



# **NYISO Operating Study Summer 2016**

*A report from the New York Independent System Operator*

**May 19, 2016**

## Executive Summary

This study is conducted as a seasonal review of the projected thermal transfer capability for the summer 2016 capability period. This study is performed to fulfill the NERC requirements R2 of FAC-013 and R11 of TOP-002-2a. 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 4. Differences in the evaluated internal interface limits from summer 2015 to summer 2016 are shown on page 9. Internal interfaces have changed due to the multitude of network alterations in the New York Control Area (NYCA) and modeling assumptions. Dysinger East is limited to 950 MW due to the network and modeling changes in the western New York (NY) system. The Marcy South Series Compensation project and the addition of the second Rock Tavern-Ramapo 345 kV line has altered both base and transfer patterns on UPNY-ConEd, Total East and Central East interfaces. UPNY-ConEd is limited to 4175 MW, Total East is limited to 5350 MW and Central east is limited to 2700 MW. Differences in the evaluated external interface limits from summer 2015 to summer 2016 are shown on page 13. External interface limits are essentially unchanged from the summer 2015, with the exception of NYISO-IESO, IESO-NYISO and PJM-NYISO which are limited to 1625 MW, 1750 MW and 2075 MW, respectively. Generation and network changes in western New York and western PJM have altered both base and transfer patterns on the western NY system. The reduction in generation in the western system has increased the flows on the limiting 230 kV system and are sensitive to load in Zone A.

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## 1. INTRODUCTION

The following report, prepared by the Operating Studies Task Force (OSTF) at the direction and guidance of the System Operations Advisory Subcommittee (SOAS), highlights the thermal analysis evaluation for the summer 2016 capability period. This analysis indicates that, for the summer 2016 capability period, the New York interconnected bulk power system can be operated reliably in accordance with the "NYSRC Reliability Rules for Planning and Operating the New York State Power System" and the NYISO System Operating Procedures.

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.

## 2. 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.

This study is being performed to fulfill NERC requirements, which include Requirement R2 of FAC-013 and Requirement R11 of TOP-002-2a as quoted below.

"FAC-013-2—Establish and Communicate Transfer Capabilities Requirement R2:

The Reliability Coordinator and Planning Authority shall each provide its inter-regional and intra-regional Transfer Capabilities to those entities that have a reliability-related need for such Transfer Capabilities and make a written request that includes a schedule for delivery of such Transfer Capabilities as follows:

R2.1. The Reliability Coordinator shall provide its Transfer Capabilities to its associated Regional Reliability Organization(s), to its adjacent Reliability Coordinators, and to the Transmission Operators, Transmission Service Providers and Planning Authorities that work in its Reliability Coordinator Area.

R2.2. The Planning Authority shall provide its Transfer Capabilities to its associated Reliability Coordinator(s) and Regional Reliability Organization(s), and to the Transmission Planners and Transmission Service Provider(s) that work in its Planning Authority Area.”

“TOP-002-2b—Normal Operations Planning Requirement R11:

The Transmission Operator shall perform seasonal, next-day, and current-day Bulk Electric System studies to determine System Operating Limits (SOLs). Neighboring Transmission Operators shall utilize identical SOLs for common facilities. The Transmission Operator shall update these Bulk Electric System studies as necessary to reflect current system conditions; and shall make the results of Bulk Electric System studies available to the Transmission Operators, Balancing Authorities (subject to confidentiality requirements), and to its Reliability Coordinator.”

### 3. STUDY PARTICIPANTS

First Name	Last Name	Company Name	First Name	Last Name	Company Name
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*	Kenneth	Wei	NYISO
Robert	Eisenhuth	PSEG Long Island*	Roleto	Mangonon	O&R
Roy	Pfleiderer	National Grid	Daniel	Head	ConEd
Vicki	O'Leary	National Grid	Ruby	Chan	Central Hudson
Diem	Ehret	National Grid	Richard	Wright	Central Hudson
Michael	Spahiu	National Grid	Keith	Lauria	Central Hudson
Brian	Gordon	NYSEG	Mohammed	Hossain	NYPA
Robert	King	NYSEG	Abhilash	Gari	NYPA
Jence	Mandizha	NYSEG	Larry	Hochberg	NYPA
Dean	LaForest	ISO-NE	Yuri	Smolanitsky	PJM
Bilgehan	Donmez	ISO-NE	Daniel	Sohm	IESO

\*Agent for LIPA

### 4. SYSTEM REPRESENTATION AND BASE STUDY ASSUMPTIONS

#### 4.1 System Representation

The representation was developed from the NYISO Data Bank and assumes the forecast summer coincident peak load of 33,360 MW. The other NPCC Balancing Areas and adjacent Regional representations were obtained from the RFC-NPCC summer 2016 Reliability Assessment power flow base case and has been updated to reflect the summer 2016 capability period.

## A. Generation Resource Changes

The generator output levels for major units are summarized in Appendix B, and are consistent with typical operation for the period. 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 2015 capability period:

<b>Deactivations</b>	
Ravenswood 04	-13 MW
Ravenswood 05	-14 MW
Ravenswood 06	-13 MW
Astoria GT 8	-11 MW
Astoria GT 10	-18 MW
Astoria GT 11	-17 MW
Dunkirk 2	-75 MW
Huntley 67	-188 MW
Huntley 68	-190 MW
<b>Total Retirements</b>	<b>-539 MW</b>
<b>Additions</b>	
Bowline 2 (Uprate)	374 MW
<b>Total Additions</b>	<b>374 MW</b>

## B. Transmission Facilities Changes

Significant facility changes since the summer 2015 capability period include:

- Addition of the Five Mile Road and Pierce Brook 345 kV Substation
- Transmission Owner Transmission Solutions (TOTS)
- Packard to Sawyer Series Reactors

Five Mile Road and Pierce Brook are being added on the 345 kV Homer City-Stolle Road line between New York and PJM. Five Mile Road is in service and is located on the New York side of the system. Pierce Brook is expected to be completed by Q3 2016 and will be located in PJM. The new stations will change the NY-PJM interface definition by replacing the Homer City-Stolle Road (37) line with the Pierce Brook-Five Mile Road (37) line and Pierce Brook - Homer City (48) line.

The Transmission Owner Transmission Solutions (TOTS) project includes the Marcy South Series Compensation project, adding compensation to the Marcy South transmission corridor through the installation of series capacitors and includes the re-conductoring of the Fraser – Coopers Corners 345 kV line. The Rock Tavern – Ramapo project will add a second Rock Tavern – Ramapo 345 kV line and create a Sugarloaf 345/138 kV connection to the Orange and Rockland system. The Staten Island Unbottling project will relieve a loss-of-source contingency through the reconfiguration of two 345 kV substations.

The Packard to Sawyer series reactors are expected to be in-service prior to the summer 2016 peak. The series reactors are being installed to help alleviate the expected increase in congestion in the western NY system.

## 4.2 System Representation

The Siemens PTI PSS<sup>TM</sup>MUST and PSS<sup>TM</sup>E software packages were used to calculate the thermal limits based on Normal and Emergency Transfer Criteria defined in the "NYSRC Reliability Rules for Planning and Operating the New York State Power System". The thermal transfer limits presented have been determined for all transmission facilities scheduled in service during the summer 2016 period.

The schedules used in the base case power flow for this analysis assumed a net flow of 1,000 MW from Public Service Electric & Gas (PSE&G) to Consolidated Edison via the PAR transformers controlling the Hudson – Farragut and Linden – Goethals interconnections, and 1,000 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 2016 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 2016, and the MMWG summer 2016 power flow base cases. The series reactors on the Dunwoodie – Mott Haven (71 and 72), the Farragut – Gowanus (41 and 42) 345 kV and the Sprain Brook – W. 49th St. (M51 and M52) 345 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.

## 5. DISCUSSION

### 5.1 Resource Assessment

#### A. Load and Capacity Assessment

The forecast peak demand for the summer 2016 capability period is 33,360 MW (1). This forecast is approximately 207 MW (0.62%) lower than the forecast of 33,567 MW for the summer 2015 capability period, and 596 MW (1.76%) 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 39,198 MW based on the NYSRC 17.5% Installed Reserve Margin (IRM) requirement for the 2016 Capability Year.

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(1) Forecast Coincident Peak Demand (50<sup>th</sup> percentile baseline forecast)

NYCA generation capacity for summer 2016 is 38,535 MW, and net external capacity purchases of 1,769 MW have been secured for the summer period. The combined capacity resources represent a 20.8% margin above the forecast peak demand of 33,360 MW. These values were taken from the 2015 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/2015%20Load%20and%20Capacity%20Data%20Report.pdf](http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Planning_Data_and_Reference_Docs/Data_and_Reference_Docs/2015%20Load%20and%20Capacity%20Data%20Report.pdf)

The equivalent forced outage rate is 4.80%, and includes forced outages and de-ratings based on historical performance of all generation in the NYCA. For summer 2015, the equivalent forced outage rate assumed was 4.89%.

## 5.2 Cross-State Interfaces

### A. 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 2016. 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. Generation shifts assumed for the thermal analysis are detailed in Appendix I.

Figure 1 presents a comparison of the summer 2016 thermal transfer limits to summer 2015 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 2016 and 2015, with limiting element/contingency descriptions. Significant differences in these thermal transfer limits are discussed below.



## Summer 2016/Summer 2015

- (1) Dysinger East
- (2) Total East
- (3) Central East
- (4) UPNY - ConEd
- (5) Spm / Dun - South
- (6) ConEd - LIPA
- (7) Moses South

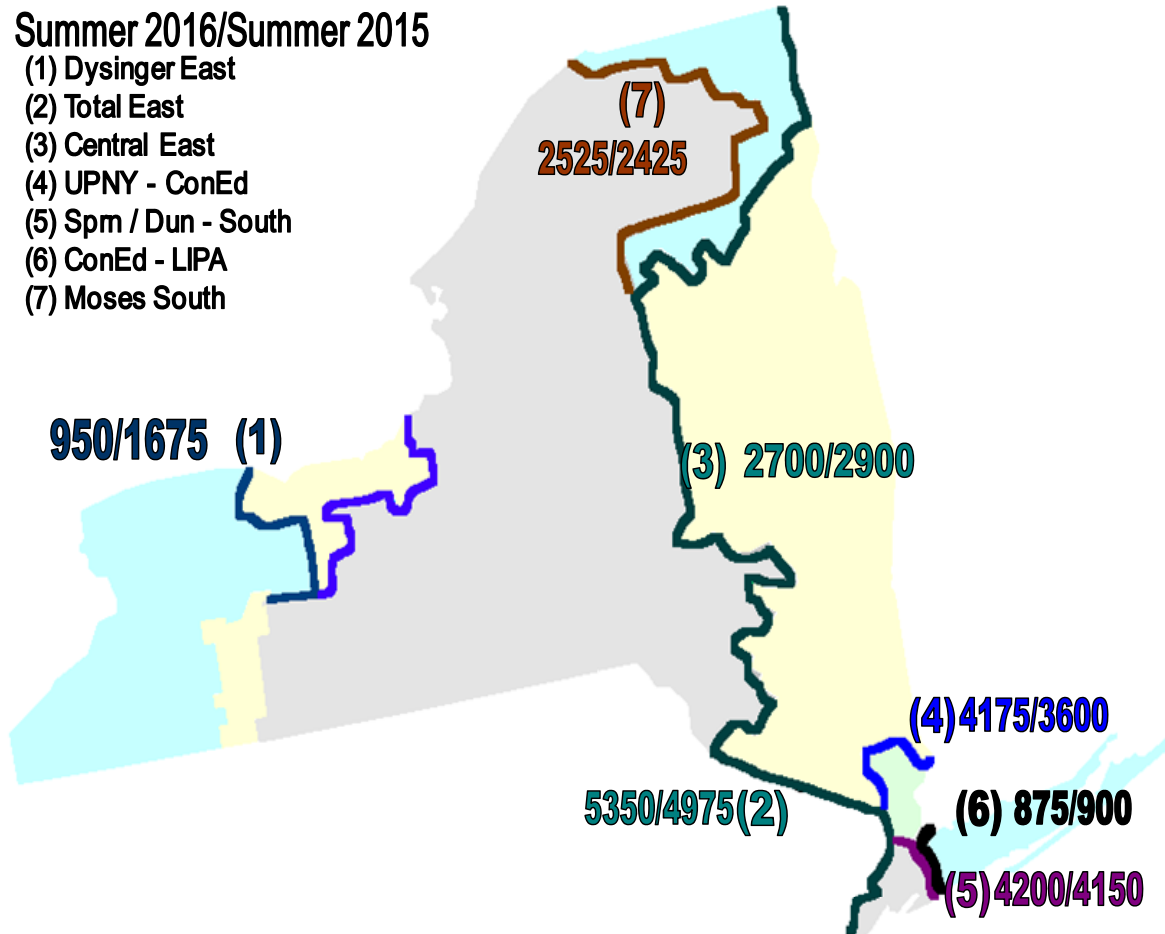


Figure 1 – Cross-State Thermal Transfer Limits

**Dysinger East** interface thermal transfer limit decreased 725 MW. This peak load limitation is due to much higher 230 kV transmission power flows between Niagara and the Dunkirk stations, for the conditions studied. These limits are 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. The reduction in generation in the western system has increased the flows on the limiting 230 kV system.

**Central East** interface thermal transfer limit decreased 200 MW. This is mainly due to the redistribution of line flows caused by both the Marcy South Series Compensation project and the addition of the second Rock Tavern-Ramapo 345 kV line.

**Total East** interface thermal transfer limit increased 375 MW. This is mainly due to the redistribution of line flows caused by both the Marcy South Series Compensation project and the addition of the second Rock Tavern-Ramapo 345 kV line.

**UPNY-ConEd** interface thermal transfer limit has increased 575 MW. This is mainly due to the redistribution of line flows caused by both the Marcy South Series Compensation project and the addition of the second Rock Tavern-Ramapo 345 kV line. A comparable UPNY-

SENY thermal transfer limit would be 5350 MW for the same limiting element and contingency as UPNY-ConEd.

**Moses South** interface thermal transfer limit increased 100 MW. This is due to the 115 kV limiting element being allowed to exceed its LTE rating and reach its STE rating post contingency for normal transfers.

#### **B. 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.

#### **C. Sensitivity Testing**

The thermal limits presented in Section 6 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.

#### **D. 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.

## E. 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	-178 MW	115 MW
Jamaica – Valley Stream 138 kV	-122 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
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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**

Historically, LIPA anticipated being able to supply a total flow up to 510 MW of emergency transfer from Long Island to Con Edison, if requested, via the ties. However, with rating changes to several 138 kV circuits internal to the LIPA system, this emergency transfer

capability will likely be reduced. Assessment of emergency transfer capability from Long island to Con Ed is under review.

#### **F. Transfer Limits for Outage Conditions**

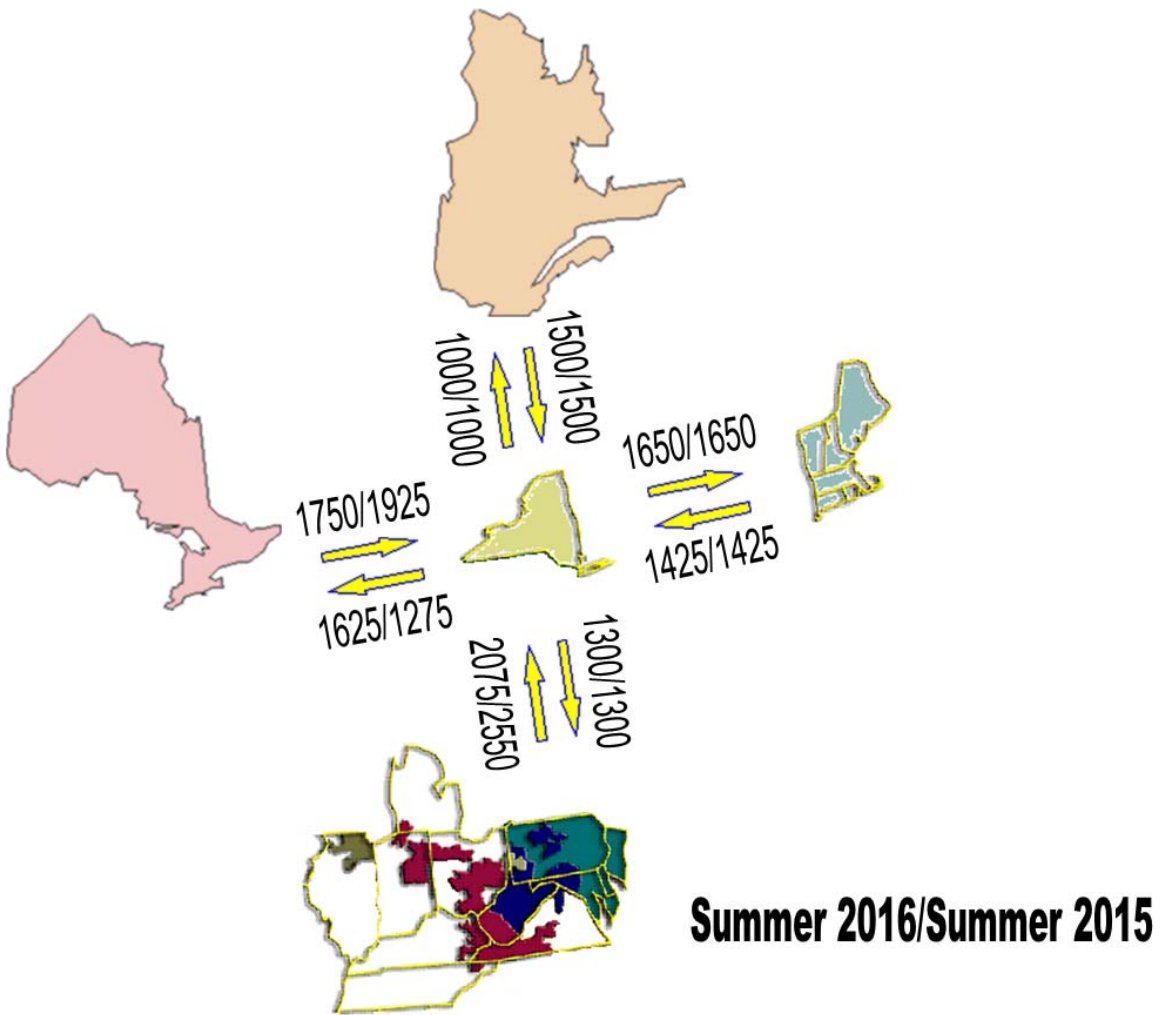
Transfer limits for scheduled outage conditions are determined by the NYISO Scheduling and Market Operations groups. The NYISO Real-Time Dispatch system monitors the EHV transmission continuously to maintain the secure operation of the interconnected EHV system.

#### **G. Transient Stability and Voltage transfer Limits**

The interface transfer limits shown in Section 6 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](http://www.nyiso.com/public/markets_operations/market_data/reports_info/index.jsp)

### 5.3 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 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.

(2) TE-NY transfer capabilities shown in Figure 2 are not thermal transfer limits; for more information see Section 5.3.D.

**PJM – New York** interface thermal transfer limit decreased 475 MW. This is mainly due to the change in pre-flows on the direct ties cause by generation changes in PJM.

**IESO – New York** interface thermal transfer limit decreased 175 MW. These limits are 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. The reduction in generation in the western system has increased the flows on the limiting 230 kV system.

**New York – IESO** interface thermal transfer limit increased 350 MW. These limits are 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. The reduction in generation in the western system has increased the flows on the limiting 230 kV system.

## **A. New York – New England Analysis**

### **a. New England Transmission/Capacity Additions**

#### **Transmission**

The construction efforts are completed for new 345 kV lines between eastern Connecticut, Rhode Island and Massachusetts as part of the Interstate Reliability Project (IRP). Two new 345 kV lines Lake Road to West Farnum (341 line) and West Farnum to Millbury (366 line) are in-service. The Sherman Road 345 kV substation is rebuilt as a new breaker-and-a-half substation.

For the summer 2016 study period, there are no major projects scheduled to be in-service which can impact New York – New England transmission capability. There a couple of 115 kV projects currently under construction far from the New York border with no impact to New York – New England transfer capability.

#### **Capacity**

In the New England Control Area, from April 2016 through September 2016, no major generation additions or retirements are scheduled.

### **b. 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.

### **c. Cross-Sound Cable**

The Cross-Sound Cable 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 NYISO – ISO-NE interface, and HVdc transfers are independent of transfers between the NYISO and ISO-NE.

**d. Smithfield – Salisbury 69 kV**

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

**e. Northport – Norwalk Harbor Cable Flow**

Flow on the NNC Norwalk Harbor to Northport, facility is controlled by a phase angle-regulating (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.

**f. Whitehall – Blissville 115 kV**

The phase angle regulator on this circuit will control pre-contingency flow between the respective stations. VELCO, National Grid, ISO-NE and NYISO developed a joint operating procedure. 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.

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

The phase angle regulating transformer 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 / system performance on the New York side of the PV20 tie for this analysis.

## **B. New York - PJM Analysis**

### **a. Thermal Transfer Limit Analysis**

The transfer limits for the New York - PJM interface are summarized in Section 6, Table 3. The phase angle regulating transformers controlling the Hopatcong – Ramapo 500 kV circuit are used to maintain flow at the normal rating of the Ramapo 500/345 kV transformer.

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

The normal criteria thermal transfer limits presented in Section 6 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 (Penelec) 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.

### **c. DC Ties**

Neptune DC tie is expected to be available at full capability, 660 MW. Hudson Transmission Project (HTP) DC tie is expected to be available at full capability for the summer 2016, 660 MW. The HTP DC project was modeled as injecting 319 MW into NYISO for the summer 2016 study.

### **d. 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 2016, Linden VFT will have 330 MW firm withdrawal right and 300 MW firm injection rights into PJM market. Linden VFT is modeled as injecting 315 MW into NYSIO for the summer 2016 study.



## C. Ontario – New York Analysis

### a. 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) plus line 171 (Warren-Falconer) out of service. The NYISO Niagara generation was modeled at an output of 2100 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://www.ieso.ca/Documents/marketReports/OntTxSystem\\_2015dec.pdf](http://www.ieso.ca/Documents/marketReports/OntTxSystem_2015dec.pdf)

### b. 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](http://www.nyiso.com/public/webdocs/market_data/reports_info/operating_studies/NOH-1/NYPP-OH_1993.PDF)

### c. 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.

### d. 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 1500

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.

#### **D. 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 limited to 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 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.

## 6. SUMMARY OF RESULTS – THERMAL TRANSFER LIMIT ANALYSIS

### Table 1 – NYISO CROSS STATE INTERFACE THERMAL LIMITS

- Table 1.a
  - Dysinger East
  - UPNY – ConEd
  - Sprain Brook – Dunwoodie So.
  - ConEd – LIPA Transfer Capability
- Table 1.b – MSC-7040 Flow Sensitivity
  - Central East
  - Total East
  - 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 2016****ALL LINES I/S**

	Dysinger East	UPNY - ConEd <sub>1</sub>	Sprain Brook Dunwoodie - So.	ConEd – LIPA Transfer Capability
<b>NORMAL</b>	950 <sup>(1)</sup>	4175 <sup>(3)</sup>	4200 <sup>(5)</sup>	875 <sup>(7)</sup>
<b>EMERGENCY</b>	1700 <sup>(2)</sup>	4900 <sup>(4)</sup>	4225 <sup>(6)</sup>	1500 <sup>(8)</sup>

	LIMITING ELEMENT	RATING		LIMITING CONTINGENCY
(1)	Packard – Sawyer (77) 230 kV	@LTE	644 MW	L/O Niagara – Packard (61) 230 kV Packard – Sawyer (78) 230 kV Sawyer – Huntley (78) 230 kV Packard 230/115 kV Transformer BK3
(2)	Packard – Sawyer (77) 230 kV	@STE	746 MW	L/O Packard – Sawyer (78) 230 kV
(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)	Dunwoodie – Mott Haven (71) 345 kV	@SCUC <sub>2</sub>	1066 MW	L/O (SB:RAIN345_7W) Mott Haven – Rainey (Q12) 345 kV Rainey 345/138 kV Transformer 7W Rainey – East 75 St. 138 kV East 75 St. – West 110 St. 138 kV
(6)	Dunwoodie – Mott Haven (71) 345 kV	@NORM	707 MW	Pre-Contingency Loading
(7)	Dunwoodie – Shore Rd. (Y50) 345 kV	@LTE	914 MW <sub>3</sub>	L/O (SB RNS2 @ Sprain Brook 345 kV) Sprain Brook – East Garden City (Y49) 345 kV Sprain Brook – Academy (M29) 345 kV
(8)	Dunwoodie – Shore Rd. (Y50) 345 kV	@NORM	653 MW <sub>3</sub>	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 (SCUC 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 2016**  
**ALL LINES I/S**

	MSC-7040 FLOW 800 MW	MSC-7040 FLOW 1310 MW	MSC-7040 FLOW 1600 MW
<b>CENTRAL EAST</b>			
NORMAL	2700 <sup>(1)</sup>	2700 <sup>(1)</sup>	2700 <sup>(1)</sup>
EMERGENCY	2775 <sup>(2)</sup>	2775 <sup>(2)</sup>	2775 <sup>(2)</sup>
<b>TOTAL EAST</b>			
NORMAL	5350 <sup>(1)</sup>	5350 <sup>(1)</sup>	5350 <sup>(1)</sup>
EMERGENCY	5425 <sup>(3)</sup>	5425 <sup>(3)</sup>	5425 <sup>(3)</sup>
<b>MOSES SOUTH</b>			
NORMAL	2150 <sup>(4)</sup>	2525 <sup>(4)</sup>	2625 <sup>(6)</sup>
EMERGENCY	2200 <sup>(5)</sup>	2575 <sup>(5)</sup>	2625 <sup>(6)</sup>

	<b>LIMITING ELEMENT</b>	<b>RATING</b>	<b>LIMITING CONTINGENCY</b>
(1)	New Scotland – Leeds (94) 345 kV	@LTE 1538 MW	L/O New Scotland – Leeds (93) 345 kV
(2)	Fraser – Coopers Corners (33) 345 kV	@STE 1703 MW	L/O Marcy – Fraser Annex (UCC2-41) 345 kV (Series Capacitor)
(3)	Coopers Corners – Middletown TAP (CMT-34) 345 kV	@STE 1793 MW	L/O Coopers Corners – Rock Tavern (CRT-42) 345 kV
(4)	Moses – Adirondack (MA2) 230 kV	@LTE 386 MW	L/O Chateauguay–Massena (MSC-7040) 765 kV Massena – Marcy (MSU1) 765 kV and TransÉnergie delivery
(5)	Browns Falls – Taylorville (4) 115 kV	@STE 126 MW	L/O Chateauguay–Massena (MSC-7040) 765 kV Massena – Marcy (MSU1) 765 kV and TransÉnergie delivery
(6)	Marcy 765/345 kV T2 Transformer	@STE 1971 MW	L/O Marcy 765/345 kV T1 Transformer

**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 2016****ALL LINES I/S**

<b>New York to New England</b>	<b>DIRECT TIE</b>	<b>NYISO FACILITY</b>	<b>ISO-NE FACILITY</b>
<b>Northport –Norwalk 100 MW</b>			
<b>NORMAL</b>	1700 <sup>(1)</sup>	3050 <sup>(3)</sup>	3025 <sup>(4)</sup>
<b>EMERGENCY</b>	2275 <sup>(2)</sup>	3050 <sup>(3)</sup>	3125 <sup>(5)</sup>
<b>Northport –Norwalk 0 MW</b>			
<b>NORMAL</b>	1650 <sup>(1)</sup>	3100 <sup>(3)</sup>	3050 <sup>(4)</sup>
<b>EMERGENCY</b>	2225 <sup>(2)</sup>	3100 <sup>(3)</sup>	3150 <sup>(5)</sup>

	<b>LIMITING ELEMENT</b>	<b>RATING</b>	<b>LIMITING CONTINGENCY</b>
(1)	Pleasant Valley – Long Mountain (398) 345 kV	@LTE 1313 MW L/O	SB:MILLST 3:14T Beseck – Millstone (348) 345 kV Millstone G3 24 kV
(2)	Pleasant Valley – Long Mountain (398) 345 kV	@STE 1596 MW L/O	Millstone G3 24.0 kV
(3)	Reynolds Rd – Greenbush (9) 115 kV	@STE 398 MW L/O	New Scotland – Alps (2) 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 LIMITS - SUMMER 2016****ALL LINES I/S**

<b>New England to New York</b>	<b>DIRECT TIE</b>	<b>NYISO FACILITY</b>	<b>ISO-NE FACILITY</b>
<b>Norwalk –Northport @ 0 MW</b>			
<b>NORMAL</b>	1825 <sup>(1)</sup>		1350 <sup>(5)</sup>
<b>EMERGENCY</b>	2000 <sup>(2)</sup>		1400 <sup>(6)</sup>
<b>Norwalk –Northport @ 100 MW</b>			
<b>NORMAL</b>	1825 <sup>(1)</sup>		1400 <sup>(5)</sup>
<b>EMERGENCY</b>	2050 <sup>(2)</sup>		1450 <sup>(6)</sup>
<b>Norwalk–Northport @ 200 MW</b>			
<b>NORMAL</b>	1425 <sup>(3)</sup>		1450 <sup>(5)</sup>
<b>EMERGENCY</b>	1875 <sup>(4)</sup>		1500 <sup>(6)</sup>

<b>LIMITING ELEMENT</b>	<b>RATING</b>	<b>LIMITING CONTINGENCY</b>
(1) Pleasant Valley – Long Mountain (398) 345 kV	@LTE 1313 MW L/O	Alps – Berkshire (393) 345 kV Berkshire – Northfield Mount (312) 345 kV 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	@LTE 513 MW L/O	Pleasant Valley – Long Mountain (398) 345 kV Pleasant Valley – East Fishkill (F37) 345 kV
(4) Northport – Norwalk Harbor (NNC) 138 kV	@STE 604 MW L/O	Pleasant Valley – Long Mountain (398) 345 kV
(5) Norwalk Junction – Archers Lane (3403D) 345 kV	@LTE 850 MW L/O	Southington 5T Stuck Breaker
(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 2016****ALL LINES I/S**

NYISO to PJM	DIRECT TIE	NYISO FACILITY	PJM FACILITY
<b>NORMAL</b>	1725 <sup>(1)</sup>	1300 <sup>(2)</sup>	1675 <sup>(3)</sup>
<b>3-115-O/S</b>	2025 <sup>(4)</sup>	1300 <sup>(2)</sup>	1400 <sup>(5)</sup>
<b>EMERGENCY</b>	1850 <sup>(6)</sup>	1575 <sup>(7)</sup>	1675 <sup>(3)</sup>
<b>3-115-O/S</b>	2025 <sup>(4)</sup>	1425 <sup>(8)</sup>	1400 <sup>(5)</sup>

LIMITING ELEMENT		RATING		LIMITING CONTINGENCY	
(1)	Falconer – Warren (171) 115 kV	@STE	119 MW	L/O	Warren – Glade 230 kV Warren – Erie South 230 kV Warren 230/115 kV Transformers #4 & #5
(2)	Packard – Sawyer (77) 230 kV	@LTE	644 MW	L/O	Packard – Sawyer (78) 230 kV
(3)	Blairsville – Blairsville East 115 kV	@EMER	190 MW	L/O	Keystone – Shelocta 230 kV
(4)	South Ripley – Dunkirk (68) 230 kV	@LTE	475 MW	L/O	Perry G1 22.0 kV
(5)	North Meshoppen – Towanda (ETL) 115 kV	@EMER	172 MW	L/O	Canyon – East Towanda 230 kV
(6)	Falconer – Warren (171) 115 kV	@STE	119 MW	L/O	Warren – Glade 230 kV
(7)	Montor Falls – Coddington Road (982) 115 kV	@STE	144 MW	L/O	Oakdale – Clarks Corners (36) 345 kV
(8)	Packard – Niagara Boulevard (181-922) 115 kV	@LTE	101 MW	L/O	Watercure – Oakdale (31) 345 kV Oakdale – Clarks Corners (36) 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.



TABLE 3.b

**PJM to NYISO INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2016**  
**ALL LINES I/S**

<b>PJM to NYISO</b>	<b>DIRECT TIE</b>	<b>NYISO FACILITY</b>	<b>PJM FACILITY</b>
<b>NORMAL</b>	1800 <sup>(1)</sup>	2500 <sup>(2)</sup>	1350 <sup>(3)</sup>
<b>3-115-O/S</b>	2075 <sup>(4)</sup>	2850 <sup>(2)</sup>	2650 <sup>(5)</sup>
<b>EMERGENCY</b>	1800 <sup>(1)</sup>	2500 <sup>(2)</sup>	1350 <sup>(3)</sup>
<b>3-115-O/S</b>	2300 <sup>(6)</sup>	2850 <sup>(7)</sup>	2650 <sup>(5)</sup>

	<b>LIMITING ELEMENT</b>	<b>RATING</b>		<b>LIMITING CONTINGENCY</b>
(1)	North Waverly – East Sayre (956) 115 kV	@STE 143 MW	L/O	Hillside – East Towanda (70) 230 kV
(2)	North Waverly – Lounsbury 115 kV	@STE 143 MW	L/O	Watercure – Oakdale (31) 345 kV
(3)	East Sayre – Towanda 115 kV	@EMER 131 MW	L/O	Hillside – East Towanda (70) 230 kV
(4)	Hillside – East Towanda (70) 230 kV	@LTE 531 MW	L/O	Watercure – Mainesburg (30) 345 kV
(5)	Tennessee Gas – South Troy 115 kV	@EMER 149 MW	L/O	Hillside – East Towanda (70) 230 kV
(6)	Hillside – East Towanda (70) 230 kV	@STE 617 MW	L/O	Watercure – Mainesburg (30) 345 kV
(7)	Chemung – North Waverly (962) 115 kV	@STE 143 MW	L/O	Watercure – Oakdale (31) 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.

TABLE 4

**IESO to NYISO INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2016**

**ALL LINES I/S**

	DIRECT TIE	NYISO FACILITY	IESO FACILITY	DIRECT TIE	NYISO FACILITY	IESO FACILITY
<b>Ontario to New York</b>	<b>100% Zone A Load (2,680 MW)</b>			<b>80% Zone A Load (2,144 MW)*</b>		
<b>NORMAL</b>	1875 <sup>(1)</sup>	125 <sup>(2)</sup>	2375 <sup>(3)</sup>	1975 <sup>(1)</sup>	1350 <sup>(2)</sup>	2375 <sup>(3)</sup>
<b>EMERGENCY</b>	2225 <sup>(4)</sup>	1425 <sup>(5)</sup>	2950 <sup>(6)</sup>	2400 <sup>(7)</sup>	2675 <sup>(5)</sup>	2950 <sup>(6)</sup>
<b>Dunkirk-South Ripley (68) 230 kV &amp; Warren-Falconer (171) 115 kV Out-of-service</b>						
<b>NORMAL</b>	1900 <sup>(1)</sup>	425 <sup>(2)</sup>	2375 <sup>(3)</sup>	2000 <sup>(1)</sup>	1750 <sup>(2)</sup>	2375 <sup>(3)</sup>
<b>EMERGENCY</b>	2300 <sup>(4)</sup>	1925 <sup>(5)</sup>	2950 <sup>(6)</sup>	2425 <sup>(7)</sup>	3325 <sup>(5)</sup>	2950 <sup>(6)</sup>

	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	@STE	846 MW	L/O Niagara – Packard (62) 230 kV Beck – Packard (PB76) 230 kV
(3)	Allanburg – Mount Hope (Q30M) 230 kV	@STE	392 MW	L/O Beck – Middleport – Beach (Q24HM) 230 kV Beck – Middleport – Beach (Q29HM) 230 kV
(4)	Beck – Niagara (PA27) 230 kV	@NORM	400 MW	Pre-Contingency Loading
(5)	Packard – Sawyer (77) 230 kV	@STE	746 MW	L/O Packard – Sawyer (78) 230 kV
(6)	Allanburg – Mount Hope (Q30M) 230 kV	@NORM	370 MW	Pre-Contingency Loading
(7)	Beck – Niagara (PA27) 230 kV	@STE	558 MW	L/O Beck – Niagara (PA 301) 345 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. 2,144 MW of Zone A Load would equate to a NYCA Load of 26,675 MW

TABLE 5

**NYISO to IESO INTERFACE THERMAL TRANSFER LIMITS - SUMMER 2016**  
**ALL LINES I/S**

	DIRECT TIE	NYISO FACILITY	IESO FACILITY
<b>New York to Ontario</b>			
<b>NORMAL</b>	1625 <sup>(1)</sup>		900 <sup>(2,5)</sup>
<b>EMERGENCY</b>	2250 <sup>(3)</sup>		1225 <sup>(4,5)</sup>

	LIMITING ELEMENT	RATING		LIMITING CONTINGENCY
(1)	Beck – Niagara (PA27) 230 kV	@LTE 460 MW	L/O	Beck – Niagara (PA 301) 345 kV Q28A 220 kV Beck #2 units 19 & 20 + Thorold GS
(2)	Allanburg – Mount Hope (Q30M) 230 kV	@STE 392 MW	L/O	Beck – Middleport – Beach (Q24HM) 230 kV 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
(5)	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.			