NEW YORK – NEW ENGLAND

TRANSFER LIMIT STUDY

SUMMER 2008 STUDY PERIOD

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MAY 2007

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Prepared by:

Tad Witowski	ISO-New England
Tom Dutkiewicz	ISO-New England
Jim Helton	ISO-New England
Emeka Ojukwu	New York ISO
Robert Wadele	New York ISO

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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, thermal and voltage/reactive performance were examined.

A study period through 2008 summer was established. Based on assessment of planned system changes between now and 2008 summer, the stability limits presented in this report can be implemented now. They will be applicable until a major system change close to the NY-NE tie lines, such as completion of the southwest Connecticut 345 kV loop or the project to enhance the Pittsfield/Greenfield areas, is completed. Regarding the thermal study results in this report, as with any such "off-line" analysis, the results represent snapshots of typical operating conditions. Actual operating limits will be determined in real-time based on prevailing system conditions.

This analysis compares limits based on thermal, voltage and stability.

The table shown below summarizes derived "all facilities in" transfer limits between the New York ISO (NY) and ISO-New England (NE).

NY TO NE TRANSFER LIMITS "ALL FACILITIES IN" (MW)		
	THERMAL	STABILITY
SUMMER		
Normal	1525 MW	2200 MW
Emergency	1575 MW	2200 MW

NE TO NY TRANSFER LIMITS "ALL FACILITIES IN" (MW)		
	THERMAL	STABILITY
SUMMER		
Normal	1200 MW	1150-2250 MW
Emergency	1425 MW	1650-2250 MW

Conclusions:

Thermal: Thermal limits are representative for the conditions tested. In real-time operations, actual thermal operating limits are dynamically calculated and may vary from the limits shown.

Voltage: Voltage/reactive performance is not limiting.

Stability: Stability limits are sensitive to NE load level, Bear Swamp pumping load and Northfield pumping load. Limits have been developed to account for these sensitivities and allow the limits to be matched to actual system conditions.

I. INTRODUCTION

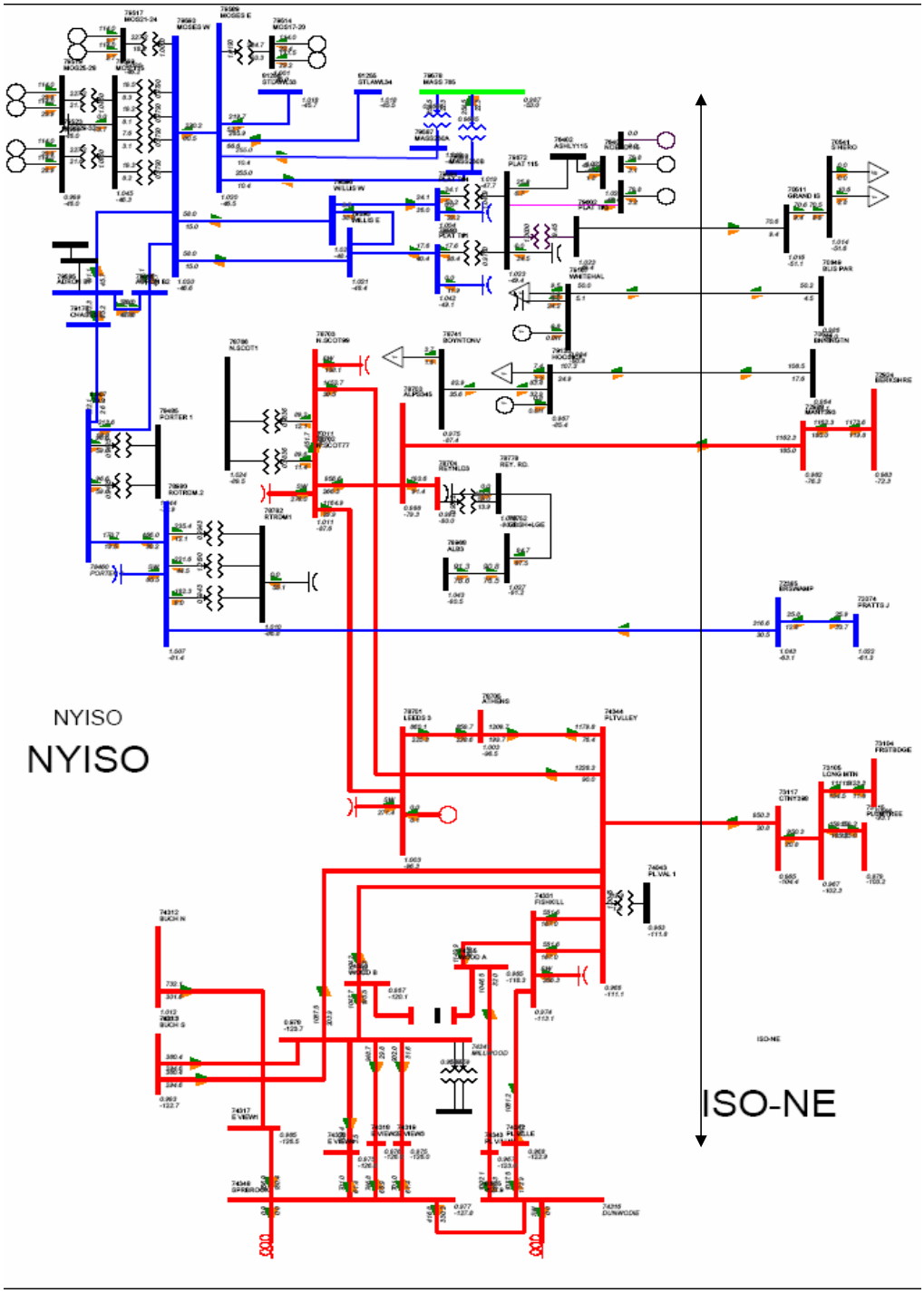
This report describes the assumptions, methodology and results from an analysis of transfer capabilities between the New York ISO (NY) and ISO-New England (NE).

A study period through 2008 summer was established. Based on assessment of planned system changes between now and 2008 summer, the stability limits presented in this report can be implemented now. They will be applicable until a major system change close to the NY-NE tie lines, such as completion of the southwest Connecticut 345 kV loop or the project to enhance the Pittsfield/Greenfield areas, is completed. Regarding the thermal study results in this report, as with any such "off-line" analysis, the results represent snapshots of typical operating conditions. Actual operating limits will be determined in real-time based on prevailing system conditions. The major factors which were varied in this study were load level, Bear Swamp pumping load and Northfield pumping load.

Study results are categorized based on the direction of transfer across the interface, NY to NE and NE to NY. System performance with regard to thermal, voltage/reactive and stability behavior was studied for "all facilities in" transmission conditions. In addition, stability behavior was studied for specific 'line out' transmission conditions.

A list of the tie lines comprising the NY-NE Interface and a one-line diagram of the Interface are shown below.

NY – NE Tie Lines
Plattsburg-S.Hero-Sandbar (PV-20) 115 kV line (PAR controlled at Sandbar or Plattsburg)
Whitehall-Blissville (K7) 115 kV line (PAR controlled at Blissville)
Hoosick-Bennington (K6) 115 kV line
Alps-Berkshire-Northfield (393/312) 345 kV line
Rotterdam-Bear Swamp (E205W) 230 kV line
Pleasant Valley-Long Mountain (398) 345 kV line
North Smithfield-Salisbury (690) 69 kV line
Northport-Norwalk Harbor (1385) 138 kV line (PAR controlled at Northport)
Shoreham-Halvarsson (481) 450 kV DC line


NYISO
NYISO
ISO-NE
ISO-NE

II. ASSUMPTIONS AND METHODOLOGY

A. GENERAL

The following base conditions were assumed for analysis:

1. Study data was derived from the 2003 NERC/MMWG series databases

2. A consolidated database was created by merging the New England, New Brunswick and Nova Scotia load flow and dynamics data (from the NE master databases) with the New York load flow and dynamics master databases. The dynamics representations for PJM and systems south and west were obtained from the NERC/MMWG 2009 forecast system (BCD 2003 series)

3. System transmission and generation additions/upgrades through Summer 2008 were reflected in the databases

4. Peak load conditions were used for thermal and voltage/reactive analyses to promote heavy loadings on transmission circuits

5. Peak and light load conditions were used for stability analysis to ensure reliable limits for all load levels

6. Generation dispatches based on real time condition patterns assuming “all units available” were modeled

7. Flows on the NY-NE regulated tie lines and power interchanges were set at typical/anticipated levels

8. “All facilities in” and specific “line out” transmission conditions were studied

B. THERMAL

1. General

Thermal analysis was performed using peak load 2008 summer cases. Thermal transfer limits (Normal and Emergency) for both NY to NE and NE to NY transfer directions were studied. These limits were studied for three categories, NY/NE tie line limits, NE internal limits and NY internal limits. A consolidated thermal transfer limit was established as the most restrictive of the limits from the three categories.

Contingency analysis was carried out using Siemens Power Transmission & Distribution, Inc. /Power Technologies International (PTI) Managing and Utilizing System Transmission (MUST) software. This software uses a PSS/E load flow, and evaluates a pre-determined list of contingencies/monitored elements and a redispatch of generation/load to simulate changing transfer level across a defined interface using distribution and adjustment factors to calculate the transfer level where a particular contingency causes a monitored element to be at its LTE or STE rating, as appropriate.

The limits indicated as “Normal” thermal transfer limits apply for the following conditions:

a. All transmission facilities in service.

b. NE – At the Normal thermal transfer limit indicated, no transmission facility will be loaded beyond its Normal rating in the pre-contingency condition. Loss of a single circuit transmission facility, generator, transformer, or bus section with normal clearing or accompanied by a stuck breaker or the loss of a double circuit transmission facility with normal clearing will not cause loadings on remaining inter-Area/NE transmission facilities in excess of Long-Time Emergency (LTE) ratings. Short-Time Emergency (STE) ratings can be used where generation or phase shifter regulation can be adjusted within 15 minutes to reduce post-contingency flows to the LTE rating or lower.

c. NY – For normal transfers, no facility will be loaded beyond its normal rating in the pre-contingency condition. No transmission facility will be loaded beyond its long-time emergency (LTE) rating following the loss of a single or double circuit transmission facility, generator, transformer, normally cleared or circuit breaker failure or a bus section. An underground cable circuit may be loaded to its short-time emergency (STE) rating post-contingency provided generation resources or phase angle regulation are available to reduce the loading to its LTE rating within 15 minutes and not cause any other facility to be loaded beyond it’s LTE rating.

The limits indicated as “Emergency” thermal transfer limits apply for the following conditions:

a. All transmission facilities in service.

b. NE – At the Emergency thermal transfer limit indicated, no inter-Area facility will be loaded beyond its Normal rating and no NE transmission will be loaded beyond its LTE rating in the pre-contingency condition. No facility will be loaded beyond its STE rating following the loss of any generator, single-circuit transmission facility, transformer or bus section.

c. NY – For Emergency transfers, no facility will be loaded beyond its Normal rating in the pre-contingency condition. No facility will be loaded beyond its STE rating following the loss of any generator, single-circuit transmission facility, transformer or bus section.

d. For permanent loss of a critical facility, the loading on the limiting element must be reduced to, or below, LTE within 15 minutes.

2. NE Internal Limits

Based on system characteristics, all internal NE thermal transfer limits are based on STE facility ratings.

3. NY Internal Limits

All internal NY thermal transfer limits were based on Normal, Long Time Emergency (LTE) ratings for normal transfer limit evaluation, and Short time Emergency (STE) ratings for emergency transfer limit evaluation as described above.

C. VOLTAGE/REACTIVE

NE VOLTAGE/REACTIVE ANALYSIS

NY to NE Voltage/Reactive analysis was performed using peak load conditions with a transfer level at slightly higher than the peak load summer Normal thermal transfer limit of 1525 MW. Contingency testing showed acceptable post-contingency voltages.

NE to NY Voltage/Reactive analysis was performed using peak load conditions with a transfer level at slightly higher than the peak load summer Normal thermal transfer limit of 1200 MW. Contingency testing showed acceptable post-contingency voltages.

NY VOLTAGE REACTIVE ANALYSIS

The voltage performance of NYISO critical buses in the vicinity of the NY-NE interface is primarily dependent on the level of Central East transfer rather than NY-NE transfers and since Central East transfer for the peak analysis was 3000 MW, detailed voltage analysis was not performed for this study. A review of voltages in the vicinity of the NY-NE interface shows that voltages were within the NYISO pre and post contingency voltage criteria.

D. STABILITY

1. NE/NY Stability Criteria

Consolidated stability limits documented in this report were derived using the most restrictive of either the NE and/or NY stability criteria. Though the criteria are fundamentally similar, differences which distinguish each are described below. The limits themselves are quoted in MW of transfer on the “Northern Ties”, which consists of all the NY-NE ties as previously listed in the Introduction exclusive of the Northport-Norwalk Harbor (1385) 138 kV line and the Shoreham-Halvarsson (481) 450 kV DC line.

2. NE Stability Criteria

NE stability criteria is based on the 1.) NPCC Basic Criteria for Design and Operation of Interconnected Power Systems, 2.) Reliability Standards ISO-New England and 3.) ISO-New England Operational Procedure No. 19. These criteria define and require the testing of Normal, Emergency and Extreme contingencies. Test results are then appropriately used to either define limits for Normal and Emergency transfer conditions on the system or perform other mitigating actions to enhance system reliability.

Normal transfer limits are determined by testing a number of contingencies called Normal contingencies. Emergency transfer limits, which allow a lower level of transmission reliability during stressed system conditions, are determined by testing Emergency contingencies which are only a subset of the Normal contingencies.

Recognizing that disturbances more severe than Normal and Emergency contingencies can occur, Extreme contingencies are tested to assess system strength. If the consequences of an Extreme contingency are so severe that they jeopardize the security of a neighboring power system or the Northeast Interconnection, measures to reduce the frequency of occurrence of the Extreme contingency or mitigate its consequences are considered. Action depends on the system conditions under which the Extreme contingency is a problem.

NE stability analysis demonstrated that instability between NY and NE can take several forms:

a. Severe apparent impedance trajectories on a NY-NE tie line which could trigger relay protection to trip the tie. This condition could precipitate cascading trips of other circuits and a NY-NE separation.

b. Transient voltage dips on busses which could result in generator/load losses.

In this study, the use of Extreme contingencies for “all facilities in” conditions is warranted. For NE to NY transfers, loss of synchronism between and/or separation between NY and NE would not only leave NE and the Maritimes islanded with up to 2250 MW of excess generation, but could also impose a loss of power to the Northeast Interconnection which probably could not be sustained. For NY to NE transfers, the interruption of up to 2200 MW of flow to NE could unload transmission interfaces in NY and PJM to the point where high voltage violations would occur.

Extreme contingencies were not considered for “line out” conditions. The relative exposure to “line-out” conditions versus ”all facilities in” conditions is low. Also, the magnitudes of “line-out” NY-NE transfer limits (thermal and stability) are substantially less than “all facilities in” limits. These lower limits pose less of a threat to the Northeast Interconnection should a NY-NE separation occur due to an Extreme contingency.

3. NY Stability Criteria

The contingencies performed for this analysis, were tested and evaluated in accordance with the “New York State Reliability Council Reliability Rules” and the NYISO Transmission Planning Guideline #2.0. The NYISO stability transfer limit, obtained from a stable simulation of the most severe contingencies, is obtained by reducing the test level of the interface in question by the NYISO stability safety margin (the largest of 10% of the pre-contingency test transfer level on the interface or 200 MW).

4. Combined NE/NY Stability Criteria

The stability performance of the NY-NE ties was evaluated with respect to the most limiting of the NY and NE tests. The NYISO stability safety margin, previously described, was applied to stable test levels for all NY faults and all NE Normal and Emergency contingencies. The NYISO stability safety margin was not applied to limits obtained from NE Extreme contingencies (ECs).

5. NE Stability Analysis

For “all facilities in”, NE Extreme contingencies (ECs) and Normal and Emergency contingencies (NCs) were tested to determine which produced the most severe transient response. Using these more severe ECs, transfers between NY and NE were varied until an EC based stability limit was found. If further testing showed that Normal and Emergency contingencies were stable at transfer levels equal to the EC based stability limit plus the NYISO stability safety margin, the final stability limit was set at the EC based stability limit without reduction by the NYISO stability safety margin.

For “line out” analysis, the most severe Normal and Emergency contingencies were identified. Using these selected contingencies, transfers between NY and NE were varied until stable/unstable simulations were achieved. The final Normal and Emergency stability transfer limits were obtained by reducing the appropriate highest stable transfer levels by the NYISO stability safety margin.

In some instances, increasing transfers in search of unstable responses resulted in transfer levels well above expected thermal limits without achieving an unstable response. Final stability transfer limits for these cases were established by reducing the highest transfer level tested by the NYISO stability safety margin.

Normally, transfer limits are established by determining stable/unstable bracketing cases. However, in some cases sufficient testing established recognizable patterns with respect to system responses. Some acceptable stable response cases were established by increasing transfer to levels where patterns inferred that any further increase in transfers would result in an unacceptable response. Final transfer limits for these cases were established by reducing the highest (and stable) transfer level tested by the NYISO stability safety margin.

In some instances, transfer limits tested under similar transmission conditions but varying load levels yielded minimal variation. For these scenarios, a single flat level transfer limit might be used for all load levels.

6. NY Stability Analysis

For “All line in”, NY Area normal criteria contingencies in the vicinity of the Central East, UPNY-ConEd and NY-NE interfaces were tested on cases simulating transfers between NYISO and ISO-NE that exceeded expected emergency thermal transfer limits. After demonstrating acceptable transient responses to all the NYISO contingencies tested, stability limits based on the NYISO analysis were set at the tested transfer level minus the NYISO stability safety margin.

7. Consolidated Stability Analysis

For a given set of conditions, the final consolidated stability limit was established as the lower of the two stability limits as determined by both NY and NE analysis.

III RESULTS – NY TO NE TRANSFERS

A. ALL FACILITIES IN

1. THERMAL

a. Tie Line

SUMMER	
Normal	1525 MW (1)
Emergency	2175 MW (2)

	Limiting Element	Contingency
(1)	Pleasant Valley-Long Mountain (398) 345 kV line @ LTE=1317	Millstone 3 generator @ 1211 MW + Southington-Haddam Auto-Millstone (348) 345 kV line (Stuck 14T breaker @ Millstone)
(2)	Pleasant Valley-Long Mountain (398) 345 kV line @ STE=1601	Millstone 3 generator @ 1211 MW

b. NE Internal

SUMMER	LIMIT
Normal	1575 MW
Emergency	1575 MW

	Limiting Element	Contingency
	Blandford-Granville Junction (1512) 115 kV line @STE=147	Northfield-Ludlow (354) 345 kV line

c. NY Internal

SUMMER	LIMIT
Normal	2075 (1)
Emergency	2375 (2)

	Limiting Element	Contingency
1	Boyntonv – N. Troy 115 kV line @ LTE 159 MW	Alps-Berkshire-Northfield (393/312) 345 kV line + Berkshire 345/115 kV transformer + Northfield Units 3 and 4 (Stuck 5T breaker @ Northfield)
2	Boyntonv – N. Troy 115 kV line @ STE 159 MW	N.Scotland-Alps 345 kV line + Reynolds Road-Alps 345 kV line + Alps-Berkshire-Northfield (393/312) 345 kV line + Berkshire 345/115 kV transformer (Bus Fault@ Alps_345 kV)

d. Consolidated Thermal

SUMMER	LIMIT
Normal	1525 MW (1)
Emergency	1575 MW (2)

	Limiting Element	Contingency
(1)	Pleasant Valley-Long Mountain (398) 345 kV line @ LTE=1317	Millstone 3 generator @ 1211 MW + Southington-Haddam Auto-Millstone (348) 345 kV line (Stuck 14T breaker @ Millstone)
(2)	Blandford-Granville Junction (1512) 115 kV line @STE=147	Northfield-Ludlow (354) 345 kV line

2. VOLTAGE/REACTIVE

a. NE VOLTAGE REACTIVE ANALYSIS

NY to NE Voltage/Reactive analysis was performed using peak load conditions with a transfer level at slightly higher than the peak load summer Normal thermal transfer limit of 1525 MW. Contingency testing showed acceptable post-contingency voltages.

b. NY VOLTAGE REACTIVE ANALYSIS

The voltage performance of NYISO critical buses in the vicinity of the NY-NE interface is primarily dependent on level of Central East transfer rather than NY-NE or NE-NY transfers and since Central East transfer for the peak analysis was at 3000 MW, detailed voltage analysis was not warranted for this study. A review of voltages in the vicinity of the NYNE interface shows that voltages were within the NYISO pre and post contingency voltage criteria.

3. STABILITY

a. NE Stability Analysis

NY to NE “all facilities in” stability limits are based on potential tripping of the Rotterdam-Bear Swamp (E205W) 230 kV line and/or instability of the Bear Swamp units. The Bear Swamp units were set at full pump in order to aggravate transient swings. The Northfield pumps were left off-line to promote worst case conditions. Contingencies whose clearing would result in the tripping of the Northfield pumps would tend to unload NY to NE tie line flows and reduce transient swings. In addition, the presence of the Northfield units would provide more inertia and improve overall stability and damping. Testing identified the worst NE contingency for NY to NE “all facilities in” transfers as a three phase fault at Northfield on the Alps-Berkshire-Northfield (393/312) 345 kV line with a stuck 3T breaker at Northfield (an Extreme contingency). This contingency results in the additional loss of the Northfield-Vermont Yankee (381) 345 kV line.

Although this Northfield stuck 3T breaker was most limiting, a three phase, normally cleared fault at Northfield on the Alps-Berkshire-Northfield (393/312) 345 kV line always gave essentially the same results. Extreme and Normal contingencies recognize stuck breakers, while Emergency contingencies ignore stuck breakers. Since testing showed that the stuck breaker and non-stuck breaker results were similar, Normal and Emergency limits are considered to be the same.

b. NE Contingency Analysis

An initial NY to NE “all facilities in” transfer level of 2475 MW was tested at a light load level of 12,500 MW. This testing resulted in a stable response and an apparent impedance trajectory at Rotterdam that remained outside the zone 2 settings of the protection relays on the Rotterdam-Bear Swamp 230 kV tie line. Further testing at a transfer level of 2725 MW (2475 MW plus the NYISO stability safety margin) also resulted in an acceptable response. Finally, similar testing of 2475/2725 MW transfer levels at a 29,750 MW peak load also produced acceptable responses.

Therefore, the “all facilities in “ NY to NE stability transfer limit based on NE contingencies was set at 2475 MW (without reduction by the NY safety margin).

Appendix A-1 details the results of the above testing.

c. NY Stability Analysis

Generation shifts between Ontario, New York and New England were primarily used to adjust flow on the NYNE interface to about 2475 MW for both the summer peak and light load “all facilities in” base case with NYCA load at about 33,400 MW and 14,000 MW respectively. The Leeds/Fraser SVC and Marcy STATCOM are modeled in service, the base case load flow were solved with the SVCs/STATCOM set to minimum (0 Mvar) output by adjusting their respective voltage schedules in the pre-contingency case.

The NY contingencies tested for the both the “all facilities in” and outage conditions showed stable response for the peak and light load cases.

d. NY Contingency Analysis

Appendix E outlines the most critical/limiting contingencies tested for this analysis. Description of all the contingencies evaluated and some selected resulting simulation plots are attached in Appendix B.

The contingencies performed for this analysis, were tested and evaluated in accordance with the “Standards for Planning and Operating the New York ISO Bulk Power System” and the NYISO Transmission Planning Guideline #2. The NYISO stability transfer limit, obtained from a stable simulation of the most severe contingencies, is obtained by reducing the test level of the interface in question by the greatest of 10% of the pre-contingency transfer on the interface or 200 MW

e. Consolidated Contingency Analysis

Based on the lower of transfer limits determined by NY and NE analysis, the “all facilities in “ NY to NE stability transfer limit was based on NY contingencies and was set at 2200 MW (2475 MW reduced by the NYISO stability safety margin).

4. CONSOLIDATED

Overall Transfer Limits

NY TO NE TRANSFER LIMITS “ALL FACILITIES IN” (MW)		
	THERMAL	STABILITY
SUMMER		
Normal	1525 MW	2200 MW
Emergency	1575 MW	2200 MW

B. ALPS-BERKSHIRE-NORTHFIELD (393/312) 345 kV LINE OUT STABILITY

1. NE Stability Analysis

NY to NE stability limits with the Alps-Berkshire-Northfield (393/312) 345 kV line out are based on potential tripping of the Rotterdam-Bear Swamp (E205W) 230 kV line and/or instability of the Bear Swamp units. The Bear Swamp units were set at full pump in order to aggravate transient swings. The Northfield pumps are not a factor with the 312/393 line out. Testing identified the worst NE contingency with respect to NY to NE transfers with the 393/312 line out as the single phase fault at Long Mountain on the Pleasant Valley-Long Mountain (398) 345 kV line with a stuck 4T breaker at Long Mountain (a Normal contingency).

Although this Long Mountain stuck 4T breaker was most limiting, a three phase, normally cleared fault at Long Mountain on the Pleasant Valley-Long Mountain (398) 345 kV with 5 second reclosing always gave essentially the same results. Normal contingencies recognize stuck breakers, while Emergency contingencies ignore stuck breakers. Since testing showed that the stuck breaker and non-stuck breaker results were similar, Normal and Emergency stability limits are considered to be the same.

2. NE Contingency Analysis

An initial NY to NE transfer level of 2100 MW was tested at a light load level of 12,500 MW. This testing resulted in the apparent impedance trajectory at Rotterdam entering the zone 2 relay characteristic. Further testing at a reduced transfer level of 2000 MW resulted in the apparent impedance trajectory remaining outside the zone 2 relay characteristic.

Therefore, the NY to NE stability transfer limit with the 393/312 line out based on NE contingencies was set at 1800 MW (2000 MW less the NY safety margin).

Appendix A-2 details the results of the above testing.

Appendix A-4 details the results of testing done to establish “line-out” limits for the Berkshire-Northfield (312) 345 kV line section.

Appendix A-5 details the results of testing done to establish “line-out” limits for the Alps-Berkshire (393) 345 kV line section.

Appendix A-6 details the results of testing done to establish “line-out” limits for the New Scotland-Alps (2) 345 kV line.

C. PLEASANT VALLEY-LONG MOUNTAIN (398) 345 kV LINE OUT STABILITY

1. NE Stability Analysis

NY to NE stability limits with the Pleasant Valley-Long Mountain (398) 345 kV line out are based on potential tripping of the Rotterdam-Bear Swamp (E205W) 230 kV line and/or instability of the Bear Swamp units. The Bear Swamp units were set at full pump in order to aggravate transient swings. The Northfield pumps were left off-line to promote worst case conditions. Contingencies whose clearing would result in the tripping of the Northfield pumps would tend to unload NY to NE tie line flows and reduce transient swings. In addition, the presence of the Northfield units would provide more inertia and improve overall stability and damping. Testing identified the worst NE contingency with respect to NY to NE transfers with the 398 line out as a single phase fault at Northfield on the Alps-Berkshire-Northfield (393/312) 345 kV line with a stuck 3T breaker at Northfield (a Normal contingency). This contingency results in the additional loss of the Northfield-Vermont Yankee (381) 345 kV line.

Although this Northfield stuck 3T breaker was most limiting, a three phase, normally cleared fault at Northfield on the Alps-Berkshire-Northfield (393/312) 345 kV always gave essentially the same results. Normal contingencies recognize stuck breakers, while Emergency contingencies ignore stuck breakers. Since testing showed that the stuck breaker and non-stuck breaker results were similar, Normal and Emergency limits are considered to be the same.

2. NE Contingency Analysis:

An initial NY to NE transfer level of 1900 MW was tested at a light load level of 12,500 MW. This testing resulted in the apparent impedance trajectory at Rotterdam on the E205W line entering the zone 2 relay characteristic. Further testing at a reduced transfer level of 1800 MW resulted in the apparent impedance trajectory remaining outside the zone 2 relay characteristic.

Therefore, the NY to NE stability transfer limit with the 398 line out based on NE contingencies was set at 1600 MW (1800 MW less the NYISO stability safety margin).

Appendix A-3 details the results of the above testing.

Appendix A-7 details the results of testing done to establish “line-out” limits for the Frost Bridge-Southington (329) 345 kV line.

Appendix A-8 details the results of testing done to establish “line-out” limits for the Long Mountain-Frost Bridge (352) 345 kV line.

D. ALPS- N.SCOTLAND (2) 345 kV LINE OUT STABILITY

1. NY Stability Analysis

NY to NE stability limit with Alps – N.Scotland (2) 345 kV line out of service was evaluated at 2475 MW transfer level. Base case conditions were similar to the "all facilities in": 1500 MW import from Trans Energie and Central East at 3000 MW.

Generation shifts between Ontario, New York and New England were primarily used to adjust flow on the NYNE interface and consequently stress the interface. The Leeds/Fraser SVC and Marcy STATCOM are modeled in service, the base case load flow were solved with the SVCs/STATCOM set to minimum (0 Mvar) output by adjusting their respective voltage schedules in the pre-contingency case.

All the contingencies (which includes 3 phase Normal and Extreme contingencies at Long Mt , Pleasant Valley, Alps and Northfield) evaluated showed stable responses.

2. NY Contingency Analysis

Description of all the contingencies evaluated are included in Appendix E and selected simulation plots are included in Appendix B.

The contingencies performed for this analysis, were tested and evaluated in accordance with the "Standards for Planning and Operating the New York ISO Bulk Power System" and the NYISO Transmission Planning Guideline #2. The NYISO stability transfer limit, obtained from a stable simulation of the most severe contingencies, is obtained by reducing the test level of the interface in question by the largest of 10% of the pre-contingency transfer on the interface or 200 MW

E. SUMMARY

A summary of the consolidated NY to NE stability transfer limits based on the lowest limits from NE and NY testing analysis is shown below:

SUMMARY OF NY TO NE STABILITY LIMITS (MW) 345 Kv Ties and Series 345 kV Circuits (Based on total net MW flows on the "Northern Ties")	
Condition	Stability Limits (MW)
All Facilities In	2200
Alps-Berkshire-Northfield (393/312) line out	1800
Berkshire-Northfield (312) line section out	2200
Alps-Berkshire (393) line section out	1800
N.Scotland-Alps (2) line out	2200
Pleasant Valley-Long Mountain (398) line out	1600
Long Mountain-Frost Bridge (352) line out	2200
Frost Bridge-Southington (329) line out	2200

IV. RESULTS – NE TO NY TRANSFERS

A. ALL FACILITIES IN

1. THERMAL

a. Tie Line

SUMMER	
Normal	2125 MW (1)
Emergency	2175 MW (2)

	Limiting Element	Contingency
(1)	Bear Swamp-Rotterdam (E205W) 230 kV line @ LTE=435	Berkshire-Alps (393) 345 kV line (open breaker)
(2)	Northfield-Berkshire (312) 345 kV line @ STE=1345	Frost Bridge-Long Mountain (352) 345 kV line + Frost Bridge 345/115 kV transformer

b. NE Internal

SUMMER	LIMIT
Normal	1200 MW (1)
Emergency	1425 MW (2)

	Limiting Element	Contingency
(1)	Devon-Trap Falls (1545) 115 kV line @ STE=306	Southington-Frost Bridge (329) 345 kV line + Haddam Neck-Southington (362) 345 kV line (Stuck 4T breaker @ Southington)
(2)	Devon-Trap Falls (1545) 115 kV line @ STE=306	Southington-Frost Bridge (329) 345 kV line

c. NY Internal

SUMMER	LIMIT
Normal	2100 MW (1)
Emergency	2150 MW (2)

	Limiting Element	Contingency
1	Boyntonv – N. Troy 115 kV line @ LTE =159	Berkshire-Alps (393) 345 kV line (open breaker)
2	Boyntonv – N. Troy 115 kV line @ STE 159 MW	Alps-N.Scotland 345 kV line + Alps-Reynolds Road 345 kV line + Northfield-Berkshire-Alps (393/312) 345 kV line + Berkshire 345/115 kV transformer (Bus Fault@ Alps 345 kV)

d. Consolidated

SUMMER	LIMIT
Normal	1200 MW (1)
Emergency	1425 MW (2)

	Limiting Element	Contingency
(1)	Devon-Trap Falls (1545) 115 kV line @ STE=306	Southington-Frost Bridge (329) 345 kV line + Haddam Neck-Southington (362) 345 kV line (Stuck 4T breaker @ Southington)
(2)	Devon-Trap Falls (1545) 115 kV line @ STE=306	Southington-Frost Bridge (329) 345 kV line

2. VOLTAGE/REACTIVE

a. NE VOLTAGE/REACTIVE ANALYSIS

NE to NY Voltage/Reactive analysis was performed using peak load conditions with a transfer level at slightly higher than the peak load summer normal thermal transfer limit of 1200 MW. Contingency testing showed acceptable post-contingency voltages.

b. NY VOLTAGE REACTIVE ANALYSIS

The voltage performance of NYISO critical buses in the vicinity of the NY-NE interface is primarily dependent on level of Central East transfer rather than NY-NE transfers and since Central East transfer for the peak analysis was 3000 MW, detailed voltage analysis was not performed for this study. A review of voltages in the vicinity of the NY-NE interface shows that voltages were within the NYISO pre and post contingency voltage criteria.

3. STABILITY

a. NE/NY Stability Analysis:

NE to NY "all facilities in" stability limits are a function of NE load level and Bear Swamp pumping operation. Limits can also be a function of Northfield 3 and/or 4 pumping load. Contingencies that trip the Northfield 3 and/or 4 units increase the post-contingent flows from NE to NY and tend to aggravate transfer limits. Stability limits are based on transient low voltages and/or instability.

Testing identified the worst NE contingency for NE to NY transfers with "all facilities in" and Northfield units 3 and/or 4 off or generating as a three phase fault at Northfield on the Northfield-Berkshire-Alps (312/393) 345 kV line with a stuck 3T breaker at Northfield (an Extreme contingency). This contingency results in the additional loss of the Northfield-Vermont Yankee (381) 345 kV line. Although this Northfield stuck 3T breaker was most limiting, a three phase, normally cleared fault at Northfield on the Northfield-Berkshire-Alps (312/393) 345 kV always gave essentially the same results. Extreme and Normal contingencies recognize stuck breakers, while Emergency contingencies ignore stuck breakers. Since testing showed that the stuck breaker and non-stuck breaker results were similar, Normal and Emergency limits with Northfield 3 and/or 4 units off or generating and Emergency limits with Northfield 3 and/or 4 pumping are considered the same.

Testing identified the worst NE contingency for NE to NY transfers with "all facilities in" and Northfield units 3 and/or 4 pumping as a three phase fault at Northfield on the Northfield-Berkshire-Alps (312/393) 345 kV line with a stuck 5T breaker at Northfield (an Extreme contingency). This contingency results in the additional loss of the Northfield 3 and/or 4 units and was used to determine Normal NE to NY stability limits for "all facilities in" with Northfield 3 and/or 4 pumping.

Effects of pumping at Bear Swamp required additional testing to define limit sensitivities to the dispatch of the Bear Swamp pumps. Testing similar to that done above was repeated with one and two Bear Swamp pumps on-line and appropriate limits were established.

b. NE/NY Contingency Analysis:

1. Bear Swamp Off or Generating:

<u>Normal and Emergency limits with Northfield 3 and/or 4 off or generating and Emergency limits with Northfield 3 and/or 4 pumping:</u>

At NE load levels of 9,000 MW and 12,500 MW, tests of a NE to NY transfer of 2100 MW resulted in acceptable dynamic responses. Further testing at a NE 12,500 MW load level of a NE to NY transfer of 2325 MW (2100 MW plus the NYISO stability safety margin) also resulted in acceptable responses.

At NE load levels of 17,100 MW and 29,750 MW, tests of a NE to NY transfer of 2500 MW resulted in acceptable dynamic responses. Further testing at a 29,750 MW load

level of a NE to NY transfer of 2750 MW (2500 MW plus the NY safety margin) also resulted in acceptable responses.

Recognizing that these limits are much higher than corresponding thermal limits and that Extreme, Emergency and Normal contingencies produce similar results, the NE to NY stability transfer limit for these conditions based on the lower of NE and NY contingencies with the NYISO stability safety margin applied could be set at: a. 1850 MW for NE load levels between 9,000 MW and 12,500 MW, b. linearly increased from 1850 MW to 2250 MW for NE load levels between 12,500 MW and 17,100 MW and c. 2250 MW for NE load levels above 17,100 MW.

Normal limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 2100 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 2000 MW resulted in an acceptable response. Testing NE load levels of 9,000 MW and 17,100 MW at NE to NY transfers of 2100 MW and 2350 MW, respectively, also resulted in acceptable responses.

Recognizing that the Extreme and Normal contingencies involving the 5T stuck breaker at Northfield produce similar results, the NE to NY stability transfer limits for these conditions based on NE contingencies were set at 1800 MW (2000 MW less the NYISO stability safety margin) at a NE load level of 12,500 MW and at 2100 MW (2350 MW less the NYISO stability safety margin) at a NE load level of 17,100 MW.

2. Two Bear Swamps Pumping:

Normal and Emergency limits with Northfield 3 and/or 4 off or generating and Emergency limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 1950 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 1850 MW resulted in an acceptable response. Testing at load levels of 9,000 MW and 17,100 MW with at least 1850 MW NE to NY transfers resulted in acceptable responses.

Recognizing that Extreme, Emergency and Normal contingencies produce similar results, the NE to NY stability transfer limit for these conditions, based on NE contingencies was set at 1650 MW (1850 MW less the NYISO stability safety margin).

Normal limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 1600 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 1500 MW resulted in an acceptable response. Testing at NE load levels of 9,000 MW and 17,100 MW with at least 1500 MW of NE to NY transfers resulted in acceptable responses.

Recognizing that the Extreme and Normal contingencies involving the 5T stuck breaker at Northfield produce similar results, the NE to NY stability transfer limit for these conditions based on NE contingencies could be set at the 1300 MW (1500 MW less the NYISO stability safety margin).

3. One Bear Swamp Pumping:

Normal and Emergency limits with Northfield 3 and/or 4 off or generating and Emergency limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 2100 MW was tested at a light load level of 12,500 MW and resulted in an acceptable response. Testing NE load levels of 9,000 MW and 17,100 MW with 2100 MW NE to NY transfers also resulted in acceptable responses.

Recognizing that Extreme, Emergency and Normal contingencies produce similar results, the NE to NY stability transfer limit for these conditions based on NE contingencies was set at 1850 MW (2100 MW less the NYISO stability safety margin).

Normal limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 1850 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 1750 MW resulted in an acceptable response. Testing at NE load levels of 9,000 MW and 17,100 MW with at least 1750 MW NE to NY transfer also resulted in acceptable responses.

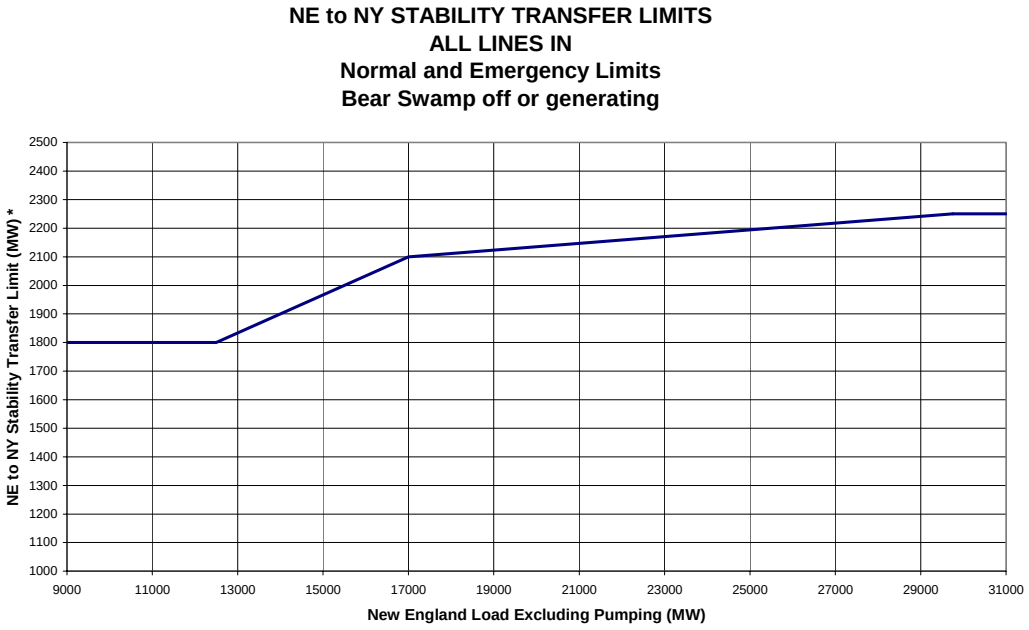
Recognizing that the Extreme and Normal contingencies involving the 5T stuck breaker at Northfield produce similar results, the NE to NY stability transfer limit for these conditions based on NE contingencies could be set at 1550 MW (1750 MW less the NYISO stability safety margin).

Appendix A-9 details the results of the above testing.

c. Consolidated Contingency Analysis

" All facilities in" NE to NY stability transfer limits are a function of NE load level and pumping load at Northfield and Bear Swamp. Based on the lower of stability transfer limits determined by NY and NE analysis, the "all facilities in" stability transfer limits with Bear Swamp off or generating for Normal and Emergency conditions with Northfield 3 and/or 4 off or generating and Emergency conditions with Northfield 3 and/or 4 pumping would be based on NY contingencies and would be set between 1850 MW (2100 MW reduced by the NY safety margin) and 2250 MW (2500 MW reduced by the NY safety margin).To eliminate the need to further reduce the 1850 MW limit derived above (for Normal and Emergency limits with Northfield 3 and/or 4 off or generating and Emergency limits with Northfield 3 and/or 4 pumping) by full Northfield 3 and/or 4 pumping load based on NE contingencies, the 1850 MW was reduced to 1800 MW based on a NE contingency. Similarly, to eliminate the need to further reduce the 2250 MW limit derived above (for Normal and Emergency limits with Northfield 3 and/or 4 off or generating and Emergency limits with Northfield 3

and/or 4 pumping) by full Northfield 3 and/or 4 pumping load based on NE contingencies, the 2250 MW was reduced to 2100 MW based on a NE contingency. Results of this analysis are represented in Graph 1 below.



* Total net NE to NY flow on Northern Ties

GRAPH 1

The NE to NY Normal stability transfer limit for “all facilities in” with 2 Bear Swamp pumps on based on NE contingencies could be set at 1300 MW (1500 MW less the NYISO stability safety margin) based on the worst case loss of Northfield 3 and 4 at full pump. However, to account for varying levels of Northfield 3 and/or 4 generation, the stability limit for this condition was set at the Emergency limit of 1650 MW (as determined above) reduced by the amount of Northfield 3 and/or 4 pumping load.

The NE to NY Normal stability transfer limit for “all facilities in” conditions with 1 Bear Swamp pump on based on NE contingencies could be set at 1550 MW (1750 MW less the NYISO stability safety margin) based on the worst case loss of Northfield 3 and 4 at full pump. However, to account for varying levels of Northfield 3 and/or 4 generation, the stability limit for this condition was set at the Emergency limit of 1850 MW (as determined above) reduced by the amount of Northfield 3 and/or 4 pumping load.

4. CONSOLIDATED

Overall Transfer Limits

NE TO NY TRANSFER LIMITS “ALL FACILITIES IN” (MW)		
	THERMAL	STABILITY
SUMMER		
Normal	1200 MW	1150-2250 MW
Emergency	1425 MW	1650-2250 MW

B. NORTHFIELD-BERKSHIRE-ALPS (312/393) 345 kV LINE OUT STABILITY

1. NE/NY Stability Analysis:

NE to NY stability limits with the Northfield-Berkshire-Alps (312/393) 345 kV line out are a function of NE load level and Bear Swamp pumping operation. Limits with the Northfield-Berkshire-Alps (312/393) 345 kV line out are not a function of Northfield 3 and/or 4 pumping.

Testing identified the worst NE contingency for NE to NY transfers with the Northfield-Berkshire-Alps (312/393) 345 kV line out as a three phase fault at Long Mountain on the Long Mountain-Pleasant Valley (398) 345 kV line with normal clearing and 5 second reclosing (a Normal contingency). Since no stuck breaker contingencies were more limiting, Normal and Emergency limits are considered the same.

Effects of pumping at Bear Swamp required additional testing to define limit sensitivities to the dispatch of the Bear Swamp pumps. Testing similar to that done above was repeated with one and two Bear Swamp pumps on-line and appropriate limits were established.

2. NE/NY Contingency Analysis:

1. Bear Swamp Off or Generating:

Normal and Emergency limits

An initial NE to NY transfer level of 1900 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 1800 MW resulted in an acceptable response. Testing at NE load levels of 9,000 MW and 29,750 MW with at least 1800 MW NE to NY transfers resulted in acceptable responses.

This NE to NY stability transfer limit with Northfield-Berkshire-Alps (312/393) 345 kV line out based on NE contingencies was set at 1600 MW (1800 MW less the NYISO stability safety margin).

2. Two Bear Swamps Pumping:

Normal and Emergency limits

An initial NE to NY transfer level of 1550 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 1450 MW resulted in an acceptable response. Testing a NE load level of 9,000 MW with at least a 1450 MW NE to NY transfer also resulted in an acceptable response.

This NE to NY stability transfer limit with Northfield-Berkshire-Alps (312/393) 345 kV line out based on NE contingencies was set at 1250 MW (1450 MW less the NYISO stability safety margin).

3. One Bear Swamp Pumping:

Normal and Emergency limits

An initial NE to NY transfer level of 1850 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 1750 MW resulted in an acceptable response. Testing a NE load level of 9,000 MW load level with at least a 1750 MW NE to NY transfer also resulted in an acceptable response.

This NE to NY stability transfer limit with the Northfield-Berkshire-Alps (312/393) 345 kV line out based on NE contingencies was set at 1550 MW (1750 MW less the NYISO stability safety margin).

Appendix A-10 details the results of the above testing.

C. LONG MOUNTAIN-PLEASANT VALLEY (398) 345 kV LINE OUT STABILITY

1. NE/NY Stability Analysis

NE to NY "all facilities in" stability limits are a function of NE load level and Bear Swamp pumping operation. Limits can also be a function of Northfield 3 and/or 4 pumping load. Contingencies that trip the Northfield 3 and/or 4 units increase the post-contingent flows from NE to NY and tend to aggravate transfer limits. Stability limits are based on transient low voltages and/or instability.

Testing identified the worst NE contingency for NE to NY transfers with the Long Mountain-Pleasant Valley (398) 345 kV line out and Northfield units 3 and/or 4 off or generating as a single phase fault at Northfield on the Northfield-Berkshire-Alps (312/393) 345 kV line with a stuck 3T breaker at Northfield (a Normal contingency). This contingency results in the additional loss of the Northfield-Vermont Yankee (381) 345 kV line. Although this single phase Northfield stuck 3T breaker was most limiting, a three phase, normally cleared fault at Northfield on the Northfield-Berkshire-Alps (312/393) 345 kV (an Emergency contingency) always gave essentially the same results. Normal contingencies recognize stuck breakers, while Emergency contingencies ignore stuck breakers. Since testing showed that the stuck breaker and non-stuck breaker results were similar, Normal and Emergency limits with Northfield 3 and/or 4 units off or generating and Emergency limits with Northfield 3 and/or 4 pumping are considered the same.

Testing identified the worst NE contingency for NE to NY transfers with the Long Mountain-Pleasant Valley (398) 345 kV line out and Northfield units 3 and/or 4 pumping as a single phase fault at Northfield on the Northfield-Berkshire-Alps (312/393) 345 kV line with a stuck 5T breaker at Northfield (a Normal contingency). This contingency results in the additional loss of the Northfield 3 and/or 4 units and was used to determine Normal NE to NY stability transfer limits for with the Long Mountain-Pleasant Valley (398) 345 kV line out and with Northfield 3 and/or 4 pumping. Since Normal limits recognize stuck breakers.

Effects of pumping at Bear Swamp required additional testing to define limit sensitivities to the dispatch of the Bear Swamp pumps. Testing similar to that done above was repeated with one and two Bear Swamp pumps on-line and appropriate limits were established.

2. NE/NY Contingency Analysis:

1. Bear Swamp Off or Generating:

<u>Normal and Emergency limits with Northfield 3 and/or 4 off or generating and Emergency limits with Northfield 3 and/or 4 pumping:</u>

An initial NE to NY transfer level of 1400 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 1300 MW resulted in an acceptable response. Testing a NE

load level of 9,000 MW with at least 1300 MW NE to NY transfer resulted in acceptable responses.

The NE to NY stability transfer limit for these conditions based on NE contingencies with the NY safety margin applied was set at a flat 1100 MW (1300 MW less the NYISO stability safety margin).

Normal limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 950 MW was tested at a light load level of 12,500 MW. This contingency resulted in an acceptable response. Testing NE load levels of 9,000 MW and 17,100 MW with at least a 950 MW NE to NY transfer also resulted in acceptable responses.

This NE to NY stability transfer limit with the Long Mountain-Pleasant Valley (398) 345 kV line out based on NE contingencies could be set at 750 MW (950 MW less the NYISO stability safety margin) based on the worst case loss of Northfield 3 and 4 at full pump. However, to account for varying levels of Northfield 3 and/or 4 generation, the stability limit for this condition was set at the Emergency limit of 1100 (as determined in the section above) reduced by the amount of Northfield 3 and/or 4 pumping load.

2. Two Bear Swamps Pumping:

Normal and Emergency limits with Northfield 3 and/or 4 off or generating and Emergency limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 1050 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 950 MW resulted in an acceptable response. Testing a NE load level of 9,000 MW with at least 950 MW NE to NY transfers also resulted in acceptable responses.

This NE to NY stability transfer limit with the Long Mountain-Pleasant Valley (398) 345 kV line out based on NE contingencies was set at 750 MW (950 MW less the NYISO stability safety margin).

Normal limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 650 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 550 MW resulted in an acceptable response. Testing a NE load level of 9,000 MW with at least 550 MW NE to NY transfers also resulted in acceptable responses.

This NE to NY stability transfer limit with the Long Mountain-Pleasant Valley (398) 345 kV line out based on NE contingencies could be set at 350 MW (550 MW less the NYISO stability safety margin) based on the worst case loss of Northfield 3 and 4 at full pump. However, to account for varying levels of Northfield 3and/or 4 generation, the

stability limit for this condition was set at the Emergency limit of 750 MW (as determined in the section above) reduced by the amount of Northfield 3 and/or 4 pumping load.

3. One Bear Swamp Pumping:

Normal and Emergency limits with Northfield 3 and/or 4 off or generating and Emergency limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 1250 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 1150 MW resulted in an acceptable response. Testing a NE load level of 9,000 MW with at least 1150 MW NE to NY transfers also resulted in acceptable responses.

This NE to NY stability transfer limit with the Long Mountain-Pleasant Valley (398) 345 kV line out based on NE contingencies was set at 950 MW (1150 MW less the NYISO stability safety margin).

Normal limits with Northfield 3 and/or 4 pumping:

An initial NE to NY transfer level of 900 MW was tested at a light load level of 12,500 MW. This contingency resulted in an unacceptable response. Testing at a reduced transfer level of 800 MW resulted in an acceptable response. Testing a NE load level of 9,000 MW load level with at least 800 MW NE to NY transfer also resulted in acceptable responses.

This NE to NY stability transfer limit with the Long Mountain-Pleasant Valley (398) 345 kV line out based on NE contingencies could be set at 600 MW (800 MW less the NYISO stability safety margin) based on the worse case loss of Northfield 3 and 4 at full pump. However, to account for varying levels of Northfield 3 and/or 4 generation, the stability limit for this condition was set at the Emergency limit of 950 MW (as determined in the section above) reduced by the amount of Northfield 3 and/or 4 pumping load.

Appendix A-11 details the results of the above testing.

Appendix A-15 details the results of testing done to establish “line-out” limits for the Southington- Frost Bridge (329) 345 kV line.

Appendix A-16 details the results of testing done to establish “line-out” limits for the Frost Bridge- Long Mountain (352) 345 kV line.

D. SUMMARY

A summary of the consolidated NE to NY stability limits based on the lowest limits from NE and NY testing analysis is shown below:

SUMMARY OF NE TO NY STABILITY LIMITS (MW) 345 kV Ties and Series 345 kV Circuits (Based on total net MW flows on the "Northern Ties")		
Bear Swamp off or generating, Normal and Emergency Limits		
1. Northfield off or generating, Normal and Emergency Limits 2. Northfield 3 and/or 4 pumping, Normal Limits * 3. Northfield 3 and/or 4 pumping, Emergency Limits		
Conditions	Stability Limits (MW)	
All Facilities In	1800-2250 (see graph 1)	
Northfield-Berkshire-Alps (312/393) line out	1600	
Northfield-Berkshire (312) line section out	1700	
Berkshire-Alps (393) line section out	1700	
Alps-N.Scotland (2) line out	1800-2250 Same as All Facilities In	
Long Mountain-Pleasant Valley (398) line out	1100 *	
Frost Bridge-Long Mountain (352) line out	1450 *	
Southington-Frost Bridge (329) line out	1550 *	
Bear Swamp pumping, Normal * and Emergency Limits		
Conditions	Stability Limits (MW)	
	2 Bear Swamp Pumps on	1 Bear Swamp pump on
All Facilities In	1650 *	1850 *
Northfield-Berkshire-Alps (312/393) line out	1250	1550
Northfield-Berkshire (312) line section out	1250	1550
Berkshire-Alps (393) line section out	1350	1650
Alps-N.Scotland (2) line out	1850	1850
Long Mountain-Pleasant Valley (398) line out	750 *	950 *
Frost Bridge-Long Mountain (352) line out	1100 *	1300 *
Southington-Frost Bridge (329) line out	1200 *	1400 *

Note: * For Normal limits with Northfield units 3 and/or 4 are pumping, reduce limits by the total pumping MW on Northfield Units 3 and 4.