hudson Gas and Electric Corporation (Central Hudson) respectively to upgrade the Shoemaker to Sugarloaf 138 kV facilities and the terminal upgrades at Rock Tavern 345 kV Substation, as part of Segment B projects.

#### T019: National Grid/Transco - NYES Segment B

National Grid/Transco-NYES Segment B proposal consists of the following components:

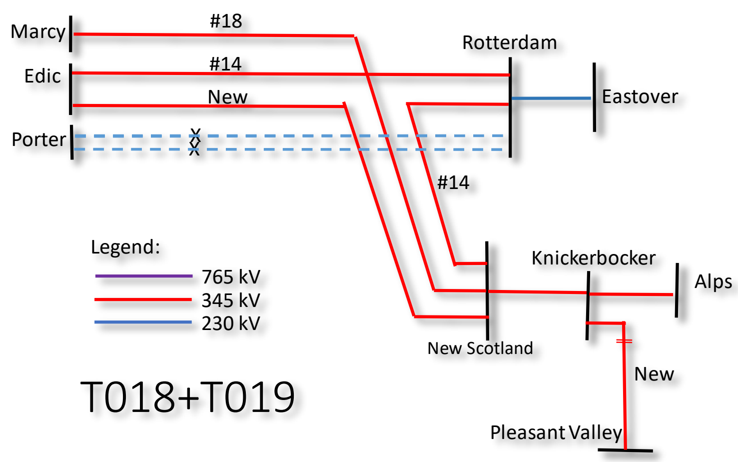
- A new double-circuit 345/115 kV line from a new Knickerbocker 345 kV Switching Station to the existing Pleasant Valley Substation, including a rebuild of the Churchtown 115 kV Switching Station and an upgrade of the existing Pleasant Valley 345/115 kV Substation, and 50% series compensation on Knickerbocker to Pleasant Valley 345 kV line
- Two new 135 MVAR 345 kV capacitor banks connected to the Pleasant Valley 345 kV Substation
- Terminal upgrades to the existing Roseton 345 kV Substation and Transition Station to upgrade the thermal ratings on the 345 kV Roseton to East Fishkill #305 line
- Terminal upgrades to the existing New Scotland 345 kV Substation to upgrade the thermal

ratings on the 345 kV New Scotland to Knickerbocker #2A line

- Retirement of aging infrastructure including multiple existing 115 kV lines between Greenbush 115 kV Substation and Pleasant Valley 115 kV Substation

Figure 3-8 shows the one-line diagram of T019 (together with components of T018).

**Figure 3-8: High-Level Diagram of T018+T019**



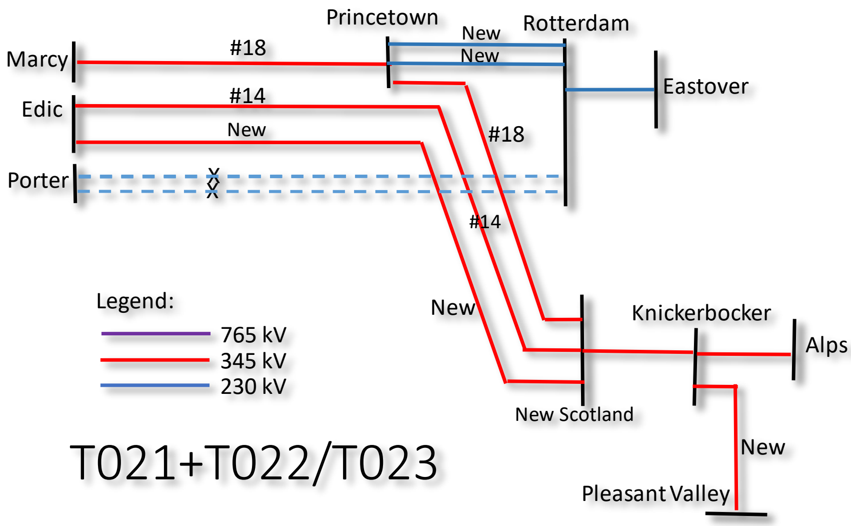

#### T022: NextEra - Enterprise Line Segment B

NextEra Enterprise Line Segment B proposal consists of the following components:

- Multiple retirements and reconfigurations on 115 kV lines between Greenbush – Pleasant Valley
- New Knickerbocker 345 kV Switchyard, approximately 13 miles southeast of New Scotland along the New Scotland - Alps 345 kV line
- Loop New Scotland - Alps 345 kV line circuit #2 into Knickerbocker Switchyard
- New North Churchtown 115 kV Switchyard, just north of NYSEG's existing Churchtown 115 kV switchyard
- A new 345 kV line from a new Knickerbocker 345 kV switching station to the existing Pleasant Valley 345 kV substation (double-circuit 345/115 kV line between Knickerbocker and Churchtown, and single–circuit 345 kV line between Churchtown and Pleasant Valley)

Figure 3-9 shows the one-line diagram of T022 (together with components of T021).

**Figure 3-9: High-Level Diagram of T022**



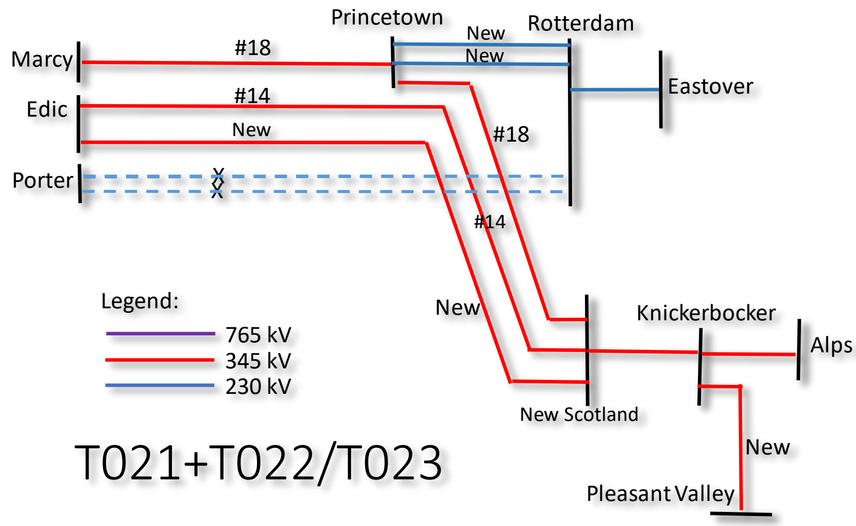

### T023: NextEra - Enterprise Line Segment B-Alt

NextEra Enterprise Line Segment B-Alt proposal consists of the following components:

- Multiple retirements and reconfigurations on 115 kV lines between Greenbush – Pleasant Valley
- New Knickerbocker 345 kV Switchyard, approximately 13 miles southeast of New Scotland along the New Scotland - Alps 345 kV line
- Loop New Scotland - Alps 345 kV line circuit #2 into Knickerbocker Switchyard
- New North Churchtown 115 kV Switchyard, just north of NYSEG's existing Churchtown 115 kV switchyard
- A new double-circuit 345/115 kV line from a new Knickerbocker 345 kV switching station to the existing Pleasant Valley 345 kV substation

Figure 3-10 shows the one-line diagram of T023 (together with components of T021).

Figure 3-10: High-Level Diagram of T023



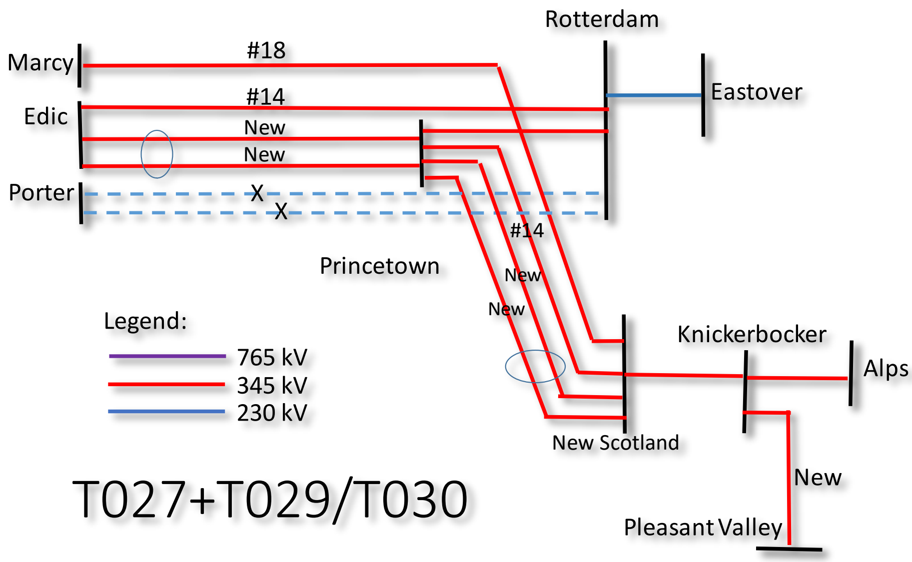

#### T029: NAT/NYPA - Segment B Base

NAT/NYPA Segment B Base Proposal consists of the following components:

- Multiple retirements and reconfigurations on 115 kV lines between Greenbush – Pleasant Valley
- A new 345 kV Knickerbocker switchyard along the New Scotland - Alps 345 kV line
- Loop the existing 345 kV New Scotland to Alps transmission line into Knickerbocker Switchyard
- A new double-circuit 345/115 kV line from a new Knickerbocker 345 kV switching station to Pleasant Valley 345 kV substation (double-bundled 345 kV line)
- A new Churchtown 115 kV substation
- Shoemaker – Shoemaker Tap – Middletown 345/138 kV transformer and 138 kV facilities upgrades

Figure 3-11 shows the one-line diagram of T029 (together with components of T027).

**Figure 3-11: High-Level Diagram of T027+T029/T030**

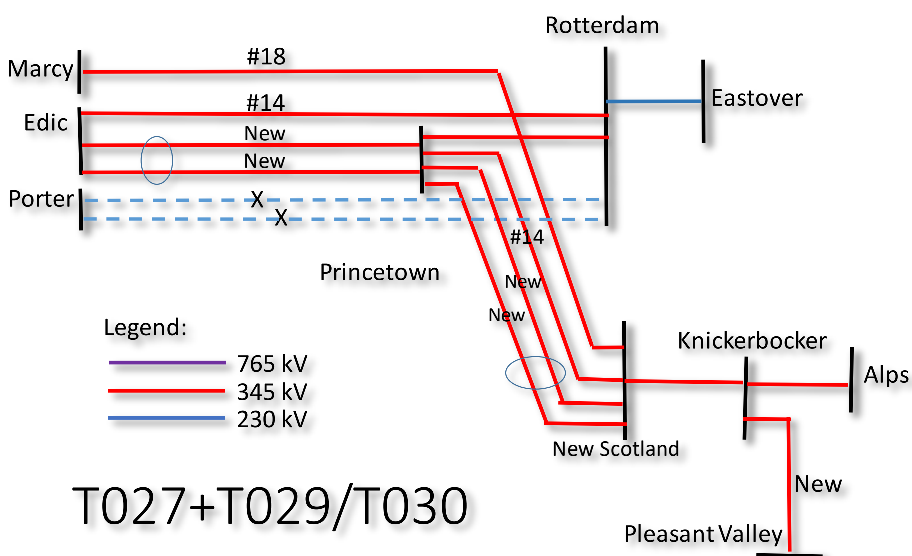



#### T030: NAT/NYPA - Segment B Enhanced

NAT/NYPA Segment B Enhanced Proposal consists of the components included with the Segment B Base Proposal with use of a triple bundle (instead of double bundle) conductor for the Knickerbocker – Pleasant Valley 345 kV transmission line.

Figure 3-12 shows the one-line diagram of T030 (together with components of T027).

**Figure 3-12: High-Level Diagram of T027+T029/T030**



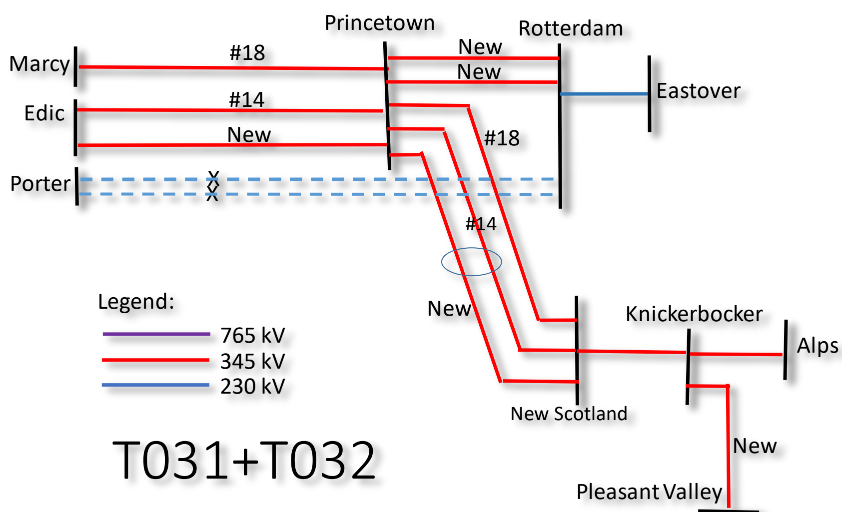
#### T032: ITC - 16NYPP1-1A AC Transmission Segment B

ITC Segment B Proposal consists of the following components:

- Multiple retirements and reconfigurations on 115 kV lines between Greenbush and Pleasant Valley
- A new Knickerbocker 345 kV Substation and a new Knickerbocker115 kV Substation by tapping the existing 345 kV New Scotland to Alps circuit and Greenbush to Pleasant Valley 115 kV lines respectively
- A new 345/115 kV double-circuit line from the Knickerbocker station to Churchtown station on existing Greenbush to Pleasant Valley right-of-way
- A new 345/115/115 kV triple-circuit line from Churchtown to Pleasant Valley on existing Greenbush to Pleasant Valley right-of-way

Figure 3-13 shows the one-line diagram of T032 (together with components of T031).

**Figure 3-13: High-Level Diagram of T031+T032**




### 3.1.3 Project Combinations

Consistent with the PSC's direction that no Public Policy Transmission Project shall be selected for Segment A unless a Public Policy Transmission Project is selected for Segment B, the NYISO combined each Segment A proposal with each developer's Segment B counterpart proposal. In order to evaluate a feasible number of possible combinations between Segment A and Segment B proposals, the NYISO developed combinations of projects that are representative of the electrical characteristics of all the proposed viable and sufficient transmission projects, as follows:

- Combining all Segment A and Segment B projects from the same developers, and
- Combining Segment A and Segment B projects from different developers based on combinations with similar electrical characteristics.

  Initial Segment A grouping:
  - Similar Segment A projects: T018, T021, T026, T028, T031
  - Segment A: T025
  - Segment A: T027

  Initial Segment B groupings:
  - Similar Segment B projects: T022, T023, T029, T030, T032
  - Segment B: T019

Table 3-1 shows the complete list of the representative combinations that were studied by the NYISO, and Table 3-2 shows how to apply the representative results to the combinations that were not explicitly studied.

**Table 3-1: Representative Combinations**

| Combination ID | Representative Combination |
|---|---|
| 1 | T018+T019 |
| 2 | T021+T022 |
| 3 | T021+T023 |
| 4 | T025+T019 |
| 5 | T025+T029 |
| 6 | T025+T030 |
| 7 | T026+T029 |
| 8 | T026+T030 |
| 9 | T027+T019 |
| 10 | T027+T029 |
| 11 | T027+T030 |
| 12 | T028+T029 |
| 13 | T028+T030 |
| 14 | T031+T032 |

**Table 3-2: Representative Results Based on Combination ID**

Representative Results for Central East Voltage Transfer and Production Cost Analysis

| | T018 | T021 | T025 | T026 | T027 | T028 | T031 |
|---|---|---|---|---|---|---|---|
| T019 | 1 | 3 | 4 | 7 | 9 | 12 | 14 |
| T022 | 1 | 2 | 5 | 7 | 10 | 12 | 14 |
| T023 | 1 | 3 | 5 | 7 | 10 | 12 | 14 |
| T029 | 1 | 3 | 5 | 7 | 10 | 12 | 14 |
| T030 | 1 | 3 | 6 | 8 | 11 | 13 | 14 |
| T032 | 1 | 3 | 5 | 7 | 10 | 12 | 14 |

Representative Results for UPNY/SENY Thermal Transfer

| | T018 | T021 | T025 | T026 | T027 | T028 | T031 |
|---|---|---|---|---|---|---|---|
| T019 | 1 | 1 | 4 | 1 | 9 | 1 | 1 |
| T022 | 2 | 2 | 5 | 2 | 10 | 2 | 2 |
| T023 | 3 | 3 | 5 | 3 | 10 | 3 | 3 |
| T029 | 7 | 7 | 5 | 7 | 10 | 12 | 12 |
| T030 | 8 | 8 | 6 | 8 | 11 | 13 | 13 |
| T032 | 14 | 14 | 5 | 14 | 10 | 14 | 14 |

## 3.2 Overview of Evaluation Assumptions

The process for the evaluation of solutions is described in the NYISO Public Policy Transmission Planning Process Manual, and evaluates the metrics set forth in the NYISO's tariff and, to the extent feasible, the criteria prescribed by the PSC. Notably, the NYISO's evaluation of Public Policy Transmission Projects differs from its evaluation of projects in its other planning processes because it can give varying levels of considerations to the baseline and the chosen scenarios based upon the nature of the proposed Public Policy Transmission Projects. In other words, certain projects may perform differently under normal operating conditions (*i.e.*, the baseline) and other potential operating conditions. Based upon the particulars of the Public Policy Transmission Need, the more efficient or cost-effective solution may be chosen based upon a scenario or a combination of scenarios and the baseline cases.

Three major types of analysis were conducted in evaluating quantitative metrics: transfer limit analysis, resource adequacy analysis, and production cost simulation. The study method, assumptions, and the metrics evaluated by the study method are described in the following sections. The results of these analyses are described in Section 3.3.

### 3.2.1 Transfer Limit Analysis

Transfer limit analysis evaluates the amount of power that can be transferred across an interface while observing applicable reliability criteria. The results of transfer limit analysis were used in the evaluation of metrics such as cost per MW, operability, and expandability. Based on the criteria set forth by the NYPSC Order, the NYISO determined that a power flow model is necessary to evaluate the transfer limits of the Central East and UPNY/SENY interfaces.

The Central East interface represents transmission lines from Utica to Albany and a line from northern New York to Vermont. Central East is typically a voltage-constrained interface; therefore, the NYISO performed a voltage transfer analysis using the PowerGEM TARA software and in accordance with the NYISO Guideline for Voltage Analysis and Determination of Voltage-Based Transfer Limits. To determine the voltage transfer limits, the NYISO created a set of power flow cases with increasing transfer levels by increasing generation upstream of the interface and decreasing generation downstream of the interface. As the transfer level across the interface was increased, the voltage-constrained transfer limit was determined to be the lower of: (1) the pre-contingency power flow at which the pre/post-contingency voltage falls below the voltage limit criteria, or (2) 95% of the pre-contingency power flow at the voltage collapse point, also known as the "tip of the nose" of the post-contingency power-voltage (PV) curve.

The UPNY/SENY interface represents a collection of transmission lines on which power flows from Upstate New York to Southeast New York. UPNY/SENY is historically limited by the thermal capability of the individual transmission lines; therefore, the NYISO performed the thermal transfer analysis for the interface in accordance with the Normal Transfer Criteria as defined by the New York State Reliability Council (NYSRC) Reliability Rules. The NYISO used the PowerGEM TARA program to perform the thermal transfer analysis. To determine the thermal transfer limits, the NYISO raised the power flow across the interface by uniformly increasing upstream generation and uniformly decreasing downstream generation. The long-term emergency (LTE) ratings of the BPTF were monitored while simulating design contingency events. During transfer analysis, the NYISO also monitored all 100 kV and above facilities that are not BPTF. Whenever the post contingency power flow on the non-BPTF exceeded short-term emergency (STE) ratings, the NYISO evaluated whether the loss of the non-BPTF would cause other facilities to be overloaded. If the affected facility's loss caused other non-BPTF to exceed their STE ratings or BPTF to exceed their LTE ratings (consistent with the NYSRC Reliability Rules and Exceptions), the NYISO determined a transfer limit that would allow the system to operate without the loss of multiple transmission facilities.

#### 3.2.1.1 Baseline Transfer Analysis

For purposes of evaluating the proposed solutions, the NYISO performed a baseline transfer analysis starting with the power flow cases that were used in the 2016 Reliability Planning Process[22] (2016 RPP) base case system representation of 2026 summer peak load to determine the performance of the AC Transmission Public Policy Transmission Projects. These 2016 RPP power flow base cases were then updated with the latest information from the 2017 Load and Capacity Data Report. Some of these updates include generation additions such as Ginna, FitzPatrick, Cayuga, CPV Valley Energy Center, Cricket Valley Energy Center, Bayonne Energy Center II, and Bethlehem Energy Center Up-rate. Other updates include retirement of the Indian Point Energy Center Units No. 2 & 3 and inclusion of Empire State Line, which the NYISO selected to satisfy Western New York Public Policy Transmission Need. Generic upgrades were also included for the underlying Shoemaker - Sugarloaf area as directed by the PSC Order. The baseline transfer analysis scenario considered two

[22] The 2016 Reliability Needs Assessment is posted at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Reliability_Planning_Studies/Reliability_Assessment_Documents/2016RNA_Final_Oct18_2016.pdf.

Roseton dispatches—one with Roseton dispatched at 100% of its capacity and another with Roseton dispatched at 85% of its capacity. The 2016 RPP base case modeled the Marcy South Series Compensation as in-service. The Hudson Transmission Project (HTP) was scheduled at 0 MW based on its cancellation of Firm Transmission Withdrawal Rights in PJM. Operational Base Flow (OBF) was not scheduled on the ABCJK PARs based on the expected expiration in October 2019.

#### 3.2.1.2 Viability and Sufficiency Assessment Transfer Analysis

This report also included the transfer analysis performed during the Viability and Sufficiency Assessment in 2016. This transfer analysis was based on the power flow cases from the NYISO 2014 Reliability Planning Process base case system representation of the 2019 summer peak load, modified to include the CPV Valley Energy Center generation plant and associated System Deliverability Upgrades. Appendix B describes the detailed assumptions used in the Viability and Sufficiency Assessment.

### 3.2.2 Resource Adequacy Analysis

Resource adequacy is the ability of the electric systems to supply the aggregate electricity demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system elements. The New York Control Area (NYCA) is planned to meet a Loss of Load Expectation (LOLE) that, at any given point in time, is less than or equal to an involuntary load disconnection that is not more frequent than once in every 10 years, or 0.1 events per year. The purpose of resource adequacy analysis for the AC Transmission Needs was not intended to identify any reliability needs, but to 1) make sure the MAPS database has enough resources in the comparative evaluation, and 2) set up the MARS database for the ICAP benefit analysis.

The NYISO performed a baseline resource adequacy evaluation of the NYCA for the AC Transmission Needs. The 2016 RPP base cases were used as a starting point and the NYCA load forecast was extended up to year 2046 to cover the study period. The generation and transmission assumptions were the same as those used by the NYISO in the baseline transfer analysis. Consistent with the MARS topology proposed for the 2018 RNA,[23] the pre-project UPNY-ConEd transfer limit was increased to 6,250 MW, and the pre-project UPNY/SENY topology was updated with dynamic limits. For comparative evaluation purpose, MARS topology was also developed for AC Transmission

[23] *See* 2018 RNA Preliminary Topology Presentation, http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_espwg/meeting_materials/2018-03-13/2018RNA_Preliminary Topology.pdf

projects based on transfer analysis.

LOLE analysis was also performed for a scenario modeling the Clean Energy Standard (CES) and retirement of aging generation (CES + Retirement). The assumptions used for this scenario are described in Section 3.2.3.2.3, and the MARS topology is the same that the NYISO used in the baseline resource adequacy analysis.

If any potential NYCA LOLE violations were identified in the analysis, compensatory MW were added to NYCA zones to resolve the LOLE violations. The compensatory MW amounts and locations were determined based on a review of binding interfaces and zonal LOLE levels in an iterative process to address the LOLE violations. The compensatory MWs were added over the study years, and Table 3-3 below shows the cumulative compensatory MW that needs to be added to satisfy the LOLE criterion of 0.1 events per year.

**Table 3-3: Cumulative Compensatory MW by 2042**

| | Project | Zone C | Zone H | Zone J | Zone K | Total |
|---|---|---|---|---|---|---|
| Baseline | Pre-Project | - | 500 | 550 | 350 | 1400 |
| | Combinations involving T018, T025, or T027 | 250 | 250 | 450 | 350 | 1300 |
| | Other Combinations | 250 | 250 | 500 | 350 | 1350 |
| CES+ Retirement | Pre-Project | - | - | 1450 | 550 | 2000 |
| | Combinations involving T018, T025, or T027 | - | - | 1150 | 550 | 1700 |
| | Other Combinations | - | - | 1250 | 550 | 1800 |

#### 3.2.3 Production Cost Analysis

Production cost analysis evaluated the proposed Public Policy Transmission Projects and their impact on NYISO wholesale electricity markets. The results of production cost analysis were used in the evaluation of metrics such as production cost savings, production cost saving/project cost ratio, system $CO_2$ emission reduction, LBMP, load payment, and performance.

##### 3.2.3.1 Baseline Analysis

The AC Transmission Needs production cost analysis baseline case was derived from the draft 2017 CARIS Phase 1 database.[24] Updates were made to the system while extensions were made for

[24] 2017 CARIS Phase 1 assumptions and results are posted at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic/meeting_materials/2018-03-15/2017_Report_CARIS2017_final_draft_031518_BIC.pdf.

increasing the range of the study period (2017 – 2046). At the November 17, 2017 ESPWG/TPAS meeting, the NYISO presented the starting database, updates, and extensions for the baseline production cost analysis.[25] The generation and transmission assumptions are the same as used in the power flow baseline.

Due to the longer study period of the AC Transmission baseline case, the load, fuel, and emissions forecasts were extended. While the fuel and emissions forecasts would affect the four-pool system in the Northeast (IESO, ISO-NE, NYISO, and PJM), the NYISO modeled the load forecast extensions only for the New York Control Area. Consistent with the CARIS methodology, the NYISO held external control area loads fixed to the 2026 level for 2027 through 2046. The baseline also modeled a national $CO_2$ program starting in 2027.

#### 3.2.3.2. Scenario Analysis

At the November 17, 2017 ESPWG meeting, the NYISO solicited from stakeholders the potential scenarios for evaluating the AC Transmission Public Policy Transmission Projects. Based on stakeholder feedback, the NYISO developed scenarios by modifying the baseline assumptions to evaluate the robustness of the proposed Public Policy Transmission Projects according to the selection metrics and the impact on NYISO wholesale electricity markets. The following sections describe the scenarios that assist in understanding the overall performance of the projects under various conditions.

##### 3.2.3.2.1. Scenario #1: National $CO_2$ removed

The baseline modeled a national $CO_2$ program starting from 2027. The NYISO developed Scenario #1, which assumes that a national $CO_2$ program is not in place.

##### 3.2.3.2.2. Scenarios #2 and #3: High fuel and low fuel

The NYISO also developed high and low fuel costs for the baseline consistent with the fuel forecast methodology used in the CARIS process. Energy Information Administration's Annual Energy Outlook forecasts of the annual national delivered price were used to generate Low and High natural gas price forecasts for each region. Figure 3-14, Figure 3-15, and Figure 3-16 show the baseline, high, and low natural gas forecasts used in these scenarios.

---

[25] The meeting materials are posted at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_espwg/meeting_materials/2017-11-17/AC_Transmission_Ph2_Assumptions.pdf.

Figure 3-14: Baseline Natural Gas Forecast

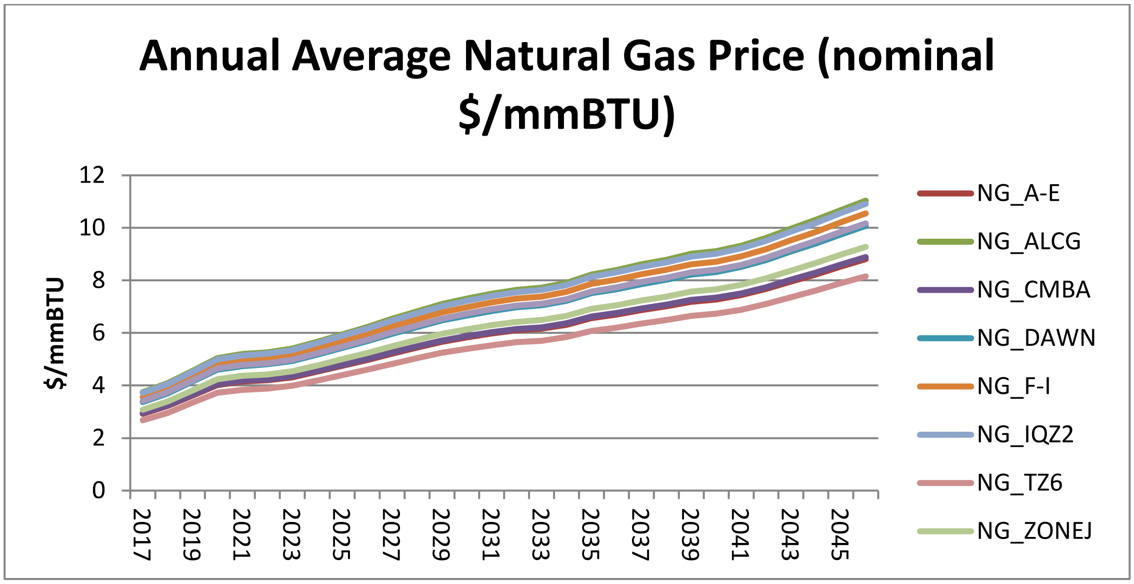



Figure 3-15: High Natural Gas Forecast

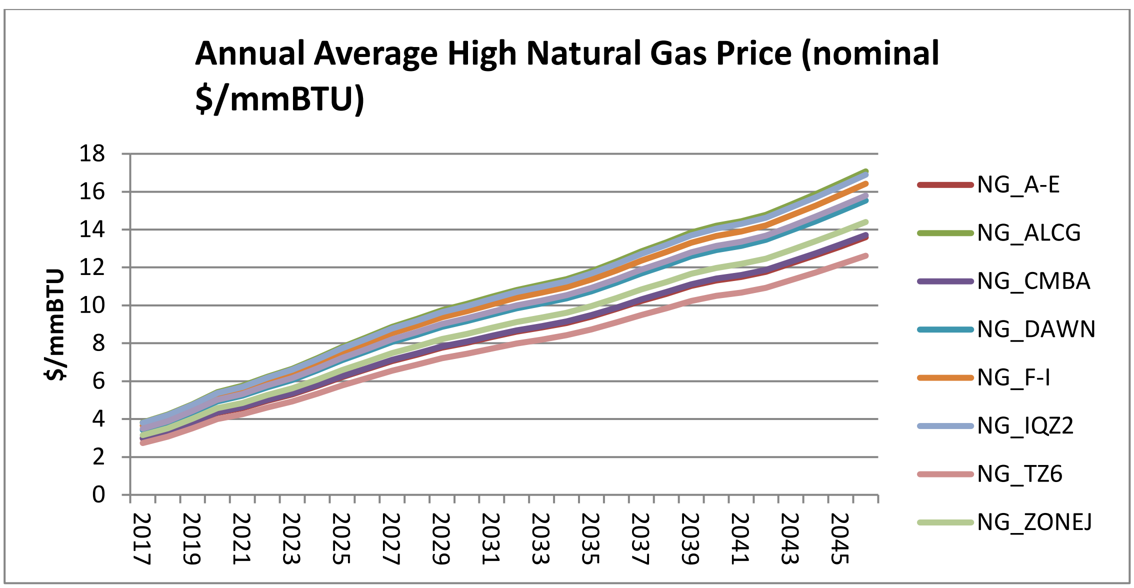
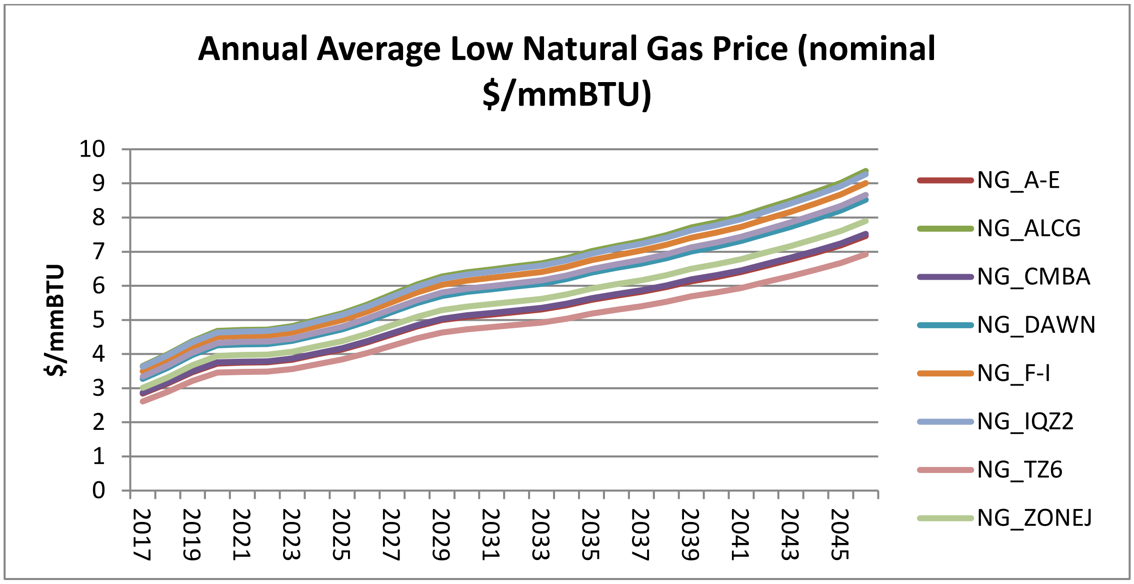


Figure 3-16: Low Natural Gas Forecast




#### 3.2.3.2.3. Scenario #4: Clean Energy Standard (CES) with Aging Generation Retirements and National $CO_2$ removed

Scenario #4 assumes the integration of sufficient renewable generation and energy efficiency to meet the objectives of the Clean Energy Standard[26] along with the retirement of all New York coal units and approximately 3,500 MW of old GTs in NYC and Long Island (CES + Retirement). The NYISO also developed Scenario #4 assuming that a national $CO_2$ program is not in place. The renewable resource additions are captured in Table 3-4. Approximately 17 TWh of energy efficiency was modeled. With these assumptions, approximately 50% of New York's energy requirements were projected to be served by renewable resources.

[26] New York State Department of Public Service, Staff White Paper on Clean Energy Standard, PSC Case No. 15-E-0302 (January 25, 2016).

## Table 3-4: Capacity of Zonal Renewable Generation added in Scenario #4 (MW)

| Zone | Capacity (MW) | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | Land-Based Wind | - | - | 73 | 473 | 317 | 522 | 346 | 293 | 285 | 615 | 657 | 91 | 780 | 106 | 4,558 |
| | Utility-Scale Solar | - | - | - | - | 462 | 570 | - | - | 1,821 | 1,227 | 338 | 2,930 | 1,241 | 2,893 | 11,482 |
| | Offshore Wind | - | - | - | - | - | - | - | - | - | - | - | - | - | 226 | 226 |
| | Imports | - | - | - | - | - | 258 | 258 | - | - | - | - | - | - | - | 516 |
| Zone A | Land-Based Wind | | | 73 | 367 | 109 | 47 | 252 | 86 | | 190 | 79 | | 30 | | 1,233 |
| | Utility-Scale Solar | | | | | | | | | | 108 | 153 | 732 | 871 | | 1,864 |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone B | Land-Based Wind | | | | | | | | | | | | | | | - |
| | Utility-Scale Solar | | | | | | | | | | | | | | 344 | 344 |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone C | Land-Based Wind | | | | | | | | | | 59 | | | 210 | | 269 |
| | Utility-Scale Solar | | | | | | | | | | | 185 | 1,219 | | 2,429 | 3,833 |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone D | Land-Based Wind | | | | | | | | | | | | | | | - |
| | Utility-Scale Solar | | | | | | | | | | | | | 152 | | 152 |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone E | Land-Based Wind | | | | | | 162 | | 112 | 245 | 284 | 553 | 91 | 429 | 106 | 1,982 |
| | Utility-Scale Solar | | | | | | | | | | | | | | | - |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone F | Land-Based Wind | | | | 56 | 71 | 221 | 94 | 95 | 40 | 42 | 25 | | 54 | | 698 |
| | Utility-Scale Solar | | | | | 462 | 345 | | | 1,821 | 58 | | 895 | | | 3,581 |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone G | Land-Based Wind | | | | 50 | 40 | 92 | | | | 40 | | | 57 | | 279 |
| | Utility-Scale Solar | | | | | | 143 | | | | 565 | | | 218 | 120 | 1,046 |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone H | Land-Based Wind | | | | | | | | | | | | | | | - |
| | Utility-Scale Solar | | | | | | 12 | | | | | | | | | 12 |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone I | Land-Based Wind | | | | | | | | | | | | | | | - |
| | Utility-Scale Solar | | | | | | | | | | | | | | | - |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone J | Land-Based Wind | | | | | | | | | | | | | | | - |
| | Utility-Scale Solar | | | | | | | | | | | | | | | - |
| | Offshore Wind | | | | | | | | | | | | | | | - |
| Zone K | Land-Based Wind | | | | | 97 | | | | | | | | | | 97 |
| | Utility-Scale Solar | | | | | | 70 | | | | 496 | | 84 | | | 650 |
| | Offshore Wind | | | | | | | | | | | | | | 226 | 226 |
| Imports | LBW Quebec | | | | | | | | | | | | | | | |
| | Ontario Utility Scale Solar | | | | | | | | | | | | | | | |
| | LBW Ontario | | | | | | 258 | 258 | | | | | | | | 516 |
| | LBW PJM | | | | | | | | | | | | | | | - |
| | PJM Utility Scale Solar | | | | | | | | | | | | | | | |
| Total | | 0 | 0 | 73 | 473 | 779 | 1,350 | 604 | 293 | 2,106 | 1,842 | 995 | 3,021 | 2,021 | 3,225 | 16,782 |

## 3.3 Evaluation Metrics

### 3.3.1 PSC Evaluation Criteria

For the purposes of evaluation and selection of the more efficient or cost-effective Public Policy Transmission Project(s) to address the AC Transmission Needs, the following criteria identified by the NYPSC Order will be applied in addition to the criteria and metrics defined by Section 31.4.8 of Attachment Y to the NYISO OATT:

**Table 3-5: PSC Evaluation Criteria**

| PSC Criteria | Evaluation |
|---|---|
| In lieu of establishing an intended in-service year against which project schedules would be evaluated, the NYISO will consider the proposed project schedule for each Public Policy Transmission Project in the evaluation of impacts to congestion and other applicable criteria over the study period. The NYISO will assume that project schedules begin January 1 of a given year following the NYISO's selection and NYPSC Article VII siting approval (*i.e.,* project schedules need not account for the timing of the NYISO or NYPSC processes). | Considered in the Schedule metric |
| The selection process will favor Public Policy Transmission Projects that minimize the acquisition of property rights for new substations and substation expansions. For the purpose of this criterion, the transfer or lease of existing property rights from a current utility company owner to a Developer shall not be considered such an acquisition. | Considered in the Property Rights metric |
| No Public Policy Transmission Project shall be selected for Segment B that does not incorporate certain specified add-ons that would be constructed (*i.e.,* as specified in the NYPSC Order the upgrades to the Rock Tavern Substation and the upgrades to the Shoemaker to Sugarloaf transmission lines), unless the NYISO determines that such add-ons, jointly or severally, are not material to the accomplishment of the purpose of a solution for Segment B. | Considered in the selection process |
| The selection process for transmission solutions for Segment B shall not use the costs of upgrades to the Rock Tavern Substation and upgrades to the Shoemaker to Sugarloaf transmission lines as a distinguishing factor between Public Policy Transmission Projects. | Reflected in the capital cost estimates of all projects at the same amount |
| No Public Policy Transmission Project shall be selected for Segment A unless a Public Policy Transmission Project is selected for Segment B. | Combinations of Segment A and B projects considered in the selection process |
| No Public Policy Transmission Project shall be selected for Segment A except on condition that the Public Policy Transmission Project selected for Segment A shall not be implemented until there is reasonable certainty established in a manner to be determined by the NYISO that the Public Policy Transmission Project selected for Segment B will be implemented. | Combinations of Segment A and B projects considered in the selection process |
| The selection process shall favor Public Policy Transmission Projects that result in upgrades to aging infrastructure. | Evaluated as a separate metric |
| Project selection will be competitive by Segment (Segment A and Segment B), but synergies produced by selecting a single Developer to provide both segments may be considered. | Considered in the selection process as synergy savings from common developers of Segment A and B projects |
| The selection process shall not use the percentage rates applied to account for contingencies and revenue requirement as a distinguishing factor between Public Policy Transmission Projects. The NYISO will evaluate costs based on raw construction costs to ensure that all of the proposed Public Policy Transmission Projects are evaluated on a comparable basis as to the scope of costs. | Reflected in the capital cost estimates based on independently estimated raw construction costs |

Aging infrastructure replacement is one of the major benefits stated in the 2015 PSC order. The Brattle Group estimated that, if no new transmission were built, the refurbishment of the Porter – Rotterdam 230 kV lines (Segment A corridor) and two 115 kV lines from Knickerbocker to Pleasant Valley (Segment B corridor) would cost $560 million and $279 million (both in 2015 $), or $839 million in total.[27] The retirement of these aging transmission facilities is included in all project proposals, therefore the avoided refurbishment cost for these lines is not a distinguishing factor between projects, but should be recognized as a significant benefit provided by the projects. As analyzed in Section 4.10 of Appendix D (SECO Report), all projects also proposed replacement of aging infrastructure in addition to the Porter – Rotterdam 230 kV lines and Knickerbocker to Pleasant Valley 115 kV lines. Among all Segment A proposals, T027 proposed the most replacement of aging infrastructure. All Segment B proposals replace similar mileage of aging transmission facilities except that T022 proposed to replace fewer 115 kV lines between Churchtown and Pleasant Valley.

#### 3.3.2 Capital Cost Estimate

The NYISO and its independent consultant, SECO, evaluated each Developer's capital cost estimates for their proposed Public Policy Transmission Project for accuracy and reasonableness, and on a comparative basis with other proposed Public Policy Transmission Projects. Each Developer was required to submit detailed and credible estimates for the capital costs associated with the engineering, procurement, permitting, and construction of a proposed transmission solution. SECO reviewed all the information submitted by the Developers and formulated independent cost estimates for each project based on material and labor cost by equipment, engineering and design work, permitting, site acquisition, procurement and construction work, and commissioning needed for the proposed Public Policy Transmission Projects. Appendix D details the analysis performed by SECO. Consistent with the PSC's direction that the costs should be evaluated using raw construction costs on a comparable basis, the NYISO applied the same contingency rate to the independent consultant's capital cost estimates for all projects. Also, per the PSC's criterion that

---

[27] *See The Brattle Group Technical Conference Presentation*, Brattle Group, PSC Case Nos. 12-T-0502, *et al.* (October 14, 2015), available at http://documents.dps.ny.gov/public/MatterManagement/MatterFilingItem.aspx?FilingSeq=148569&MatterSeq=41268

the selection process for transmission solutions for Segment B not use the costs of upgrades to the Rock Tavern Substation and upgrades to the Shoemaker to Sugarloaf transmission lines as a distinguishing factor between Public Policy Transmission Projects, the NYISO and its independent consultant SECO excluded these costs from the cost estimates.

Table 3-6 summarizes SECO's overnight capital cost estimates for Segment A and Segment B projects in 2018 dollars with and without 30% contingency rate. The 30% contingency rate was used in the New York State Department of Public Service Trial Staff Final Report.[28] SECO reviewed it and agreed that the level of contingency is sufficient to account for unanticipated costs and estimating accuracy to forecast a reasonable worst case scenario for the development of the selected projects.

---

[28] *See Comparative Evaluation of Alternating Current Transmission Upgrade Alternatives*, New York State Department of Public Service Trial Staff Final Report, PSC Case Nos. 12-T-0502, *et al.* (September 22, 2015).

**Table 3-6: Independent Cost Estimate[29]**

| Segment | Project ID | Independent Cost Estimate: 2018 $M (w/ 30% contingency rate) | Independent Cost Estimate: 2018 $M (w/o 30% contingency rate) |
|---|---|---|---|
| A | T018 | 520 | 400 |
| | T021 | 498 | 383 |
| | T025 | 863 | 664 |
| | T026 | 491 | 377 |
| | T027 | 750 | 577 |
| | T028 | 514 | 395 |
| | T031 | 570 | 438 |
| B | T019 | 479 | 369 |
| | T022 | 373 | 287 |
| | T023 | 424 | 326 |
| | T029 | 422 | 324 |
| | T030 | 441 | 339 |
| | T032 | 536 | 412 |

The five percent synergy savings level is based on SECO's experience in developing transmission projects, and is calculated by evaluating the average cost of individual cost components of the projects and represents a conservative estimate of the cost savings a Developer could realize if awarded projects for both Segments. These individual cost components included items such as Labor & Equipment, Matting, Materials, Contractor Mobilization/Demobilization, Project Management, Field Construction Management and Inspection Staffing, Incumbent Utility Project Manager and Project Oversite, Site Facilities, Material Handling & Storage, Design Engineering, LiDAR, Geotech, Testing & Commissioning of T-Line and Equipment, Contractor Warranties, Legal Fees, and Contractor Markup (Overhead & Profit). Each of these items were assessed for economy of scale; utilization of resources, equipment and materials; duplication of services; and replication of engineering designs to estimate the potential savings.

**Table 3-7** summarizes the cost estimates for all the Segment A and Segment B project combinations. The NYISO considered a five percent synergy in cost estimates if the same Developer were to develop both Segment A and Segment B projects. PSC's criteria allows for consideration of cost synergies if the same developer develops both Segment A and Segment B projects. The five

[29] At the time that this draft report was released, the System Impact Studies for all of the projects were still in progress. Preliminary Network Upgrade Facilities were included in the cost estimates, and the discussion is included in Section 3.3.12 Interconnection Studies.

percent synergy savings level is based on SECO's experience in developing transmission projects, and is calculated by evaluating the average cost of individual cost components of the projects and represents a conservative estimate of the cost savings a Developer could realize if awarded projects for both Segments. These individual cost components included items such as Labor & Equipment, Matting, Materials, Contractor Mobilization/Demobilization, Project Management, Field Construction Management and Inspection Staffing, Incumbent Utility Project Manager and Project Oversite, Site Facilities, Material Handling & Storage, Design Engineering, LiDAR, Geotech, Testing & Commissioning of T-Line and Equipment, Contractor Warranties, Legal Fees, and Contractor Markup (Overhead & Profit). Each of these items were assessed for economy of scale; utilization of resources, equipment and materials; duplication of services; and replication of engineering designs to estimate the potential savings.

### Table 3-7: Independent Cost Estimate – Project Combinations

| Developers | Project ID | Independent Cost Estimate: 2018 $M (w/ 30% contingency rate) (w/o synergies) | Independent Cost Estimate: 2018 $M (w/ 30% contingency rate) (w/ 5% synergies if same developers) |
|---|---|---|---|
| Same Developers | T018+T019 | | 949 |
| | T021+T022 | | 827 |
| | T021+T023 | | 875 |
| | T025+T029 | | 1194 |
| | T025+T030 | | 1211 |
| | T026+T029 | | 867 |
| | T026+T030 | | 885 |
| | T027+T029 | | 1113 |
| | T027+T030 | | 1131 |
| | T028+T029 | | 889 |
| | T028+T030 | | 907 |
| | T031+T032 | | 1051 |
| Different Developers | T021+T019 | 977 | |
| | T025+T019 | 1309 | |
| | T026+T019 | 970 | |
| | T027+T019 | 1229 | |
| | T028+T019 | 993 | |
| | T031+T019 | 1049 | |
| | T018+T022 | 893 | |
| | T025+T022 | 1207 | |
| | T026+T022 | 863 | |
| | T027+T022 | 1123 | |
| | T028+T022 | 887 | |
| | T031+T022 | 943 | |
| | T018+T023 | 944 | |
| | T025+T023 | 1258 | |
| | T026+T023 | 915 | |
| | T027+T023 | 1174 | |
| | T028+T023 | 938 | |
| | T031+T023 | 994 | |
| | T018+T029 | 942 | |
| | T021+T029 | 919 | |
| | T031+T029 | 992 | |
| | T018+T030 | 961 | |
| | T021+T030 | 938 | |
| | T031+T030 | 1011 | |
| | T018+T032 | 1056 | |
| | T021+T032 | 1034 | |
| | T025+T032 | 1360 | |
| | T026+T032 | 1027 | |
| | T027+T032 | 1286 | |
| | T028+T032 | 1050 | |

#### 3.3.3 Cost Per MW Ratio

The NYISO calculated the cost per MW ratio metric by dividing SECO's independent cost estimates by the MW value of transfer capability. For the purpose of calculating cost per MW based on transfer limits, the NYISO calculated the Central East voltage transfer limits and UPNY/SENY thermal transfer limits. The incremental increase for Central East is defined in terms of increases in voltage transfer capability because that interface is limited by voltage transfer limits. For UPNY/SENY, the incremental increase is defined in terms of increases in thermal transfer capability because that interface in limited by thermal transfer limits.

Table 3-8 and Table 3-9 summarize the baseline transfer results. The incremental increase for Central East is defined in terms of increases in voltage transfer capability because that interface is limited by voltage transfer limits. For UPNY/SENY, the incremental increase is defined in terms of increases in thermal transfer capability because that interface in limited by thermal transfer limits.

**Table 3-8: Voltage Transfer across Central East**

| Project ID | Transfer Limit | Incremental |
|---|---|---|
| Pre-Project | 2,575 | - |
| T018+T019 | 3,000 | 425 |
| T021+T022 | 2,925 | 350 |
| T021+T023 | 2,925 | 350 |
| T025+T019 | 3,875 | 1,300 |
| T025+T029 | 3,700 | 1,125 |
| T025+T030 | 3,775 | 1,200 |
| T026+T029 | 2,850 | 275 |
| T026+T030 | 2,850 | 275 |
| T027+T019 | 3,450 | 875 |
| T027+T029 | 3,400 | 825 |
| T027+T030 | 3,400 | 825 |
| T028+T029 | 2,975 | 400 |
| T028+T030 | 2,900 | 325 |
| T031+T032 | 2,975 | 400 |

## Table 3-9: Thermal Transfer across UPNY/SENY

| Project ID | Roseton at 100% | | | Roseton at 85% | | | Optimal Transfer Limit | | |
|---|---|---|---|---|---|---|---|---|---|
| | Limit | Constraint | Delta | Limit | Constraint | Delta | Limit | Constraint | Delta |
| Pre-Project | 4775 | (1) | - | 4825 | (1) | - | 5025 | (1) | - |
| T018+T019 | 6375 | (2)(A) | 1600 | 6500 | (2)(A) | 1675 | 7000 | (2) | 1975 |
| T021+T022 | 5975 | (3) | 1200 | 6350 | (1) | 1525 | 6525 | (1) | 1500 |
| T021+T023 | 5975 | (3) | 1200 | 6300 | (1) | 1475 | 6475 | (1) | 1450 |
| T025+T019 | 5825 | (4) | 1050 | 5825 | (4) | 1000 | 6175 | (4) | 1150 |
| T025+T029 | 6600 | (3) | 1825 | 6950 | (1) | 2125 | 7250 | (1) | 2225 |
| T025+T030 | 6700 | (3) | 1925 | 7100 | (1) | 2275 | 7350 | (1) | 2325 |
| T026+T029 | 5925 | (3) | 1150 | 6225 | (1) | 1400 | 6425 | (1) | 1400 |
| T026+T030 | 6000 | (3) | 1225 | 6375 | (1) | 1550 | 6550 | (1) | 1525 |
| T027+T019 | 6525 | (2)(A) | 1750 | 6700 | (2)(A) | 1875 | 7125 | (2) | 2100 |
| T027+T029 | 6125 | (3) | 1350 | 6150 | (1) | 1325 | 6350 | (1) | 1325 |
| T027+T030 | 6175 | (3) | 1400 | 6300 | (1) | 1475 | 6475 | (1) | 1450 |
| T028+T029 | 5950 | (3) | 1175 | 6250 | (1) | 1425 | 6450 | (1) | 1425 |
| T028+T030 | 6025 | (3) | 1250 | 6400 | (1) | 1575 | 6575 | (1) | 1550 |
| T031+T032 | 6000 | (3) | 1225 | 6325 | (1) | 1500 | 6500 | (1) | 1475 |

Notes:
(1) Leeds - Pleasant Valley at 1538 MW LTE rating for TE44:L/O ATHENS-PV 345 91
(2) Middletown Transformer at 707 MW STE rating for T:77&76
(3) Roseton - East Fishkill at 2676 MW LTE rating for T:77&76
(4) Knickerbocker Series Comp at 2308 MW LTE rating for T:34&44

(A) Limited by cascading test

Table 3-10 displays the cost per MW ($M/MW) ratio based on transfer limits. The table displays the proportional UPNY/SENY transfer limit with Roseton dispatched at 100% and 85% as well as the optimal UPNY/SENY transfer limit.

**Table 3-10: Cost Per MW Ratio**

| Project ID | Segment A Independent Cost Estimate: 2018 $M | Segment B Independent Cost Estimate: 2018 $M | Cost/MW: incremental Central East Voltage Limit (N-1) | | Cost/MW: incremental UPNY/SENY thermal Limit (N-1 NTC) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Roseton at 100% | | Roseton at 85% | | Optimized Transfer | |
| | | | Inc. MW | $M /MW | Inc. MW | $M /MW | Inc. MW | $M /MW | Inc. MW | $M /MW |
| T018+T019 | 494 | 455 | 425 | 1.16 | 1,600 | 0.28 | 1,675 | 0.27 | 1975 | 0.23 |
| T021+T022 | 473 | 354 | 350 | 1.35 | 1,200 | 0.29 | 1,525 | 0.23 | 1500 | 0.23 |
| T021+T023 | 473 | 403 | 350 | 1.35 | 1,200 | 0.34 | 1,475 | 0.27 | 1450 | 0.27 |
| T025+T019 | 863 | 479 | 1,300 | 0.66 | 1,050 | 0.46 | 1,000 | 0.48 | 1150 | 0.41 |
| T025+T029 | 820 | 401 | 1,125 | 0.73 | 1,825 | 0.22 | 2,125 | 0.19 | 2225 | 0.18 |
| T025+T030 | 820 | 419 | 1,200 | 0.68 | 1,925 | 0.22 | 2,275 | 0.18 | 2325 | 0.18 |
| T026+T029 | 466 | 401 | 275 | 1.69 | 1,150 | 0.35 | 1,400 | 0.29 | 1400 | 0.29 |
| T026+T030 | 466 | 419 | 275 | 1.69 | 1,200 | 0.35 | 1,525 | 0.27 | 1525 | 0.27 |
| T027+T019 | 750 | 479 | 875 | 0.86 | 1,750 | 0.27 | 1,875 | 0.26 | 2100 | 0.23 |
| T027+T029 | 712 | 401 | 825 | 0.86 | 1,350 | 0.30 | 1,325 | 0.30 | 1325 | 0.30 |
| T027+T030 | 712 | 419 | 825 | 0.86 | 1,400 | 0.30 | 1,475 | 0.28 | 1450 | 0.28 |
| T028+T029 | 488 | 401 | 400 | 1.22 | 1,175 | 0.34 | 1,425 | 0.28 | 1425 | 0.28 |
| T028+T030 | 488 | 419 | 325 | 1.50 | 1,250 | 0.33 | 1,575 | 0.27 | 1550 | 0.27 |
| T031+T032 | 542 | 509 | 400 | 1.35 | 1,225 | 0.42 | 1,500 | 0.34 | 1475 | 0.35 |

### 3.3.4 Expandability

In assessing the expandability of the proposed projects, the NYISO considers the feasibility and ease of physically expanding a facility, which can include consideration of future opportunities to economically expand a facility and the likelihood of future transmission siting. Such consideration may include future modifications to increase equipment ratings of the proposed facilities, staging or phasing of future transmission development, or otherwise benefiting from the proposed facilities for future reliability or congestion relief purposes. The details are summarized in the following sections.

#### 3.3.4.1 Physical Expandability

The NYISO contracted SECO as its independent consultant to perform the project expandability assessment to account for any possibilities of facilitating future transmission or substation expansion or generation interconnection as the result of the project proposals. SECO conducted evaluation of the expansion capability of the Developers' proposals by using the projects' information submitted by the Developers during the Viability and Sufficiency Assessment and additional information, specifically on expandability, provided by Developers in response to a request for additional information by the NYISO.

Applicable design approaches to enhance future expandability are limited in the AC Public Policy Transmission Projects since only the existing rights-of-way (ROW) can be utilized. Much of the existing transmission ROW will be fully utilized in construction of this project, but there remains is some opportunity for expansion.

Potential transmission expansion includes the following:

- All proposals for Segment A involve replacement of the existing Porter-Rotterdam 230 kV circuits #30 and #31 with a single Edic to New Scotland 345 kV line. This will provide space for future use of the existing ROW and may allow for the addition of another circuit from Edic/Porter to Princetown Junction within the existing ROW, based on current electrical clearance requirements. Any proposal to construct an additional circuit is subject to the applicable permitting and regulatory requirements, such as public acceptance of visual impact, EMF compliance, compatibility with existing gas facilities, and regulatory approvals.
    - For the base proposals, NextEra affords the most efficient use of the existing ROW by utilizing 100 foot single-pole delta structures. National Grid/Transco, NAT/NYPA and ITC propose using 65-85 foot H-pole structures, which requires the use of more space within the ROW. In all base proposals, there may be adequate space in the existing ROW remaining for an additional 345 kV line. However, a compact transmission line configuration may be required to fit a future 345 kV line in the remaining ROW.
    - All alternative proposals may also provide adequate space within the existing ROW for a future line. T027 utilizes all four existing circuit positions for the first 12 miles out of Edic.
    - During detailed engineering the placement of structures should be optimized to maximize the remaining ROW.
    - Refer to the Table 3-11 below for summary of the ROW requirements for each Developer's projects in the Edic to Princetown Junction corridor.

### Table 3-11: ROW requirements in the Edic to Princetown Junction corridor

| Segment-A | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sector** | **Corridor Width (ft.)** | **Developer** | **Proposal** | **Proposed Structure Configuration** | **ROW Reqd. (ft.)** | **ROW Corridor Remaining (ft.)** | **Remarks** |
| Edic SS to Prince-town Jct | 200 | NGRID/ Transco | T018 | 1 Ckt – 345kV H-pole Horizontal | 120 | 80 | Sufficient reserved ROW for expansion utilizing Compact Vertical Configuration |
| | | NextEra | T021 | 1 Ckt – 345kV Single Pole Delta | 80 | 120 | Sufficient reserved ROW for expansion utilizing H-pole Horizontal Configuration |
| | | NAT/NYPA | T026 & T028 | 1 Ckt – 345kV H-pole Horizontal | 140 | 60 | Sufficient reserved ROW for expansion utilizing Compact Vertical Configuration |
| | | NAT/NYPA | T027 | 2 Ckt – 345kV Single Pole Vertical | 105 | 95 | Sufficient reserved ROW for expansion utilizing Single Pole Delta Configuration with exception of the first 12.6 miles out of Edic |
| | | ITC | T031 | 1 Ckt – 345kV H-pole Horizontal | 100 | 100 | Sufficient reserved ROW for expansion utilizing Single Pole Delta Configuration |

- The new Edic to New Scotland line for Segment A could be designed for double circuit capability similar to the NAT/NYPA T027 double circuit line proposal.
- Transmission lines could be constructed with higher ampacity conductor or re-conductored in the future.
- Most proposals provide for future expansion of substations or could be modified to provide for additional line terminals and transformers in the new substations.

Potential substation expansion for each Developer's specific proposal is discussed in Table 3-12.

**Table 3-12: AC Transmission Projects Substation Expandability Analysis**

| Segment | Project ID | Substation Expandability |
|---|---|---|
| A | T018 | At Rotterdam Substation, the 345 kV gas-insulated substation design provides one open 345 kV bay position and room for additional 345 kV bays. Design also provides ability to connect one additional 345 kV/115 kV transformer to support the local transmission system. Lastly, the design allows for the rebuilding of the 115 kV straight bus configuration into a breaker-and-a-half configuration. |
| | T021 | NextEra is proposing a "Princetown" substation approximately two miles west of Rotterdam Substation on a new greenfield site. The design provides two open 345 kV bay positions and room on the property for adding bays. It maintains the existing and aging Rotterdam 230 kV yard intact. |
| | T025, T027, T028 | At Rotterdam, rebuilding and relocating the 345 kV substation allows for the rebuilding of the 115 kV straight bus configuration into a breaker-and-a-half configuration. A new Princetown Substation is proposed at the junction of the 345 kV Edic-New Scotland line and the 230 kV Porter to Rotterdam lines. Due to the proximity to the neighboring properties, constructing or expanding the substation will be difficult. T025 also creates an open line terminal position at New Scotland substation. |
| | T026 | At Rotterdam, rebuilding and relocating the 345 kV substation allows for the rebuilding of the 115 kV straight bus configuration into a breaker-and-a-half configuration.<br>The proposed design for New Scotland provides the possibility of reconfiguring the substation as a breaker-and-a-half. |
| | T031 | ITC's proposal does not provide any additional bays at Princetown or Rotterdam Substations. ITC's proposal maintains the existing and aging Rotterdam 230 kV yard intact. Additionally, physical limitations at these properties may preclude future expansions without purchasing additional property. |
| B | T019 | At Knickerbocker Substation, the design provides one open 345 kV bay position. The Knickerbocker design also allows the 345 kV ring bus configuration to be converted to a breaker-and-a-half configuration with room on the property for adding bays. At Churchtown Substation, design provides one open 115 kV bay position. Additional breaker-and-a-half bays can be added in the future. |
| | T022, T023 | At Knickerbocker Substation, the proposed design provides one open 345 kV bay position. The Knickerbocker design also allows the 345 kV ring bus configuration to be converted to a breaker-and-a-half configuration with room on the property for adding bays. At North Churchtown Substation, design provides one open 115 kV bay position with room on the property for adding bays. The southern-most bay could also be built out to a breaker-and-a-half configuration. |
| | T029, T030 | The Developer proposes a new 115 kV breaker-and-a-half substation and eliminates the existing NYSEG Churchtown substation. The three-bay substation is proposed for south of the existing substation and north of Orchard Road. This location will permit future expansion of the proposed substation to the north. At Knickerbocker, the Developer's design allows the 345 kV ring bus configuration to be converted to a breaker-and-a-half configuration with room on the property for adding bays. |
| | T032 | At Knickerbocker Substation, design provides one open 345 kV bay position and one open 115 kV bay position. Additionally, during detailed design, the ability to connect up to two 345 kV – 115 kV transformers to support the local transmission system could be provided. |

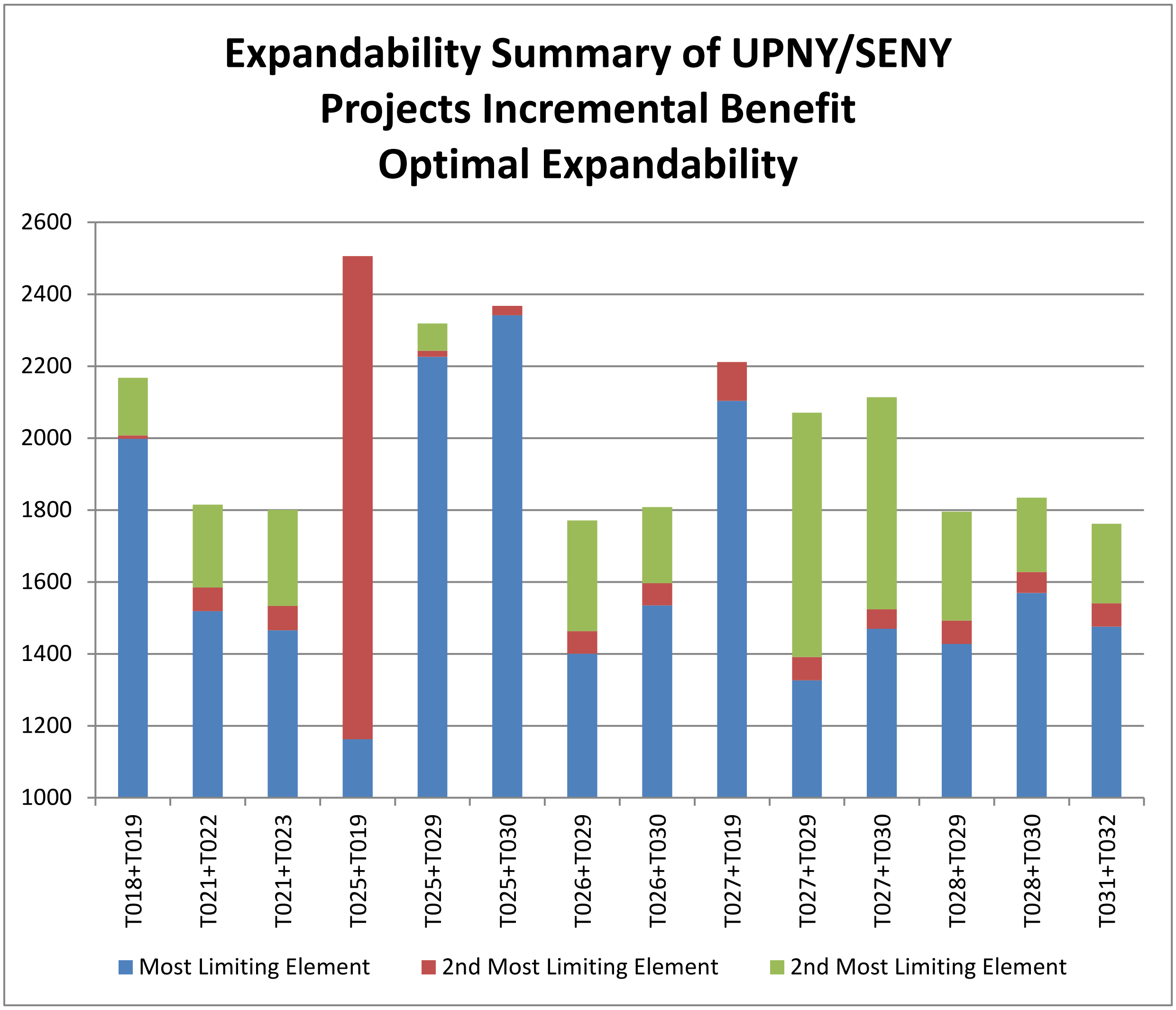
#### 3.3.4.2 Electrical Expandability

This analysis focused on the potential incremental transfer limits of each proposed project if the limiting element or path is resolved by future additional transmission expansion.

The optimal N-1 UPNY/SENY transfer limits and the constraints summarized in Section 3.2.1.2 were analyzed to determine the most limiting element. To find the next most limiting element, the optimal N-1 transfer level was calculated again while excluding the most limiting monitored element. To find the next most limiting path, this process was repeated until a new limiting pathway was found. The incremental transfer capability between the transfer limits constrained by the most limiting element and the second most limiting element captures the electrical benefits of future modifications to increase equipment ratings of the most limiting facilities. Furthermore, if expansion can be made to the entire constraint path, the electrical benefits could be approximated by the incremental transfer capability. Based on the results of the transfer limit analysis, the NYISO determined the two transfer paths are: (i) the Marcy South path and (ii) the Leeds-Pleasant Valley corridor.

Figure 3-17 summarizes the potential benefits using Optimal N-1 Transfers. The blue portion of the bars represents the transfer limits based on the project proposal, the red portion represents the transfer limits if the most limiting constraint shown in Table 3-9 is resolved, and the green portion represents the transfer limits should the most limiting transfer path be resolved. The limiting path for combinations T018 + T019 and T027 + T019 would be the Marcy South path, while the other combinations would be the Leeds-Pleasant Valley corridor.

**Figure 3-17: Electrical Expandability Analysis**




#### 3.3.4.3 Summary of Expandability Assessment

The NYISO used the assessment of incremental transfer limits as a proxy to determine the network strength and potential benefits if these project proposals could be expanded based on their substation designs. The project proposals that have substation designs with potentials to accommodate transmission expansion to significantly increase transfer limits are considered more favorable and are ranked as "Good". However, if the transfer limits could be increased or such increase could be handled more efficiently compared to other projects, those projects are ranked as "Excellent".

Table 3-13: Expandability Summary

| Segment | Project ID | Project Components with the Potential for Expansion | Ranking |
|---|---|---|---|
| A | T018 | Rotterdam Substation and ability to connect one additional 345 kV - 115 kV transformer at Rotterdam | Good |
| | T021 | Princetown | Good |
| | T025 | Rotterdam, New Scotland | Good |
| | T027 | Rotterdam, New Scotland. Additionally, Double-circuit design tends to maximize the Central East transfer capability | Excellent |
| | T028 | Rotterdam, New Scotland | Good |
| | T026 | Rotterdam | Good |
| | T031 | - | Good |
| B | T019 | Knickerbocker, Churchtown | Good |
| | T022 | Knickerbocker, Churchtown | Good |
| | T023 | Knickerbocker, Churchtown | Good |
| | T029 | Knickerbocker, Churchtown | Good |
| | T030 | Knickerbocker, Churchtown | Good |
| | T032 | Knickerbocker station and ability to connect two 345kV -115 kV transformers | Good |

#### 3.3.5 Operability

The NYISO considered how the proposed Public Policy Transmission Projects affect flexibility in operating the system, such as dispatch of generation, access to operating reserves, access to ancillary services, or the ability to remove transmission facilities for maintenance. The NYISO also considered how the proposed projects may affect the cost of operating the system, such as how they may affect the need for operating generation out of merit for reliability needs, reduce the need to cycle generation, or provide more balance in the system to respond to system conditions that are more severe than design conditions.

##### 3.3.5.1 Substation Configuration Assessment

The operability of the proposals was evaluated by the NYISO and also by SECO. The following factors were considered in evaluating each of the proposals:

1. Level of integration: operational preference is for a project that would integrate with the existing New York State Transmission System to the maximum extent possible. For example,

a project using an existing right-of-way (ROW) should not bypass existing substations on the ROW except for reasons such as short circuit limitations, space limitations, and design perspective where a new substation is desirable.

2. Substation design configuration: operational preference is for substation designs in the following order: double-breaker-double-bus, a breaker-and-a-half, ring bus, main and transfer bus, sectionalized bus, and straight (single) bus.
3. Transfer capability under outage conditions: from an operations perspective, it is desirable for a project not to lose its improvement to transfer capability as a result of the loss of any transmission component.

In this assessment, the proposed projects have the greatest impact on the following three substations: Princetown 345 kV, Rotterdam 345 kV, and Knickerbocker 345 kV Substations. Based on the substation configuration, the findings and comparisons are summarized in Table 3-14 for Princetown 345 kV Substation, and Table 3-15 for Rotterdam 345 kV Substation, and Table 3-16 for Knickerbocker 345 kV Substation.

**Table 3-14: Princetown 345 kV Substation Arrangement Comparison**

| Project ID | # of new Lines | # of new Transformers | Total new elements | Proposed Breaker Arrangement | # of Breakers |
|---|---|---|---|---|---|
| T018 | No Princetown Substation proposed. | | | | |
| T021 | 2 – 345kV<br>2 – 230kV | 2 | 6 | Breaker & Half | 7 – 345kV<br>6 – 230kV |
| T026 | No Princetown Substation proposed. | | | | |
| T025 | 4 | 0 | 4 | Ring Bus | 4 |
| T027 | 6 | 0 | 6 | Breaker & Half | 9 |
| T028 | 4 | 0 | 4 | Ring Bus | 4 |
| T031 | 8 | 0 | 8 | Breaker & Half | 12 |

T021 and T031 offer a breaker-and-a-half configuration for Princetown Substation. T021 has three bays, and T031 has four bays. Potential issues with siting the Princetown substation are discussed in the Risk Analysis section of the report. Proposals T025 and T028, proposes a four-breaker ring-bus configuration for Princetown Substation. For T027, NAT/NYPA proposes a gas-insulated three-bay breaker-and-a-half configuration.

**Table 3-15: Rotterdam 345 kV Substation Arrangement Comparison**

| Project ID | # of new Lines | # of new Transformers | Total new elements | Proposed Breaker Arrangement | # of Breakers |
|---|---|---|---|---|---|
| T018 | 2 – 345kV<br>1 – 230kV<br>2 – 115kV* | 1 – 345kV-230kV<br>2 – 345kV-115kV | 8 | Breaker & Half<br>(Gas-Insulated) | 9 – 345kV<br>1 – 230kV |
| T021 | No changes to Rotterdam proposed. | | | | |
| T026 | 2 – 345kV<br>1 – 230kV<br>2 – 115kV* | 1 – 345kV-230kV<br>2 – 345kV-115kV | 8 | Breaker & Half | 8 – 345kV<br>1 – 230kV |
| T025 | Same as T026 | | | | |
| T027 | Same as T026 | | | | |
| T028 | Same as T026 | | | | |
| T031 | 2 – 345kV | 2 – 345kV-230kV | 4 | Sectionalized Bus | 3 – 345kV<br>1 – 230kV |
| *These are tie lines to the existing 115 kV yard at Rotterdam. | | | | | |

Proposals T018, T025, T026, T027 and T028 propose new 345 kV breaker-and-a-half substations at Rotterdam. These proposals also add two 345 kV-115 kV transformers and one 345 kV-230 kV transformer. T031 adds a 345 kV sectionalized bus yard to the north side of the existing Rotterdam 230 kV yard. T021 makes no changes to the existing Rotterdam bus arrangement.

**Table 3-16: Knickerbocker 345 kV Substation Arrangement Comparison**

| Project ID | # of new Lines | # of new Transformers | Total new elements | Proposed Breaker Arrangement | # of Breakers |
|---|---|---|---|---|---|
| T019 | 3 | 0 | 3 (also includes Series Compensation) | Ring Bus<br>(built for future Breaker & Half) | 3 |
| T022 | 3 | 0 | 3 | Ring Bus<br>(built for future Breaker & Half) | 3 |
| T023 | Same as T022. | | | | |
| T025 | 1 – 765kV<br>2 – 345kV | 2 | 5 | 765kV – Ring Bus<br>345kV – Ring Bus | 3 – 765kV<br>4 – 345kV |
| T029 | 3 | 0 | 3 | Ring Bus (built for future Breaker & Half) | 3 |
| T030 | Same as T029. | | | | |
| T032 | 3 – 345kV<br>3 – 115kV | 0 | 6 | 345kV - Ring Bus<br>115kV – Ring Bus | 3 – 345kV<br>3 – 115kV |

Except for combinations that include T025, all Developers propose a new Knickerbocker Substation with similar 345 kV ring bus arrangements. T019 includes Series Compensation on the line terminal to Pleasant Valley. T032 adds an independent 115 kV ring bus yard. T025 proposes a 765 kV ring bus yard and a 345 kV ring bus yard with two 765 kV – 345 kV transformers. T025 will also require the installation of a new 765 kV breaker and associated equipment at the Marcy Substation.

#### 3.3.5.2 Benefits under Maintenance Conditions

These Central East voltage transfer limits were found after an N-1 outage of a major transmission line that would affect the Central East interface. These results are based on the 2016 RPP case with updates detailed in Section 3.2.1 and use the same methodology as the N-1 Central East voltage transfer analysis. Table 3-17 shows the N-1-1 results.

**Table 3-17: Central East N-1-1 Voltage Transfer Capability**

| Project ID | Maintenance Outage | Transfer Limit | Delta |
|---|---|---|---|
| Pre-Project | Marcy-New Scotland 345 kV Line | 1,861 | - |
| T021+T022 | Marcy-Princetown 345 kV Line | 2,250 | 389 |
| T025+T019 | Marcy-Knickerbocker 765 kV Line | 2,165 | 304 |
| T025+T029 | Marcy-Knickerbocker 765 kV Line | 2,243 | 382 |
| T027+T019 | Marcy-New Scotland 345 kV Line | 2,976 | 1,115 |
| T027+T029 | Marcy-New Scotland 345 kV Line | 2,883 | 1,022 |
| T031+T032 | Marcy-Princetown 345 kV Line | 2,400 | 539 |
| T018+T019 | Marcy-New Scotland 345 kV Line | 2,285 | 424 |

The following thermal transfer analysis calculates the N-1 transfer capability under different system maintenance conditions by using optimal N-1-1 transfer limits. The N-1-1 transfer analysis optimally shifts generation from Ontario and Upstate New York and sinks it to the Lower Hudson Valley while securing New York elements to both their pre- and post-contingency ratings. When an overload cannot be mitigated, the optimal transfer limit is determined. Internal NYC PARs were optimized to mitigate local overloads.

Based on the 2016 RPP case with the updates detailed in Section 3.2.1, the Table 3-18 below shows the N-1-1 transfer limits.

**Table 3-18: Incremental UPNY/SENY N-1-1 Thermal Transfer Capability**

| Maintenance Outage | No Outage | CPV - Rock Tavern 345 kV Line | Marcy - Coopers Corners 345 kV Line | Roseton - East Fishkill 345 kV Line | Athens-Pleasant Valley 345 kV Line |
|---|---|---|---|---|---|
| T018+T019 | 1998 | 2073 | 1856 | 660 | 1895 |
| T021+T022 | 1519 | 1457 | 1466 | 449 | 1248 |
| T021+T023 | 1466 | 1408 | 1418 | 439 | 1203 |
| T025+T019 | 1163 | 1711 | 1456 | 1104 | 2034 |
| T025+T029 | 2226 | 2149 | 2169 | 2117 | 1769 |
| T025+T030 | 2342 | 2269 | 2178 | 2257 | 1881 |
| T026+T029 | 1401 | 1340 | 1344 | 1360 | 1142 |
| T026+T030 | 1535 | 1465 | 1470 | 1487 | 1260 |
| T027+T019 | 2103 | 2027 | 1995 | 782 | 1419 |
| T027+T029 | 1326 | 1299 | 1320 | 1331 | 1128 |
| T027+T030 | 1470 | 1423 | 1455 | 1459 | 1233 |
| T028+T029 | 1427 | 1367 | 1371 | 1383 | 1171 |
| T028+T030 | 1569 | 1493 | 1501 | 1511 | 1290 |
| T031+T032 | 1476 | 1418 | 1413 | 455 | 1217 |

#### 3.3.5.3 Summary of Operability Assessment

The NYISO used the assessment of flexibility in operating the system to determine the operability, such as the ability to remove transmission for maintenance, or high transfer limit under N-1-1 contingency. **Table 3-19** shows the summary of the operability assessment.

### Table 3-19: Operability Summary

| Segment | Project ID | Substation and Transmission Configuration | Electrical Operability | | Ranking |
|---|---|---|---|---|---|
| | | | UPNY/SENY N-1-1 | Central East N-1-1 | |
| A | T018 | Breaker-and-a-half 345 kV Rotterdam substation, foundations and structures beyond NESC standard | N/A | Low | Good |
| | T021 | Breaker-and-a-half 345 kV Princetown substation | N/A | Low | Good |
| | T025 | Breaker-and-a-half 345 kV Rotterdam substation, ring-bus 345 kV Princetown substation | N/A | Low | Good |
| | T026 | Breaker-and-a-half 345 kV Rotterdam substation | N/A | Low | Good |
| | T027 | Breaker-and-a-half 345 kV Rotterdam substation, breaker-and-a-half 345 kV Princetown substation | N/A | Highest | Excellent |
| | T028 | Breaker-and-a-half 345 kV Rotterdam substation, ring-bus 345 kV Princetown substation | N/A | Low | Good |
| | T031 | Breaker-and-a-half Princetown substation looping in all 345 kV lines, straight-bus at Rotterdam substation, no bus reconfiguration at New Scotland, new tower contingency created south of Princetown | N/A | Low | Good |
| B | T019 | Ring bus at Knickerbocker 345 kV substation , foundations and structures beyond NESC standard | - | N/A | Good |
| | T022 | Ring bus at Knickerbocker 345 kV substation | - | N/A | Good |
| | T023 | Ring bus at Knickerbocker 345 kV substation | - | N/A | Good |
| | T029 | Ring bus at Knickerbocker 345 kV substation | Improved N-1-1 performance due to Middletown upgrades proposed | N/A | Excellent |
| | T030 | Ring bus at Knickerbocker 345 kV substation | Improved N-1-1 performance due to Middletown upgrades proposed | N/A | Excellent |
| | T032 | Ring bus at Knickerbocker 345 kV substation | - | N/A | Good |

### 3.3.6 Performance

For the AC Transmission Needs, the performance metric is primarily concerned with maximizing energy transfer from upstate to downstate over the Central East and UPNY/SENY interfaces. Table 3-20 and Table 3-21 list the 20-year incremental energy flows across the Central East and UPNY/SENY interfaces for each of the projects compared to the pre-project case. The flows are from the MAPS Baseline and CES + Retirement without National $CO_2$ program cases.

**Table 3-20: Baseline 20-year Incremental Energy (GWh)**

| Project ID | CENTRAL EAST | UPNY/SENY |
|---|---|---|
| T018+T019 | 28,721 | 27,500 |
| T021+T022 | 26,420 | 24,699 |
| T021+T023 | 26,050 | 24,058 |
| T025+T019 | 89,669 | 40,642 |
| T025+T029 | 72,646 | 27,889 |
| T025+T030 | 76,301 | 29,734 |
| T026+T029 | 23,081 | 15,115 |
| T026+T030 | 23,806 | 15,905 |
| T027+T019 | 61,551 | 40,089 |
| T027+T029 | 55,818 | 27,524 |
| T027+T030 | 56,664 | 28,546 |
| T028+T029 | 26,361 | 18,984 |
| T028+T030 | 26,114 | 19,485 |
| T031+T032 | 25,775 | 31,841 |

**Table 3-21: CES + Retirement without National CO2 20-year Incremental Energy (GWh)**

| Project ID | CENTRAL EAST | UPNY/SENY |
|---|---|---|
| T018+T019 | 52,543 | 34,444 |
| T021+T022 | 46,260 | 32,657 |
| T021+T023 | 45,841 | 32,024 |
| T025+T019 | 149,696 | 57,394 |
| T025+T029 | 128,379 | 46,939 |
| T025+T030 | 134,174 | 49,003 |
| T026+T029 | 38,377 | 22,467 |
| T026+T030 | 38,812 | 23,187 |
| T027+T019 | 104,019 | 47,535 |
| T027+T029 | 96,623 | 36,942 |
| T027+T030 | 96,878 | 38,166 |
| T028+T029 | 49,548 | 25,394 |
| T028+T030 | 44,079 | 24,472 |
| T031+T032 | 46,711 | 26,718 |

### 3.3.7 Production Cost

The NYISO calculated the system production costs for the AC Transmission Public Policy Transmission Projects. Each entry in the following tables represents the differences between the pre-project and post-project over the duration of a project's study period. The study period begins with the in-service date proposed by the Developers and extends 20 years. Entries with a dollar value are listed in 2018 millions of dollars. The discount rate used to calculate present value is 6.988% consistent with the 2017 CARIS Phase 1 database. The NYISO used scenarios to distinguish projects and to measure the robustness of project performance. Blank entries mean that a certain scenario was not a distinguishing factor for that particular project. In general, a negative value (listed in red) is a more positive outcome for the various metrics (*i.e.,* the system benefits from the reduction in production cost, lower LBMPs, and reduced emissions).

Table 3-22 through Table 3-28 shows the various results associated with the production cost analysis for each proposal:

**Table 3-22: NYCA Production Cost Saving in 2018 M$**

| Project ID | Baseline | National CO2 Removed | High Natural Gas | Low Natural Gas | CES + Retirement w/o National CO2 |
|---|---|---|---|---|---|
| | | Based off Baseline | | | |
| T018+T019 | (236) | (268) | (391) | (182) | (830) |
| T021+T022 | (199) | (223) | (329) | (159) | (714) |
| T021+T023 | (196) | | | | (707) |
| T025+T019 | (513) | (555) | | | (1,492) |
| T025+T029 | (437) | (517) | (815) | (343) | (1,417) |
| T025+T030 | (457) | | | | (1,461) |
| T026+T029 | (190) | | | | (626) |
| T026+T030 | (195) | | | | (615) |
| T027+T019 | (368) | | | | (1,179) |
| T027+T029 | (331) | (373) | (603) | (255) | (1,129) |
| T027+T030 | (337) | | | | (1,108) |
| T028+T029 | (221) | | | | (840) |
| T028+T030 | (205) | | | | (704) |
| T031+T032 | (206) | (242) | (336) | (168) | (570) |

### Table 3-23: Baseline 20-Year Average LBMP Change in 2018 $M

| Project | West | Genesee | Central | North | Mohawk Valley | Capital | Hudson Valley | Millwood | Dunwoodie | NY City | Long Island |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T018+T019 | 0.43 | 0.41 | 0.43 | 0.44 | 0.47 | (0.02) | (0.07) | (0.15) | (0.19) | (0.16) | (0.12) |
| T021+T022 | 0.38 | 0.38 | 0.40 | 0.45 | 0.45 | 0.01 | (0.08) | (0.17) | (0.20) | (0.16) | (0.13) |
| T021+T023 | 0.37 | 0.38 | 0.40 | 0.45 | 0.45 | (0.00) | (0.08) | (0.17) | (0.20) | (0.16) | (0.13) |
| T025+T019 | 0.97 | 0.90 | 0.84 | 1.29 | 1.04 | (0.31) | (0.13) | (0.24) | (0.26) | (0.22) | (0.16) |
| T025+T029 | 0.95 | 0.90 | 0.90 | 1.30 | 1.05 | (0.28) | (0.12) | (0.24) | (0.26) | (0.21) | (0.17) |
| T025+T030 | 0.97 | 0.92 | 0.91 | 1.31 | 1.06 | (0.30) | (0.14) | (0.25) | (0.28) | (0.23) | (0.18) |
| T026+T029 | 0.39 | 0.38 | 0.40 | 0.48 | 0.45 | 0.01 | (0.02) | (0.10) | (0.14) | (0.10) | (0.08) |
| T026+T030 | 0.41 | 0.39 | 0.40 | 0.48 | 0.45 | 0.02 | (0.02) | (0.10) | (0.14) | (0.10) | (0.09) |
| T027+T019 | 0.75 | 0.71 | 0.70 | 0.84 | 0.79 | (0.26) | (0.19) | (0.29) | (0.32) | (0.27) | (0.20) |
| T027+T029 | 0.67 | 0.66 | 0.67 | 0.83 | 0.78 | (0.28) | (0.16) | (0.26) | (0.29) | (0.24) | (0.18) |
| T027+T030 | 0.69 | 0.67 | 0.68 | 0.83 | 0.78 | (0.27) | (0.16) | (0.26) | (0.29) | (0.24) | (0.18) |
| T028+T029 | 0.43 | 0.44 | 0.46 | 0.58 | 0.55 | (0.13) | (0.08) | (0.17) | (0.20) | (0.16) | (0.12) |
| T028+T030 | 0.43 | 0.41 | 0.42 | 0.52 | 0.49 | (0.09) | (0.08) | (0.17) | (0.20) | (0.16) | (0.12) |
| T031+T032 | 0.37 | 0.37 | 0.38 | 0.44 | 0.46 | 0.06 | (0.16) | (0.27) | (0.30) | (0.25) | (0.19) |

**Table 3-24: CES + Retirement Without National CO2 20-Year Average LBMP Change in 2018 $M**

| Project | West | Genesee | Central | North | Mohawk Valley | Capital | Hudson Valley | Millwood | Dunwoodie | NY City | Long Island |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T018+T019 | 1.65 | 1.89 | 1.96 | 2.43 | 2.24 | (1.18) | (0.15) | (0.63) | (0.84) | (0.55) | (0.49) |
| T021+T022 | 1.41 | 1.60 | 1.66 | 2.04 | 1.92 | (0.66) | (0.10) | (0.57) | (0.79) | (0.49) | (0.46) |
| T021+T023 | 1.39 | 1.60 | 1.65 | 2.06 | 1.92 | (0.71) | (0.11) | (0.57) | (0.79) | (0.49) | (0.46) |
| T025+T019 | 3.09 | 3.58 | 3.58 | 4.80 | 4.06 | (2.31) | (0.62) | (1.19) | (1.37) | (0.92) | (0.83) |
| T025+T029 | 2.94 | 3.42 | 3.47 | 4.64 | 3.92 | (2.21) | (0.65) | (1.22) | (1.40) | (0.93) | (0.85) |
| T025+T030 | 3.05 | 3.55 | 3.60 | 4.82 | 4.06 | (2.34) | (0.70) | (1.27) | (1.45) | (0.97) | (0.88) |
| T026+T029 | 1.26 | 1.41 | 1.47 | 1.74 | 1.70 | (0.31) | 0.02 | (0.46) | (0.69) | (0.41) | (0.37) |
| T026+T030 | 1.25 | 1.38 | 1.44 | 1.69 | 1.66 | (0.32) | 0.02 | (0.45) | (0.68) | (0.41) | (0.37) |
| T027+T019 | 2.40 | 2.78 | 2.83 | 3.63 | 3.21 | (1.91) | (0.46) | (0.97) | (1.17) | (0.80) | (0.72) |
| T027+T029 | 2.27 | 2.67 | 2.74 | 3.56 | 3.15 | (1.82) | (0.43) | (0.96) | (1.15) | (0.77) | (0.71) |
| T027+T030 | 2.25 | 2.63 | 2.69 | 3.50 | 3.09 | (1.91) | (0.45) | (0.96) | (1.15) | (0.77) | (0.72) |
| T028+T029 | 1.58 | 1.85 | 1.94 | 2.44 | 2.26 | (0.76) | (0.10) | (0.59) | (0.80) | (0.50) | (0.46) |
| T028+T030 | 1.38 | 1.55 | 1.61 | 1.95 | 1.87 | (0.42) | (0.02) | (0.50) | (0.73) | (0.44) | (0.40) |
| T031+T032 | 1.38 | 1.59 | 1.68 | 2.08 | 2.02 | (1.62) | (0.14) | (0.62) | (0.83) | (0.62) | (0.55) |

**Table 3-25: Baseline 20-Year Total Load Payment Change in 2018 $M**

| Project | West | Genesee | Central | North | Mohawk Valley | Capital | Hudson Valley | Millwood | Dunwoodie | NY City | Long Island |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T018+T019 | 143 | 92 | 156 | 40 | 131 | (16) | (42) | (11) | (32) | (238) | (77) |
| T021+T022 | 127 | 85 | 147 | 41 | 106 | 45 | (7) | (12) | (33) | (234) | (78) |
| T021+T023 | 124 | 84 | 147 | 41 | 106 | 43 | (7) | (11) | (32) | (232) | (78) |
| T025+T019 | 320 | 189 | 301 | 119 | 344 | (128) | (110) | (16) | (42) | (305) | (93) |
| T025+T029 | 303 | 186 | 312 | 120 | 325 | (111) | (24) | (15) | (40) | (282) | (93) |
| T025+T030 | 310 | 190 | 318 | 121 | 331 | (117) | (45) | (16) | (42) | (301) | (97) |
| T026+T029 | 128 | 84 | 145 | 44 | 135 | 6 | 5 | (7) | (23) | (163) | (55) |
| T026+T030 | 134 | 86 | 147 | 44 | 135 | 10 | (2) | (7) | (23) | (165) | (56) |
| T027+T019 | 241 | 149 | 246 | 78 | 255 | (125) | (74) | (19) | (49) | (358) | (108) |
| T027+T029 | 216 | 139 | 235 | 77 | 251 | (131) | (28) | (17) | (43) | (319) | (100) |
| T027+T030 | 222 | 140 | 237 | 77 | 251 | (130) | (37) | (17) | (45) | (323) | (98) |
| T028+T029 | 139 | 94 | 163 | 54 | 173 | (57) | (8) | (11) | (31) | (227) | (71) |
| T028+T030 | 139 | 89 | 152 | 48 | 165 | (47) | (16) | (11) | (31) | (231) | (74) |
| T031+T032 | 122 | 81 | 140 | 39 | 123 | 26 | (24) | (18) | (44) | (326) | (103) |

### Table 3-26: CES + Retirement without National CO2 20-Year Total Load Payment Change in 2018 $M

| Project | West | Genesee | Central | North | Mohawk Valley | Capital | Hudson Valley | Millwood | Dunwoodie | NY City | Long Island |
|---|---|---|---|---|---|---|---|---|---|---|---|
| T018+T019 | 496 | 359 | 609 | 215 | 339 | (243) | (36) | (36) | (116) | (627) | (204) |
| T021+T022 | 429 | 310 | 522 | 181 | 286 | (80) | (2) | (32) | (110) | (564) | (194) |
| T021+T023 | 424 | 309 | 521 | 182 | 287 | (95) | (3) | (33) | (109) | (569) | (195) |
| T025+T019 | 903 | 649 | 1,083 | 425 | 652 | (512) | (150) | (66) | (174) | (934) | (307) |
| T025+T029 | 856 | 620 | 1,048 | 411 | 623 | (486) | (100) | (66) | (177) | (934) | (314) |
| T025+T030 | 885 | 642 | 1,085 | 428 | 643 | (518) | (121) | (69) | (182) | (967) | (323) |
| T026+T029 | 387 | 277 | 469 | 154 | 273 | (26) | 19 | (26) | (97) | (493) | (160) |
| T026+T030 | 385 | 272 | 460 | 150 | 268 | (27) | 13 | (26) | (97) | (491) | (161) |
| T027+T019 | 705 | 509 | 861 | 322 | 509 | (441) | (92) | (54) | (152) | (833) | (275) |
| T027+T029 | 665 | 489 | 832 | 316 | 500 | (424) | (59) | (53) | (149) | (805) | (275) |
| T027+T030 | 660 | 481 | 815 | 310 | 490 | (448) | (68) | (53) | (150) | (807) | (277) |
| T028+T029 | 473 | 351 | 603 | 217 | 361 | (147) | 1 | (33) | (109) | (562) | (188) |
| T028+T030 | 419 | 301 | 510 | 173 | 309 | (67) | 8 | (29) | (101) | (514) | (169) |
| T031+T032 | 413 | 299 | 520 | 184 | 303 | (349) | 1 | (34) | (109) | (653) | (217) |

**Table 3-27: NYCA 20-Year Total Demand Congestion Change in 2018 M$**

| Project ID | Baseline | National CO2 Removed | High Natural Gas | Low Natural Gas | CES + Retirement w/o National CO2 |
|---|---|---|---|---|---|
| | | Based off Baseline | | | |
| T018+T019 | (1,556) | (1,991) | (2,578) | (1,405) | (6,863) |
| T021+T022 | (1,253) | (1,597) | (2,126) | (1,089) | (5,629) |
| T021+T023 | (1,233) | | | | (5,661) |
| T025+T019 | (2,959) | (3,820) | | | (11,851) |
| T025+T029 | (2,675) | (3,598) | (4,707) | (2,364) | (11,363) |
| T025+T030 | (2,801) | | | | (11,837) |
| T026+T029 | (1,355) | | | | (4,831) |
| T026+T030 | (1,385) | | | | (4,749) |
| T027+T019 | (2,576) | | | | (9,633) |
| T027+T029 | (2,333) | (3,003) | (3,958) | (2,088) | (9,292) |
| T027+T030 | (2,369) | | | | (9,194) |
| T028+T029 | (1,683) | | | | (6,499) |
| T028+T030 | (1,575) | | | | (5,336) |
| T031+T032 | (1,369) | (1,935) | (2,636) | (1,184) | (5,733) |

**Table 3-28: System 20-Year Total CO2 Emission Change (1000 tons)**

| Project ID | Baseline | National CO2 Removed | High Natural Gas | Low Natural Gas | CES + Retirement w/o National CO2 |
|---|---|---|---|---|---|
| | | Based off Baseline | | | |
| T018+T019 | 1,150 | (2,476) | 441 | 678 | (4,686) |
| T021+T022 | 1,111 | (1,285) | (240) | 628 | (7,298) |
| T021+T023 | 1,306 | | | | (8,235) |
| T025+T019 | 3,239 | 5,215 | | | (15,416) |
| T025+T029 | 7,570 | 7,499 | 20,356 | 4,160 | (11,656) |
| T025+T030 | 8,424 | | | | (11,524) |
| T026+T029 | 2,211 | | | | (6,231) |
| T026+T030 | 1,943 | | | | (6,908) |
| T027+T019 | 2,474 | | | | (10,661) |
| T027+T029 | 2,616 | 1,163 | 8,629 | 863 | (9,429) |
| T027+T030 | 2,128 | | | | (10,184) |
| T028+T029 | 3,758 | | | | (4,056) |
| T028+T030 | 2,074 | | | | (5,901) |
| T031+T032 | (1,724) | (6,475) | (4,868) | (2,621) | (8,814) |

### 3.3.8 ICAP Benefits

The NYISO calculated a range of capacity procurement benefits for those proposals identified as Tier 1 and Tier 2 in the NYISO's initial tiered-ranking. The benefits identified capture the long-term impact on capacity procurement costs and, when summed with the production cost savings metric, provide the total market-based economic benefits of a project. However, given the ranges of benefits developed and the precision of the estimates, the NYISO did not deem it prudent to use the ICAP benefit as a factor in differentiating projects but rather as a means to demonstrate the overall value of the selecting projects to satisfy the AC Transmission Needs.

In order to develop the capacity benefits, the NYISO utilized a methodology to optimize statewide capacity procurement costs that mirrors the methodology recently approved by the NYISO's Management Committee and Board of Directors to optimize locational capacity requirements. This methodology minimizes procurement costs by removing capacity from upstate surplus zones (*i.e.,* Zones A, C, and D) and shifting capacity between the transmission-constrained zones (*i.e.,* Zones G-K) and upstate, observing all Emergency Transfer Criteria Interface Limits, which is consistent with the NYSRC Reliability Rules.[30] Capacity is then priced in each locality based on a set of Net Cost of New Entry (CONE) curves for each capacity region.

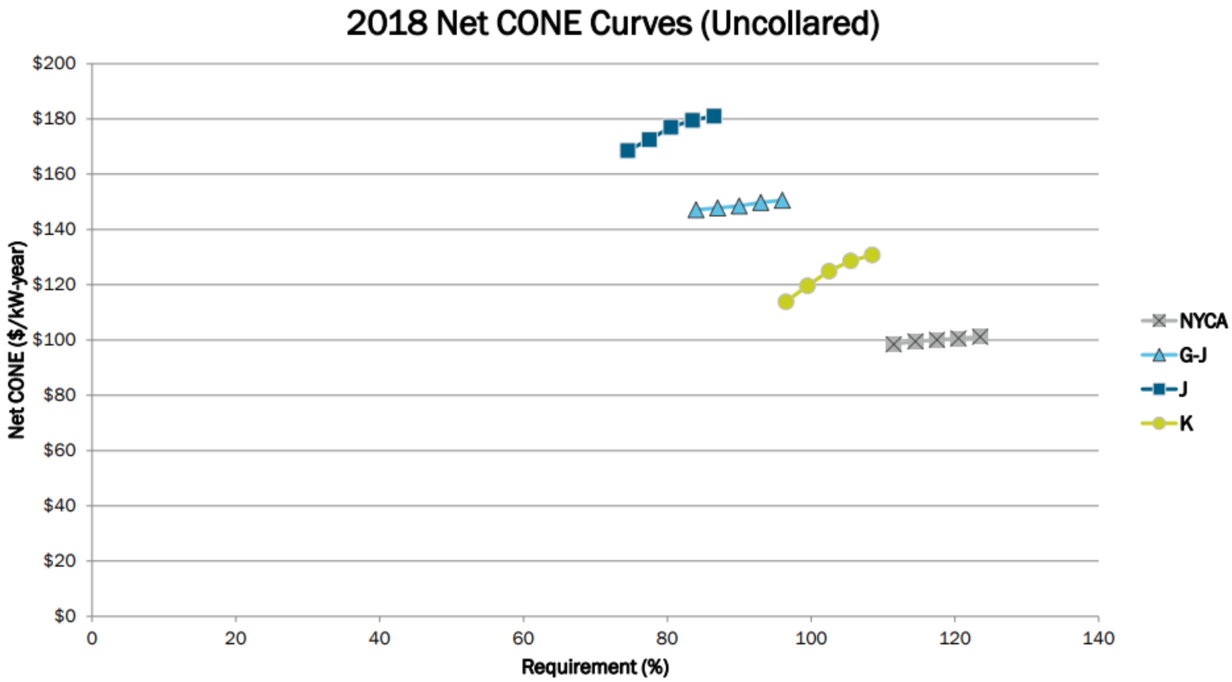
The Net CONE curves that the NYISO used in this evaluation were identical to those constructed in the NYISO's evaluation of the Alternative LCR methodology and reflect updates to the 2017 Net CONE Curves and Reference Points as shown in the Figure 3-18 below[31]:

---

[30] NYSRC Reliability Rules A.1 Establishing NYCA Installed Reserve Margin Requirements.

[31] Alternative Method for Determining LCRs presentation is posted at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2018-02-06/ICAPWG_2-06-18_AlternativeMethodsforLCRs_Final.pdf

**Figure 3-18: 2018 Net CONE Curves**




In order to calculate the change in "optimized" procurement costs between the pre-project and post-project cases, the NYISO determined the change in emergency transfer limits for key interfaces impacted by Tier 1 and Tier 2 projects through transfer limit analyses of representative project combinations. These analyses yielded the following increases in emergency transfer limits:

- For the UPNY/SENY interface, increases ranged from 1,150 MW to 1,400 MW
- For the Zone F to Zone G interface, increases ranged from 1,275 MW to 1,325 MW
- For the UPNY-Con Ed interface, increases ranged from 225 MW to 350 MW

The NYISO then utilized the optimization methodology to calculate a pre-project procurement costs and post-project procurement costs for sample years in the study period (*i.e.,* 2025, 2030, 2035, and 2040) for two cases to represent the range in increased emergency transfer limits. These pre- and post-projects results were utilized to calculate a range of impacts for each case, by year and by region (NYCA, Zones A-F, and Zones G-K). These results are as follows:

- NYCA annual savings ranged from $79M to $86M across the four study years and two cases studied, with an average savings of $80M
- Zones A-F annual increases were less than $9M, with an average increase of $4M
- Zones G-K annual savings ranged from $79M to $90M, with an average savings of $84M

Given the narrow range of annual savings values estimated, the NYISO opted to construct a 20-year time-series of annual savings values using the simple average of the four study years for each case. The annual values were escalated by 1.92% to reflect growth in Net CONE, based on the 2018/2019 escalator used to escalate the NYISO's Demand Curves, and discounted by 6.988% (as in the production cost savings metric) in order to calculate a stream of benefits in 2018 dollars.

One underlying assumption of the primary analysis is that capacity prices would converge to Net CONE beginning in 2023 (from approximately 33% of Net CONE in 2018). Recognizing that the pace at which the clearing prices approached Net CONE would be a key factor in estimating the ICAP benefit, the NYISO created an alternate calculation in which it was assumed that the capacity prices would gradually increase relative to Net CONE and converge to Net CONE by the end of the study period in 2042.

Using this optimization methodology and a range of model and analysis assumptions, the Net Present Value of Capacity Market procurement costs for the NYCA were estimated to decrease in the range of $550M to $850M for all combinations of Tier 1 and Tier 2 projects for the 20-year study period.

While the NYISO views these values as reasonable orders of magnitude estimates, the NYISO cautions that this assessment is a long-term planning analysis and is not intended to represent a forecast of future capacity requirements or prices. This is reinforced by the limited adjustments of Net CONE through this study period; applying a single escalation factor across all the Net CONE values for all localities; and not adjusting the net CONE curves for changes in Energy and Ancillary Services revenues or the gross CONE as could occur through time due to shifts in technology and market conditions.

In summary, the NYISO continues to develop its ICAP benefit metric methodology, and therefore, it did not use this metric to distinguish among projects. However, the range of $550M to $850M in ICAP savings supports the NYISO staff's recommendation that the Board of Directors approve this report recommending selection of transmission projects to meet the AC Transmission Needs as such selection would be consistent with the NYISO's markets and the interests of consumers.

#### 3.3.9 Property Rights and Routing

For each project, the NYISO reviewed whether the Developer already possesses the right of way (ROW) necessary to implement the project or has specified a plan or approach for determining routing and acquiring property rights. In assessing the availability of real property rights for each proposed project, the NYISO relied on SECO, along with the knowledge of DPS and factual information provided by the Transmission Owners in the applicable Transmission Districts. The NYISO and SECO also reviewed, in consultation with the DPS, transmission routing studies provided by Developers that identified potential routing alternatives and land-use or environmentally sensitive areas, such as wetlands, agriculture, and residential areas.

SECO reviewed the Developers' property rights acquisition plans associated with the proposals using the Developers' projects information submitted in the Viability and Sufficiency Assessment process and responses provided by Developers to requests for additional information relating to property rights and transmission siting. Additionally, the NYISO and SECO consulted with a third-party consultant to understand the viability of Developer's property rights acquisition plans, and determined that there are no legal obstacles to incumbent and non-incumbent Developers obtaining the right to use existing ROWs and easements owned by incumbent utilities at commercially reasonable rates.

SECO found that the following items were common among all proposals in their property rights:

- All Developers propose to use existing ROW for their transmission facilities.
- Some additional real estate is required for new substation construction at Princetown Junction:
  - NextEra's project (T021) proposes a new Greenfield site located between Princetown Junction and Rotterdam, and has an option to purchase the real estate for the substation.
  - ITC's project (T031) proposes a larger substation at Princetown Junction compared to the substations proposed by other projects, and will require additional property acquisition.
- All Developers have completed preliminary routing of their proposed lines.
- All Developers have documented plans to obtain site control.

All of the non-incumbent Developers claim the following two common rights to assist in obtaining property:

- Developers cite the December 2015 Order to obtain access to the incumbent utility ROW. In that order, the PSC stated its expectation that incumbent transmission owners will act in a reasonable manner to negotiate access to and usage of their ROWs for the selected transmission project.
- If negotiations with the incumbent transmission owners or the private land owners are unsuccessful, Developers have asserted that under New York State Law, they would have or

obtain eminent domain authority after certification of a route by the PSC.

SECO also reviewed Developers' proposals for routing their transmission lines and substations to identify where new property rights would need to be acquired. SECO derived estimates for property from recent comparable sales and tax assessments in the town and county where the property would be located.

All Developers proposed to utilize existing incumbent transmission owner-owned property and ROW with the following exceptions:

- All proposals for Segment A will likely require the acquisition of easements to meet electric and magnetic field (EMF) guidelines in the Princetown Junction to New Scotland corridor. NAT/NYPA's T025 765 kV line conversion also requires additional easements to meet EMF guidelines.
- *De minimis* property rights may be required for construction laydown area and access, tree trimming or danger tree clearing.
- Development of a new substation at the Princetown Junction may require additional property or easements:
    - T018 and T026 do not include a substation at Princetown Junction.
    - T021 proposes to build the substation at Princetown Junction on a new Greenfield site for which they have obtained an option to acquire.
    - T031 proposes to tie all seven lines into a substation at Princetown Junction, which will require additional property.
    - T025, T027, and T028 propose smaller substations at Princetown Junction with four breaker ring bus arrangements or GIS equipment that may fit in the existing property. Although it appears that placing these stations on the site is possible, the review team has identified this as a potential risk that will need to be carefully considered and potentially mitigated during detailed engineering and licensing development.

PSC policy limits the electrical and magnetic fields that may be produced by a transmission line. The maximum limits at the edge of the right of way for the electrical field is 1.6 kilovolts per meter (kV/m)[32] and for the magnetic field is 200 milligauss (mG).[33] The existing transmission line corridor between Princetown Junction and New Scotland Substation is currently estimated to exceed PSC standards for EMF levels. Although the proposed designs may actually improve existing levels on this transmission corridor, current Article VII regulations will require that any project proposing upgrades on the corridor correct the exceedance to comply with current standards. Based on EMF calculations provided by Developers, there would still be EMF standard exceedances between Princetown and New Scotland for all Segment A projects. The calculations provided by the Developers are preliminary in nature and would have to be confirmed during detailed engineering design. After review meetings with the Developers and the stakeholders at ESPWG/TPAS, the NYISO requested SECo to complete an independent EMF study of T027. SECo completed a study utilizing PLSCadd software. Additionally, SECo's subcontractor, HMV Engineering, conducted a separate study using the EPRI EMF software. This study focused on the T027 proposal for the line segment between Princetown and New Scotland and calculated EMF levels at the three sections of the corridor where the ROW widths varied. The results of the independent studies indicated that the EMF levels for 13.4 miles of the line corridor are expected to exceed NYS PSC standards. Nevertheless, the updated EMF results indicate that compared with the other Segment A proposals, T027 requires the least additional easement (16.2 acres) to mitigate EMF impacts due to its double-circuit design.

During siting, these findings could require purchasing additional EMF easements from property owners along the ROW between Princetown and New Scotland. Table 3-29 and Table **3-30** show a summary of SECO's review of property rights acquisitions and the property requirements to mitigate EMF for all of the Segment A and Segment B proposals. A detailed analysis on property right analysis and routing can be found in Appendix D of this study report.

---

[32] The applicable electric field strength standards established by the PSC are set forth in Opinion No. 78-13 (issued June 19, 1978).

[33] The magnetic field standards established by the PSC are set forth in the PSC's Interim Policy Statement on Magnetic Fields, issued September 11, 1990. This statement also reaffirmed the electric field strength standards set in Opinion No. 78-13.

## Table 3-29: Summary of Property Rights Acquisitions & Requirements – Segment A

| Project ID | Summary of Property Rights Acquisition | Substation Property Requirements | | | | | Ranking |
|---|---|---|---|---|---|---|---|
| | | Substation | County | Owner | | EMF Mitigation (Width in Feet) | |
| | | | | Incumbent Utility (Acres) | Non-Utility (Acres) | | |
| T018 | • NGrid completed routing study<br>• Project ROW is fee-owned by, or under the control (via easement or permit) of, NGrid.<br>• NGrid will transfer ownership of all assets to Transco. | Rotterdam Substation (Extension) | Schenectady | 2.6 | 0 | 10 | Good |
| T021 | • NextEra has an option to purchase property for the proposed Princetown Substation.<br>• Would use existing ROW, owned by the incumbent utility.<br>• Has a well-documented plan to obtain property and site control | Princetown Substation (New) | Schenectady | 0 | 24 | 10 | Good |
| T025 | • NAT/NYPA would use existing ROW, owned by the incumbent utility.<br>• Does not yet possess the required ROWs.<br>• Has a well-documented plan to obtain property and site control<br>• NYPA to lead negotiations with the NYTO's in negotiating and obtaining easements. | Knickerbocker Substation (New) | Rensselaer | 30 | 0 | 8 to 25 | Fair |
| | | Princetown Substation (New) | Schenectady | 3 | 0 | | |
| | | Rotterdam Substation (New) | Schenectady | 7.5 | 0 | | |
| T026 | Same as T025 | Rotterdam Substation (New) | Schenectady | 7.5 | 0 | 10 | Good |
| T027 | Same as T025 | Edic Substation (Extension) | Oneida | 1.3 | 0 | 10 | Good |
| | | Princetown Substation (New) | Schenectady | 3 | 0 | | |
| | | Rotterdam Substation (New) | Schenectady | 7.5 | 0 | | |
| T028 | Same as T025 | Princetown Substation (New) | Schenectady | 3 | 0 | 10 | Good |
| | | Rotterdam Substation (New) | Schenectady | 7.5 | 0 | | |
| T031 | • ITC would use existing ROW, owned by the incumbent utility.<br>• Would likely require additional property to construct the proposed Princetown Substation.<br>• Has a well-documented plan to obtain property and site control. | Princetown Substation (New) | Schenectady | 5.5 | 2.6 | 10 | Fair |
| | | Rotterdam Substation (Extension) | Schenectady | 2.5 | 0 | | |

## Table 3-30: Summary of Property Rights Acquisitions & Requirements – Segment B

| Project ID | Summary of Property Rights Acquisition | Substation Property Requirements | | | | EMF Mitigation (Width in Feet) | Ranking |
|---|---|---|---|---|---|---|---|
| | | Substation | County | Owner: Incumbent Utility (Acres) | Owner: Non-Utility (Acres) | | |
| T019 | • NGrid completed routing study<br>• Project ROW is fee-owned by, or under the control (via easement or permit) of, NGrid.<br>• NGrid will transfer ownership of all assets to Transco. | Knickerbocker Substation (New) | Rensselaer | 14 | 0 | 0 | Good |
| | | Churchtown Substation (Extension) | Columbia | 11.4 | 0 | | |
| | | Pleasant Valley Substation (Extension) | Dutches | 1.4 | 0 | | |
| T022 | • NextEra have an option to purchase property for the proposed Princetown Substation.<br>• Would use existing ROW, owned by the incumbent utility.<br>• Has a well-documented plan to obtain property and site control | Knickerbocker Substation (New) | Rensselaer | 14 | 0 | 0 | Good |
| | | Churchtown Substation (Extension) | Columbia | 5.5 | 0 | | |
| T023 | Same as T022 | Knickerbocker Substation (New) | Rensselaer | 14 | 0 | 0 | Good |
| | | Churchtown Substation (Extension) | Columbia | 5.5 | 0 | | |
| T029 | • NAT/NYPA would use existing ROW, owned by the incumbent utility.<br>• Does not yet possess the required ROWs.<br>• Has a well-documented plan to obtain property and site control<br>• NYPA to lead negotiations with the NYTO's in negotiating and obtaining easements. | Knickerbocker Substation (New) | Rensselaer | 14 | 0 | 0 | Good |
| | | Churchtown Substation (Extension) | Columbia | 11.4 | 0 | | |
| T030 | Same as T029 | Knickerbocker Substation (New) | Rensselaer | 14 | 0 | 0 | Good |
| | | Churchtown Substation (Extension) | Columbia | 11.4 | 0 | | |
| T032 | • ITC would use existing ROW, owned by the incumbent utility.<br>• Would likely require additional property to construct the proposed Princetown Substation.<br>• Has a well-documented plan to obtain property and site control. | Knickerbocker Substation (New) | Rensselaer | 20 | 0 | 0 | Good |
| | | Churchtown Substation (Extension) | Columbia | 0.3 | 0 | | |

### 3.3.10 Potential Construction Delay

The NYISO initially evaluated Developers' schedules for project completion as part of the Viability and Sufficiency Assessment to determine whether projects were feasible. During the evaluation stage, the NYISO conducted a more in-depth analysis of the project schedules of the viable and sufficient transmission projects to determine the accuracy of schedules provided to the NYISO and the likelihood of project delay. For this purpose, the NYISO used the more detailed engineering and design information as required by Section 31.4.8.1.7 of the OATT.

SECO evaluated the development schedules for each proposed Public Policy Transmission Project for potential construction delay. SECO focused on the proposed durations of the tasks in each Developer's project schedule. Based on this evaluation, SECO independently determined its own time estimates for each project schedule and compared it to the Developer's proposed project duration. SECO conducted this evaluation using its expertise and experience with transmission lines and substation projects in New York State and by using comparisons to actual projects that completed the Article VII process. Appendix D provides greater details on the evaluation of the project schedules.

Summary results of the evaluation of the project schedules are presented in Table 3-31. The independent minimum duration was calculated using what SECO determined to be the minimum duration for Article VII application preparation, the anticipated time for the Article VII approval process, ROW procurement where significant, and the anticipated time for construction of the project. The independent minimum duration is the best case and is shown for comparative purposes. The independent duration includes some float to the schedule to establish a reasonable schedule recognizing the potential for minor delays for the purpose of determining the in-service date once a project is selected. SECO recommended adding four (4) months to each minimum schedule to account for the following additional time requirements:

- Two months to the construction schedule for each proposal to account for typical slippage of construction activities (*i.e.,* potential weather events, delays if construction crews are needed to respond and provide storm support, unanticipated material and equipment issues, and inability to obtain outages on a timely basis); and
- Two months to the schedule for additional licensing and permitting activities between the PSC issuing the Article VII Certificate and the submittal of the Environmental Management & Construction Plan (EMCP) to account for possible delays in submitting the EMCP should the PSC require changes to the plan submitted in the application.

Table 3-31: Results of Evaluation of the Projects Schedules

| Segment | Project ID | Independent Minimum Duration Estimate: Months | Independent Duration Estimate: Months |
|---|---|---|---|
| A | T018 | 48 | 52 |
| | T021 | 48 | 52 |
| | T025 | 50 | 54 |
| | T026 | 48 | 52 |
| | T027 | 51 | 55 |
| | T028 | 48 | 52 |
| | T031 | 48 | 52 |
| B | T019 | 45 | 49 |
| | T022 | 43 | 47 |
| | T023 | 45 | 49 |
| | T029 | 45 | 49 |
| | T030 | 45 | 49 |
| | T032 | 47 | 51 |

#### 3.3.11 Potential Risks to Project Completion

SECO evaluated any potential risks associated with the individual proposals that might affect the project completion under the development schedules in addition to those identified by the developers in their proposals. The significant drivers to the individual project risks were:

- Article VII review approval process and potential environmental issues, including visual impact
- Procurement of major equipment
- Real Estate acquisition
- Construction
- Other risks to project siting or operation

Section 4.3 of the SECO report attached as Appendix D to this study report provides a detailed risk analysis for each proposal. It also shows all of the risks in common for all projects and also project specific risks that may distinguish each project from the other projects. Table 3-34 summarizes the significant risks associated with each project. T019, T025, T031, and T032 each have specific risks relative to other projects, as discussed below.

T019 introduced a potential subsynchronous resonance (SSR) risk to the operation of its facilities caused by interactions between the proposed 50% series compensation and nearby synchronous generators. Transient torque may be induced on the generators in the vicinity by system disturbances, and could lead to a catastrophic event that could damage the generator-turbine shaft. Diagnosing such events requires highly specialized expert knowledge and technology. To prevent catastrophic events that damage the generator shaft, special protection schemes can be designed and installed on the generators in the vicinity, if necessary. Such significant SSR risk can be assessed by screening and performing a frequency scan analysis; however, it is difficult to fully anticipate other potential impacts to generator operation and maintenance. In addition, the installation of the series compensation may require further sub-transient evaluation for voltage recovery to ensure enough interruption capacity from circuit breakers, and may require extensive relay and protection upgrades beyond the substations in the immediate vicinity.

T025, which proposes a 765 kV design, needs potential mitigation for clearance and corona issues and hardware replacement for insulation. Moreover, the 765 kV project introduces additional siting and permitting risks due to adding up to eight new large towers and larger conductors, creating potentially significant visual impact issues. Finally, increasing the operation of the existing and new facilities to 765 kV creates EMF compliance risks and operational risks to the power system that would be caused by the size of the electric contingency resulting from an outage of that size transmission facility.

Transmission line crossings and paralleling of natural gas pipelines may require grounding or other mitigation measures. Natural gas pipeline entities are increasingly aware of such issues and are demanding mitigation measures to be installed by transmission utilities. SECO identified rebuilding Rotterdam substation over existing gas pipelines as a risk for projects T025, T026, T027, T028, and T031. The risk mitigation measure could be relocating the gas pipelines near the Rotterdam substation within the existing property. While regulatory processes have to be followed to permit and implement the relocation, this was not considered as a major risk given that the relocation involves only a small segment of the pipelines. The cost associated with the gas pipeline relocation has been incorporated into the overall project cost estimates. Furthermore, T025, T026, T027, and T028 also proposed alternative locations for the Rotterdam substation, which would not require the relocation of the gas pipelines.

Because of the large footprint required for the Princetown Junction Substation in T031, it will need additional property acquisition since the proposed design will not fit within the existing National Grid ROW. The proposed substation is located close to existing homes and buildings, and the need to purchase additional property may result in delays associated with obtaining regulatory approvals and increased costs.

The triple-circuit design between Churchtown and Pleasant Valley substations in T032 makes the operation and maintenance complex. Specifically, future maintenance of the triple-circuit transmission circuits and associated structures may depend on the outage availability of all of the three circuits.

Typically, visual impacts are categorized as minor, moderate, or significant/major with regard to how project structures may be seen from sensitive receptors (*i.e.*, parks, trails, scenic roads, and historic sites) and overall community/neighborhood character. Visual assessments of the proposed transmission lines may also be required for the design and siting processes, which would include visual simulations and viewshed maps. Many factors affect the visibility and visual impact of the proposed lines, including surrounding vegetation, presence of existing lines, topography, land use, structure design, and the number of structures. If the line is determined to impact scenic resources or is not compatible with the character of the community, the line configuration could require modifications during final design to reduce the visual impact. The type of structure will affect its visibility with lattice-type towers having the highest potential visual impact. None of the Developers propose to construct lattice towers, and most of the structures being removed are lattice towers. All Developers have proposed the use of steel or concrete monopole and H frame structures. Since all of the proposed projects are essentially using the same existing ROW, with the exception of the 765 kV portion of T025 proposal, the remaining variable for evaluating potential visual impact is the structure height and number of structures. In its December 2015 Order, the PSC concluded that height increases of less than 25 feet over existing structures will not create an "adverse impact of a regional nature that would significantly impair the physical visual character of the Hudson Valley and its communities."[34] However, the construction of new structures, even with minimal increase in height, may result in siting challenges due to their potential local visual impact. The PSC determined that the local visual impacts will be addressed in the Article VII siting proceedings.[35]

Segment A: The height of the structure may increase its visibility and, therefore, potentially increase the visual impact. The following Table 3-32 summarize the estimated difference in height of the existing structures that would be removed and proposed structures for the Segment A projects. Green highlights in the table below represent there likely being no visual impact due to height of the

[34] December 2015 Order, at p 35.

[35] *See id.*

proposed structures. When structures are replaced, height increases over 10 feet are typically classified as “severe” visual impacts, absent a viewshed analysis.

If solely based upon the height increase comparison estimates above, T031 would have the least potential adverse visual impacts by a considerable margin, but it proposes to use more structures (65 more) than all other proposals, except T021, and thus the proposal is not preferable from the perspective of visual and agriculture impacts. T021 would have the greatest potential adverse visual impact in comparison to the other proposals with 99% of the structures having a height increase of more than 10 feet. In addition, T021 proposes the greatest number of structures. T025 would have the third lowest overall potential adverse visual impact based upon the table and method discussed above. However, the most significant potential adverse visual impacts for T025 results from the height increases for the 2.5 miles of the new 765 kV transmission structures.

**Table 3-32: Number and Height of Structures for the Segment A Projects**

| | Number of Structures | | | | | |
|---|---|---|---|---|---|---|
| | T018 | T021 | T025 | T026/T028 | T027 | T031 |
| 1. Less than 0 ft. | 62 | 0 | 269 | 269 | 19 | 28 |
| 2. Same Ht. | 9 | 0 | 7 | 7 | 11 | 581 |
| 3. From 0.1ft to 5 ft. | 30 | 3 | 51 | 51 | 76 | 69 |
| 4. From 5.1 ft to 10 ft. | 56 | 5 | 33 | 33 | 5 | 10 |
| 5. From 10.1 ft to 15 ft. | 72 | 45 | 35 | 34 | 47 | 0 |
| 6. From 15.1 ft to 20 ft. | 97 | 72 | 65 | 66 | 40 | 2 |
| 7. From 20.1 ft to 25 ft. | 74 | 490 | 38 | 38 | 69 | 1 |
| 8. From 25.1 ft to 30 ft. | 68 | 67 | 9 | 9 | 204 | 0 |
| 9. From 30.1 ft to 40 ft. | 52 | 67 | 18 | 18 | 95 | 0 |
| 10. From 40.1 ft to 50 ft. | 21 | 21 | 10 | 9 | 34 | 0 |
| 11. From 50.1 ft to 60 ft. | 23 | 4 | 6 | 1 | 22 | 0 |
| 12. From 60.1 to 70 ft. | 8 | 1 | 1 | 0 | 1 | 0 |
| 13. From 70.1 to 80 ft. | 2 | 1 | 1 | 1 | 4 | 0 |
| 14. From 80.1 to 90 ft. | 0 | 0 | 5 | 0 | 4 | 0 |
| 15. From 90.1 to 100 ft. | 1 | 0 | 3 | 1 | 0 | 0 |
| 16. From 100.1 to 110 ft. | 0 | 0 | 0 | 0 | 0 | 0 |
| 17. From 110.1 to 120 ft. | 0 | 0 | 2 | 0 | 0 | 0 |
| Total | 575 | 776 | 553 | 537 | 631 | 691 |

| | Percent of Structures | | | | | |
|---|---|---|---|---|---|---|
| | T018 | T021 | T025 | T026/T028 | T027 | T031 |
| 1. Less than 0 ft. | 10.8% | 0.0% | 48.6% | 50.1% | 3.0% | 4.1% |
| 2. Same Ht. | 1.6% | 0.0% | 1.3% | 1.3% | 1.7% | 84.1% |
| 3. From 0.1ft to 5 ft. | 5.2% | 0.4% | 9.2% | 9.5% | 12.0% | 10.0% |
| 4. From 5.1 ft to 10 ft. | 9.7% | 0.6% | 6.0% | 6.1% | 0.8% | 1.4% |
| 5. From 10.1 ft to 15 ft. | 12.5% | 5.8% | 6.3% | 6.3% | 7.4% | 0.0% |
| 6. From 15.1 ft to 20 ft. | 16.9% | 9.3% | 11.8% | 12.3% | 6.3% | 0.3% |
| 7. From 20.1 ft to 25 ft. | 12.9% | 63.1% | 6.9% | 7.1% | 10.9% | 0.1% |
| 8. From 25.1 ft to 30 ft. | 11.8% | 8.6% | 1.6% | 1.7% | 32.3% | 0.0% |
| 9. From 30.1 ft to 40 ft. | 9.0% | 8.6% | 3.3% | 3.4% | 15.1% | 0.0% |
| 10. From 40.1 ft to 50 ft. | 3.7% | 2.7% | 1.8% | 1.7% | 5.4% | 0.0% |
| 11. From 50.1 ft to 60 ft. | 4.0% | 0.5% | 1.1% | 0.2% | 3.5% | 0.0% |
| 12. From 60.1 to 70 ft. | 1.4% | 0.1% | 0.2% | 0.0% | 0.2% | 0.0% |
| 13. From 70.1 to 80 ft. | 0.3% | 0.1% | 0.2% | 0.2% | 0.6% | 0.0% |
| 14. From 80.1 to 90 ft. | 0.0% | 0.0% | 0.9% | 0.0% | 0.6% | 0.0% |
| 15. From 90.1 to 100 ft. | 0.2% | 0.0% | 0.5% | 0.2% | 0.0% | 0.0% |
| 16. From 100.1 to 110 ft. | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 17. From 110.1 to 120 ft. | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% | 0.0% |

Segment B: Table 3-33 below summarizes the estimated difference in height of existing structures that would be removed and proposed structures for Segment B projects. The comparison demonstrates the relative height differences for the proposed projects. Green highlights in the table below represent that there would likely be no visual impact due to height of the proposed structures.

When structures are replaced, height increases over 10 feet are typically classified as "severe" visual impacts, absent a viewshed analysis.

**Table 3-33: Number and Height of Structures for the Segment B Projects**

| | Number of Structures | | | | |
|---|---|---|---|---|---|
| | **T019** | **T022** | **T023** | **T029/T030** | **T032** |
| 1. Less than 0 ft. | 87 | 49 | 6 | 222 | 240 |
| 2. Same Ht. | 3 | 1 | 2 | 77 | 6 |
| 3. From 0.1ft to 5 ft. | 97 | 58 | 60 | 44 | 218 |
| 4. From 5.1 ft to 10 ft. | 108 | 181 | 114 | 44 | 6 |
| 5. From 10.1 ft to 15 ft. | 66 | 116 | 227 | 12 | 0 |
| 6. From 15.1 ft to 20 ft. | 20 | 0 | 0 | 3 | 0 |
| 7. From 20.1 ft to 25 ft. | 12 | 0 | 0 | 1 | 0 |
| 8. From 25.1 ft to 30 ft. | 4 | 0 | 0 | 0 | 0 |
| 9. From 30.1 ft to 40 ft. | 4 | 0 | 0 | 0 | 0 |
| 10. From 60.1 ft to 70 ft. | 0 | 0 | 0 | 2 | 0 |
| Total | 401 | 405 | 409 | 405 | 470 |

| | Percent of Structures | | | | |
|---|---|---|---|---|---|
| | **T019** | **T022** | **T023** | **T029/T030** | **T032** |
| 1. Less than 0 ft. | 21.7% | 12.1% | 1.5% | 54.8% | 51.1% |
| 2. Same Ht. | 0.7% | 0.2% | 0.5% | 19.0% | 1.3% |
| 3. From 0.1ft to 5 ft. | 24.2% | 14.3% | 14.7% | 10.9% | 46.4% |
| 4. From 5.1 ft to 10 ft. | 26.9% | 44.7% | 27.9% | 10.9% | 1.3% |
| 5. From 10.1 ft to 15 ft. | 16.5% | 28.6% | 55.5% | 3.0% | 0.0% |
| 6. From 15.1 ft to 20 ft. | 5.0% | 0.0% | 0.0% | 0.7% | 0.0% |
| 7. From 20.1 ft to 25 ft. | 3.0% | 0.0% | 0.0% | 0.2% | 0.0% |
| 8. From 25.1 ft to 30 ft. | 1.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 9. From 30.1 ft to 40 ft. | 1.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 10. From 60.1 ft to 70 ft. | 0.0% | 0.0% | 0.0% | 0.5% | 0.0% |

Based upon the estimates and criteria described above, T032 would have the least potential adverse visual impact due to structure height increases. However, it adds 61 (15%) more structures than any other proposed project, which could have other potential visual impacts. T029 and T030 would have the second least potential adverse visual impact with only 5% of the structures increasing in height by more than 10 feet and a reduction in the height of more than 50% of the structures.

**Table 3-34: Summary of Risk analysis**

| Segment | Project ID | Risks | | | Risk Level |
|---|---|---|---|---|---|
| | | Overall Visual Impact | Easement Needed to Mitigate EMF (Acres) | Other Risks Including Siting | |
| A | T018 | Medium structure height increase | 24 | - | Medium |
| | T021 | High structure height increase, more structures, less impact to agriculture due to monopoles | 24 | - | Medium |
| | T025 | Low structure height increase | 243 | Potential mitigation for clearance and corona issues, hardware replacement for insulation, siting and permitting risks | High |
| | T026 | Low structure height increase | 24 | - | High |
| | T027 | High structure height increase, 6 miles of lattice tower removed, less impact to agriculture due to monopoles | 16 | - | Medium |
| | T028 | Low structure height increase | 24 | - | Medium |
| | T031 | Low structure height increase, more structures, more impact to agriculture, 20 miles of lattice tower removed | 24 | Property acquisition for Princetown substation | Medium |
| B | T019 | Medium structure height increase | - | Risk due to 50% series compensation | High |
| | T022 | Medium structure height increase | - | - | Medium |
| | T023 | High structure height increase | - | - | High |
| | T029 | Low structure height increase | - | - | Low |
| | T030 | Low structure height increase | - | - | Low |
| | T032 | Low structure height increase, more structures, more impact to agriculture, two-pole configuration with triple circuits | - | Operation and maintenance complexity due to triple-circuit design | High |

The impact of this risk assessment is factored into the tiered ranking as described in Section 4.

### 3.3.12 Interconnection Studies

In addition, the Public Policy Transmission Planning Process considers the status and results of the interconnection studies in evaluating and selecting the more efficient or cost-effective project. All of the AC Transmission projects are currently under evaluation in their respective System Impact Studies in the NYISO's Transmission Interconnection Procedures under Attachment P to the NYISO's tariff. Table 3-35 shows the interconnection queue numbers for all the projects.

**Table 3-35: Interconnection Queue**

| Segment | Project ID | Interconnection Queue # |
|---|---|---|
| A | T018 | Q542 |
| | T021 | Q537 |
| | T026 | Q555 |
| | T028 | Q557 |
| | T027 | Q556 |
| | T025 | Q558 |
| | T031 | Q608 |
| B | T019 | Q543 |
| | T022 | Q538 |
| | T023 | Q539 |
| | T029 | Q559 |
| | T030 | Q414 |
| | T032 | Q609 |

The independent cost estimates include all the preliminary costs of the Network Upgrade Facilities identified or will likely be identified in the respective System Impact Studies. The preliminary System Impact Study results for T027 identified an N-1-1 overload on the Everett - Wolf Road 115 kV line, and proposed reconductoring of this line as a potential Network Upgrade Facility. Therefore, the independent cost estimate for T027 includes approximately $5 million representing the preliminary estimated cost for the Network Upgrade Facility. In addition, violations have been preliminarily identified related to transfer limit degradation from NYISO to ISO-NE for all Segment B projects. System Impact Studies identified potential Network Upgrade Facilities to address such violations. For the purpose of ranking and selection, the independent cost estimates for each Segment B project include a $30 million cost representing the potential Network Upgrade Facilities.[36] The detailed design and cost estimates for the Network Upgrade Facilities will be finalized in the Facilities Studies for the selected projects in accordance with the Transmission Interconnection Procedures.

Orange and Rockland Utilities, Inc., as the Connecting Transmission Owner, raised concerns

[36] Using the results from the System Impact Study for T027 as an example, the NYISO identified three options for potential NUFs to mitigate the New York – New England transfer limit degradation, with the preliminary cost estimates ranging from $30 million to $90 million dollars. These options would be the same for each Segment B project. For the purpose of the ranking and selection, the NYISO used the $30 million cost as a reasonable estimate considering the nature of the various options and the potential decrease in the preliminary cost estimates for some of the NUFs if Q#444 Cricket Valley Energy Center II is in service.

related to the Middletown 345 kV/115 kV transformer replacement proposed in T029 and T030. The NYISO and its independent consultant SECO investigated this issue, and determined that the current evaluation adequately addresses this issue. The Frequently Asked Questions ("FAQ") document provides the detail of the NYISO/SECO analysis. It is important to note that even if additional Network Upgrade Facilities were required to address this concern, it would not change the outcome of the NYISO's ranking and selection.

### 3.4 Consequences for Other Regions

In addition to its evaluation to identify the more efficient or cost-effective solution to the AC Transmission Needs, the NYISO also coordinates with neighboring regions to identify the consequences, if any, of the proposed transmission solutions on the neighboring regions using the respective planning criteria of such regions.

Through the NYISO's Transmission Interconnection Procedures and the associated System Impact Studies currently in progress, the NYISO is consulting with the ISO-NE concerning any potential impacts due to the proposed AC Transmission Needs Projects. Preliminary results from the System Impact Studies identified that each of the proposed Segment B projects potentially causes a negative impact on the export capability from the NYISO to ISO-NE. The proposed interconnection of the proposed Segment B projects, in conjunction with the proposed interconnection of Q#444 Cricket Valley Energy Center II, worsened the potential export capability degradation. Therefore, in accordance with the Transmission Interconnection Procedures, the necessary Network Upgrade Facilities were identified in the System Impact Study to mitigate these potential issues. The NYISO's independent cost estimates include the cost of mitigating the transfer limit degradation from NYISO to ISO-NE for all Segment B projects.

### 3.5 Impact on Wholesale Electricity Markets

The NYISO evaluates the impact of proposed viable and sufficient Public Policy Transmission Projects on its wholesale electricity markets, using economic metrics including change in production cost, congestion, and load payments.[37] Based on the transfer and production cost analysis results described in Sections 3.3.3 and 3.3.7, the proposed transmission projects all tend to increase the Central East and UPNY/SENY transfer capability and reduce congestion. Therefore, the NYISO staff has determined that the viable and sufficient Public Policy Transmission Projects proposed to address the AC Transmission Needs will have no adverse impact on the competitiveness of the New

[37] *See* OATT Sections 31.4.10 and 31.4.8.1.9.

York wholesale electricity markets. Rather, the transmission projects all tend to improve the competitiveness of the NYISO's markets by increasing system transfer capability, allowing more resources and suppliers to compete to serve loads. The review from the NYISO's Market Monitoring Unit is included in Appendix E.[38]

### 3.6 Evaluation of Interaction with Local Transmission Owner Plans

In its Public Policy Transmission Planning Process, the NYISO is required to review the Local Transmission Owner Plans (LTPs)[39] as they relate to the BPTF to determine whether any proposed regional Public Policy Transmission Project on the BTPF can (i) more efficiently or cost-effectively satisfy any local needs driven by a Public Policy Requirement identified in the LTPs, or (ii) might more efficiently or cost-effectively satisfy the identified regional Public Policy Transmission Needs than any local transmission solutions driven by Public Policy Requirements identified in the LTPs.

The Transmission Owners' current LTPs have not identified any needs driven by a Public Policy Requirement in New York State. Accordingly, the NYISO determined that there are no proposed regional Public Policy Transmission Projects that could more efficiently or cost-effectively satisfy a need driven by a Public Policy Requirement identified in an LTP. In the absence of any public policy needs in the LTPs, it is also not necessary for the NYISO to determine whether a regional transmission project would more efficiently or cost effectively satisfy such a transmission need on the BPTF than a local transmission solution.

[38] See OATT Section 31.4.11.1 ("[T]he draft report will be provided to the Market Monitoring Unit for its review and consideration").

[39] *See* Section 31.2.1.1.2.1 of the OATT.

# 4. Conclusions and Recommendations

In determining which of the proposed Public Policy Transmission Projects is the more efficient or cost-effective solution to satisfy the AC Transmission Needs, the NYISO staff considered each Public Policy Transmission Project's total performance under all of the selection metrics (described in Section 3 of this report), risks associated with each project, and inputs from Developers, stakeholders, and DPS. The evaluation includes scenarios that modify the assumptions to evaluate the proposed Public Policy Transmission Projects according to the selection metrics and the impact on the NYISO's wholesale electricity markets. This section describes the summary of project evaluations, ranking of projects, selection recommendation, and next steps.

## 4.1 Summary of Project Evaluations

The project evaluations are summarized in this section based on their individual performance. Below is a brief summary of the key design differences and the highlighted evaluation results for each of the seven Segment A projects. All Segment A projects retire the Porter to Rotterdam 230 kV lines as directed by the December 2015 Order, and since this component of the projects is not a distinguishing factor, it is not repeated in the summary below.

**T018: National Grid/Transco - NYES Segment A**

- Single Edic to New Scotland 345 kV line proposed on existing ROW, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Rotterdam 345 kV substation, capacitor bank at Rotterdam 345 kV substation
- The independent cost estimate is $520 million
- The independent duration estimate is 52 months
- Low Central East limit increase
- Good operability and expandability, and foundations and structures beyond NESC standard
- Easement needed to mitigate EMF violations

**T021: NextEra - Enterprise Line Segment A**

- Single Edic to New Scotland 345 kV line proposed on existing ROW, the existing Marcy to New Scotland 345 kV line #18 looped into and out of a new Princetown 345 kV substation, and additional non-utility property needed for Princetown substation but with an option to purchase
- The independent cost estimate is $498 million
- The independent duration estimate is 52 months
- Low Central East limit increase

- Good operability and expandability
- Easement needed to mitigate EMF violations

**T025: NAT/NYPA - Segment A + 765 kV**

- Single Edic to New Scotland 345 kV line proposed on existing ROW, existing 345 kV line between Marcy and Knickerbocker converted to 765 kV operation, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Princetown 345 kV substation, a new Princetown substation tapping the new line and line #14, and terminal upgrades at Marcy and Edit substations
- The independent cost estimate is the highest at $863 million
- The independent duration estimate is 54 months
- High Central East limit increase, but still low N-1-1 performance
- Good operability and expandability
- The most easement needed to mitigate EMF violations, and high risks to project completion associated with clearance, corona, insulation, and siting issues

**T026: NAT/NYPA - Segment A Base**

- Single Edic to New Scotland 345 kV line proposed on existing ROW, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Rotterdam 345 kV substation, and terminal upgrades at Marcy and Edit substations
- The independent cost estimate is the lowest at $491 million
- The independent duration estimate is 52 months
- Low Central East limit increase
- Good operability and expandability
- Easement needed to mitigate EMF violations

**T027: NAT/NYPA - Segment A Double-Circuit**

- Double-circuit Edic to New Scotland 345 kV line proposed on existing ROW, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Rotterdam 345 kV substation, a new Princetown substation tapping the new line and line #14, and terminal upgrades at Marcy and Edic substations
- The independent cost estimate is at $750 million
- The independent duration estimate is 55 months
- High Central East limit increase
- Excellent operability and expandability

- Least easement required to mitigate EMF violations
- Most aging infrastructure replacement

**T028: NAT/NYPA - Segment A Enhanced**

- Single Edic to New Scotland 345 kV line proposed on existing ROW, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Rotterdam 345 kV substation, a new Princetown substation tapping the new line and line #14, and terminal upgrades at Marcy and Edit substations
- The independent cost estimate is at $514 million
- The independent duration estimate is 52 months
- Low Central East limit increase
- Good operability and expandability
- Easement needed to mitigate EMF violations

**T031: National Grid/Transco - NYES Segment A**

- Single Edic to New Scotland 345 kV line proposed on existing ROW, a new Princetown substation tapping all 345 kV lines, common tower structures used for the new line and line #14 south of Princetown, two new Princetown to Rotterdam 345 kV lines proposed on existing ROW, and additional non-utility property needed for Princetown substation
- The independent cost estimate is $570 million
- The independent duration estimate is 52 months
- Low Central East limit increase
- Good operability and expandability
- Easement needed to mitigate EMF violations

All Segment B projects include the common upgrades required by the PSC in its December 2015 Order, which ordered Orange and Rockland Utilities, Inc. (O&R) and Central Hudson Gas and Electric Corporation (Central Hudson), respectively, to upgrade the Shoemaker to Sugarloaf 138 kV facilities and the terminal upgrades at Rock Tavern 345 kV Substation. These projects were not considered by the NYISO as a distinguishing factor in selecting among proposed projects. Below is a brief summary of the key design differences and the highlighted evaluation results for each of the six Segment B projects.

**T019: National Grid/Transco - NYES Segment B**

- Double-circuit Knickerbocker to Pleasant Valley 345/115 kV line proposed on existing ROW, 50% series compensation on the proposed 345 kV line, two capacitor banks proposed at Pleasant Valley, and terminal upgrades at Roseton and New Scotland substations
- The independent cost estimate is $479 million
- The independent duration estimate is 49 months
- High UPNY/SENY transfer limit increase due to series compensation
- Good operability and expandability, and foundations and structures beyond NESC standard
- Medium structure height increase, relay coordination due to series compensation, and risk of SSR and voltage rise mitigation due to series compensation

**T022: NextEra - Enterprise Line Segment B**

- Double-circuit Knickerbocker to Churchtown 345/115 kV line and single-circuit Churchtown to Pleasant Valley 345 kV line proposed on existing ROW, and a new Churchtown 115 kV substation proposed next to the existing one
- The independent cost estimate is the lowest at $373 million
- The independent duration estimate is 47 months
- Average UPNY/SENY transfer limit increase
- Good operability and expandability
- Medium structure height increase

**T023: NextEra - Enterprise Line Segment B-Alt**

- Double-circuit Knickerbocker to Pleasant Valley 345/115 kV line proposed on existing ROW, and a new Churchtown 115 kV substation proposed next to the existing one
- The independent cost estimate is $424 million
- The independent duration estimate is 49 months
- Average UPNY/SENY transfer limit increase
- Good operability and expandability
- High structure height increase

**T029: NAT/NYPA - Segment B Base**

- Double-circuit Knickerbocker to Pleasant Valley 345/115 kV line proposed on existing ROW, and Middletown upgrades proposed
- The independent cost estimate is $422 million
- The independent duration estimate is 49 months

- Average UPNY/SENY transfer limit increase
- Excellent operability and good expandability
- Lowest structure height increase, more than 50% of the structures with reduced height

**T030: NAT/NYPA - Segment B Enhanced**

- Double-circuit Knickerbocker to Pleasant Valley 345/115 kV line proposed on existing ROW with three-bundle conductors for the 345 kV line, and Middletown upgrades proposed
- The independent cost estimate is $441 million
- The independent duration estimate is 49 months
- Average UPNY/SENY transfer limit increase
- Excellent operability and good expandability
- Lowest structure height increase, more than 50% of the structures with reduced height

**T032: ITC - 16NYPP1-1A AC Transmission Segment B**

- Double-circuit Knickerbocker to Churchtown 345/115 kV line and triple-circuit Churchtown to Pleasant Valley 345 kV line proposed on existing ROW
- The independent cost estimate is the highest at $536 million
- The independent duration estimate is 51 months
- Average UPNY/SENY transfer limit increase
- Good operability and expandability
- Low structure height increase, but more structures used resulting in higher risk to siting due to potential visual and agricultural impacts

## 4.2 Ranking

A two-step process was used to rank the AC Transmission Public Policy Transmission Projects. Step 1 divided projects in each segment into three tiers based on their individual performance and risks. Step 2 ranked the projects numerically in each segment based on combination results.

### 4.2.1 Step 1: Tiered Ranking

Projects in each segment were first analyzed individually, and then compared against each other to identify the major performance and risk differences. Metrics analyzed in this step include independent cost estimates, duration estimates, transfer capability, operability, expandability, property rights, replacement of aging infrastructure, and risks. The remaining metrics were considered in Step 2.

Table 4-1 and Table 4-2 show the major performance and risk differences for Segment A and

Segment B projects, respectively. Both tables are color-coded such that the pros are highlighted in green and cons are highlighted in red. A dash used in the tables signifies that the project has an average performance. Based on the NYISO staff's consideration of these evaluation metrics, together with inputs from Developers, stakeholders, and DPS, the AC Transmission Public Policy Transmission Projects were divided into three tiers for each segment with Tier 1 being the most favorable and Tier 3 being the least favorable.

The objective of Segment A is to increase the Central East transfer capability by constructing new 345 kV transmission on the ROW made available through decommissioning the existing Porter to Rotterdam 230 kV lines. Compared with other Segment A projects, T027 significantly increases the Central East transfer capability, and results in excellent operability, expandability, and replacement of aging infrastructure, and require least easement to mitigate EMF issues due to the double-circuit design. Therefore, T027 was placed in Tier 1. In contrast, though T025 has the highest Central East incremental transfer capability and average performance on other metrics, it was placed in Tier 3 because of significant risks associated with this 765 kV project design as described in Section 3.3.11. T026 was also placed in Tier 3 due to its lowest Central East incremental transfer capability. The remaining projects were placed in Tier 2 due to relatively similar performance and risks.

All Segment B projects are electrically similar except for T019 with the proposed series compensation. As a result, the NYISO identified that the distinguishing factors among the Segment B projects are the structure heights and the number of structures due to the associated risks to obtaining the Article VII siting certificate based on potential adverse visual impacts to the Hudson Valley.[40] In order to quantify the difference in visual impacts among projects, SECO's evaluation compares the proposed structure topology provided by the Developers to the information of the existing structures provided by the current facility owner. The differences in the structure height and the number of towers are identified and then further compared between proposals.[41]

This analysis identified that more than 50% of the new tower structures proposed by T029 and T030 have a reduced height compared to existing structures. Therefore, T029 and T030 were placed in Tier 1 because of low structure height increase, excellent operability, and relatively low cost

[40] While the December 2015 Order encouraged new structures to have minimal increase in height, and determined that height increases of less than 25 feet over existing structures will not be considered to be an adverse visual impact on the regional basis, the construction of new structures even with minimal increase in height may result in greater siting challenges due to their visual impact. *See* December 2015 Order, at p 35.

[41] The final project design and visual impact identification and mitigation will be addressed by the PSC in the Public Service Law Article VII siting proceedings.

estimates. T022 was placed in Tier 2 because of medium structure height increase and relatively less aging infrastructure replacement. T019 was placed in Tier 3 because of its medium structure height increases and risks associated with the proposed series compensation. T023 was placed in Tier 3 because of its high structure height increases. Although T032 has low structure height increase, it was placed in Tier 3 since it adds more structures, increasing the siting risk due to potential visual and agricultural use impacts.

## Table 4-1: Summary of Results for Segment A

| Project ID | Independent Cost Estimate: 2018 $M | Independent Duration Estimate: Months | Incremental Central East Voltage Transfer Limit | Operability | Propriety Rights | Expandability | PSC Criterion: Replacement of Aging Infrastructure | Risks | | | Tiered Ranking |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Overall Visual Impact | Easement Needed to Mitigate EMF (acres) | Other Risks Including Siting | |
| T018 | 520 | 52 | Low | Breaker-and-a-half 345 kV Rotterdam substation, foundations and structures beyond NESC standard, low N-1-1 performance | - | - | - | Medium structure height increase | 24 | - | 2 |
| T021 | 498 | 52 | Low | Breaker-and-a-half 345 kV Princetown substation, low N-1-1 performance | Non-utility property needed for Princetown substation, but with an option to purchase | Property available to expand the Princetown substation | No upgrades at Rotterdam substation | High structure height increase, more structures, less impact to agriculture due to monopoles | 24 | - | 2 |
| T025 | 863 | 54 | Highest | Breaker-and-a-half 345 kV Rotterdam substation, ring-bus 345 kV Princetown substation, low N-1-1 performance | - | - | - | Low structure height increase | 243 | Potential mitigation for clearance and corona issues, hardware replacement for insulation, siting, and permitting risks, and risk to system operations due to contingency size | 3 |
| T026 | 491 | 52 | Lowest | Breaker-and-a-half 345 kV Rotterdam substation, low N-1-1 performance | - | - | - | Low structure height increase | 24 | - | 3 |
| T027 | 750 | 55 | High | breaker-and-a-half 345 kV Rotterdam substation, breaker-and-a-half 345 kV Princetown substation, best N-1-1 performance | - | All projects allow one more 345 kV line to be added within existing ROW, but double-circuit design tends to maximize the Central East transfer capability | More replacement due to double-circuit design, rebuild of Edic - New Scotland 345 kV line #14 for 6.3 miles, terminal upgrades at Marcy and Edic 345 kV substations | High structure height increase, 6 miles of lattice tower removed, less impact to agriculture due to monopoles | 16 | - | 1 |
| T028 | 514 | 52 | Low | breaker-and-a-half 345 kV Rotterdam substation, ring-bus 345 kV Princetown substation, low N-1-1 performance | - | - | - | Low structure height increase | 24 | - | 2 |
| T031 | 570 | 52 | Low | Breaker-and-a-half Princetown substation looping in all 345 kV lines, straight-bus at Rotterdam substation, no bus reconfiguration at New Scotland, new tower contingency created south of Princetown, low N-1-1 performance | Non-utility property needed for Princetown substation | - | Rebuild of Edic - New Scotland 345 kV line #14 for 20 miles | Low structure height increase, more structures, more impact to agriculture, 20 miles of lattice tower removed | 24 | Property acquisition for Princetown substation | 2 |

## Table 4-2: Summary of Results for Segment B

| Project ID | Independent Cost Estimate: 2018 $M | Independent Duration Estimate: Months | Incremental UPNY/SENY Thermal Transfer Limit | Operability | Propriety Rights | Expandability | PSC Criterion: Replacement of Aging Infrastructure | Risks | | Tiered Ranking |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Overall Visual Impact | Other Risks Including Siting | |
| T019 | 479 | 49 | Higher with series compensation, but similar to others if bypassed | Foundations and structures beyond NESC standard | - | - | Churchtown 115 kV substation rebuild, terminal upgrades at New Scotland and Roseton substations | Medium structure height increase | Risks of SSR, voltage rise mitigation, relay coordination due to 50% series compensation | 3 |
| T022 | 373 | 47 | - | | - | - | Less 115 kV upgrades between Churchtown and Pleasant Valley | Medium structure height increase | - | 2 |
| T023 | 424 | 49 | - | | - | - | | High structure height increase | - | 3 |
| T029 | 422 | 49 | - | Improved N-1-1 performance due to Middletown upgrades | - | - | Middletown upgrades, Churchtown 115 kV substation rebuild | Low structure height increase, reduced height for more than 50% of the structures | - | 1 |
| T030 | 441 | 49 | - | Improved N-1-1 performance due to Middletown upgrades | - | - | Middletown upgrades, Churchtown 115 kV substation rebuild | Low structure height increase, reduced height for more than 50% of the structures | - | 1 |
| T032 | 536 | 51 | - | - | - | Transformers could be added to connect the Knickerbocker 345kV and 115 kV switching stations | - | Low structure height increase, more structures, more impact to agriculture, two-pole configuration with triple circuits | Operation and maintenance complexity due to triple-circuit design | 3 |

Notes:
1. With 30% contingency rate, without 5% synergy, and without cost for Rock Tavern and Shoemaker-Sugarloaf upgrades

#### 4.2.2 Step 2: Individual Ranking

In Step 2, combinations of Segment A and Segment B projects were evaluated based on consideration of all the evaluation metrics for efficiency or cost effectiveness. Synergies of projects were identified in two factors: i) cost saving for both Segment A and Segment B projects proposed by the same Developer, and ii) the overall system efficiency or cost effectiveness based on the combined electrical characteristics, regardless of whether the projects are proposed by the same Developers or not. The combination results were then used to inform the numerical ranking in each Segment.

Table 4-3 provides a summary of Tier 1 and Tier 2 project combination results for each metric evaluated for the AC Transmission Needs.[42] The table is color-coded such that the best values are highlighted in green, average values are highlighted in yellow, and low values are highlighted in red. This table does not comprehensively summarize all evaluations documented in this report, but offers a high-level summary of the relative performance of each Tier 1 and Tier 2 project combination for each metric using the primary study assumptions. No single metric or set of assumptions acts as the single deciding factor in determining the more efficient or cost effective transmission solution.

Based on consideration of all the evaluation metrics for efficiency or cost effectiveness, together with inputs from stakeholders and DPS, the NYISO staff ranked the projects in each segment. The relative ranking was first developed by comparing project performance and risks in pairs, and then the differences were identified to distinguish the projects.

[42] Note that the combination for all possible pairs from the same Developers were evaluated and the results are included in Section 3, but in this section the results for Tier 3 projects were not summarized due to low performance and/or high risks.

## Table 4-3: Summary of Evaluations

| Project ID | Independent Cost Estimate: 2018 $M (1) | Independent Duration Estimate: Months (2) | UPNY/SENY Incremental Thermal Transfer Limit: MW (3) | Central East Incremental Voltage Transfer Limit: MW | UPNY/SENY Cost/MW: $M/MW (3) | Central East Cost/MW: $M/MW | Baseline Production Cost Savings: 2018 $M | Baseline Production Cost Savings /Capital Cost | CES Production Cost Savings: 2018 $M | CES Production Cost Savings /Capital Cost | System CO2 Emission Reduction: 1000 tons (4) | Performance: 20-Year Incremental Flow on UPNY/SENY + Central East: GWh (4) | Operability | | Expandability | | Property Rights | | PSC Criterion: Aging Infrastructure | | Tiered Ranking | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Seg A | Seg B | Seg A | Seg B | Seg A | Seg B | Seg A | Seg B | Seg A | Seg B |
| T018+T022 | 893 | 52 | 1,519 | 425 | 0.25 | 1.22 | 236 | 0.26 | 830 | 0.93 | 4,686 | 86,987 | Good | Good | Good | Good | Good | Good | Good | Fair | 2 | 2 |
| T018+T029 | 942 | 52 | 1,401 | 425 | 0.30 | 1.22 | 236 | 0.25 | 830 | 0.88 | 4,686 | 86,987 | Good | Excellent | Good | Good | Good | Good | Good | Good | 2 | 1 |
| T018+T030 | 961 | 52 | 1,535 | 425 | 0.29 | 1.22 | 236 | 0.25 | 830 | 0.86 | 4,686 | 86,987 | Good | Excellent | Good | Good | Good | Good | Good | Good | 2 | 1 |
| T021+T022 | 827 | 52 | 1,519 | 350 | 0.23 | 1.35 | 199 | 0.24 | 714 | 0.86 | 7,298 | 78,917 | Good | Good | Good | Good | Good | Good | Good | Fair | 2 | 2 |
| T021+T029 | 919 | 52 | 1,401 | 350 | 0.30 | 1.42 | 196 | 0.21 | 707 | 0.77 | 8,235 | 77,865 | Good | Excellent | Good | Good | Good | Good | Good | Good | 2 | 1 |
| T021+T030 | 938 | 52 | 1,535 | 350 | 0.29 | 1.42 | 196 | 0.21 | 707 | 0.75 | 8,235 | 77,865 | Good | Excellent | Good | Good | Good | Good | Good | Good | 2 | 1 |
| T027+T022 | 1123 | 55 | 1,326 | 825 | 0.28 | 0.91 | 331 | 0.29 | 1129 | 1.01 | 9,429 | 133,565 | Excellent | Good | Excellent | Good | Good | Good | Excellent | Fair | 1 | 2 |
| T027+T029 | 1113 | 55 | 1,326 | 825 | 0.30 | 0.86 | 331 | 0.30 | 1129 | 1.01 | 9,429 | 133,565 | Excellent | Excellent | Excellent | Good | Good | Good | Excellent | Good | 1 | 1 |
| T027+T030 | 1131 | 55 | 1,470 | 825 | 0.28 | 0.86 | 337 | 0.30 | 1108 | 0.98 | 10,184 | 135,044 | Excellent | Excellent | Excellent | Good | Good | Good | Excellent | Good | 1 | 1 |
| T028+T022 | 887 | 52 | 1,519 | 400 | 0.25 | 1.28 | 221 | 0.25 | 840 | 0.95 | 4,056 | 74,942 | Good | Good | Good | Good | Good | Good | Good | Fair | 2 | 2 |
| T028+T029 | 889 | 52 | 1,427 | 400 | 0.28 | 1.22 | 221 | 0.25 | 840 | 0.94 | 4,056 | 74,942 | Good | Excellent | Good | Good | Good | Good | Good | Good | 2 | 1 |
| T028+T030 | 907 | 52 | 1,569 | 325 | 0.27 | 1.50 | 205 | 0.23 | 704 | 0.78 | 5,901 | 68,551 | Good | Excellent | Good | Good | Good | Good | Good | Good | 2 | 1 |
| T031+T022 | 943 | 52 | 1,519 | 400 | 0.25 | 1.43 | 206 | 0.22 | 570 | 0.60 | 8,814 | 73,429 | Good | Good | Good | Good | Fair | Good | Excellent | Fair | 2 | 2 |
| T031+T029 | 992 | 52 | 1,427 | 400 | 0.30 | 1.43 | 206 | 0.21 | 570 | 0.57 | 8,814 | 73,429 | Good | Excellent | Good | Good | Fair | Good | Excellent | Good | 2 | 1 |
| T031+T030 | 1011 | 52 | 1,569 | 400 | 0.28 | 1.43 | 206 | 0.20 | 570 | 0.56 | 8,814 | 73,429 | Good | Excellent | Good | Good | Fair | Good | Excellent | Good | 2 | 1 |

Notes:
1. With 30% contingency rate, with 5% synergy if from same developers, and without cost for Rock Tavern and Shoemaker-Sugarloaf upgrades
2. Max of Segment A and Segment B
3. UPNY/SENY N-1 optimized thermal transfer
4. CES + Retirement w/o National $CO_2$

Critical comparisons and the resulting ranking are summarized below for the Segment A projects:

- T027, as shown in Table 4-3, consistently performs best regardless of which Segment B project is paired with it. While T027 has the second highest cost among Segment A projects, the overall benefits provided by the double-circuit design warrant the cost. These benefits include a significant increase in Central East transfer capability, increased production cost savings, and excellent operability and expandability. T027 also requires the least easement to mitigate the EMF issues compared with other Segment A projects. In addition, T027 has the most aging infrastructure replacement. As a result, T027 was ranked highest among all Segment A projects.
- The combinations with either T028 or T018 for Segment A have similar performance in several metrics based on representative results. T028 includes the new Princetown 345 kV substation that better integrates the existing system and provides future expandability. Moreover, T028 includes terminal upgrades at the Edic and Marcy 345 kV substations, which help reduce congestion. T028 was ranked higher than T018 for these reasons.
- The three Segment A Tier 2 projects were compared against each other. T018 has several key features, such as including a capacitor bank, looping the existing Edic to New Scotland 345 kV line #14 into the Rotterdam GIS substation, which has three proposed transformers, and the foundations and structures proposed are beyond the minimum requirement of National Electrical Safety Code (NESC). In contrast, T021 loops the existing Marcy to New Scotland 345 kV line into the Princetown substation with two proposed transformers, which causes congestion under certain system conditions. Moreover, T021 does not propose to replace the aging infrastructure at the Rotterdam substation. T031 is the most expensive among the Segment A Tier 2 projects. While T031 provides a good increase in the Central East transfer capability, it creates an additional tower contingency south of Princetown. Compared with the combinations with T021, the combinations with T031 perform less efficiently in many metrics such as cost per MW. Furthermore, T031 requires additional non-utility property for Princetown substation due to its large footprint, which poses a siting risk. Therefore, T018 ranks better than T021, and T021 ranks better than T031.
- T026 is a Tier 3 project due to the least benefits of all Segment A projects, even though it is also the least expensive.

- T025 is a Tier 3 project with the highest cost. Although it greatly increases the Central East transfer capability, it has the highest risks due to the potential siting and operations risks associated with its 765 kV design. Therefore, it was given the lowest ranking among Segment A proposals.

Critical comparisons and the resulting ranking are summarized below for Segment B projects:

- T029 and T030, both Tier 1 projects, propose the lowest structure height increase and more than 50% of the new structures have a reduced height. Compared with other projects, they also have more replacement of aging infrastructure and better operability. Therefore, they were ranked higher among Segment B projects. The additional cost of the triple-bundle circuit proposed in T030 is less than the incremental production cost savings, and T030 is therefore less preferable. As a result, T029 was ranked higher than T030.
- T022, a Tier 2 project, is the least expensive Segment B project with medium structure height increases and relatively less aging infrastructure replacement. Therefore, it was ranked below T029 and T030.
- T023 and T019 are both Tier 3 projects. T023 has lower cost but comparatively more increases in structure height. T019 proposes medium structure height increase and stronger foundations and structures that exceed NESC standards, and also enables higher UPNY/SENY transfer capability. Accordingly, T019 was ranked higher than T023. However, as described in Section 3.3.11, this project poses risks of voltage rise, relay coordination, and subsynchronous resonance mitigation due to the proposed 50% series compensation.
- T032 is the most expensive Segment B project with numerous inherent siting risks in the design. These include additional structures with potential adverse visual and agricultural impacts, and operational and planning risk due to the triple circuit design. Accordingly, it was given the lowest ranking among Segment B proposals.

Taking all the metrics into consideration, the overall ranking of the projects in each segment is summarized in Table 4-4.

**Table 4-4: Overall Ranking**

| Segment | Ranking | Project ID | Developer Name | Project Name |
|---|---|---|---|---|
| A | 1 | T027 | North America Transmission / NYPA | Segment A Double Circuits |
| | 2 | T028 | North America Transmission / NYPA | Segment A Enhanced |
| | 3 | T018 | National Grid / Transco | New York Energy Solution Seg. A |
| | 4 | T021 | NextEra Energy Transmission New York | Enterprise Line: Segment A |
| | 5 | T031 | ITC New York Development | 16NYPP1-1A AC Transmission |
| | 6 | T026 | North America Transmission / NYPA | Segment A Base |
| | 7 | T025 | North America Transmission / NYPA | Segment A + 765 kV |
| B | 1 | T029 | North America Transmission / NYPA | Segment B Base |
| | 2 | T030 | North America Transmission / NYPA | Segment B Enhanced |
| | 3 | T022 | NextEra Energy Transmission New York | Enterprise Line: Segment B |
| | 4 | T019 | National Grid / Transco | New York Energy Solution Seg. B |
| | 5 | T023 | NextEra Energy Transmission New York | Enterprise Line: Segment B-Alt |
| | 6 | T032 | ITC New York Development | 16NYPP1-1B AC Transmission |

### 4.3 Selection Recommendation

Based on consideration of all the evaluation metrics for efficiency or cost effectiveness, together with input from Developers, stakeholders, and DPS, the NYISO staff recommends that the Board of Directors selects NAT/NYPA's T027 Segment A Double-Circuit proposal and NAT/NYPA's T029 Segment B Base proposal as the more efficient or cost-effective transmission solutions to satisfy the AC Transmission Needs.

Compared with other projects, the overall benefits provided by the double-circuit design in T027 warrant the more-expensive cost. These benefits include significant increase in Central East transfer capability, increased production cost savings, and excellent operability and expandability. T027 also requires the least easement to mitigate EMF violations compared with other Segment A projects. T029 provides similar UPNY/SENY transfer incremental and production cost savings with the second lowest cost. T029 also demonstrates excellent operability. Moreover, T029 has the lowest siting risk due to the lower increases in structure height compared to other projects; in fact, more than half of its new structures will be lower than existing structure heights along the right-of-way.

Both T027 and T029 are proposed by the same Developer, NAT/NYPA, which will result in synergy cost savings when developing two projects simultaneously. The selection of T029 for

Segment B by itself will not likely result in significant production cost savings to relieve Central East congestions, but when combined with T027 for Segment A, the synergies of transmission projects lead to best overall performance across evaluation metrics. Therefore, the NYISO staff determined that T027 for Segment A and T029 for Segment B are the more efficient or cost effective transmission solutions to satisfy the AC Transmission Public Policy Transmission Needs.

The combination of T027 and T029 is estimated to cost $856 million, taking into account a 5% discount for cost efficiency synergies of having a single developer for both projects. Assuming a 30% contingency factor of $257 million, the combined projects are estimated to cost $1,113 million. The projects are expected to provide combined production cost savings and capacity procurement savings in a range of $881 million to $1,979 million depending on future system conditions. Combining the production cost savings and ICAP savings for T027+T029, the savings over capital cost ratio is 0.8 to 1.1 for the baseline, and 1.5 to 1.8 for the CES + Retirement scenario. Moreover, the projects would also result in savings from avoided aging transmission refurbishment costs estimated to total $839 million. Based on the project schedule estimated by SECO, the in-service date for the selected projects is April 2023, assuming that the preparation of an Article VII application will begin immediately following the approval of this report and the project selections by the NYISO Board of Directors.

### 4.4 Next Steps

Following the approval of this report by the NYISO Board of Directors, the NYISO will tender Development Agreements to the Developers of the selected transmission projects. The Development Agreements will reflect project milestone schedules under which the Developers of the selected projects will complete the interconnection process, apply for Article VII siting and other necessary permits and authorizations, enter into an Operating Agreement(s) with the NYISO, and bring the projects into service.

# Appendices

## Appendix A – Public Policy Transmission Planning Process Glossary

## Appendix B – AC Transmission Public Policy Transmission Planning Need Viability and Sufficiency Assessment

## Appendix C – Phase 2 Selection Assumptions

## Appendix D – SECO Report

## Appendix E – Market Monitoring Unit Report

## Appendix F – Frequently Asked Questions