NYISO Operating Study Winter 2016-17

A report from the New York Independent System Operator

December 15, 2016

Executive Summary

This study is conducted as a seasonal review of the projected thermal transfer capability for the winter 2016-17 operating 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 peak load and dispatch conditions studied.

The evaluated limits are shown in Tables 1 through 4. Differences in the evaluated internal interface limits from winter 2015-2016 to winter 2016-2017 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 1875 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 5175 MW, Total East is limited to 5425 MW and Central East is limited to 2775 MW. Moses South is limited to 1850 MW due to the Moses – Massena 230 kV line modeled in-service. Differences in the evaluated external interface limits from winter 2015-2016 to winter 2016-2017 are shown on page 13. All the evaluated external interface limits have changed from the winter of 2015-2016. The increased line rating on the limiting element has increased both the NYISO-ISONE and ISONE-NYISO interface limits. NYISO-ISONE is limited to 1625 MW and ISONE-NYISO is limited to 1975 MW. 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. This has caused the NYISO-IESO and IESO-NYISO interfaces to be limited to 1750 MW and 1900 MW, respectively. The PJM-NYISO interface is limited to 2200 MW, mainly due to the Ramapo 345 kV PAR (3500) being modeled out-of-service along with the redistribution of flows in western NY and western PJM. Allowing the 115 kV limiting element to exceed its LTE rating and reach its STE rating post contingency for normal transfers, limits the NY-PJM interface to 1475 MW.

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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 winter 2016-17 capability period. This analysis indicates that, for the winter 2016-17 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 forecast peak 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
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4. SYSTEM REPRESENTATION AND BASE STUDY ASSUMPTIONS

4.1 System Representation

The representation was developed from the NYISO Data Bank and assumes the forecast winter coincident peak load of 24,445 MW. The other NPCC Balancing Areas and adjacent Regional representations were obtained from the RFC-NPCC winter 2016-17 Reliability Assessment power flow base case and has been updated to reflect the winter 2016-17 operating 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 winter 2015-16 capability period:

Deactivations	
Ravenswood 04	-16 MW
Ravenswood 05	-17 MW
Ravenswood 06	-17 MW
Astoria GT 8	-15 MW
Astoria GT 10	-23 MW
Astoria GT 11	-24 MW
Huntley 67	-188 MW
Huntley 68	-187 MW
Total Retirements	**-487 MW**
Additions	
Bowline 2 (Uprate)	378 MW
Total Additions	**378 MW**

B. Transmission Facilities Changes

Significant facility changes since the winter 2015-16 capability period include:

- Addition of the Pierce Brook 345 kV Substation
- Transmission Owner Transmission Solutions (TOTS)
- Packard to Sawyer Series Reactors
- Ramapo PAR 3500 out-of-service
- Moses to Massena (MMS1) 230 kV line in-service

Pierce Brook is being added on the 345 kV Homer City-Five Mile Road line between New York and PJM. Pierce Brook is expected to be completed by Q3 2016 and will be located in PJM. The new station will change the NY-PJM interface definition by replacing the Homer City-Five Mile 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 installed to help alleviate the expected increase in congestion in the western NY system.

The Ramapo 345 kV PAR (3500) is modeled out-of-service for the winter 2016-17 operating period.

Moses to Massena (MMS1) 230 kV line is modeled in-service for the winter 2016-17 operating period.

4.2 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 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 winter 2016-17 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 winter 2016-17 base case, the schedule for the tie is 200 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 winter 2016-17, and the MMWG winter 2016-17 power flow base cases. The series reactors on the Dunwoodie – Mott Haven (71 and 72) and the Sprain Brook – W. 49th St. 345 kV cables (M51 and M52) are out of service in the base case. The series reactors on the Sprain Brook – East Garden City 345 kV (Y49), E. 179th St. – Hell Gate (15055) 138 kV feeder and Gowanus to Farragut (41 and 42) cables are in-service.

5. DISCUSSION

5.1 Resource Assessment

A. Load and Capacity Assessment

The forecast peak demand for the winter 2016-17 capability period is 24,445 MW (1). This forecast is approximately 70 MW (0.29%) lower than the forecast of 24,515 MW for the winter 2015-16 capability period, and 1,293 MW (5.02%) lower than the all-time New York Control Area (NYCA) seasonal peak of 25,738 MW, which occurred on January 7, 2014.

The Installed Capacity (ICAP) requirement for the winter period is 28,723 MW based on the NYSRC 17.5% Installed Reserve Margin (IRM) requirement for the 2016-2017 Capability Year. NYCA generation capacity for winter 2016-17 is 40,945 MW, and net external capacity purchases of 504 MW have been secured for the winter period. The combined capacity resources represent a 69.6% margin above the forecast peak demand of 24,445 MW. These values were taken from the 2016 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/2016_Load__Capacity_Data_Report.pdf

The equivalent forced outage rate is 10.70%, and includes forced outages and de-ratings based on historical performance of all generation in the NYCA. For winter 2015-16, 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 winter 2016-17. 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". NYISO contingencies include stuck breakers, double tower contingencies, single element contingencies and loss of generation facilities. For this assessment period the most severe single generation contingency is Nine Mile Point 2 at 1,300 MW. 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.

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

Figure 1 presents a comparison of the winter 2016-17 thermal transfer limits to winter 2015-16 transfer limits. Changes in these limits from the 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 winter 2016-17 and 2015-16, with limiting element/contingency descriptions. Significant differences in these thermal transfer limits are discussed below.

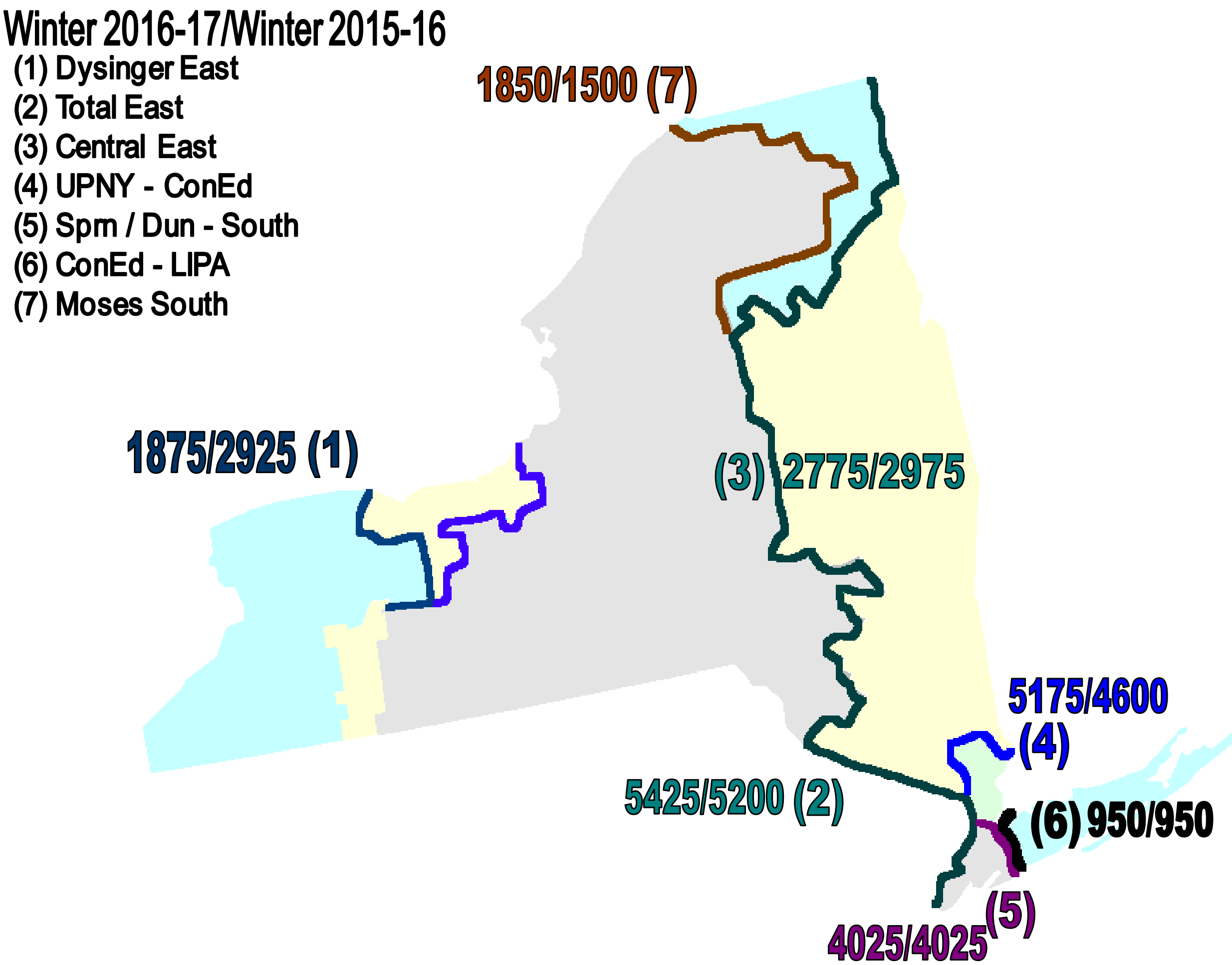

Figure 1 – Cross-State Thermal Transfer Limits

Dysinger East interface thermal transfer limit decreased 1,050 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 the 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 255 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 5900 MW for the same limiting element and contingency as UPNY-ConEd.

Moses South interface thermal transfer limit increased 250 MW. This is mainly due to the Moses – Massena (MMS1) 230 kV line being modeled in-service.

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 (winter 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	-210 MW	115 MW
Jamaica – Valley Stream 138 kV	-108 MW	120 MW
Sprain Brook – E. Garden City 345 kV	635 MW	635 MW

ISO-NE – LIPA PAR Settings

	Normal	Emergency
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 approximately 459 MW of emergency transfer from Long Island to Con Edison, if requested, via the ties.

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

5.3 Thermal Transfer Capabilities with Adjacent Balancing Areas

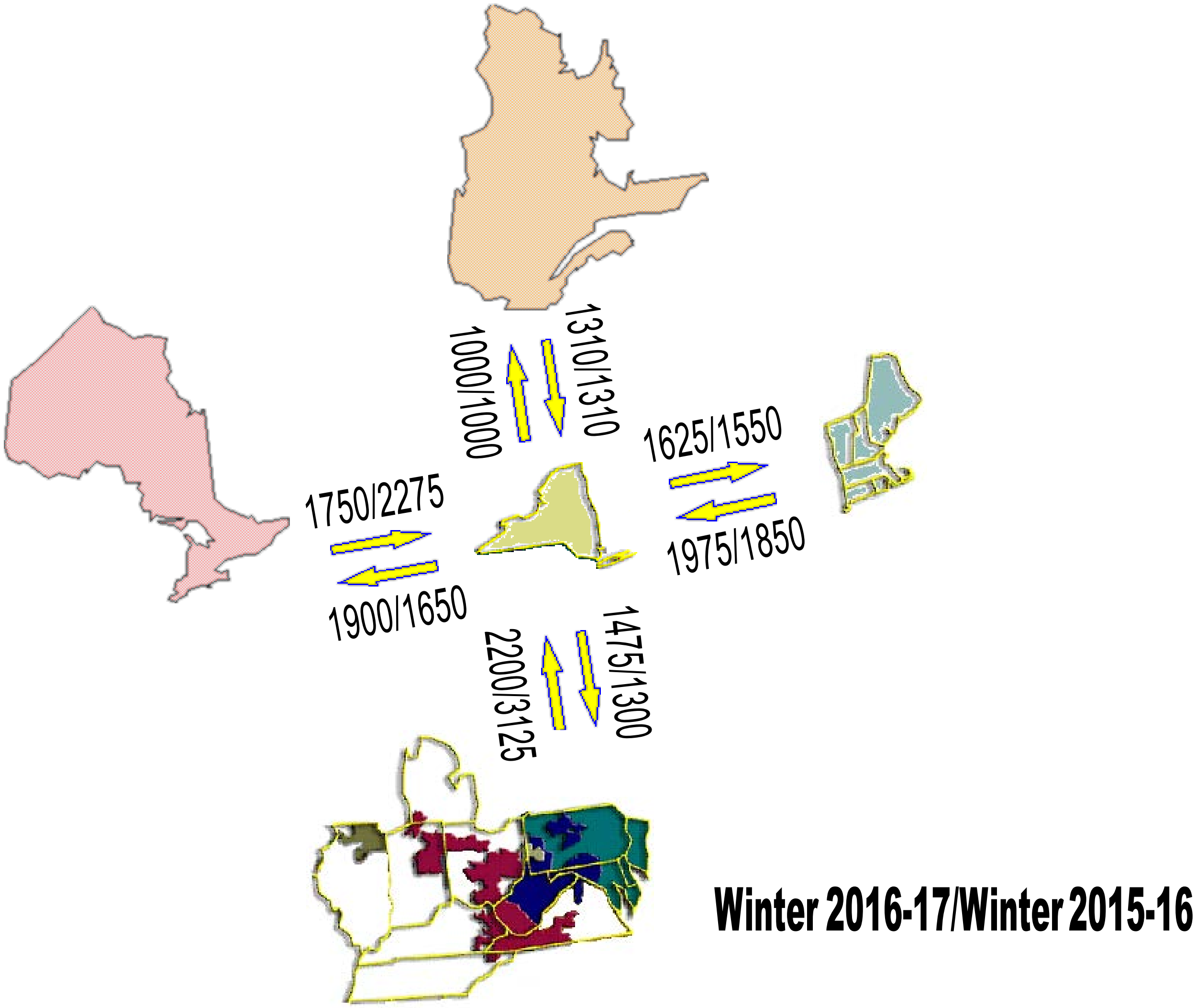

Figure 2 – Inter-Area Thermal Transfer Capabilities (2)

Thermal transfer limits between New York and adjacent Balancing Areas also are determined in this analysis for the conditions studied. As noted in the introduction transfer limits cited in this report are based on the forecast peak 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.

PJM – New York interface thermal transfer limit decreased 925 MW. This is due to the Branchburg-Ramapo PAR 3500 being modeled out-of-service and the change in pre-flows on the direct ties cause by generation changes in PJM.

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

New York – PJM interface thermal transfer limit increased 175 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.

IESO – New York interface thermal transfer limit decreased 525 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 250 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.

ISONE – New York interface thermal transfer limit increased 125 MW. This is due to the increase in the limiting element's line rating.

New York – ISONE interface thermal transfer limit increased 75 MW. This is due to the increase in the limiting element's line rating.

A. New York – New England Analysis

a. New England Transmission/Capacity Additions

Transmission

For the 2016 – 2017 Winter study period there are no major projects coming into service that will impact the transmission capability of New York – New England. Two notable projects that came into service are the Haddam 345/115 kV transformer addition in Connecticut and Erving 115 kV substation in Western Massachusetts.

The Haddam 345/115 kV transformer is the second transformer at Haddam substation allowing more generation to flow into West and Southwest Connecticut; there is no noticeable impact on thermal transfer capability.

The Erving 115 kV substation is built south of Northfield and has no noticeable impact on thermal transfer capability. Plans exist to connect Erving and Northfield with a 345/115 kV transformer early in 2017. This new 345/115 kV transformer at Northfield can have an impact on New York – New England transfers, which we will evaluate as part of the Summer 2017 Operating Study.

Other equipment added that have no impact on thermal transfer capability are North Keene 115 kV substation and connecting line built on a through path of the East-West interface in New Hampshire, Saco Valley synchronous condenser in New Hampshire, Eagle 345 and 115 kV substation, 345/115 kV transformer, connecting lines and four 115 kV capacitors in New Hampshire and Westside 115kV capacitor in Connecticut.

Capacity

In the New England Control Area, from October 2016 through March 2017, a total of 329 MW of new generation is expected. Wind Units make up 313 MW, solar PV makes up 39 MW and a 16 MW battery makes up the rest. There are no major retirements 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 100 MW into NE on the PV20 tie when the case was stressed for NE to NY transfer capability. When the case was stressed for NY to NE transfer capability, PV20 tie flow was reduced to 0 MW because NY does not allow credit to be taken for post contingency insertion of Sand Bar overload mitigation systems (OMS) reactor to fix over STE overloads.

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.

For the winter 2016-17 study the most limiting facility for the PJM to NYISO transfer was identified as an overload on the Everts Dive – South Troy 115 kV line (a segment on the Everts Drive – East Towanda 115 kV circuit) for a loss of Watercure – Mainesburg 345 kV line. This overload was observed due to a new 345/115 kV transformer being installed at the Mainesburg station. PJM has developed an Operating Procedure to manually open the Mainesburg "B3" CB pre-contingency, to alleviate this constrain. With the switching being implemented pre-contingency would result into the Mainesburg 345/115 kV transformer being open ended on the high side post-contingency.

One of the limiting facilities for the PJM to NYISO transfer was identified as an overload on the Farms Valley – Pierce Brook 115 kV line for l/o Glade-Seneca 230 kV, this constrain could be mitigated via opening the "Pierce Brook" CB at Farmers Valley, as per operating memo OM106.

c. DC Ties

Neptune DC tie is expected to be available at full capability, 660 MW, for winter 2016-17. Neptune DC tie is a transmission facility connecting Raritan River 230 kV (First Energy East, PJM) to Duffy Avenue 345 kV (LIPA, NYISO). Back to Back AC-DC-AC Hudson Transmission Project (HTP) tie is expected to be available at full capability, 660 MW, for winter 2016-17. HTP is a transmission tie connecting Bergen 230 kV (PSEG, PJM) to the West 49th street station at (ConEd, NYISO). Transfer across HTP might be limited, based on the real-time system conditions, down to the Firm Transmission Withdrawal Rights of 320 MW, as specified in the Interconnection Service Agreement O66. Both DC links have only withdrawal rights from PJM region.

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 winter 2016-17, 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 winter 2016-17 study.

e. New Coordinated Transaction Scheduling system (CTS)

On November 4th 2014 PJM Interconnection and the New York Independent System Operator launched a coordinated transaction scheduling system to streamline the flow of electricity across the two systems, cutting energy production costs.

The system incorporates projected price differences between the two markets into interregional scheduling decisions and is expected to reduce LMP price differential between two markets.

f. Opening of western PJM - New York 230/115 kV Ties as Required

In recognition of recent field experience that simultaneous high transfers in western New York with high transfers to PJM can result in potential cascade contingencies on NYISO 115 kV circuits a NYISO/PJM operating protocol was introduced in the summer of 2014. The Warren – Falconer 115 KV and the Erie – South Ripley 230 kV interconnections, between First Energy East and New York may be opened in accordance with NYISO and PJM operating protocol provided that this action does not cause unacceptable impact on local reliability in either system.

With the Shawville plant being re-powered as a gas fired facility (December 2016 is expected full commercial operation time-frame) in North-Eastern portion of Pennsylvania, PJM expects substantial push back on the North to South flow between First Energy East and New York, to extend that switching on the Dunkirk-South Ripley 230 kV line is no longer required and line to be operate as normally closed, in accordance with the way transmission system was designed.

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 with 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

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

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 1675 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 199 MW in winter, 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 - WINTER 2016-17
ALL LINES I/S

	Dysinger East	UPNY - ConEd $_1$	Sprain Brook Dunwoodie - So.	ConEd – LIPA Transfer Capability
NORMAL	1875 (1)	5175 (3)	4025 (5)	950 (7)
EMERGENCY	2700 (2)	5650 (4)	4125 (6)	1600 (8)

	LIMITING ELEMENT	RATING			LIMITING CONTINGENCY
(1)	Niagara – Packard (61) 230 kV	@STE	949 MW	L/O	Beck – Packard (BP76) 230 kV Niagara – Packard (62) 230 kV
(2)	Niagara 230/115 kV Transformer	@STE	288 MW	L/O	Niagara – Robinson Rd. (64) 230 kV
(3)	Leeds – Pleasant Valley (92) 345 kV	@LTE	1783 MW	L/O	Athens – Pleasant Valley (91) 345 kV
(4)	Leeds – Pleasant Valley (92) 345 kV	@STE	1912 MW	L/O	Athens – Pleasant Valley (91) 345 kV
(5)	Dunwoodie – Mott Haven (71) 345 kV	@SCUC $_2$	1084 MW	L/O	Dunwoodie – Mott Haven (72) 345 kV
(6)	Dunwoodie – Mott Haven (71) 345 kV	@NORM	741 MW		Pre-Contingency Loading
(7)	Dunwoodie – Shore Rd. (Y50) 345 kV	@LTE	977 MW $_3$	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	741 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 (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 - WINTER 2016-17
ALL LINES I/S

	MSC-7040 FLOW HQ->NY 600 MW	MSC-7040 FLOW 0 MW	MSC-7040 FLOW NY->HQ 600 MW
CENTRAL EAST			
NORMAL	2775 (1)	2775 (1)	2775 (1)
EMERGENCY	3150 (3)	3150 (3)	3150 (3)
TOTAL EAST			
NORMAL	5425 (2)	5425 (2)	5425 (2)
EMERGENCY	5425 (4)	5425 (4)	5425 (4)
MOSES SOUTH			
NORMAL	2300 (7)	1850 (5)	1325 (5)
EMERGENCY	3100 (8)	2475 (6)	1750 (6)

	LIMITING ELEMENT	RATING			LIMITING CONTINGENCY
(1)	New Scotland – Leeds (94) 345 kV	@LTE	1692 MW	L/O	New Scotland – Leeds (93) 345 kV
(2)	Coopers Corners – Middletown TAP (CMT-34) 345 kV	@LTE	1793 MW	L/O	Coopers Corners – Rock Tavern (CRT-42) 345 kV Coopers Corners 345/115 kV Transformer
(3)	New Scotland – Leeds (94) 345 kV	@STE	1912 MW	L/O	New Scotland – Leeds (93) 345 kV
(4)	Coopers Corners – Middletown TAP (CMT-34) 345 kV	@STE	1793 MW	L/O	Coopers Corners – Rock Tavern (CRT-42) 345 kV
(5)	Adirondack – Porter (12) 230 kV	@LTE	478 MW	L/O	Moses – Massena (MMS1) 230 kV Moses – Massena (MMS2) 230 kV
(6)	Moses – Massena (MMS1) 230 kV	@STE	1593 MW	L/O	Moses – Massena (MMS2) 230 kV
(7)	Adirondack – Porter (12) 230 kV	@LTE	478 MW	L/O	Chateauguay – Massena (MSC-7040) 765 kV Massena – Marcy (MSU1) 765 kV and TransÉnergie delivery
(8)	Browns Falls – Taylorville (4) 115 kV	@STE	152 MW	L/O	Browns Falls – Taylorville (3) 115 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 - WINTER 2016-17
ALL LINES I/S

New York to New England	DIRECT TIE	NYISO FACILITY	ISO-NE FACILITY
		Northport –Norwalk 100 MW	
NORMAL	1675 (1)	3000 (4)	3025 (6)
EMERGENCY	2125 (2)	3550 (5)	3025 (7)
		Northport –Norwalk 0 MW	
NORMAL	1625 (1)	3025 (4)	3050 (6)
EMERGENCY	2125 (3)	3600 (5)	3050 (7)

	LIMITING ELEMENT	RATING			LIMITING CONTINGENCY
(1)	Pleasant Valley – Long Mountain (398) 345 kV	@LTE	1549 MW	L/O	PV-20 Overload Mitigation Scheme
(2)	Northport (PAR) 138 kV	@STE	569MW	L/O	Pleasant Valley – Long Mountain (398) 345 kV
(3)	Pleasant Valley – Long Mountain (398) 345 kV	@STE	1796 MW	L/O	Millstone G3 24.0 kV
(4)	New Scotland – Alps (2) 345 kV	@LTE	1410 MW	L/O	Long Mountain – Pleasant Valley (398) 345 kV Smithfield – Salisbury (690) 69 kV
(5)	Reynolds Road – Greenbush (9) 115 kV	@STE	398 MW	L/O	New Scotland – Alps (2) 345 kV
(6)	Berkshire – Northfield (312) 345 kV	@LTE	1793 MW	L/O	Pleasant Valley – Long Mountain (398) 345 kV
(7)	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 - WINTER 2016-17
ALL LINES I/S

New England to New York	DIRECT TIE	NYISO FACILITY	ISO-NE FACILITY
		Norwalk –Northport @ 0 MW	
NORMAL	1975 (1)		1475 (5)
EMERGENCY	2275 (2)		1475 (5)
		Norwalk –Northport @ 100 MW	
NORMAL	1950 (3)		1500 (5)
EMERGENCY	2000 (4)		1500 (5)
		Norwalk–Northport @ 200 MW	
NORMAL	1425 (3)		1500 (5)
EMERGENCY	1475 (4)		1500 (5)

	LIMITING ELEMENT	RATING			LIMITING CONTINGENCY
(1)	Pleasant Valley – Long Mountain (398) 345 kV	@LTE	1549MW	L/O	Alps – Berkshire (393) 345 kV Reynolds – Alps (1) 345 kV New Scotland – Alps (2) 345 kV Empire unit G1
(2)	Pleasant Valley – Long Mountain (398) 345 kV	@NORM	1414 MW		Pre-Contingency Loading
(3)	Northport (PAR) 138 kV	@LTE	562 MW	L/O	Pleasant Valley – Long Mountain (398) 345 kV Pleasant Valley – East Fishkill (F37) 345 kV
(4)	Northport (PAR) 138 kV	@STE	569MW	L/O	Pleasant Valley – Long Mountain (398) 345 kV
(5)	Norwalk Junction – Archers Lane (3403D) 345 kV	@LTE	922 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 - WINTER 2016-17
ALL LINES I/S

NYISO to PJM	DIRECT TIE	NYISO FACILITY	PJM FACILITY
NORMAL	1800 (1)	1225 (2)	1875 (3)
3-115 & 68 O/S	2000 (4)	1475 (5)	1575 (3)
EMERGENCY	1800 (1)	1875 (6)	2450 (7)
3-115 & 68 O/S	2075 (4)	1625 (6)	1725 (8)

	LIMITING ELEMENT	RATING			LIMITING CONTINGENCY
(1)	Falconer – Warren (171) 115 kV	@STE	140 MW	L/O	South Ripley – Dunkirk (68) 230 kV
(2)	Gardenville – Cloverbank (142) 115 kV	@STE	123 MW	L/O	Gardenville – Dunkirk (73) 230 kV Gardenville – Dunkirk (74) 230 kV
(3)	Peach Bottom – Conastone (5012) 500 kV	@LTE	3022 MW	L/O	Hunterstown – Conastone (2013) 500 kV
(4)	Hillside – East Towanda (70) 230 kV	@LTE	564 MW	L/O	Watercure – Mainesburg (30) 345 kV
(5)	Montor Falls – Coddington Road (982) 115 kV	@STE	162 MW	L/O	Watercure – Oakdale (31) 345 kV Oakdale – Clarks Corners (36) 345 kV
(6)	Montor Falls – Coddington Road (982) 115 kV	@STE	162 MW	L/O	Oakdale – Clarks Corners (36) 345 kV
(7)	Towanda – East Sayre 115 kV	@EMER	131 MW	L/O	Hillside – East Towanda (70) 230 kV
(8)	Pierce Brook – Farmers Valley 115 kV	@EMER	191 MW	L/O	Seneca – Glad 230 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 - WINTER 2016-17
ALL LINES I/S

PJM to NYISO	DIRECT TIE	NYISO FACILITY	PJM FACILITY
NORMAL	1800 (1)	2350 (3)	1375 (5)
3-115-O/S	2200 (6)	2600 (3)	2300 (7)
EMERGENCY	1900 (2)	2700 (4)	1375 (5)
3-115-O/S	2300 (9)	3000 (10)	2300 (8)

	LIMITING ELEMENT	RATING			LIMITING CONTINGENCY
(1)	North Waverly – East Sayre (956) 115 kV	@STE	139 MW	L/O	Hillside – East Towanda (70) 230 kV Hillside – Watercure (69) 230 kV Hillside 230/34.5 kV Transformer Hillside 115/34.5 kV Transformer
(2)	North Waverly – East Sayre (956) 115 kV	@STE	139 MW	L/O	Hillside – East Towanda (70) 230 kV
(3)	North Waverly – Lounsberry 115 kV	@STE	167 MW	L/O	Watercure – Oakdale (31) 345 kV Clarks Corners – Oakdale (36) 345 kV
(4)	North Waverly – Lounsberry 115 kV	@STE	167 MW	L/O	Watercure – Oakdale (31) 345 kV
(5)	East Sayre – Towanda 115 kV	@EMER	131 MW	L/O	Hillside – East Towanda (70) 230 kV Hillside – Watercure (69) 230 kV Hillside 230/34.5 kV Transformer Hillside 115/34.5 kV Transformer
(6)	Hillside – East Towanda (70) 230 kV	@LTE	564 MW	L/O	Watercure – Mainesburg (30) 345 kV
(7)	North Meshoppen 230/115 kV Transformer	@EMER	217 MW	L/O	East Towanda – Canyon 230 kV Canyon – East Meshoppen 230 kV North Meshoppen 230/115 kV Transformer
(8)	North Meshoppen 230/115 kV Transformer	@EMER	217 MW	L/O	East Towanda – Canyon 230 kV
(9)	Hillside – East Towanda (70) 230 kV	@STE	598 MW	L/O	Watercure – Mainesburg (30) 345 kV
(10)	Watercure – Oakdale (71) 230 kV	@STE	440 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 - WINTER 2016-17
ALL LINES I/S

	DIRECT TIE	NYISO FACILITY	IESO FACILITY
Ontario to New York			
NORMAL	2275 (1)	1350 (2)	2925 (3)
EMERGENCY	2775 (4)	2625 (5)	3575 (6)
Dunkirk-South Ripley (68) 230 kV & Warren-Falconer (171) 115 kV Out-of-service			
NORMAL	2300 (1)	1750 (2)	2925 (3)
EMERGENCY	2850 (4)	3275 (5)	3575 (6)

	LIMITING ELEMENT	RATING			LIMITING CONTINGENCY
(1)	Beck – Niagara (PA27) 230 kV	@LTE	540 MW	L/O	Beck – Niagara (PA 301) 345 kV
(2)	Niagara – Packard (61) 230 kV	@STE	949 MW	L/O	Niagara – Packard (62) 230 kV Beck – Packard (PB76) 230 kV
(3)	Allanburg – Mount Hope (Q30M) 230 kV	@STE	450 MW	L/O	Beck – Middleport – Beach (Q24HM) 230 kV Beck – Middleport – Beach (Q29HM) 230 kV
(4)	Beck – Niagara (PA27) 230 kV	@NORM	480 MW		Pre-Contingency Loading
(5)	Packard – Sawyer (77) 230 kV	@STE	836 MW	L/O	Packard – Sawyer (78) 230 kV
(6)	Allanburg – Mount Hope (Q30M) 230 kV	@NORM	427 MW		Pre-Contingency Loading

Note
1: Ontario - NYISO limit used the NYSRC Rules Exception No. 13 – Post Contingency Flows on Niagara Project Facilities

TABLE 5

NYISO to IESO INTERFACE THERMAL TRANSFER LIMITS - WINTER 2016-17
ALL LINES I/S

	DIRECT TIE	NYISO FACILITY	IESO FACILITY
New York to Ontario			
NORMAL	1900 (1)		925 (2,5)
EMERGENCY	2625 (3)		1500 (4,5)

	LIMITING ELEMENT	RATING			LIMITING CONTINGENCY
(1)	Beck – Niagara (PA27) 230 kV	@LTE	540 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	450 MW	L/O	Beck – Middleport – Beach (Q24HM) 230 kV Beck – Middleport – Beach (Q29HM) 230 kV
(3)	Beck – Niagara (PA27) 230 kV	@NORM	480 MW		Pre-Contingency Loading
(4)	Beck – Hannon (Q29HM) 230 kV	@NORM	507 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.