2020 New York – New England Transfer Limit Stability Analysis

New York ISO Operations and ISO New England Operations

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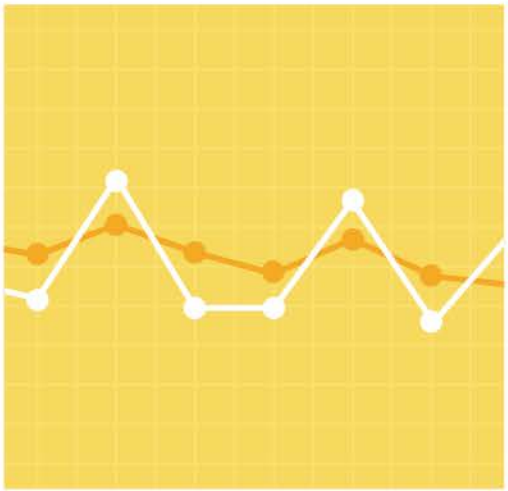
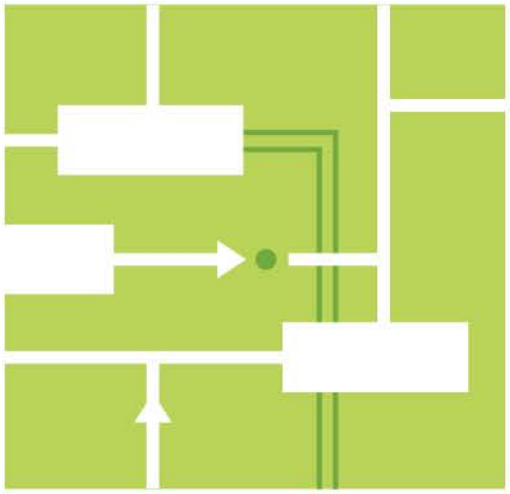
NYISO - FINAL





Executive Summary

This report describes the assumptions, methodology and results from an analysis of transfer limits between the New York ISO (NY) and ISO-New England (NE). Transfer limits based on system stability were examined and compared to current thermal limitations.

A study period through Summer 2020 was established. Based on this assessment of planned system changes between now and Summer 2020, the stability limits presented in this report will be implemented. Major changes to the system included in this study are the retirement of Indian Point Unit #2 and the addition of the Cricket Valley Energy Center LLC generation facility ("Cricket Valley"), along with its corresponding transmission changes and system upgrades in the New England system. This system configuration will be applicable until a major system change occurs close to the NY-NE tie lines, such as the expected retirement of the Indian Point Unit #3 generation facility in 2021. The thermal study results are as reported in the NYISO Summer 2019 Operating Study. The results represent snapshots of typical operating conditions. Actual operating limits will be determined in real-time based on prevailing system conditions. Please refer to the latest applicable seasonal Operating Study for the most recent thermal limits.

This study is being conducted due to Cricket Valley generation facility coming into service. Cricket Valley is a natural gas plant that is interconnected via a new Cricket Valley 345 kV substation on the 398 line, a 345kV tie line between New York and New England, and is located within Consolidated Edison's service territory. The plant consists of three combined cycle trains, with each train consisting of a combustion turbine generator (CTG) and a steam turbine generator (STG). The output of each combustion unit is 226 MW. Each steam unit has an output of 139 MW. Overall, maximum generating capacity of the plant is 1095 MW.

Cricket Valley is located approximately 14.5 miles from Pleasant Valley and 3.25 miles from the New York – Connecticut border. The Cricket Valley substation consists of a new six breaker ring bus configuration that tapped the existing Pleasant Valley – Long Mountain 345 kV tie line (398 line).

The following transmission upgrades were performed to mitigate any potential degradation of the current system transfer limits incurred by the addition of Cricket Valley:

1. Re-conductor and upgraded the thermal ratings of the 398 line from Cricket Valley to Long Mountain
2. Built an additional 345kV line from Cricket Valley to Pleasant Valley (F84)

The previous 398 line section was renamed as the F83 line from Cricket Valley to Pleasant Valley.

With the addition of a 1095 MW power plant not far from the New York (NY) – New England (NE) border along with the transmission upgrades associated with the project, there is the potential for a change in the stability characteristics both in the local area and for the NY – NE Interface. Therefore, the Interface

was re-assessed under both all lines in (ALI) and facility out conditions to determine the impact on stability limits.

The stability transfer limit study was conducted in accordance with the stability criteria indicated in NPCC Regional Reliability Reference Directory # 1, Design and Operation of the Bulk Power System, and New York State Reliability Council (NYSRC) Reliability Rule C.1-R3.

The required reliability criterion stated in ISO-NE Operating Procedure 19 – Transmission Operations and Master/Local Control Center Procedure No. 15 were also respected in this study. Applicable sensitivities were tested for critical generation plants local to the Interface and were incorporated into the finalized stability limits.

The final stability limits were jointly agreed upon between NYISO and ISO-NE and are summarized in the table below.

Stability Limits		
Facility Out	**NY-NE**	**NE-NY**
All Lines In-Service	2200	2200
398	1400	800
398 & NF 2T OPEN	1750	N/A
312 & 393	1950	1650
393	1950	1700
312	2200	1800
354	2200	1600
F83 or F84	2200	1150
F83 or F84 with 2 CV IS	N/A	1650
F83 or F84 with 1 CV IS	N/A	2050
CV 3 OPEN	N/A	1850
PV RNS3 OPEN	N/A	1400
PV RNS3 OPEN & CV 5 OPEN	N/A	1800
CV 4 OPEN	N/A	1850
PV RNS 2 OPEN	N/A	1400
PV RNS2 OP, CV 6 OP	N/A	1800

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Section 1
Introduction

In 2020, the Cricket Valley generation facility went into service. Cricket Valley interconnects at the Cricket Valley substation between the Pleasant Valley and Long Mountain substations on a major 345 kV tie line between New England (NE) - New York (NY), tapping the existing 398 line and terminating it at Cricket Valley. It consists of three sets of combined cycle power plant units with three sets of combustion turbine and steam turbine generators. The 398 line from Long Mountain now terminates at the Cricket Valley Station. The old 345 kV line from Pleasant Valley is now terminated at Cricket Valley and named the F83 line. A new parallel 345 kV line, the F84, was installed from Cricket Valley to Pleasant Valley.

In addition to the Cricket Valley power plant, one of New York's nuclear power plants will be retiring. The Indian Point power plant consists of two nuclear reactors named Indian Point 2 and Indian Point 3. Indian Point 2 has a nameplate capacity of 1,299 MW and Indian Point 3 has a nameplate capacity of 1,012 MW. Indian Point 2 is scheduled to retire no later than April 30, 2020, and Indian Point 3 is scheduled to retire no later than April 30, 2021.

Both New England and New York have recently incorporated several transmission upgrades, including the Greater Springfield Reliability Project, Interstate Reliability Project, and Eastover Substation. These resulted in additions, upgrades and modifications of several major 345 kV, 230 kV and 115 kV circuits in the New England and New York systems. These projects were predominantly in the Capital Region, Connecticut, and Western and Central Massachusetts areas. These projects were all modeled in the scope of this study.

With the Cricket Valley generation facility interconnected directly on a NE-NY Interface tie line, it was anticipated that it would impact how the Interface needs to be limited under different facility out conditions. This project also added a parallel line to the existing F83 line to reinforce the flows in that corridor. Also, with the modified transmission topology and new facilities associated with Cricket Valley, the protection of these facilities has also been changed.

This operational analysis report summarizes the results of the joint stability analysis performed between NYISO and ISO-NE to determine the operations stability limits of the NE-NY/NY-NE Interface under light load and peak load conditions and under different facilities out and generation dispatches.

1.1 NY-NE One-Line Diagram

Below in Figure 1 is the pre-Cricket Valley topology of the NY-NE Interface. All the lines are also listed below, in the NY to NE direction, with the corresponding voltage of each.

- Plattsburg – South Hero – Sandbar (PV-20) 115 kV line with PAR controls
- Whitehall – Blissville (K7) 115 kV line with PAR controls
- Eastover – Bear Swamp (E205W) 230 kV
- Hoosick – Bennington (K6) 115 kV
- Alps – Berkshire (393) 345 kV
- North Smithfield – Salisbury (690) 69 kV
- Pleasant Valley – Long Mountain (398) 345 kV

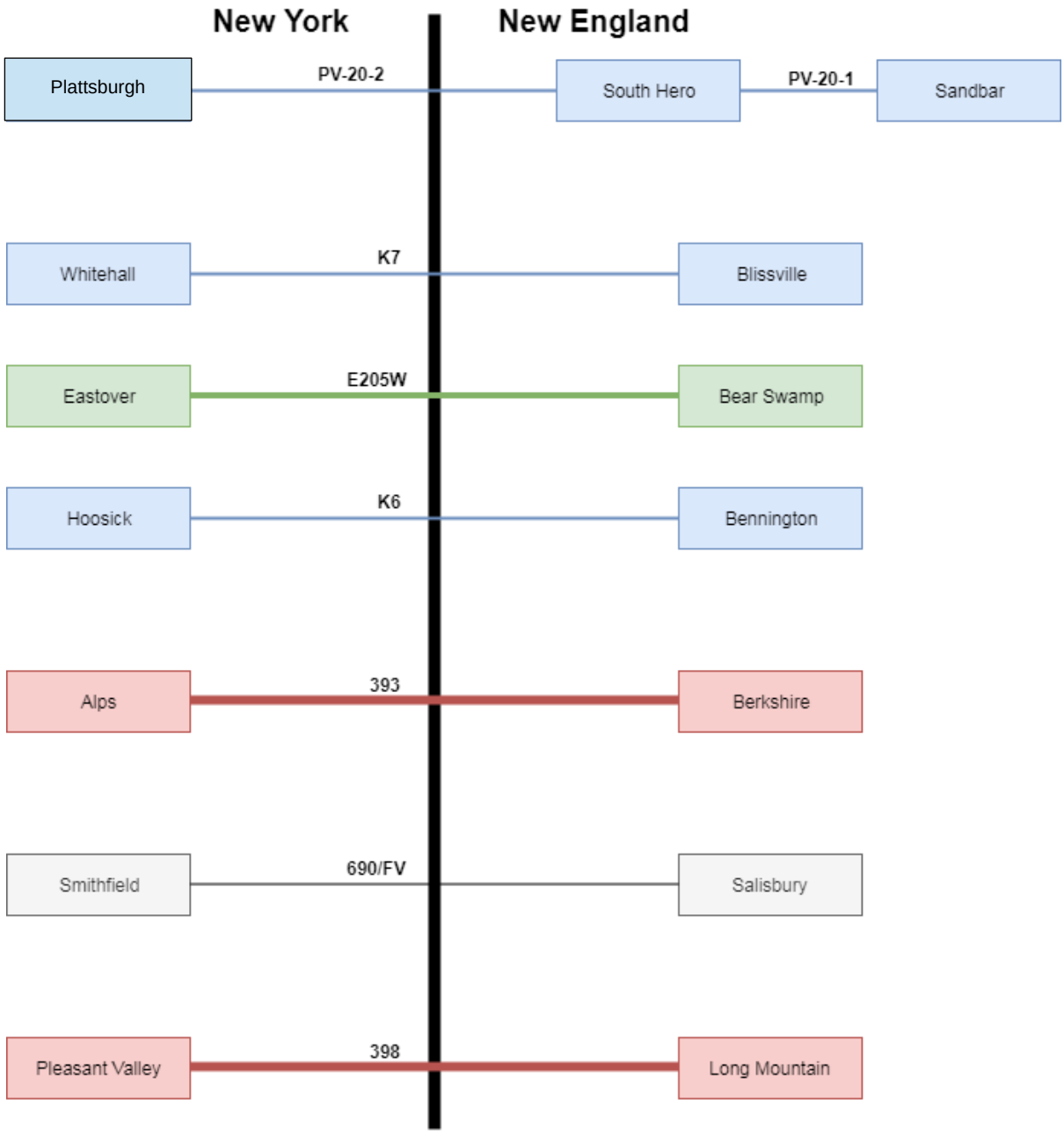

Figure 1*: New York – New England Interface pre-project*

Figure 2 shows the current configuration of the Cricket Valley-Long Mountain interface. The 398 line is the only interface line affected by the addition of the Cricket Valley substation. All the lines are also listed below, in the NY to NE direction, with the corresponding voltage of each.

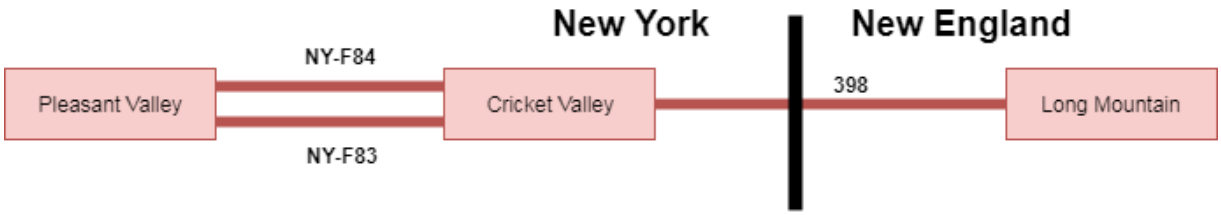

Figure 2 ***: New York – New England Interface post project***

- Plattsburgh – South Hero – Sandbar (PV-20) 115 kV line with PAR controls
- Whitehall – Blissville (K7) 115 kV line with PAR controls
- Eastover – Bear Swamp (E205W) 230 kV
- Hoosick – Bennington (K6) 115 kV
- Alps – Berkshire (393) 345 kV
- North Smithfield – Salisbury (690) 69 kV
- Cricket Valley – Long Mountain (398) 345 kV

Section 2
Assumptions and Methodology

2.1 Scope

The scope of this study was to identify the transfer limits between New England and New York based on the applicable stability criteria. The criteria for defining limits are different for ISO-NE and the NYISO and are detailed in the Results and Analysis section. Results were assessed to both sets of criteria. The most restrictive of the two criteria was used to determine the applicable limit. The study was based on both light load and peak load conditions. This study was conducted for different facility out conditions as well as different generation dispatches of the critical facilities around the NE-NY Interface stability limits. The study entails application of single line to ground faults with and without a stuck breaker, three phase faults and reclosing attempts to determine the most limiting fault to establish a reliable transfer limit.

2.2 Critical Assumptions

For the light load cases, the internal interface flows were maintained as close to targeted simultaneous stresses as possible. These interfaces and corresponding values are shown in Table 2 - 1 below.

There are two interface lines that are Phase Angle Regulator (PAR) controlled. The first of these two lines, the K7 line (Whitehall to Blissville), was maintained at 0 MW in all cases; the second, the PV-20 line (Plattsburg to South Hero), was maintained at a transfer of 0 MW for the NY-NE transfers, and 100 MW from NY to NE for the NE-NY transfers. These transfers were consistent for both the light load and peak load cases. There are two other lines interconnected between New England and New York, however neither are considered part of the Interface because they are independently scheduled tie lines. The first is the Northport – Norwalk Harbor Cable (NNC), which is a PAR controlled cable. The NNC had a NE-NY flow of 200 MW in all cases. The second is the Cross Sound Cable (CSC), which is an HVdc facility. This HVdc facility was scheduled to 330 MW NE-NY flow in all cases.

There are also a group of static VAR compensators (SVCs) in NY that needed to be dispatched to 0 MVARs pre-contingency. A script was created to assure that this requirement was honored.

Table 2 - 1

Internal New England interface limits

Stability Interface Limits	Margin (MW)	RAW (MW)
NB-NE	50	1050
OR-SO	50	1375
SUR-SO	100	1600
ME-NH	100	2000
NNE-SCO	100	3135

2.3 Basecase Creation

2.3.1 Light Load Cases

Table 2 - 2

Summary of Light Load Cases

Summary of Light Load cases – PSS/e Ver 32						
NE-NY Transfers*	East-West Transfers*	PV-20 Schedules*	NNC Schedules*	Central East*	Total East*	Sensitivity Cricket Valley Gen
3000	3000	-100	200	1300	2800	On/Off
-3000	-3000	0	200	2900	5000	On/Off

- *The flow may vary depending on the line out conditions and the different transfer levels.
- For the light load cases, ISO-NE load was 13,500 MW and NYISO load was 15,370 MW.
- For the light load case there were 20 facility out conditions and 58 contingencies tested.

2.3.2 Peak Load Cases

Table 2 - 3

Summary of Peak Load cases

Summary of Peak Load cases – PSS/e Ver 33						
NE-NY Transfers*	East-West Transfers*	PV20 Schedules*	NNC Schedules*	Central East*	Total East*	Sensitivity Cricket Valley Gen
3000	3000	-100	200	2359	4181	On/Off
-3000	-3000	0	200	2451	4291	On/Off

- *The flow may vary depending on the line out conditions and the different transfer levels.
- For the peak load case, ISO-NE load was 27,700 MW and NYISO load was 32,450 MW.
- For the peak load case there were 13 facility out conditions and 58 contingencies tested.
-

2.3.4 Case Updates

The light and peak load basecases were reviewed and updated by NYISO and ISO-NE to ensure the accuracy of the models. These reviews included, but were not limited to, topology verification, verification of line impedances, verification of generator dynamic models, voltage schedules, real and reactive power capabilities, reactive dispatch, etc.

2.3.5 Scaling Deck

Both NYISO and ISO-NE identified and used predetermined generation to change the Interface flow to determine limits. Conditions that affected this included direction of flow, facility outages, etc.

2.4 Study Sensitivities

There were multiple generation sensitivities tested throughout the study. These sensitivities were tested on both the New York and New England side, with critical generators being identified as potentially impactful to the Interface. Studies were conducted for various dispatches of Northfield, Bear Swamp, Altresco, Empire and Cricket Valley generating stations along with the Phase II HVDC line.

2.5 Facility Out

There were 20 different facility out conditions tested for the light load cases. These varied between line outs, line outs with the terminal breakers of the line open, and individual breaker out conditions.

Tested Facility Out Conditions:

ISO-NE Facility Out

- 312 Line – Berkshire – Northfield – 345 kV
- 321 Line – Plumtree – Long Mountain – 345 kV
- 329 Line – Frost Bridge – Southington – 345 kV
- 352 Line – Long Mountain – Frost Bridge – 345 kV
- 354 Line – Northfield – Ludlow – 345 kV
- 381 Line – Vernon – Northfield – 345 kV
- 393 Line – Alps – Berkshire – 345 kV
- 398 Line – Cricket Valley – Long Mountain – 345 kV
- 398 Line – Open Breaker 16R-2T-2 at Northfield
- 312/393 Line – Northfield – Berkshire – Alps – 345 kV
- E205W Line – Eastover – Bear Swamp – 230 kV

NYISO Facility Out

- NY2 Line – Alps – New Scotland - 345 kV
- NY-F83 Line – Cricket Valley – Pleasant Valley – 345 kV
- NY-F83 Line – Open terminal breakers #3 and #5 at Cricket Valley
- NY-F84 Line – Cricket Valley – Pleasant Valley – 345 kV
- NY-F84 Line – Open terminal breakers #4 and #6 at Cricket Valley

- Open breaker #3 at Cricket Valley
- Open breaker #4 at Cricket Valley
- Open breaker RNS2 at Pleasant Valley
- Open breaker RNS3 at Pleasant Valley

For the peak load cases, there were 13 facilities out conditions tested, all the line out conditions above except for the 329 line out. The 329 line was not included as the light load study was conducted first, and showed that this line out performed similar to the 352 line out. In addition to the tie line outages being tested, other lines in close proximity to the Interface were evaluated to determine the impact on transfer limits. The goal was to determine all internal facility out conditions that would affect the transfers across the NY-NE Interface.

2.6 Post Contingent Acceptable Response

ISO – NE uses the IEEE Standard 1346-1998 guideline for voltage sag as explained in the NEPOOL VOLTAGE SAG PARAMETERS as a guidance to determine the operating limits due to a post-fault voltage dip. The guidance states that the minimum post-fault voltage dip must be equal to or above 70% of nominal voltage and should not remain below 80% of nominal voltage for more than 250 milliseconds within 10 seconds of a fault occurrence. These parameters can be expanded on a case-by-case basis if it's determined that the resultant system response is still a reliable operating point. Overall system requirements state that all generators must maintain transient stability except for generators tripped by the clearing of the fault or operation of an SPS. System oscillations must have a 53% reduction in magnitude over the last four cycles of oscillation. Finally, loss of source tripped due to the fault must not exceed 1200 MW.

For this study, a post-fault voltage dip of 80% of nominal voltage was considered acceptable, while a voltage dip below 80% was considered unacceptable. This was done to establish a minimum safety margin.

NYISO utilizes the NYSRC Reliability Rules for Planning and Operating the New York State Power System, which provide the documented methodology employed to develop System Operating Limits (SOLs) within the NYISO Reliability Coordinator Area. NYSRC Reliability Rule C.1 addresses the contingencies to be evaluated and the performance requirements to be applied. Rule C.1 also references the "Guideline for Stability Analysis and Determination of Stability-Based Transfer Limits" found in the NYISO "Transmission Expansion and Interconnection Manual" Attachment H.

Separate limits were found using both of the above criteria for all light and peak load cases. The most limiting of the two was used to set the interface transfer limit.

2.7 Studied Contingencies

Due to criteria in the NPCC Directory #1, Table 3, Clause II and V, the stability of the bulk power system shall be maintained during and following the most severe contingencies, with due regard to successful and unsuccessful reclosing, except for small or radial portions of the system, provided the performance requirements are not violated for the remaining bulk power system. Some lines are built with automatic reclosing, while others have only manual reclosing. All evaluated three phase faults were tested either with the equipped automatic reclosing or with a manual reclosing simulated at 25 seconds.

Below in Table 3-2 are all the contingencies that were run throughout the course of the study. There were three phase faults, single line to ground, and single line to ground with stuck breakers all studied.

Table 3 - 1

List of all contingencies tested

Contingency List	
Three Phase Faults	**Single Line to Ground w/ stuck breaker**
Alps - Berkshire - Northfield - 345kV	Alps Bus - 345kV
Alps Bus - 345kV	Alps - Berkshire - Northfield - 345kV
Bear Swamp - Pratts Junction - 230kV	Alps - Berkshire - Northfield - 345kV
Bear Swamp - Eastover - 230kV	Alps - Berkshire - Northfield - 345kV
Cricket Valley - Long Mountain - 345kV	Bear Swamp - Pratts Junction - 230kV
Cricket Valley - Pleasant Valley - 345kV	Bear Swamp - Eastover - 230kV
Cricket Valley - Pleasant Valley - 345kV	Cricket Valley - Long Mountain - 345kV
Eastover - Bear Swamp - 230kV	Cricket Valley - Long Mountain - 345kV
Eastover - Rotterdam - 230kV	Cricket Valley - Pleasant Valley - 345kV
Long Mountain - Cricket Valley - 345kV	Cricket Valley - Pleasant Valley - 345kV
Northfield - Ludlow - 345kV	Cricket Valley - Pleasant Valley - 345kV
Northfield - Vernon - 345kV	Cricket Valley - Pleasant Valley - 345kV
Northfield - Berkshire - Alps - 345kV	Cricket Valley - Pleasant Valley - 345kV
Pleasant Valley - Cricket Valley - 345kV	Cricket Valley - Pleasant Valley - 345kV
Pleasant Valley - Cricket Valley - 345kV	Eastover - Bear Swamp - 230kV
Single Line to Ground	Eastover - Bear Swamp - 230kV
Rotterdam - Eastover - 230kV	Eastover - Rotterdam - 230kV
Cricket Valley - Long Mountain - 345kV	Long Mountain - Cricket Valley - 345kV
Cricket Valley - Pleasant Valley - 345kV	Long Mountain - Cricket Valley - 345kV
Cricket Valley - Pleasant Valley - 345kV	Long Mountain - Cricket Valley - 345kV
Long Mountain - Cricket Valley - 345kV	Northfield - Ludlow - 345kV
Northfield - Berkshire - Alps - 345kV	Northfield - Ludlow - 345kV
Pleasant Valley - Cricket Valley - 345kV	Northfield - Vernon - 345kV
Pleasant Valley - Cricket Valley - 345kV	Northfield - Berkshire - Alps - 345kV
	Northfield - Berkshire - Alps - 345kV
	Northfield - Berkshire - Alps - 345kV
	Northfield Bus - 345kV
	Northfield - Erving - 115kV
	Pleasant Valley Bus - 345kV
	Pleasant Valley - Cricket Valley - 345kV
	Pleasant Valley - Cricket Valley - 345kV
	Pleasant Valley - Cricket Valley - 345kV
	Pleasant Valley - Cricket Valley - 345kV
	Pleasant Valley - Cricket Valley - 345kV
	Pleasant Valley - Cricket Valley - 345kV

Section 3
Results and Analysis

Table 3-1 below contains all of the most limiting results for every facility out condition tested, under all load levels and sensitivities.

Table 3 - 2

Summary of Results

All Facility Out Limits		
	NY-NE	NE-NY
Facility Out	Limit (Final)	Limit (Final)
All Lines In-Service	2200	2200
398	1400	800
398 & NF 2T OPEN	1750	N/A
312393	1950	1650
393	1950	1700
312	2200	1800
354	2200	1600
F83	2200	1150
F84	2200	1150
F83 or F84 with 2 CV IS	N/A	1650
F83 or F84 with 1 CV IS	N/A	2050
CV 3 OPEN	N/A	1850
PV RNS3 OPEN	N/A	1400
PV RNS3 OPEN & CV 5 OPEN	N/A	1800
CV 4 OPEN	N/A	1850
PV RNS2 OPEN	N/A	1400
PV RNS2 OP & CV 6 OPEN	N/A	1800
321	2200	2200
329	2200	2200
352	2200	2200
NY2	2200	2200
E205W	2200	2200
381	2200	2200

ISO-NE and NYISO use different criteria for adding margin to their respective raw limits. NYISO utilizes a margining criteria of the larger of 200 MW or 10% less than the raw limit that is calculated. For ISO-NE, using the criteria of a post-fault voltage dip of 80% of nominal voltage as the acceptable raw limit, automatically built some margin into the raw limits that were

calculated. This meant not as much margin needed to be added to the raw limits. To determine this margin, the raw limit difference between 70% and 80% was tested with an average difference of 150 MW. To achieve a margin similar to that utilized by NYISO, it was decided an additional 50 MW of margin should be taken off the raw limits, as this would total a 200 MW margin from a 70% voltage dip.

Due to the light load study being conducted prior to the peak load study, the findings of the light load study were used to more efficiently study the peak load cases. Therefore, the peak load cases were tested at the light load limit for each scenario and only if they undercut the previous result would the limit be defined for the peak load cases. Both the light and peak load cases were tested to a maximum raw limit of 3000 MW, as this was determined to be high enough that even after margin was applied, the limit would be undercut by thermal and voltage results. In all cases the light load limits undercut the peak load and therefore the light load limit was used to set all limits. There are some sensitivities where the peak load did undercut the light load, but they were not the limit setting sensitivities. For the results that fall into this category the peak load results will be shared with the light load.

The current all lines in stability limit is 2200 MW. This study asserts that this limit is still valid and provides adequate margin over thermal and voltage limits. Using ISO-NE's margining criteria, any raw limit above 2250 MW would be margined to 2200 MW. Therefore, any facility out conditions that had a raw limit above 2250 MW would fall under the all lines in limit, and no additional limit would need to be published for that facility out condition. Using NYISO's margining criteria, any raw limit above 2450 MW would be margined to 2205 MW. Therefore, any facility out conditions that had a raw limit above 2450 MW following the NYISO's stability criteria, was considered to fall into the all lines in limit of 2200 MW, and no additional limit would need to be published for that facility out condition.

3.1 NE – NY Transfers

3.1.1 All Lines In

For the all lines in topology, the raw limit is 2650 MW. This is margined to 2200 MW as the all lines in-service limit is currently 2200 MW and thermal and voltage limits undercut this limit.

3.1.2 Cricket Valley to Long Mountain (398) Line Out

With the 398 line out-of-service, the lowest margined limit is 800 MW. As one of the two 345 kV tie lines between New England and New York this line being out-of-service greatly decreases the amount of power that can be transferred and results in the lowest overall limit to come out of this study. The limit is low enough that it could undercut thermal or voltage limits. Because of this additional critical generation sensitivity testing was conducted that resulted in a potential margined limit of 1450 MW depending on generation dispatch.

3.1.3 Alps to Berkshire to Northfield (312/393) Line Out

For the 312/393 line out-of-service, the lowest raw limit is 1750 MW. However, the lowest raw limit didn't set the limit for this line out due to the different criterias being used by NYISO and ISO-NE. Therefore, the limit is actually a raw limit of 1850 MW that is margined to 1650 MW per NYISO criteria. This limit is quite high considering that the 312/393 line is one of the two 345 kV lines on the Interface.

This line out is one of the few where some of the peak load limits were close to the light load limits. This can be attributed to the generation dispatch and the reactive resource dispatch variation between the light load and peak load cases.

3.1.4 Alps to Berkshire (393) Line Out

For the 393 line out-of-service, the lowest raw limit is 1800 MW. However, the lowest raw limit didn't set the limit for this line out due to the different criteria being used by NYISO and ISO-NE. Therefore, the limit is actually a raw limit of 1900 MW that is margined to 1700 MW per NYISO criteria. These results are very similar to the 312/393 line out results presented above. With just the 393 line section out-of-service the connection between New York and New England is disconnected, so the topology between the two line outs is almost identical. The only difference is the 312 line being left in service.

As with the 312/393 line out, the 393 line out was one of the few where some of the peak load limits were close to the light load limits. This can be attributed to the generation dispatch and the reactive resource dispatch variation between the light load and peak load cases.

3.1.5 Berkshire to Northfield (312) Line Out

For the 312 line out-of-service, the lowest raw limit is 1850 MW. This results in a margined limit of 1800 MW. These results are very similar to the 312/393 and 393 line out results presented above.

As with the 312/393 and 393 line out, the 312 line out is one of the few cases where some of the peak load limits are close to the light load limits. This can be attributed to the generation dispatch and the reactive resource dispatch variation between the light load and peak load cases.

3.1.6 Pleasant Valley to Cricket Valley (F83) Line Out

For the F83 line out-of-service, the lowest raw limit is 1200 MW. This results in a margined limit of 1150 MW. Due to the F83 being a new line that connects with the Cricket Valley substation additional testing was required to capture the impact the line has on the Interface. These additional sensitivities used a combination of New York and New England generation dispatches.

3.1.7 Pleasant Valley to Cricket Valley (F83) Line Out with Terminal Breakers Open

For the F83 line is out-of-service with its terminal breakers open, the lowest raw limit is 1600 MW. This results in a margined limit of 1550 MW.

3.1.8 Cricket Valley Breaker #3 Open

For the #3 breaker at Cricket Valley is out-of-service, the lowest raw limit is 1900 MW. This results in a margined limit of 1850 MW.

3.1.9 Pleasant Valley Breaker RNS3 Open

For the RNS3 breaker at Pleasant Valley being out-of-service, the lowest raw limit is 1450 MW. This results in a margined limit of 1400 MW.

3.1.10 Pleasant Valley to Cricket Valley (F84) Line Out

The F83 and F84 are parallel lines with impedances that are close to each other. Because of this, all of the results for the F83 line out matched the F84 line out limits. Due to the two lines essentially being the same line out, under certain conditions the F84 line out was not tested, but

instead the F83 limit was used in its place. These results are supported by the limits that were tested, which proves the results are the same.

For the F84 line out-of-service, the lowest raw limit is 1200 MW. This results in a margined limit of 1150 MW. Due to the F84 being a new line that connects the Cricket Valley substation to the Pleasant Valley substation, additional testing was done to capture the impact the line had on the Interface.

3.1.11 Pleasant Valley to Cricket Valley (F84) Line Out with Terminal Breakers Open

For the F84 line out-of-service with its terminal breakers open, the lowest raw limit is 1600 MW with Cricket Valley online. This results in a margined limit of 1550 MW.

3.1.12 Cricket Valley Breaker #4 Open

For the #4 breaker at Cricket Valley out-of-service, the lowest raw limit is 1900 MW. This results in a margined limit of 1850 MW. As with the F84 line out and F84 line out with open terminal breakers, not every single scenario was tested for this condition, as the initial results indicated that they were the same limits as with the #3 breaker at Cricket Valley out.

3.1.13 Pleasant Valley Breaker RNS2 Open

For the RNS2 breaker at Pleasant Valley being out-of-service, the lowest raw limit is 1450 MW. This results in a margined limit of 1400 MW. As with the F84 line out, the F84 line out with open terminal breakers, and open breaker #4, not every single scenario was tested for this condition, as the initial results indicated that they were the same limits as the same outages tested above (F83/open breaker #3/open breaker RNS3).

3.1.14 Ludlow to Northfield (354) Line Out

For the 354 line out-of-service, the lowest raw limit is 1650 MW. This results in a margined limit of 1600 MW. This limit is less than the all lines in limit, as the 354 line is an internal line of the New England system.

3.1.15 New Scotland to Alps (NY-2) Line Out

For the NY-2 line out-of-service, the lowest raw limit is 2250 MW. This results in a margined limit of 2200 MW, which is the all lines in limit.

3.1.16 Eastover to Bear Swamp (E205W) Line Out

For the E205W line out-of-service, the lowest raw limit is 2400 MW. This results in a margined limit of 2200 MW, which is the all lines in-service limit. This limit is slightly unique, as the E205W was the only 230 kV line out tested, the rest were all 345 kV. It was tested as it is one of the tie lines with New York and therefore, an important line regardless of the kV class.

3.1.17 Vernon to Northfield (381) Line Out

For the 381 line out-of-service, the lowest raw limit is 2450 MW. This raw limit is high enough that it is margined to the all lines in limit of 2200 MW.

3.1.18 Plumtree to Long Mountain (321) Line Out

For the 321 line out-of-service, the lowest raw limit is 2500 MW. This line out is comparable to the all lines in-service topology, as the 321 line is interior to the Interface and does not have a large impact on interface flows.

3.1.19 Frost Bridge to Southington (329) Line Out

For the 329 line out-of-service, the lowest raw limit is 2600 MW. This results in a margined limit of 2200 MW, which is the all lines in-service limit. The 329 line out is comparable to a 321 or 352 line out, with less impact as the line isn't on the Interface, but is one of the 345 kV paths that allows power to be pushed out the New England system from the 398 line.

3.1.20 Long Mountain to Frost Bridge (352) Line Out

For the 352 line out-of-service, the lowest raw limit is 2600 MW. This results in a margined limit of 2200 MW, which is the all lines in-service limit. The 352 line out is comparable to a 321 or 329 line out, with less impact as the line isn't on the Interface, but is one of the 345 kV paths that allows power to be pushed out the New England system from the 398 line.

3.2 NY – NE Transfers

3.2.1 All Lines In-Service

For the all lines in-service topology, there is no limiting scenario, as all tested scenarios reached a raw limit of 3000 MW, which is the highest of any case tested. This is because, even from an all lines in-service topology, the stability limit will be undercut by thermal or voltage limits when testing at 3000 MW. As with all other topologies, anything that tests with a raw limit above 2500 MW, is margined to the current published all lines in-service limit of 2200 MW. The margined 2200 MW limit is already undercut by voltage and thermal limits.

3.2.2 Cricket Valley to Long Mountain (398) Line Out

For the 398 line out-of-service, the lowest raw limit is 1450 MW. This results in a margined limit of 1400 MW. This limit is quite high, considering that the 398 line is one of the two 345 kV lines on the Interface. This limit can go up to a margined limit of 1800 MW depending on generation dispatch.

3.2.3 Alps to Berkshire to Northfield (312/393) Line Out

For the 312/393 line out-of-service, the lowest raw limit is 2000 MW. This results in a margined limit of 1950 MW. This limit is quite high, considering that the 312/393 line is one of the two 345 kV lines on the Interface.

3.2.4 Alps to Berkshire (393) Line Out

For the 393 line out-of-service, the lowest raw limit is 2000 MW. This results in a margined limit of 1950 MW. This limit is quite high, considering that the 393 line is one of the two 345 kV lines on the Interface. These results are very similar to the 312/393 line out results presented above. With just the 393-line section out-of-service, the connection between New York and New England is disconnected, so the topology between the two line outs is almost identical. The only difference is the 312 line being left in-service.

3.2.5 Berkshire to Northfield (312) Line Out

For the 312 line out-of-service, the lowest raw limit is 2550 MW. This results in a margined limit of 2200 MW, which is the all lines in-service limit. This limit is significantly higher than the 312/393 and 393 line out limits. This is due to the 393 line still being in-service, which allows additional power to flow to the Berkshire bus. From the Berkshire bus it is able to travel down the 115kV autotransformer and from there disperse deeper into the New England system.

3.2.6 Pleasant Valley to Cricket Valley (F83) Line Out

For the F83 line out-of-service, the lowest raw limit is 3000 MW for all sensitivities, as no results hit a voltage dip violation before reaching 3000 MW, which is the highest transfer level tested. Due to the raw limit hitting the 3000 MW max testing, this line out will be grouped with the margined all lines in-service limit of 2200 MW.

3.2.7 Pleasant Valley to Cricket Valley (F84) Line Out

For the F84 line out-of-service, the lowest raw limit is 3000 MW for all scenarios, as no results hit a voltage dip violation before reaching 3000 MW, which is the highest transfer level tested. Due to the raw limit hitting the 3000 MW max testing, this line out will be grouped with the margined all lines in-service limit of 2200 MW.

3.2.8 Ludlow to Northfield (354) Line Out

For the 354 line out-of-service, the lowest raw limit is 3000 MW for all scenarios, as no results hit a voltage dip violation before reaching 3000 MW, which is the highest transfer level tested. Due to the raw limit hitting the 3000 MW max testing, this line out will be grouped with the margined all lines in-service limit of 2200 MW.

3.2.9 New Scotland to Alps (NY-2) Line Out

For the NY-2 line out-of-service, the lowest raw limit is 2700 MW. This results in a margined limit of 2200 MW, which is the all lines in-service limit.

3.2.10 Eastover to Bear Swamp (E205W) Line Out

For the E205W line out-of-service, the lowest raw limit is 2800 MW. This results in a margined limit of 2200 MW, which is the all lines in-service limit.

3.2.11 Vernon to Northfield (381) Line Out

For the 381 line out-of-service, the lowest raw limit is 3000 MW for all scenarios, as no results hit a voltage dip violation before reaching 3000 MW, which is the highest transfer level tested. Due to the raw limit hitting the 3000 MW max testing, this line out will be grouped with the margined all lines in-service limit of 2200 MW.

3.2.12 Plumtree to Long Mountain (321) Line Out

For the 321 line out-of-service, the lowest raw limit is 3000 MW for all scenarios, as no results hit a voltage dip violation before reaching 3000 MW, which is the highest transfer level tested. Due to the raw limit hitting the 3000 MW max testing, this line out will be grouped with the margined all lines in-service limit of 2200 MW.

3.2.13 Frost Bridge to Southington (329) Line Out

For the 329 line out-of-service, the lowest raw limit is 3000 MW for all scenarios, as no results hit a voltage dip violation before reaching 3000 MW, which is the highest transfer level tested. Due to the raw limit hitting the 3000 MW max testing, this line out will be grouped with the margined all lines in-service limit of 2200 MW.

3.2.14 Long Mountain to Frost Bridge (352) Line Out

For the 352 line out-of-service, the lowest raw limit is 3000 MW for all scenarios, as no results hit a voltage dip violation before reaching 3000 MW, which is the highest transfer level tested. Due to the raw limit hitting the 3000 MW max testing, this line out will be grouped with the margined all lines in-service limit of 2200 MW.