New York Independent System Operator

2005 Comprehensive Area Transmission Review of the New York State Bulk Power Transmission System (Study Year 2010)

Prepared by the
NYISO System and Resource Planning

For Presentation to the
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and the
New York State Reliability Council

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Executive Summary

This is the second Comprehensive Area Transmission Review (CATR) submitted by New York Independent System Operator (NYISO) since the last CATR was completed in July 2000. This report summarizes the results of the assessment for the planned year 2010 system.

Major changes in this CATR as compared to previous CATR include (1) a 2,830 MW increase in load forecast, (2) about 6,313 MW of new generation (already excluding generation retirement), (3) nine new bulk power substations, (4) two new HVdc tie lines between Connecticut or New Jersey and Long Island, and (5) three cancellation of bulk power substations. Several short transmission lines at voltage levels from 138 to 345 kV will be built to integrate this new generation into the New York transmission grid. Of this 6,313 MW of new generation, 3,279 MW and 250 MW are coming into New York City and Long Island, respectively. The rest will be located in Western, Upstate, and Lower Hudson Valley of New York. A list of proposed projects and a summarized map of New York Control Area (NYCA) in Appendix B would provide a general idea where these projects are located.

This CATR is done in accordance with the applicable NPCC Basic Criteria, NPCC Area Transmission Review Guidelines, and New York State Reliability Council Rules. Six assessments are made to complete this CATR and are discussed below.

In the first assessment, powerflow and stability analyses were conducted to evaluate the thermal, voltage and stability performance of the New York State Bulk Power System (NYSBPS) for normal (or design) contingencies as defined in the NPCC and NYSRC reliability criteria and rules. The transfer limit analysis indicates that there is a potential reduction of transfer limit for UPNY/CONED interface. This reduction is due to load growth in the lower Hudson Valley and RECO areas, generation retirement in the load growth areas, and implementation of series reactors at Dunwoodie and Sprain Brook. In addition, lacking of dynamics VAR supports in these areas may also reduce the transfer limits of Millwood South and Sprain Brook-Dunwoodie South interfaces. However, these reductions do not pose an adverse reliability impact on NYSBPS because there are potentially 3,529 MW of increased generation and 990 MW of two transmission projects located east of these interfaces, which more than offset the reductions in transfer limits (Note – of 3,529 MW of increased generation and 990 MW of transmission projects, 1,510 MW of generation and 330 MW of a transmission project are already in service). The difference of other interfaces' transfer limits between this CATR and previous CATR is due to difference in generation dispatch pattern, installation of capacitor banks at Edic and Oakdale 345 kV buses, and/or change of interface definition.

In the second assessment, powerflow and stability analysis was conducted to evaluate the performance of the bulk power system for extreme contingencies as defined in the NPCC Basic Criteria. The stability analysis results indicate that the system would be stable for the system conditions tested. The powerflow analysis results indicate that, in most cases, extreme contingencies would not cause significant thermal or voltage problems over a widespread area for the conditions tested. In a few cases, an extreme contingency may result in a loss of local load within an area due to low voltage, STE thermal overload or first-swing instability of isolated generators. In most of these cases the affected area would be confined to the NYISO system. Overall, the results are comparable to previous CATR.

The third assessment evaluated the designed operation and the possible consequences of failure or misoperation of special protection systems (SPSs) within NYCA. This assessment indicated that the time delay for the Bowline rejection SPS may need to be adjusted to reduce the risk of system instability in order to accommodate the proposed Bowline 3 project. In addition, the assessment indicated that the following two SPSs may be reclassified: (1) The St. Lawrence generation rejection scheme, currently a Type I, may be reclassified as Type III, and (2) the Niagara generation rejection scheme, currently a Type I, may be reclassified as Type III. The assessment also confirmed the current classifications of the other SPSs.

The fourth assessment evaluated the dynamic control systems (DCSs) within NYCA that are actually installed on the system or are being proposed. This evaluation included large generator exciters, SVCs, FACTS, HVDC systems, and power system stabilizers. The assessment confirmed the current classifications of all DCSs that they may remain classified as Type III.

The fifth assessment evaluated the fault duty at selected substations. The analysis indicates six stations where breakers were overdutied for the conditions tested. The overdutied breakers at these stations are the results of future proposal projects (e.g., Fortistar VP, Fortistar VAN, and PJM-LI HVdc projects). These overdutied breakers will be replaced as part of the planned system upgrades.

The sixth assessment evaluated the extreme system conditions, which have a low probability of occurrence (e.g., loss of major gas supply and peak load condition resulting from extreme weather conditions.) Based on the nature of network of gas supplies and fuel diversity in NYCA, it’s determined that loss of a major gas pipeline would not create a detrimental negative adverse impact to the NY electric system. Powerflow analysis indicated that under the tested extreme weather conditions, loss of local loads in Central Hudson, O&R and RG&E territories could possibly happen for design contingencies such as tower contingency (CE18), loss of Ginna generation (LOG02) and tower contingency (UC26).

In conclusion, the New York State Bulk Power Transmission System, as planned through the year 2010, is in conformance with the NPCC "Basic Criteria for Design and Operation of Interconnected Power Systems" and the reliability criteria described in the NYSRC Reliability Rules.

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1 INTRODUCTION

1.1 BACKGROUND

The New York Independent System Operator (NYISO) is required to conduct an annual assessment of the reliability of the planned New York State Bulk Power Transmission System (NYSBPTS), in accordance with established Northeast Power Coordinating Council (NPCC), New York State Reliability Council (NYSRC), and NYISO criteria, rules and procedures. This report is the NYISO 2005 Comprehensive Area Transmission Review (CATR) report and summarizes the results of the assessment for the planned year 2010 system.

NPCC, a regional council of the North American Electric Reliability Council (NERC), has established criteria for the design and operation of interconnected power systems (NPCC Basic Criteria) [1]. As part of its ongoing reliability compliance and enforcement program, NPCC requires each of the five NPCC Areas (New York, New England, Ontario, Quebec, and Maritimes) to conduct and present an annual Area Transmission Review, which is an assessment of the reliability of the planned bulk power transmission system within the Area in a future year. The process and requirements for this assessment are outlined in the Guidelines for NPCC Area Transmission Reviews [2].

In addition to the NPCC Basic Criteria, NYSRC has established rules for planning and operating the New York State Power System (NYSRC Reliability Rules) [3]. The NYSRC Reliability Rules are consistent with, but in certain cases more specific or stringent than the NPCC Basic Criteria. NYSRC also has a compliance monitoring program, and NYISO provides its annual transmission reliability assessment to NYSRC in accordance with that program.

The Guidelines for NPCC Area Transmission Reviews require each Area to conduct a Comprehensive Review at least every five years and either an Interim Review or an Intermediate Review in each of the intervening years between comprehensive reviews, as appropriate. This assessment was conducted in accordance with the requirements for a CATR as described in the Guidelines.

The most recent CATR of NYSBPTS was presented by NYISO staff in July 2000 and covered the year 2006 [4]. Since then, four (4) intermediate reviews were conducted in 2001, 2002, 2003 and 2004 covering years 2006, 2007, 2008 and 2009, respectively. This CATR focuses on year 2010 with an updated forecast of system conditions, including a number of proposals for new generation in the New York Control Area (NYCA) since the last intermediate review [5].

1.2 FACILITIES INCLUDED IN THIS REVIEW

The system representation used in this transmission review was developed from the NPCC 2004 Base Case Development (BCD) library. The representation for NYCA is based on the NYISO 2005 FERC 715 filing with minor changes made to the NYCA system to reflect the most recent updates as provided by the transmission owners through March 2005. The representations reflect the conditions reported in the NYISO 2005 Load and Capacity Data report [6].

The New York State Bulk Power System (NYSBPS), as defined in NYSRC Reliability Rules, primarily consists of 4,039 miles of 765, 345 and 230 kV transmission and is supplemented by about 6,750 miles of 138 and 115 kV transmission, a small portion of which is considered to be bulk power transmission. A 500 kV tie-line connects the Branchburg station in PJM to the Ramapo station in Southeastern New York. Also included in NYSBPS are a number of large generating units that are generally, but not necessarily, 300 MW or larger. NYSBPTS, as defined in this review, consists of the transmission facilities included in the NYSBPS. A list of NYSBPS facilities and one-line diagrams depicting their layout are presented in Appendix B.

This review is based on the NYISO 2005 Load and Capacity Data report, and includes proposed transmission and generation projects throughout the period of the review that have met two milestone requirements. The first milestone is the approval by the NYISO Operating Committee of a System Reliability Impact Study (SRIS). The second milestone is demonstration of satisfactory progress in the regulatory process. Details of proposed projects are presented in Appendix B and discussed below. Projects that have met these two milestones by March 1, 2005, and were not considered in the previous CATR review, are included in this CATR.

Proposed transmission improvements since previous CATR through the year 2010 consist of seven 345 kV, one 230 kV and one 138 kV transmission modifications to interconnect new generation or supply load, and two HVdc tie lines (an HVdc tie between Connecticut and Long Island and an HVdc tie between Raritan River, New Jersey and Newbridge Road, Long Island). The 345 kV proposed modifications are: (1) a new 5-breaker ring substation splitting one Coopers Corners-Rock Tavern (CCRT-42) line to interconnect Calpine Wawayanda project; (2) a new 345 kV cable connection of the Bowline Point 3 generation project, located near the existing Bowline Point 1&2 units, to the Ladentown substation; (3) one 345 kV cable which provide a radial connection from the Besicorp project to Reynolds Road 345 kV station; (4) one 345 kV cable which provide a radial connection from PSE&G Cross Hudson project to W. 49th St. station in Manhattan; (5) a reconfiguration of Goethals 345 kV station to accommodate Liberty Radial Interconnection project; (6) a new substation splitting both Dunwoodie-Rainey circuits (71 and 72) for the interconnection of the Mott Haven project that is planned to supply the South Bronx load; and (7) a new 345 kV cable connected Sprain Brook and Sherman Creek and two 345/138 kV phase angle regulators at Sherman Creek.

Thirty three proposed major generation and transmission projects listed in Table 1.1. Two (PG&E Athens and PSEG Bethlehem) of the thirty three proposed projects were also included in previous CATR and have been in service. Of the remainder thirty-one proposed projects, nine (LIPA/TE DC tie, NYPA 2001 GTs, KeySpan Ravenwood, Canastota Fenner Wind Power, ConEd East River Repowering, CHG&E Rock Tavern Transformer, Flat Rock Wind Power [198 MW], Entergy IP 2, and Entergy IP3) have been in service. The other twenty-two projects are briefly described below or in Table 1.1. Although there are many more proposed projects in NYCA, these are the only ones that completed the two "milestone" requirements mentioned above.

Table 1.1- Proposed Projects Included in the 2005 New York CATR

Projects Modeled in the 2000 CATR Developer / Project	Size (MW)	Proposed In-Service Date	Interconnection Points	
			Name	Bus Number
PG&E Athens	1080	In Service	Athens 345	78705
PSEG Bethlehem	350	In Service	Albany 115	78966-78969
Projects Modeled in the 2005 CATR Developer / Project				
LIPA/TE CT-LI DC Tie-line	330	In Service	Shoreham	75062
NYPA 2001 GTs	452	In Service	Fox Hills, Gow-Green Hell Gate 1, Hell Gate 4 Ver-Grenw, Vernon 138 Brentwood 69	74466, 74476 74492, 74495 74504, 74556 75146
KeySpan Ravenswood	270	In Service	Vernon East	74556
NYPA Poletti Project	500	In Service	Astoria West	74403
Canastota Wind Power – Fenner	30	In Service	Whitman-OM Fenner	77500-79667
ConEd East River Repowering	288	In Service	E13th, ER69	74632, 74434
CHG&E Rock Tavern Transformer	N/A	In Service	Rock Tavern 345	74001
Flat Rock Wind Power	300	In Service	Adirondack-Porter 230	79585-78460
Entergy IP 2 Uprate	36	In Service	IP2 345	74338
Entergy IP 3 Uprate	38	In Service	IP3 345	79582
NYC Energy Kent Ave	79.9	2007/06	Ver-Grenw	74504
KeySpan Spagnoli Road CC Unit	250	2008-2009	Ruland Road 138	75082
Calpine Wawayanda	500	2008/Q2	CoopC-Rock Tav	75400-74001
Reliant Repowering Phases 1 & 2	1092	2010/Q2	Astoria E & W	74402, 74403
Mirant Bowline Point 3	750	2008/Q2	Bowline3 345	74399
SCS Astoria Energy	1000	2006-2007	Astoria E	74402
LMA Lockport II	79.9	2007/Q2	Harrison Radiator	76262, 76263
Besicorp Empire State Newsprint	660	2007/Q2	Reynolds Road 345	78704
Fortistar VP	79.9	2007/Q2	Fresh Kills	74468
Fortistar VAN	79.9	2007/Q2	Fresh Kills	74468
PSEG Cross Hudson Project	550	2008	West 49th St.	74354
Calpine JFK Expansion	45	2006/06	JFK	74506
AE Neptune PJM-LI DC Line	660	2007/Q3	Newbridge Rd 138	75050
Liberty Radial Interconnection to NYC	400	2007/05	Linden 230	74671
Global Winds Prattsburgh	75	2006/10	Eelpot-Flatsburgh 115	75448-75453
Rochester Transmission	N/A	2008/SPR	Station 80 and various	79800
Mott Haven Substation	N/A	2007/S	Dunwoodie-Rainey	74316-74345
Sherman Creek Substation	N/A	2007/S	Sprain Brook	74348
Chautauqua Winds	50	2006/11	Dunkirk-S. Ripley 230kV	76500-76501
Ecogen Winds Prattsburg	79.5	2006/07	Eelpot-Flatsburgh 115	75448-75453
Constellation Ginna Uprate	95	2006/11	Ginna 115	79824

1.3 CHANGES SINCE THE PREVIOUS REVIEW

1.3.1 System Facilities

The major changes to existing and proposed NYSBPS transmission and generation facilities since previous CATR are presented in Tables 1.2 and 1.3. As indicated in Table 1.2, an HVdc tie project between Connecticut and Long Island, referred to as the Cross Sound Cable, is a 330 MW link between the Shoreham 138 kV station and the East Shore 345 kV station near New Haven, Connecticut. The technology for the project is a form of FACTS device known as "HVdc Light" and uses two voltage sourced converters (VSC) at each end. Unlike conventional HVdc technology, HVdc Light does not drain reactive power from the AC system; in fact, it is capable of supplying VARs to maintain AC voltages. This project has been in service since 2002.

Spagnoli Road is a 138 kV substation in Long Island, NY to accommodate a 250 MW combined cycle plant. The output of this plant will be fed into Ruland road substation through a one mile 138 kV underground cable.

Calpine Wawayanda is a new 5-breaker ring substation splitting one Coopers Corners-Rock Tavern (CCRT-42) line to interconnect a 500 MW combined cycle plant into NYPA transmission near Middletown in southeastern New York.

An HVdc tie project between New Jersey and Long Island, known as Project Neptune PJM-LI HVdc Line, is a 660 MW link between the Raritan River 230 kV station in Sayreville, NJ and the Newbridge Road 138 kV station in Long Island, NY. This project has an anticipated in-service date in the year of 2007.

The Rochester Transmission project is a plan to (1) add a fourth Station 80 345/115 kV transformer connecting the RG&E Station 80 345 kV and 115 kV substations, (2) reconductor, build, and move various 115 kV transmission lines that lead to Russell and/or Ginna stations, and (3) add a significant amount of capacitors to the 115 kV system around RG&E control area for voltage support. This project is expected to be in service by Spring of 2008. RG&E plans to implement this project to address the potential local reliability problem as a result of the Russell generation plants' retirement.

The proposed load project called the Mott Haven project is located in the ConEd system. This project will split both Dunwoodie-Rainey 345 kV circuits to feed South Bronx load.

As listed in Table 1.3, twelve generation projects have been or will be interconnected to the in-city Con Edison system. In addition, there are numerous other proposed projects to be interconnected to the in-city Con Edison system. Therefore, in order to accommodate all of proposed projects in the Con Edison system, it will be necessary to implement fault duty mitigation measures to prevent circuit breakers from being overdutied in the event of a fault. The mitigation measures in the Con Edison Fault Duty Management Plan [7] are represented in this study. These measures are: insertion of 3.26% series reactors in the M51, M52 (Sprain Brook-W. 49th St.), 71 and 72 (Dunwoodie-Rainey) 345 kV cables, insertion of 5% PU series reactors in the 15055 (E. 179th St.-Hell Gate 6) feeder and Corona bus tie, insertion of a phase angle regulator in the Astoria East bus tie, moving the Hell Gate #1 and #4 transformers from the Astoria East feeders to the Astoria West feeders, and replacement of numerous breakers. Insertion of series reactors at M51, M52, 71, 72 and 15055 feeders and moving the Hell Gate #1 and #4 transformers from the Astoria East feeders to the Astoria West feeders were completed in 2004. Other measures are scheduled to be completed in 2007.

Since last CATR, three proposed transmission projects (Exeter 345/115 kV Substation, Plattsburg-Vermont Upgrade to 230 kV, and East Astoria Tap to Dunwoodie-Rainey 345 kV) have been canceled, and eight generation plants (NRG Huntley 63 & 64, Waterside 6, 8 & 9, Mirant Lovett 5, RG&E Russell, NYPA Poletti 1, Mirant Lovett 3 & 4, and Astoria 2 & 3) have been scheduled to be retired.

Table 1.2 - Changes in Bulk Power Transmission Facilities

	Last CATR: 1999 Forecast for Summer 2006	This CATR: 2005 Forecast for Summer 2009	
Bulk Transmission:	**Planned I/S Date**	**Status / I/S Date**	**Included**
Plattsburgh IPC	1998	In Service	Y
Marcy FACTS Project	Phase 1 - 2000 Phase 2 - 2002	In Service In Service	Y N
Middletown 345/138 kV Substation	2002 S	In Service	Y
Exeter 345/115 kV Substation	2002 S	Cancelled	N
Athens 345 kV Substation and Athens-Leeds 345 kV Double-Circuit Line(Associated with the Athens Gen Project)	2002	In Service	Y
Plattsburgh-Vermont Upgrade to 230 kV	2002	Cancelled	N
East Astoria Tap to Dunwoodie-Rainey 345 kV	2003	Cancelled	N
LIPA CT-LI DC Tie Line		In Service	Y
Spagnoli Rd 138 kV Substation		2008-2009	Y
Calpine Wawayanda 345 kV Substation		2008/Q2	Y
Bowline 3 345 kV Cable		2008/Q2	Y
Besicorp Empire State Newsprint 345 kV Substation		2007/Q2	Y
PSEG Cross Hudson 345 kV Cable		2008	Y
Atlantic Energy Neptune PJM-LI DC		2007/Q3	Y
Liberty 230 kV Substation and 345 kV Goethals Substation Upgrade		2007/05	Y
Flat Rock Wind Power 230 kV Substation		In Service - 2005	Y
Mott Haven 345 kV Substation		2007/S	Y
Sherman Creek 345 kV Substation		2007/S	Y

Table 1.3 - Changes in Generation Facilities

		Last CATR: 1999 Forecast for Summer 2006	This CATR: 2005 Forecast for Summer 2010	
Additions/Upgrades:		**Planned I/S Date**	**Status / I/S Date**	**Included**
Athens	1080 MW	2002	In Service	Y
Bethlehem (Albany)	323 MW	2005	In Service	Y
NYPA GTs	452 MW		In Service - 2001	Y
Keyspan Rav.	270 MW		In Service - 2004	Y
Canastota Wind Fenner	30 MW		In Service - 2001	Y
East River Repwr.	288 MW		In Service - 2004	Y
Entergy IP2 Upgrade	36 MW		In Service - 2005	Y
Entergy IP3 Upgrade	38 MW		In Service - 2005	Y
Flat Rock Wind	300 MW		In Service (198 MW) – 2005/12	Y
NYPA Poletti X	500 MW		In Service - 2006	Y
SEFCO Kent Ave.	79.9 MW		2007/06	Y
KeySpan Spagnoli	250 MW		2008-2009	Y
Calpine Wawayanda	500 MW		2008/Q2	Y
Reliant 1 & 2 Repwr	1092 MW		2010/Q2	Y
Bowline 3	750 MW		2008/Q2	Y
SCS Astoria	1000 MW		2006-2007	Y
Fortistar Lockport	79.9 MW		2007/Q2	Y
Besicorp Empire	660 MW		2007/Q2	Y
Fortistar VP	79.9 MW		2007/Q2	Y
Fortistar VAN	79.9 MW		2007/Q2	Y
PSEG Cross Hud.	550 MW		2008	Y
Calpine JFK	45 MW		2006/06	Y
Liberty Radial	400 MW		2007/05	Y
Global Winds Pratts	75 MW		2006/10	Y
Chautauqua Winds	50 MW		2006/11	Y
Ecogen Winds Pratts	79.5 MW		2006/07	Y
Ginna Upgrade	95 MW		2006/11	Y
Shutdowns/Deratings:		**Planned O/S Date**	**Status / O/S Date**	
NRG Huntley 63, 64	61 MW	In Service	Retired – 2005/11	N
Waterside 6, 8, 9	167 MW	In Service	Retired – 2005/12	N
NRG Huntley 65, 66	167 MW	In Service	Retired – 2006/11	N
Mirant Lovett 5	194 MW	In Service	Retired – 2007/06	N
RG&E Russell	240 MW	In Service	Retired – 2007/12	N
NYPA Poletti 1	855 MW	In Service	Retired – 2008/02	N
Mirant Lovett 3, 4	227 MW	In Service	Retired – 2008/06	N
Astoria 2, 3	536 MW	In Service	Retired – 2010/Q2	N

1.3.2 Interface Definitions

The transfer of the Rockland Electric Company (RECO) system from the NYCA to PJM resulted in changes to several interface definitions. RECO is radially connected to the Orange & Rockland (O&R) system through ten ties. Since the RECO system comprises only load and no appreciable generation, the addition of these ties to the interface definitions reduces the interface flows by an amount which is independent of the generation dispatch (roughly 485 MW for summer 2010 peak conditions). Calculated transfer limits across the affected interfaces are accordingly reduced.

The Cross Sound Cable HVdc creates a new tie line between the Shoreham 138 kV station in Long Island, NY and the East Shore 345 kV station near New Haven, CT. This tie line is therefore added to those interface definitions which currently include a Norwalk Harbor-Northport 138 kV tie line. The flow across this HVdc tie adds to the interface flows and calculated transfer limits for these interfaces.

The Neptune PJM-LI HVdc creates a new tie line between PJM (FE/GPU/JCPL) and NYISO (LIPA). This tie line is therefore added to those interface definitions which currently include the parallel Mahwah-Waldwick, Hudson-Farragut, and Linden-Goethals lines. The flow across this HVdc tie adds to the interface flows and calculated transfer limits for these interfaces.

1.3.3 Scheduled Transfers

Table 1.4 provides a list of the NYISO inter-Area powerflow transfer schedule modeled in the base case.

Table 1.4 - NYCA Scheduled Transfers

Region		Transaction
From	To	
NYCA	NE	-172 MW
NYCA	HQ	-1200 MW*
NYCA	MAAC	-520 MW
NYCA	ECAR	115 MW
NYCA	ONTARIO	63 MW

* - Approximately 390 MW comes from each pole of the Chateauguay HVdc and the rest came from Beauharnois units.

1.3.4 Load and Capacity

Table 1.5 provides a comparison of the 1999 load and capacity forecast used in previous CATR to the 2005 forecast used in this CATR. This table was derived from the NYISO 2005 Load and Capacity Data report. The peak load forecast for the 2010 summer in that report is 34,200 MW and the corresponding total capacity is 43,632 MW. Based on this, the reserve margin for NYCA is 27.6%. This is above the required installed reserve margin of 18% approved by NYSRC.

Table 1.5 - Load and Capacity Schedule

	Previous CATR: 1999 Forecast for Summer 2006	This CATR: 2005 Forecast for Summer 2010	Change
Peak Load (MW)	31,370	34,200	+2,830
Total Capacity (MW)	37,319(1)	43,632(2)	+6,313
Reserve Margin	19.0%	27.6%	+8.6%

(1) This number is derived from the NYPP 1999 Load and Capacity Data book. It includes the capacity included under Energy-Only IPPs.

(2) This is derived from the NYISO 2005 Load and Capacity Data book. It's the 2010 Total Resource Capability (38,823.1 MW) plus Proposed Resource Additions (5,338.8 MW) minus canceled Proposed Resource Additions (Bay Energy [79.9 MW] and ANP Brookhaven Energy Center [580 MW]) plus unaccounted qualified Proposed Resource Additions (Chatauqua Wind [50 MW] and Ecogen Prattsburg Wind [79.5]).

2 STUDY RESULTS DEMONSTRATING CONFORMANCE WITH NPCC BASIC CRITERIA AND NYSRC RELIABILITY RULES

2.1 STUDY METHODOLOGY

The analysis for this review was conducted in accordance with NYSRC Reliability Rules. Specific guidelines for voltage and stability analysis are found in NYISO Transmission Planning Guidelines #2-0 [8] and #3-0 [9] respectively. These two NYISO guidelines are Attachments E and F of the NYISO Transmission Expansion and Interconnection Manual [10]. These guidelines conform to NPCC Basic Criteria, Guidelines for NPCC Area Transmission Reviews and NYSRC Reliability Rules. The NYISO guidelines provide additional details regarding NYISO's methodology for evaluating the performance of the NYSBPTS.

The procedure used to evaluate the performance of NYSBPTS consists of the following basic steps: (1) develop a mathematical model (or representation) of the New York State and external electrical systems for the period of study (in this case, the year 2010), (2) develop various powerflow base cases to model the system conditions (load and power transfer levels, commitment and dispatch of generation and reactive power devices) to be tested, and (3) conduct powerflow and stability analysis to determine whether or not the transmission system meets NYSRC Reliability Rules and NPCC Basic Criteria for thermal, voltage and stability performance. In actual practice, steps (2) and (3) are interwoven during the conduct of a study, and the detailed procedures differ for the various types of analyses conducted. The details regarding the representation, base cases, analysis procedures, and results are discussed in the sections that follow.

2.2 DESCRIPTION OF BASE CASES

The base cases used in evaluating NYCA system performance were developed from NPCC Base Case Development (BCD) libraries. Most of the relevant system representations were taken from the year 2010 cases in the 2004 NPCC BCD library. The NYCA representation was taken from the NYISO 2005 FERC 715 filing. Minor changes were made to the NYCA system to reflect the most recent updates.

The summer peak base case was developed as described above. Summer peak stability margin transfer cases (UPNY margin, western margin, central margin, and Moses margin cases) were then created from the base case. In the margin cases, the transfer levels of the interfaces in western, northern and southeastern New York are at least 11.1% greater than the smaller of the emergency thermal or voltage transfer limits.

The light load base case was developed from the NYISO 2005 FERC 715 filing and the 2004 NPCC BCD spring light load 2010 representations. The load level is approximately 48 percent of summer peak. In this case, the Central East and Moses South interface flows are 2,085 MW and 603 MW, respectively. This represents an expected Central East flow and above average Moses South flow based on a historical average.

The extreme contingency base case was developed from the summer peak base case by reducing the load to approximately 80% of the summer peak load and adjusting the transfer levels to approximately the 75th percentile of the expected maximum transfer levels.

The extreme system condition base case was developed from the summer peak base case with the load increased to meet the extreme weather forecast load which reflects weather conditions that are expected to occur no more than once in ten years. The weather conditions were based on weather observations since 1950.

Diagrams and descriptions of the base cases utilized in criteria testing can be found in Appendix D.

2.3 THERMAL ANALYSIS

2.3.1 Methodology

Thermal analysis was performed using the PTI MUST program with all NYCA open and closed interfaces, all 100kV and above transmission lines in the vicinity of these interfaces, and all NYCA tie lines with the neighboring systems being monitored. A listing of all NYCA intra-Area and inter-Area interface definitions in Appendix E.

The contingencies examined include the individual opening of all lines connected between buses with base voltage between 100 kV and 765 kV and all appropriate common structure, stuck breaker, generator, multiple element, and DC contingencies. Phase angle regulators maintain their scheduled powerflow pre-contingency but are fixed at their corresponding pre-contingency angle post-contingency. The general direction of generation shifts is from the North and West to Southeastern New York and New England. When an interface besides the one being studied became limiting, the general shift pattern was modified, within the base case conditions and limitations, to minimize this effect. However, no attempt was made to find the maximum thermal limit based on an ideal shift pattern.

Approximately two thousand contingencies were evaluated. All contingencies studied are in accordance with the NPCC Basic Criteria and the NYSRC Reliability Rules.

2.3.2 Analysis Results

Tables 2.1, 2.2 and 2.3 provide summaries for the normal and emergency thermal transfer limits determined for the NYCA intra-Area and inter-Area transmission interfaces. Additional details regarding the thermal analysis results are provided in Appendix F.

Compared to the previous CATR, West Central open limits are lower due Russell generation retirement. Dysinger East and West Central closed limits are lower due to change of interface definition (the RECO ties were added to these interfaces' definition.)

Volney limits are lower than previous CATR due to high HQ import in the base case and change of interface definition. Normal Moses South limits are higher than previous CATR due to high HQ import, but emergency Moses South limits are lower than previous CATR due to Flatrock wind project. Dispatching Flatrock project would cause Marcy 765/345 transformers carried more power during pre-contingency loading. Therefore, Moses South interface would reach its limit at a faster rate than previous CATR.

Lower limits at UPNY/SENY, UPNY/ConEd, Millwood South and Sprain Brook Dunwoodie South interfaces are the result of increased generation dispatch in the Hudson Valley region through the South. This generation pattern affects the balance of flows from NYCA upstate to NYCA downstate on the Hudson Valley transmission path versus the Marcy-South path.

Different generation dispatch (e.g., dispatching PSE&G Cross Hudson project on) is not the only reason for reducing the Sprain Brook Dunwoodie South limits. The other reasons could also be because of implementing the 3.26% 345 kV series reactors at Sprain Brook and Dunwoodie 345 kV buses and the Mott Haven project. Previous CATR does not have the series reactors in service, therefore, in-city generation changes have a much larger effect on the balance of flows over the Sprain Brook-W49 St (M51 and M52) and Dunwoodie-Rainey (71 and 72) cables. With the series reactors in service, they create a balance of flows on these cables; therefore, significant changes to the in-city generation dispatch have little effect on this situation. Consequently, the pre-contingency flow on the M51 and M52 cables does not reach their normal ratings when the 71 and 72 cables are loaded to their full capability.

The Mott Haven project splits both Dunwoodie-Rainey 345 kV circuits to supply the South Bronx load, which results in creating four 345 kV circuits (two Dunwoodie-South Bronx and two South Bronx-Rainey). Power on Dunwoodie-South Bronx 345 kV circuits supplies South Bronx load and the remainder flows to Rainey 345 kV substation via two South Bronx-Rainey 345 kV circuits. Therefore, if one of South Bronx-Rainey 345 kV circuits is lost, the other circuit will carry an approximate additional 96% of the power that previously carried by the lost circuit. Consequently, the lower the South Bronx load is, the faster South Bronx-Rainey 345 kV circuit reaches its limit for the loss of other circuit. Subsequently, Sprain Brook Dunwoodie South limits would be reduced.

Long Island imports are higher than the previous CATR due to the addition of CT-LI and PJM-LI HVdc ties to the Long Island import interface definition.

It should be noted that all transfer limits determined in this study are not optimized and should not be used indiscriminately, such as for Resource Adequacy studies. To be consistent with the previous CATR, there were no sensitivity cases developed to increase transfer limits in this CATR, although it is expected that the transfer levels can be increased significantly by adjusting PAR settings and generation dispatch pattern.

A general difference in inter-Area transfer limits between New York and New England, PJM or Ontario or vice versa is due to different generation dispatch pattern. A specific difference in inter-Area transfer limits between New York and New England or PJM is due to interface definition change (RECO load and CT-LI and PJM-LI HVdc tie lines). The other specific difference in inter-Area transfer limits between New York and PJM is due to Brachburg-Ramapo PAR schedule.

It is noted that these limits were determined with the following assumptions:

PAR settings at key locations

Ramapo PAR (1 & 2)	= 120 MW each into New York
St. Lawrence PAR	= 0 MW
Plattsburgh Tie	= 115 MW into New England
Farragut (1 & 2)	= 400 MW each into New York
Goethals	= 200 MW into New York
Northport	= 100 MW into New York

DC lines modeled in the study

Neptune PJM-LI tie	= 660 MW into Long Island
LIPA/CT Tie at Shoreham	= 330 MW into New York

Table 2.1 (A)
NYCA Intra-Area Bulk Power System Normal Thermal Transfer Limits (MW)

Interface	2000 Comprehensive Review (Study Year 2006)		2005 Comprehensive Review (Study Year 2010)	
	Open	Closed	Open	Closed
Dysinger East	2875 (1)	3975 (1)	2869 (1)	3696 (1)
West Central	1475 (1)	2575 (1)	1328 (1)	2155 (1)
Volney East	5300 (2)	5625 (2)	4042 (9)	4437 (9)
Moses South	1300 (3)	1450 (3)	1566 (10)	1684 (10)
Central East	2725 (4)	--	2870 (4)	--
Total East	--	5375 (4)	--	5451 (4)
UPNY-SENY	4600 (5)	4750 (5)	4575 (5)	5159 (5)
UPNY-CONED	5425 (6)	6525 (6)	5222 (11)	7309 (11)
Millwood South	--	8025 (6)	--	8820 (12)
Dunwoodie-South	4950 (7)	6075 (7)	4846 (15) (B)	6933 (15) (B)
LIPA	--	1200 (8)	--	2065 (14)

Notes:

1. **Niagara-Rochester 345** at 1502 MW LTE rating for loss of Kintigh-Rochester 345
2. **Rochester-Pannell 345** at 1502 MW LTE rating for loss of other Rochester-Pannell 345
3. **Porter-Adirondack 230** at 353 MW LTE rating for loss of both Moses-Massena 230
4. **Leeds-New Scotland 345** at 1538 MW LTE rating for loss of Leeds-New Scotland 345
5. **Pleasant Valley-Leeds 345** at 1538 MW LTE rating for loss of Pleasant Valley-Athens 345
6. **Dunwoodie- Sprain Brook 345** at 2708 MW LTE rating for loss of Fishkill-Pleasantville 345, Pleasantville 345/13.0 kV transformer, Fishkill-Wood 345, and Wood-Pleasantville 345
7. **Dunwoodie-Astepar1 345** at 715 MW Normal rating for pre-contingency loading
8. **Reactor Bus-Daven Port 345** at 948 MW LTE rating for loss of Dunwoodie-Shore Rd 345
9. **Coopers Corners-Fraser 345** at 1404 MW LTE rating for loss of Porter-Rotterdam 230 and Coopers Corners-Marcy 345
10. **Porter-Adirondack 230** at 353 MW LTE rating for loss of Edic-Porter 345/230 and Porter-Flatrock 230
11. **Rock Tavern-Ramapo 345** at 1890 MW LTE rating for loss of Roseton-Fishkill 345 and Sugar Loaf-Rock Tavern 115
12. **East View 3-Sprain Brook 345** at 2214 MW LTE rating for loss of East View 2-Millwood 345, East View 2-Sprain Brook 345, East View 2-East View 345/138, East View 4-Millwood 345, East View 4-Sprain Brook 345, and East View 4-East View 345/138
13. **Rainey-South Bronx 345** at 1081 MW STE rating for loss of Rainey-South Bronx 345
14. **Dunwoodie-Shore Rd 345** at 962 MW LTE rating for loss of Sprain Brook-East Garden City 345 and Sprain Brook/Dunwoodie North 345/138 kV transformer

A. Limits determined in this study were not optimized.
B. Sherman Creek, Parkchester, Dunwoodie No., and Dunwoodie So. PARs are scheduled at 300, 250, 120 and 120 MW, respectively, into NYC.
-- Interface does not exist

Table 2.2 (A)
NYCA Intra-Area Bulk Power System Emergency Thermal Transfer Limits (MW)

Interface	2000 Comprehensive Review (Study Year 2006)		2005 Comprehensive Review (Study Year 2010)	
	Open	Closed	Open	Closed
Dysinger East	3175 (1)	4400 (1)	3181 (2)	4069 (2)
West Central	1725 (1)	2950 (1)	1631 (2)	2518 (2)
Volney East	5500 (3)	5825 (3)	4887 (11)	5281 (11)
Moses South	2075 (4)	2225 (4)	2049 (12)	2167 (12)
Central East	3075 (5)	--	3180 (5)	--
Total East	--	6000 (5)	--	6077 (5)
UPNY-SENY	5250 (6)	5400 (6)	5217 (6)	5802 (6)
UPNY-CONED	6925 (7)	8025 (7)	6234 (13)	8322 (13)
Millwood South	--	11150 (8)	--	9537 (14)
Dunwoodie-South	4950 (9)	6075 (9)	4846 (15) (B)	6933 (15) (B)
LIPA	--	1225 (10)	--	2121 (10)

Notes:

1. **Niagara-Rochester 345** at 1686 MW STE rating for loss of Kintigh-Rochester 345
2. **Niagara-Rochester 345** at 1685 MW STE rating for loss of Kintigh-Rochester 345
3. **Rochester-Pannell 345** at 1620 MW STE rating for loss of other Rochester Pannell 345
4. **Massena-Moses 230** at 1348 MW STE rating for loss of Massena-Moses 230
5. **Leeds-New Scotland 345** at 1724 MW STE rating for loss of Leeds-New Scotland 345
6. **Pleasant Valley-Leeds 345** at 1724 MW STE rating for loss of Pleasant Valley-Leeds/Athens 345
7. **Rock Tavern-Ramapo 345** at 2169 MW STE rating for loss of Fishkill-Roseton 345
8. **Pleasantville-Dunwoodie 345** at 1720 MW Normal rating for pre-contingency loading
9. **Dunwoodie-Astepar1 345** at 715 MW Normal rating for pre-contingency loading
10. **Dunwoodie-Shore Road 345** at 679 MW Normal rating for pre-contingency loading
11. **Coopers Corners-Fraser 345** at 1207 MW Normal rating for pre-contingency loading
12. **Marcy-Marcy 765/345** at 1654 MW STE rating for loss of Marcy-Marcy 765/345
13. **Roseton-Fishkill 345** at 1935 MW Normal rating for pre-contingency loading
14. **Buchanan South-Millwood 345** at 1902 MW STE rating for loss of Buchanan South-Millwood 345
15. **Rainey-South Bronx 345** at 1081 MW STE rating for loss of Rainey-South Bronx 345

A. Limits determined in this study were not optimized.
B. Sherman Creek, Parkchester, Dunwoodie No., and Dunwoodie So. PARs are scheduled at 300, 250, 120 and 120 MW, respectively, into NYC.
-- Interface does not exist

Table 2.3 (D)
NYCA Inter-Area Bulk Power System Thermal Transfer Limits (MW)

Interface	2000 Comprehensive Review (Study Year 2006)		2005 Comprehensive Review (Study Year 2010)	
	Normal Transfer (MW)	Emergency Transfer (MW)	Normal Transfer (MW)	Emergency Transfer (MW)
NY – NE	1325 (1)	2050 (2)	1265 (13)(A)	1758 (14)(A)
NE – NY	1450 (3)	2125 (4)	2248 (15)(A)	2486 (16)(A)
NY – Ontario	1675 (5)	1800 (6)	1364 (17)	1558 (18)
Ontario – NY	850 (7)	1175 (8)	1377 (19)	1777 (20)
NY – PJM	750 (9)	890 (10)	2382 (10)(B)	2382 (10)(B)
PJM – NY	2200 (11)	2325 (12)	3039 (11)(C)	3413 (12)(C)

Notes:

1. **Grand Island-Plattsburgh 115** at 186 MW LTE rating for loss of Northfield Mountain-Berkshire 345, Northfield Mountain-MANH381 345, and Berkshire 345/115 kV transformer
2. **Grand Island-Plattsburgh 115** at 205 MW STE rating for loss of MANY393-ALPS345 345
3. **Norwalk Harbor-Northport 138** at 315 MW LTE rating for loss of CTNY398-Pleasant Valley 345
4. **Norwalk Harbor-Northport 138** at 428 MW STE rating for loss of CTNY398-Pleasant Valley 345
5. **Niagara-PA27 230** at 528 MW LTE rating for loss of Beck2PA2-Beck B 345
6. **Niagara-PA27 230** at 558 MW STE rating for loss of Niagara-Beck B 345
7. **Niagara-Rochester 345** at 1502 MW LTE rating for loss of Kintigh-Rochester 345
8. **Niagara-Rochester 345** at 1686 MW STE rating for loss of Kintigh-Rochester 345
9. **Hillside-E. Towanda 230** at 531 MW LTE rating for loss of Erie South-S. Ripley 230 and E. Sayre-N. Waverly 115
10. **S Ripley-Erie South 230** at 499 MW Normal rating for pre-contingency loading
11. **Hillside-E. Towanda 230** at 531 MW LTE rating for loss of Homer City-Watercure 345 and E. Sayre-N. Waverly 115
12. **Homer City-Watercure 345** at 755 MW Normal rating for pre-contingency loading
13. **CTNY398-Pleasant Valley 345** at 1386 MW LTE rating for loss of Southington-Haddam 345 and Millstone-Haddam 345
14. **CTNY398-Pleasant Valley 345** at 1195 MW Normal rating for pre-contingency loading
15. **Norwalk Harbor 138-Norwalk Harbor 115** at 402 MW LTE rating for loss of Fishkill-Pleasant Valley 345, CTNY398-Pleasant Valley 345, and Long Mountain-CTNY398 345
16. **Norwalk Harbor 138-Norwalk Harbor 115** at 449 MW STE rating for loss of Long Mountain-CTNY398 345
17. **Niagara-PA27 230** at 460 MW LTE rating for loss of Niagara 345-Niagara2E 230 and Niagara-Beck B 345
18. **Niagara-PA27 230** at 400 MW Normal rating for pre-contingency loading
19. **Niagara-Rochester 345** at 1501 MW LTE rating for loss of Kintigh-Rochester 345
20. **Niagara-Rochester 345** at 1685 MW STE rating for loss of Kintigh-Rochester 345

A. Norwalk Harbor-Northport 138 STE rating corrected from 1577 MW to 577 MW.
B. Ramapo PAR set to 1000 MW toward PJM and Neptune PJM-LI HVDC is out of service.
C. Ramapo PAR set to 1000 MW toward New York.
D. Limits determined in this study were not optimized.

2.4 VOLTAGE ANALYSIS

2.4.1 Methodology

The voltage analysis was conducted using PTI's PSS/E in conjunction with the NYISO Voltage Contingency Analysis Procedure (VCAP). VCAP is used to evaluate voltage-based transfer limits in accordance with the NYISO Transmission Planning Guideline #2-0, and with consideration of the voltage limit practice (Exhibit A-3 of NYISO Emergency Operation Manual [11], formerly known as OP-1 practice) which specifies minimum and maximum voltage limits at key NYSBPS buses. The required post-contingency voltage is typically within 5% of nominal. A set of powerflow cases with increasing transfer levels was created from the 2010 summer peak load base case. The generation shifts that were employed for VCAP are similar to the ones used for the thermal analysis. These shifts were used to obtain an increase in transfers across the particular interface being studied. The first part of the shift was similar for all interfaces studied, while unique shifts particular to each interface were employed to complete the shifts, within the limitations and condition of the base case. The VCAP program was run on the particular set of transfer cases for an interface to evaluate the system response to that interface's appropriate contingencies.

In this analysis, all areas in NYCA except New York City use the traditional constant power model for load to conservatively represent the restoration of load to its pre-contingency state. The Con Edison voltage-varying load model is used to model the New York City load in both pre and post-contingency powerflow cases.

The reactive power of generators is regulated, within the capabilities of the units, to hold scheduled voltage in both the pre-contingency and post-contingency powerflows. All previously classified utility-owned generation and about two-thirds of the previously classified non-utility-owned (NUG) generation is modeled as having some reactive capability. The remaining one-third of the NUG generation, mostly located in upstate New York, is modeled as having no reactive capability.

Tap settings of phase angle regulators and autotransformers are adjusted (within their capabilities) to regulate power flow and voltage, respectively, in the pre-contingency powerflows but are fixed at their corresponding pre-contingency settings in the post-contingency powerflows. Similarly, switched shunt capacitors and reactors are switched at pre-determined voltage levels in the pre-contingency powerflows but are held at their corresponding pre-contingency position in the post-contingency powerflows.

In accordance with NYISO operating practice, SVC and FACTS devices are held at or near zero output in the pre-contingency powerflows, but are allowed to regulate voltage, within their capabilities, in the post-contingency powerflows. Inertial pickup is assumed for contingencies involving a loss of generation or HVdc import.

As the transfer across an interface is increased, the voltage-constrained transfer limit is determined to be the lesser of (a) the pre-contingency powerflow at which the post-contingency voltage falls below the OP-1 post-contingency limit, or (b) 95% of the pre-contingency powerflow at the "nose" of the post-contingency PV curve. The "nose" is the point at which the slope of the PV curve becomes infinite (vertical) and reaches the point of voltage collapse. This operating point occurs when the reactive capability supporting the power transfer becomes exhausted. The region near the "nose of the curve" is generally referred to as the region of "voltage instability". Therefore, the voltage-constrained transfer limit is intended to ensure adequate post-contingency voltage and to avoid operating within this region of voltage instability.

The NYISO uses the above methodology to model a worst case steady-state voltage response based on examination of actual system events. For the New York system, this represents a time frame of approximately 30-60 seconds after the contingency occurs, which recognizes the automatic response of the system following the contingency, but before system operator actions are undertaken.

The voltage-constrained transfer limits for the following transmission interfaces were studied:

Dysinger East	Open & Closed
West Central	Open & Closed
Volney East	Open & Closed
Moses South	Open & Closed
Central East	Open
Total East	Closed
UPNY-SENY	Open & Closed
UPNY-CONED	Open & Closed
Millwood South	Open & Closed
Sprain Brook Dunwoodie South	Open & Closed

2.4.2 Results

The pre-contingency voltage profile of the bulk transmission system was found to be acceptable. Normal, emergency and OP-1 pre-contingency Dysinger East and West Central voltage limits are higher than the previous CATR as the results of lower Western NY load forecast, more local generation being dispatched and additional shunt capacitors of the Rochester Transmission project; however, the voltage collapse points of West Central interface are lower than the previous CATR as results of Russell generation retirement and Ginna uprate.

As in thermal, the voltage-constrained transfer limits of the closed versions of these two interfaces are affected by the addition of the RECO and PJM-LI HVdc ties to the interface definition. This addition changes the voltage limits across the closed versions of these two interfaces.

Normal, emergency and OP-1 pre-contingency Volney East voltage limits are lower than the previous CATR due to a higher pre-contingency flow on Moses South interface and Calpine Wawayanda project. Normal, emergency and OP-1 pre-contingency Central East and Total East voltage limits are higher than the previous CATR as the results of additional FACTS Phases I & II capacitor banks installed at Edic and Oakdale 345 kV buses and lower Athens and Bethlehem generation dispatched.

Normal, emergency and OP-1 pre-contingency UPNY-ConEd voltage limits are lower than the previous CATR due to load growth in lower Hudson and RECO areas (4,898 MW vs. 3992 MW), generation retirement in the load growth areas (421 MW of generation retirement), and implementation of four 3.26% 345 kV series reactors at Sprain Brook-W49 and Dunwoodie-Rainey circuits (each of these reactors is roughly equivalent to a 65-mile 345 kV transmission line).

Moses South, UPNY-SENY, Millwood South, and Sprain Brook Dunwoodie South interfaces were not studied in previous CATR. Therefore, there is no comparison available. Results of above analyses are summarized in Table 2.4.1. Detailed results and evaluated contingencies are presented in Appendix G.

Table 2.4.1 - Summary Table of Voltage Limits

	2000 CATR		2005 CATR		Limiting Station	Limiting Contingency
	open	closed	open	closed		
Dysinger East						
PL	2330	3608			Station 80 345	OP-1 Pre-contingency Low
NL	**2407**	**3716**			Station 80 345	L/O Kintigh - Rochester - Pannell
EL	**2493**	**3824**			Station 80 345	L/O Kintigh - Rochester
XL	2605	3946				L/O Kintigh - Rochester - Pannell
XL			**2726**	**3789**		L/O Ginna
NL			2886[e]	4013[e]	Station 80 345	L/O Ginna
EL			2886[e]	4013[e]	Station 80 345	L/O Ginna
PL			3258	4836	Station 80 345	OP-1 Pre-contingency Low
West Central						
PL	1041	2316			Station 80 345	OP-1 Pre-contingency Low
NL	**1113**	**2423**			Station 80 345	L/O Kintigh - Rochester - Pannell
EL	**1198**	**2529**			Station 80 345	L/O Kintigh - Rochester
XL	1367	2708				L/O Kintigh - Rochester - Pannell
XL			**1283**	**2346**		L/O Ginna
NL			1366[e]	2493[e]	Station 80 345	L/O Ginna
EL			1366[e]	2493[e]	Station 80 345	L/O Ginna
PL			1705	3284	Station 80 345	OP-1 Pre-contingency Low

Volney East						
NL	**4325**	**5050**			Oakdale 345	L/O Marcy-South Northern Ckt
PL	4375	5090			Oakdale 345	OP-1 Pre-contingency Low
XL	**4400**	**5175**				L/O Marcy-South Northern Ckt
EL	4565	5339			Oakdale 345	L/O Lafayette-Oakdale
XL			**4089**	**4647**		L/O Tower 34/42 Southern Ckt.
PL			4120	4611	Marcy 345	OP-1 Pre-contingency Low
NL			4190	4715	New Scot-Alps 345	L/O Tower 34/42 Southern Ckt.
EL			4454	5124	New Scot-Gilb 345	L/O New Scotland Bus (Alps)
Moses South						
XL	**	**	**2530***	**2167***		
PL	**	**	2677[e]	2299[e]	Marcy 345	OP-1 Pre-contingency Low
NL	**	**	2949[e]	2668[e]	Marcy 345	STK Marcy R3108 Bkr
EL	**	**	3735[e]	3733[e]	Marcy 345	L/O Phase II HVdc 2000 MW
Central East & Total East						
XL	**2873**	**5341**				L/O Marcy-South Northern Ckt.
PL	2922	5426			New Scotland 345	OP-1 Pre-contingency Low
NL	2959	5489			New Scotland 345	L/O Marcy-South Southern Ckt.
EL	3004	5566			Marcy 345	L/O Phase II HVdc 1200 MW
XL			**3040**	**5781**		L/O Tower 34/42 Southern Ckt.
PL			3093	5828	Marcy 345	OP-1 Pre-contingency Low
NL			3134	5924	New Scotland 345	L/O Tower 34/42 Southern Ckt.
EL			3283	6298	New Scotland 345	L/O New Scotland 77-Alps Bus
UPNY-SENY						
NL	**	**			Pleasant Valley 345	L/O Tower 34/42 Southern Ckt.
XL	**	**				L/O Tower 34/42 Southern Ckt.
PL	**	**			Rock Tavern 345	OP-1 Pre-contingency Low
EL	**	**			C. Corners 345	L/O New Scotland 77 Bus
PL			**4811**	**5394**	Pleasant Valley 345	L/O Tower 34/42 Southern Ckt.
XL			**4860**	**5500**		L/O Tower 34/42 Southern Ckt.
PL			4970	5575	Dunw 345	OP-1 Pre-contingency Low
EL			5056	5708	Dunw 345	L/O Ravenswood #3
UPNY-CONED						
PL	5445	6549			Pleasant Valley 345	OP-1 Pre-contingency Low
NL	**5549**	**6671**			Pleasant Valley 345	L/O Tower 34/42
EL	**5772**	**6925**			Pleasant Valley 345	L/O Ravenswood # 3
XL	5777	6943				L/O Ravenswood # 3
NL			**4582**	**6669**	Ramapo 500	L/O Tower 34/42 Southern Ckt.
PL			4733	6819	Dunw 345	OP-1 Pre-contingency Low
XL			**4905**	**6893**		L/O Tower 34/42 Southern Ckt.
EL			4938	7026	Dunw 345	L/O Ravenswood #3
Millwood South						
PL	N/A	**	N/A	7493	Dunw 345	OP-1 Pre-contingency Low
XL	N/A	**	N/A	**7630**		L/O Tower 67/68 or Ravenswood #3
NL	N/A	**	N/A	7698	Dunw 345	L/O Ravenswood #3
EL	N/A	**	N/A	7698	Dunw 345	L/O Ravenswood #3

Sprain Brook Dunwoodie South						
PL	**	**	4479	6565	Dunw 345	OP-1 Pre-contingency Low
NL	**	**	**4680**	6768	Dunw 345	L/O Ravenswood #3
EL	**	**	**4680**	6768	Dunw 345	L/O Ravenswood #3
XL	**	**	4762	**6745**		L/O Tower 67/68 or Ravenswood #3

PL – OP-1 Pre-Contingency Low Limit
NL – Normal Criteria Pre-Contingency Transfer Voltage Limit
EL – Emergency Criteria Pre-Contingency Transfer Voltage Limit
XL – 95% Voltage Collapse Criteria Limit
* – 95% of highest transfer tested. Actual voltage collapse limit is likely to be higher.
** – This interface was not evaluated.
e – Extrapolated limit

2.5 STABILITY ANALYSIS

2.5.1 Methodology

Five cases were used for this analysis: four summer peak stability margin cases (UPNY margin, western margin, central margin, and Moses margin cases) and a light load case. The UPNY-SENY/CONED interfaces of the margin case are loaded at 5,600 and 5485 MW, respectively. These flows are 11.1% above the more restrictive of the emergency thermal or voltage limit. This case has all Oswego complex generation dispatched at an output of 4,536 MW and 1,200 MW of import from Hydro Quebec.

The Dysinger East and West Central interfaces of the western margin case are loaded at 3,040 and 1,565 MW, respectively. These flows are 11.1% above the more restrictive of the emergency thermal or voltage limit.

The Total East and Central East interfaces of the central margin case are loaded at 3,230 and 6,155 MW, respectively. The Moses South interface of the Moses margin case is loaded at 2,424 MW. This flow is 11.1% above the more restrictive of the emergency thermal or voltage limit.

The light load case uses a load level of 48% of the peak load and Central East and Moses South flows of 2,085 and 603 MW, respectively. This represents an expected Central East flow and above average Moses South flow based on a historical average. Diagrams and descriptions of these base cases can be found in Appendix D.

The dynamic representation used in this analysis was developed from the 2004 NPCC BCD library. The real power load models used for various Areas were (1) constant current (power varies with the voltage magnitude) for Hydro Quebec, New Brunswick, MAAC, and ECAR, (2) constant impedance (power varies with the square of the voltage magnitude) for New York and New England, and (3) 50% constant current and 50% constant impedance for Ontario, Nova Scotia, and Cornwall. Reactive load was modeled as constant impedance for all Areas except Hydro Quebec, which uses a 13% constant current and 87% constant impedance model for reactive load.

2.5.2 Results

Table H.1 of Appendix H lists the contingencies evaluated and a determination of the overall system response as being stable or unstable. For margin and light load cases, all contingencies were stable and damped. Some selected plots are provided in the Appendix H.

2.6 SUMMARY

Table 2.5 at the end of this section provide a summary of the normal and emergency transfer limits for the transmission interfaces used in NYISO transmission planning studies. The corresponding transfer limits of "open" interfaces used in system operation are also provided for informational purposes only.

Table 2.5 (A)
NYS BULK POWER SYSTEM COMPARISON TRANSFER LIMITS

Interface	2000 CATR Limit (Study Year 2006)				2005 CATR Limit (Study Year 2010)			
	Normal		Emergency		Normal		Emergency	
Dysinger East (closed)	3700	V	3800	V	3696	T	3789	VX
Dysinger East (open)	2400	V	2475	V	2726	VX	2726	VX
West Central (closed)	2400	V	2525	V	2155	T	2346	VX
West Central (open)	1100	V	1175	V	1283	VX	1283	VX
Volney East (closed)	5050	V	5175	VX	4437	T	4647	VX
Volney East (open)	4325	V	4400	VX	4042	T	4089	VX
Moses South (closed)	1450	T	1875	T	1684	T	2167	T
Moses South (open)	1300	T	1700	T	1566	T	2049	T
Total East	5325	VX	5325	VX	5451	T	5541	S
Central East	2725	T	2850	VX	2870	T	2907	S
UPNY/SENY (closed)	4750	T	5400	T	5159	T	5500	VX
UPNY/SENY (open)	4600	T	5250	T	4575	T	4860	VX
UPNY/CONED (closed)	6525	T	6925	V	6669	V	6893	VX
UPNY/CONED (open)	5425	T	5750	V	4582	V	4905	VX
Millwood South (closed)	8025	T	11150	T	7630	VX	7630	VX
Dunwoodie South (closed)	6075	T	6075	T	6745	VX	6745	VX
Dunwoodie South (open)	4950	T	4950	T	4680	V	4680	V
Long Island Import	1200	T	1225	T	2065	T	2121	T

Notes:
1) Thermal and Voltage Limits Apply under Summer Peak Load Conditions.
2) Emergency Limits account for more restrictive voltage collapse limit.
3) Transfer Limits for All-Lines-In Condition.
4) Transfer Limits assume 280 MW for 2000 CATR and 240 MW for 2005 CATR base scheduled on the Ramapo PAR.

A. Limits determined in this study were not optimized.

Type Codes: T – Thermal
V - Voltage Post-contingency
VX - Voltage 95% from collapse point
S – Stability

3 EXTREME CONTINGENCY ASSESSMENT

3.1 Methodology

Analysis of the NYCA extreme contingencies was performed using Power Technologies Incorporated Power System Simulator software, PSS/E. Each contingency was tested for dynamic stability, voltage, and thermal limits.

3.1.1 Pre-contingency Powerflow Base Case

All extreme contingencies start with the same initial conditions. Since extreme contingencies are considered low probability events they were not tested against the peak summer case used for normal contingencies. Instead, a powerflow case was developed from the summer peak base case with the load reduced by approximately 20%. The generation dispatch of the NYCA system was modified to obtain transfer levels on the key NYCA interfaces of approximately the 75th percentile of expected maximum transfer levels. This modeling assumption was used based on the NPCC C-18 Procedures for Testing & Analysis of Extreme Contingencies [16].

3.1.2 Dynamics Simulation

In order to test the ability of the system to return to a stable operating point after a disturbance, dynamic simulations are performed. The simulation was first initialized to the pre-contingency powerflow conditions and then run to 0.1 seconds before altering the system configuration. For the no fault contingencies, this was a simple case of removing an element from service. In the case of a fault contingency, several events change the system in sequence to match breaker actions. All simulations were run for 20 seconds to show system stability. A set of plots was created for each contingency. After an inspection of these plots, a determination was made whether or not the system remains stable after the event.

3.1.3 Post-contingency Powerflow Analysis

A powerflow solution was calculated to determine voltage impacts and line overloads with the new (post-contingency) system settings. This procedure required that each element taken out of service in the dynamics simulation be taken out of service for the post-contingency powerflow.

3.2 Extreme Contingency Analysis

Extreme contingencies (EC) for NYCA were developed for conformance to NYSRC Reliability Rules and NPCC Basic Criteria as outlined in NPCC document A-2, section 7.0 and reported here as required in NPCC document B-4, section 5.1.3 and the NYSRC Reliability Rules, section B-R4. Each contingency is discussed below and the summarized powerflow results and the stability plots of some selected contingencies are placed under Appendices I and J respectively.

3.2.1 EC01 - Loss of Niagara Ties Between NYCA and ON

Disconnect 230 kV line BP76 connecting Packard to Beck in ON Disconnect 230 kV line PA27 connecting Niagara 230kV to Beck in ON Disconnect 345 kV line PA301 connecting Niagara 345kV to Beck in ON Disconnect 345 kV line PA302 connecting Niagara 345 kV to Beck in ON

This contingency is the *no fault loss* of the Beck-Niagara 345 kV ties, PA301 and PA302, the Beck-Niagara 230 kV tie PA27 and the Beck-Packard 230 kV tie BP76. The net pre-contingency flow on all of these ties is around 36 MW into New York. Removing these ties shows no voltage violations, voltage deviations, thermal overloads, or instability. The results are consistent with the previous CATR findings.

3.2.2 EC02 - Loss of Niagara Station

Disconnect 13.8kV generator Niagara 1	Disconnect 13.8kV generator Niagara 13
Disconnect 13.8kV generator Niagara 2	Disconnect Niagara Circuits 1 & 2 345kV
Disconnect 13.8kV generator Niagara 3	Disconnect Niagara 2 E 230kV
Disconnect 13.8kV generator Niagara 4	Disconnect Niagara 2 W 230kV
Disconnect 13.8kV generator Niagara 5	Disconnect Niagara 115 E 115kV
Disconnect 13.8kV generator Niagara 6	Disconnect Niagara 115 W 115kV
Disconnect 13.8kV generator Niagara 7	Disconnect 13.8kV generators Lewiston 1-3
Disconnect 13.8kV generator Niagara 8	Disconnect 13.8kV generators Lewiston 4-6
Disconnect 13.8kV generator Niagara 9	Disconnect 13.8kV generators Lewiston 7-9
Disconnect 13.8kV generator Niagara 10	Disconnect 13.8kV generators Lewiston 10-11
Disconnect 13.8kV generator Niagara 11	Disconnect 13.8kV generators Lewiston 13-14
Disconnect 13.8kV generator Niagara 12	

This extreme contingency involves the *no fault* loss of the Niagara 345 kV, 230 kV and 115 kV buses. The resulting loss includes four 345 kV circuits, four 230 kV circuits, eleven 115 kV circuits, three 345/230 kV transformers, two 230/115 kV transformers, the isolation of one 115 kV bus and the loss of 2700 MW of generation at Niagara and Lewiston.

Gilboa 345, Rochester 345 and Pannell 345 buses violated the OP-1 high limit. Four 115 kV buses were above 1.06 PU and twenty-six 115 kV buses were below 0.9 PU. There were a large number of severe voltage drops at one 345 kV bus, ten 230 kV buses, and 132 115 kV buses. Two transformers (one 230/115 kV and one 115/34.5 kV) exceeded 100% of their STE rating. There were no instabilities.

It is anticipated that this extreme contingency could result in loss of local load in NYCA Western region. The results are consistent with the previous CATR findings.

3.2.3 EC03 - Loss of the Right Of Way West of Rochester

Disconnect line NR2 connecting Rochester 345kV to Niagara 345kV Disconnect line SR1-39 connecting Rochester 345kV to Kintigh 345kV

This contingency is the *no fault loss* of two 345 kV circuits west of Rochester, SR1-39 and NR2. These lines connect Rochester to Kintigh and Rochester to Niagara. Their loss reduces the Dysinger-East transmission interface capacity and forces power flowing from west to east to flow along alternate paths. Fifteen 115 kV branches exceeded 100% of their STE ratings and one 115 kV branch exceeded 95% of their STE ratings. There were twenty-eight 138/115 kV buses have voltage deviations greater than 5%. No instability was found. It is anticipated that this extreme contingency could result in loss of local load in NYCA Genesee region.

The previous CATR showed six 115 kV branches exceeded 95% of their STE ratings. The difference in the results of this CATR compared to the previous CATR is probably due to a higher pre-contingency flow from west to east.

3.2.4 EC04 - Loss of the Right Of Way East of Rochester

Disconnect line RP-1 connecting Rochester 345kV to Pannell 345kV Disconnect line RP-2 connecting Rochester 345kV to Pannell 345kV

This contingency is the *no fault loss* of both Rochester-Pannell lines, RP-1 and RP-2. Pannell 345 kV bus violated the OP-1 high limit. There were no large deviations, no thermal overloads, and no instability.

The previous CATR showed one 345 kV and three 115 kV branches exceeded 95% of their STE ratings. The difference in the results of this CATR compared to the previous CATR is probably due to a lower Kintigh dispatched.

3.2.5 EC05 - Loss of Watercure Station

Disconnect Watercure 345kV bus Disconnect Watercure 230kV bus

This contingency is the *no fault loss* of the Watercure 345 kV and 230 kV buses. The Watercure substation consists of two ring buses connected by a transformer. Dropping the station buses results in the loss of two 345 kV branches, two 230 kV branches and one 345/230 kV transformer reducing west to east transfers. There were no voltage violations, no large deviations, no thermal overloads, and no instability. The results are consistent with the previous CATR findings.

3.2.6 EC06 - Loss of Right Of Way North of Volney

Disconnect 24kV generator 2 at Nine Mile 2	Disconnect 24kV Steam generator 5 at Sithe
Disconnect 24kV generator 1 at Nine Mile 1	Disconnect 24kV Steam generator 6 at Sithe
Disconnect 24kV generator 1 at JA Fitzpatrick	Disconnect 345kV Scriba Bus
Disconnect 24kV GT generator 1 at Sithe	Disconnect 345kV Nine Mile One Bus
Disconnect 24kV GT generator 2 at Sithe	Disconnect 345kV Independence Bus
Disconnect 24kV GT generator 3 at Sithe	Disconnect 115kV Scriba Bus
Disconnect 24kV GT generator 4 at Sithe	Disconnect 345kV Fitzpatrick Bus

This contingency is the *no fault loss* of the Scriba-Volney, Nine Mile Pt.1-Clay, and Independence-Clay lines. The resulting overload on Fitzpatrick-Edic will cause the line to trip out, isolating the Scriba 345 kV and 115 kV station and 2750 MW of generation at Nine Mile Pt. 1 and 2, Fitzpatrick, and Sithe. Gilboa 345 bus violated the OP-1 high limit. There were no large deviations, no thermal overloads, and no instability. The results are consistent with the previous CATR findings.

3.2.7 EC07 - Loss of Right Of Way South of Volney

Disconnect line 8 connecting Nine Mile Point 1 to Clay
Disconnect line 6 connecting Volney to Clay
Disconnect line 26 connecting Independence to Clay

This contingency is the *no fault loss* of circuits south of Volney. This event requires power flowing out of the Oswego area generators to be redistributed along circuits parallel to those removed. There were no voltage violation, no large voltage deviations, no thermal overloads, and no instability. The results are consistent with the previous CATR findings.

3.2.8 EC08 - Loss of Clay Station

Disconnect Clay 345kV and 115kV bus

This contingency is the *no fault loss* of the Clay substation. Clay connects to 6 substations in the 345 kV network and the resulting loss includes eight 345 kV branches, eight 115 kV branches, and two 345/115 kV transformers. There were no voltage violation, no large voltage deviations, no thermal overloads, and no instability.

The previous CATR showed six 115 kV bus voltage deviations were greater than 5%, but there were no OP-1 post-contingency voltage violations, no thermal overloads, and no instabilities. The differences in the results of this CATR compared to the CATR are probably due to more local reactive supporting devices were in service.

3.2.9 EC09 - Loss of Lafayette Station

Disconnect Lafayette 345kV bus

This contingency is the *no fault loss* of Lafayette substation resulting in the loss of three 345 kV branches and reduction of exports from the Oswego-Syracuse area. No voltage deviations, OP-1 voltage violations, thermal overloads, or instabilities occurred. This result is consistent with the previous comprehensive review.

3.2.10 EC10 - Loss of Oakdale Station

Disconnect Oakdale 345kV bus Disconnect Oakdale 230kV bus Disconnect all three Oakdale 115kV buses

This contingency is the *no fault loss* of all Oakdale buses: one 345 kV ring bus, one 230 kV bus, and three 115 kV buses. The resulting loss includes three 345 kV branches, one 230 kV branch, seven 115 kV branches, two 345/115 kV transformers, and one 230/115 kV transformer, isolating three underlying load buses. One 115 kV bus showed a voltage gain exceeded 5% and seventeen 115 kV buses showed a voltage exceeded 1.06 PU, but no OP-1 voltage violations, thermal overloads, or instabilities occurred.

The previous CATR showed voltage drops of at least 5% occurred at twenty-eight 115 kV buses, including a 50% drop at two buses and a 40% drop at another eight buses. Voltage drops as large as 11% also occurred at three 230 kV buses and one 345 kV bus. Seven 115 kV branches exceeded their STE ratings and voltage drops were observed in the adjoining PJM territory. The Bowline 1 345kV bus violated its OP-1 post-contingency high voltage limit by 0.1%.

The differences in the results of this CATR compared to the CATR are probably due to the Marcy FACTS and its supporting devices (e.g., Oakdale 345 and Edic 345 capacitor banks) were in service in this CATR.

3.2.11 EC11 - Loss of Right Of Way North of Adirondack

Disconnect 230 kV lines 1 & 2 connecting Adironack to Moses Disconnect 765 kV line MSU-1 connecting Marcy to Massena

This contingency is the *no fault loss* of circuits on the right of way north of the Adirondack substation. The Marcy-Massena 765 kV and Adirondack-Moses 230 kV lines are dropped resulting in rejection of 1200 MW of Hydro Quebec import, triggered by the loss of the Marcy-Massena 765 kV line. This test resulted in (1) voltage deviations (>5%) at one 765 kV bus, four 230 kV buses, and seventy-two 115 kV buses, (2) low voltage violations (<0.9 PU) at six 115 kV buses, and (3) thermal overloads at two 230 kV and fifteen 115 kV branches. However, the system remained stable. It is anticipated that this extreme contingency could result in loss of local load in NYCA Northern region.

The previous comprehensive review results showed that there was one 765 kV bus and two 230 kV bus voltage deviations greater than 5% and one 115 kV branch thermal overload. The differences in the results of this CATR compared to the previous CATR are probably due to a higher pre-contingency flow imported from Hydro Quebec.

3.2.12 EC12 - Stuck Breaker at Marcy

3PH on #19 line	t = 0 sec
Clear Volney	t = 4.5 cyc
Clear Marcy (Backup)	t = 10 cyc
Clear Edic (Backup)	t = 11 cyc

This contingency is the three-phase version of the criteria fault CE15, a fault at Marcy 345 on the Marcy-Volney #19 line with a stuck breaker at Marcy resulting in the delayed clearing of the fault when the Edic-Marcy line is tripped. The effect of this contingency is to leave a three-phase fault on Edic/Marcy for 11 cycles, clearing the fault by opening two of the east-west 345 kV paths supplying Central East. No significant voltage deviations, OP-1 voltage violations, thermal overloads, or instabilities occurred. The results were found to be consistent with the previous CATR.

3.2.13 EC13 - Loss of Edic Station

Disconnect Edic 345kV bus

This contingency is the *no fault loss* of the Edic substation resulting in the loss of six 345 kV branches, one 345/230 kV transformer, two 345/115 kV transformers, and one 200 MVAR capacitor bank. Rochester 345 and Pannell 345 violated the OP-1 high limit. One 345 kV bus, five 230 kV buses, and ninety-one 115 kV buses showed a voltage drop greater than 5%. One 115 kV branch exceed 100% of its STE rating. No instabilities were found.

The previous comprehensive review results indicated no significant voltage deviations. The difference in the results of this CATR compared to the previous CATR is probably due to a higher pre-contingency flow on the Total East interface.

3.2.14 EC14 - Loss of Right Of Way South of Utica

Disconnect 345 kV line EF24-40 connecting Edic to Fraser Disconnect 345 kV line connecting Marcy to Coopers Corners Disconnect 230 kV lines 30 and 31 connecting Porter to Rotterdam

This contingency is the *no fault loss* of circuits south of Utica. These are the lines connecting Rotterdam-Porter, Marcy-Coopers Corners, and Edic-Fraser. No significant voltage deviations, OP-1 voltage violations, or instabilities occurred, but five 115 kV branches exceeded their STE ratings.

The previous CATR showed no significant voltage deviations, OP-1 voltage violations, thermal overloads or instabilities. The difference in the results of this CATR compared to the previous CATR is probably due to a higher pre-contingency flow on the Total East interface.

3.2.15 EC15 - Loss of Right Of Way East of Utica

Disconnect 345 kV line 14 connecting Edic to New Scotland bus 77 Disconnect 345 kV line USN18 connecting Marcy to New Scotland bus 99

This contingency is the *no fault loss* of circuits east of Utica. These are the lines connecting Edic to New Scotland and Marcy to New Scotland. One 230 kV bus and fourteen 115 kV buses showed a voltage drop greater than 5%, and two 115 kV branches exceeded 100% of their STE ratings, but there were no OP-1 violations or system instabilities.

The previous CATR showed no significant voltage deviations, OP-1 voltage violations, thermal overloads or instabilities. The difference in the results of this CATR compared to the previous CATR is probably due to a higher pre-contingency flow on the Total East interface.

3.2.16 EC16 - Loss of Fraser Station

Loss of Fraser Substation Loss of Fraser 345, 115, SVC Disconnect both Fraser 345 kV buses and the 115 kV bus

This contingency is the *no fault loss* of the Fraser substation. Loss of the Fraser 345 kV, 115 kV, and SVC buses results in loss of four 345 kV branches, two 115 kV branches, and two 345/115 kV transformers. Voltage of one 345 kV bus and four 115 kV buses exceeded 1.06 PU. A 5% voltage drop at one 115 kV bus and one 115 kV branch exceeded its STE rating were found, but there were no OP-1 violations or instabilities. This result is consistent with the previous CATR.

3.2.17 EC17 - Loss of Right Of Way West of Rotterdam

Disconnect 345 kV line 14 connecting New Scotland bus 77 to Edic Disconnect 345 kV line UNS18 connecting New Scotland bus 99 to Marcy Disconnect 230 kV lines 30 and 31 connecting Porter to Rotterdam

This contingency is the *no fault loss* of lines west of Rotterdam. This loss of right of way essentially severs Central East, dropping lines connecting Rotterdam to Porter, Edic to New Scotland, and Marcy to New Scotland. Voltage of ten 115 kV buses dropped below 0.9 PU. Voltage drops greater than 5% occurred at four 345 kV buses, four 230 kV buses, and eighty-four 115 kV buses. Fourteen 115 kV branches exceeded 95% of their STE ratings, ten of which exceeded 100% of their STE. There were no OP-1 violations or system instabilities. It is anticipated that this extreme contingency could result in loss of local load in NYCA Capital region.

The previous CATR showed voltage drops greater than 5% occurred at six 115 kV buses and six 115 kV branches exceeded 95% of their STE ratings. The impact of this contingency was indicated to be somewhat more severe in this CATR compared to the previous CATR due to (1) a higher pre-contingency loading on the Central East interface and (2) a higher HQ import.

3.2.18 EC18 - Loss of New Scotland Station

Disconnect New Scotland 345 kV 77 bus Disconnect New Scotland 345 kV 99 bus Disconnect New Scotland 115 kV bus

This contingency is the *no fault loss* of New Scotland substation. This station contains two straight buses, # 99 and # 77, connected by two breakers in series and 3 sets of 135 Mvar capacitor banks. The loss of six 345 kV lines connected into the station results in a significant disruption in the northeastern portion of the cross-state 345 kV system. The results showed voltage drops greater than 5% occurred at four 345 kV buses, one 230 kV bus, and fifty-six 115 kV buses, and one 345 kV branches and two 115 kV branches exceeded 95% of their ratings. There were no OP-1 violations or system instabilities.

The previous CATR showed no significant voltage deviations, voltage violations, thermal overloads, or system instabilities. The impact of this contingency was indicated to be somewhat more severe in this CATR compared to the previous CATR due to (1) a higher pre-contingency loading on the Central East interface and (2) a higher HQ import.

3.2.19 EC19 - Loss of Leeds Station

Disconnect Leeds 345 kV bus

This contingency is the *no fault loss* of Leeds 345 kV substation. Two 135 MVAR capacitor banks, an SVC, and six transmission lines terminate on this bus. Coopers Corners 345 kV bus violated the OP-1 low limit. Rochester 345 and Pannell 345 kV buses violated the OP-1 high limit. Voltage of nine 115 kV buses dropped below 0.9 PU. Voltage deviations greater than 5% occurred at four 345 kV buses and sixty-eight 115 kV buses. One 345 kV branch and sixteen 115 kV branches exceeded 100% of their STE ratings. There were no instabilities. It is anticipated that this extreme contingency could result in loss of local load in NYCA Eastern region.

The previous CATR showed voltage drops greater than 5% occurred at two 345 kV and eighteen 138/115 kV buses along with thermal overloads of 99-132% of STE rating on six 115 kV branches. The impact of this contingency was indicated to be somewhat more severe in this CATR compared to the previous CATR due to a higher pre-contingency loading on the UPNY/SENY interface.

3.2.20 EC20 - Loss of Fishkill Station

Disconnect East Fishkill 345 kV and 115 kV buses Disconnect Fishkill Plains115 kV bus

This contingency is the *no fault loss* of the Fishkill substation, including the loss of the East Fishkill 345 kV and 115 kV buses, Fishkill Plains 115 kV bus, two 135 Mvar capacitor banks, and the termination point for five 345 kV transmission lines. Twelve voltage deviations slightly greater than 5% at 115 kV buses were found, but all bus voltages were within their post-contingency limits. No thermal overloads or instabilities were present. The results are somewhat consistent with the previous CATR.

3.2.21 EC21 - Loss of Roseton Station

Disconnect Roseton 345 kV bus Disconnect Roseton 24 kV generators GN1 and GN2

This contingency is the *no fault loss* of Roseton, including the loss of the 345 kV bus, two 24 kV generators and three 345 kV branches. No significant voltage deviations, thermal overloads, or instabilities were present. This result is consistent with the previous CATR.

3.2.22 EC22 - Loss of Ramapo Station

Disconnect Ramapo 345 kV bus Disconnect Ram Par 345 kV bus Disconnect Ramapo 138 kV bus Disconnect Ramapo 500 kV bus

This contingency is the *no fault loss* of Ramapo substation and the PJM Branchburg tie, including the loss of the Ramapo 500 kV, 345 kV, and 138 kV buses, one 500 kV, eight 345 kV, and five 138 kV branches, and one 500/345 kV and two 345/138 kV transformers. Two 115 kV branches exceeded 100% of their STE ratings and two voltage deviations greater than 5% occurred at 138 kV buses, but there were no OP-1 violations or system instabilities.

The previous CATR showed no significant voltage deviations, OP-1 post-contingency voltage violations, thermal overloads, or instabilities. The difference in the results of this CATR compared to the previous CATR is probably due to a higher load growth and the retirement of some local generations in the area.

3.2.23 EC23 - Loss of Buchanan Station

Disconnect Buchanan North	Disconnect Indian Pt 2 22kV
Disconnect Buchanan South	Disconnect Indian Pt 3 33kV
Disconnect Indian Pt 2 345kV	Disconnect Buchanan TA5
Disconnect Indian Pt 3 345kV	Disconnect Buchanan 138 kV

This contingency is the *no fault loss* of the Buchanan substation, including the loss of the north and south 345 kV buses, one 138 kV bus, one 13.6 kV bus, five 345 kV branches, one 345/138 kV transformer, and the Indian Point #2 and #3 generators. No significant voltage deviations, OP-1 post-contingency voltage violations, thermal overloads, or instabilities were present. This result is consistent with the previous CATR.

3.2.24 EC25 - Loss of Millwood Station

Disconnect Millwood 345 kV, 138 kv and 13.6 kV buses Disconnect OSS 138 kV and 13.6 kV buses

This contingency is the *no fault loss* of the Millwood 345, 138, and 13.6 kV buses. A total of four 345 kV buses, four 138 kV buses, two 345/138 kV transformers are lost, along with the isolation of three underlying load buses and the loss of East View circuits 2, 3, and 4. No voltage deviations, OP-1 post-contingency voltage violations, significant thermal overloads, or instabilities were present. This result is consistent with the previous CATR.

3.2.25 EC26 - Loss of Right Of Way South of Millwood

Disconnect Elmsford 2 13.6 kV bus Disconnect Elmsford 1 East and West 138 kV buses Disconnect Elmsford 2 East and West 138 kV buses Disconnect Harrison 13.6 kV bus Disconnect Harrison 1, 2 and 3 138 kV buses Disconnect White Plains 5 / Harrison 3 138 kV bus Disconnect White Plains 6 138 kV bus	Disconnect White Plains 7 / Harrison 2 138 kV bus Disconnect White Plains 8 / Harrison 1 138 kV bus Disconnect White Plains 1R 13.6 kV bus Disconnect White Plains 2R 13.6 kV bus Disconnect Eastview 1-4 345 kV buses Disconnect Eastview 138 kV bus

This contingency is the *no fault loss* of the circuits south of Millwood and Eastview substation. These are lines connecting Millwood, Sprain Brook, and Buchanan. No significant voltage deviations, OP-1 post-contingency voltage violations, thermal overloads, or instabilities were present. This result is consistent with the previous CATR.

3.2.26 EC27 - Loss of Astoria Generation

Disconnect Astoria Reliant Repowering 15 kV generator Disconnect Astoria 4 20 kV generator Disconnect Astoria 5 20 kV generator Disconnect Astoria East 13 kV GT generator Disconnect Astoria West 13 kV GT generator	Disconnect Astoria 5 13 kV GT generator Disconnect Polletti Expansion 18 kV generator Disconnect Astoria 7 13 kV GT generator Disconnect Astoria 8 13 kV GT generator Disconnect Astoria 9 13 kV GT generator

This contingency is the *no fault loss* of Astoria and Polletti generation. Voltage drops of greater than 5% occurred at seven 138 kV buses. There were no OP-1 violations, thermal overloads, or instabilities.

The previous CATR showed voltage drops of greater than 5% occurred on forty-three 138 kV buses in the vicinity of the Astoria station, and the voltage dropped as low as 0.89 PU on six 138 kV buses. One Astoria 138/345 kV transformer, a 345 kV branch, and two 138 kV branches were loaded above their STE ratings. The difference in the results of this CATR compared to the previous CATR is probably due to a lower pre-contingency dispatch of Astoria generations.

3.2.27 EC28 - Loss of Ravenswood Generation

Disconnect Ravenswood 1 20 kV generator Disconnect Ravenswood 2 20 kV generator Disconnect Ravenswood 3 20 kV generator

This contingency is the *no fault loss* of 1430 MW of generation at the Ravenswood substation. No voltage deviations, OP-1 post-contingency voltage violations, thermal overloads, or instabilities were present. This result is consistent with the previous CATR.

3.2.28 EC29 - Loss of Northport Station

Disconnect Northport 1 138 kV bus
Disconnect Northport 138 kV bus
Disconnect Northport P 138 kV bus
Disconnect Northport 22 kV generators G1, G2, G3 and G4

This contingency is the *no fault loss* of the Northport cable, the Northport 138kV bus, and Northport generation. Voltage deviations greater than 5% occurred at two 230 kV buses and forty-eight Significant voltage deviations, but no OP-1 post-contingency voltage violations, thermal overloads, or system instability were present. The results showed more severe voltage deviations compared to the previous CATR. The differences could be the results of different pre-contingency generation dispatch pattern in Long Island system.

3.2.29 EC30 - Stuck Breaker at Moses

3 PH at Moses	t= 0
Clear Massena	t= 5.5 cyc
Clear Moses (backup)	t= 12.5 cyc
Clear Moses 230/115	t= 12.5 cyc

This contingency is the three-phase version of the criteria fault MS06. A three-phase fault occurs at Moses 230 kV on MMS-2 with a stuck breaker at Moses initiating the loss of one of the two Moses-Massena 230 kV circuits and requiring backup clearing of the fault by the trip of one of the Moses 230/115 kV transformer banks. The effect of this contingency is to leave a three-phase fault on the Moses 115 kV bus for 12.5 cycles, clearing the fault by opening one Moses-Massena 230 kV path and one of the four Moses 230/115 kV paths. This event resulted in the first-swing instability of all of the Moses-St. Lawrence units (800 MW); however, the remainder of the bulk power system remained stable. No significant voltage deviations or thermal overloads were present. These results are consistent with the previous CATR review.

3.2.30 EC31 - 3 Ph Fault @ Edic on EF24-40 with a Stuck Breaker at Edic

3PH at Edic	t = 0
Clear Fraser	t = 5.0 cyc
Clear Edic (Backup)	t = 9.5 cyc
Clear Clay	t = 12.0 cyc

This contingency is the three-phase version of the criteria fault CE16, a fault at Edic 345 on the Edic-Fraser EF24-40 line with a stuck breaker at Edic, initiating the trip of the Edic-Fraser line and requiring backup clearing on one of the two Clay-Edic 345 circuits. The effect of this contingency is to leave a three-phase fault on Edic for 12 cycles, clearing the fault by opening one of the east-west 345 kV paths and one Central-SENY path. No significant voltage deviations, OP-1 post-contingency voltage violations, thermal overloads, or instabilities were present. This result is consistent with the previous CATR.

3.2.31 EC32 - 3 Ph Fault @ Edic on #14 with a Stuck Breaker at Edic

3PH at Edic	t = 0
Clear New Scotland	t = 5.0 cyc
Clear Edic (Backup)	t = 8.5 cyc
Clear Fitzpatrick	t = 10.5 cyc

This contingency is the three-phase version of the criteria fault CE03. A fault occurs at Edic on the Edic-New Scotland #14 line with a stuck breaker at Edic, initiating the trip of the Edic-New Scotland circuit and requiring backup clearing on the Edic-Fitzpatrick 345 kV line. The effect of this contingency is to leave a three-phase fault on Edic for 10.5 cycles, clearing the fault by opening one of the Central-East 345 kV paths and one Oswego Complex-Central path. No significant voltage deviations, OP-1 post-contingency voltage violations, thermal overloads, or instabilities were present. This result is consistent with the previous CATR.

3.2.32 EC33 - Stuck Breaker at Rochester

3PH at Rochester	t = 0
Clear Pannell	t = 4.5 cyc
Clear Rochester (Backup)	t = 16.25 cyc
Clear Kintigh (Backup)	t = 16.25 cyc

This contingency is the three-phase version of the criteria fault WC12, a fault at Rochester 345 on the Rochester-Pannell RP-1 345 kV circuit with a stuck breaker at Rochester requiring backup clearing on the Kintigh-Rochester 345 line. The effect of this contingency is to leave a three-phase fault on Rochester for 16.75 cycles, clearing the fault by opening one of two West Central 345 kV paths with no generation rejection. No significant voltage deviations, OP-1 post-contingency voltage violations, thermal overloads, or instabilities were present. This result is consistent with the previous CATR.

3.2.33 EC35 - 3 Ph Fault @ Edic on FE1 with a Stuck Breaker at Edic

3PH at Edic	t = 0
Clear Fitzpatrick	t = 5.5 cyc
Clear Edic (Backup)	t = 8.5 cyc
Clear New Scotland (Backup)	t = 10.0 cyc

This contingency is the three-phase version of the criteria fault CE09. A fault occurs at Edic on the Edic-Fitzpatrick FE-1 line with a stuck breaker at Edic, initiating the trip of the Edic-Fitzpatrick circuit and requiring backup clearing on the Edic-New Scotland 345 kV line. The effect of this contingency is to leave a three-phase fault on Edic for 10 cycles, clearing the fault by opening one of the Central-East 345 kV paths and one Oswego Complex-Central path. No significant voltage deviations, OP-1 post-contingency voltage violations, thermal overloads, or instabilities were present. This result is consistent with the previous CATR.

3.3 Extreme Contingency Summary

As stated in the NPCC Basic Criteria, the purpose of extreme contingency assessment is "... to obtain an indication of system strength, or to determine the extent of a widespread system disturbance, even though extreme contingencies do have low probabilities of occurrence." In this CATR, the system response to extreme contingencies was comparable to the previous CATR. This indicates that the strength of the planned interconnected power systems is not expected to deteriorate in the near future.

4 REVIEW OF SPECIAL PROTECTION SYSTEMS

A review of the special protection systems (SPSs) in the New York Control Area (NYCA) was conducted. These SPSs include transmission cross-tripping schemes for the Chateauguay-Massena 765 kV (MSC-7040) and the Plattsburgh-Vermont 115 kV (PV-20) lines and generation rejection schemes for units at Moses, Niagara, Oswego, and Bowline Point. A complete list of the SPS in New York is provided in Appendix K.

4.1 METHODOLOGY

Simulations were conducted for several actions that could occur for each SPS. The first was a test for the correct operation of the SPS. A fault or contingency would be applied and the cross-trip or generation rejection would be included to determine whether the action would help the system to remain stable. The next test was for the failure of the SPS to operate. Here the contingency would be applied without the cross-trip or generation rejection. The outcome of this test helps to determine the classification (Type I or Type III) of the SPS. The final test is for the misoperation of the SPS. The cross-trip or generation rejection would now be applied without an initiating contingency. The misoperations were only tested if they caused the loss of more than one element (greater than a normal criteria contingency). Inter-Area flow diagrams for the load flow cases used in this testing are included in Appendices D & K. The SPS Stability Simulation Summary Table in Appendix K indicates which powerflow case was used for each SPS evaluation.

4.2 RESULTS

The simulation of the Type I SPS which cross-trips the Massena-Chateauguay (MSC-7040) line for loss of the Massena-Marcy line was stable for correct operation and misoperation of the SPS but unstable for the failure to operate. Since this SPS resulted in inter-Area effects it should remain classified as Type I.

The simulation of the Type I SPS that rejects generation at St. Lawrence for local contingencies was stable for correct operation, failure to operate, and misoperation. These results indicate that this SPS can be reclassified as Type III, for the conditions tested. This reclassification will not be pursued with NPCC.

The simulation of the Type I SPS that rejects generation at Niagara for local contingencies was stable for correct operation, failure to operate and misoperation of the SPS following normal and extreme contingencies. The previous CATR showed for SPS failure, the system was stable following normal contingencies but unstable following one extreme contingency (3-phase fault on Niagara-Rochester 345 kV (NR-2) with delayed clearing). This discrepancy is most likely due to changes in system conditions between the two reviews. The results in this CATR indicate that this SPS can be reclassified as Type III, for the conditions tested. This reclassification will not be pursued with NPCC.

The Type II SPS that currently rejects Bowline unit #2 following the loss of both 345 kV lines from Ladentown will require modifications in order to accommodate the proposed Bowline #3 plant. As shown in the Bowline #3 SRIS (supplement #4) [12], the SPS may be redesigned to trip Bowline #2 and #3 if the 345 kV circuits W72 (Ladentown-Ramapo) and Y88 (Ladentown-Buchanan) both have no flow and a reverse flow (away from Ladentown) is detected on circuit 67 (Ladentown-W. Haverstraw-Bowline #1). This SPS acts to prevent all of the Bowline output from being directed through the 138 kV system. Because the Ladentown station ring bus would be expanded to interconnect Bowline #3, the Ladentown bus may be either intact or split following the loss of both W72 and Y88, resulting in two possible scenarios for SPS operation. Both scenarios were examined in this review, although the two scenarios have very similar results.

Simulations of the Bowline rejection SPS showed different results depending on whether Bowline #3 was running. For cases with Bowline #3 out of service, the simulations were stable for correct operation and misoperation of the SPS but showed undamped oscillations for the failure of the SPS to operate. For simulations with Bowline #3 in service, the system was stable following SPS misoperation but unstable following both correct SPS operation and failure of the SPS to operate due to first-swing instability of all Bowline units. The simulations modeled a delay of 45 cycles for tripping the Bowline units following the simultaneous no-fault loss of W72 and Y88. The delay for tripping Bowline #2 and #3 would need to be reduced to 27 cycles (critical rejection time) to prevent instability for the system conditions tested. It is recommended that the time delay for this SPS be studied and adjusted accordingly to reduce the risk of system instability in order to accommodate the proposed Bowline 3 project. Since the initiating contingency is an extreme contingency, this SPS should continue to be classified as Type II.

The SPS that rejects generation at Oswego is for protection against extreme contingencies (Type II). The simulation of the SPS was stable for correct operation and for misoperation but was unstable for the failure to operate. Since this SPS correctly protects against instability for extreme contingencies, it should continue to be classified as Type II.

The simulation of the Type III SPS which cross-trips the Plattsburg-Grand Island (PV20) line for loss of the both Moses-Willis-Plattsburg ties was stable for correct operation, failure to operate and misoperation of the SPS. This indicates that the SPS has only local area effects and should remain classified as Type III.

A list of the SPSs along with the summary results of the Special Protection System analysis is included in Appendix K.

5 REVIEW OF DYNAMIC CONTROL SYSTEMS

In 1991/2, the JWG-1 performed an evaluation and classification of the DCSs that existed in NPCC [13]. As part of this comprehensive review, the classifications of the DCSs which are in NYCA were reassessed. Existing and proposed control systems in NYCA are listed in Tables 5.1 and 5.2 respectively. The generators whose excitation systems were tested represent the largest units in NYCA.

As recommended in the JWG-1 report, Type I DCS (those whose failure has the potential to impact other Areas) should have functional redundancy, self diagnostics, or support from another DCS. In this last case, the two control systems are collectively considered to be a single Type I DCS. Therefore, a particular DCS may be classified as Type III only if its failure combined with the failure of any other Type III DCS does not have inter-Area consequences.

Table 5.1
Existing Dynamic Control Systems in NYCA

DYNAMIC CONTROL SYSTEM	TYPE
Chateauguay HVdc Controls	
CSP	Type III
LVCL	Type III
Bang-Ramp	Type III
Chateauguay SVCs	Type III
Fraser SVC	Type III
Leeds SVC	Type III
Marcy STATCOM	Type III
Nine Mile Pt. #1 Exciter	Type III
Nine Mile Pt. #2 Exciter	Type III
Fitzpatrick Exciter	Type III
Oswego #5 & #6 Exciters	Type III
Ravenswood #3 Exciter	Type III
Indian Pt. #2 Exciter	Type III
Indian Pt. #3 Exciter	Type III
North End PSS	Type III
Sithe PSS	Type III
Bethlehem PSS	Type III
East River PSS	Type III
Poletti PSS	Type III

Table 5.2
Proposed Dynamic Control Systems in NYCA

DYNAMIC CONTROL SYSTEM	TYPE
Calpine Wawayanda PSS	Type III

5.1 METHODOLOGY

Two of the base cases developed for testing the Special Protection Systems were also used to evaluate the DCSs:

Moses South Stressed (MSC-7040 > 1900MW)
UPNY Margin Case (Oswego Complex > 3200 MW)

Generation levels and MW interface flows of these cases are listed in Appendices D & K. The case in which the system is stressed in closest proximity to the device being tested was assigned to each device. Then both the DCS and its supporting DCS were disabled and a fault applied. Table L-1 in appendix L lists all the DCS stability simulations with the device affected and the fault type. If all faults were stable, the control is considered to affect only the local area and is classified as Type III. If any faults were unstable, the faults were rerun with the DCS disabled but the supporting DCS would be active. If the faults were then stable, the DCS has inter-Area impact and is classified as Type I.

5.1 RESULTS

None of the faults resulted in an unstable system oscillation. Therefore, all DCSs will continue to be considered as Type III.

6 FAULT CURRENT ASSESSMENT

The short circuit assessment for this year CATR was relied on the results of the short circuit study for the Cost Allocation Study for Catch-up Class Year (2003-2005) Projects [14] since the base cases of the two studied are slowly matched and the short circuit base case of the Cost Allocation Study is more up to date.

6.1 DESCRIPTION OF THE SHORT CIRCUIT BASE CASE

NYISO staff uses the 2005 up to date statewide short circuit database, referred to as “as found system” database or “as found” case as a starting point for this short circuit study. The “as found” case was modified to include all new proposed class year projects. The neighboring system representation (e.g., PJM, ISO-NE and IEMO) was updated with their latest available planning model reflecting 2009 load since 2010 model was not ready at the time of this study began; however, no significant changes were anticipated in their 2010 model.

6.2 METHODLOGY

The short circuit analysis was conducted using the ASPEN OneLiner program. The short circuit assessment was performed in accordance with the NYISO Guideline for Fault Current Assessment (SC Guideline), which was approved by the Operating Committee on March 12, 2003 [15]. Key assumptions used in this SC Guideline are as follows:

a. All generating units are in service
b. All transmission lines and transformers are in service
c. All series elements (series reactors, series capacitors) are in service except those that are normally out of service
d. Ignore load
e. Ignore shunts (shunt capacitors, shunt reactors, line charging, etc)
f. Do not ignore delta-wye transformer phase shift
g. Do not ignore tap positions of fixed tap transformers
h. Use flat generator voltage profile (also called network solution voltage profile)
i. Apply the following faults:
    - Three line to ground
    - Double line to ground
    - Single line to ground.

NYISO staff used the above methodology to determine the fault currents at key buses throughout the NYCA. The highest of the three faults at each bus was compared against the respective circuit breaker rating at that bus to determine whether the fault duty exceeds the circuit breaker rating.

In many situations, a high substation fault does not automatically mean that each circuit breaker rated lower than the substation fault will be overdutied. Only an Individual Breaker Analysis (IBA) can provide true fault current a particular breaker will see. Con

Edison has provided IBA methodology that was used by NYISO for Con Edison system. Other Transmission owners did not have any specific IBA methodology. NYISO staff used the standard, conservative methodology in which the breaker being evaluated opens the last regardless of the voltage level.

6.3 RESULTS

Based on the study results, there are six substations (i.e., East Garden City 138, Fresh Kills 138, Greenwood 138, Newbridge 138, Ruland Rd 69 and TBG 5E 69 kV substations) with overdutied breakers. The overdutied breakers at these stations are the results of future proposal projects (e.g., Fortistar VP, Fortistar VAN, and PJM-LI HVdc projects). These overdutied breakers will be replaced as part of the planned system upgrades.

Table 6.1 summarizes overdutied breakers at each substation. For more information (e.g., fault currents at selected stations or IBA), see Appendix M.

Table 6.1 Overdutied Breaker Summary (Study Year 2010)

Station	kV	Number of Overdutied Breaker(s)	Breaker ID
FRESH KILLS	138	1	BT1-4
GREENWOOD	138	1	BT
EGC	138	3	1330, 1360, 1450
NEWBRIDGE	138	4	1330, 1340, 1370, 1420
RULAND	69	3	6020, 6610, 6620
TBG 5G 69	69	1	6630

7 REVIEW OF EXCLUSIONS FROM THE NPCC BASIC CRITERIA

The NPCC Basic Criteria contains a provision that allows a member to request an exclusion from criteria contingencies that are "Simultaneous permanent phase to ground faults on different phases of each of two adjacent transmission circuits on a multiple circuit tower, with normal fault clearing." NYISO does not have any such exclusion at this time and, therefore, none were reviewed. Furthermore, NYISO does not anticipate requesting any exclusion in the near future.

8 EXTREME SYSTEM CONDITION ASSESSMENT

As part of NPCC Basic Criteria, each Area is required to assess the extreme system conditions, which have a low probability of occurrence, such as loss of major gas supply and peak load condition resulting from extreme weather conditions.

Natural gas-fired generations in NYCA are supplied by various networks of major gas pipelines (e.g., Duke Energy, Columbia Gas Transmission, CNG Transmission, National Fuel Supply, Tennessee Gas Pipeline, and Iroquois Gas Transmission). In addition, NYCA generating capacity has a well balance of fuel mix which provides operational flexibility and reliability. Especially, many generation plants have a dual fuel capability. Figure 8.1 presents the fuel mix as it existed as of year end 2004. As indicated in Figure 8.1, 15% of generating capacity is fueled by natural gas only, 35% of generating capacity is fueled by oil and natural gas, and the rest is fueled by oil, coal, nuclear, hydro and other.

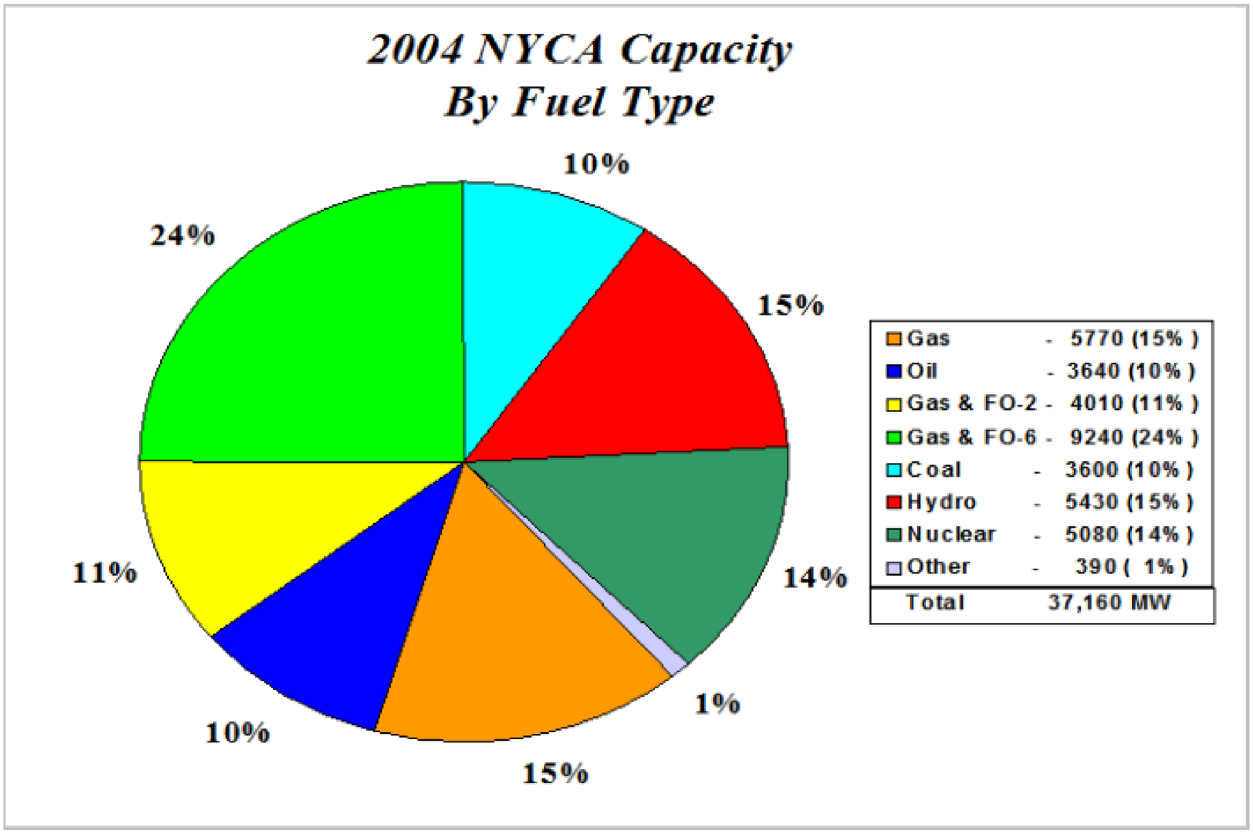

Figure 8.1: 2004 NYCA Capacity by Fuel Type

Based on (1) the nature of network of gas supplies and fuel diversity and (2) the NYSRC Loss of Generator Gas Supply Reliability Rule that requires the BPS in New York City and Long Island to be operated so that the loss of single gas facility does not result in the loss of electric load, it's determined that loss of a major gas pipeline would not create a detrimental negative adverse impact to the NY electric system. This assessment is also supported by the NYSERDA/NYISO Gas Study ("Ability to Meet Future Gas Demands from Electricity Generation in New York State", prepared by Charles Rivers Associates for NYSERDA and NYISO) and the Northeast Regional Gas Study ("Multi-Region Assessment of the Adequacy of the Northeast Natural Gas Infrastructure to Serve the Electric Power Generating Section", [Classified Confidential for Homeland Security], prepared by Levitan & Associates for PJM, ISO-NE, NYISO, NERC and IMO).

To satisfy the requirement of assessing the peak load condition resulting from the extreme weather conditions, a powerflow case was developed from the summer peak base case with the load increased to meet the extreme weather forecast load which reflects weather conditions that are expected to occur no more than once in ten years. The weather conditions were based on weather observations since 1950.

Several critical normal contingencies were selected for testing this extreme system condition base case. Each contingency was tested for dynamic stability, voltage, and thermal limits, and 115 kV and above buses or branches were observed for STE thermal and voltage violations. Each contingency is discussed below and the powerflow results and the stability plots of each contingency are placed in Appendix N.

8.1 CE01 – Normal Clearing Three-Phase Fault at Edic

This contingency is a normal clearing three-phase fault at Edic 345 kV bus resulted in loss of Edic–New Scotland 345 kV line. No voltage or thermal violations were observed. No system instabilities were observed either.

8.2 CE07 – Line-to-Line-to-Ground Fault on Tower UCC2-41/EF24-40

This contingency is a line-to-line-to-ground fault on tower UCC2-41/EF24-40 resulted in loss of Marcy-Coopers Corners and Edic–Frasers 345 kV lines. Post-contingency voltage less than 0.95 PU observed at seven 115 kV buses, but none was below 0.9 PU. No branches loaded above 100% of their STE ratings. No system instabilities were observed.

8.3 CE18 – Line-to-Line-to-Ground Fault on Tower CCRT-34/CCRT-42

This contingency is a line-to-line-to-ground fault on tower CCRT-34/CCRT-42 resulted in loss of Rock Tavern-Calpine Wawayanda and Rock Tavern–Middletown Tap-Coopers Corners 345 kV lines, Rock Tavern 345/115 transformer bank # 3, Middletown Tap 345/138 transformer, and Rock Tavern capacitor banks. Post-contingency voltage greater than 1.05 PU observed at two 345 kV buses and seven 115 kV buses. Post-contingency voltage less than 0.95 PU observed at seven 345 kV buses, one 230 kV bus, twenty-one 138 kV buses, and sixty-five 115 kV buses. Of these, two 138 kV buses and nine 115 kV buses were below 0.9 PU, and one 345 kV bus and two 138 kV buses were below 0.8 PU. One 138 kV branch, one 115 kV branch, and three 115/69 kV transformers loaded above 100% of their STE ratings. No system instabilities were observed. It is anticipated that this contingency could result in loss of local load in O&R and Central Hudson territories.

8.4 CE20 – Single-Line-to-Ground fault with Stuck Breaker at Edic

This contingency is a single-line-to-ground fault with stuck breaker at Edic 345 kV bus resulted in loss of Edic-Marcy 345 kV line, Edic 345/230 kV transformer and Edic 345/115 transformer. Post-contingency voltage less than 0.95 PU observed at one 230 kV bus and five 115 kV buses, but none was below 0.9 PU. No branches loaded above 100% of their STE ratings. No system instabilities were observed.

8.5 CE29 (CE17 Dynamics) – Normal Clearing Three-Phase Fault at Marcy

This contingency is a normal clearing three-phase fault at Marcy 345 kV bus resulted in loss of Marcy–Coopers Corners 345 kV line. No voltage and thermal violations or system instabilities were observed.

8.6 LOG02 (WC16 Dynamics) - Normal Clearing Three-Phase Fault at Ginna

This contingency is a normal clearing three-phase fault at Ginna 115 kV bus resulted in loss of Ginna generation. Post-contingency voltage less than 0.95 PU observed at sixty-three 115 kV buses, but none was below 0.9 PU. One 115/34.5 kV transformer loaded above 100% of its STE ratings, which could result in loss of local load in RG&E territory. No system instabilities were observed either.

8.7 LOG03 (UC04 Dynamics) - Single-Line-to-Ground fault with Stuck Breaker at Buchanan North

This contingency is a single-line-to-ground fault with stuck breaker at Buchanan 345 kV bus resulted in loss of Indian Point 2 generation. No voltage and thermal violations or system instabilities were observed.

8.8 LOG05 (MS01 Dynamics) - Normal Clearing Three-Phase Fault at Marcy

This contingency is a normal clearing three-phase fault at Marcy 765 kV bus resulted in loss of Marcy–Massena 765 kV line and rejection of HQ generation by 1200 MW. No voltage and thermal violations or system instabilities were observed.

8.9 LOG09 (UC25 Dynamics) - Normal Clearing Three-Phase Fault at Rainey

This contingency is a normal clearing three-phase fault at Rainey 345 kV bus resulted in loss of Ravenswood #3 generation. Post-contingency voltage less than 0.95 PU observed at nine 345 kV buses and one hundred twenty four 138 kV buses. Of these, only two 138 kV buses was below 0.9 PU. No branches loaded above 100% of their STE ratings. No system instabilities were observed.

8.10 LOG17 (CE34 Dynamics – No Fault Loss of Phase II at 1200 MW

This contingency is a no-fault loss of Phase II HVdc at 1200 MW. No voltage and thermal violations or system instabilities were observed.

8.11 TE32 – Normal Clearing Three-Phase Fault at New Scotland 77

This contingency is a normal clearing three-phase fault at New Scotland 345 kV bus resulted in loss of New Scotland 77 345 kV substation. No voltage and thermal violations or system instabilities were observed.

8.12 TE33 – Normal Clearing Three-Phase Fault at New Scotland 99

This contingency is a normal clearing three-phase fault at New Scotland 345 kV bus resulted in loss of New Scotland 99 345 kV substation. No voltage and thermal violations or system instabilities were observed.

8.13 UC26 – Line-to-Line-to-Ground Fault on Tower 67/68

This contingency is a line-to-line-to-ground fault on tower 67/68 resulted in loss of Ladentown-West Haverstraw and Ladentown-Ramapo 345 kV lines and Bowline 1 & 2 generations. Post-contingency voltage less than 0.95 PU observed at eight 138 kV buses, but none was below 0.9 PU. Three 138 kV branches loaded above 100% of their STE ratings, which could result in loss of local load in O&R territory. No system instabilities were observed.

8.14 UC18 – Normal Clearing Three-Phase Fault at Ladentown

This contingency is a normal clearing three-phase fault at Ladentown 345 kV bus resulted in loss of Ladentown-Buchanan South and Ramapo-Buchanan North 345 kV lines. No voltage and thermal violations or system instabilities were observed.

8.15 VE08 (VE05 Dynamics) – Single-Line-to-Ground fault with Stuck Breaker at Oakdale

This contingency is a single-line-to-ground fault with stuck breaker at Oakdale 345 kV bus resulted in loss of Oakdale-Fraser/Lafayette 345 kV lines. No voltage and thermal violations or system instabilities were observed.

8.16 WC04 – Normal Clearing Three-Phase Fault at Rochester

This contingency is a normal clearing three-phase fault at Rochester 345 kV bus resulted in loss of Rochester-Somerset (Kintigh) 345 kV line. No voltage and thermal violations or system instabilities were observed.

8.17 WC12 – Single-Line-to-Ground fault with Stuck Breaker at Rochester

This contingency is a single-line-to-ground fault with stuck breaker at Rochester 345 kV bus resulted in loss of Rochester-Somerset (Kintigh) and Rochester-Pannell Rd 345 kV lines. No voltage and thermal violations or system instabilities were observed.

Based on the study results, it’s possible that under the tested extreme weather conditions, loss of local loads in Central Hudson, O&R and RG&E territories could possibly happen for design contingencies such as tower contingency (CE18), loss of Ginna generation (LOG02), and tower contingency (UC26).

9 OVERVIEW SUMMARY OF SYSTEM PERFORMANCE

The six assessments presented in this report are summarized here. In the first assessment, powerflow and stability analyses, which were conducted to evaluate the thermal, voltage and stability performance of the NYSBPS for normal (or design) contingencies as defined in the NPCC and NYSRC reliability criteria and rules, indicated that the transfer limit for the UPNY/CONED interface could be reduced. This reduction is due to load growth in lower Hudson Valley and RECO areas, generation retirement in the load growth areas, and implementation of series reactors at Dunwoodie and Sprain Brook. In addition, lacking of dynamics VAR supports in these areas may also reduce the transfer limits of Millwood South and Sprain Brook-Dunwoodie South interfaces. However, these reductions do not pose an adverse reliability impact on NYSBPS because there are potentially 3,529 MW of increased generation and 990 MW of two transmission projects located east of these interfaces, which more than offset the reductions in transfer limits. The difference of other interfaces' transfer limits between this CATR and previous CATR is due to difference in generation dispatch pattern, installation of capacitor banks at Edic and Oakdale 345 kV buses, and/or change of interface definition.

In the second assessment, powerflow and stability analysis was conducted to evaluate the performance of the bulk power system for extreme contingencies as defined in the NPCC Basic Criteria. The stability analysis results indicate that the system would be stable for the system conditions tested. The powerflow analysis results indicate that, in most cases, extreme contingencies would not cause significant thermal or voltage problems over a widespread area for the conditions tested. In a few cases, an extreme contingency may result in a loss of local load within an area due to low voltage, STE thermal overload or first-swing instability of isolated generators. In most of these cases the affected area would be confined to the NYISO system. Overall, the results are comparable to previous CATR.

The third assessment evaluated the designed operation and the possible consequences of failure or misoperation of special protection systems (SPSs) within NYCA. This assessment indicated that the time delay for the Bowline rejection SPS may need to be adjusted to reduce the risk of system instability in order to accommodate the proposed Bowline 3 project. In addition, the assessment indicated that the following two SPSs may be reclassified: (1) The St. Lawrence generation rejection scheme, currently a Type I, may be reclassified as Type III, and (2) the Niagara generation rejection scheme, currently a Type I, may be reclassified as Type III. The assessment also confirmed the current classifications of the other SPSs.

The fourth assessment evaluated the dynamic control systems (DCSs) within NYCA that are actually installed on the system or are being proposed. This evaluation included large generator exciters, SVCs, FACTS, HVDC systems, and power system stabilizers. The assessment confirmed the current classifications of all DCSs that they may remain classified as Type III.

The fifth assessment evaluated the fault duty at selected substations. The analysis indicates six stations where breakers were overdutied for the conditions tested. The overdutied breakers at these stations are the results of future proposal projects (e.g., Fortistar VP, Fortistar VAN, and PJM-LI HVdc projects). These overdutied breakers will be replaced as part of the planned system upgrades.

The sixth assessment evaluated the extreme system conditions, which have a low probability of occurrence (e.g., loss of major gas supply and peak load condition resulting from extreme weather conditions.) Based on the nature of network of gas supplies and fuel diversity in NYCA, it’s determined that loss of a major gas pipeline would not create a detrimental negative adverse impact to the NY electric system. Powerflow analysis indicated that under the tested extreme weather conditions, loss of local loads in Central Hudson, O&R and RG&E territories could possibly happen for design contingencies such as tower contingency (CE18), loss of Ginna generation (LOG02) and tower contingency (UC26).

10 CONCLUSION

The main conclusion of this review is that NYSBPTS, as planned through the year 2010, is in conformance with the NPCC "Basic Criteria for Design and Operation of Interconnected Power Systems" and the reliability criteria described in the NYSRC Reliability Rules.

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