New York Transco LLC

NEW YORK ENERGY SOLUTION

EXHIBIT E-4
ENGINEERING JUSTIFICATION

PREPARED PURSUANT TO 16 NYCRR § 88.4

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LIST OF ACRONYMS AND ABBREVIATIONS

AC	alternating current
AC Transmission PPTN	AC Transmission Public Policy Transmission Need(s)
Board	Board of Directors of the New York Independent System Operator, Inc.
CECPN	Certificate of Environmental Compatibility and Public Need
Central Hudson	Central Hudson Gas & Electric Corporation
Con Edison	Consolidated Edison Company of New York, Inc.
Commission	New York State Public Service Commission
Staff	Department of Public Service Staff
FERC	Federal Energy Regulatory Commission
kV	kilovolt
MW	megawatt
National Grid	Niagara Mohawk Power Corporation d/b/a National Grid
NYCRR	New York Codes, Rules and Regulations NYES
Project or Project	New York Energy Solution Project
NYISO	New York Independent System Operator, Inc.
NYSRC	New York State Reliability Council
OATT	NYISO's Open Access Transmission Tariff
O&R	Orange and Rockland Utilities, Inc.
PPTPP	Public Policy Transmission Planning Process
PSL	New York State Public Service Law
ROW	right(s)-of-way
SECO	Substation Engineering Company
Transco	New York Transco LLC

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EXHIBIT E-4: ENGINEERING JUSTIFICATION

In accordance with the PSL § 122 and 16 NYCRR § 88.4, this exhibit provides the engineering justification for the NYES Project, including a description of the reliability benefits associated with the Project, information about the Project's proposed in-service date and the impact on the larger electric grid system if the Project is not completed on time, and a summary of appropriate system studies.

E-4.1 Summary of the NYES Project

Following selection by the Board as the more cost-effective and efficient solution to satisfy one of the segments of the Commission's declared AC Transmission PPTN, Transco proposes to construct and operate the NYES Project. The Project includes the installation of a new, 54.5-mile 345 kV electric transmission line—to be known as the Transco #96 line—that will be co-located with existing 115 kV electric transmission lines (referred to throughout the Application as the "new, 54.5-mile 345/115 kV double-circuit transmission line") on new monopoles between the new 345 kV Knickerbocker Switching Station owned by Transco and located in the Town of Schodack, Rensselaer County, the rebuilt 115 kV Churchtown Switching Station owned by Transco and located in the Town of Claverack, Columbia County, and the existing 345 kV and 115 kV Pleasant Valley Substations owned by Con Edison and Central Hudson, respectively, and located in the Town of Pleasant Valley, Dutchess County (together, the "345/115 kV Pleasant Valley Substation," and individually, the "345 kV Pleasant Valley Substation" or "115 kV Pleasant Valley Substation"); the replacement of 2.2-miles of 115 kV electric transmission line in an existing National Grid ROW that extends from the existing 115 kV Blue Stores Substation to a tap with the existing National Grid #8 115 kV Lafarge to Pleasant Valley line (referred to as the "Blue Stores Tap"); and the installation of a 0.8-mile double-circuit 345 kV electric transmission line that will run from the existing 345 kV Pleasant Valley Substation to and from the new 345 kV Van Wagner Capacitor Bank Station.

Additionally, Transco is working with O&R and Central Hudson on a development schedule and implementation plan to permit, develop, and construct certain Commission-required transmission additions associated with the NYES Project, which include, for example, performing terminal work at the existing Coopers Corners and Rock Tavern 345 kV Substations to improve the thermal ratings on lines #34 and #42 (*see* Section E-4.3, *infra*).

The NYES Project will use existing utility ROW and adjacent utility-owned land and will retire, replace, or upgrade certain existing, aging electric transmission infrastructure. More specifically, the NYES Project will reduce the overall quantity of structures in the existing ROW by eliminating approximately

700 structures, reducing the footprint of structures in the Project's ROW between the Churchtown and Pleasant Valley Substations. The new transmission line structures will consist of approximately 470 self-supporting steel monopole structures, eliminating the need for guys and anchors, and approximately 25 wood H-frame structures associated with the Blue Stores Tap.

Pursuant to Article VII of the PSL, Transco seeks a CECPN from the Commission to construct and operate the NYES Project.

E-4.2 Description of Existing Transmission System

There has been no large-scale, high-voltage, AC transmission facilities constructed in New York State in over 30 years. As a result, the State's existing electric transmission infrastructure is aging, congested, and cannot adequately accommodate the State's future energy goals, including the requirement codified by the Climate Leadership and Community Protection Act that at least 70% of New York's electricity come from renewable energy sources, such as wind and solar, by 2030.

The NYES Project will be constructed within the existing UPNY/SENY interface (*see* Section E-4.3, *infra*, for a discussion of the significance of the UPNY/SENY interface). This interface represents a collection of transmission lines on which power flows from Upstate New York to Southeast New York. More specifically, the UPNY/SENY interface includes the following electric transmission facilities:

- Hopatcong – Ramapo 500 kV line
- Alps – Pleasant Valley 345 kV line
- Salisbury – Smithfield 69 kV line
- Coopers Corners – Dolson Ave. 345 kV line
- Coopers Corners – Middletown Tap 345 kV line
- West Woodbridge 115-69 kV Transformer
- Leeds – Hurley 345 kV line
- Leeds – Pleasant Valley 345 kV line
- Athens – Pleasant Valley 345 kV line
- ADM Milling – Pleasant Valley 115 kV line
- Blue Stores East – Pleasant Valley 115 kV line
- Blue Stores – Pleasant Valley 115 kV line
- Airco Tap – North Catskill 115 kV line

The UPNY/SENY interface has been historically limited by the thermal capability of the individual transmission lines. A map of the existing transmission system in the UPNY/SENY interface is included in Exhibit 2 as Figure 2-4.

E-4.3 Need for the NYES Project

In November 2012, following the release of Governor Andrew M. Cuomo's 2012 *Energy Highway Blueprint*, which called for, among other things, the development of over 1,000 MW of new AC transmission upgrades to move power from upstate to downstate, the Commission initiated the *Examine Alternating Current Transmission Upgrades* proceeding. In this proceeding, the Commission identified the AC transmission corridor traversing the Mohawk Valley Region, the Lower Hudson Valley region, and the Capitol Region as a source of persistent congestion. These regions include facilities connected to Marcy, New Scotland, Leeds, and the Pleasant Valley substations, along with two major electrical interfaces. The Commission referred to these two major electrical interfaces as "Central East" and "UPNY/SENY." Ultimately, the Commission identified the need to relieve congestion and replace aging infrastructure along the UPNY/SENY and Central East interfaces. In a series of orders over the next several years, the Commission sought and evaluated, with the NYISO's assistance, proposals from a number of transmission owners and developers to increase electric transmission transfer capability across these interfaces.

On August 1, 2014, while this evaluation was taking place at the Commission, the NYISO commenced its first PPTPP pursuant to Attachment Y of the OATT[1] and solicited potential Statewide transmission needs from interested developers. After submitting those needs to the Commission, the Commission determined that there was a transmission need "driven by Public Policy Requirements for new 345 kV major electric transmission facilities to cross the Central East and UPNY/SENY interfaces to provide additional transmission capacity to move power from upstate to downstate" (*i.e.*, the AC Transmission PPTN). The Commission further explained that the AC Transmission PPTN is divided into two segments—Segment A

[1] Pursuant to the OATT, the PPTPP consists of four main steps: (1) the identification of a public policy transmission need, (2) the proposal of solutions to identify a public policy transmission need, (3) the evaluation of the viability and sufficiency of proposed transmission and non-transmission solutions to a public policy transmission need, and (4) the evaluation and selection of the more efficient or cost-effective project to satisfy a public policy transmission need.

i.e., Central East interface) and Segment B (*i.e.*, UPNY/SENY interface)—and it described those segments, along with certain necessary "Segment B additions"[2] as follows (*see also* Figure E-4-1 below):

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 ROW (primarily using Edic to Rotterdam ROW 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 ROW; decommissioning of two 230 kV lines from Edic to Rotterdam; 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 ROW; 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 ROW; 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; related switching or substation work at Greenbush, Knickerbocker, Churchtown and Pleasant Valley substations.

SEGMENT B ADDITIONS

Upgrades to the Rock Tavern Substation

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

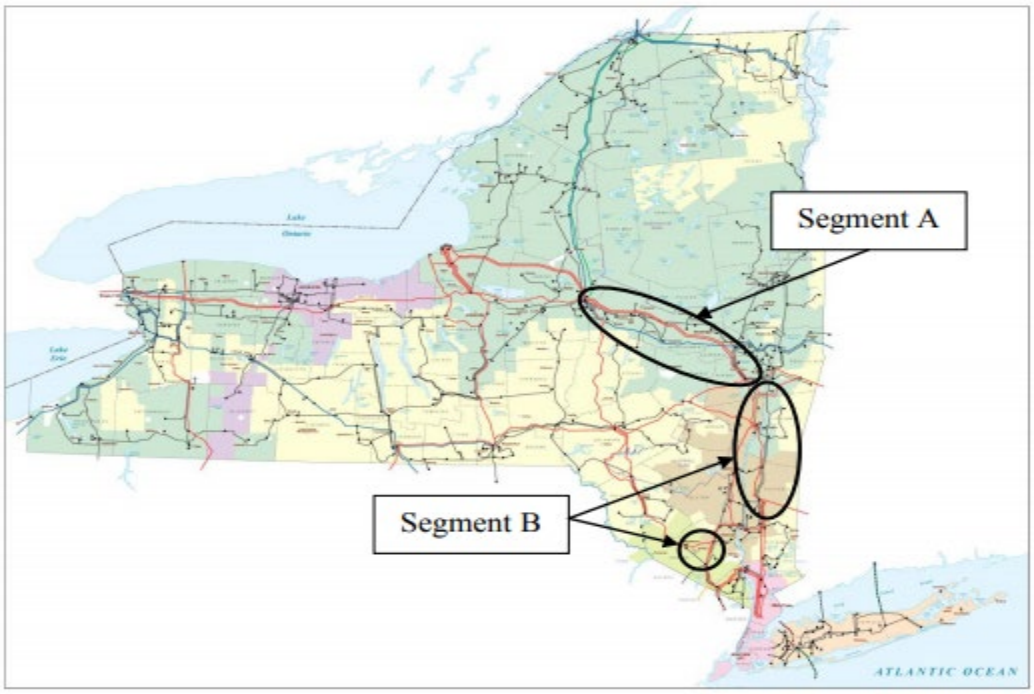
[2] Specifically, in December 2015, the Commission ordered O&R and Central Hudson, respectively, to upgrade the Shoemaker to Sugarloaf 138 kV facilities and conduct terminal upgrades at the Rock Tavern Substation as part of the Segment B project proposals.

Edic/Marcy to New Scotland; Princetown to Rotterdam and Knickerbocker to Pleasant Valley lines.

Shoemaker to Sugarloaf

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

Figure E-4-1: AC Transmission PPTN Map



After declaring the AC Transmission PPTN, the Commission ordered the NYISO to solicit solutions to the AC Transmission PPTN. The Commission explained, however, that any proposed solution submitted to the NYISO to satisfy the AC Transmission PPTN must meet, at 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 NYSRC Reliability Rules.

- 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.

- Proposed solutions to Segment A (Central East) must include all project components included in Segment A as described in Appendix A of the Commission's December 17, 2015 order.

- Proposed solutions to Segment B (UPNY/SENY) must include all project components included in Segment B as described in Appendix A of the Commission's December 17, 2015 order.

- No acquisition of new permanent transmission ROW, except for *de minimis* acquisitions that cannot be avoided due to unique circumstances. The transfer or lease of existing transmission ROW 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 a proposed transmission facility.

- For those projects that were also evaluated in the AC Transmission proceedings, the Commission's December 17, 2015 order states that the cost estimate must not exceed the level estimated by Staff for each project, unless the applicant can demonstrate that an upward adjustment is necessary to correct errors or omissions made by Staff for the components that were added or adjusted by Staff.

On February 29, 2016, the NYISO issued a solicitation for solutions to satisfy both segments of the AC Transmission PPTN. A total of 6 developers, including Transco with National Grid, submitted 16 projects to the NYISO to satisfy the AC Transmission PPTN. More specifically, Transco and National Grid submitted two separate projects to satisfy Segments A and B of the AC Transmission PPTN—NYES Segment A and NYES Segment B projects. The "NYES Project" now refers solely to Segment B.

Next, the NYISO conducted a viability and sufficiency assessment to determine whether any of the submitted proposals satisfied the AC Transmission PPTN. More specifically, the NYISO performed a comparable transfer limit analysis of each proposal to determine whether it met the sufficiency criterion that the Commission established. On October 27, 2016, the NYISO issued its *AC Transmission Viability and Sufficiency Assessment*, which details the NYISO's conclusion, among others, that the NYES Project is viable and sufficient to satisfy the AC Transmission PPTN (*see* Figure E-4-2 below).

Figure E-4-2: NYISO Viability and Sufficiency Project Findings

Developer Name	Project Name	Segment	Includes All Segment A Components?	Includes All Segment B Components?	Meets ROW Acquisition Criterion Except For de minimis?	Meets Hudson River Crossing Criterion?	Meets Cost Estimate Criterion?	Central East Limit Increases 350+ MW ?	UPNY-SENY Limit Increases 900+ MW ?	Sufficient?
National Grid / Transco	New York Energy Solution Seg. A	A	Yes	N/A	Yes	Yes	Yes	Yes	N/A	Yes
NextEra Energy Transmission New York	Enterprise Line: Segment A	A	Yes	N/A	Yes	Yes	N/A	Yes	N/A	Yes
North America Transmission / NYPA	Segment A +765 kV	A	Yes	N/A	Yes	Yes	N/A	Yes	N/A	Yes
North America Transmission / NYPA	Segment A Base	A	Yes	N/A	Yes	Yes	N/A	Yes	N/A	Yes
North America Transmission / NYPA	Segment A Double Circuit	A	Yes	N/A	Yes	Yes	N/A	Yes	N/A	Yes
North America Transmission / NYPA	Segment A Enhanced	A	Yes	N/A	Yes	Yes	N/A	Yes	N/A	Yes
ITC New York Development	16NYPP1-1A AC Transmission	A	Yes	N/A	Yes	Yes	N/A	Yes	N/A	Yes
National Grid / Transco	New York Energy Solution Seg. B	B	N/A	Yes	Yes	Yes	Yes	N/A	Yes	Yes
NextEra Energy Transmission New York	Enterprise Line: Segment B	B	N/A	Yes	Yes	Yes	Yes	N/A	Yes	Yes
NextEra Energy Transmission New York	Enterprise Line: Segment B-Alt	B	N/A	Yes	Yes	Yes	Yes	N/A	Yes	Yes
North America Transmission / NYPA	Segment B Base	B	N/A	Yes	Yes	Yes	N/A	N/A	Yes	Yes
North America Transmission / NYPA	Segment B Enhanced	B	N/A	Yes	Yes	Yes	N/A	N/A	Yes	Yes
ITC New York Development	16NYPP1-1B AC Transmission	B	N/A	Yes	Yes	Yes	N/A	N/A	Yes	Yes
AvanGrid	Connect New York Recommended	A and B	No	No	Yes	No	N/A	Yes	No	No
AvanGrid	Connect New York Alternative	A and B	No	No	Yes	Yes	N/A	Yes	No	No
GlidePath	Distributed Generation Portfolio	N/A	N/A	N/A	N/A	N/A	N/A	No	No	No

The NYISO also filed the *AC Transmission Viability and Sufficiency Assessment* with the Commission for consideration and action.

On January 24, 2017, the Commission issued an order confirming the AC Transmission PPTN and determining that the NYISO should evaluate and select the proposed transmission solutions to satisfy this declared transmission need. In accordance with the Commission's directive, NYISO staff, in coordination with its independent consultant, SECO, conducted a detailed evaluation and ranked each proposed 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 Commission (*e.g.*, replacement of aging infrastructure), and other metrics (*e.g.*, production cost savings, Location Based Marginal Pricing savings, Installed Capacity savings, and emissions savings). NYISO staff spent the next two years using a number of scenarios and sensitivities to evaluate the proposed projects' performance across these metrics. After conducting these evaluations (the results of which are detailed below in Section E-4.4 to describe the benefits of the NYES Project), each proposal was ranked according to its performance across these metrics.

On April 8, 2019, following these comprehensive and extensive comparative evaluations, and after consideration of all factors, the NYISO Board of Directors announced its selection of the NYES Project to satisfy Segment B of the AC Transmission PPTN.[3] It rendered this decision after concluding that the

[3] The NYISO Board also announced its selection of one of the New York Power Authority's and North American Transmission's proposed solutions to satisfy Segment A of the AC Transmission PPTN (*id*. at 6).

NYES Project demonstrated superior performance across a broader range of metrics when compared against other proposed Segment B projects and, as a result, is the more cost-effective or efficient solution to satisfy Segment B of the AC Transmission PPTN (*see* Figure E-4-3 below). As part of this selection, the NYISO reiterated its requirement that the NYES Project be operational by the end of 2023.

Figure E-4-3[4]: Segment B Overall Ranking

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 summary, following the NYISO Staff and SECO's evaluation, the Board determined that the NYES Project will more cost effectively and efficiently satisfy the AC Transmission PPTN that the Commission identified. More specifically, the NYISO Board of Directors concluded that the Project will increase the UPNY/SENY interface transfer capability to allow for additional power to flow from Upstate New York to Southeast New York where the larger population centers are located and replace existing, aging, and insufficient electric transmission facilities. In addition to satisfying these Commission-identified needs, the NYES Project offers several benefits to New York's electric transmission system. As is described in Section E-4.4 below, the satisfaction of the AC Transmission PPTN, coupled with the other significant benefits the Project provides, justifies the construction of the Project at the cost detailed in Exhibit 9.

E-4.4 Benefits of the NYES Project

The Board discussed the many quantitative and qualitative benefits of the NYES Project in its April 8, 2019 executive summary of its approval of NYISO Staff's *AC Transmission Public Policy Transmission Planning Report* and selection of public policy transmission projects. These quantitative and qualitative benefits, which are discussed below, allowed the Board to conclude that the cost of the Project is warranted when compared against the other Segment B proposals.

[4] Note that Project ID T019 is the NYES Project.

For example, the Board noted that the NYES Project's qualitative benefits include providing more transfer capability across the UPNY/SENY transfer interface than other proposals, which is the primary objective of the AC Transmission PPTN. In addition to providing the greatest transfer capability of any other proposed Segment B solution (*e.g.*, additional N-1 emergency transfer capability of 400-550 MW relative to other Segment B proposals), the studies performed by the NYISO staff and SECO reveal that the NYES Project features the lowest cost per MW ratio ($0.228/MW), highest production cost savings (*i.e.*, $37 million more than the second-ranked Segment B proposal for the baseline analysis), greatest carbon dioxide reductions, and the highest Installed Capacity savings (*i.e.*, estimated 20-year savings for "existing localities" of $160 million to $224 million relative to other Segment B proposals) of the Segment B projects. These benefits of the NYES Project were also summarized by the Board as follows:

- 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 the greater CO_2 reductions.
- Project T019 produces the greatest 20-year incremental energy flow across UPNY/SENY and Central East interfaces.

In addition to the quantitative benefits described above, the Project also features many qualitative benefits. For example, the Project's series compensation element provides performance benefits to the State's electric transmission system by providing greater operational flexibility and increased use of the UPNY/SENY interface. Additionally, the Project's foundation and structure design are the most resilient of any proposed Segment B solution, which results in significant benefits to the operability of the transmission system during extreme weather events.

These demonstrated quantitative and qualitative benefits provided the NYISO Board of Directors with the bases to conclude that the NYES Project is the more cost-effective or efficient transmission solution to satisfy Segment B of the AC Transmission PPTN.

E-4.5 Impact of a Delay in the Completion of the NYES Project

Transco has been directed by the NYISO to have the NYES Project in service by December 31, 2023 in order to meet the AC Transmission PPTN with respect to Segment B. Transco fully intends to comply

with this directive. In addition, as described above, satisfying the AC Transmission PPTN with respect to Segment B which, notably, will immediately reduce system constraints, replace aging infrastructure, and increase operability of the electric transmission system. Thus, any delay in the completion of the NYES Project will perpetuate current system constraints and delay the other benefits associated with the Project described above in Section E-4.4.

E-4.6 System Impact Study

The NYES Project has secured queue position Q543 in the NYISO's Transmission Interconnection Process. The NYISO issued a System Impact Study report on September 21, 2018. A copy of the System Impact Study report for the NYES Project is provided in Confidential Appendix D to this application. Transco has begun the process to execute a Facilities Study Agreement with the NYISO. Transco's Facilities Study Agreement was entered into with the NYISO September 20, 2019 and that the resulting Facilities Study for the NYES Project will be complete by June 2020.

E-4.7 References

Federal Energy Regulatory Commission, *Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities*, Order No. 1000, 76 FR 49,842 (Dated Aug. 11, 2011).

New York State Independent System Operator, Inc., *Letter to NYISO Stakeholder or Interest Party Initiating Public Policy Transmission Planning Process* (Dated Aug. 1, 2014), available at https://www.nyiso.com/documents/20142/1406936/Public%20Policy%20Needs%20Solicitation%20Letter_2014-08-01.pdf/5d6295b2-9184-570f-62a9-93b01c186cdb (last accessed April 26, 2019).

New York State Independent System Operator, Inc., *AC Transmission Public Policy Transmission Needs Project Solicitation* (Dated Feb. 29, 2016), available at https://www.nyiso.com/documents/20142/1390750/AC_Transmission_PPTN_Solution_Solicitation_2016-02-29.pdf/d7c645d2-74ee-b173-cff2-15453e21be0f (last accessed April 26, 2019).

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New York State Public Service Commission, Case 12-T-0502, *Proceeding on Motion of the Commission to Examine Alternating Current Transmission Upgrades*, Order Instituting Proceeding (Issued Nov. 30, 2012).

New York State Public Service Commission, Case 12-T-0502, *Proceeding on Motion of the Commission to Examine Alternating Current Transmission Upgrades*, Order Adopting Additional Procures and Rule Changes for Review of Multiple Projects Under Article VII of the Public Service Law (Issued Sept. 19, 2013).

New York State Public Service Commission, Case 12-T-0502, *Proceeding on Motion of the Commission to Examine Alternating Current Transmission Upgrades*, Order Finding Transmission Needs Driven by Public Policy Requirements (Issued Dec. 17, 2015).

New York State Public Service Commission, Case 12-T-0502, *Proceeding on Motion of the Commission to Examine Alternating Current Transmission Upgrades*, NYISO AC Transmission PPTN VSA Report (Filed Oct. 28, 2016).

New York State Public Service Commission, Case 12-T-0502, *Proceeding on Motion of the Commission to Examine Alternating Current Transmission Upgrades*, Order Addressing Public Policy Transmission Need for AC Transmission Upgrades (Issued Jan. 24, 2017).

Substation Engineering Company, *AC Transmission New York Public Policy Transmission Need Technical Review Report* (Dated June 18, 2018), available at https://www.nyiso.com/documents/20142/1393382/Appendix_D_SECO_Report_Clean.pdf/e26b631b-961a-5beb-152c-7d2c45478b93 (last accessed May 13, 2019).

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