# NYISO Operating Study Summer 2018

## A Report by the
## New York Independent System Operator

June 2018

# Table of Contents

**EXECUTIVE SUMMARY** .......... 4

**INTRODUCTION** .......... 5

**PURPOSE** .......... 5

**SYSTEM OPERATING LIMIT (SOL) METHODOLOGY** .......... 5

**STUDY PARTICIPANTS** .......... 6

**SYSTEM REPRESENTATION AND BASE STUDY ASSUMPTIONS** .......... 6

System Representation .......... 6

*Generation Resource Changes* .......... 7
*Transmission Facilities Changes* .......... 7

System Representation .......... 8

**DISCUSSION** .......... 8

Resource Assessment .......... 8

*Load and Capacity Assessment* .......... 8

Cross-State Interfaces .......... 9

*Transfer Limit Analysis* .......... 9
*Athens SPS* .......... 11
*Sensitivity Testing* .......... 11
*West Woodbourne Transformer* .......... 11
*ConEd – LIPA Transfer Analysis* .......... 11
*Transfer Limits for Outage Conditions* .......... 12
*Transient Stability and Voltage transfer Limits* .......... 13

Thermal Transfer Capabilities with Adjacent Balancing Areas .......... 13

*New York – New England Analysis* .......... 14
*New York - PJM Analysis* .......... 16
*Ontario – New York Analysis* .......... 18
*TransÉnergie–New York Interface* .......... 19

**SUMMARY OF RESULTS – THERMAL TRANSFER LIMIT ANALYSIS** .......... 20

TABLE 1.a – NYISO CROSS-STATE INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S .......... 21

TABLE 1.b – NYISO CROSS-STATE INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S .......... 22

TABLE 2.a – NYISO to ISO-NE INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S ........ 23

TABLE 2.b – ISO-NE to NYISO INTERFACE THERMAL LIMITS - SUMMER 2018 ALL LINES I/S.... 24

TABLE 3.a – NYISO to PJM INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S ........ 25

TABLE 3.b – PJM to NYISO INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S ........ 27

TABLE 4 – IESO to NYISO INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S ........ 29

TABLE 5 – NYISO to IESO INTERFACE THERMAL TRANSFER LIMITS – SUMMER 2018 ALL LINES I/S ........ 31

**APPENDIX A – SCHEDULE OF SIGNIFICANT INTERCHANES ASSUMED FOR TRANSFER LIMITS STUDIES ........ 32**

**APPENDIX B – SUMMER 2018 BASE CASE CONDITIONS ........ 35**

**APPENDIX C – POWER FLOW TRANSCRIPTION DIAGRAM ........ 37**

**APPENDIX D – RATINGS OF MAJOR TRANSMISSION FACILITIES IN NEW YORK ........ 38**

**APPENDIX E – INTERFACE DEFINITIONS ........ 87**

**APPENDIX F – ANNOTATED MUST OUTPUT ........ 92**

**APPENDIX G – TRANSFER LIMIT SENSITIVITY GRAPHS ........ 93**

**APPENDIX H – COMPARSION OF TRANSFER LIMITS SUMMER 2018 VS. 2017 ........ 101**

**APPENDIX I – DISTRIBUTION FACTORS ........ 105**

## Executive Summary

This study is conducted as a seasonal review of the projected thermal transfer capability for the summer 2018 capability period. The study evaluates the projected internal and external thermal transfer capabilities for the forecasted load and dispatch conditions studied. The evaluated limits are shown in Tables 1 through 5. Differences in the evaluated internal interface limits from summer 2017 to summer 2018 are shown in Figure 1 on page 10. Internal interfaces have changed due to the network alterations in the New York Control Area (NYCA) and modeling assumptions. Dysinger East limit decreased to 625 MW because of the 148 MW increase in forecasted load in West area of NYISO. The modeling of CPV Valley generation caused the redistribution of flows in the Hudson Valley area. This is the main cause for the decrease in the Total East thermal transfer limit to 4,125 MW. The modeling of mothballing of JMC Selkirk caused the redistribution of flows in the Capital area. This is the main cause for the increase in the Central East thermal transfer limit to 2,825 MW. The changes in the Hudson Valley and Capital areas are the main reason for the increase of UPNY-ConEd limit to 5,050 MW. Differences in the evaluated external interface limits from summer 2017 to summer 2018 are shown in Figure 2 on page 13. External interface limits are essentially unchanged from the summer 2017, with the exception of PJM-NYISO, NYISO-PJM and NYISO-IESO which are limited to 1,975 MW, 1,375 MW and 1,750 MW respectively. The modeling of the Ramapo PAR 3500 in-service is the main cause for the increase in PJM-NYISO and NYISO-PJM thermal transfer limits. NYISO-IESO thermal limit is sensitive to the generation dispatch and load in Zone A.

# INTRODUCTION

The following report, prepared by the Operating Studies Task Force (OSTF) at the direction and with the guidance of the System Operations Advisory Subcommittee (SOAS), highlights the thermal analysis evaluation for the summer 2018 capability period. This analysis indicates that, for the summer 2018 capability period, the New York interconnected bulk power system can be operated reliably in accordance with the "NYSRC Reliability Rules and Compliance for Planning and Operating the New York State Power System" and the NYISO System Operating Procedures.

Thermal transfer limits cited in this report are based on the forecasted load and dispatch assumptions and are intended as a guide to system operation. Changes in generation dispatch or load patterns that significantly change pre-contingency line loadings may change limiting contingencies or limiting facilities, resulting in higher or lower interface transfer capabilities.

System Operators should monitor the critical facilities noted in the included tables along with other limiting conditions while maintaining bulk power system transfers within secure operating limits.

# PURPOSE

The purpose of the study is to determine:

- The total transfer capabilities (TTC) between NYISO and adjacent areas including IESO, PJM and ISO-NE for normal conditions in the summer/winter periods. The TTC is calculated based on NERC TPL-001-4 Category P1 and P2 contingencies and a set of selected Category P4, P5 and P7 contingencies.
- The TTC between NYISO and adjacent areas including IESO, PJM and ISO-NE for emergency conditions in the summer/winter periods. The TTC is calculated based on NERC TPL-001-4 Category P1 and P2 contingencies.

# System Operating Limit (SOL) Methodology

The NYSRC Reliability Rules provide the documented methodology for use in developing System Operating Limits (SOLs) within the NYISO Reliability Coordinator Area. NYSRC Reliability Rules require compliance with all North American Electric Reliability Corporation (NERC) Standards and Northeast Power Coordinating Council (NPCC) Standards and Criteria. NYSRC Rule C.1, Tables C-1 and C-2 address the contingencies to be evaluated and the performance requirements to be applied. Rule C.1 also incorporates by reference Attachment H, NYISO

Transmission Planning Guideline #3-1, "Guideline for Stability Analysis and Determination of Stability-Based Transfer Limits" of the NYISO Transmission Expansion and Interconnection Manual.

## STUDY PARTICIPANTS

| First | Last | Company | First | Last | Company |
|---|---|---|---|---|---|
| Hoa | Fu | PSEG Long Island* | David | Mahlmann | NYISO |
| Anie | Philip | PSEG Long Island* | Robert | Golen | NYISO |
| Amrit | Singh | PSEG Long Island* | De Dinh | Tran | NYISO |
| Jalpa | Patel | PSEG Long Island* | Raj | Dontireddy | NYISO |
| Robert | Eisenhuth | PSEG Long Island* | Roleto | Mangonon | O&R |
| John | Hastings | National Grid | Ruby | Chan | Central Hudson |
| James | Harper | National Grid | Richard | Wright | Central Hudson |
| Christopher | Falanga | National Grid | Akim | Faisal | Central Hudson |
| Daniel | Head | ConEd | Yuri | Smolanitsky | PJM |
| Mohammed | Hossain | NYPA | Mohamed | Younis | IESO |
| Abhilash | Gari | NYPA | Farzad | Farahmand | IESO |
| Brian | Gordon | NYSEG | Isen | Widjaja | IESO |
| Robert | King | NYSEG | Bryan | Hartwell | IESO |
| Jence | Mandizha | NYSEG | George | Fatu | IESO |
| Dean | LaForest | ISO-NE | | | |
| Bilgehan | Donmez | ISO-NE | | | |

*Agent for LIPA

## SYSTEM REPRESENTATION AND BASE STUDY ASSUMPTIONS

### System Representation

The representation was developed from the NYISO Data Bank and assumes the forecast summer coincident peak load of 32,903 MW. The other NPCC Balancing Areas and adjacent Regional representations were obtained from the RFC-NPCC summer 2018 Reliability Assessment power flow base case and have been updated to reflect the summer 2018 capability period. The base case model includes:

- The NYISO Transmission Operator area
- All Transmission Operator areas contiguous with NYISO
- All system elements modeled as in service
- All generation represented
- Phase shifters in the regulating mode in accordance with the NYISO Available Transfer

Capability Implementation Document (ATCID)

- The NYISO Load Forecast
- Transmission Facility additions and retirements
- Generation Facility additions and retirements
- Remedial Action Scheme (RAS) models where currently existing or projected for implementation within the studied time horizon.
- Series compensation for each line at the expected operating level unless specified otherwise in the ATCID.
- Facility Ratings as provided by the Transmission Owner and Generator Owner

#### Generation Resource Changes

The status and dispatch level of generation represented in this analysis is a reasonable expectation based on the information available at the time of the study. Those modeling assumptions incorporate known unit outage status. The inter-Area schedules represented in the study base case are summarized in Appendix A. The following table shows generation deactivations and additions since the summer 2017 capability period:

| | |
|---|---|
| **Deactivations** | |
| Ravenswood GT9 | -25 MW |
| Binghamton | -47 MW |
| Ravenswood GTs | -300 MW |
| Selkirk I&II | -446 MW |
| **Total Retirements** | **-818 MW** |
| **Additions** | |
| Arthur Kill Cogen | 11 MW |
| Shoreham Solar | 25 MW |
| Bethlehem EC (Uprate) | 72 MW |
| Bayonne EC II | 132 MW |
| CPV Valley | 820 MW |
| **Total Additions** | **1060 MW** |

#### Transmission Facilities Changes

Significant facility changes since the summer 2017 capability period include:

- Modeling Ramapo PAR 3500 in-service
- Modeling the Hudson Transmission Project – W49th St. (Y56) 345 kV line in-service
- Modeling Andover – Palmeter (932) 115 kV line in-service
- Addition of the South Perry 230 kV substation

South Perry is being added on the 230 kV Wethersfield – Meyers (85/87) line.

### System Representation

The Siemens PTI PSS™MUST and PSS™E software packages were used to calculate the thermal limits based on Normal and Emergency Transfer Criteria defined in the NYSRC Reliability Rules. The thermal transfer limits presented have been determined for all transmission facilities scheduled in service during the summer 2018 period.

The schedules used in the base case power flow for this analysis assumed a net flow of 400 MW from Public Service Electric & Gas (PSE&G) to Consolidated Edison via the PAR transformers controlling the Hudson – Farragut and Linden – Goethals interconnections, and 400 MW on the South Mahwah – Waldwick circuits from Consolidated Edison to PSE&G, controlled by the PARs at Waldwick. The Hopatcong – Ramapo 500 kV (5018) circuit is scheduled in accordance with the "Market-to-Market Coordination Process", August 14, 2013. For the summer 2018 base case, the schedule for the tie is 380 MW from PJM to New York. The four Ontario – Michigan PARs are modeled in-service and scheduled to a 0 MW transfer. These schedules are consistent with the scenarios developed in the RFC-NPCC Inter-Regional Reliability Assessment for summer 2018, and the MMWG summer 2017 power flow base cases. The series reactors on the Dunwoodie – Mott Haven (71 and 72), the Farragut – Gowanus (41 and 42) 345 kV, the Sprain Brook – W. 49th St. (M51 and M52) 345 kV, Packard – Sawyer (77 and 78) 230 kV cables, as well as the E. 179th St. – Hell Gate (15055) 138 kV feeder are in-service in the base case. The series reactors on the Sprain Brook – East Garden City (Y49) 345 kV cable are by-passed. The series capacitors on the Marcy – Coopers Corners (UCC2-41) 345 kV, the Edic – Fraser (EF24-40) 345 kV and the Fraser – Coopers Corners (33) 345 kV cables are in-service in the base case.

The NYISO Niagara generation was modeled using a 50-50 split on the 230 kV and 115 kV generators. The total output for the Niagara facility was modeled at 2,100 MW. The Ontario Niagara generation was modeled at an output of 1,300 MW.

## DISCUSSION

### Resource Assessment

#### Load and Capacity Assessment

The forecast peak demand for the summer 2018 capability period is 32,903 MW[1]. This forecast

[1] Forecast Coincident Peak Demand (50th percentile baseline forecast)

is approximately 275 MW (0.83%) lower than the forecast of 33,178 MW for the summer 2017 capability period, and 1,053 MW (3.10%) lower than the all-time New York Control Area (NYCA) seasonal peak of 33,956 MW, which occurred on July 19, 2013.

The Installed Capacity (ICAP) requirement for the summer period is 38,891 MW based on the NYSRC 18.2% Installed Reserve Margin (IRM) requirement for the 2018 Capability Year. NYCA generation capacity for summer 2018 is 39,325 MW, and net external capacity purchases of 1,625 MW have been secured for the summer period. The combined capacity resources represent a 24.5% margin above the forecast peak demand of 32,903 MW. These values were taken from the 2018 Load & Capacity Data report produced by the NYISO, located at:

http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Planning_Data_and_Reference_Docs/Data_and_Reference_Docs/2018-Load-Capacity-Data-Report-Gold-Book.pdf

The equivalent forced outage rate is 4.9%, and includes forced outages and de-ratings based on historical performance of all generation in the NYCA. For summer 2017, the equivalent forced outage rate assumed was 4.83%.

## Cross-State Interfaces

### Transfer Limit Analysis

This report summarizes the results of thermal transfer limit analyses performed on power system representation modeling the forecast peak load conditions for summer 2018. Normal and emergency thermal limits were calculated according to Normal and Emergency Transfer Criteria definitions in the "NYSRC Reliability Rules for Planning and Operating the New York State Power System". Facility ratings applied in the analysis were from the online MW ratings in the EMS, and are detailed in Appendix D.

Figure 1 presents a comparison of the summer 2018 thermal transfer limits to summer 2017 thermal transfer limits. Changes in these limits from previous years are due to changes in the base case load flow generation and load patterns that result in different pre-contingency line loadings, changes in limiting contingencies, or changes in circuit ratings, or line status. Appendix H presents a summary comparison of Cross-State thermal transfer limits between summer 2018 and 2017, with limiting element/contingency descriptions. Significant differences in these thermal transfer limits are discussed below.

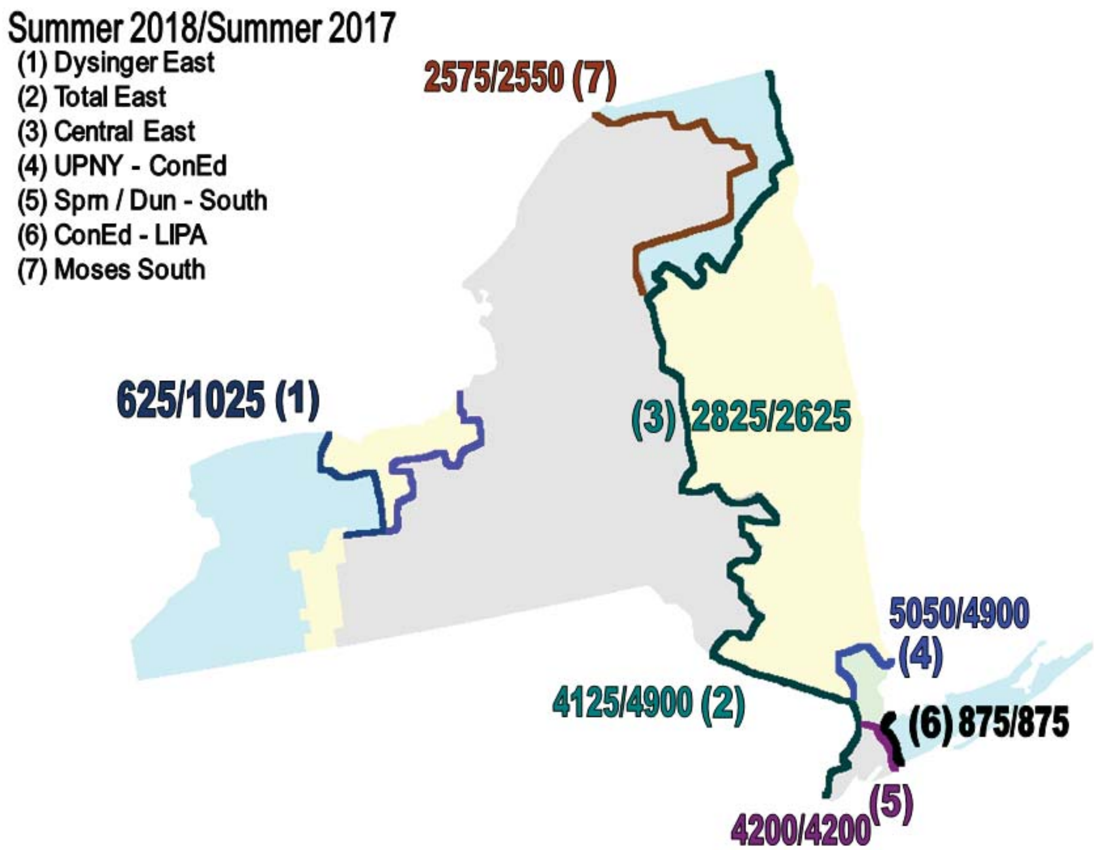


**Figure 1 – Cross-State Thermal Transfer Limits**

**Dysinger East** interface thermal transfer limit decreased 400 MW. This is mainly due to the 148 MW increase of forecasted load in West Zone when compared to summer 2017.

**Total East** interface thermal transfer limit decreased 775 MW. This is mainly due to the redistribution of line flows caused by the dispatch of CPV Valley and re-dispatch of generation in the Hudson Valley Zone.

**Central East** interface thermal transfer limit increased 200 MW. This is mainly due to the redistribution of line flows caused by mothballing of JMC Selkirk units in the Capital Zone.

**UPNY-ConEd** interface thermal transfer limit has increased 150MW. This is mainly due to the redistribution of line flows caused by CPV Valley unit in the Hudson Zone and mothballing for JMC Selkirk in the Capital Zone. A comparable UPNY-SENY thermal transfer limit would be 4,425MW for the same limiting element and contingency as UPNY-ConEd.

#### Athens SPS

In 2008, a Special Protection System (SPS) went in-service impacting the thermal constraint on the Leeds to Pleasant Valley 345 kV transmission corridor. The SPS is designed to reject generation at the Athens combined-cycle plant if either the Leeds to Pleasant Valley 345 kV (92) circuit or the Athens to Pleasant Valley 345 kV (91) circuit are out-of-service and the flow on the remaining circuit is above the LTE rating. Generation at Athens will be tripped until the flow is below the LTE rating, the out-of-service circuit recloses, or the remaining circuit trips. This SPS is expected to be active when there is generation on-line at the Athens station, and will allow the NYCA transmission system to be secured to the STE rating of the 91 line for the loss of the 92 line, and vice-versa, for normal operating conditions. The SPS increases the normal thermal limit to match the emergency thermal limit across the UPNY-ConEd operating interface when the 91 or 92 is the limiting circuit. The Table 1 "Emergency" limit for the UPNY-ConEd interface can be interpreted as the "Normal" limit, when the Athens SPS is active.

#### Sensitivity Testing

The thermal limits presented in "SUMMARY OF RESULTS – THERMAL TRANSFER LIMIT ANALYSIS" section were determined using the base conditions and schedules. The effects of various intra- and inter-Area transfers or generation patterns in the system are presented in Appendix G. Certain graphs indicate that there may not be a measurable sensitivity to the specific variable condition (summer peak load), or the sensitivity may occur at transfer levels above other transfer constraints (e.g., voltage or transient stability limitations). This analysis demonstrates how the particular constraint (thermal transfer limits) may respond to different conditions.

#### West Woodbourne Transformer

The Total-East interface may be limited at significantly lower transfer levels for certain contingencies that result in overloading of the West Woodbourne 115/69 kV transformer. Should the West Woodbourne tie be the limiting facility, it may be removed from service to allow higher Total-East transfers. Over-current relays are installed at West Woodbourne and Honk Falls to protect for contingency overloads.

#### ConEd – LIPA Transfer Analysis

Normal transfer capabilities were determined using the base case generation dispatch and PAR settings as described in Appendix B. Emergency limits are dispatch dependant, and can vary based on generation and load patterns in the LIPA system.

For emergency transfer capability analysis, the PARs controlling the LIPA import were adjusted to allow for maximum transfer capability into LIPA:

ConEd – LIPA PAR Settings

| | Normal | Emergency |
|---|---|---|
| Jamaica – Lake Success 138 kV | -200 MW | 115 MW |
| Jamaica – Valley Stream 138 kV | -100 MW | 120 MW |
| Sprain Brook – E. Garden City 345 kV | 637 MW | 637 MW |

ISO-NE – LIPA PAR Settings

| | | |
|---|---|---|
| Norwalk Harbor – Northport 138 kV | 100 MW | 286 MW |

The PAR schedules referenced above and the ConEd - LIPA transfer assessment assume the following loss factors and oil circulation modes in determination of the facility ratings for the 345 kV cables:

- Y49 has a 70% loss factor in slow oil circulation mode.
- Y50 has a 70% loss factor in rapid circulation mode.

#### Emergency Transfer via the 138 kV PAR-controlled Jamaica ties between ConEdison and LIPA

Con Edison and LIPA have determined possible emergency transfer levels via the Jamaica - Valley Stream (901) 138 kV and Jamaica - Lake Success (903) 138 kV PAR-controlled ties that could be used to transfer emergency power between the two entities during peak conditions. The emergency transfer levels were calculated in both directions, for system peak load conditions with all transmission lines in service and all generation available for full capacity.

#### ConEd to LIPA emergency assistance

Based on analysis of historical conditions performed by LIPA and Con Edison, Con Edison anticipates being able to supply a total flow up to 235 MW of emergency transfer from Con Edison to Long Island, if requested, via the ties.

#### LIPA to ConEd emergency assistance

LIPA anticipates being able to supply a total flow up to 505 MW of emergency transfer from Long Island to Con Edison, if requested, via the ties under ideal conditions (i.e. all lines and generation in-service, imports via Neptune, Norwalk Harbor to Northport Cable - NNC and Cross Sound Cable - CSC).

### Transfer Limits for Outage Conditions

Transfer limits for scheduled outage conditions are determined by the NYISO Scheduling and Market Operations groups. The NYISO Real-Time Dispatch system monitors the EHV transmission continuously to maintain the secure operation of the interconnected EHV system.

#### Transient Stability and Voltage transfer Limits

The interface transfer limits shown in "SUMMARY OF RESULTS – THERMAL TRANSFER LIMIT ANALYSIS" section are the results of a thermal transfer limit analysis only. Transient stability and voltage interface transfer limits for all lines in-service and line outage conditions are summarized and available through the NYISO website located at:

http://www.nyiso.com/public/markets_operations/market_data/reports_info/index.jsp

### Thermal Transfer Capabilities with Adjacent Balancing Areas

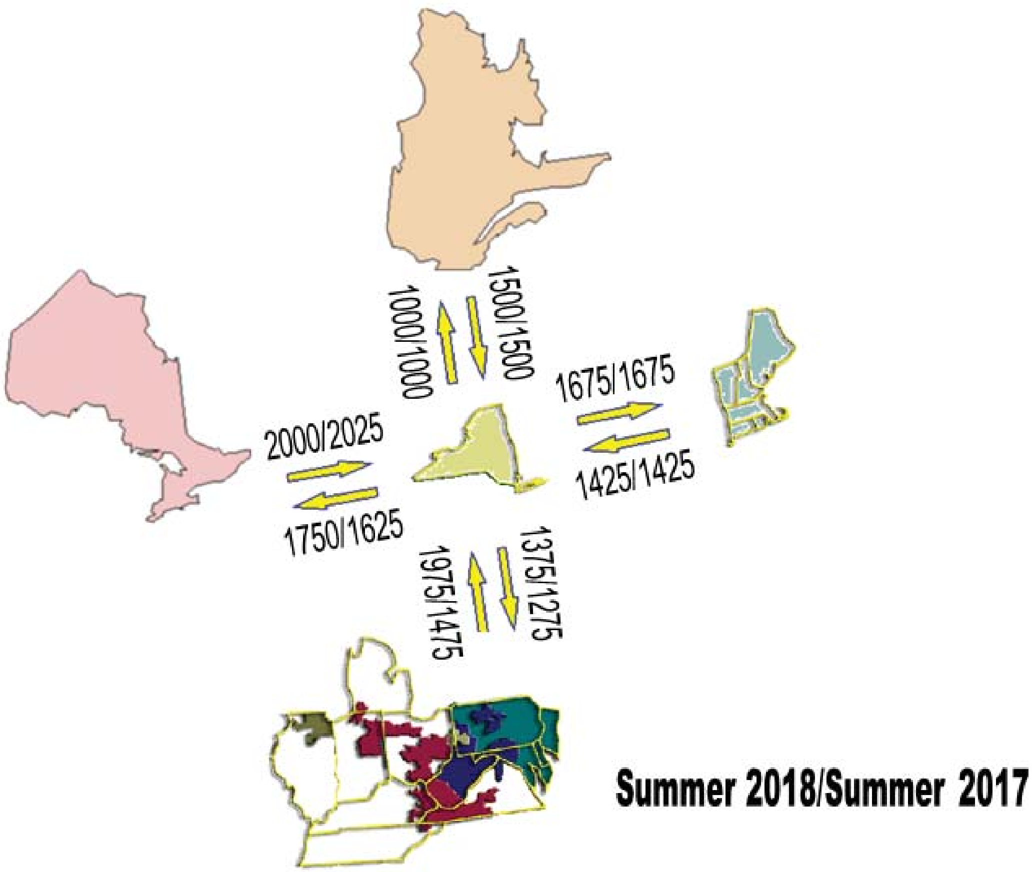


**Figure 2 – Inter-Area Thermal Transfer Capabilities[2]**

Thermal transfer limits between New York and adjacent Balancing Areas also are determined in this analysis. These transfer limits supplement, but do not change, existing internal operating

[2] TE-NY transfer capabilities shown in Figure 2 are not thermal transfer limits; for more information see page 20

limits. There may be facilities internal to each system that may reduce the transfer limits between Balancing Areas. Reductions due to these situations are considered to be the responsibility of the respective reliability authority. Some of these potential limitations are indicated in the summary tables by “[Reliability Coordinating] Facility” limits, which supplement the “Direct Tie” limits between the Balancing Areas. Transfer conditions within and between neighboring Balancing Areas can have a significant effect on inter- and intra-Area transfer limits. Coordination between Balancing Areas is necessary to provide optimal transfer while maintaining the reliability and security of the interconnected systems.

**PJM – New York** interface thermal transfer limit increased 500 MW. This is mainly due to the modeling of the Ramapo PAR 3500 in-service.

**New York –PJM** interface thermal transfer limit increased 100 MW. This is mainly due to the modeling of the Ramapo PAR 3500 in-service.

**New York - IESO** interface thermal transfer limit increased 125MW. This limit is sensitive to load in Zone A and flow toward PJM on the Dunkirk-Erie 230 kV tie. Generation dispatch also affects the system constraints as it affects the flows on the 230 kV system.

### New York – New England Analysis

#### New England Transmission/Capacity Additions

##### Transmission

For the summer 2018 study period, there are no major projects coming into service that will significantly impact the New York – New England transmission capability. Three notable transmission elements that have been commissioned are the Towantic 115 kV substation including re-termination of transmission lines in the vicinity, the Pootatuck 115 kV substation, and the 1854 115 kV transmission line between Frost Bridge and Campville substations. These transmission improvements are associated with the ongoing Greater Hartford Central Connecticut (GHCC) and Southwest Connecticut (SWCT) transmission projects.

The Towantic 115 kV substation located southwest of Waterbury, Connecticut provides the required 115 kV transmission infrastructure to support the interconnection of the Towantic combined-cycle natural gas plant. Commissioning of the Towantic 115 kV substation with the associated transmission line re-termination and generation interconnection has minimal benefit to the New York – New England transmission capability.

The Pootatuck 115 kV substation located west of New Haven, Connecticut will provide additional 115 kV transmission infrastructure in the immediate area. During the summer of 2018, the Pootatuck substation is only comprised of an existing single powerflow through path. The commissioning of the Pootatuck substation in its current state did not impact the New York – New England transmission capability.

The 1854 115 kV transmission line between Frost Bridge and Campville substations provides a parallel path into the Falls Village area located in northwestern Connecticut. The commissioning of the new 1854 115 kV transmission line did not impact the New York – New England transmission capability.

#### Capacity

In the New England Control Area, from April through September 2018, three major generation additions are anticipated. Towantic Energy Center (TO1A&B) is a 2x1 combined-cycle natural gas plant interconnecting into the Towantic 115 kV substation with an anticipated net generation capacity of 745 MW. Footprint Power Salem Harbor 5&6 (SAL5&6) each exhibit a 2x1 combined-cycle natural gas configuration interconnecting into the Salem Harbor 115 kV substation located in northeastern Massachusetts north of the Boston metropolitan area. These generators each have an anticipated capacity of 357 MW or 715 MW total. Wallingford Energy 6&7 (WAL6&7) each exhibit a combustion turbine natural gas configuration interconnecting into the Wallingford 115 kV substation located in Wallingford, Connecticut. These generators each have an anticipated capacity of 50 MW or 100 MW total. Approximately 120 MW of solar photovoltaic alternative energy resources are also anticipated to become commercial by the end of September 2018. There are no significant generator retirements anticipated from April through September 2018.

### Thermal Transfer Limit Analysis

The transfer limits between the NYISO and ISO New England for normal and emergency transfer criteria are summarized in Section 6, Table 2.

### Cross-Sound Cable

The Cross-Sound Cable (CSC) is an HVDC merchant transmission facility connecting the New Haven Harbor 345 kV (United Illuminating, ISO-NE) station and Shoreham 138 kV (LIPA, NYISO) station. It has a design capacity of 330 MW. This facility is not metered as part of the NYISO – ISO-NE interface, and HVDC transfers are independent of transfers between the NYISO and ISO-NE.

### Smithfield – Salisbury 69 kV

CHG&E and Eversource will normally operate the Smithfield - Salisbury 69 kV (FV/690) line closed. The maximum allowable flow on this line is 31 MVA based on limitations in the Eversource 69 kV system. When the ISO-NE to NYISO transfer is greater than approximately 400 MW, the line will be opened due to post contingency limits within the Eversource system. The FV/690 line has directional over-current protection that will trip the FV/690 line in the event of an overload when the flow is into ISO-NE. No protection exists to trip the FV/690 line in the event of an overload when the flow is into NYISO.

#### Northport – Norwalk Harbor Cable Flow

Flow on the NNC Norwalk Harbor to Northport facility is controlled by PAR transformer at Northport. As system conditions vary, the scheduled flow on the NNC may be used to optimize transfer capability between the Balancing Areas. The thermal transfer limits are presented in Table 2 for different PAR schedule assumptions on the Northport – Norwalk Harbor interconnection. Exhibits in Appendix G graphically demonstrate the optimization of transfer capability by regulating the flow on the Northport-Norwalk Harbor tie.

#### Whitehall – Blissville 115 kV

The PAR transformer on the K7 line at the VELCO Blissville substation will control pre-contingency flow between the respective stations. For the analyses, the pre-contingency schedule is 25 MW from Blissville (ISO-NE) to Whitehall (NYISO). The scheduled flow may be adjusted to protect the National Grid local 115 kV transmission south of Whitehall for 345 kV contingency events in southern Vermont pursuant to joint operating procedure developed by VELCO, National Grid, ISO-NE and NYISO.

#### Plattsburgh – Sand Bar 115 kV (i.e. PV20)

The PAR transformer on the PV20 line at the VELCO Sand Bar substation was modeled holding a pre-contingency flow of approximately 100 MW on the PV20 tie. This modeling assumption was premised upon common operating understandings between ISO-NE and the NYISO given local operating practice on the Moses – Willis – Plattsburgh 230 kV transmission corridor. ISO-NE’s analysis examined and considered New England system limitations given this modeling assumption and did not examine generation dispatch or system performance on the New York side of the PV20 tie.

### New York - PJM Analysis

#### Thermal Transfer Limit Analysis

The transfer limits for the NYISO – PJM and PJM – NYISO interfaces are summarized in Tables 3a and 3b respectively of the "SUMMARY OF RESULTS – THERMAL TRANSFER LIMIT ANALYSIS" section of this report.

#### Dunkirk-South Ripley (68) 230 kV Tie

Generation retirements in Southwestern NY and increased flows into PJM via the Dunkirk – South Ripley (68) 230 kV line have resulted in reliability concerns in the NY local 115kV network. Consequently the NYISO and PJM developed an operating document that limits operation of the Dunkirk-South Ripley line to maintain reliability in both the PJM and NYISO systems.

#### Opening of PJM - New York 115 kV Ties as Required

The normal criteria thermal transfer limits presented in "SUMMARY OF RESULTS – THERMAL TRANSFER LIMIT ANALYSIS" section were determined for an all lines in-service condition. The 115 kV interconnections between First Energy East and New York (Warren – Falconer, North Waverly – East Sayre, and Laurel Lake – Westover) may be opened in accordance with NYISO and PJM Operating Procedures provided that this action does not cause unacceptable impact on local reliability in either system. Over-current protection is installed on the Warren - Falconer and the North Waverly – East Sayre 115 kV circuits; either of these circuits would trip by relay action for an actual overload condition. There is no overload protection on the Laurel Lake - Westover circuit, but it may be opened by operator action if there is an actual or post-contingency overload condition. However, opening the Laurel Lake – Westover tie could potentially cause local thermal and pre- and post-contingency voltage violations for the 34.5 kV distribution system within First Energy East transmission zone. Sensitivity analysis performed indicated that the thermal and voltage conditions were exacerbated for conditions that modeled high simultaneous interface flows from NY to PJM and NY to Ontario.

#### DC Ties

Neptune DC tie is expected to be available. Hudson Transmission Project (HTP) DC tie is expected to be available.

#### Variable Frequency Transformer (VFT) Tie

The Variable Frequency Transformer Tie is a transmission facility connecting the Linden 230 kV (PSEG, PJM) to Linden 345 kV (ConEd, NYISO). For the summer 2017, Linden VFT will have 330 MW non-firm withdrawal right and 300 MW firm injection rights into PJM market.

#### Elimination of ConEdison – PJM Wheel and Implementation of 400 MW Operational Base Flow

As of May 1st, 2017 a new protocol has been implemented to set desired flow on the Hopatcong-Ramapo (5018) 500 kV, Ramapo-Waldwick K and J 345 kV, Linden-Goethals A 230 kV, Marion-Farragut C 345 kV and Hudson-Farragut B 345 kV lines, based on the scheduled PJM-NYSIO AC interchange and RECO load. The change was implemented due to the termination of non-conforming wheeling service that has been historically modeled as a fixed 1,000 MW flow from NYSIO to PJM over the JK interface and from PJM to NYSIO over the ABC interface.

### Ontario – New York Analysis

#### Thermal Transfer Limit Analysis

The thermal transfer limits between the NYISO and Ontario's Independent Electricity System Operator (IESO) Balancing Areas for normal and emergency transfer criteria are presented in Tables 4 and 5. The thermal transfer limits from Ontario to NY were determined at 80% of Zone A load, 100% of Zone A load, all-in-service, and with line 68 (Dunkirk-South Ripley) and 171 (Warren-Falconer) lines out of service. The NYISO Niagara generation was modeled at an output of 2,100 MW.

The Ontario – New York ties at St. Lawrence, L33P and L34P, were controlling to 0 MW in all four scenarios. The interconnection flow limit across these ties is 300 MW, as presented in Table 4.3 "Interconnection Total Transfer Capability (TTC) Limits" from the document "Ontario Transmission System" available at:

http://ieso.ca/-/media/files/ieso/document-library/planning-forecasts/18-month-outlook/onttxsystem_2017dec.pdf

#### Transient Stability Limitations

Transient stability limits for the NYISO - IESO interconnection are reported in "NYPP-OH TRANSIENT STABILITY TESTING REPORT on DIRECT TIE TRANSFER CAPABILITY - OCTOBER 1993" available at:

http://www.nyiso.com/public/webdocs/market_data/reports_info/operating_studies/NOH-1/NYPP-OH_1993.PDF

#### Ontario – Michigan PARs

All of the PARs on the four transmission lines interconnecting Ontario and Michigan are in service and regulating. For this study, the PARs were scheduled to regulate at 0 MW.

#### Impact of the Queenston Flow West (QFW) Interface on the New York to Ontario Transfer Limit

The QFW interface is defined as the sum of the power flows through the 230 kV circuits out of Beck. QFW is the algebraic sum of the following:

- Total generation in the Niagara zone of Ontario including the units at the Beck #1, #2 & Pump Generating Stations, Thorold and Decew Falls GS
- The total load in the zone
- The import from New York

For a given QFW limit, the import capability from New York depends on the generation dispatch and the load in the Niagara zone. The Ontario Niagara generation is set to 1,300 MW. The import capability from New York can be increased by decreasing generation in the Ontario Niagara zone, increasing demand in the Ontario Niagara zone, or both.

#### TransÉnergie–New York Interface

Thermal transfer limits between TransÉnergie (Hydro-Quebec) and New York are not analyzed as part of this study. Respecting the NYSRC and NYISO operating reserve requirements, the maximum allowable delivery into the NYCA from TransÉnergie on the Chateauguay – Massena (MSC-7040) 765 kV tie is 1310 MW. However in real-time the total flow is limited to 1800 MW; the additional flow is a "wheel-through" transaction to another Balancing Authority Area. Maximum delivery from NYCA to Quebec on the 7040 line is 1000 MW.

The Dennison Scheduled Line represents a 115 kV dual-circuit transmission line that interconnects the New York Control Area to the Hydro-Quebec Control Area at the Dennison Substation, near Massena, NY. The Dennison Line has a nominal north to south capacity of 190 MW in summer, into New York, and a nominal south to north capacity of 100 MW into Quebec.

## SUMMARY OF RESULTS – THERMAL TRANSFER LIMIT ANALYSIS

Table 1 – NYISO CROSS STATE INTERFACE THERMAL TRANSFER LIMITS

- Table 1.a
    a. Dysinger East
    b. UPNY – ConEd
    c. Sprain Brook – Dunwoodie So.
    d. ConEd – LIPA Transfer Capability
- Table 1.b – MSC-7040 Flow Sensitivity
    a. Central East
    b. Total East
    c. Moses South

Table 2.a – NYISO to ISO-NE INTERFACE THERMAL TRANSFER LIMITS

- Northport-Norwalk Flow Sensitivity

Table 2.b – ISO-NE to NYISO INTERFACE THERMAL TRANSFER LIMITS

- Northport-Norwalk Flow Sensitivity

Table 3.a – NYISO to PJM INTERFACE THERMAL TRANSFER LIMITS

- 3-115 kV Ties I/S and O/S

Table 3.b – PJM to NYISO INTERFACE THERMAL TRANSFER LIMITS

- 3-115 kV Ties I/S and O/S

Table 4 – IESO to NYISO INTERFACE THERMAL TRANSFER LIMITS

- Zone A System Sensitivity

Table 5 – NYISO to IESO INTERFACE THERMAL TRANSFER LIMITS

## TABLE 1.a – NYISO CROSS-STATE INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018

## ALL LINES I/S

| | Dysinger East | UPNY - ConEd[1] | Sprain Brook Dunwoodie - So. | ConEd – LIPA Transfer Capability |
|---|---|---|---|---|
| **NORMAL** | 675 (1) | 5050 (3) | 4200 (5) | 875 (7) |
| **EMERGENCY** | 1725 (2) | 5775 (4) | 4225 (6) | 1500 (8) |

| | LIMITING ELEMENT | RATING | | | LIMITING CONTINGENCY |
|---|---|---|---|---|---|
| (1) | Niagara – Packard (61) 230 kV | @STE[4] | 846 MW | L/O | Niagara – Packard (62) 230 kV<br>Beck – Packard (BP76) 230 kV |
| (2) | Packard – Niagara Boulevard (181-922) 115 kV | @NORM | 160 MW | | Pre-Contingency Loading |
| (3) | Leeds – Pleasant Valley (92) 345 kV | @LTE | 1538 MW | L/O | Athens – Pleasant Valley (91) 345 kV |
| (4) | Leeds – Pleasant Valley (92) 345 kV | @STE | 1724 MW | L/O | Athens – Pleasant Valley (91) 345 kV |
| (5) | Mott Haven – Rainey (Q11) 345 kV | @MTE[2] | 1066 MW | L/O | (SB:RAIN345_4W)<br>Mott Haven – Rainey (Q12) 345 kV<br>Rainey 345/138 kV Transformer 3W<br>Rainey – East 75 St. 138 kV |
| (6) | Dunwoodie – Mott Haven (71) 345 kV | @NORM | 707 MW | | Pre-Contingency Loading |
| (7) | Dunwoodie – Shore Rd. (Y50) 345 kV | @LTE | 916 MW[3] | L/O | (SB RNS2 @ Sprain Brook 345 kV)<br>Sprain Brook – East Garden City (Y49) 345 kV<br>Sprain Brook – Academy (M29) 345 kV |
| (8) | Dunwoodie – Shore Rd. (Y50) 345 kV | @NORM | 656 MW[3] | | Pre-Contingency Loading |

**Note**

1: See Section 5.2.B for discussion on Athens SPS

2: The rating used for cable circuits during SCUC reliability analysis is the average of the LTE and STE rating (MTE Rating).

3: LIPA rating for Y50 circuit is based on 70 % loss factor and rapid oil circulation.

4: Dysinger East limit used the NYSRC Rules Exception No. 13 – Post Contingency Flows on Niagara Project Facilities

## TABLE 1.b – NYISO CROSS-STATE INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018

## ALL LINES I/S

| | MSC-7040 FLOW 800 MW | MSC-7040 FLOW 1310 MW | MSC-7040 FLOW 1600 MW |
|---|---|---|---|
| **CENTRAL EAST** | | | |
| NORMAL | 2825 (1) | 2825 (1) | 2825 (1) |
| EMERGENCY | 3050 (2) | 3050 (2) | 3050 (2) |
| **TOTAL EAST** | | | |
| NORMAL | 4125 (3) | 4125 (3) | 4125 (3) |
| EMERGENCY | 4400 (4) | 4375 (4) | 4400 (4) |
| **MOSES SOUTH**$_{1,2}$ | | | |
| NORMAL | 2250 (5) | 2575 (5) | 2600 (8) |
| EMERGENCY | 2250 (6) | 2700 (6) | 2675 (7) |

| | LIMITING ELEMENT | RATING | | | LIMITING CONTINGENCY |
|---|---|---|---|---|---|
| (1) | Leeds – New Scotland (93) 345 kV | @LTE | 1538 MW | L/O | Leeds – New Scotland (94) 345 kV |
| (2) | Fraser – Coopers Corners (33) 345 kV | @STE | 1793 MW | L/O | Marcy – Fraser Annex (UCC2-41) 345 kV (Series Capacitor) |
| (3) | Rock Tavern – Dolson Ave (DART44) 345 kV | @LTE | 1852 MW | L/O | Rock Tavern – Roseton (311) 345 kV<br>Rock Tavern–Middletown TAP (CCRT34) 345 kV<br>Coopers Corners–Middletown TAP (CCRT34) 345 kV<br>Middletown 345/138 kV Transformer |
| (4) | Coopers Corners – Middletown TAP (CCRT34) 345 kV | @STE | 1793 MW | L/O | Rock Tavern – Dolson Ave (DART44) 345 kV |
| (5) | Moses – Adirondack (MA2) 230 kV | @LTE | 386 MW | L/O | Chateauguay–Massena (MSC-7040) 765 kV<br>Massena – Marcy (MSU1) 765 kV<br>and TransÉnergie delivery |
| (6) | Browns Falls – Taylorville (4) 115 kV | @STE | 134 MW | L/O | Chateauguay–Massena (MSC-7040) 765 kV<br>Massena – Marcy (MSU1) 765 kV<br>and TransÉnergie delivery |
| (7) | Marcy 765/345 kV T2 Transformer | @STE | 1971 MW | L/O | Marcy 765/345 kV T1 Transformer |
| (8) | Marcy – Edic (UE1-7) 345 kV | @LTE | 1650 MW | L/O | Marcy – Fraser Annex (UCC2-41) 345 kV (Series Capacitor)<br>Chases Lake – Porter (11) 230 kV |

**Note**

1: Moses South limit used the NYSRC Rules Exception No. 10 – Post Contingency Flows on Marcy AT-1 Transformer
2: Moses South limit used the NYSRC Rules Exception No. 12 – Post Contingency Flows on Marcy Transformer T2

## TABLE 2.a – NYISO to ISO-NE INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S

| New York to New England | DIRECT TIE | NYISO FACILITY | ISO-NE FACILITY |
|---|---|---|---|
| | | **Northport –Norwalk 100 MW** | |
| **NORMAL** | 1725 (1) | 3075 (3) | 3025 (4) |
| **EMERGENCY** | 2250 (2) | 3075 (3) | 3125 (5) |
| | | **Northport –Norwalk 0 MW** | |
| **NORMAL** | 1675 (1) | 3125 (3) | 3050 (4) |
| **EMERGENCY** | 2225 (2) | 3125 (3) | 3150 (5) |

| | LIMITING ELEMENT | RATING | | | LIMITING CONTINGENCY |
|---|---|---|---|---|---|
| (1) | Pleasant Valley – Long Mountain (398) 345 kV | @LTE | 1313 MW | L/O | Millstone G3 24.0 kV |
| (2) | Pleasant Valley – Long Mountain (398) 345 kV | @STE | 1596 MW | L/O | Millstone G3 24.0 kV |
| (3) | Reynolds Rd – Wyantskill (13-988) 115 kV | @STE | 237 MW | L/O | Berkshire – Alps (393) 345 kV |
| (4) | Berkshire – Northfield (312) 345 kV | @LTE | 1697 MW | L/O | Pleasant Valley – Long Mountain (398) 345 kV |
| (5) | Berkshire – Northfield (312) 345 kV | @STE | 1793 MW | L/O | Pleasant Valley – Long Mountain (398) 345 kV |

NOTE

1: The Northport – Norwalk Harbor (NNC) flow is positive in the direction of transfer
2: The Northport – Norwalk Harbor (NNC) line is no longer part of the New York – New England Interface Definition

## TABLE 2.b – ISO-NE to NYISO INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S

| New England to New York | DIRECT TIE | NYISO FACILITY | ISO-NE FACILITY |
|---|---|---|---|
| | | **Norwalk –Northport @ 0 MW** | |
| **NORMAL** | 1825 (1) | | 1550 (6) |
| **EMERGENCY** | 2050 (2) | | 1550 (6) |
| | | **Norwalk –Northport @ 100 MW** | |
| **NORMAL** | 1850 (5) | | 1600 (6) |
| **EMERGENCY** | 1900 (3) | | 1600 (6) |
| | | **Norwalk–Northport @ 200 MW** | |
| **NORMAL** | 1425 (4) | | 1650 (6) |
| **EMERGENCY** | 1425 (3) | | 1650 (6) |

| | LIMITING ELEMENT | RATING | | | LIMITING CONTINGENCY |
|---|---|---|---|---|---|
| (1) | Pleasant Valley – Long Mountain (398) 345 kV | @LTE | 1313 MW | L/O | Alps – Berkshire (393) 345 kV<br>Berkshire – Northfield Mount (312) 345 kV<br>Northfield Mount – Vernon (381) 345 kV<br>Berkshire 345/115 kV Transformer |
| (2) | Pleasant Valley – Long Mountain (398) 345 kV | @NORM | 1135 MW | | Pre-Contingency Loading |
| (3) | Northport – Norwalk Harbor (NNC) 138 kV | @STE | 532 MW | L/O | Pleasant Valley – Long Mountain (398) 345 kV |
| (4) | Northport – Norwalk Harbor (NNC) 138 kV | @LTE | 518 MW | L/O | Pleasant Valley – Long Mountain (398) 345 kV<br>Pleasant Valley – East Fishkill (F37) 345 kV |
| (5) | Pleasant Valley – Long Mountain (398) 345 kV | @LTE | 1313 MW | L/O | Alps – New Scotland (2) 345 kV<br>Alps – Reynolds Rd (1) 345 kV<br>Alps – Berkshire (393) 345 kV<br>Empire Gen #1 |
| (6) | Norwalk Junction – Archers Lane (3403D) 345 kV | @LTE | 850 MW | L/O | Long Mountain – Frost Bridge (352) 345 kV |

**NOTE**

1: The Northport – Norwalk Harbor (NNC) flow is positive in the direction of transfer
2: The Northport – Norwalk Harbor (NNC) line is no longer part of the New England – New York Interface Definition

## TABLE 3.a – NYISO to PJM INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S

| | DIRECT TIE | NYISO FACILITY | | PJM FACILITY |
|---|---|---|---|---|
| | | **Normal** | | |
| **NORMAL** | 1775(1) | 1075(2) [3] | 1400(3) [4] | 2175(8) |
| **3-115-O/S** | 2450(6) | 1025(2) [3] | 1325(3) [4] | 1625(10) |
| **EMERGENCY** | 1775(1) | 2125(7) [3] | 1600(5) [4] | 2175(9) |
| **3-115-O/S** | 2500 (4) | 2050(7) [3] | 1525(5) [4] | 1625(10) |
| **Dunkirk-South Ripley (68) 230 kV Out-of-service** | | | | |
| **NORMAL** | 1650(1) | 1225(2) [3] | 1425(3) [4] | 2025(8) |
| **3-115-O/S** | 2150(6) | 1200(2) [3] | 1375(3) [4] | 1475 (10) |
| **EMERGENCY** | 1650(1) | 2550(7) [3] | 1600(5) [4] | 2050(9) |
| **3-115-O/S** | 2450(12) | 2450(11) [3] | 1550(5) [4] | 1475(10) |

| | LIMITING ELEMENT | RATING | | | LIMITING CONTINGENCY |
|---|---|---|---|---|---|
| (1) | Goudey – Laurel Lake (952) 115 kV | @STE | 108 MW | | Pre-Contingency Loading |
| (2) | Niagara – Packard (62) 230 kV | @STE[1] | 846 MW | L/O | Niagara – Packard (61) 230 kV<br>Niagara – Robinson Rd (64) 230 kV |
| (3) | Packard – Niagara Boulevard (181-922) 115 kV | @STE | 206 MW | L/O | Packard – Sawyer (77) 230 kV<br>Sawyer – Huntley (77) 230 kV<br>Packard – Sawyer (78) 230 kV<br>Sawyer – Huntley (78) 230 kV<br>Sawyer 230/23 kV Transformers |
| (4) | South Ripley – Dunkirk (68) 230 kV | @STE | 475 MW | L/O | Warren – Glade (26) 230 kV |
| (5) | Packard – Niagara Boulevard (181-922) 115 kV | @NORM | 160 MW | | Pre-Contingency Loading |
| (6) | Hillside – East Towanda (70) 230 kV | @LTE | 531 MW | L/O | Liberty Generation |
| (7) | Niagara – Packard (62) 230 kV | @STE[1] | 846 MW | L/O | Niagara – Packard (61) 230 kV |
| (8) | Tiffany – Laurel Lake 115 kV | @STE | 151 MW | L/O | Rock Tavern – Dolson Ave (DART44) 345 kV<br>Rock Tavern–Middletown TAP (CCRT34) 345 kV<br>Coopers Corners–Middletown TAP (CCRT34) 345 kV<br>Middletown 345/138 kV Transformer |
| (9) | Tiffany – Laurel Lake 115 kV | @STE | 151 MW | L/O | Canyon – East Towanda 230 kV |
| (10) | East Towanda – North Meshoppen 115 kV | @STE | 172 MW | L/O | Canyon – East Towanda 230 kV |
| (11) | Hillside – Watercure (69) 230 kV | @STE | 657 MW | L/O | Watercure – Mainesburg (30) 345kV |
| (12) | Hillside – East Towanda (70) 230 kV | @STE | 630 MW | L/O | Watercure – Mainesburg (30) 345kV |

**NOTE**

1: Emergency Transfer Capability Limits may have required line outages as described in Section 5.3.B.
2: PAR schedules have been adjusted in the direction of transfer.
3: Internal Secured Limit: Limit to secure internal transmission elements that are secured with pricing in the NYISO markets (typically 230 kV and above)
4: Internal Non-Secured Limit: Limit to secure internal transmission elements that are not secured with pricing in the NYISO markets (typically 115 kV)

## TABLE 3.b – PJM to NYISO INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES I/S

| | DIRECT TIE | NYISO FACILITY | | PJM FACILITY |
|---|---|---|---|---|
| | | **Normal** | | |
| **NORMAL** | 1600(1) | 2825(2)[3] | 2375(3)[4] | 2075(4) |
| **3-115-O/S** | 2100(9) | 2750(13)[3] | 2700(3)[4] | 3050(10) |
| **EMERGENCY** | 1800(5) | 2900(7)[3] | 2725(6)[4] | 2325(8) |
| **3-115-O/S** | 2375(11) | 2750(12)[3] | 3100(6)[4] | 3050(15) |
| **Dunkirk-South Ripley (68) 230 kV Out-of-service** | | | | |
| **NORMAL** | 1500(5) | 2850(2)[3] | 2325 (3)[4] | 1975(4) |
| **3-115-O/S** | 1975(9) | 2825(14)[3] | 2600(3)[4] | 2875(16) |
| **EMERGENCY** | 1500(5) | 2925(7)[3] | 2625 (6)[4] | 2200(8) |
| **3-115-O/S** | 2225(11) | 2950(7)[3] | 2900(17)[4] | 2875(16) |

| | LIMITING ELEMENT | RATING | | | LIMITING CONTINGENCY |
|---|---|---|---|---|---|
| (1) | North Waverly – East Sayre (956) 115 kV | @STE | 143 MW | L/O | Hillside – East Towanda (70) 230 kV<br>Hillside – Watercure (69) 230 kV<br>Hillside 230/115 kV Transformer |
| (2) | Buchanan – Millwood (W98) 345 kV | @STE[1] | 1876 MW | L/O | Buchanan – Millwood (W97) 345 kV<br>Buchanan – Millwood (F96952) 138 kV |
| (3) | North Waverly – Lounsberry 115 kV | @STE | 143 MW | L/O | Watercure – Oakdale (31) 345 kV<br>Oakdale – Clarks Corner (36) 345 kV |
| (4) | Towanda – East Sayre 115 kV | @STE | 246 MW | L/O | Hillside – East Towanda (70) 230 kV<br>Hillside – Watercure (69) 230 kV<br>Hillside 230/115 kV Transformer |
| (5) | Falconer – Warren (171) 115 kV | @STE | 140 MW | L/O | Pierce Brook – Five Mile Rd. (37) 345 kV |
| (6) | North Waverly – Lounsberry 115 kV | @STE | 143 MW | L/O | Watercure – Oakdale (31) 345 kV |
| (7) | Buchanan – Millwood (W97) 345 kV | @STE[1] | 1876 MW | L/O | Buchanan – Millwood (W98) 345 kV |
| (8) | Towanda – East Sayre 115 kV | @STE | 246 MW | L/O | Hillside – East Towanda (70) 230 kV |
| (9) | Hillside – East Towanda (70) 230 kV | @LTE | 531 MW | L/O | Lackawana – Hopatcong (5063) 500 kV |
| (10) | Erie East – Fourmile 230 kV | @LTE | 584 MW | L/O | Pierce Brook – Five Mile Rd. (37) 345 kV |
| (11) | Hillside – East Towanda (70) 230 kV | @NORM | 483 MW | | Pre-Contingency Loading |
| (12) | South Ripley – Dunkirk (68) 230 kV | @STE | 475 MW | L/O | Pierce Brook – Five Mile Rd. (37) 345 kV |
| (13) | South Ripley – Dunkirk (68) 230 kV | @LTE | 475 MW | L/O | Pierce Brook – Five Mile Rd. (37) 345 kV |
| (14) | Watercure – Oakdale (71) 230 kV | @LTE | 400 MW | L/O | Watercure – Oakdale (31) 345 kV<br>Oakdale – Clarks Corner (36) 345 kV |
| (15) | Erie East – Fourmile 230 kV | @STE | 584 MW | L/O | Pierce Brook – Five Mile Rd. (37) 345 kV |

| | | | | | |
|---|---|---|---|---|---|
| (16) | Everett Dr – Mainesburg 115 kV | @STE | 245 MW | L/O | Hillside – East Towanda (70) 230 kV |
| (17) | Stolle Road – Girdle Road (706) 115 kV | @STE | 239 MW | L/O | Pierce Brook – Five Mile Rd. (37) 345 kV |

**NOTE**

1: Emergency Transfer Capability Limits may have required line outages as described in Section 5.3.B.
2: PAR schedules have been adjusted in the direction of transfer.
3: Internal Secured Limit: Limit to secure internal transmission elements that are secured with pricing in the NYISO markets (typically 230 kV and above)
4: Internal Non-Secured Limit: Limit to secure internal transmission elements that are not secured with pricing in the NYISO markets (typically 115 kV)

## TABLE 4 – IESO to NYISO INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2018 ALL LINES

### I/S

| | DIRECT TIE | NYISO FACILITY | | IESO FACILITY | DIRECT TIE | NYISO FACILITY | | IESO FACILITY |
|---|---|---|---|---|---|---|---|---|
| | **100% Zone A Load (2,801 MW)** | | | | **80% Zone A Load (2,241 MW)*** | | | |
| **NORMAL** | 1875 (13) | 0 (2)3 | 625 (3)4 | 2075 (4) | 2000 (1) | 1300 (2)3 | 1925 (10)4 | 2075 (4) |
| **EMERGENCY** | 2225 (5) | 1325 (6)3 | 1200 (7)4 | 3425 (8) | 2400 (9) | 2675 (6)3 | 2150 (11)4 | 3425 (8) |
| **Dunkirk-South Ripley (68) 230 kV & Warren-Falconer (171) 115 kV Out-of-service** | | | | | | | | |
| **NORMAL** | 1900 (1) | 175 (2)3 | 625 (3)4 | 2075 (4) | 2000 (1) | 1575 (2)3 | 1950 (10)4 | 2075 (4) |
| **EMERGENCY** | 2250 (5) | 1650 (6)3 | 1275 (7)4 | 3450 (8) | 2425 (9) | 3100(12)3 | 2200 (11)4 | 3425 (8) |

| | LIMITING ELEMENT | RATING | | | LIMITING CONTINGENCY |
|---|---|---|---|---|---|
| (1) | Beck – Niagara (PA27) 230 kV | @LTE | 460 MW | L/O | Beck – Niagara (PA 301) 345 kV |
| (2) | Niagara – Packard (61) 230 kV | @STE1 | 846 MW | L/O | Niagara – Packard (62) 230 kV<br>Beck – Packard (PB76) 230 kV |
| (3) | Packard – Niagara Boulevard (181-922) 115 kV | @STE | 206 MW | L/O | Packard – Sawyer (77) 230 kV<br>Sawyer – Huntley (77) 230 kV<br>Packard – Sawyer (78) 230 kV<br>Sawyer – Huntley (78) 230 kV<br>Sawyer 230/23 kV Transformers |
| (4) | Cherrywood DK2 – Pickering (BP27-30) 220 kV | @LTE | 950 MW | L/O | Cherrywood DK1 – Pickering (BP27-30) 220 kV |
| (5) | Beck – Niagara (PA27) 230 kV | @NORM | 400 MW | | Pre-Contingency Loading |
| (6) | Packard – Sawyer (77) 230 kV | @STE | 746 MW | L/O | Packard – Sawyer (78) 230 kV |
| (7) | Young – Huntley (133) 115 kV | @STE | 206 MW | L/O | Buffalo – Huntley (130) 115 kV |
| (8) | Agincrt_JC5R – Leslie_TSjc5 220 kV | @NORM | 320 MW | | Pre-Contingency Loading |
| (9) | Beck – Niagara (PA27) 230 kV | @STE | 558 MW | L/O | Beck – Niagara (PA 301) 345 kV |
| (10) | Niagara 230/115 kV Transformer | @STE1 | 288 MW | L/O | Packard – Sawyer (77) 230 kV<br>Sawyer – Huntley (77) 230 kV<br>Packard – Sawyer (78) 230 kV<br>Sawyer – Huntley (78) 230 kV<br>Sawyer 230/23 kV Transformers |
| (11) | Niagara 230/115 kV Transformer | @NORM | 192 MW | | Pre-Contingency Loading |
| (12) | Niagara – Robinson Rd (64) 230 kV | @NORM | 496 MW | | Pre-Contingency Loading |
| (13) | Beck – Niagara (PA27) 230 kV | @LTE | 460 MW | L/O | Beck – Packard (PB76) 230 kV |

**Note**

1: Ontario - NYISO limit used the NYSRC Rules Exception No. 13 – Post Contingency Flows on Niagara Project Facilities
2: * Zone A Load is approximately 8% of the total NYCA Load. 2,241 MW of Zone A Load would equate to a NYCA Load of 26,325 MW
3: Internal Secured Limit: Limit to secure internal transmission elements that are secured with pricing in the NYISO markets (typically 230 kV and above)
4: Internal Non-Secured Limit: Limit to secure internal transmission elements that are not secured with pricing in the NYISO markets (typically 115 kV)

## TABLE 5 – NYISO to IESO INTERFACE THERMAL TRANSFER LIMITS – SUMMER 2018ALL LINES I/S

| | DIRECT TIE | NYISO FACILITY | IESO FACILITY[1] |
|---|---|---|---|
| **Dunkirk-South Ripley (68) 230 kV & Warren-Falconer (171) 115 kV Out-of-Service** | | | |
| **NORMAL** | 1750(1) | | 1350(2) |
| **EMERGENCY** | 2250(3) | | 1725(4) |
| **Dunkirk-South Ripley (68) 230 kV & Warren-Falconer (171) 115 kV In-Service** | | | |
| **NORMAL** | 1750(1) | | 1375(2) |
| **EMERGENCY** | 2250(3) | | 1750(4) |

| | LIMITING ELEMENT | RATING | | | LIMITING CONTINGENCY |
|---|---|---|---|---|---|
| (1) | Beck – Niagara (PA27) 230 kV | @LTE | 460 MW | L/O | Beck – Niagara (PA 301) 345 kV<br>Beck – Allanburg (Q28A) 230 kV<br>Thorold GS |
| (2) | Beck – Hannon (Q24HM) 230 kV | @LTE | 480 MW | L/O | Middleport – Beach - Carluke (Q25BM) 230 kV<br>Beck – Middleport – Beach (Q29HM) 230 kV |
| (3) | Beck – Niagara (PA27) 230 kV | @STE | 558 MW | L/O | Beck – Niagara (PA 302) 345 kV |
| (4) | Beck – Hannon (Q29HM) 230 kV | @NORM | 415 MW | | Pre-Contingency Loading |

**Note**

1: This limit can be increased by reducing generation or increasing demand in the Niagara zone of Ontario. See Section 5.3.C.d. for discussion.