AC Transmission Cases: Updated Powerflow Analysis

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AC Transmission Technical Conference
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Background

- **PSC requested that the NYISO perform powerflow analysis of the 22 portfolios of projects proposed in the AC Transmission proceeding. Initial results were presented at the July 20, 2015 Technical Conference.**
- **Following completion of the initial analysis, the developer of CPV Valley generation facility announced that construction will commence.**
- **DPS requested that the NYISO re-evaluate the portfolios considering the effects of the CPV Valley facility.**

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Scope of Updated Analysis

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

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System Representation

- **2014 NYISO Comprehensive Reliability Plan baseline representation for 2019 includes:**
  - ***Transmission Owner Transmission Solutions (TOTS)***
    - **Marcy South Series Compensation**
    - **Second Rock Tavern – Ramapo 345 kV line**
    - **Staten Island Unbottling project**
  - ***125-MW New York City DR/EE/CHP program***
  - ***Proposed CPV Valley Energy Center generation project***

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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***
    - **NYISO 2014 *Load & Capacity Data Report* (the "Gold Book")**

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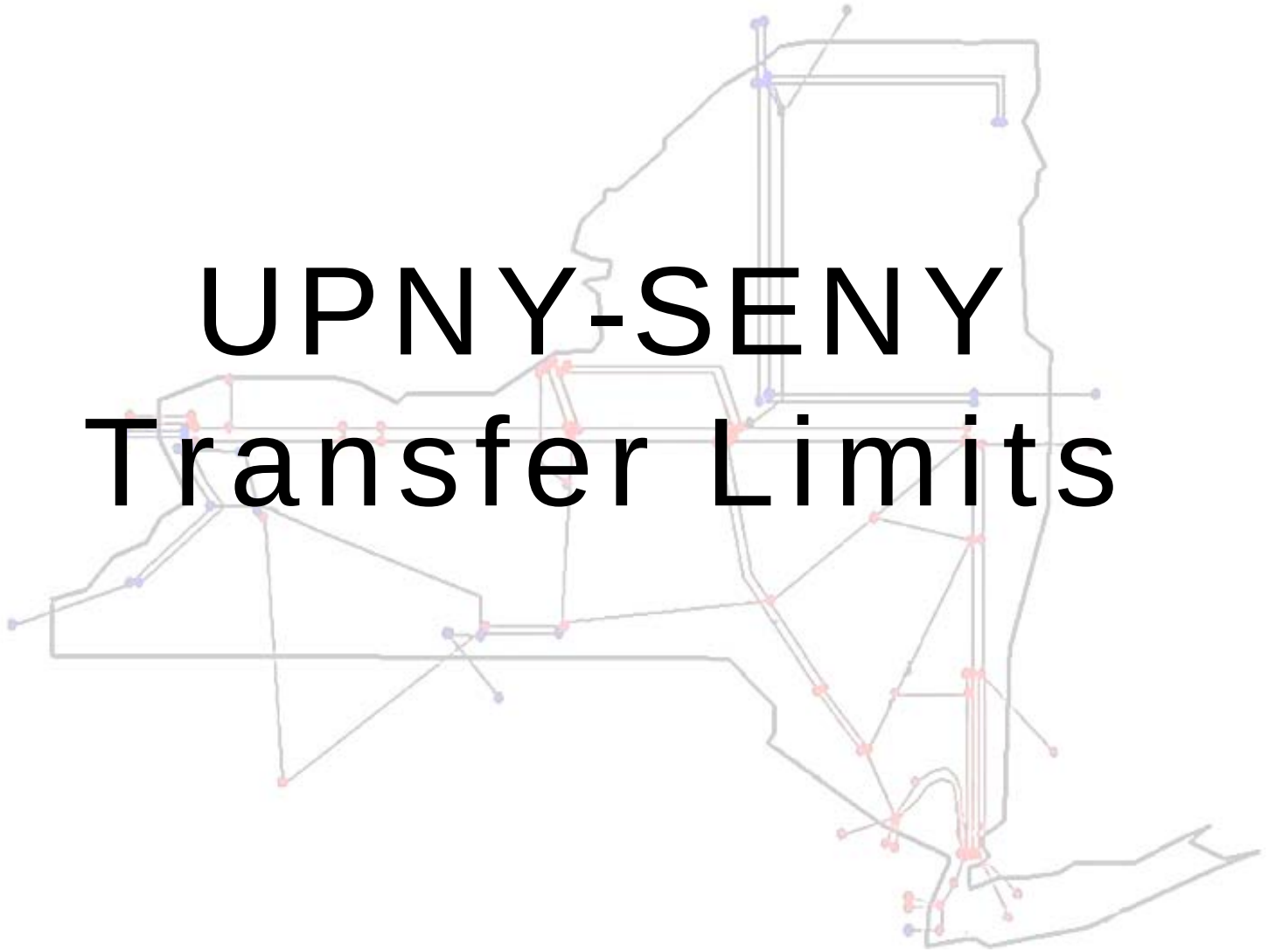

UPNY-SENY Transfer Limits

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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***

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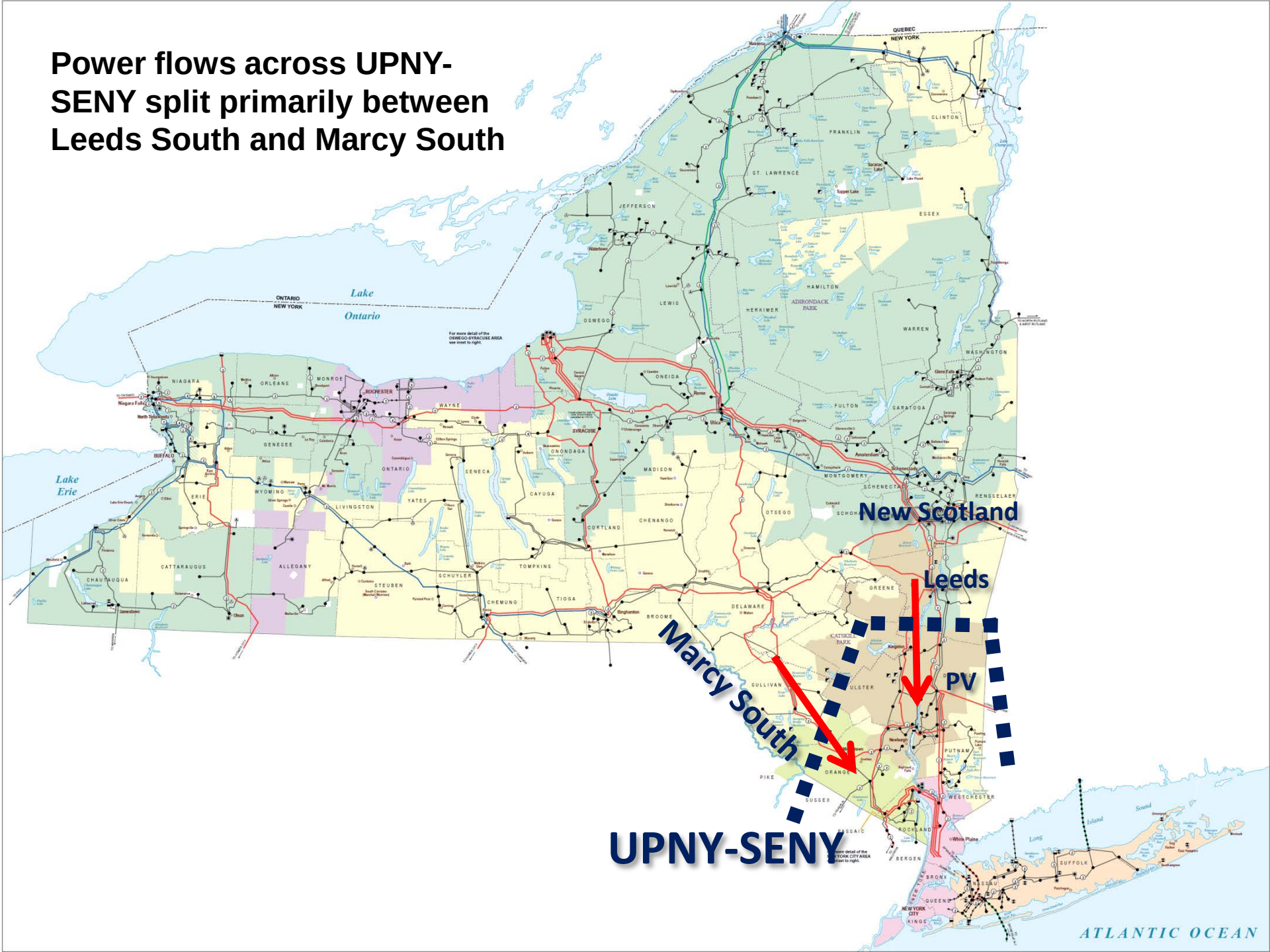
Power flows across UPNY-SENY split primarily between Leeds South and Marcy South



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.***

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UPNY-SENY: Base Case NTC

- **Normal Transfer Criteria (NTC) Limit: 5113 MW**
- **Limiting Element: Leeds – Pleasant Valley ("PV") @ LTE 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 AND if the contingency is the parallel circuit***
  - ***Athens SPS agreement calls for the retirement of the SPS following installation of a permanent solution***
- **Limiting Contingency: Common-tower loss of CPV – Rock Tavern and Coopers Corners – Rock Tavern (Tower 34&42B)**
  - ***Athens SPS does not apply. Leeds-PV must be secured to the long term emergency (LTE) rating.***

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UPNY-SENY: Base Case ETC

- **Emergency Transfer Criteria (ETC) Limit:**
  - ***5319 MW***
- **Limiting Element:**
  - ***CPV – Rock Tavern***
- **Limiting Contingency:**
  - ***Coopers Corners – Rock Tavern***

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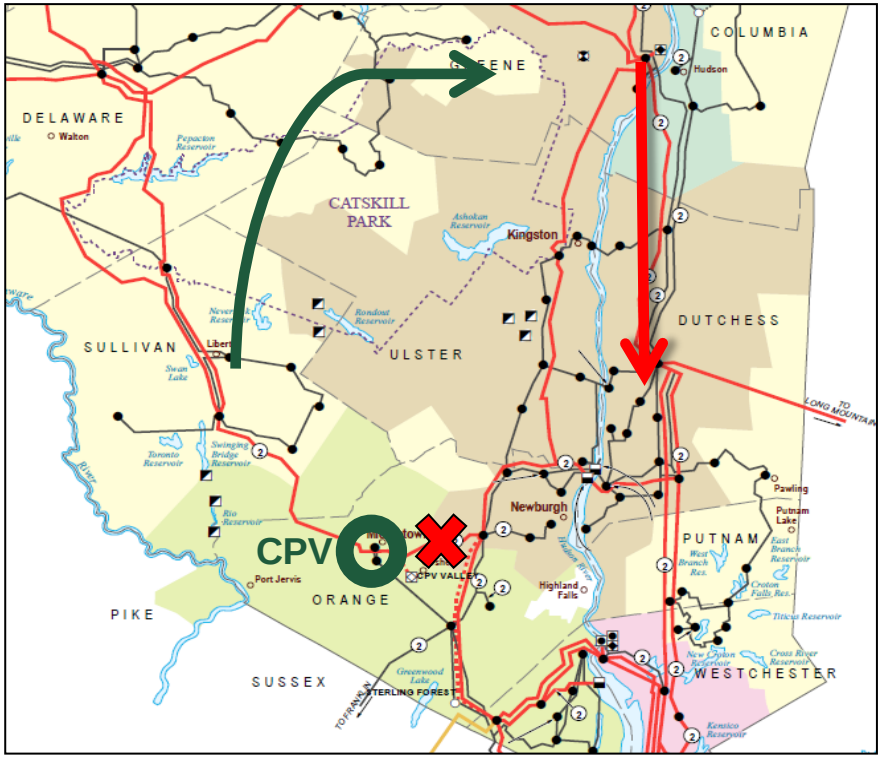
UPNY-SENY: Base Case

Normal Transfer Criteria

Limit: Leeds – PV 345 kV

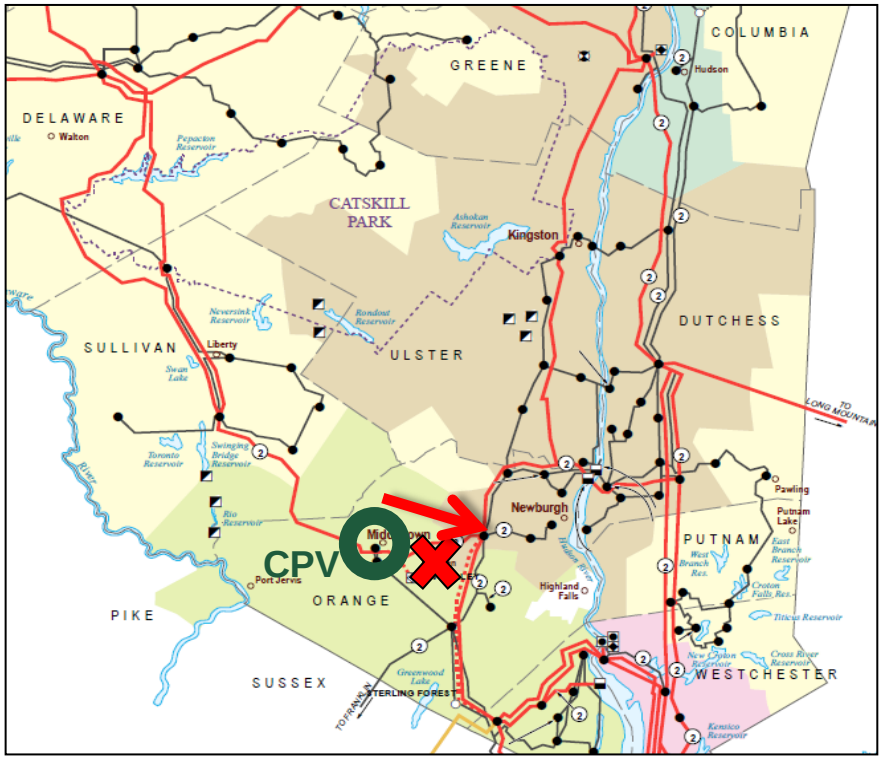
Contingency: Tower 34&42B



Emergency Transfer Criteria

Limit: CPV – Rock Tavern 345 kV

Contingency: Coopers Corners – Rock Tavern



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Additional Upgrades

- **Preliminary analysis identified two transmission limitations that were common to nearly all proposed projects:**
  - ***Rock Tavern 345 kV terminal equipment***
  - ***Shoemaker – Chester – Sugarloaf 138 kV line***
- **CPV – Rock Tavern 345 kV and Coopers Corners – Rock Tavern 345 kV**
  - ***Limiting for loss of the parallel circuit***
  - ***Circuit rating limited by terminal equipment at Rock Tavern***

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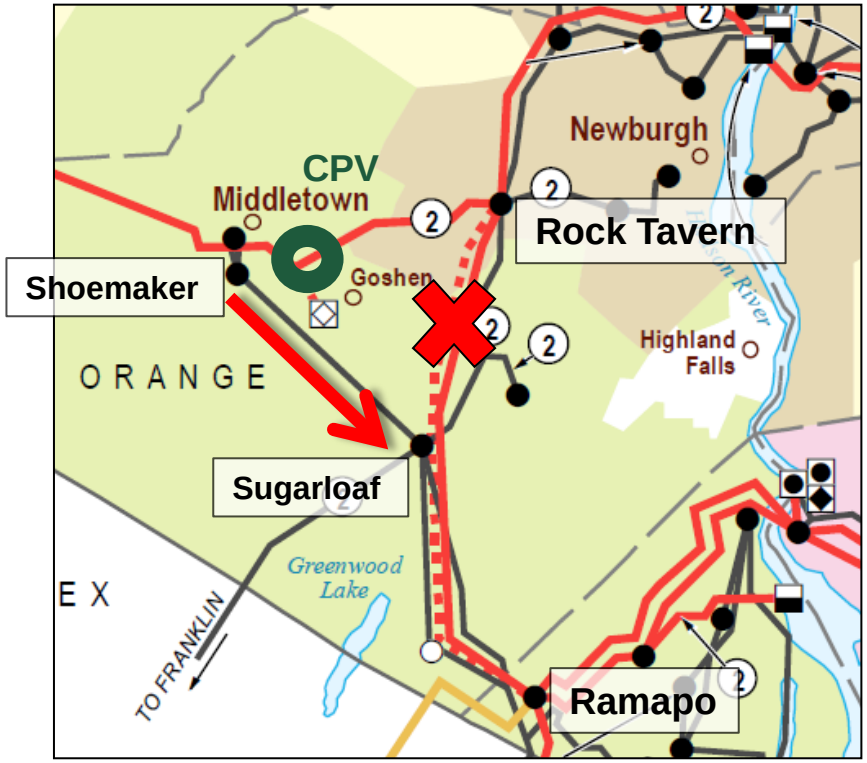
Additional Upgrades

- **Shoemaker – Chester – Sugarloaf 138 kV**
  - ***Limiting for loss of Rock Tavern – Ramapo 345 kV tower***
  - ***Carries roughly 5% of the UPNY-SENY flow***
  - ***Loss of line would cause cascading on 345 kV system***



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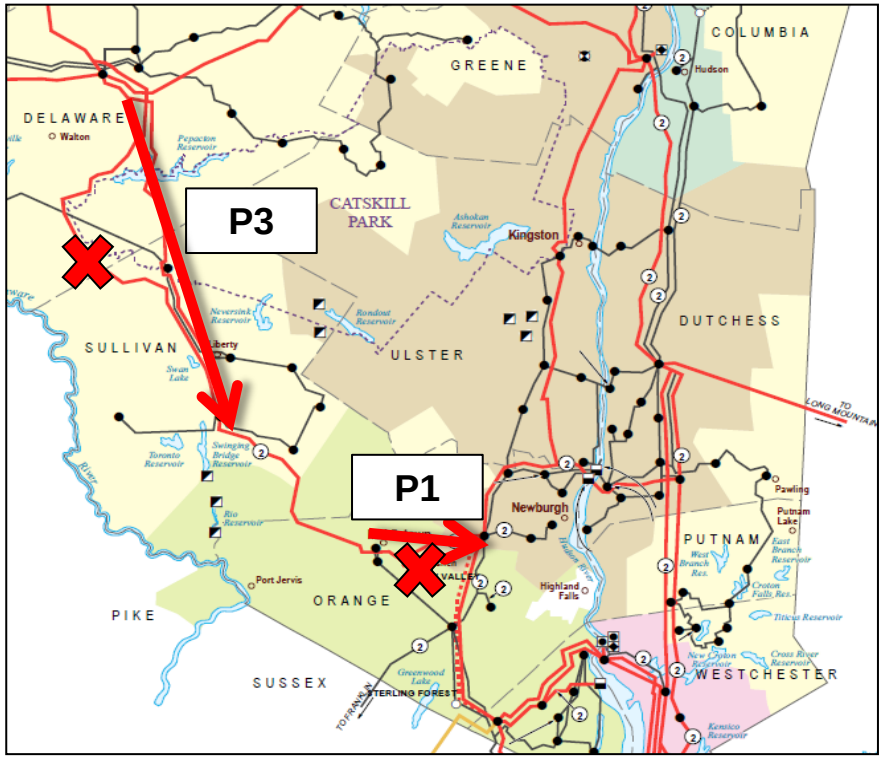
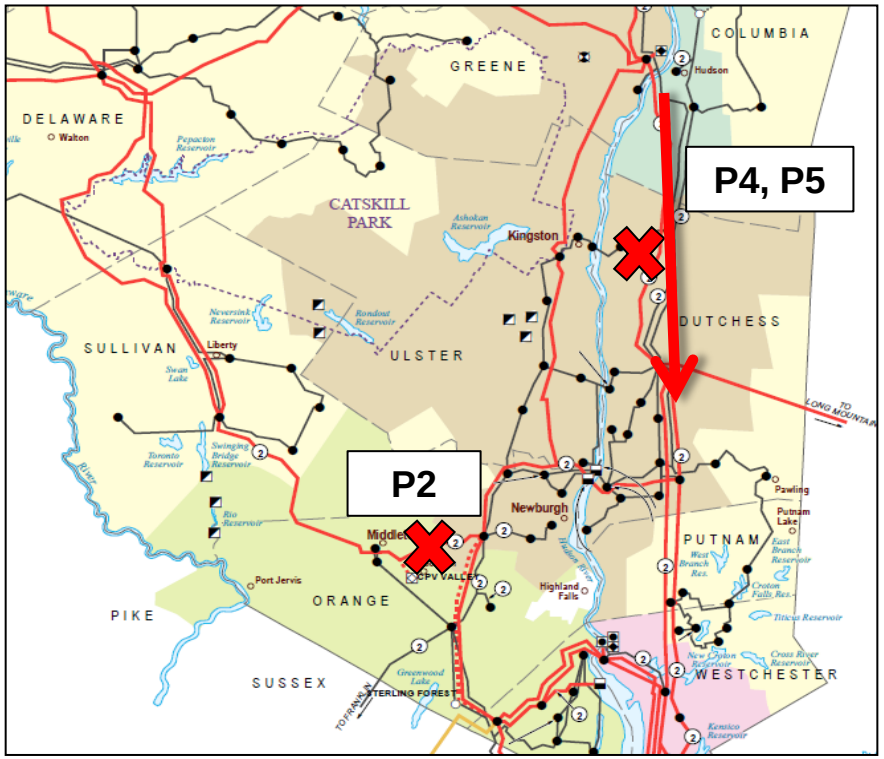
UPNY-SENY: NAT NTC

Portfolio	UPNY-SENY Normal Transfer Criteria	Delta	Limiting Element (LTE rating)	Contingency
P1 - NAT	7219	2106	CPV – Rock Tavern	CC – Rock Tavern
P2 - NAT	6823	1710	Leeds – PV	Tower 34&42B
P3 - NAT	7251	2138	Fraser - CC (new)	Fraser - CC
P4 - NAT	6576	1463	Leeds – PV	Athens - PV
P5 - NAT	6637	1524	Leeds – PV	Athens - PV





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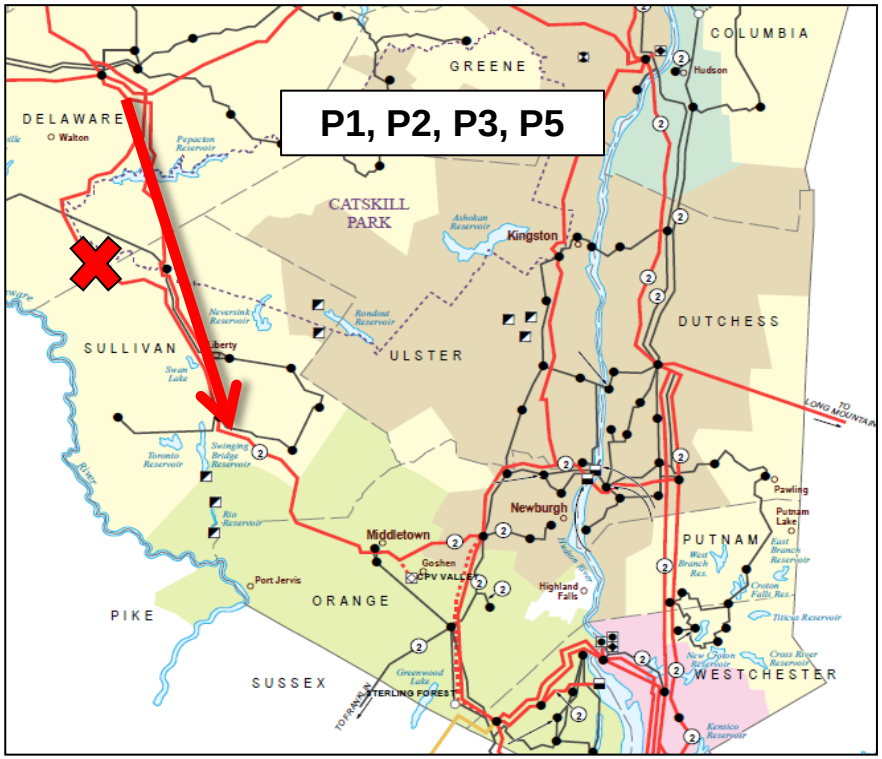
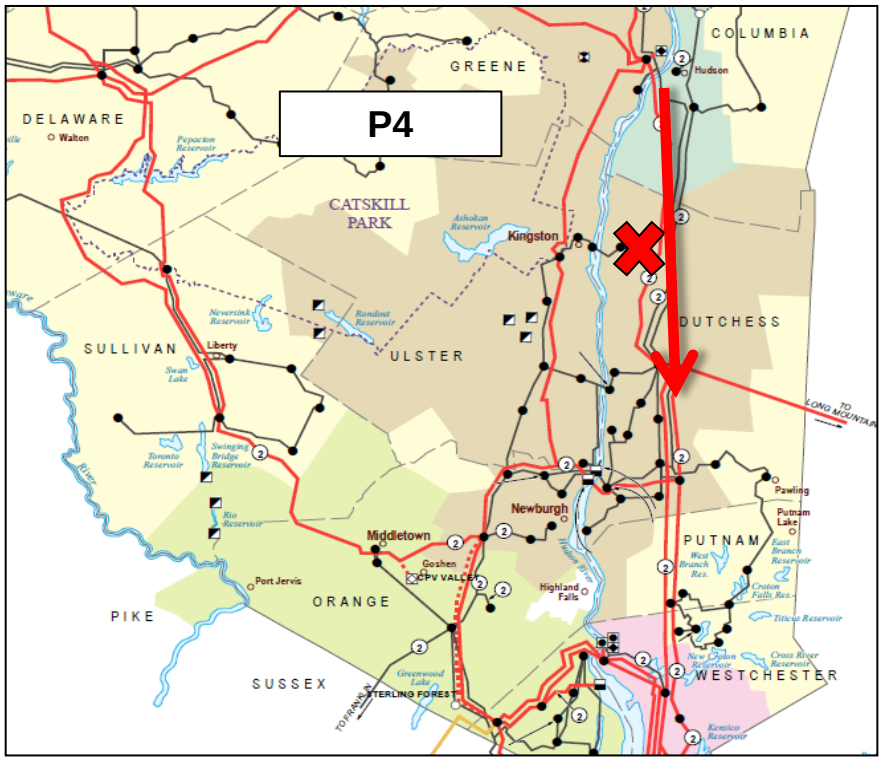
UPNY-SENY: NAT ETC

Portfolio	UPNY-SENY Emergency Transfer Criteria	Delta	Limiting Element (STE rating)	Contingency
P1 - NAT	7704	2385	Fraser – CC	Marcy – CC
P2 - NAT	7590	2271	Fraser – CC	Marcy – CC
P3 - NAT	7028	1709	Fraser - CC (new)	Fraser - CC
P4 - NAT	7546	2227	Leeds – PV	Athens - PV
P5 - NAT	7420	2101	Fraser - CC (new)	Fraser - CC





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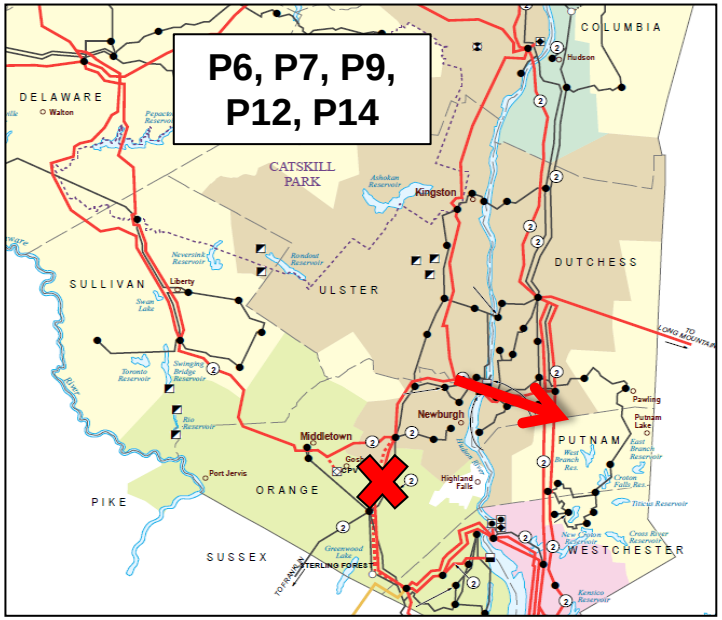
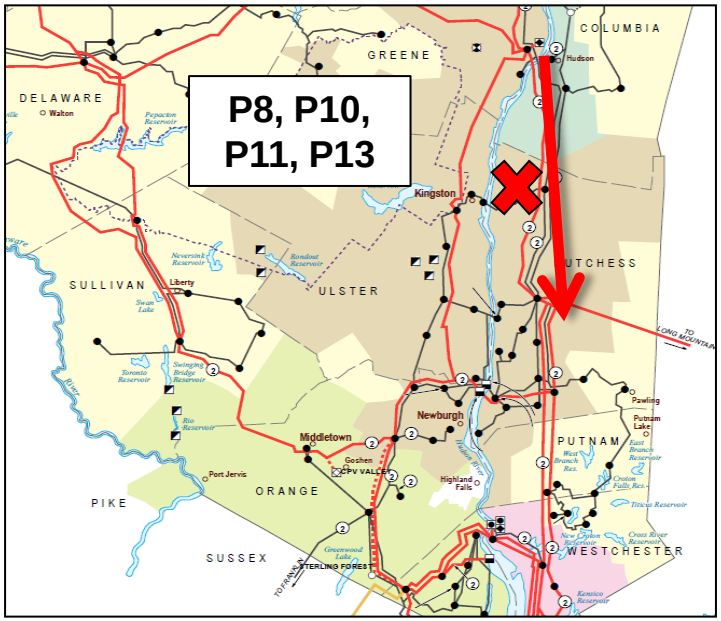
UPNY-SENY: NYTOs NTC

Portfolio	UPNY-SENY Normal Transfer Criteria	Delta	Limiting Element (LTE rating)	Contingency
P6 - NYTO	6031	918	Roseton - E.Fishkill	Tower: Rock Tavern - Ramapo
P7 - NYTO	5465	352	Roseton - E.Fishkill	Tower: Rock Tavern - Ramapo
P8 - NYTO	4783	(330)	Leeds – PV	Athens - PV
P9 - NYTO	6151	1038	Roseton - E.Fishkill	Tower: Rock Tavern - Ramapo
P10 - NYTO	6319	1206	Leeds – PV	Athens - PV
P11 - NYTO	6052	939	Leeds – PV	Athens - PV
P12 - NYTO	5545	432	Roseton - E.Fishkill	Tower: Rock Tavern - Ramapo
P13 - NYTO	4784	(329)	Leeds – PV	Athens - PV
P14 - NYTO	6249	1136	Roseton - E.Fishkill	Tower: Rock Tavern - Ramapo





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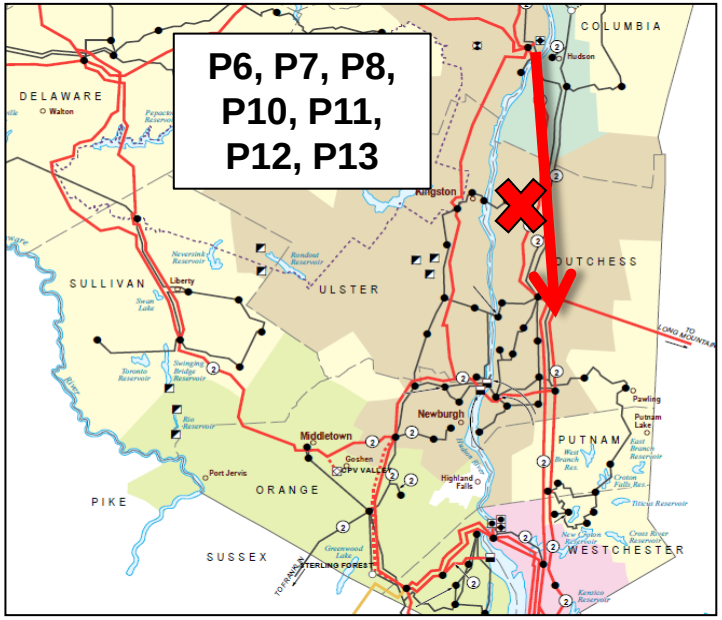
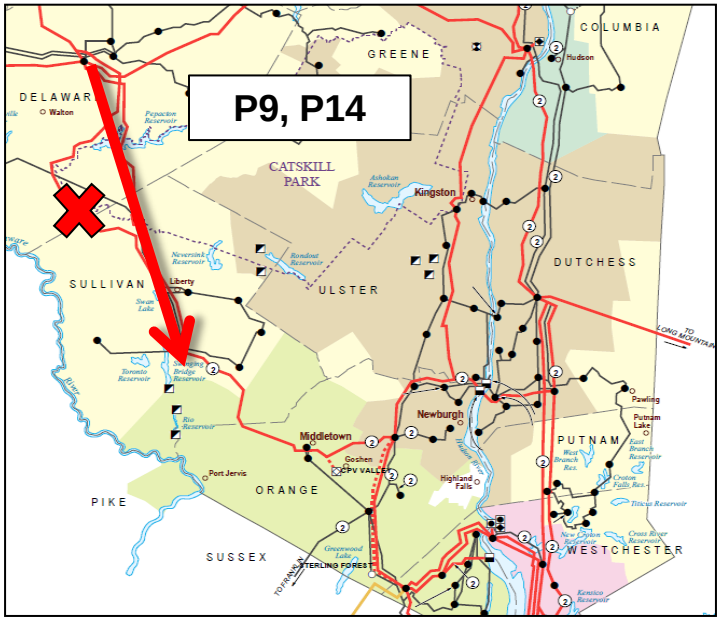
UPNY-SENY: NYTOs ETC

Portfolio	UPNY-SENY Emergency Transfer Criteria	Delta	Limiting Element (STE rating)	Contingency
P6 - NYTO	7005	1686	Leeds – PV	Athens - PV
P7 - NYTO	6723	1404	Leeds – PV	Athens - PV
P8 - NYTO	5555	236	Leeds – PV	Athens - PV
P9 - NYTO	7410	2091	Fraser – CC	Marcy – CC
P10 - NYTO	7226	1907	Leeds – PV	Athens - PV
P11 - NYTO	6940	1621	Leeds – PV	Athens - PV
P12 - NYTO	6660	1341	Leeds – PV	Athens - PV
P13 - NYTO	5534	215	Leeds – PV	Athens - PV
P14 - NYTO	7605	2286	Fraser – CC	Marcy – CC





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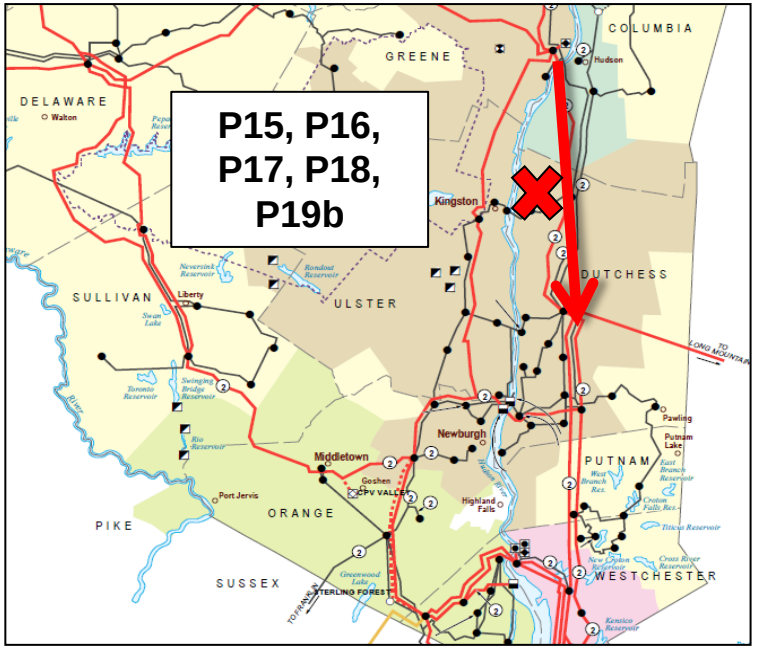
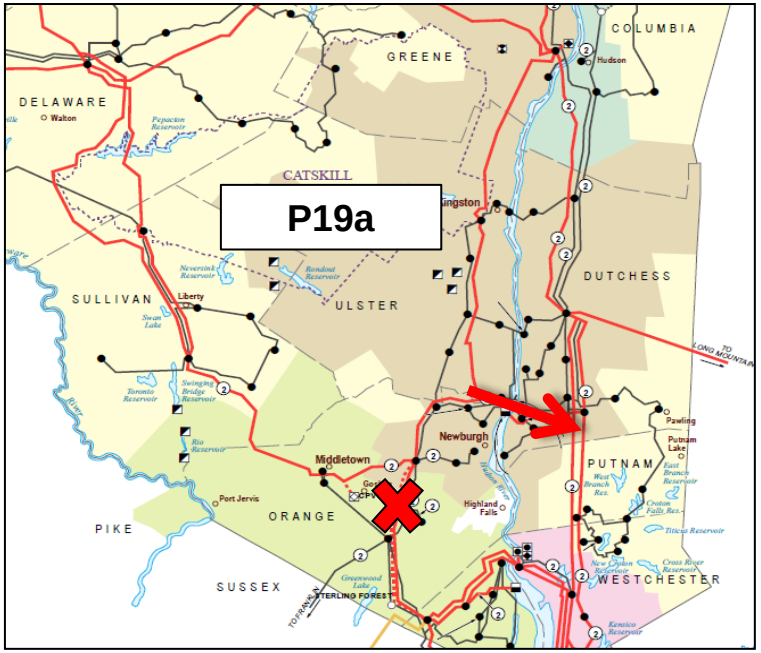
UPNY-SENY: NextEra NTC

Portfolio	UPNY-SENY Normal Transfer Criteria	Delta	Limiting Element (LTE rating)	Contingency
P15 - NextEra	6543	1430	Leeds – PV	Athens - PV
P16 - NextEra	6344	1231	Leeds – PV	Athens - PV
P17 - NextEra	6402	1289	Leeds – PV	Athens - PV
P18 - NextEra	6221	1108	Leeds – PV	Athens - PV
P19a - NextEra	6074	961	Roseton - E.Fishkill	Tower: Rock Tavern - Ramapo
P19b - NextEra	4663	(450)	Leeds – PV	Athens - PV





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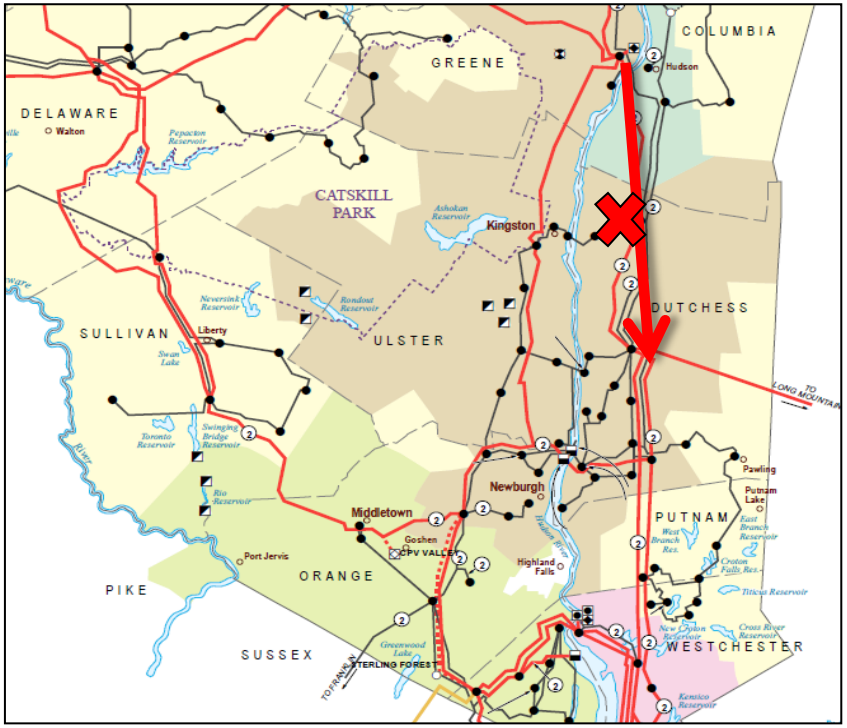
UPNY-SENY: NextEra ETC

Portfolio	UPNY-SENY Emergency Transfer Criteria	Delta	Limiting Element (STE rating)	Contingency
P15 - NextEra	7523	2204	Leeds – PV	Athens - PV
P16 - NextEra	7318	1999	Leeds – PV	Athens - PV
P17 - NextEra	7398	2079	Leeds – PV	Athens - PV
P18 - NextEra	7181	1862	Leeds – PV	Athens - PV
P19a - NextEra	7066	1747	Leeds – PV	Athens - PV
P19b - NextEra	5455	136	Leeds – PV	Athens - PV



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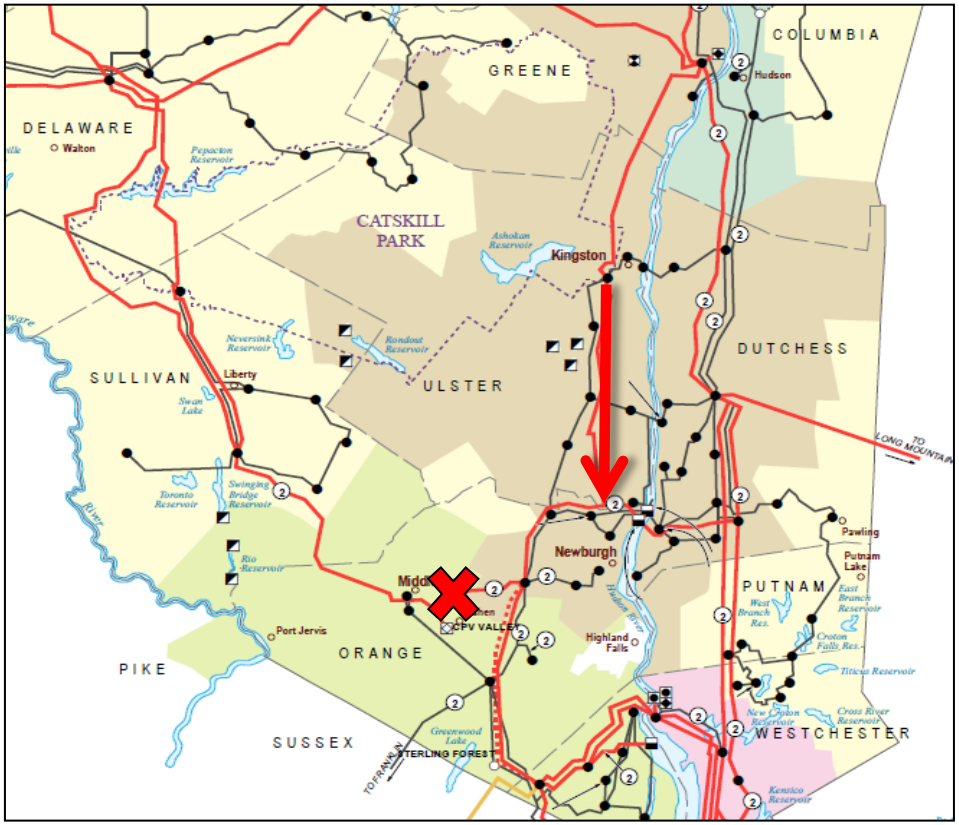
UPNY-SENY: Boundless NTC

Portfolio	UPNY-SENY Normal Transfer Criteria	Delta	Limiting Element (LTE rating)	Contingency
P20 - Boundless	5800	687	Hurley – Roseton	T 34&42B
P21 - Boundless	5718	605	Hurley – Roseton	T 34&42B



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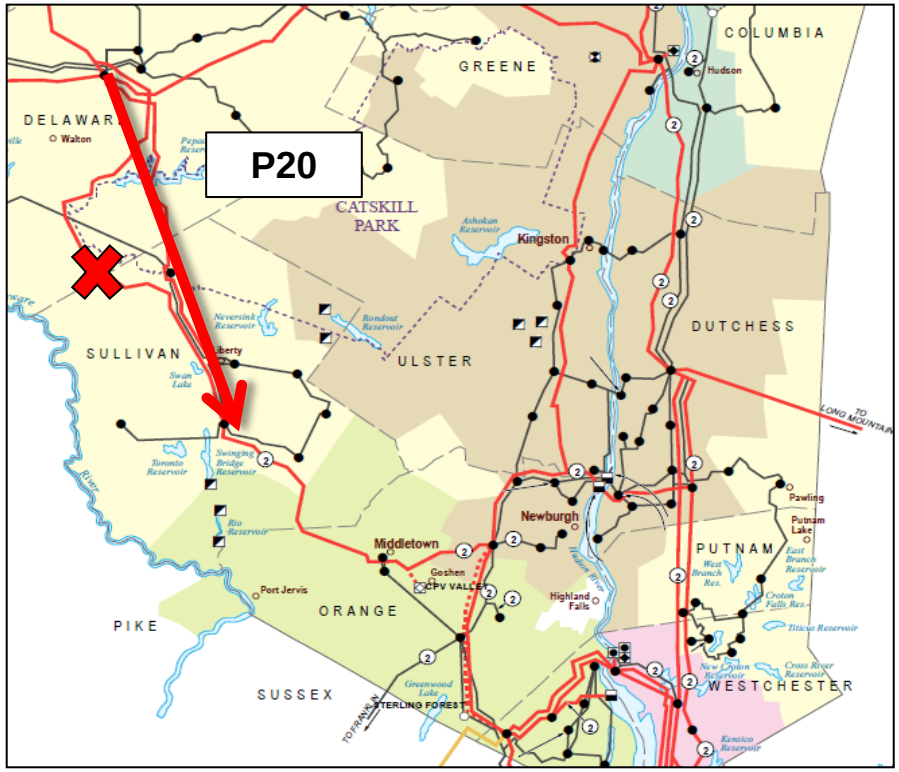
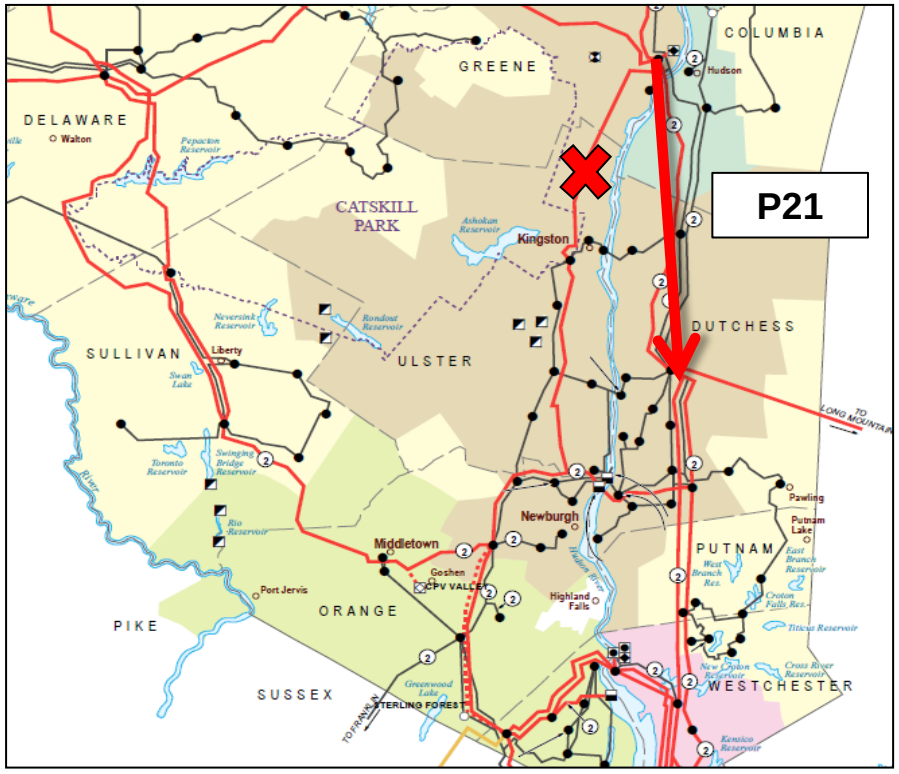
UPNY-SENY: Boundless ETC

Portfolio	UPNY-SENY Emergency Transfer Criteria	Delta	Limiting Element (STE rating)	Contingency
P20 - Boundless	7072	1753	Fraser – CC	Marcy – CC
P21 - Boundless	6752	1433	Leeds – PV	Leeds – Hurley





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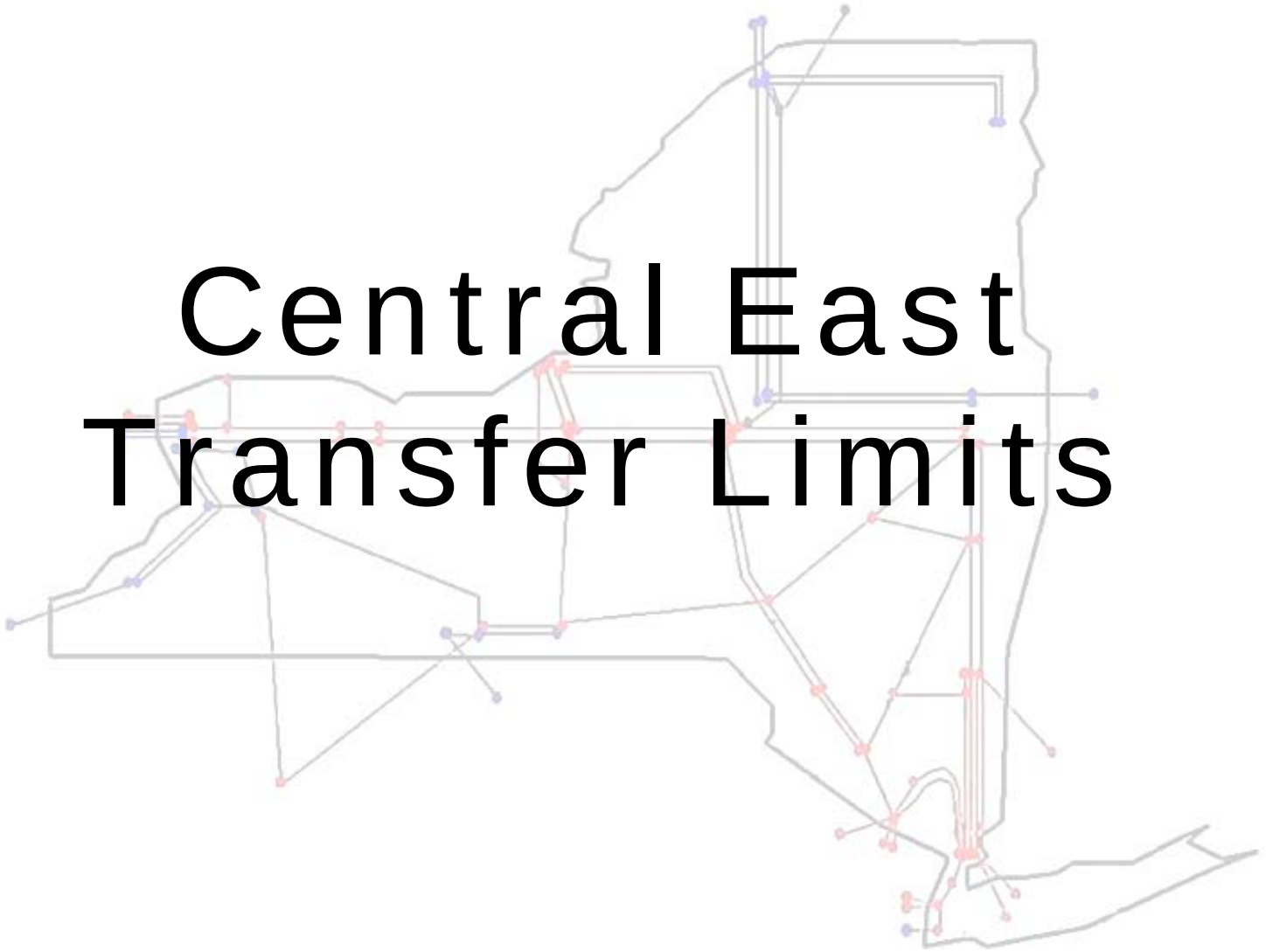

Central East Transfer Limits

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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 voltage limits were the focus of the re-evaluations.**

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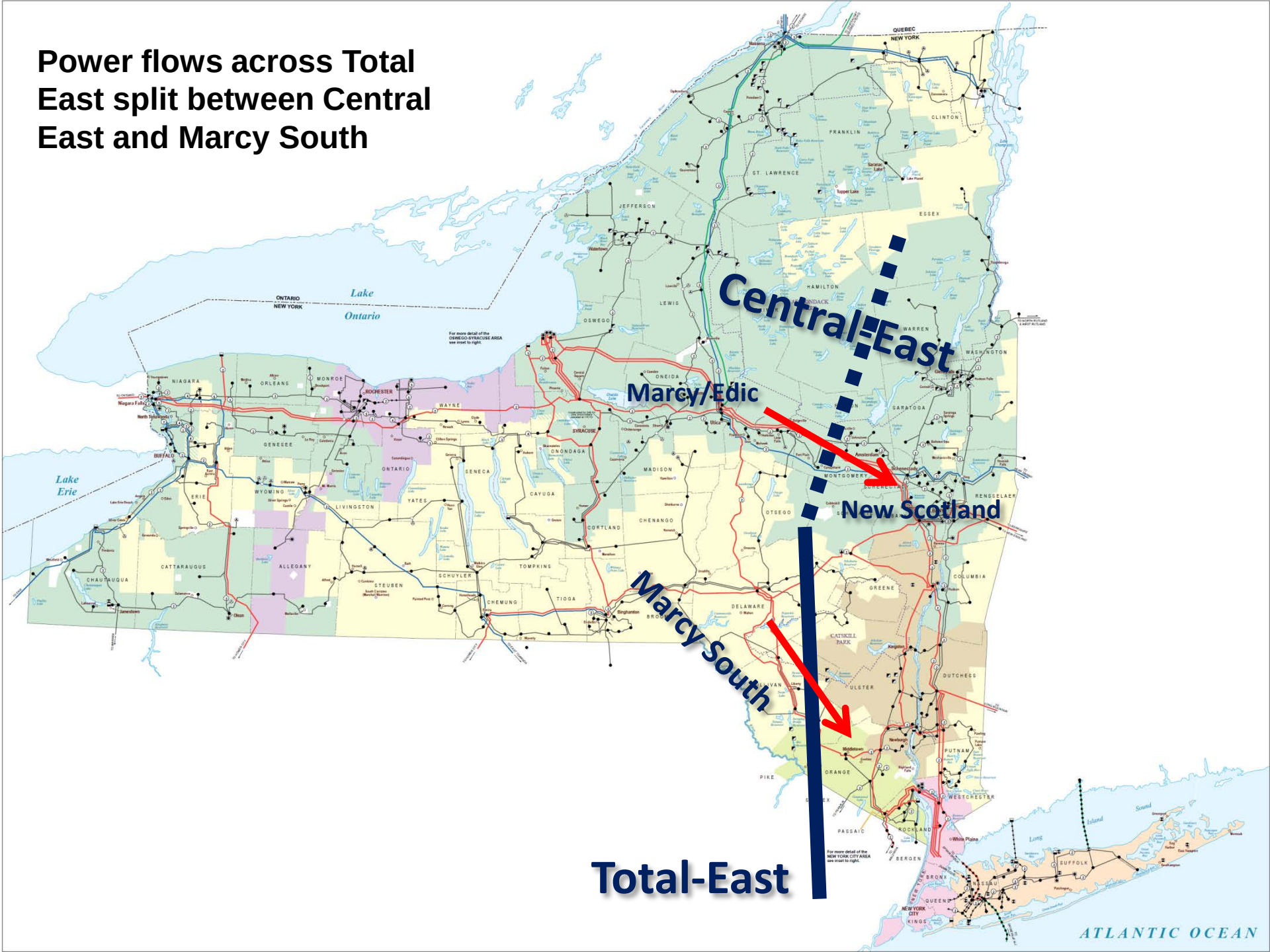
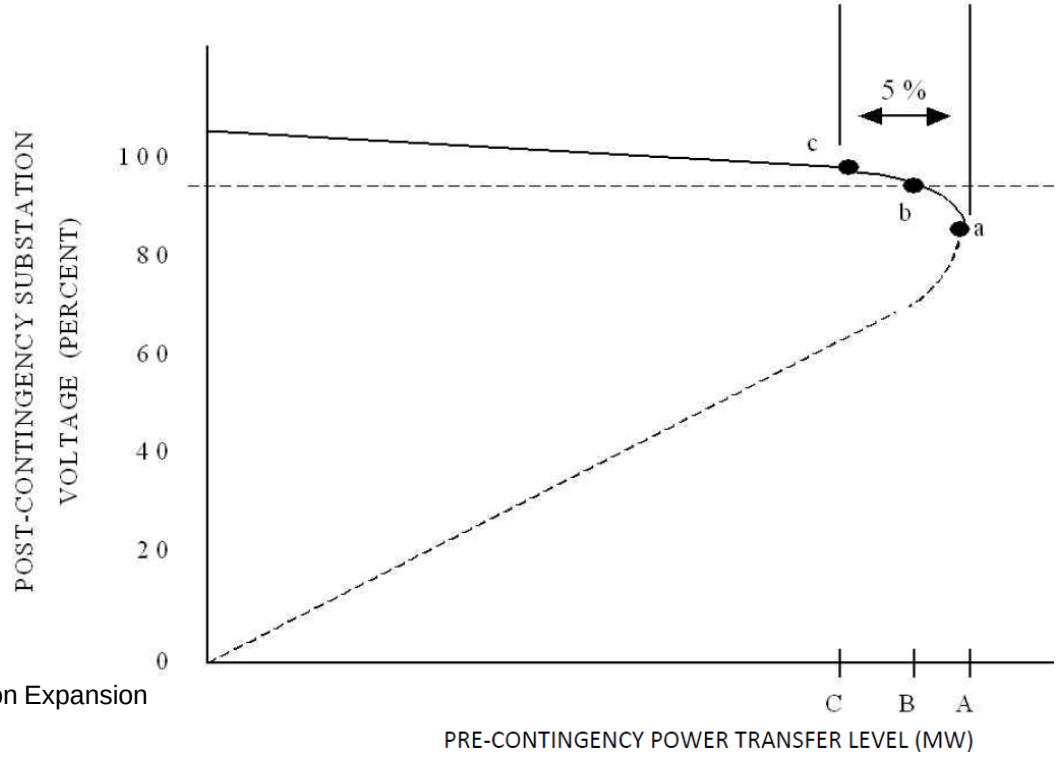
Power flows across Total East split between Central East and Marcy South



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

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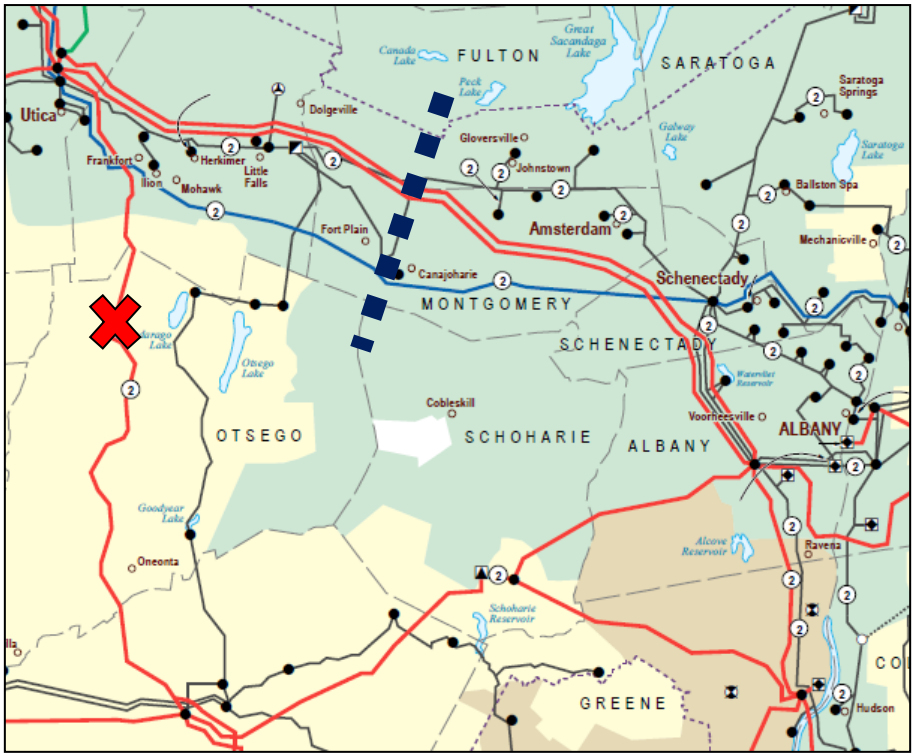
Central East: Base Case voltage

- **Base Case limit: 2725 MW**
- **Limiting Contingency: Marcy South tower (40&41)**



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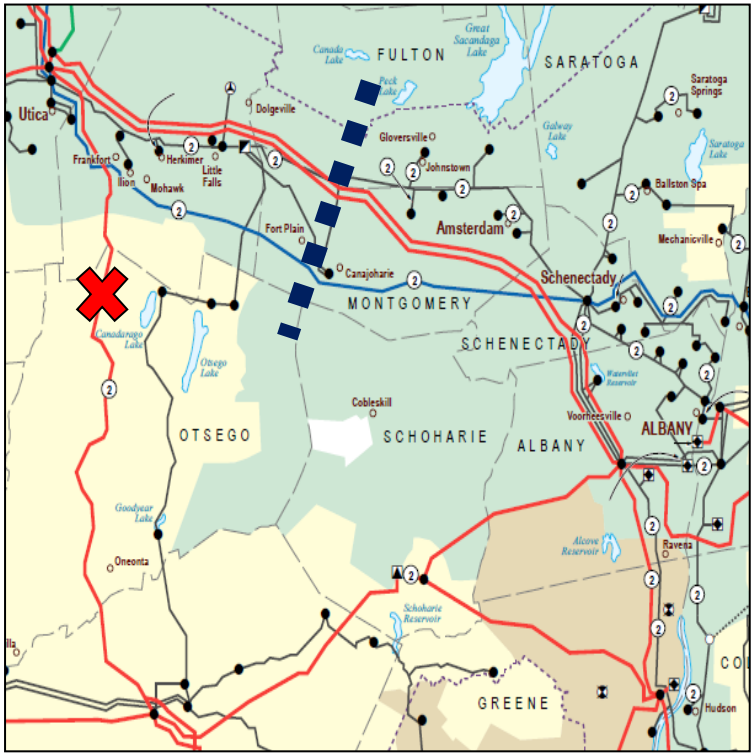
Central East voltage results

	Central East	Delta	Contingency
P6 - NYTO	2825	100	Marcy South tower (40&41)
P7 - NYTO	2750	25	Marcy South tower (40&41)
P9 - NYTO	2775	50	Marcy South tower (40&41)
P11 - NYTO	3100	375	Marcy South tower (40&41)
P12 - NYTO	3100	375	Marcy South tower (40&41)
P14 - NYTO	3100	375	Marcy South tower (40&41)
P19a - NextEra	2825	100	Marcy South tower (40&41)
P20 - Boundless	2700	(25)	Marcy South tower (40&41)
P21 - Boundless	2700	(25)	Marcy South tower (40&41)



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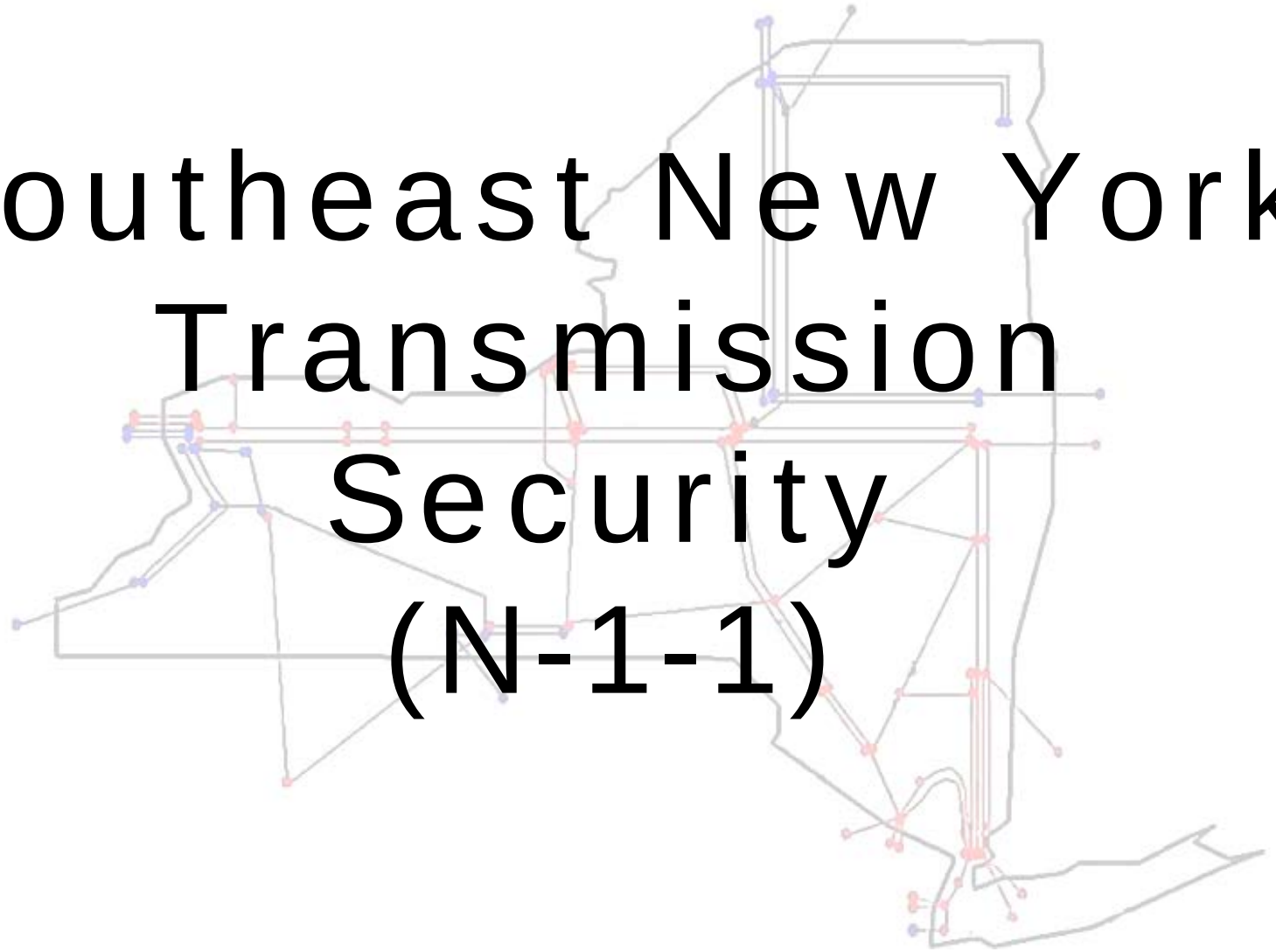
Southeast New York Transmission Security (N-1-1)



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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***

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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.**

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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***

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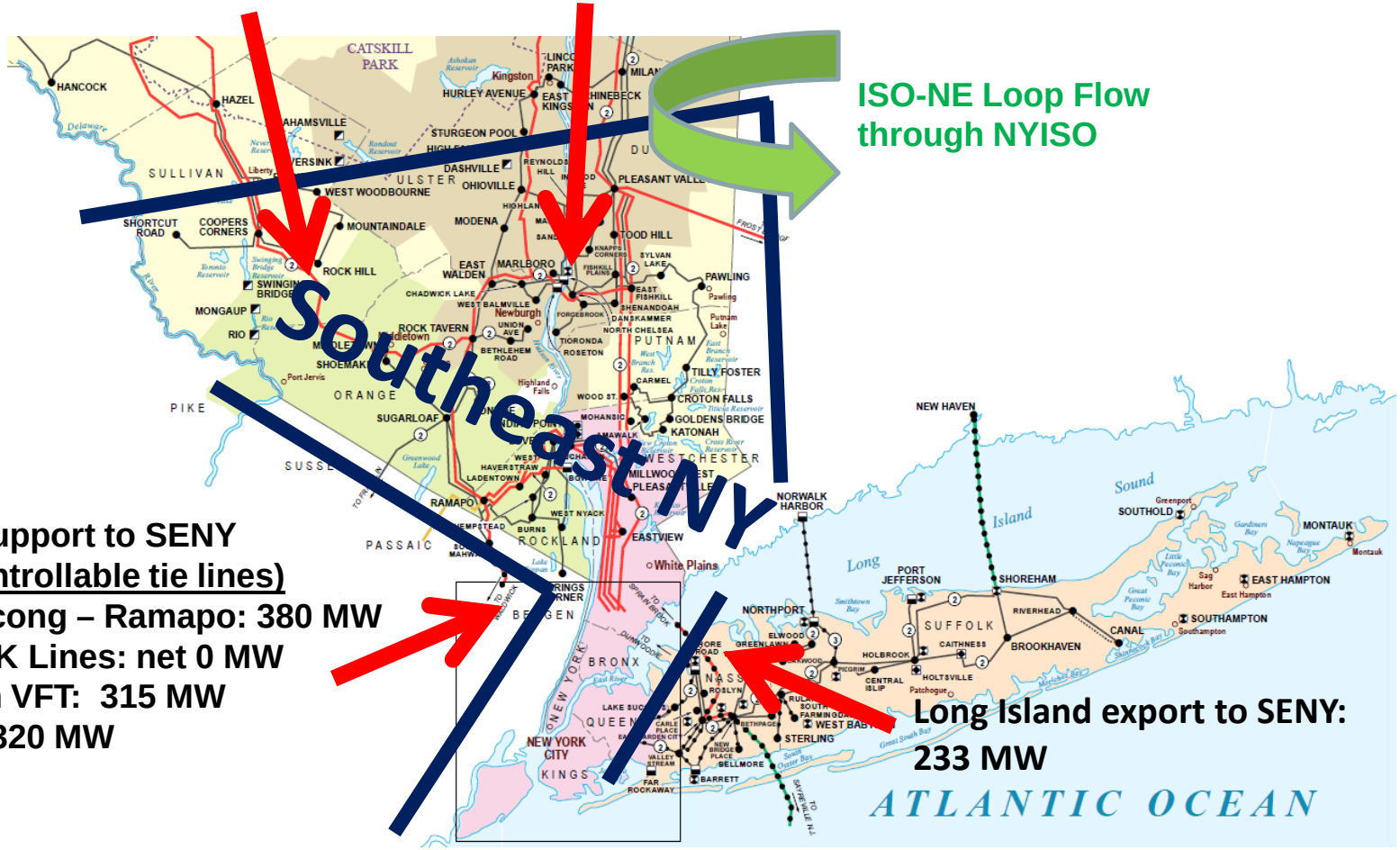
Factors on SENY Limitations

Distribution of flow between
Marcy South and Leeds South paths



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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-project and post-project cases represents the increased transfer capability provided by the project**

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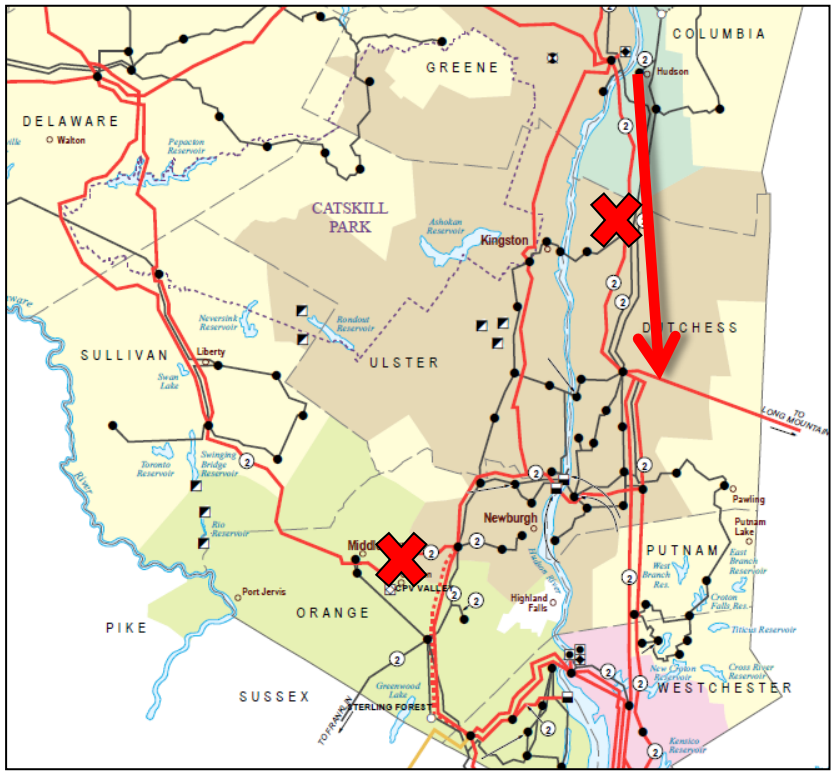
N-1-1 Results: Base Case

- **Limiting Element: Leeds – Pleasant Valley (“PV”)**
- **First Contingency: Athens – PV**
- **Second Contingency: Common-tower loss of CPV – Rock Tavern and Coopers Corners – Rock Tavern (Tower 34&42B)**



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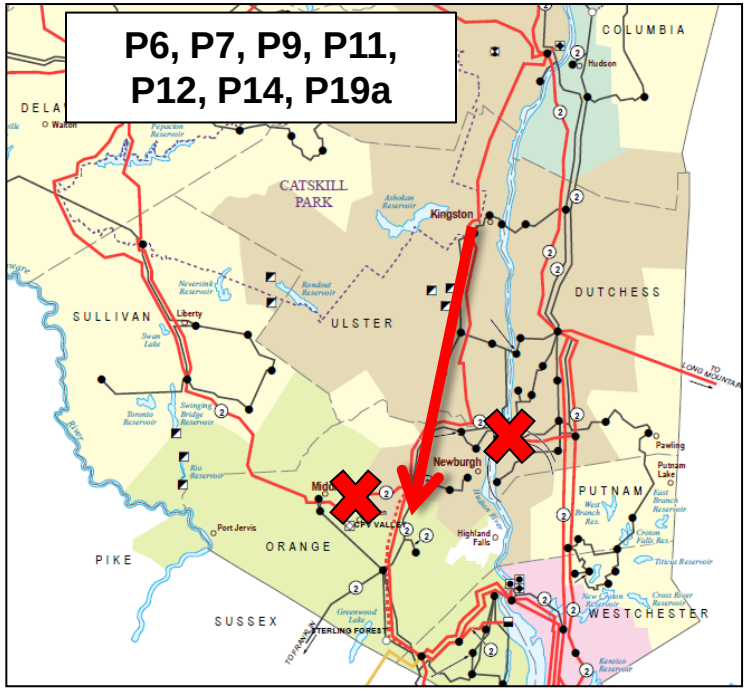
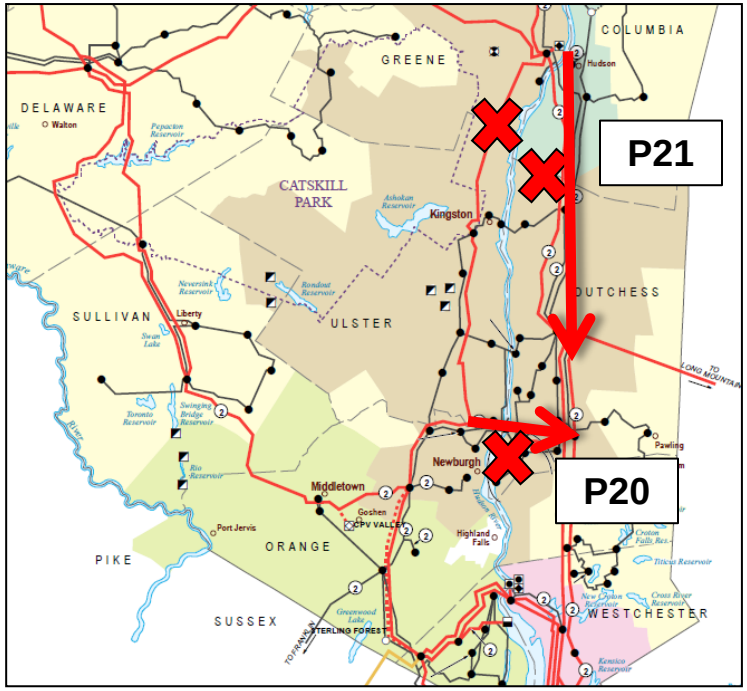
N-1-1 Results

Portfolio	Delta (MW)	Limiting Element	First Contingency	Second Contingency
P6 - NYTO	791	Roseton - Rock Tavern	Roseton - E Fishkill	T 34&42B
P7 - NYTO	392	Roseton - Rock Tavern	Roseton - E Fishkill	T 34&42B
P9 - NYTO	970	Roseton - Rock Tavern	Roseton - E Fishkill	T 34&42B
P11 - NYTO	794	Roseton - Rock Tavern	Roseton - E Fishkill	T 34&42B
P12 - NYTO	635	Roseton - Rock Tavern	Roseton - E Fishkill	T 34&42B
P14 - NYTO	973	Roseton - Rock Tavern	Roseton - E Fishkill	T 34&42B
P19a - NextEra	860	Roseton - Rock Tavern	Roseton - E Fishkill	T 34&42B
P20 - Boundless	365	Roseton - W Fishkill 345 #2	Roseton - E Fishkill	Pre-Contingency
P21 - Boundless	283	Leeds - PV	Leeds - Hurley	Athens - PV 345





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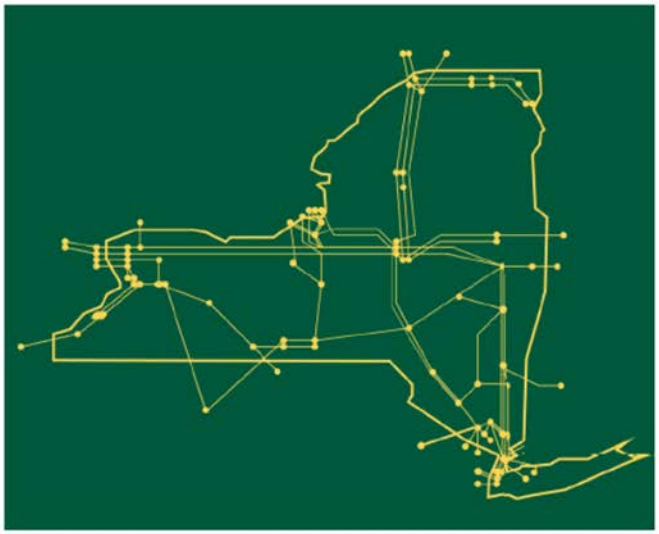

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