

July 23, 2015

Hon. Kathleen H. Burgess
Secretary to the Commission
New York State Public Service Commission
Agency Building 3, 19th Floor
Albany, NY 12223-1350

Subject: **CASE 12-T-0502** - Alternating Current Transmission Upgrades.
CASE 13-E-0488 - Alternating Current Transmission Upgrades– Comparative Proceeding.
CASE 13-T-0454 - North America Transmission Corporation and North America Transmission, LLC – Alternating Current Transmission Upgrade Project
CASE 13-T-0455 - NextEra Energy Transmission New York, Inc. – Marcy to Pleasant Valley Project.
CASE 13-T-0456 - NextEra Energy Transmission New York, Inc. – Oakdale to Fraser Project.
CASE 13-M-0457 - New York Transmission Owners – Electric Transmission Facilities in Multiple Counties in New York State.
CASE 13-T-0461 - Boundless Energy NE, LLC – Leeds Path West Project.

Dear Secretary Burgess:

Submitted for filing herewith in the above-entitled cases is the NYISO's presentation to the Department of Public Service Staff technical conference on July 20, 2015, entitled "AC Transmission Cases Powerflow Analysis." Please contact me at (518) 356-6220 or at cpatka@nyiso.com if you have any questions or concerns.

Very truly yours,

/s/ Carl F. Patka

Carl F. Patka
Assistant General Counsel
New York Independent System Operator, Inc.
10 Krey Boulevard
Rensselaer, New York 12144

Cc.

Henry Chao, Vice President, System and Resource Planning, NYISO
Zach Smith, Director, Transmission Planning, NYISO

AC Transmission Cases Powerflow Analysis

Zach Smith

*Director, Transmission Planning
New York Independent System Operator*

PSC AC Transmission Technical Conference

July 20, 2015

Background

- ◆ **PSC requested that the NYISO perform powerflow analysis of the 21 portfolios of projects proposed in the AC Transmission proceeding.**
- ◆ **The focus of the analysis, as defined by DPS, was to evaluate the impact of each portfolio upon transfer capability across the Central East and UPNY-SENY interfaces.**

Scope

- ◆ **Transmission security (N-1-1)**
 - *Measured impact on generation-to-load balance for Southeast New York*
- ◆ **Thermal transfer limits (N-1)**
 - *UPNY-SENY*
 - *Total East*
 - *Central East*
 - *New England – New York*
- ◆ **Voltage transfer limits (N-1)**
 - *Central East*

System Representation

- ◆ **2014 NYISO Comprehensive Reliability Plan baseline representation for 2019**
 - *Includes the Transmission Owner Transmission Solutions (TOTS)*
 - Marcy South Series Compensation
 - Second Rock Tavern – Ramapo 345 kV line
 - Staten Island Unbottling project
 - *Includes 125 MW New York City DR/EE/CHP program*
 - *Does not include the proposed CPV Valley Energy Center generation project*

Powerflow Model

- ◆ **Model of the Eastern Interconnection electric grid**
- ◆ **Snapshot in time**
 - *A single NYCA-wide generator dispatch to secure all bulk power transmission facilities simultaneously for the forecasted peak demand hour*
- ◆ **Baseline peak load forecast for 2019**
 - *“50/50” forecast: 50% chance of exceeding that load level*
 - *Forecast statewide coincident peak = 35,454 MW*
 - 2014 NYISO Load & Capacity Data Report, aka “Gold Book”

Southeast New York Transmission Security (N-1-1)

N-1-1 Criteria

- ◆ **Starting from an all-facilities-in-service base condition (N), system performance is evaluated for one contingency event (N-1) followed by another contingency event (N-1-1).**
- ◆ **Design requirement by NERC, NPCC, and NYSRC**
 - *NPCC and NYSRC are more stringent: all design contingencies are evaluated and virtually no load shedding is allowed*
- ◆ **A reliability violation is identified when any allowable re-dispatch of the system cannot alleviate a thermal overload**
 - *If overloads occur, system is dispatched to minimize overloads*

N-1-1 Methodology

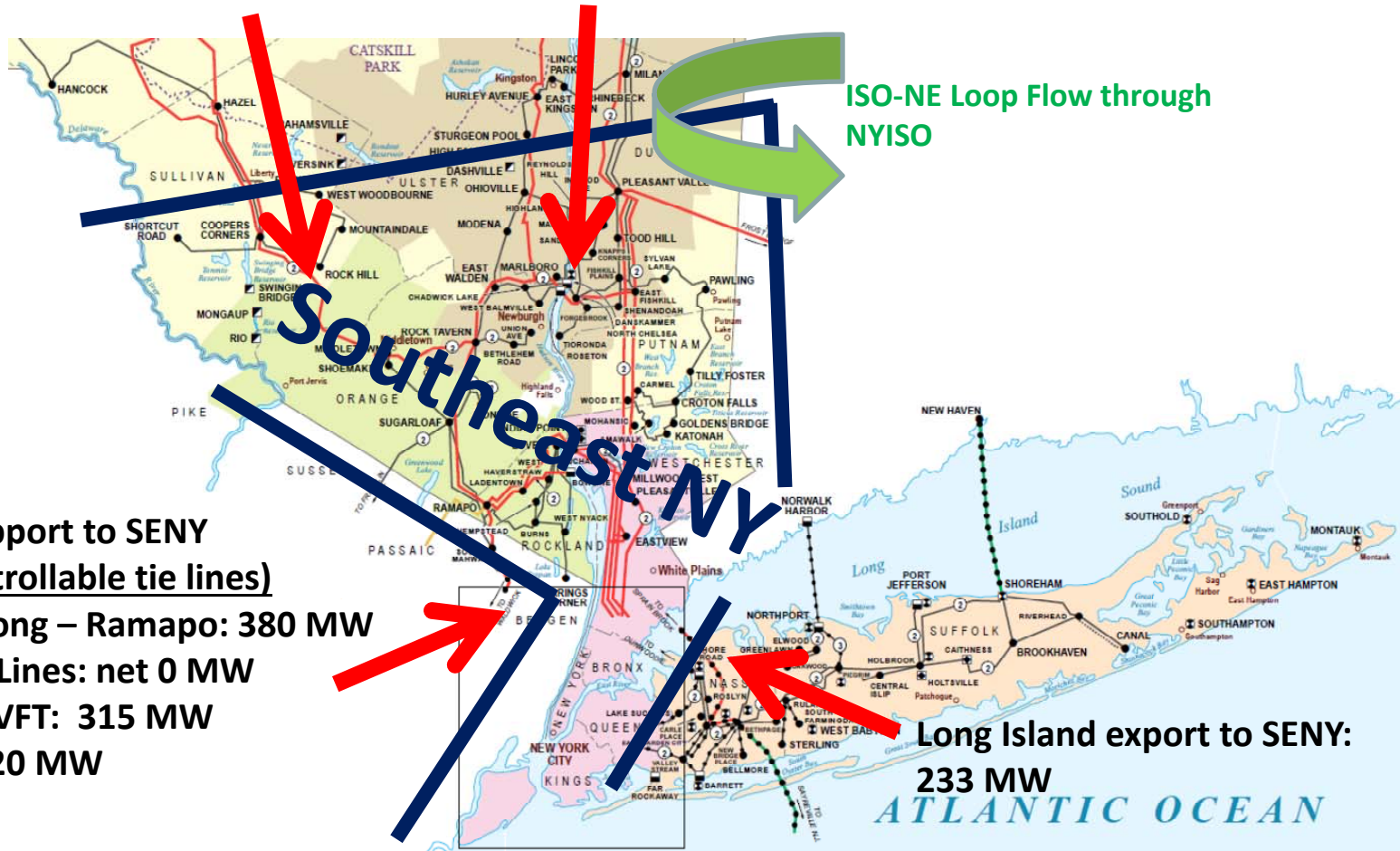
- 1. N-1: Loss of any critical generator, transmission circuit, transformer, series or shunt compensating device, or HVDC pole**
- 2. Any generation and power flow adjustments inside the NYCA that can be made within 30 minutes are applied to secure the system for the next contingency**
- 3. N-1-1: Loss of any critical design contingency, including multiple lines on a common tower or a stuck breaker**

Southeast NY

- ◆ **One large load pocket**
 - *Zones G through J plus Rockland Electric (RECO) load*
 - *RECO is served by the PJM market but electrically radial to NYISO. Power to serve RECO must flow across NYISO transmission system in SENY.*
- ◆ **Load + Losses = Generation + Imports**
- ◆ **Load + Losses: 17,518 MW forecast Summer 2019 peak**
- ◆ **Generation: 14,763 MW planned capacity in 2019**
- ◆ **Difference is made up with imports**
 - *Upstate NY (UPNY-SENY interface)*
 - *Long Island*
 - *PJM*

Factors on SENY Limitations

Distribution of flow between
Marcy South and Leeds South paths



**PJM support to SENY
(all controllable tie lines)**

Hopatcong – Ramapo: 380 MW

ABC-JK Lines: net 0 MW

Linden VFT: 315 MW

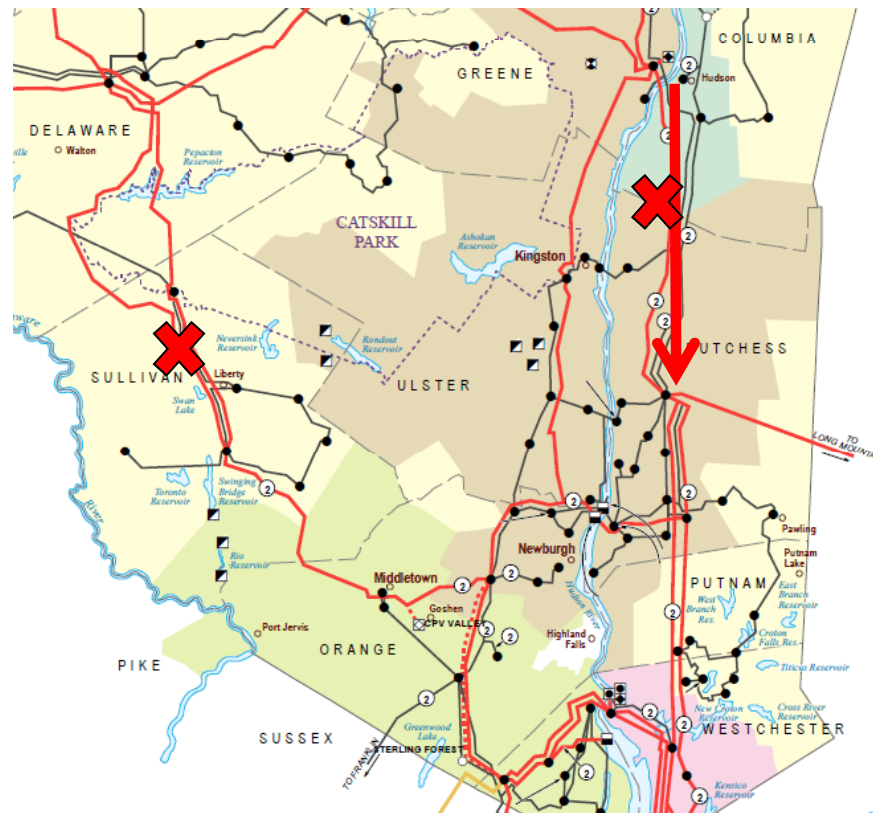
HTP: 320 MW

Applying N-1-1 to SENY

- ◆ **Load + Losses = Generation + Imports**
- ◆ **Generation maximized in SENY subject to transmission constraints**
- ◆ **Imports from PJM and Long Island held constant**
 - *The only path for power to flow is across UPNY-SENY*
- ◆ **Representative load modeled at Sprainbrook is increased until thermal overload occurs under N-1-1 conditions**
 - *NYCA-wide generation dispatch is optimized with an objective to avoid overloads (i.e. transfer as much power as possible)*
- ◆ **Difference in representative load between pre- and post-project cases represents the increased transfer capability provided by the project**

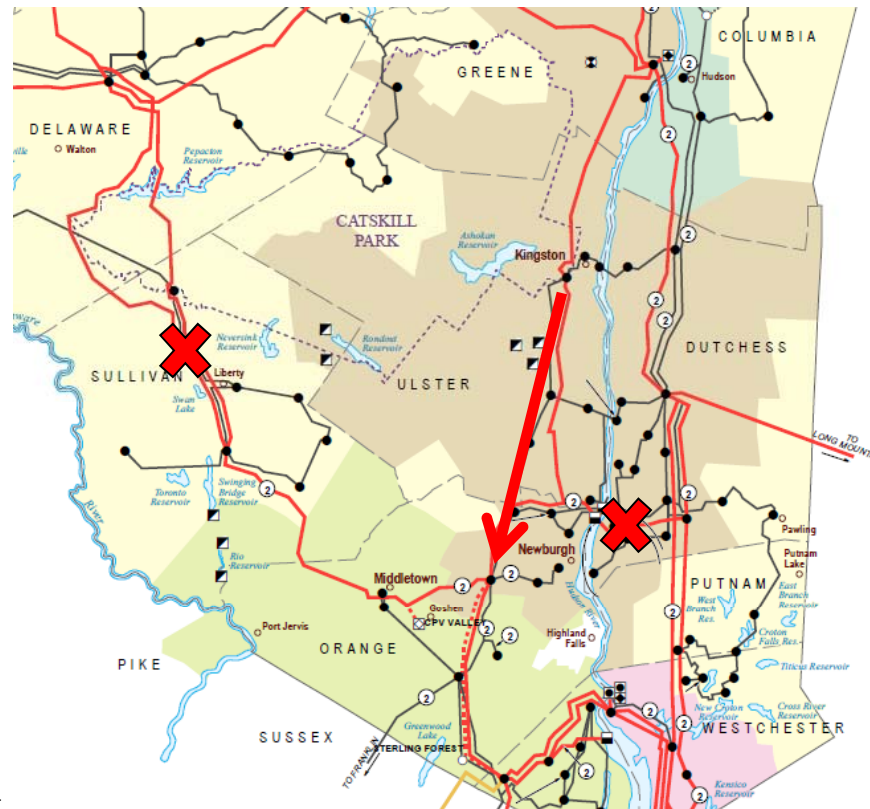
N-1-1 Results: Base Case

- ◆ Limiting Element: Leeds – Pleasant Valley (“PV”)
- ◆ First Contingency: Athens – PV
- ◆ Second Contingency: Marcy South common tower (41&33)



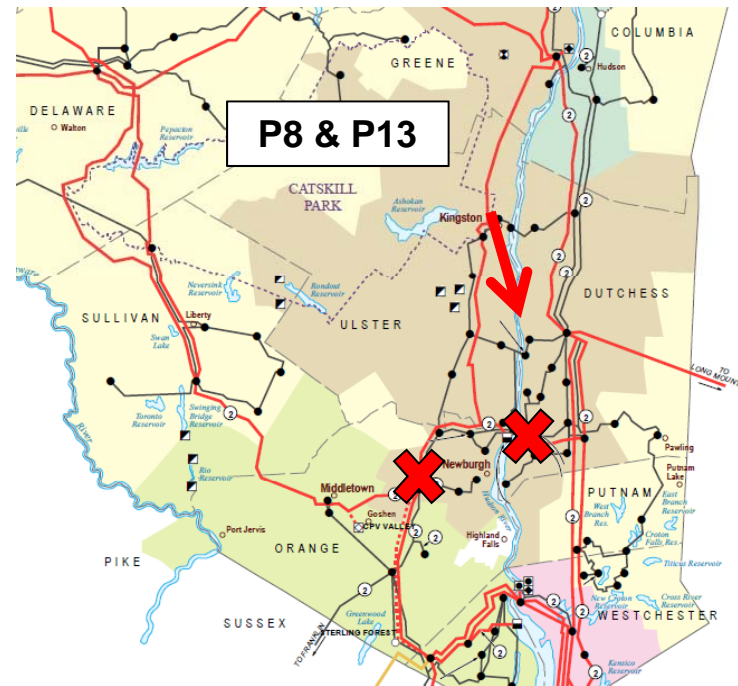
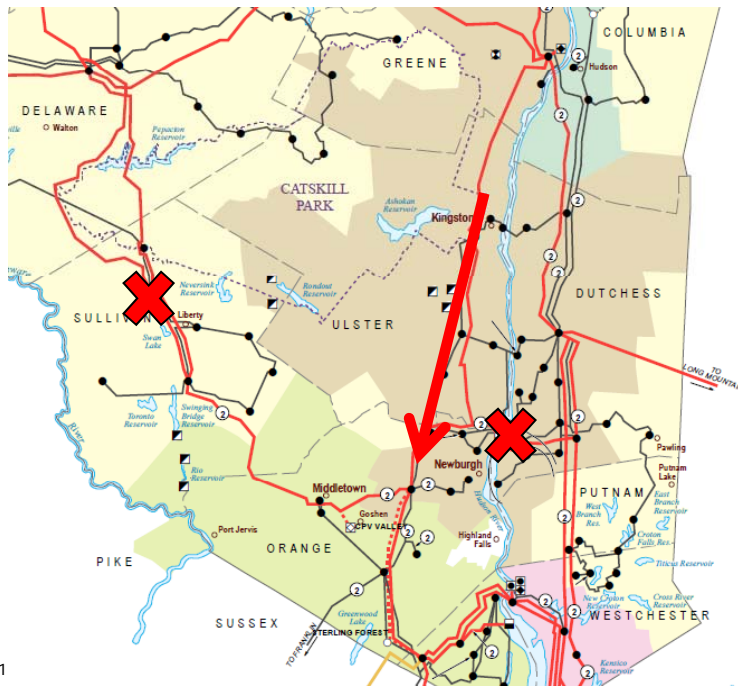
N-1-1 Results: NAT

Portfolio	Delta (MW)	Limiting Element	First Contingency	Second Contingency
P1 - NAT	1354	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P2 - NAT	1158	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P3 - NAT	1284	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P4 - NAT	1048	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P5 - NAT	1090	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)



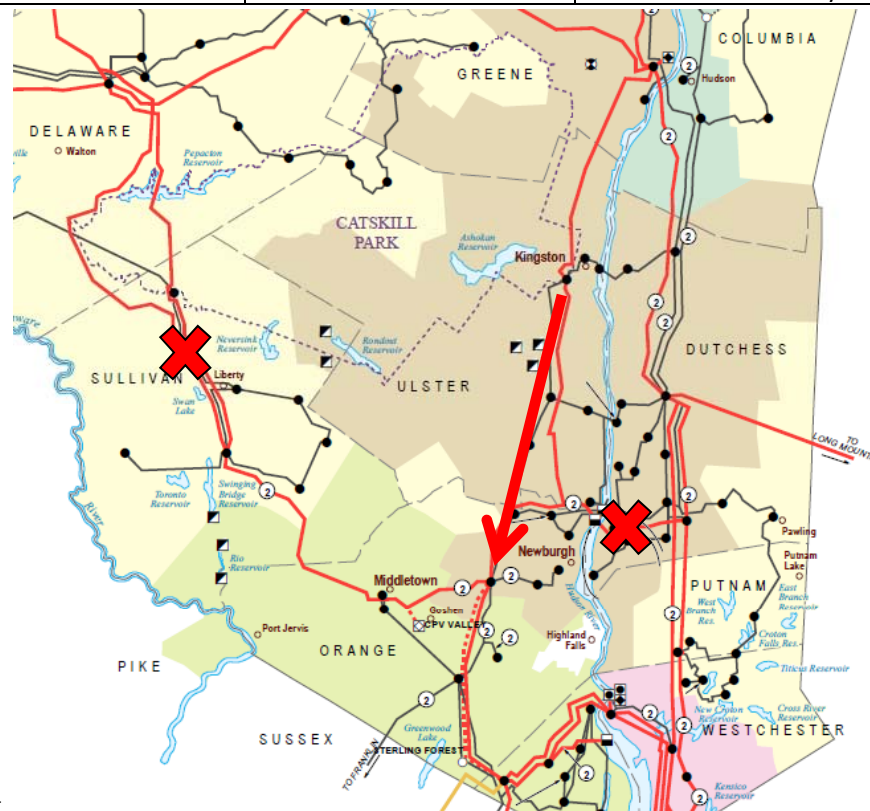
N-1-1 Results: NYTOs

Portfolio	Delta (MW)	Limiting Element	First Contingency	Second Contingency
P6 - NYTO	993	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P7 - NYTO	509	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P8 - NYTO	218	Hurley 345/115	Roseton - E Fishkill	SB: Roseton - Rock Tavern & Coopers Corners - Rock Tavern
P9 - NYTO	1198	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P10 - NYTO	959	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P11 - NYTO	946	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P12 - NYTO	1228	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P13 - NYTO	248	Hurley 345/115	Roseton - E Fishkill	SB: Roseton - Rock Tavern & Coopers Corners - Rock Tavern
P14 - NYTO	1154	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)



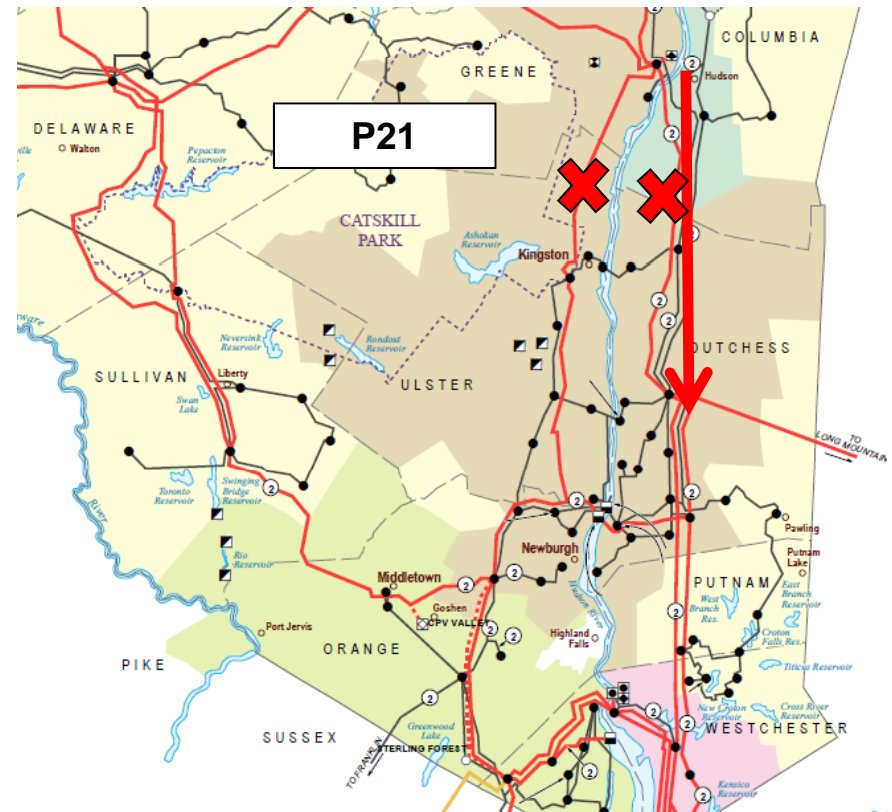
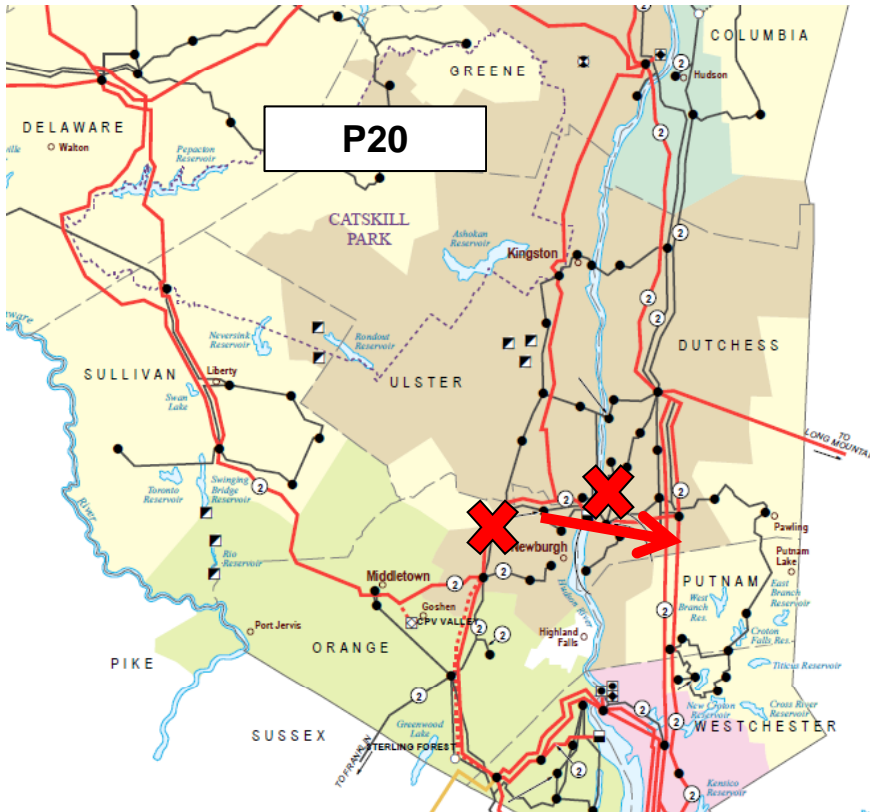
N-1-1 Results: NextEra

Portfolio	Delta (MW)	Limiting Element	First Contingency	Second Contingency
P15 - NextEra	1071	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P16 - NextEra	1095	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P17 - NextEra	1123	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P18 - NextEra	1038	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P19 - NextEra	1127	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)
P19a - NextEra	1106	Roseton - Rock Tavern	Roseton - E Fishkill	Marcy South tower (41&33)



N-1-1 Results: Boundless

Portfolio	Delta (MW)	Limiting Element	First Contingency	Second Contingency
P20 - Boundless	601	Roseton - W Fishkill 345 #1	Roseton - Rock Tavern	SB: Roseton - E.Fishkill & Roseton - W.Fishkill
P21 - Boundless	339	Leeds - PV	Leeds - Hurley	Athens - PV

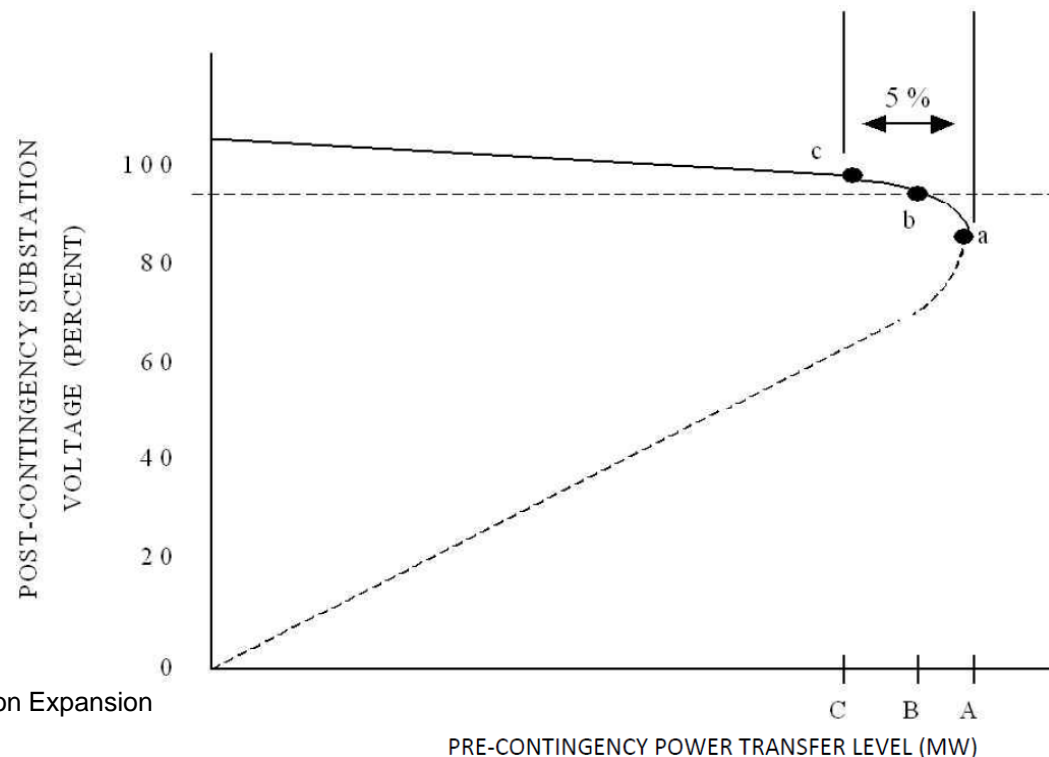


Thermal Transfer Limits

- ◆ **Power flow across an interface is increased by uniformly increasing upstream generation and uniformly decreasing downstream generation.**
- ◆ **The thermal ratings of transmission lines are monitored while simulating design contingency events**
- ◆ **N-1 thermal transfer limits are calculated in accordance with NYSRC Normal Transfer Criteria and the NYISO Planning Transfer Capability Methodology.**
 - *Not intended to determine the maximum transfer capability, but provides consistent measure of changes to interface transfer limits.*

Voltage Transfer Limits

- ◆ **Uses same method as thermal analysis, monitoring voltages of bulk power stations for pre-contingency and post-contingency conditions.**



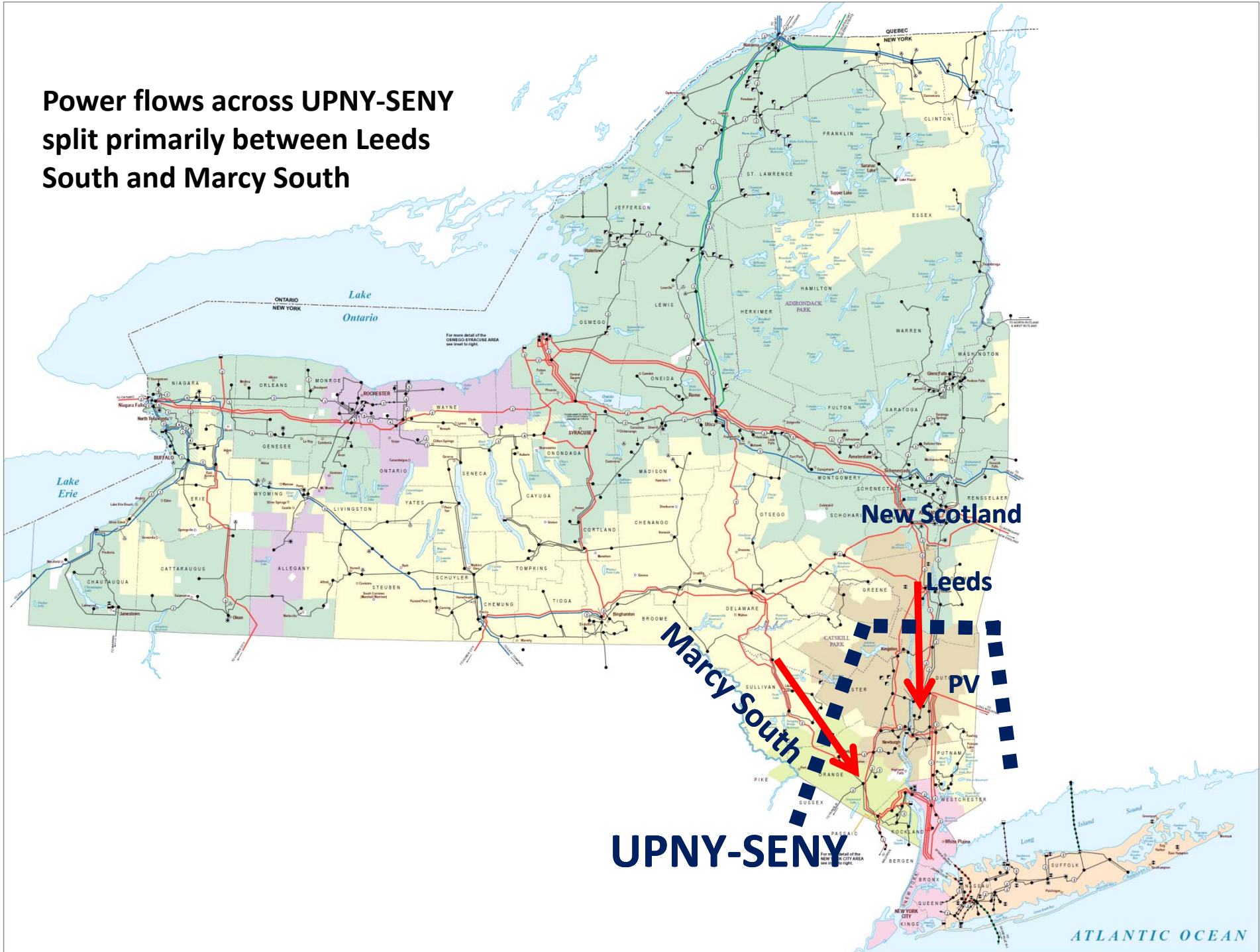
Source: NYISO Transmission Expansion Interconnection Manual

UPNY-SENY Transfer Limits

UPNY-SENY Interface

- ◆ **UPNY-SENY** represents the collection of transmission on which power flows from Upstate New York to Southeast New York
 - *Marcy South: Two 345 kV lines from Utica to south of the Catskills*
 - *Leeds South: Three 345 kV lines from Athens south to Kingston and Pleasant Valley, plus underlying 115 kV lines*
 - *Pleasant Valley-Long Mountain: One 345 kV line from Connecticut to Pleasant Valley*

Power flows across UPNY-SENY split primarily between Leeds South and Marcy South

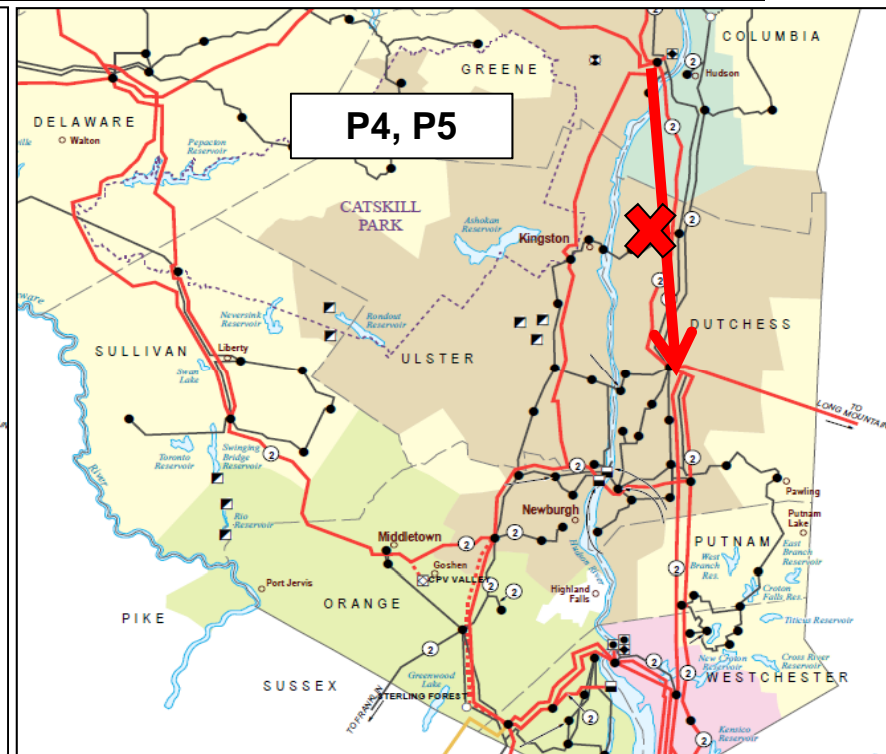
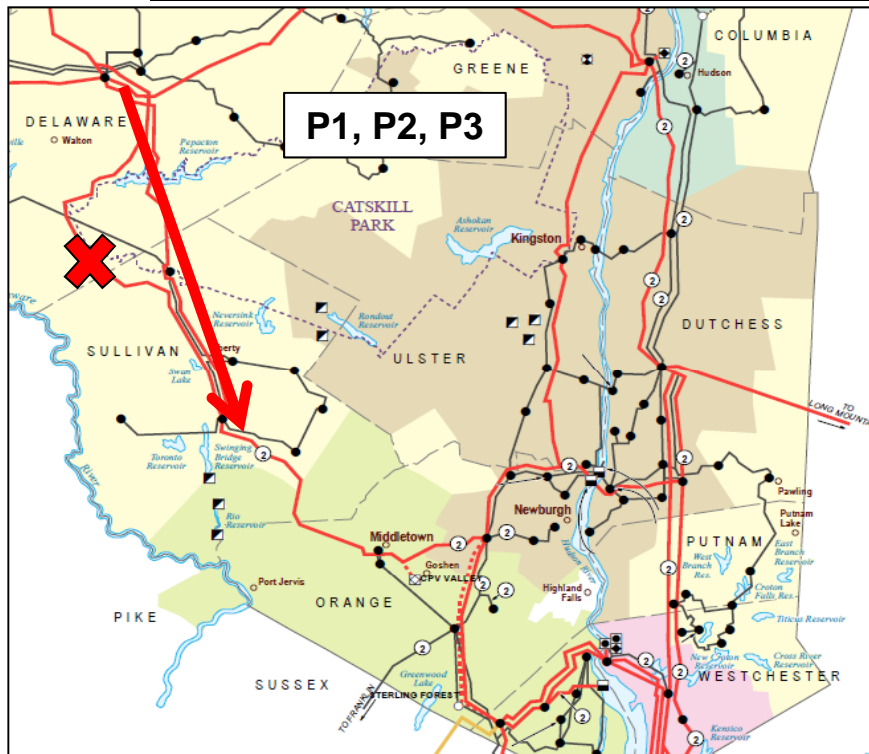


UPNY-SENY Results: Base Case

- ◆ **Normal Transfer Criteria Limit: 5469 MW**
- ◆ **Limiting Element: Leeds – PV @ STE rating**
 - *Athens Special Protection System (SPS) allows Leeds-PV to be secured to higher short term emergency (STE) rating if Athens generation can be backed down*
 - *Without the Athens SPS, the UPNY-SENY limit would be 4747 MW at the long term emergency (LTE) rating*
 - *Athens SPS agreement calls for the retirement of the SPS following installation of a permanent solution*
- ◆ **Contingency: Athens – PV**

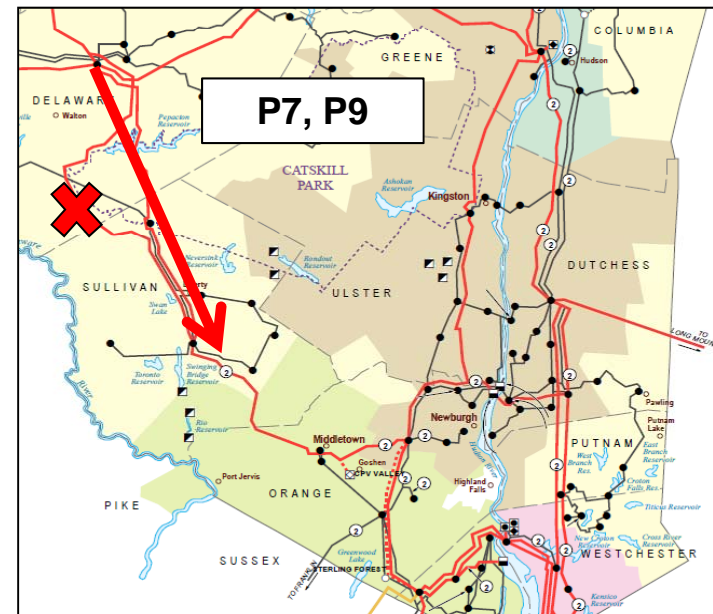
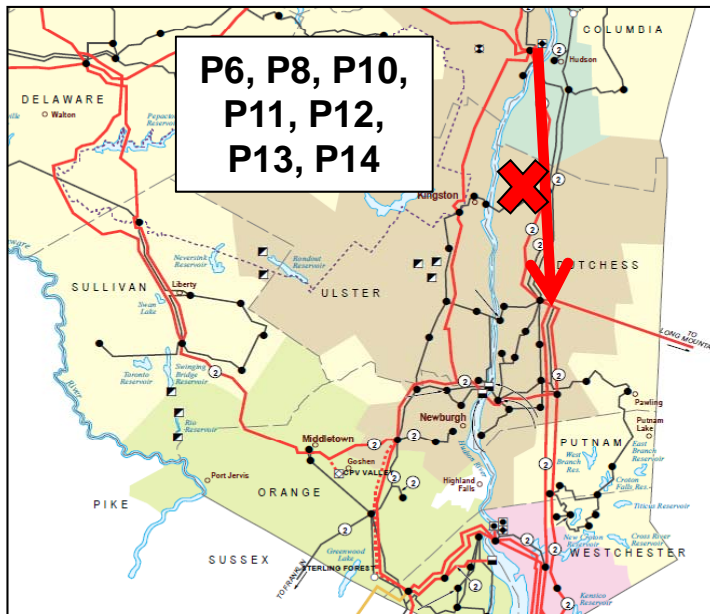
UPNY-SENY Results: NAT

Portfolio	UPNY-SENY Normal Transfer Criteria	Delta	Limiting Element (LTE rating)	Contingency
P1 - NAT	6535	1066	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P2 - NAT	6451	982	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P3 - NAT	6402	933	Fraser - CC (new)	Fraser - CC
P4 - NAT	6402	933	Leeds - PV	Athens - PV
P5 - NAT	6428	959	Leeds - PV	Athens - PV



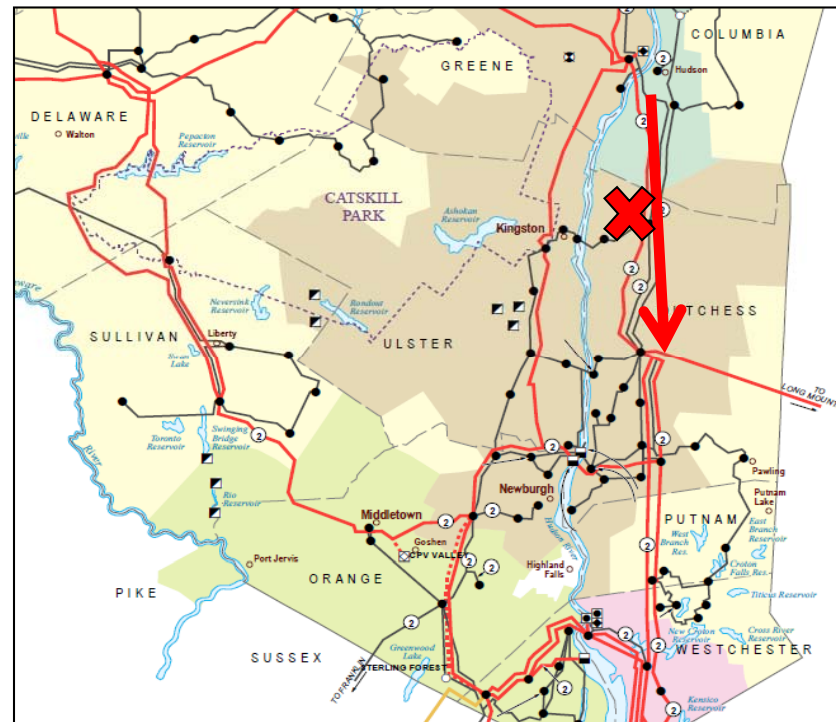
UPNY-SENY Results: NYTOs

Portfolio	UPNY-SENY Normal Transfer Criteria	Delta	Limiting Element (LTE rating)	Contingency
P6 - NYTO	6125	656	Leeds - PV	Athens - PV
P7 - NYTO	6534	1065	Fraser - CC	Marcy - Coopers Corners
P8 - NYTO	5000	-469	Leeds - PV	Athens - PV
P9 - NYTO	6791	1322	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P10 - NYTO	6107	638	Leeds - PV	Athens - PV
P11 - NYTO	6072	603	Leeds - PV	Athens - PV
P12 - NYTO	6669	1200	Leeds - PV	Athens - PV
P13 - NYTO	4792	-677	Leeds - PV	Athens - PV
P14 - NYTO	6969	1500	Leeds - PV	Leeds - PV #3



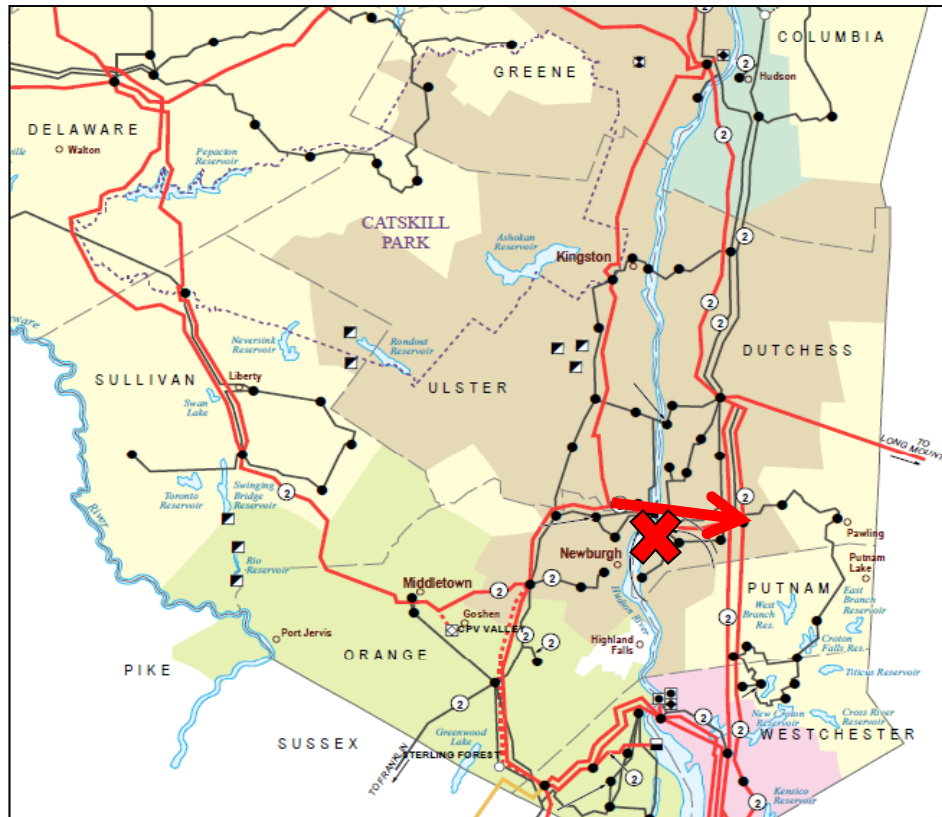
UPNY-SENY Results: NextEra

Portfolio	UPNY-SENY Normal Transfer Criteria	Delta	Limiting Element (LTE rating)	Contingency
P15 - NextEra	6343	874	Leeds - PV	Athens - PV
P16 - NextEra	6166	697	Leeds - PV	Athens - PV
P17 - NextEra	6286	817	Leeds - PV	Athens - PV
P18 - NextEra	6027	558	Leeds - PV	Athens - PV
P19 - NextEra	6166	697	Leeds - PV	Athens - PV
P19a - NextEra	6148	679	Leeds - PV	Athens - PV



UPNY-SENY Results: Boundless

Portfolio	UPNY-SENY Normal Transfer Criteria	Delta	Limiting Element (LTE rating)	Contingency
P20 - Boundless	6057	588	Roseton - W.Fishkill	Roseton - W.Fishkill & Roseton - E.Fishkill
P21 - Boundless	5951	482	Roseton - W.Fishkill	Roseton - W.Fishkill & Roseton - E.Fishkill

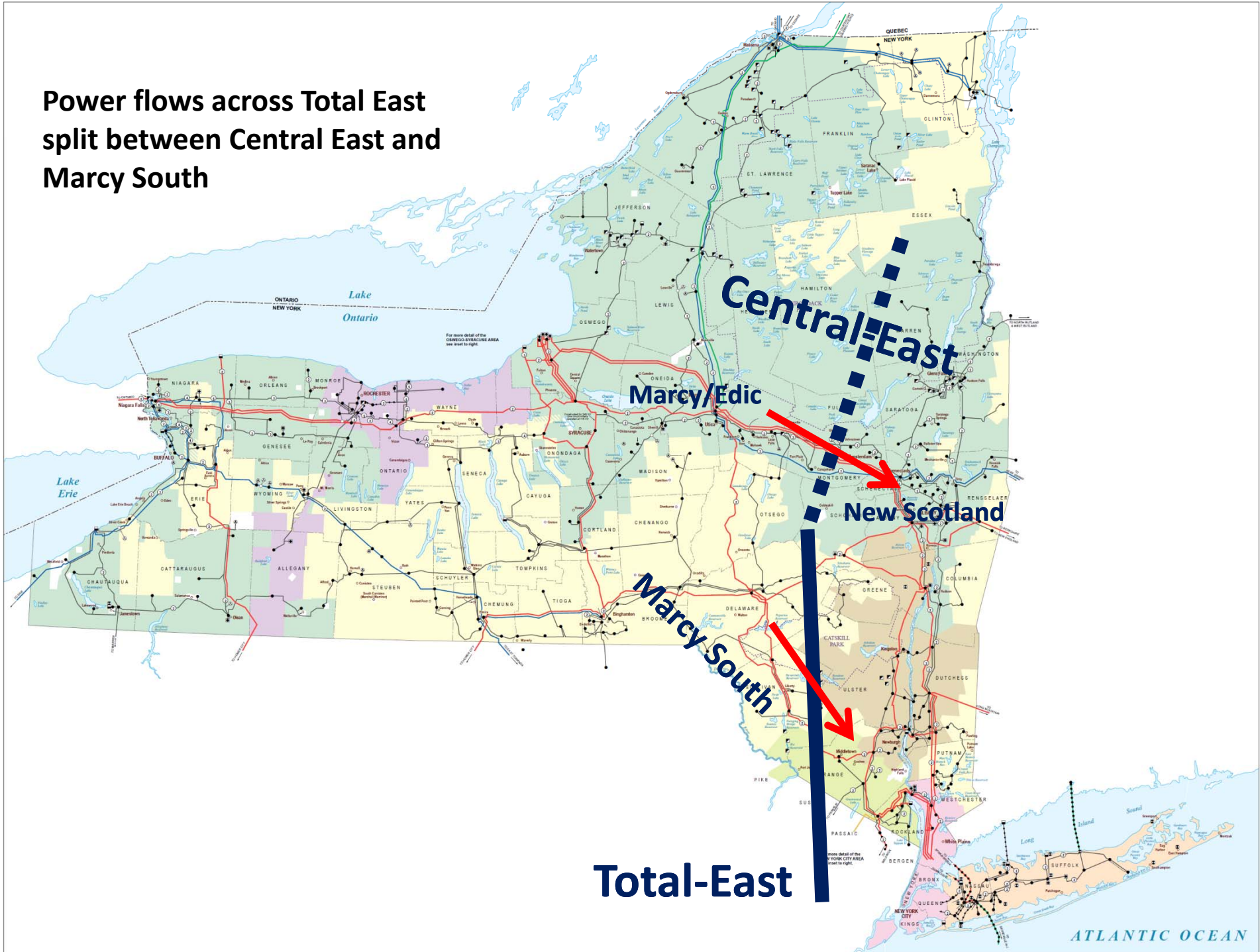


Central East & Total East Transfer Limits

Central East & Total East Interfaces

- ◆ **Central East interface is a subset of the Total East interface**
 - *Central East is the transmission from Utica to Albany*
 - *Total East includes Central East plus all other transmission from west to east in New York*
- ◆ **Central East is typically voltage limited, therefore both thermal and voltage limits are evaluated for each portfolio.**

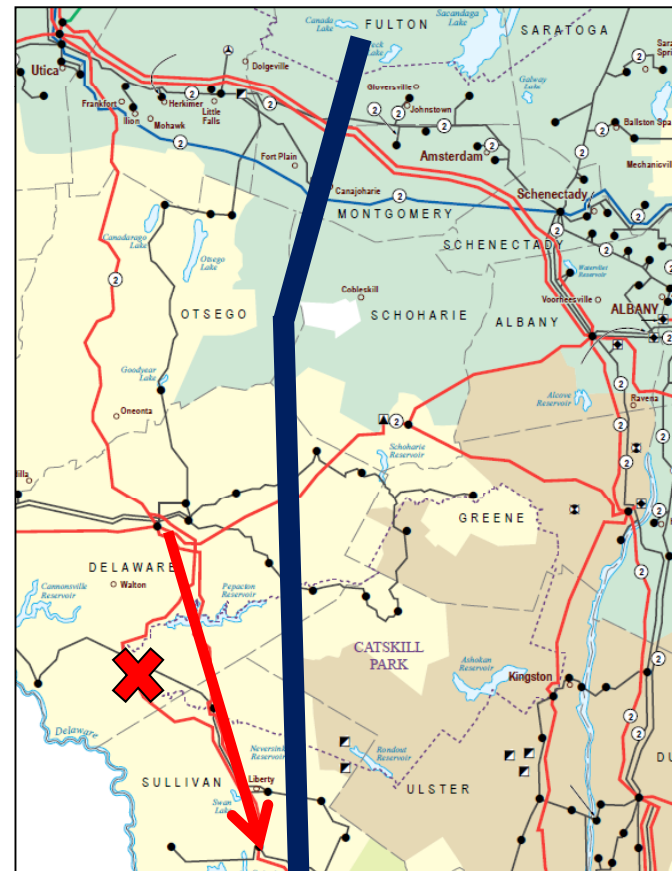
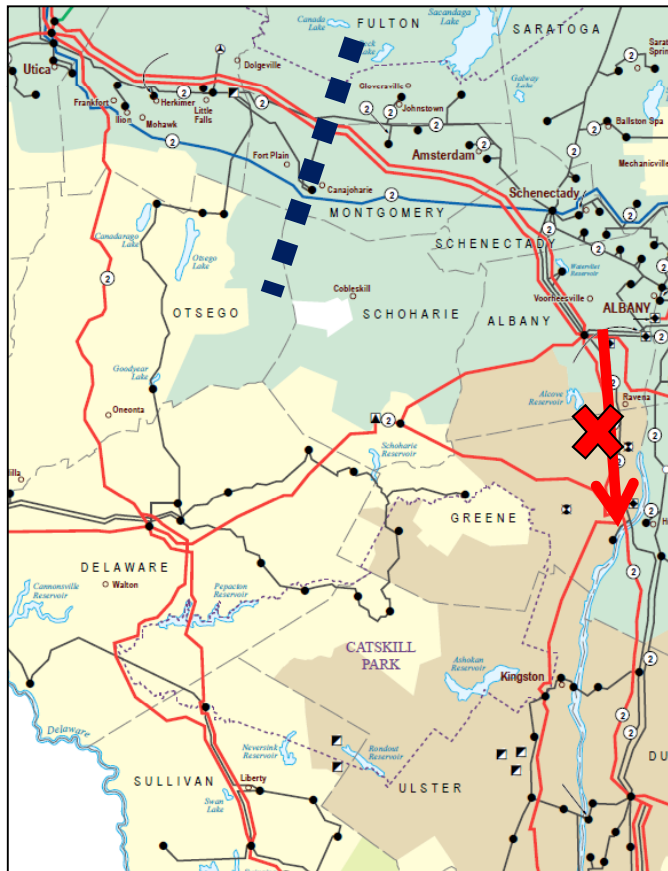
Power flows across Total East split between Central East and Marcy South



Total-East

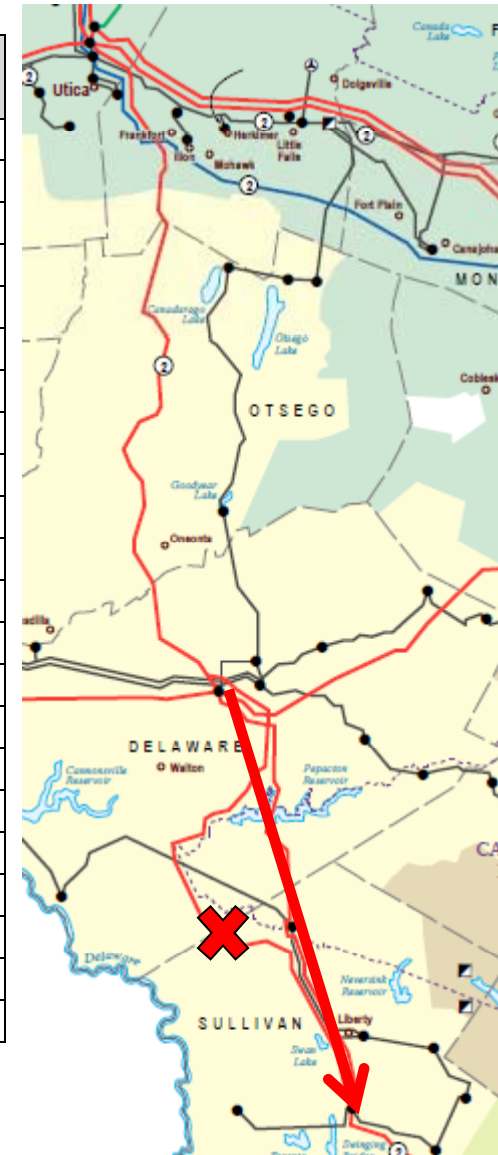
Central East & Total East: Base Case thermal

	Limit	Limiting Element (LTE rating)	Contingency
Central East	2433	New Scotland #77 - Leeds	New Scotland #99 - Leeds
Total East	5685	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam



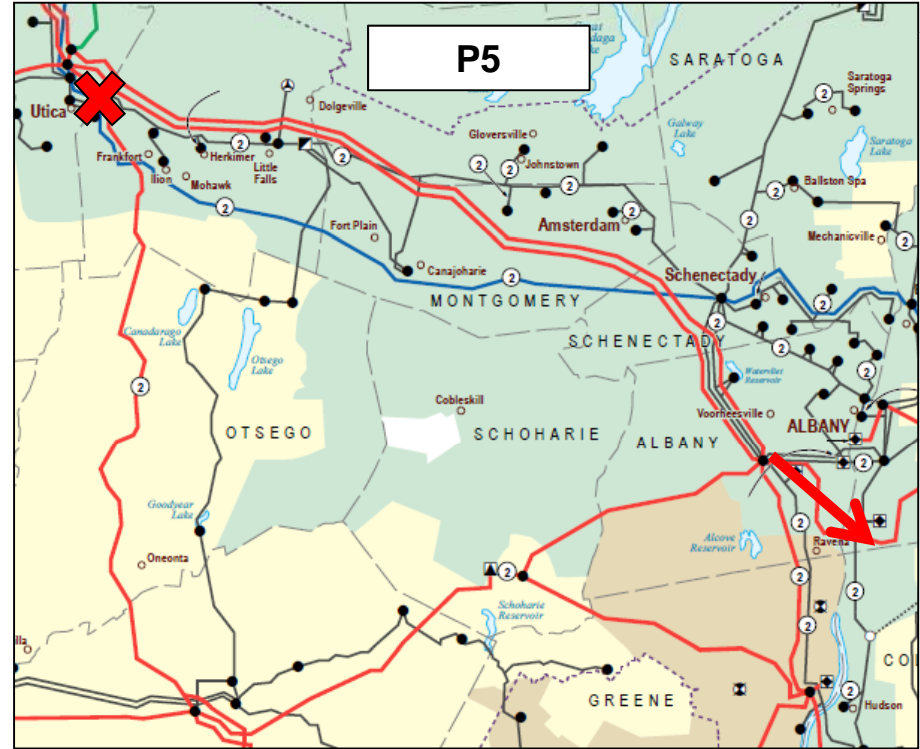
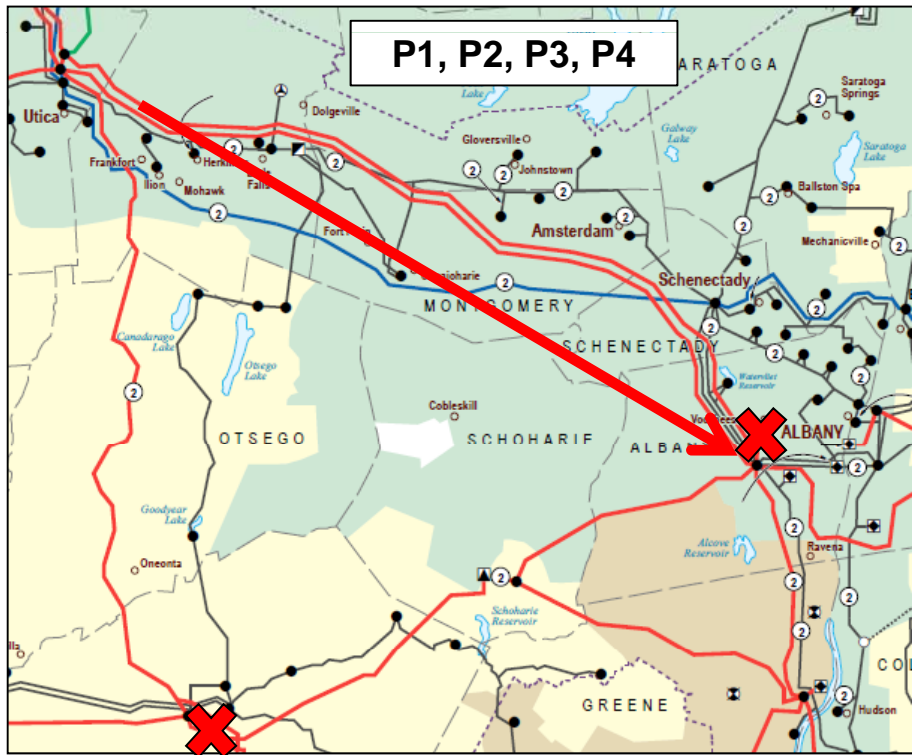
Total East thermal results

	Total East	Delta	Limiting Element (LTE rating)	Contingency
P1 - NAT	5736	51	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P2 - NAT	5660	-25	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P3 - NAT	5606	-79	Fraser - CC (new)	Fraser - CC
P4 - NAT	5786	101	Fraser - CC (new)	Fraser - CC
P5 - NAT	5741	56	Fraser - CC (new)	Fraser - CC
P6 - NYTO	6042	357	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P7 - NYTO	5805	120	Fraser - CC	Marcy - Coopers Corners
P8 - NYTO	5657	-28	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P9 - NYTO	5968	283	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P10 - NYTO	6204	519	Fraser - CC	Marcy - Coopers Corners
P11 - NYTO	6275	590	Fraser - CC	Marcy - Coopers Corners
P12 - NYTO	5938	253	Fraser - CC	Marcy - Coopers Corners
P13 - NYTO	5795	110	Fraser - CC	Marcy - Coopers Corners
P14 - NYTO	6179	494	Fraser - CC	Marcy - Coopers Corners
P15 - NextEra	6119	434	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P16 - NextEra	5920	235	Fraser - CC	Tower: Marcy – CC & Marcy – Princetown
P17 - NextEra	5887	202	Fraser - CC	Tower: Marcy – CC & Marcy – Princetown
P18 - NextEra	6275	590	Fraser - CC	Tower: Marcy – CC & Marcy – Princetown
P19 - NextEra	5973	288	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P19a - NextEra	6059	374	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P20 - Boundless	5725	40	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam
P21 - Boundless	5716	31	Fraser - CC	Tower: Marcy – CC & Porter – Rotterdam



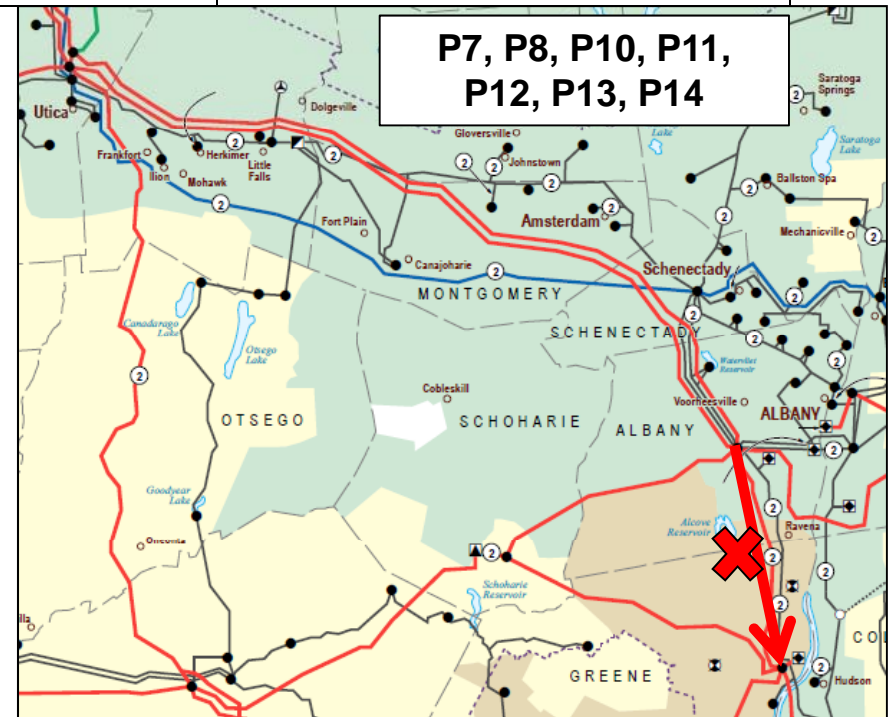
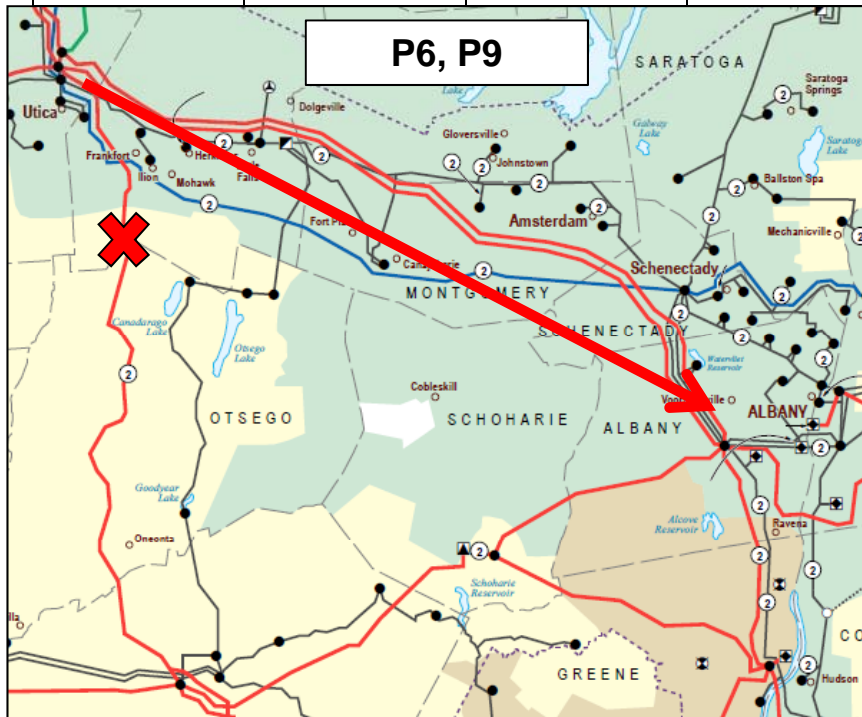
Central East thermal: NAT

	Central East	Delta	Limiting Element (LTE rating)	Contingency
P1 - NAT	2963	530	Marcy - New Scotland	Marcy South tower (41&33)
P2 - NAT	2957	524	Marcy - New Scotland	Marcy South tower (41&33)
P3 - NAT	3177	744	Marcy - New Scotland	New Scotland bus #99
P4 - NAT	2853	420	Marcy - New Scotland	New Scotland bus #99
P5 - NAT	3629	1196	New Scotland - Knickerbocker	Tower: Marcy - Fraser & Edic - Princetown



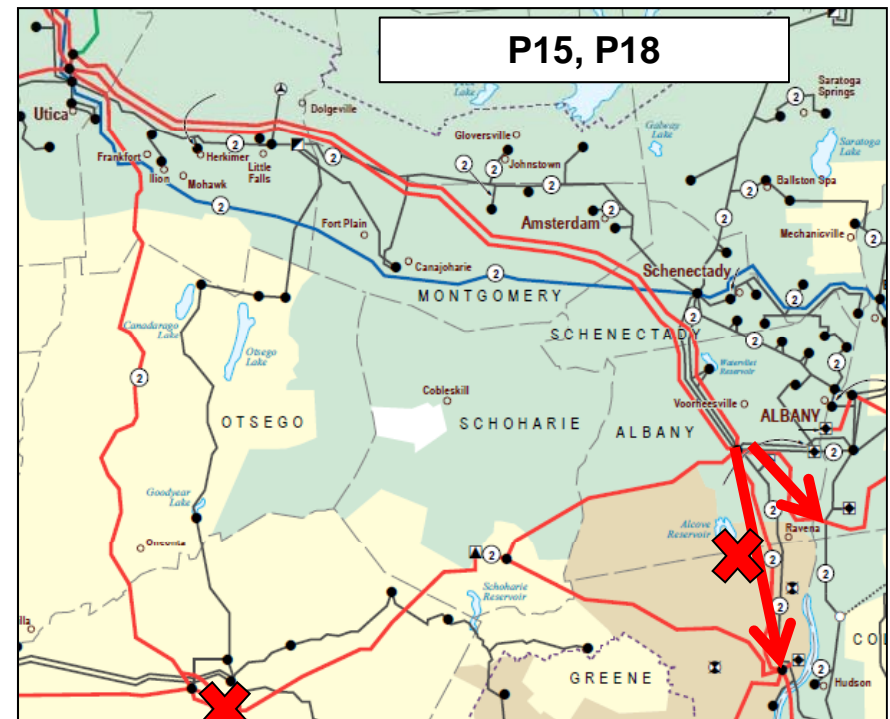
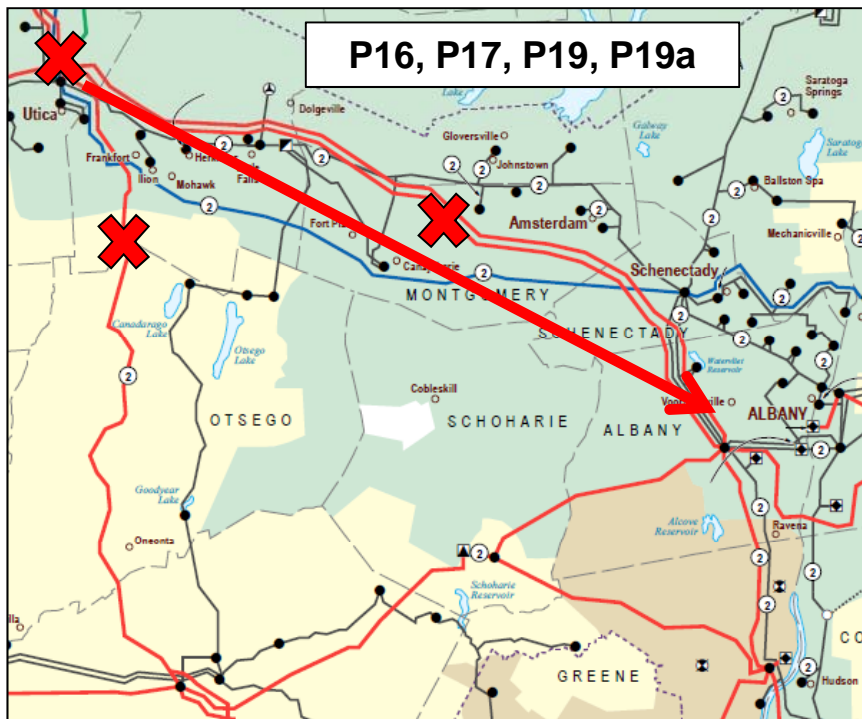
Central East thermal: NYTOs

	Central East	Delta	Limiting Element (LTE rating)	Contingency
P6 - NYTO	2947	514	Edic - New Scotland	Marcy South tower (40&41)
P7 - NYTO	2409	-24	New Scotland #77 - Leeds	New Scotland #99 - Leeds
P8 - NYTO	2457	24	New Scotland #77 - Leeds	New Scotland #99 - Leeds
P9 - NYTO	2896	463	Edic - New Scotland	Marcy South tower (40&41)
P10 - NYTO	2826	393	New Scotland #77 - Leeds	New Scotland bus #99
P11 - NYTO	2845	412	New Scotland #77 - Leeds	New Scotland bus #99
P12 - NYTO	3426	993	New Scotland #77 - Leeds	New Scotland #99 - Leeds
P13 - NYTO	2560	127	New Scotland #77 - Leeds	New Scotland #99 - Leeds
P14 - NYTO	3147	714	New Scotland #77 - Leeds	New Scotland #99 - Leeds



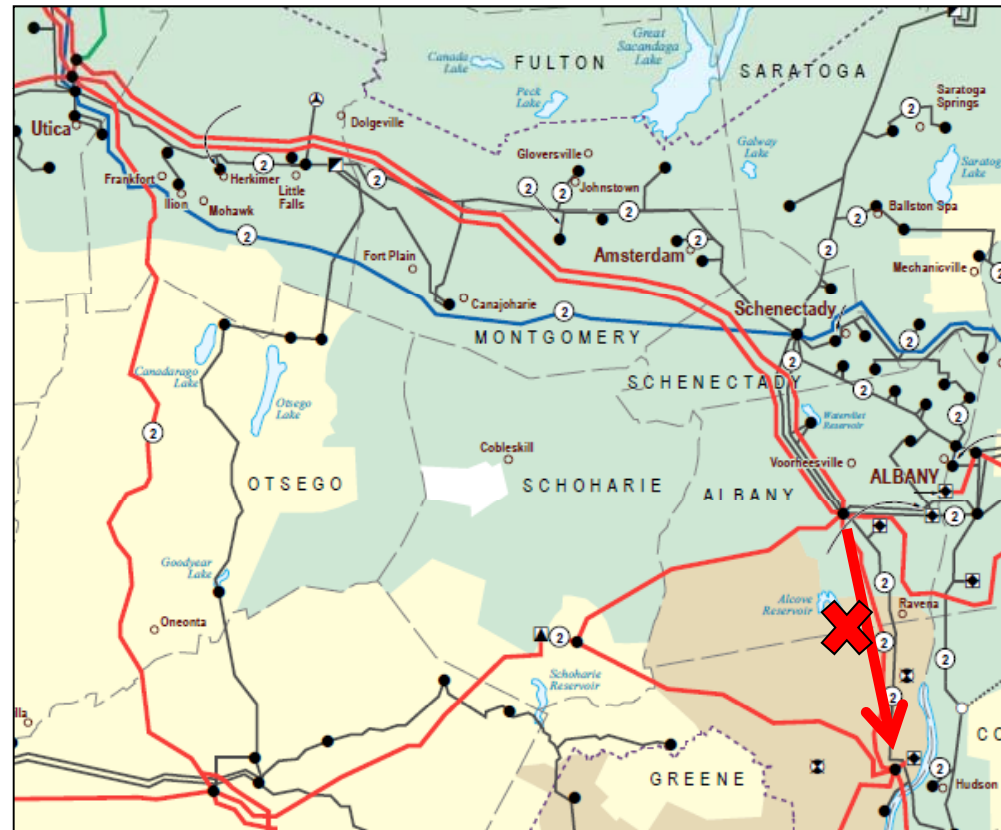
Central East thermal: NextEra

	Central East	Delta	Limiting Element (LTE rating)	Contingency
P15 - NextEra	3169	736	New Scotland #77 - Leeds	New Scotland #99 - Leeds
P16 - NextEra	2489	56	Princetown - New Scotland	New Scotland bus #99
P17 - NextEra	3273	840	Edic - New Scotland	SB: Marcy - Edic & Marcy - Volney
P18 - NextEra	3160	727	Orchard Hill - Knickerbocker	Marcy South tower (41&33)
P19 - NextEra	2876	443	Marcy - New Scotland	Marcy South tower (40&41)
P19a - NextEra	2795	362	Marcy - New Scotland	Marcy South tower (40&41)



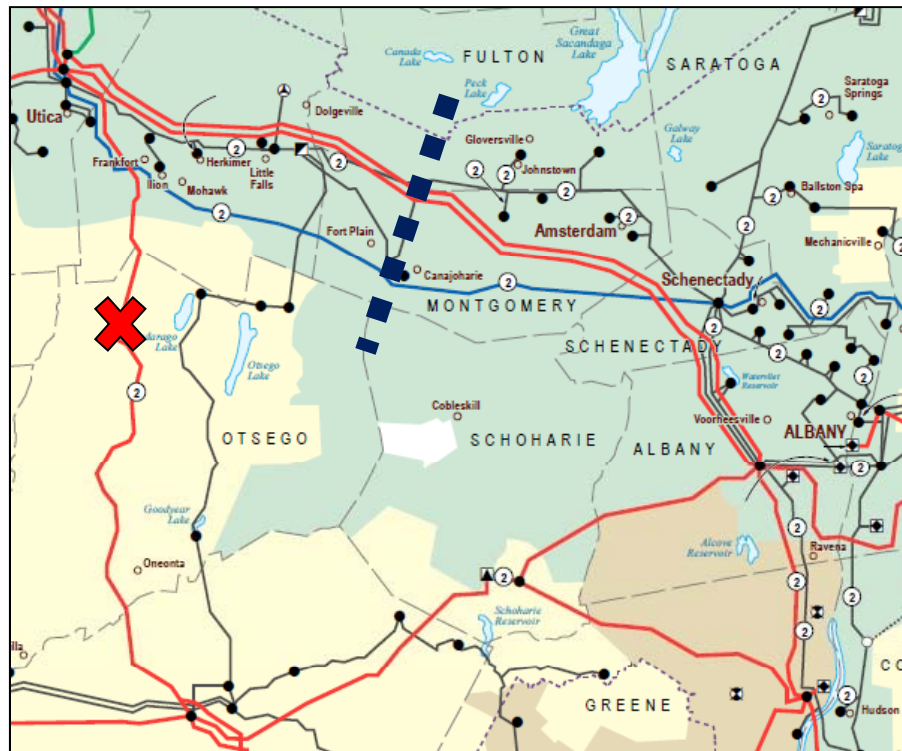
Central East thermal: Boundless

	Central East	Delta	Limiting Element (LTE rating)	Contingency
P20 - Boundless	2704	271	New Scotland #77 - Leeds	New Scotland #99 - Leeds
P21 - Boundless	2708	275	New Scotland #77 - Leeds	New Scotland #99 - Leeds



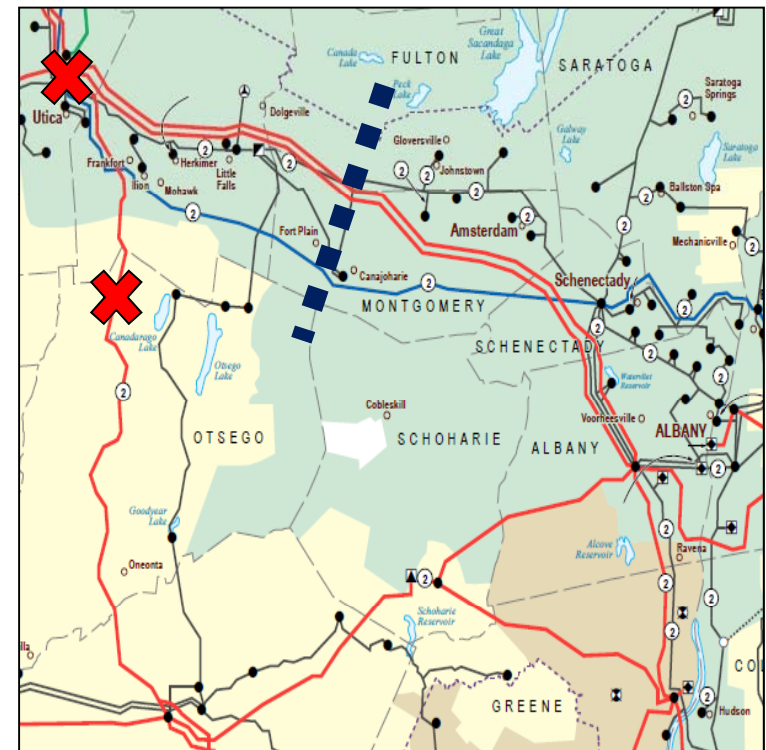
Central East: Base Case voltage

- ◆ **Base Case limit: 2700 MW**
- ◆ **Limiting Contingency: Marcy South tower (40&41)**



Central East voltage results

	Central East	Delta	Contingency
P1 - NAT	3000	300	SB: Edic-New Scotland & Edic-Fitzpatrick
P2 - NAT	3000	300	SB: Edic-New Scotland & Edic-Fitzpatrick
P3 - NAT	3000	300	SB: Edic-New Scotland & Edic-Fitzpatrick
P4 - NAT	3000	300	SB: Edic-New Scotland & Edic-Fitzpatrick
P5 - NAT	3000	300	SB: Edic-New Scotland & Edic-Fitzpatrick
P6 - NYTO	2725	25	Marcy South tower (40&41)
P7 - NYTO	2650	-50	Marcy South tower (40&41)
P8 - NYTO	2650	-50	Marcy South tower (40&41)
P9 - NYTO	2725	25	Marcy South tower (40&41)
P10 - NYTO	3050	350	Marcy South tower (40&41)
P11 - NYTO	3050	350	Marcy South tower (40&41)
P12 - NYTO	3050	350	Marcy South tower (40&41)
P13 - NYTO	2650	-50	Marcy South tower (40&41)
P14 - NYTO	3050	350	Marcy South tower (40&41)
P15 - NextEra	3050	350	Marcy South tower (40&41)
P16 - NextEra	3050	350	Marcy South tower (40&41)
P17 - NextEra	3050	350	Marcy South tower (40&41)
P18 - NextEra	3050	350	Marcy South tower (40&41)
P19 - NextEra	2750	50	Marcy South tower (40&41)
P19a - NextEra	2750	50	Marcy South tower (40&41)
P20 - Boundless	2650	-50	Marcy South tower (40&41)
P21 - Boundless	2650	-50	Marcy South tower (40&41)

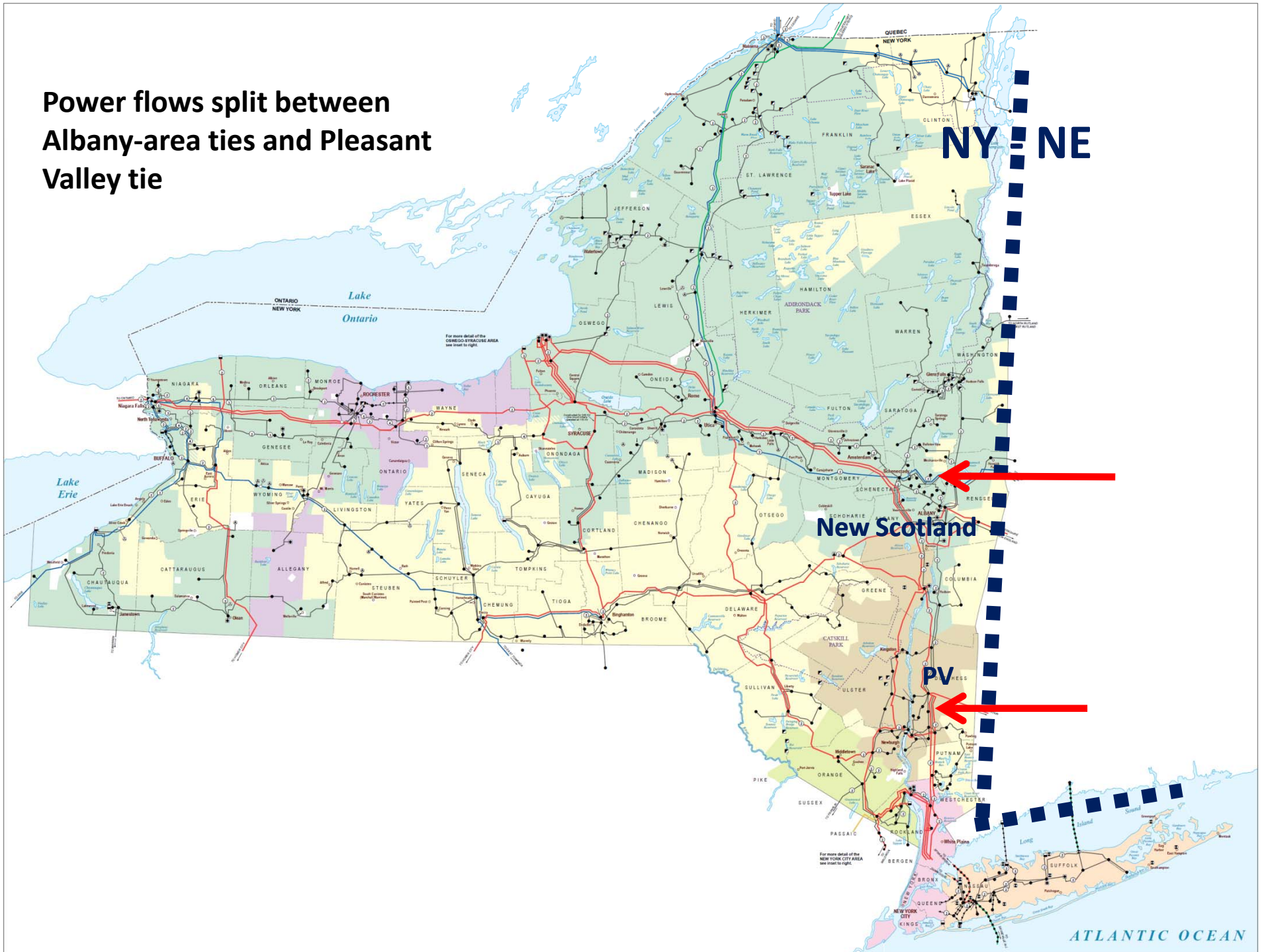


New England Transfer Limits

New England - NY Interface

- ◆ **The NE-NY interface represents the collection of transmission ties between New England and New York**
 - *Albany area ties: One 345 kV line, one 230 kV line, plus two underlying 115 kV lines*
 - *Pleasant Valley-Long Mountain: One 345 kV line from Connecticut to Pleasant Valley*
 - *Plattsburgh tie: One controllable tie to Vermont*
 - *Long Island ties: Northport-Norwalk Harbor and Cross Sound Cable controllable ties*

**Power flows split between
Albany-area ties and Pleasant
Valley tie**



New England Import: Base Case

- ◆ **Base Case Limit: 1596 MW**
- ◆ **Limiting Element: Reynolds Rd 345/115 kV transformer**
- ◆ **Contingency: Alps – New Scotland**



New England Import results

	NE-to-NY	Delta	Limiting Element (LTE rating)	Contingency
P1 - NAT	1411	-185	Reynolds Rd. 345/115	Alps - New Scotland
P2 - NAT	1438	-158	Reynolds Rd. 345/115	Alps - New Scotland
P3 - NAT	1410	-186	Reynolds Rd. 345/115	Alps - New Scotland
P4 - NAT	1410	-186	Reynolds Rd. 345/115	Alps - New Scotland
P5 - NAT	1391	-205	Reynolds Rd. 345/115	Alps - Knickerbocker
P6 - NYTO	1579	-17	Reynolds Rd. 345/115	Alps - Knickerbocker
P7 - NYTO	1559	-37	Reynolds Rd. 345/115	Alps - New Scotland
P8 - NYTO	1577	-19	Reynolds Rd. 345/115	Alps - New Scotland
P9 - NYTO	1538	-58	Reynolds Rd. 345/115	Alps - New Scotland
P10 - NYTO	1562	-34	Reynolds Rd. 345/115	Alps - Knickerbocker
P11 - NYTO	1541	-55	Reynolds Rd. 345/115	Alps - Knickerbocker
P12 - NYTO	1585	-11	Reynolds Rd. 345/115	Alps - New Scotland
P13 - NYTO	1592	-4	Reynolds Rd. 345/115	Alps - New Scotland
P14 - NYTO	1536	-60	Reynolds Rd. 345/115	Alps - New Scotland
P15 - NextEra	1493	-103	Reynolds Rd. 345/115	Alps - New Scotland
P16 - NextEra	1502	-94	Reynolds Rd. 345/115	Alps - Knickerbocker
P17 - NextEra	1465	-131	Reynolds Rd. 345/115	Alps - Knickerbocker
P18 - NextEra	1508	-88	Reynolds Rd. 345/115	Alps - Knickerbocker
P19 - NextEra	1508	-88	Reynolds Rd. 345/115	Alps - Knickerbocker
P19a - NextEra	1523	-73	Reynolds Rd. 345/115	Alps - Knickerbocker
P20 - Boundless	1565	-31	Reynolds Rd. 345/115	Alps - New Scotland
P21 - Boundless	1548	-48	Reynolds Rd. 345/115	Alps - New Scotland

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.



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