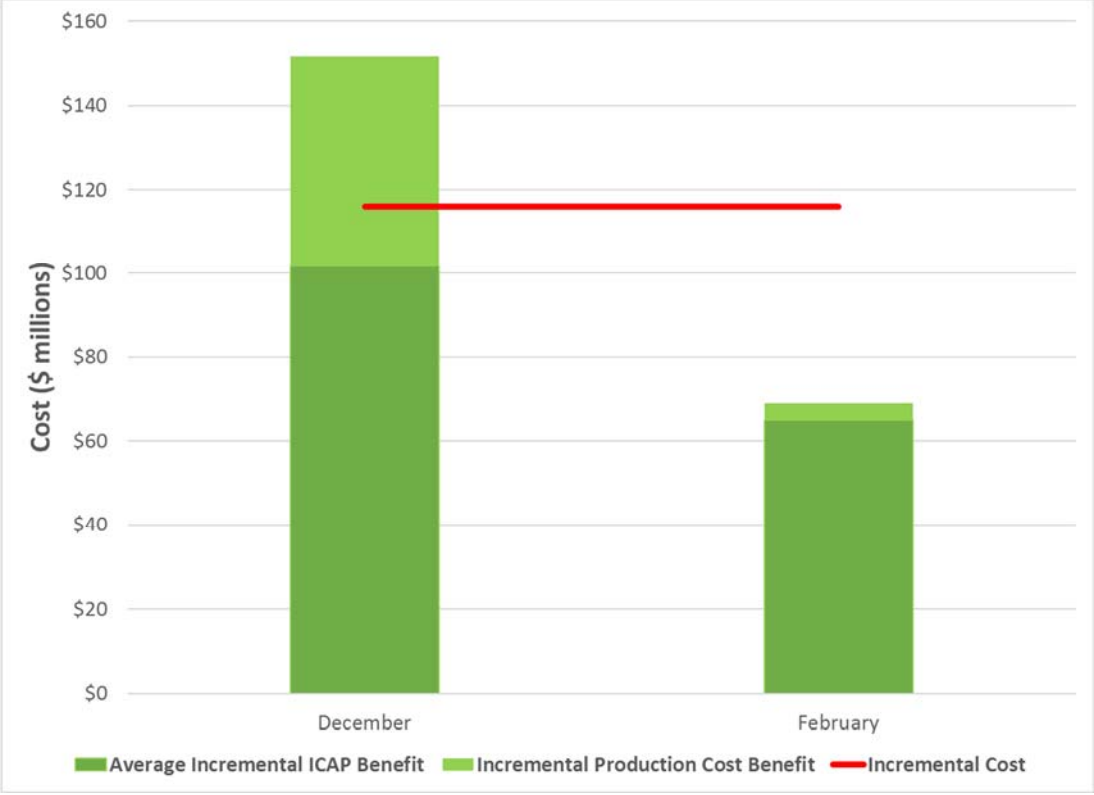
March 1, 2019

Ms. Ave M. Bie
Chair of the Board
New York Independent System Operator, Inc.
10 Krey Blvd.
Rensselaer, NY 12144

Dear Chair Bie:

LS Power Grid New York, LLC (f/k/a North America Transmission, LLC) and the New York Power Authority appreciate the opportunity for stakeholder review and comment on the Addendum to the AC Transmission Public Policy Transmission Planning Report dated December 27, 2018.

In the course of stakeholder review of the Addendum, several corrections have been made. The emergency transfer differential between T019 and other Segment B projects decreased from 950 MW to a range of 400 MW to 550 MW. As a result, the incremental benefits of T019 relative to T029 have been reduced by more than half. Today, NYISO no longer estimates incremental benefits of T019 to be greater than its estimated incremental cost, as shown in the figure below.



Incremental Cost and Benefit of T019 Above T029

The following points, detailed in our comments to the Management Committee (attached), are relevant to the Board's final selection:

- NYISO estimates the cost of T027+T019 to be $116 million more than T027+T029. T019 also has a higher risk of increased cost.
- NYISO estimates the production cost benefits of T027+T019 to be only $4 million more than T027+T029. Congestion on the New Scotland – Knickerbocker 345 kV transmission line limits the production cost benefits for T027+T029, which is a by-product of false modeling parameters. If corrected, the production cost savings of T027+T029 would likely be significantly higher than T027+T019.
- NYISO has not estimated the capacity benefits of T027+T019 as compared to T027+T029 based on the corrected transfer capacity, but just states the reduced differential in UPNY/SENY emergency transfer limits (from 950 MW to 550 MW) would have a corollary effect. The inferred average estimated incremental ICAP benefits for T027+T019 is approximately $65 million relative to T027+T029. As stated by the MMU, "[b]ecause of the uncertainty, it would be reasonable to give these benefits less weight in the selection than more certain costs and benefits."[1]

Altogether, T027+T019 will cost $116+ million more than T027+T029 and provide less than $70 million in incremental benefits – benefits that are uncertain by their nature as ICAP benefits. The selection of Proposal T019 is no longer supported, and the Board should correct the conclusions of the Addendum to reaffirm the selection of T027+T029 as the more efficient and cost effective projects.

Sincerely,

Paul Thessen
President
LS Power Grid New York, LLC

Sarah Orban Salati
Executive Vice President and Chief Commercial Officer
New York Power Authority

CC: Board of Directors

[1] MMU Memorandum to the NYISO Board of Directors, November 8, 2018, Page 7

Comments of LS Power and the New York Power Authority on the AC Addendum
February 26, 2019

INTRODUCTION

LS Power Grid New York, LLC (f/k/a North America Transmission, LLC) and the New York Power Authority appreciate this opportunity to submit the following comments for NYISO and stakeholder consideration regarding the NYISO Board's December 27, 2018 Summary of Proposed Modifications to Draft AC Transmission Public Policy Transmission Report and Proposed Selections (Addendum) regarding the selection of projects for the AC Upgrades Public Policy Transmission Need. The Addendum departs from the recommended selections contained in the June 2018 draft AC Transmission Public Policy Transmission Planning Report (Draft Report). The Draft Report received an 80% positive endorsement from market participants in the advisory vote held at the June 26, 2018 Management Committee meeting, with opposing votes only from Transmission Owner sector members who are sponsors of Proposal T019.

The most efficient and cost effective selection for Segment B is Proposal T029, because:

- Proposal T029 is estimated to cost $116 million less than Proposal T019. In addition, the cost estimate for Proposal T019 does not include certain known costs, and has a higher risk of increased costs.
- Proposal T029 and Proposal T019 are estimated to provide comparable production cost savings. However, Proposal T029 is not provided the benefit of New Scotland terminal upgrades to be completed as part of Proposal T027. If accounted for, the production cost savings for Proposal T029 would likely be higher than Proposal T019.
- Estimated capacity savings are uncertain, and the estimated capacity savings from T019 do not justify the additional costs.
- Using the independent cost estimates, T029 provides a higher benefit to cost ratio than T019.
- Proposal T019 series compensation is not optimally sized, and prematurely implementing series compensation may lead to technical system limitations – and higher system costs - as the State's electric transmission system evolves.

The process of developing the Addendum was flawed since it employed new measures and factors that were not previously vetted with stakeholders until after conclusions were made. In addition, NYISO has not provided a comparable level of detail regarding Proposal T030 to fully assess if it may be more efficient and cost effective.

DISCUSSION

The revised recommendation of Proposal T019 over Proposal T029 is not supported by the analysis presented in the Draft Report and Addendum.

1. Higher Cost With Greater Risk

NYISO's cost estimates for the various projects have not changed from the Draft Report. The combination of Proposal T027+T019 is estimated to cost $1,229 million (Draft Report, p. 55). The combination of Proposals T027+T029 is estimated to cost $1,113 million (Draft Report, p. 55). Selection of Proposals T027+T019 results in an estimated cost that is $116 million more than Proposal T027+T029. In addition, this difference is conservatively low. There are several areas where Proposal T019 clearly has a much higher risk of cost increases than Proposal T029, including the following:

SSR Mitigation – Sub-synchronous resonance (SSR) mitigation costs were recognized in the Draft Report but not quantified. Since the Draft Report was issued, the System Impact Study Report (SISR) for Proposal T019

has been completed,[1] which includes a preliminary estimate of up to $4.875 million of SSR mitigation costs (see Addendum p. 27), not including contractor mark-up (15%) and contingency (30%). The SRIS also did not include an analysis of potential SUFs related to Transient Recovery Voltage (TRV). The cost of every element identified for every other proposal was included in the comprehensive SECO cost estimates, with contractor mark-up and contingency, but the T019 estimate has not been updated to include this expected cost.

NE-NY Interface Mitigation - The SISRs for both Proposal T019 and Proposal T029 identify potential system upgrade facilities (SUFs) to mitigate impacts to the NE-NY interface. However, there are important differences summarized in the table below.

SRIS	Impact	NUF Option 1	NUF Option 2	NUF Option 3
T019	-236 MW	$30 M - Alps PAR (Loopflow issues)	$123 M - PV Series Reactor, Reynolds Road Transformer, Reconductor Eastover 230 kV Line	$90 M - Reconductor Pleasant Valley – Long Mountain
T029	-140 MW	$30 M - Alps PAR	$60 M - PV Series Reactor, Reynolds Road Transformer	$90 M - Reconductor Pleasant Valley – Long Mountain

Proposal T019 has a larger impact to the interface, 236 MW compared to 140 MW for Proposal T029. Since Proposal T019 has a greater impact on the interface, there is a higher risk that the SUFs to mitigate the impact will cost more, potentially significantly more. This is reflected in the potential SUFs identified in each SISR. The SISR for Proposal T019 identifies SUFs in the range of $30-123 million compared to a range of $30-90 million for Proposal T029. While the least cost upgrade is the same for both, installation of a new PAR on the 345 kV system at Alps, the SISR for Proposal T019 identifies potential loopflow issues that may not make this upgrade suitable. In addition, Proposal T029 was studied with Proposal T027 (double circuit upgrade to Central East) while Proposal T19 was studied with Proposal T018 (single circuit upgrade to Central East). The combination of Proposal T027 (double circuit upgrade to Central East) and Proposal T019 may have a larger negative impact to the NE-NY interface.

Visual Impact Mitigation - The Addendum identifies that Proposal T019 could mitigate visual impacts of structure heights in the Article VII process, but does not take into account the cost of such mitigation. Proposal T029 includes many engineering measures taken to reduce structure heights that result in significant cost impacts including matching existing structure locations, increasing conductor tension, adding in-line dead-ends, and adding structure weights to remediate uplift, estimated to add costs in the tens of millions of dollars. An apples-to-apples comparison of the proposals requires these costs to be added to the cost estimate of Proposal T019, or subtracted from the cost estimate of Proposal T029.

SENY Reserve Requirement – The Addendum identifies that Proposal T019 has a larger SENY reserve requirement relative to Proposal T029. This has the potential to lead to higher costs for ratepayers. Further, "access to operating reserves" should be reflected in the metric of operability under Section 31.4.8.1.4 of the NYISO Tariff. Instead the impact on this metric has been ignored.

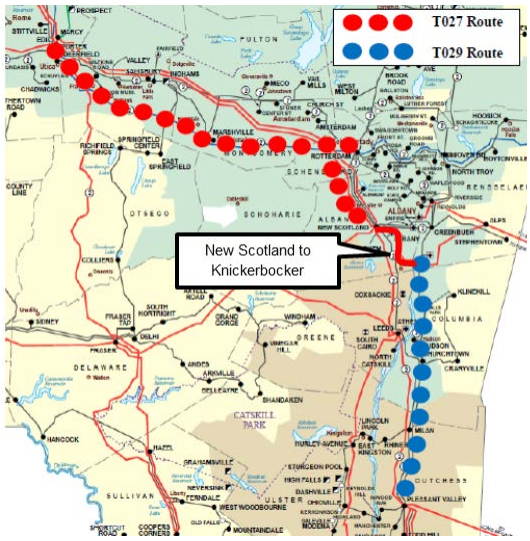
Considering risks of SSR mitigation, NE-NY interface mitigation, visual impact mitigation, and increased SENY reserve requirements, the estimated cost difference between a selection of Proposal T019 and Proposal T029 could be much higher than $116 million. Finally, NYISO has noted that some of these additional costs will be covered by the project contingency. This is inappropriate. If one project possesses more risk than another, those risks should be incorporated into the base cost or a higher level of contingency should be allocated to such proposal in order to facilitate an accurate and equitable comparison of proposals. Known project elements should be included in the project estimate. The contingency is available to address any variations to the costs of the known elements not to be the sole source of funding for these elements.

[1] The SISR for Proposal T019 was performed with Segment A Proposal T018, with a single circuit. A SISR will need to be performed with Segment A Proposal T027.

2. Production Cost Benefits

The latest production cost analysis presented by NYISO staff shows minimal production cost benefits of Proposal T019 relative to Proposal T029, only $4 million (February Addendum, p. 23). This is not surprising, since there is little congestion on UPNY-SENY. Production cost benefits in this process have been shown to correlate very well to Central East Transfer, and very poorly to UPNY-SENY Transfer.

However, properly modeled, T027+T029 should have greater production cost benefits than Proposals T027+T019. The production cost savings for both proposals is shown to be limited by congestion on the New Scotland to Knickerbocker path, which is located between Segment A and Segment B as shown in the figure below.



The table below identifies congestion on New Scotland-Knickerbocker from the production cost modeling results (See Feb 11 ESPWG presentation, Slide 15). However, these results reflect an inaccurate modeling assumption.

Annual Demand Congestion in 2018 M$ for New Scotland - Knickerbocker:

CES+ Retirement Scenario	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Pre-Project*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T027+T019	5	10	17	26	50	97	127	199	175	161	174	165	173	160	159	128	138	115	129	114
T027+T029	2	7	11	14	32	54	76	119	104	93	107	101	105	91	92	72	84	69	79	68
T027+T030	7	12	18	27	52	94	126	191	170	158	172	164	171	153	146	123	133	114	126	109

The Pre-Project New Scotland to Knickerbocker/Alps path is limited by terminal equipment at New Scotland. Proposal T019 includes upgrades to terminal equipment at New Scotland and, in the production cost analysis, Proposals T027+T019 are provided the benefit of those upgrades and a higher limit on the New Scotland to Knickerbocker path. The series compensation associated with Proposal T019 causes significantly increased flows on New Scotland to Knickerbocker and, as a result, congestion still occurs.

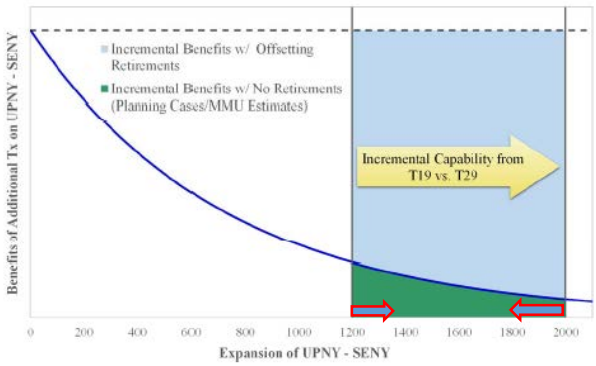
NYISO's production cost analysis for Proposals T027+T029 assumes the New Scotland to Knickerbocker path is still limited by terminal equipment at New Scotland. Importantly, Proposal T027 includes new terminal equipment at New Scotland. As a result, the combination of Proposals T027+T029 should also include an upgrade to the terminal equipment at New Scotland for the transmission line to Knickerbocker and, as a result, the New Scotland to Knickerbocker path should have a rating equal to the conductor rating. Correcting this error in NYISO's modeling will increasing this limit and is expected to significantly increase the production cost savings for Proposals T027+T029. The same is true for Proposals T027+T030.

3. Capacity Benefit

In regards to ICAP benefits, the Draft Report concluded that "In summary, the NYISO continues to develop its ICAP benefit metric methodology, and therefore, it did not use this metric to distinguish among projects." (Draft Report, p. 79) The MMU also identifies that capacity savings "… are relatively uncertain because they depend on decisions over a long time horizon by participants and the State. Because of the uncertainty, it would be reasonable to give these benefits less weight in the selection then more certain costs and benefits."[2] However, the Addendum finds ICAP Benefits to be distinguishing.

The revised Addendum, dated February 20, 2019 recognizes differences in the transfer capability from the Addendum dated December 27, 2019 would reduce the ICAP benefits, but additional analysis was not performed to identify the precise level of ICAP benefits. Instead, the February Addendum only states that the change in results would have a "corollary effect on the ICAP savings differential" (p. 28). The figure below attempts to illustrate this effect. The figure below is Figure 1 from the MMU November 8, 2018 memo to the NYISO Board of Directors. It identifies increasing benefits of expansion of UPNY-SENY. The red arrows have been added to show

Figure 1: Incremental Benefits of Additional Capacity on the UPNY-SENY Interface



the change in capability from the December 27, 2019 to the February 20, 2019, from 1150 MW to 1300 MW for Proposal T029, and from 2100 MW to 1850 MW for Proposal T019. In order to estimate the impact of the change in capacity a simple linear interpolation can be made. Note that this conservative methodology does not account for diminishing marginal returns or limitations that arise from UPNY-ConEd.[3] The table below estimates the NPV of ICAP benefits for each project based on a linear interpolation of the values in the December 27, 2019 Addendum updated for the February 2019 capability values.

ICAP Benefits 20-year savings, 2018 $M			
	T027+T019	T027+T029	Difference
NYISO Existing Localities Case			
Convergence to Net CONE	702	609	93
Net CONE	981	851	130
NYISO – Elimination of G-J Case			
Convergence to Net CONE	1370	1336	34
Net CONE	1915	1869	46
MMU Method[6]			
Baseline Case	237	218	19
CES+Retirement Case	592	523	69

Under almost every scenario, the capacity benefits for Proposal T019 do not approach the additional cost of at least $116 million. The only assumption which would support benefits greater than $116 million is if the ICAP cost in all zones were to equal the net CONE for all years, which is not a realistic assumption.

[2] MMU Memorandum to NYISO Board of Directors, November 8, 2018, p. 7

[3] The MMU Memorandum identifies that additional increases in the UPNY-SENY interface, couples with assumed retirements in Zones J-K, cause UPNY-ConEd to become limiting on the ICAP benefits (p. 5)

4. Resilience Benefit

The Addendum identifies "Grid Resilience Benefits" of T019, including design greater than minimum standards and an ability to withstand heavier ice accumulation loadings and limit cascading structure failures as compared to other proposals. These conclusions are not supported by engineering analysis and are not true. For example, these conclusions do not recognize that Proposal T029 is also designed to greater than minimum standards (100 mph extreme wind) and as a result Proposal T029 has a design less susceptible to cascading failure than Proposal T019. (See Attached memorandum from Power Engineers). The use of this criteria is also contrary to past NYISO PPTN evaluations where the selected proposal utilized wood poles, which are susceptible to cascading structure failure.

5. Long-Term Planning Principles

Long-term planning principles do not support the selection of Proposal T019 over Proposal T029. The amount of series compensation included in Proposal T019 (50%) was designed to optimize transfer in combination with Proposal T018 submitted by the same bidder, which only includes a single Edic to New Scotland circuit on Central East. The danger of pairing the series compensation with other upgrades can be seen in the production cost analysis discussion above. Too much series compensation can lead to congestion on the system, such as on New Scotland to Knickerbocker. This is also seen in NYISO's analysis of Proposal T025 (765 kV conversion) in combination with Proposal T019, which had the lowest UPNY-SENY transfer amount of any studied proposal combination in the Draft Report.

Series compensation consists of discrete equipment within a substation that can be easily added to the system in the future, when and if it proves to be beneficial and cost effective. Long-term planning principles suggest an approach of selecting Proposal T029, and keeping open the possibility of additions, such as appropriately-sized series compensation, if needed. This approach would have many benefits:

- The level of series compensation would be designed to match specific future needs as the system develops.
- The cost to ratepayers would be approximately $95 million lower (the estimated cost of the series compensation equipment alone is $8 million, or approximately $21 million installed.[4]).
- New technology could develop which provides greater controllability, and without the risk of SSR issues (for example, See AC Addendum Attachment H – ABB Study, p. 24-27)

6. Analysis of Proposal T030

As discussed above, the Addendum overly values the incremental UPNY-SENY transfer of Proposal T019 relative to Proposal T029. Proposal T030 also provides incremental UPNY-SENY transfer relative to Proposal T029. However, the incremental UPNY-SENY benefits of Proposal T030 have not been valued at all. Proposal T030 provides a triple-bundle conductor on Segment B, which a lower impedance without the risks of series compensation, at a very low incremental cost. Proposal T030 provides approximately 30% of the incremental capacity of Proposal T019 relative to Proposal T029[5], but at a much lower incremental cost.[6] As discussed above, the incremental production cost benefits of Proposal T030 are not properly modeled due to false New Scotland to Knickerbocker congestion. The incremental ICAP benefits of Proposal T030 have not been calculated at all.

[4]Series compensation equipment only $8 million (Draft Report Appendix D (SECO Report) on p. 588). Conservative estimate of $21 million calculated as total direct and indirect cost difference for Knickerbocker substation for T019 ($49.6 million) and T022/T023 ($28.6 million) (p. 43-46).

[5] Proposal T029 provides 1,250 MW, Proposal T019 provides 1,800 MW or an increment of 550 MW, Proposal T030 provides 1,400 MW or an increment of 150 MW.

[6] Proposal T019 has an incremental cost of $116 million relative to Proposal T029. Proposal T030 has an incremental cost of $18 million.

In addition, in its memo the Board falsely identifies Proposal T019 as maximizing the use of the right-of-way:

> "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." Board December 27, 2018 Memo, page 4

Proposal T019 does not maximize the transmission capacity of the right-of-way. Proposals T019 and T029 install the same conductor within the right-of-way, making the same use of the right-of-way. The incremental transfer capacity of Proposal T019 arises from substation equipment (series compensation), which can be installed in the future. Proposal T030 is the proposal that maximizes the transmission capacity of the right-of-way, since Proposal T030 has the greatest transfer based on transmission line upgrades alone of any Segment B Proposal. If the goal is to maximize the use of the right-of-way, the Segment B recommended proposal should be Proposal T030.

7. The Scenarios Used to Justify the Proposed Decision are Inconsistent

The Board's provisional selection of T019 is premised in part on a number of assumptions and scenarios that were newly constructed or identified by the Board after the Draft Report was completed and which were not vetted with stakeholders. This conflicts with the NYISO tariff provisions that require sharing decisional factors in advance with stakeholders and securing stakeholder views on the use of such scenarios and factors. Specifically, the Tariff requires the ISO to consider metrics "in consultation with stakeholders[.]"[7] Similarly, the NYISO Public Policy Transmission Planning Process Manual requires NYISO to conduct "consultation with stakeholders" regarding other metrics considered expressly including both ICAP and transfer limits.[8] The PPTP Manual requires NYISO's chosen metrics to be identified and presented to ESPWG *prior* to NYISO commencing its evaluation.[9]

NYISO has employed several new scenarios and assumptions to support its proposed selection of T019 even though those scenarios and assumptions are mutually inconsistent with each other. For example, NYISO established a new scenario that assumed achievement of Clean Energy Standard (CES) goals, retirement of significant amounts of generation in southeastern New York (SENY) (the CES-Retirements Scenario) and then coupled this scenario with the assumption that energy prices will rise due to adoption of carbon pricing in the wholesale markets. As one would expect, because T019 provides the largest transfer increase across UPNY/SENY (albeit at the greatest cost of any project), this scenario suggested the project would provide the best $/MW savings. It must be noted, however, that the base case results showed that UPNY/SENY transfer increases beyond the magnitude identified in the AC Need provide little incremental benefit because the power becomes bottled in the lower Hudson Valley absent additional transmission upgrades into zones J and K.

Moreover, NYISO gave significance to these projected savings while simultaneously concluding that the concomitant requirement that 450 MW of incremental operating reserves that must be procured in SENY as a result of the increased size of T019 can be met at little if any incremental cost, because historically NYISO has tended to procure most of its reserves in SENY. However, given that the scenario that produced the production cost savings assumed significant levels of SENY generation retirements, it is not valid, absent an analysis that NYISO evidently failed to perform, to assume that the additional 450 MW SENY operating reserves can be procured without added cost in the system as it will exist post SENY generation retirements.

[7] OATT 31.4.8.1.9.
[8] PPTP Manual 6.1.3.
[9] *Id.*

NYISO also presented a new scenario that assumes the new capacity zone can be eliminated due to the increased UPNY/SENY transfer capacity provided by T019. However, there are a number of flaws with this scenario. First, NYISO rejected the request to establish zone elimination rules, so there currently is no ability to eliminate zones. Second, NYISO's most recent zone elimination proposal required two demand curve reset studies to be conducted after transmission is in service before eliminating a zone, because NYISO asserted it would be imprudent to remove a zone more quickly due to toggling concerns. Therefore, a minimum of 8 years, and likely more, would be required before one could assume a zone is eliminated. Finally, this again is a scenario that is inconsistent with the CES-Retirements scenario. NYISO has failed to demonstrate that one can remove significant quantities of generation from SENY and still support zone elimination.

NYISO should acknowledge that these scenarios are mutually inconsistent, so one is not left with the misimpression that NYISO believes all of these potential benefits can be obtained simultaneously. Making such an acknowledgement, clearly required, undercuts the new revised economic and cost comparison analyses contained in the Boards revised draft.

8. **Use of ICAP Savings**

In the Draft Report and in prior stakeholder meetings, NYISO staff explained that it declined to use forecast ICAP savings as a distinguishing factor between projects for a number of reasons, including (1) it had not vetted the methodology it used to forecast ICAP savings with stakeholders, (2) the accuracy and precision of those estimates are highly assumption driven and have not been satisfactorily established, and (3) the range of benefits based on different assumptions renders comparison difficult and potentially misleading. The Proposed Decision and supporting documentation do nothing to demonstrate that the concerns mentioned above have been ameliorated. Neither has the NYISO vetted its analysis in the stakeholder process following issuance of the Draft Report. This process contravenes the PPTP Manual which calls for the "models and assumptions to be used" to be "reviewed and discussed" with stakeholders prior to their application. Project developers instead learned of NYISO's new approach to ICAP only after the Proposed Decision.

CONCLUSION

The additional cost of Proposal T019 relative to Proposal T029 is not justified by a corresponding amount of incremental benefits. The table below includes the benefits quantified in the Draft Report, as updated with the latest Addendum values. Even without including identified SSR mitigation costs and other potentially higher costs, the Benefit to Cost Ratio of Proposal T027+T029 is meaningfully higher than Proposal T027+T019.

	T027+T019	T027+T029	Difference
Cost	>$1,229	$1,113	>$116
Benefits	$2,511	>$2,438	
Production Cost Benefits: CES+Retirement Case	$1,080	>$1,076	<$4
Capacity Benefits: MMU CES+Retirement Case	$592	$523	$69
Avoided Refurbishment Costs	$839	$839	-
Benefit: Cost Ratio	**2.04**	**2.19**	

Therefore Proposal T029 is the more efficient and cost effective Segment B proposal.

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MEMORANDUM

DATE: January 28, 2019

TO: Jim Andersen

C: Casey Carroll, Andy Scott, Marc Tavares, Simon Murley

FROM: Steve Walker
Sr. Project Manager

SUBJECT: 153160 NY AC Transmission NYISO PPTP Report Response on Resilience

MESSAGE

This memorandum addresses comments made by the NYISO in their AC Transmission Public Policy Transmission Planning Report Addendum, specifically the comments in Section 3.1 regarding the Resilience Benefits of the various project alternatives' Transmission Line Design characteristics.

Foundation Type

The NYISO report states (Section 3.1.1, page 11)

> *"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. 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."*

The assertion that drilled-shaft concrete foundations are inherently more reliable than direct embedded poles is not correct. The applied loading, geotechnical parameters, the diameter and depth of the foundation determine the reliability of a foundation. Both types of foundations utilize similar mechanisms for resisting overturning moments from single pole structures. Industry standards such as the IEEE Guide for Transmission Structure Foundation Design and Testing[i] provide guidance on acceptable methods of design for these types of foundations to achieve the desired level of performance. Using these design methods, directly embedded foundations for transmission structures have been used with success, both from an overall performance standpoint as well as economics. By justifying an incremental cost delta without due consideration of the engineering mechanics and design basis of these two foundation types, the NYISO report inappropriately concludes that drilled shaft foundations provide more resilience than directly embedded pole foundations.

Longitudinal Cascade Event Containment

The NYISO report also states the following:

> *"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"*

Mitigation of longitudinal cascade events is an important element of a robust transmission line design basis. Left unchecked, longitudinal structure loads arising from broken conductors, broken hardware or unbalanced ice loading can result in longitudinal collapse of a transmission structure. In some cases progressive collapse of a large number of transmission structures can result. As the NYISO report notes, this was witnessed in the 1998 ice storm, as well as a number of other severe weather events[ii]. It is informative to note that most reported cases of longitudinal cascading failures involved unsymmetrical structure types, such as H-frame and rectangular lattice tower structures. This trend is related to the inherent lack of longitudinal strength in these types of structures, which are configured to primarily resist transverse wind loads. As will be discussed in more detail below, single pole structures do not suffer from this inherent weakness.

To address the potential for longitudinal cascading of transmission lines ASCE Manual 74[iii] recommends three mitigation strategies. These are: 1) Design all structures for longitudinal loads, 2) Install failure containment structures at specified intervals, or 3) Install release mechanisms. For a description of these mitigation strategies, refer to the ASCE Manual.

The NYISO assumes in their assessment that only option 2, installing failure containment structures at specified intervals, is available for mitigating longitudinal failure loads and makes no mention of the other options or the economics of these options relative to one another for this specific project. The ASCE manual in discussing option 1 in section 3.3.2.1 notes the following, "….single pole supports are capable of resisting longitudinal loads and providing failure containment at a relatively low cost", indicating that transmission lines using single pole structures are likely to find option 1 to be most economical in mitigating longitudinal cascade events. The reason for that is single pole structures are symmetrical, so the strength required to resist transverse wind loads is available to resist longitudinal loads. In addition, single pole structures are usually very flexible, which has the effect of reducing the longitudinal load resulting from broken conductors and balancing the load from any unbalanced ice loading. Therefore, it is generally much more economical to rely on the inherent longitudinal strength and flexibility of single pole structures than to add containment structures at specified intervals. This is highlighted in a 2008 study by Cigre[iv] which analyzed the impact on structure design of adding a longitudinal load case to tangent steel poles as a longitudinal cascade mitigation strategy. By designing a single pole structure first for transverse loads only, and then adding a longitudinal load case the study was able to identify the likely cost impacts of employing option 1 recommended by ASCE. The report concluded that "The steel pole structure was not noticeably affected by the unbalanced loads because of its geometrical properties and flexibility".

Given that the LS Power Grid New York/NYPA proposal includes a longitudinal broken wire and an unbalanced ice load case to be applied to all structures, the statements by the NYISO indicating that the proposals with more deadend structures are superior from a resilience point is unfounded. In addition, the LS Power Grid New York/NYPA proposal is designed using a 100 MPH extreme wind case versus at 90 MPH wind case used in T019. Given the square relationship between wind speed and wind pressure, this represents a 23.5% increase in transverse wind load over the T019 proposal.

In summary, the additional cost associated with the additional deadend structures in the T019 proposal, certainly at such a small interval as one mile, is not justified as there are more economical methods to address the issue of longitudinal cascading, as demonstrated by the LS Power Grid New York/NYPA proposal.

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[i] IEEE Standard 691, "Guide for Transmission Structure Foundation Design and Testing", 2007
[ii] Cigre, Working Group B2.22, "Mechanical Security of Overhead Lines Containing Cascading Failures and Mitigating Their Effects", October 2012
[iii] ASCE, Manuals and Reports on Engineering Practice No. 74, "Guidelines for Electrical Transmission Line Structural Loading", Third Edition, 2010
[iv] Cigre, Working Group B2-204, "Assessment of the Impacts of Increasing Structural Reliability and Security by Designing Lines for Longitudinal Broken Conductor and Unbalanced Icing Loads", Ghannoum, 2008