2010 Comprehensive Area Transmission Review
Of the New York State Bulk Power Transmission System
(Study Year 2015)

FINAL REPORT

June 1, 2011

Caution and Disclaimer

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Executive Summary

The Area Transmission Review (ATR) is an annual reliability assessment of the planned New York State Bulk Power Transmission Facilities (BPTF) conducted by the New York Independent System Operator (NYISO), as required by the Northeast Power Coordinating Council (NPCC) and the New York State Reliability Council (NYSRC). The purpose of the assessment is to demonstrate that the planned New York State BPTFs are in conformance with the applicable North American Electric Reliability Corporation (NERC) Reliability Standards, NPCC Transmission Design Criteria and NYSRC Reliability Rules. The study year is 4 to 6 years (typically 5 years) from the reporting date to allow for minimum lead times required for construction, and the ability to alter plans or facilities. The reviews may be conducted for a longer term beyond 6 years to address identified marginal conditions that may have longer lead-time solutions. A Comprehensive ATR is required at least once every five years, with Intermediate or Interim Reviews conducted in the years between Comprehensive Reviews to address changes in the system.

This report comprises the 2010 NYISO Comprehensive Area Transmission Review (CATR) of the planned system for the year 2015. The 2005 CATR, completed in May 2006, was the last Comprehensive Review. Interim Reviews were completed in 2006 and 2007; Intermediate Reviews were performed in 2008 and 2009. Eight assessments are made for this Comprehensive Review, as discussed below. Overall, the results are comparable to the previous 2009 Intermediate and 2005 Comprehensive Area Transmission Review which found the planned New York State BPTFs are in conformance with the applicable North American Electric Reliability Corporation (NERC) Reliability Standards, NPCC Transmission Design Criteria and NYSRC Reliability Rules.

The system representation used in this transmission review was developed based on the NPCC 2009 Base Case Development (BCD) library and the NYISO 2010 FERC 715 filing powerflow model updated with the NYISO 2010 Load and Capacity Data. The 2010 Load and Capacity Data load forecast used in the power system base case model incorporates a portion of the Governor’s statewide goal to reduce energy usage on the electric system by 15% of the 2015 usage level from the 2007 forecast (26,886 GWh), and of the New York Public Service Commission’s (NYSPSC) Energy Efficiency Portfolio Standard Order (EEPS) that represents its jurisdictional portion of the Governor’s goal (8,291 GWh). By 2015, the energy reductions in the 2010 load forecast account for 9,914 GWh (37%) of the statewide goal and 5,144 GWh (62%) of the EEPS goal.

Changes in this review as compared to the 2005 CATR include a 179 MW reduction in load forecast and an increase of approximately 1,613 MW in capacity resources. Lists of changes to the transmission system and generation resource are shown in Tables 1.2.1 and 1.2.2. The updated Local Transmission Plans were also incorporated into the CATR base case.

In the first and second assessments, power flow and stability analyses were conducted to evaluate the thermal, voltage and stability performance of the New York State BPTF for normal (or design) contingencies as defined in the NPCC and the NYSRC reliability criteria and rules. The BPTF, as defined in this review, includes all of the facilities designated by the NYISO to be part of the bulk power system as defined by the NPCC; additional non-BPS facilities are also included in the BPTF. The power flow analysis indicates there are no thermal or voltage violations for normal contingencies on BPTF for the 2010 CATR base case condition. The stability simulations show no stability issues for summer peak load or light load conditions.

As part of the first assessment, power flow analyses were conducted to evaluate the performance of New York State BPTF for the N-1-1 contingencies. NPCC and NYSRC Design Criteria apply after any critical generator, transmission circuit, transformer, series or shunt compensating device or HVdc pole has already been lost, assuming that the Planning Coordinator Area generation and power flows are adjusted between outages by the use of ten-minute reserve and where available, phase angle regulator control and HVdc control. Corrective actions were identified for each first contingency (N-1) such that there were no post-contingency thermal and voltage violations following any second contingencies (N-1-1).

The third assessment evaluated the fault duty at select critical buses in the short-circuit representation. The analysis indicates four BPTF stations may experience over-dutied breakers for the conditions tested. The owners of these over-dutied breakers are responsible for making the necessary facility upgrades as part of their internal planning and compliance processes.

In the fourth assessment, power flow and stability analyses were conducted to evaluate the performance of the bulk power system for low probability extreme contingencies as defined in the NPCC Directory #1 and NYSRC Reliability Rules. The stability analysis results indicate that the interconnected power system would be stable for the extreme contingencies tested and for the system conditions tested. The power flow analysis results indicate that, in most cases, extreme contingencies would not cause significant thermal or voltage problems over a widespread area for the system conditions tested. In a few cases, an extreme contingency may result in a loss of local load within an area due to low voltage or first-swing instability of isolated generators. In most of these cases the affected area would be confined to the New York Control Area (NYCA) system.

The fifth assessment evaluated the extreme system conditions, which have a low probability of occurrence (e.g., loss of major gas supply and high load conditions resulting from extreme weather). No significant thermal, voltage or stability issues were found for the BPTF for the tested loss of major gas supply condition. There are no stability issues for the tested extreme weather condition.

The sixth assessment was a review of Special Protection Systems (SPSs). It evaluated the designed operation and possible consequences of failure or misoperation of SPSs within NYCA that are due to stability issues. There are no proposed additional SPSs and system conditions in the vicinity of existing SPSs have not changed significantly since the previous review. 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. Due to a system configuration change, the Type III SPS for the Plattsburg-Grand Island (PV-20) tie line between New York and Vermont was considered to be out of service in this review.

The seventh assessment evaluated Dynamic Control Systems (DCS) within NYCA that are installed on the system or are being proposed. This evaluation included loss of large generator exciters, SVCs, FACTS, HVdc systems and power system stabilizers. Since the previous Comprehensive Review, there is one proposed addition to DCS in the NYCA: the proposed CPV Valley (Q#251) project includes exciters and a power system stabilizer. The analysis showed no adverse impact for the loss of the exciters on the two gas turbines and one steam turbine along with the loss of the stabilizer on the steam turbine. The expected system conditions in the vicinity of existing DCS facilities in NYCA have not changed significantly, therefore this assessment confirmed the current classifications of all DCS including the proposed additional DCS that they may remain classified as Type III.

For the eighth assessment, the NYCA has no existing exclusions to NPCC *Basic Criteria* and makes no requests for new exclusions.

An assessment of issues specific to the NYSRC Reliability Rules is included in Section 11 of this report. The topics covered in Section 11 include: System Restoration Assessment B-R5 and Local Rules Consideration I-R1 through I-R5.

In conclusion, the analysis presented in the 2010 Comprehensive Area Transmission Review found that the New York State BPTF, as planned through the year 2015, is in conformance with the applicable NERC Reliability Standards, NPCC Transmission Design Criteria and the NYSRC Reliability Rules.

1. Introduction

1.1. Background

The New York Independent System Operator (NYISO) conducts an annual assessment of the reliability of the planned New York State Bulk Power Transmission Facilities (BPTF) as required in accordance with established North American Electric Reliability Corporation (NERC) Reliability Standards, Northeast Power Coordinating Council (NPCC), New York State Reliability Council (NYSRC), and NYISO criteria, rules, and procedures. The 2010 Comprehensive Area Transmission Review (CATR) is conducted for the near-term (years one through five) planning horizon, assessing the planned year 2015 system. The CATR may conduct additional analysis to address the longer-term (years six through ten) planning horizons if marginal conditions are identified that may have longer lead-time solutions, as supported by the NYISO 2010 Reliability Needs Assessment (RNA) [1]. The 2010 RNA determined there are no Reliability Needs through the ten-year study period and identified no marginal conditions to warrant additional analysis of years six through ten.

NERC is the electric reliability organization (ERO) certified by the Federal Energy Regulatory Commission to establish and enforce reliability standards for the bulk power system. NERC develops and enforces reliability standards such as TPL-001-0.1, TPL-002-0a, TPL-003-0a, and TPL-004-0 (NERC TPL Reliability Standards) [2], that regional councils adopt to establish their regional reliability standards.

NPCC, a regional council of NERC, has established Regional Reliability Reference Directory #1 the "Design and Operation of the Bulk Power System" [3] (NPCC Directory #1) which describes the Transmission Design Criteria that apply to each Area. These criteria are consistent with or more stringent than the NERC TPL Reliability Standards. 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 ATR: 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 Directory #1 "Appendix B - Guidelines and Procedures for NPCC Area Transmission Reviews".

In addition to the NPCC Directory #1, the NYSRC has established rules for planning and operating the New York State Bulk Power System ("NYSRC Reliability Rules") [4]. The NYSRC Reliability Rules are consistent with and in certain cases are more specific or stringent than the NPCC Transmission Design Criteria and the NERC TPL Reliability Standards. The NYSRC process for this assessment is described in the NYSRC Procedure for New York Control Area Transmission Reviews [5].

The Guidelines and Procedures for NPCC Area Transmission Reviews require each Area to conduct a CATR at least every five years and either an Interim or an Intermediate ATR in each of the years between CATRs, as appropriate. This assessment was conducted in accordance with the requirements for a Comprehensive Review, as described in the Directory #1 - Appendix B "Guidelines and Procedures for NPCC Area Transmission Reviews".

The previous Comprehensive Review of the New York State BPTF was performed in 2005 (approved May 26, 2006) and covered the year 2010 [6]. Interim Reviews were conducted in 2006 and 2007 covering the years 2011 and 2012, respectively. Intermediate Reviews were conducted in 2008 and 2009 covering the years 2013 and 2014, respectively. This Comprehensive Review focuses on the year 2015 with an updated forecast of system conditions, including a number of proposals for new, retired or cancelled generation and transmission facilities in NYCA since the previous CATR and the last Intermediate Review [7].

1.2. Facilities Included in this Review

The system representation used in this transmission review was developed from the NPCC 2009 Base Case Development (BCD) library. The representation for the NYCA is based on the NYISO 2010 FERC 715 filing powerflow model with transmission system and load changes made to the NYCA system including existing and planned facilities. The representations reflect the conditions reported in the NYISO 2010 Load and Capacity Data [8].

The New York State Bulk Power System (BPS), as defined by NPCC and adopted by the NYSRC Reliability Rules, primarily consists of 4,039 miles of 765, 345 and 230 kV transmission, including a 500 kV tie-line between New York and New Jersey. A small portion of the 6,750 miles of 138 and 115 kV transmission is also considered to be part of the New York State Bulk Power System. Also included in New York State Bulk Power System are a number of large generating units that are generally 300 MW or larger. As part of this review, the NYISO and the New York State Transmission Owners performed simulations in accordance with the NPCC Classification of Bulk Power System Elements methodology (A-10) [9] to determine any change in BPS status to existing or planned facilities; the results are documented in Appendix P.

The New York State Bulk Power Transmission Facilities (BPTF) defined in this review includes all facilities designated by the NYISO to be part of the BPS as defined by the NYSRC and NPCC, as well as other transmission facilities that are relevant to planning the New York transmission system. Remaining sub-transmission facilities not identified as BPTF are evaluated by the local Transmission Owner and coordinated through the NYISO Local Transmission Planning Process. The list of New York State BPTF and one-line diagrams depicting those facilities are presented in Appendix B.

This review is based on the NYISO 2010 Load and Capacity Data. The review includes proposed transmission and generation projects modeled in the Class Year 2010 Annual Transmission Reliability Assessment. The 2010 Load and Capacity Data load forecast used in the power system base case model incorporates a portion of the Governor's statewide goal to reduce energy usage on the electric system by 15% of the 2015 usage level from the 2007 forecast (26,886 GWh), and of the New York Public Service Commission's (NYSPSC) Energy Efficiency Portfolio Standard Order (EEPS) that represents its jurisdictional portion of the Governor's goal (8,291 GWh). By 2015, the energy reductions in the 2010 load forecast account for 9,914 GWh (37%) of the statewide goal and 5,144 GWh (62%) of the EEPS goal.

The transmission plans shown on Table 1.2.1 reflect changes since the previous CATR. There has been no additional bulk power projects proposed for the NYCA beyond those in the NYISO 2010 Load and Capacity Data. Proposed major generation projects are listed in Table 1.2.2.

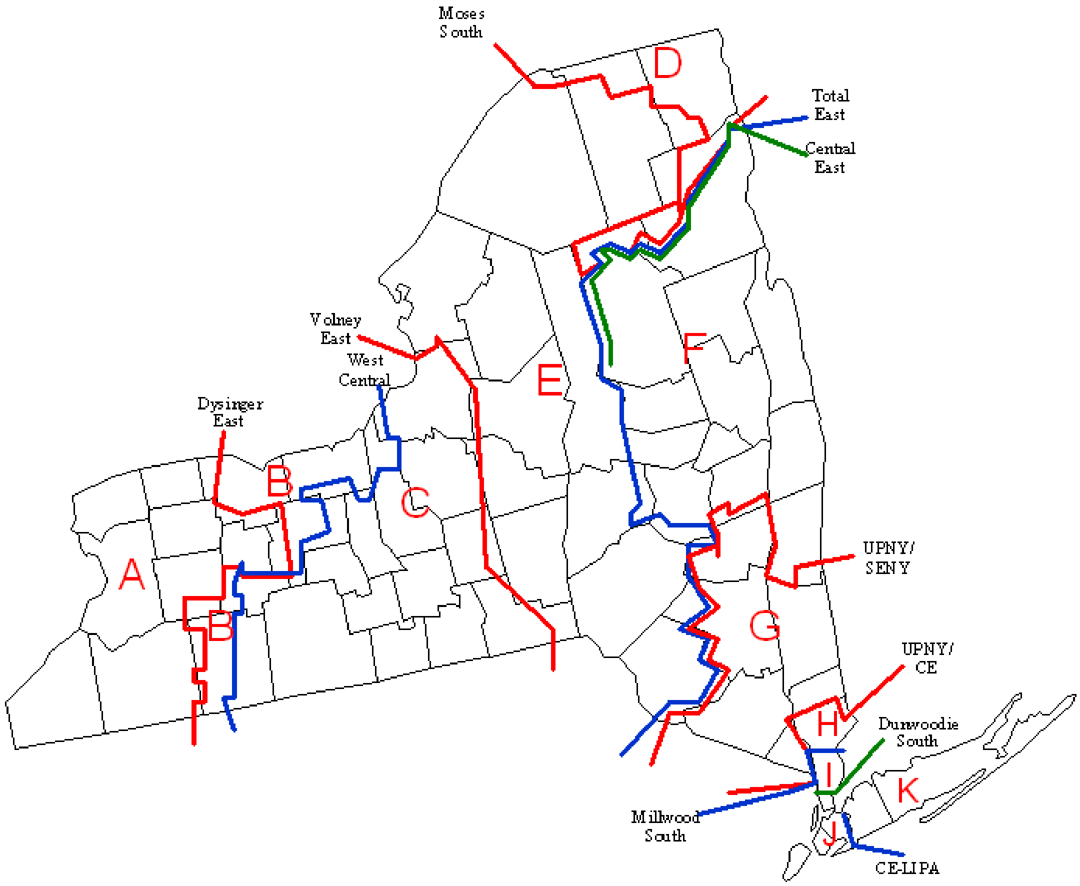
The NYISO Class Year 2010 Facilities Study[1] found the following New York State BPTF with fault current exceeding their lowest circuit breaker rating: Farragut 345 kV, Gowanus N 345 kV, Gowanus S 345 kV, Rainey 345 kV, Jamaica 138 kV (all in ConEdison). To mitigate this fault current, NYISO proposed to place in-service the existing Gowanus 345 kV Series Reactors (SR) R41 and R42, which were previously bypassed under summer peak conditions. NYISO performed a sensitivity analysis in cooperation with ConEdison which concluded the system has sufficient voltage performance, therefore the series reactors were modeled in-service for this review.

1.2.1. Interface Definitions

This ATR monitored and evaluated eleven major interfaces between zones within the NYCA: Dysinger East, West Central, Volney East, Moses South, Central East, Total East, UPNY-SENY, UPNY-ConEd, Millwood South, Sprain Brook – Dunwoodie South, and LIPA Import. Additionally this review evaluated the interfaces between NYISO and the following neighboring control areas: IESO (Ontario), Hydro-Quebec, ISO-New England, and PJM. These interfaces are described in Appendix E. Figure 1.2.1 geographically depicts the NYCA interfaces and LBMP load zones:

[1] As of the date of this report, the Class Year 2010 Facilities Study has not yet been approved by the NYISO Operating Committee.

Figure 1.2.1 NYCA Interfaces and LBMP Load Zones



Since the previous Comprehensive Review, new tie lines have been added to the modeled interface with PJM. The Linden Variable-Frequency Transformer (VFT) Inter-tie between Goethals and Linden creates a new controllable tie line between New York City and New Jersey. The Hudson Transmission Project (HTP), a 660 MW HVdc line, creates another new controllable tie line between Bergen 230 kV substation in PJM and West 49th Street 345 kV substation in New York City. These tie lines are added to the interface definitions of NY-PJM, Total East, Millwood South, and all NY closed interfaces. The schedule on the VFT is 300 MW and 660 MW on the HVdc line, both towards New York.

1.2.2. Scheduled Transfers

Table 1.2.3 provides a list of the NYCA scheduled inter-Area transfers modeled in the base case between New York and neighboring systems. New York does not use the firm transfer concept though transfer limit analysis is performed to ensure adequate capability.

1.2.3. Load and Capacity

Table 1.2.4 provides a comparison between the current 2015 forecast used in this review and the 2010 and 2014 load and capacity forecasts used in the previous Comprehensive and Intermediate Reviews, respectively. The statewide coincident peak load forecast from the NYISO 2010 Load and Capacity Data for the 2015 summer is 34,021 MW and the corresponding installed capacity is 45,245 MW. Including the Special Case Resources (SCR) of 2,251 MW, the reserve margin would be 33%. This is well above the required Installed Reserve Margin (IRM) of 17.9% approved by the NYSRC for the 2010-2011 capability period.

Table 1.2.1 Changes in Bulk Power Transmission Facilities

	2005 CATR: Forecast for Summer 2010	2009 ATR: Forecast for Summer 2014	2010 CATR: Forecast for Summer 2015
Bulk Transmission:	**Included/IS Date**	**Included/IS Date**	**Included/IS Date**
Spagnoli Rd 138 kV Substation (Q#20)	Y / 2009	N / NA	N / NA
Calpine Wawayanda 345 kV Substation (Q#22)	Y / 2008-Q2	Canceled	Canceled
Bowline 3 345 kV Cable (Q#29)	Y / 2008-Q2	Canceled	Canceled
Besicorp (aka First Light Energy) 345 kV Substation (Q#69)	Y / 2007-Q2	Y / 2010S	Y / In-Service
PSEG Cross Hudson 345 kV Cable (Q#93)	Y / 2008	Canceled	Canceled
Atlantic Energy Neptune PJM-LI DC (Q#94)	Y / 2007-Q3	Y / In-Service	Y / In-Service
Liberty 230 kV Substation and 345 kV Goethals Substation Upgrade (Q#110)	Y / 2007S	Canceled	Canceled
Linden VFT Goethals 345 kV Substation Upgrade (Q#125)	N / NA	Y / 2009	Y / 2011
Canandaigua 230 kV Substation (Q#135)	N / NA	Y/ In-Service	Y/ In-Service
High Sheldon 230 kV Substation (Q#144)	N / NA	Y/ In-Service	Y/ In-Service
Mott Haven 345 kV Substation (Q#146)	Y / 2007S	Y/ In-Service	Y/ In-Service
Sherman Creek 345 kV Substation (M29, Q#153)	Y / 2007S	Y / 2011S	Y / 2011S
Patnode 230 kV Substation (Q#161)	N / NA	Y/ 2010W	Y/ 2011S
Duley 230 kV Substation (Q#174)	N / NA	Y/ In-Service	Y/ In-Service
Ryan 230 kV Substation (Q#175)	N / NA	Y/ In-Service	Y/ In-Service
Wethersfield 230 kV Substation (Q#177)	N / NA	Y/ In-Service	Y/ In-Service
Jordanville 230 kV Substation (Q#186)	N / NA	N / 2009-Q4	Y/ 2011-Q4
Hudson Transmission Project HVdc (Q#206)	N / NA	N / NA	Y / 2013
Ball Hill 230 kV Substation (Q#222)	N / NA	N / NA	Y/ 2011-Q4
Clarks Corners 345 Substation (Q#225)	N / NA	Y / 2010W	Y / In-Service
Bayonne Energy Center Gowanus 345 kV Substation Upgrade (Q#232)	N / NA	N / NA	Y / 2012-Q2
CPV Valley 345 kV Substation (Q#251)	N / NA	N / NA	Y / 2012-Q4
South Ripley 230 kV Substation (Q#254)	N / NA	N / NA	Y/ 2011-Q4
Stony Creek 230 kV Substation (Q#263)	N / NA	N / NA	Y/ NA
Stony Ridge 230 kV Substation (Q#289)	N / NA	N / 2009-Q4	Y/ 2011S
Millwood Shunt Capacitor Banks (240 MVAr)	N / NA	Y / In-Service	Y / In-Service
O&R 345/138 kV Lovett transformer	N / NA	Y / 2013S	Y (O/S) / NA

Table 1.2.2 Changes in Generation Facilities

Additions/Uprates > 100 MW:	***Size***	***2005 CATR: Forecast for Summer 2010***	***2009 ATR: Forecast for Summer 2014***	***2010 CATR: Forecast for Summer 2015***
		Included/IS Date	***Included/IS Date***	***Included/IS Date***
KeySpan Spagnoli Road CC Unit (Q#20)	250	Y / 2009	N / NA	N / NA
Calpine Wawayanda (Q#22)	500	Y / 2008-Q2	N / Withdrew	N / Withdrew
Mirant Bowline Point 3 (Q#29)	750	Y / 2008-Q2	N / Withdrew	N / Withdrew
Besicorp State Newsprint CC (Q#69)	660	Y / 2007-Q2	Y / 2010-Q1	Y / In-Service
Reliant Re-powering Phases 1 & 2 (Q#70)	1092	Y / 2010-Q2	N / Withdrew	N / Withdrew
Fortistar VP (Q#90)	79.9	Y / 2007-Q2	N / Withdrew	N / Withdrew
Fortistar VAN (Q#91)	79.9	Y / 2007-Q2	N / Withdrew	N / Withdrew
PSEG Cross Hudson Project (Q#93)	550	Y / 2008	N / Withdrew	N / Withdrew
Caithness Long Island CC (Q#107)	310	N / NA	Y / 2009S	Y / In-Service
Liberty Radial Interconnection to NYC (Q#110)	400	Y / 2007S	N / Withdrew	N / Withdrew
Canandaigua I & II Wind Project (Q#135)	125	N / NA	Y / In-Service	Y / In-Service
Ginna Uprate (Q#143)	95	2006/F	Y / In-Service	Y / In-Service
High Sheldon Wind Project (Q#144)	129	N / NA	Y / In-Service	Y / In-Service
Fairfield Wind Project (Q#156)	120	N / NA	N / NA	Y / In-Service
AES St. Lawrence Wind Project (Q#166)	130	N / NA	N / NA	Y / 2012F
Marble River I & II (Q#161, Q#171)	218	N / NA	N / NA	Y / 2011F
Noble Clinton I & II Wind Project (Q#172, Q#211)	100.5	N / NA	Y / In-Service	Y / In-Service
Noble Bliss I & II Wind Project (Q#173, Q#212)	100.5	N / NA	Y / In-Service	Y / In-Service
Noble Altona Wind Project (Q#174)	97.5	N / NA	Y / In-Service	Y / In-Service
Noble Ellenburg Wind Project (Q#175)	81	N / NA	Y / In-Service	Y / In-Service
Noble Wethersfield Windfield (Q#177)	126	N / NA	Y / In-Service	Y / In-Service
NYPA Gilboa Uprate (Q#185)	120	N / NA	Y / 2010S	Y / In-Service
Jordanville Wind Project (Q#186)	150	N / NA	N / NA	Y / 2011W
Cape Vincent Wind Project (Q#207)	210	N / NA	N / NA	Y / 2012W
Noble Ellenberg II Windfield (Q#213)	21	N / NA	Y / 2011W	Y / 2011W
Noble Chateauguay Windpark (Q#214)	106.5	N / NA	Y / In-Service	Y / In-Service
Nine Mile Point Uprate (Q#216)	168	N / NA	N / NA	Y / 2012-Q2
Ball Hill Wind Park (Q#222)	90	N / NA	N / NA	Y / 2011W
Bayonne Energy Center (Q#232)	500	N / NA	N / NA	Y / 2011S
Allegany Wind Project (Q#237)	72.5	N / NA	N / NA	Y / 2011F
CPV Valley (Q#251)	656	N / NA	N / NA	Y / 2010F

Additions/Uprates > 100 MW:	***Size***	***2005 CATR: Forecast for Summer 2010***	***2009 ATR: Forecast for Summer 2014***	***2010 CATR: Forecast for Summer 2015***
		Included/IS Date	***Included/IS Date***	***Included/IS Date***
Ripley-Westfield Wind Project (Q#254)	124.2	N / NA	N / NA	Y / NA
South Pier Improvement (Q#261)	103.7	N / NA	N / NA	Y / 2012S
Stony Creek Wind Farm (Q#263)	88.5	N / NA	N / NA	Y / NA
Berrians GT III (Q#266)	744	N / NA	N / NA	Y / 2012S
Astoria Energy II (Q#308)	576	N / NA	N / NA	Y / 2011S
Shutdowns/Deratings:	***Size***	***Included/OS Date***	***Included/OS Date***	***Included/OS Date***
Astoria 2, 3	536	N / 2010-Q2	Y / Canceled	Y / Canceled
Onondaga Cogen	78	Y / NA	N / Retired	N / Retired
Greenidge 3	54	Y / NA	N / Retired	N / Retired
Westover 7	43	Y / NA	N / Retired	N / Retired
Norcon – Energy Systems North East[1]	74.5	Y / NA	Y / NA	Y (O/S) / Retired
Temple Syracuse Unit[1]	90	Y / NA	Y / NA	Y / Retired
Greenidge 4[1]	108	Y / NA	Y / NA	Y / 2011-03
Westover 8[1]	80	Y / NA	Y / NA	Y / 2011-03

Note:

1– Unit included in the base case because retirement or lay-up announcement received after the study started

NA – Not Applicable or Not Available

Table 1.2.3 NYCA Scheduled Inter-Area Transfers

Region		Transaction
From	To	
NYCA	NE	-252 MW
NYCA	HQ	-1200 MW
NYCA	PJM and Others	-2294 MW
NYCA	Ontario	0 MW

Table 1.2.4 Load and Capacity Schedule

	Comprehensive Review: 2005 Forecast for Summer 2010	Intermediate Review: 2009 Forecast for Summer 2014	Comprehensive Review: 2010 Forecast for Summer 2015	Change From Previous CATR
Peak Load (MW)	34,200	34,309	34,021 (1)	-179
Total Capacity (MW)	43,632	43,311	45,245 (2)	1,613
Reserve Margin	27.6%	26.2%	33%	5.4%

Notes:

1. The 2015 forecast considers Alcoa and Reynolds industrial loads in-service in Zone D.
2. This is derived from the NYISO 2010 Load and Capacity Data. It's the 2015 Total Resource Capability (43,581.2 MW), from Table V-2a in NYISO 2010 Load and Capacity Data, plus Proposed Resource Additions (1,663.9 MW) from Table IV-1 in NYISO 2010 Load and Capacity Data.

2. Study Results Demonstrating Conformance

2.1. Study Methodology

The analysis for this review was conducted in accordance with NERC TPL Reliability Standards, NPCC Design Criteria, and NYSRC Reliability Rules and Procedures. Specific guidelines for voltage and stability analysis are found in NYISO Transmission Planning Guidelines #2-0 [10] and #3-0 [11] respectively, which are Attachments E and F of the NYISO Transmission Expansion and Interconnection Manual [12]. These guidelines provide additional details regarding NYISO methodology for evaluating the performance of the New York State BPTF and they conform to NPCC Directory #1 “Appendix B - Guidelines and Procedures for NPCC Area Transmission Reviews” and NYSRC Reliability Rules.

The procedure used to evaluate the performance of New York State BPTF consists of the following basic steps: (1) develop a mathematical model (or representation) of the NYCA and external electrical systems for the period of study (in this case, the year 2015); (2) develop various power flow 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 steady-state power flow and transient stability analysis to determine whether or not the performance of the New York State BPTF as modeled meets NERC TPL Reliability Standards, NPCC Design Criteria, and NYSRC Reliability Rules for thermal, voltage and stability performance. In practice, steps (2) and (3) are interwoven while conducting a study and the detailed procedures can 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 2010 CATR was performed for selected demand levels over the range of forecast system demand representations of the year 2015 demonstrating system performance including critical system conditions such as stability margin transfers and extreme weather as required by the NPCC.

The base cases used in evaluating New York State BPTF performance were developed from NPCC BCD libraries. Most of the relevant system representations were taken from the year 2015 cases in the 2009 NPCC BCD library. The PJM system representation was derived from the PJM Regional Transmission Expansion Plan (RTEP) planning process. The NYCA representation was derived from the NYISO 2010 FERC 715 filing. Changes were made to the NYCA system to reflect the most recent updates included in the NYISO 2010 Load and Capacity Data. There are no planned outages in the NYCA for 2015, therefore all facilities were assumed in-service. Generation was dispatched to match load plus system losses while respecting transmission security.

As part of the base case development process, AC contingency analysis was performed on the base cases using Siemens PTI PSS® MUST. If thermal or voltage limit violations on the New York State BPTF were identified, generation dispatch or phase angle regulator (PAR) adjustments were made to satisfy the NERC Category A, B, and C contingencies of Table I and NPCC and NYSRC Design Criteria. This is confirmed through the thermal, voltage, and stability analysis performed in the following sections.

Summer peak stability margin transfer cases (Western margin, Moses margin, Central margin, UPNY margin cases) were then created from the 2015 summer peak load base case. In the margin cases, the transfer levels of the interfaces in western, northern and southeastern New York are at least 10% higher than the lower of either the emergency thermal or the voltage constrained transfer limits in accordance with NYISO Transmission Planning Guideline #3-0.

The light load base case was developed from the NYISO 2010 FERC 715 filing and 2009 NPCC BCD spring light load 2015 representations. The load level is approximately 55 percent of summer peak. In this case, the West Central, Moses South, Central East and UPNY-SENY open interface flows are 1004 MW, 625 MW, 1881 MW and 3167 MW respectively.

The extreme contingency base case was developed from the 2015 summer peak load base case by reducing the load to approximately 80% and adjusting interface flows to a minimum of the transfer levels expected to occur approximately 75% of the time on a load flow duration basis. This represents a reasonable transfer condition within and between Planning Coordinator Areas.

The base case for the extreme weather system condition was developed from the 2015 summer peak load base case with the load increased to meet the extreme weather forecast statewide coincident peak load (approximately 34,953 MW), reflecting weather conditions expected to occur no more than once in ten years (90/10). The weather conditions were based on weather observations since 1975.

The extreme condition of natural gas fuel shortage is more likely to occur during the winter peak demand period, thus the base case models winter peak demand levels (approximately 80% of the summer peak load) assuming NYCA gas-only units are not available. This case was developed from the NYISO 2010 FERC 715 filing.

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 transfer limit analysis was performed using the Siemens PTI PSS®MUST program utilizing the Linear FCITC Calculation activity by shifting generation across the given interface under evaluation. All NYCA tie lines with neighboring systems were monitored as appropriate. A listing of NYCA intra-Area and inter-Area interface definitions including those evaluated in this study is presented in Appendix E.

Approximately nine-hundred contingencies were evaluated including single element, common structure, stuck breaker, generator, multiple element, and DC contingencies. All contingencies studied are consistent with the NERC Category A, B, and C contingencies and NPCC and NYSRC Design Criteria contingencies. The monitored elements include the facilities with base voltage between 100 kV and 765 kV and all New York State BPTF. Phase angle regulators (PARs) maintain their scheduled power flow pre-contingency but are fixed at their corresponding pre-contingency angle in the post-contingency solution.

The thermal transfer limits could be sensitive to the base case load and generation conditions as well as the generation selection utilized to create the transfers. Certain interface limits could also be sensitive to the PAR schedules and inter-area power transfers. These sensitivities were not considered during thermal transfer analysis as no attempts were made to find the ideal shift pattern for maximum transfer limits.

Table 2.3.1 summarizes powerflow schedules of inter-Area controllable-ties in the base case. The base case generation resources were adjusted to allow for equal participation of all aggregated generators in the generation shift to calculate the transfer limits. The general direction of generation shifts is from the north and west to Southeastern New York.

Table 2.3.1 Schedules on Inter-Area Controllable Devices

	2005 CATR Forecast for Summer 2010	2009 ATR: Forecast for Summer 2014	2010 CATR Forecast for Summer 2015	
Location	MW Schedule	MW Schedule	MW Schedule	Direction
Ramapo PAR 1	120	500	100	Toward NY
Ramapo PAR 2	120	500	100	Toward NY
St. Lawrence PARs (L33/34)	0	0	0	
Sandbar PAR (PV-20)	115	117	115	Toward VT
Farragut PAR 1 (B3402)	400	333	333	Toward NY
Farragut PAR 2 (C3403)	400	333	333	Toward NY
Goethals PAR (A2253)	200	334	334	Toward NY
Linden VFT	-	300	300	Toward NY
Hudson Transmission HVdc	-	-	660	Toward NY
Neptune HVdc	660	660	660	Toward NY
Cross-Sound Cable HVdc	330	330	330	Toward NY
Northport PAR	100	100	100	Toward NY
Chateauguay HVdc	760	698	720	Toward NY

2.3.2. Analysis Results

Tables 2.3.2, 2.3.3 and 2.3.4 provide summaries for the normal and emergency thermal transfer criteria limits determined for the NYCA intra-Area and inter-Area open transmission interfaces (where applicable). The limits for the closed intra-Area interfaces are provided in Appendix F. The CATR demonstrates the New York State BPTF system meets Table I for Category A, B, and C of NERC TPL Reliability Standards with respect to thermal ratings. New York State BPTF system security is maintained by limiting power transfers according to the determined thermal transfer limits. Additional details regarding the thermal analysis results are provided in Appendix F.

Dysinger East and West Central limits decreased mainly due to new generation projects in Zone A which cause constraints on Dysinger East and West Central interfaces.

Moses South normal transfer limit increased due to an increased LTE rating of the limiting element, Moses-Adirondack 230 kV line. Volney East thermal transfer limits increased due to a change in the limiting element and contingency pair.

Volney East normal and emergency limits have increased compared to previous years due to the impact of dispatch assumptions for the proposed CPV Valley combined cycle plant which interconnects to the Coopers Corners – Rock Tavern 345 kV line. That project was dispatched at 100% output, pushing back against west-to-east and north-to-south flows that typically bind on the Marcy South corridor.

The Central-East interface limits are largely unchanged in comparison to previous assessments. The Fraser-Gilboa 345 kV line appeared as the first limit due to a decreased rating in the base case, however this rating has since increased and therefore the line is not identified as the limiting element.

The Total-East interface, as defined, has a lower limit in comparison to previous assessments due to a change in limiting element and a change in definition. The proposed CPV Valley project injects 656 MW immediately downstream of the Total-East interface and creates a new limitation for loss of the parallel circuit. However, since the interface definition does not capture the additional downstream injection from the project, the overall flow across this corridor is relatively the same.

The UPNY-SENY and UPNY-ConEd transfer limits are sensitive to the Ramapo PARs MW schedule. In the thermal and voltage analysis for this review, the megawatt schedules for the Ramapo PARs are 500 MW each into New York. In the 2005 CATR the schedules for the Ramapo PARs were 120 MW each into New York. This difference is the main cause for the increase in UPNY-SENY interface transfer limit between the 2005 and 2010 CATR.

UPNY-ConEd emergency thermal transfer limit is lower compared to 2005 and 2009, due to high output in the base case from generation in the lower Hudson Valley.

Compared to the 2005 CATR, the thermal transfer limits for Sprain Brook – Dunwoodie South are higher due to higher megawatt schedules at the Sherman Creek, Parkchester, Dunwoodie North, and Dunwoodie South PARs into New York City. Compared to the 2009 ATR, the difference in emergency thermal transfer limit for Sprain Brook – Dunwoodie South is negligible. The effects on Millwood South are closely tied to Sprain Brook – Dunwoodie South, and therefore similar results are observed. Details are provided in Appendix F.

The Long Island Import emergency transfer limit is higher in this review due to differences in the Lake Success, Valley Stream, and Northport PAR schedule resulting in higher flow into LIPA.

The inter-Area transfer limits are greatly impacted by generation dispatch assumptions in the neighboring Areas. Generation participation factors in the generation-to-generation shifts are dictated by the pre-shift generation dispatch in the neighboring Area. If generation close to the New York border participates more as a source or sink, the transmission lines in the vicinity may appear more limiting. The New York to PJM limit is lower than in 2005 due to additional proposed generation in New York's western zones. The transfer limits between New York and New England differ from the 2005 assessment due to a change in source/sink assumptions. The ratings modeled in the base case for the Norwalk Junction – Archers Lane 345 kV line and the Norwalk Harbor transformer were corrected based on feedback from ISO-NE, resulting in the limit reported in Table 2.3.4.

Table 2.3.2 Normal Transfer Criteria Intra-Area Thermal Transfer Limits

Interface	2005 Comprehensive Review (Study Year 2010)	2009 Intermediate Review (Study Year 2014)	2010 Comprehensive Review (Study Year 2015)
Dysinger East	2850 (1)	2850 (2)	2700 (2)
West Central	1325 (1)	1675 (2)	1425 (2)
Volney East	4025 (3)	3875 (3)	4600 (3)
Moses South	1550 (5)	2325 (6)	2475 (6)
Central East	2850 (7)	2750 (7)	2900 (7)
Total East	5450 (7)	6100 (3)	5725 (8)
UPNY-SENY	4575 (9)	5325 (9)	5250 (9)(A)
UPNY-ConEd	5200 (10)	5675 (11)	5375 (11)(A)
Sprain Brook Dunwoodie-South	4825 (12)	5250 (13)	5625 (14)(B)
Long Island Import	2050 (15)	2050 (15)	1950 (16)(C)

Notes:

1. **Niagara-Rochester 345** at 1501 MW LTE rating for loss of Somerset-Rochester 345
2. **Wethersfield-Meyer 230** at 494 MW LTE rating for loss of Niagara-Rochester 345 and Rochester-Pannell 345
3. **Fraser-Coopers Corners 345** at 1404 MW LTE rating for loss of Porter-Rotterdam 230 and Marcy-Coopers Corners 345
4. **Fraser-Gilboa 345** at 1195 MW LTE rating for loss of CPV Valley-Rock Tavern 345, Coopers Corners-Middletown Tap-Rock Tavern 345 and Rock Tavern 345/115 auto
5. **Adirondack-Porter 230** at 353 MW LTE rating for loss of Edic-Porter 345/230 and Flat Rock-Porter 230
6. **Moses-Adirondack 230** at 386 MW LTE rating for loss of Chateauguay-Massena-Marcy 765 (change from 359 rating)
7. **New Scotland 77-Leeds 345** at 1538 MW LTE rating for loss of New Scotland 99-Leeds 345
8. **CPV Valley-Rock Tavern 345** at 1733 MW LTE rating for loss of Coopers Corners-Middletown Tap-Rock Tavern 345 and Rock Tavern-Roseton 345
9. **Leeds-Pleasant Valley 345** at 1538 MW LTE rating for loss of Athens-Pleasant Valley 345
10. **Rock Tavern-Ramapo 345** at 1890 MW LTE rating for loss of Roseton-Fishkill 345 and Rock Tavern-Sugarloaf 115
11. **Rock Tavern-Ramapo 345** at 1990 MW LTE rating for loss of Roseton-Fishkill 345 and Fishkill 345/115
12. **Mott Haven-Rainey 345** at 1081 MW STE rating for loss of South Bronx-Rainey 345
13. **Mott Haven-Rainey 345** at 851 MW LTE rating for loss of Mott Haven-Rainey 345
14. **Mott Haven - Rainey 345 kV at** 1196 MW STE rating for loss of Mott Haven-Rainey 345 kV, 8W transformer.
15. **Dunwoodie-Shore Rd. 345** at 962 MW LTE rating for loss of Sprain Brook-E.G.C. 345 and Sprain Brook-Dunwoodie No. 345/138
16. **Dunwoodie-Shore Rd. 345** at 877 MW LTE rating for loss of Sprain Brook-E.G.C. 345 and Sprain Brook-Academy 345/138

A. Ramapo PAR1 and PAR2 are scheduled at 500 MW each into New York

B.
- Sherman Creek PAR1 and PAR2 are scheduled at 200 MW each into NYC.
- Parkchester PAR1 and PAR2 are scheduled at 245 MW each into NYC.
- Dunwoodie No. PAR1 and PAR2 are scheduled at 115 MW each into NYC.
- Dunwoodie So. PAR1 and PAR2 are scheduled at 120 and 115 MW respectively into NYC.

C.
- E.G.C. PAR1 & PAR2 are scheduled at 315 MW each into LIPA.
- Lake Success and Valley Stream PARs are schedule at 165 and 123 MW each into NYC
- Northport PAR are scheduled at 100 MW into LIPA,
- Neptune and CSC HVdc are scheduled at 660 and 330 MW into LIPA

Table 2.3.3 Emergency Transfer Criteria Intra-Area Thermal Transfer Limits

Interface	2005 Comprehensive Review (Study Year 2010)	2009 Intermediate Review (Study Year 2014)	2010 Comprehensive Review (Study Year 2015)
Dysinger East	3175 (1)	2925 (2)	2775 (2)
West Central	1625 (1)	1750 (2)	1500 (2)
Volney East	4875 (3)	4625 (3)	5450 (4)
Moses South	2025 (5)	2625 (6)	2675 (6)
Central East	3175 (7)	3075 (7)	3200 (7)
Total East	6075 (7)	6875 (3)	5975 (8)
UPNY-SENY	5200 (9)	6025 (9)	5900 (9)(A)
UPNY-ConEd	6225 (10)	6675 (10)	5925 (10)(A)
Sprain Brook Dunwoodie-South	4825 (11)	5725 (12)	5625 (13)(B)
Long Island Import	2100 (14)	2100 (14)	2675(15)(C)

Notes:

1. **Niagara-Rochester 345** at 1685 MW STE rating for loss of Somerset-Rochester 345
2. **Wethersfield-Meyer 230** at 430 MW Normal rating for pre-contingency loading
3. **Fraser-Coopers Corners 345** at 1207 MW Normal rating for pre-contingency loading
4. **Edic-Fraser 345** at 1195 MW STE rating for loss of Oakdale-Fraser 345
5. **Marcy 765/345** at 1654 MW STE rating for loss of Marcy 765/345
6. **Marcy 765/345** at 1971 MW STE rating for loss of Marcy 765/345
7. **New Scotland 77- Leeds 345** at 1724 MW STE rating for loss of New Scotland 99-Leeds 345
8. **CPV Valley-Rock Tavern 345** at 1793 MW STE rating for loss of Coopers Corners-Middletown Tap-Rock Tavern 345
9. **Leeds-Pleasant Valley 345** at 1724 MW STE rating for loss of Athens-Pleasant Valley 345
10. **Roseton-Fishkill 345** at 1935 MW Normal rating for pre-contingency loading
11. **Rainey-South Bronx 345** at 1081 MW STE rating for loss of Rainey-South Bronx 345
12. **Dunwoodie-Mott Haven 345** at 783 MW Normal rating for pre-contingency loading
13. **Mott Haven-Rainey 345kV** at 1196 MW STE rating for loss of Mott Haven-Rainey 345kV
14. **Dunwoodie-Shore Road 345** at 679 MW Normal rating for pre-contingency loading
15. **Dunwoodie-Shore Road 345** at 599 MW Normal rating for pre-contingency loading

A. Ramapo PAR1 and PAR2 are scheduled at 500 MW each into New York

B.
- Sherman Creek PAR1 and PAR2 are scheduled at 200 MW each into NYC.
- Parkchester PAR1 and PAR2 are scheduled at 245 MW each into NYC.
- Dunwoodie No. PAR1 and PAR2 are scheduled at 115 MW each into NYC.
- Dunwoodie So. PAR1 and PAR2 are scheduled at 120 and 115 MW respectively into NYC.

C.
- E.G.C. PAR1 & PAR2 are scheduled at 315 MW each into LIPA.
- Lake Success and Valley Stream PARs are schedule at 85 and 90 MW each into LIPA
- and Northport PAR are scheduled at 286 MW into LIPA,
- Neptune and CSC HVdc are scheduled at 660 and 330 MW into LIPA.

Table 2.3.4 Inter-Area Thermal Transfer Limits

Interface	2005 Comprehensive Review (Study Year 2010)		2010 Comprehensive Review (Study Year 2015)	
	Normal Transfer (MW)	Emergency Transfer (MW)	Normal Transfer (MW)	Emergency Transfer (MW)
New York – New England	1250 (1)	1750 (2)	1425 (3)	2000 (4)
New England – New York	2225 (5)	2475 (6)	2025 (7)	2350 (2)
New York - Ontario	1350 (8)	1550 (9)	1600 (8)	1900 (9)
Ontario – New York	1375 (10)	1775 (11)	1725 (10)	1875 (11)
New York – PJM (A)	2375 (12)	2375 (12)	1775 (12)(A)	1775 (12)(A)
PJM - New York (B)	3025 (13)	3400 (14)	3400 (15)(B)	3500 (16)(B)

Notes:

1. **Long Mountain-Pleasant Valley 345** at 1386 MW LTE rating for loss of Southington-Haddam 345 and Millstone-Haddam 345
2. **Long Mountain-Pleasant Valley 345** at 1195 MW Normal rating for pre-contingency loading
3. **Long Mountain -Pleasant Valley 345** at 1386 MW LTE rating for loss of Millstone unit #3 and PV-20 OMS
4. **Long Mountain -Pleasant Valley 345** at 1685 STE rating for loss of Millstone unit #3
5. **Norwalk Harbor 138-Norwalk Harbor 115** at 402 MW LTE rating for loss of Fishkill-Pleasant Valley 345, Long Mountain -Pleasant Valley 345
6. **Norwalk Harbor 138-Norwalk Harbor 115** at 449 MW STE rating for loss of Long Mountain -Pleasant Valley 345
7. **Reynolds Road 345/115** at 562 MW LTE rating for loss of Alps-New Scotland 345
8. **Niagara-PA27 230** at 460 MW LTE rating for loss of Niagara 345-Niagara2E 230 and Niagara-Beck B 345
9. **Niagara-PA27 230** at 400 MW Normal rating for pre-contingency loading
10. **Niagara-Rochester 345** at 1501 MW LTE rating for loss of Somerset-Rochester 345
11. **Wethersfield-Meyer 230** at 430 MW Normal rating for pre-contingency loading
12. **S Ripley-Erie South 230** at 499 MW Normal rating for pre-contingency loading
13. **Hillside-E. Towanda 230** at 531 MW LTE rating for loss of Homer City-Watercure 345 and E. Sayre-N. Waverly 115
14. **Homer City-Watercure 345** at 755 MW Normal rating for pre-contingency loading
15. **Watercure 345/230** at 520 LTE rating for loss of Watercure-Oakdale 345, Oakdale 345/115 bank #2
16. **Stolle Rd. – Pavement Rd. 115** at 179 MW STE rating for loss of Watercure-Homer City 345

A.

- Ramapo PAR1 and PAR2 are scheduled at 500 MW each into PJM,
- Neptune PJM-LI HVdc and Hudson transmission HVdc is out of service.
- Linden VFT is scheduled at 0 MW.

B.

- Ramapo PAR1 and PAR2 are scheduled at 500 MW each into NY
- Neptune PJM-LI HVdc and Hudson transmission HVdc are scheduled at 660MW and 605 MW into NY
- Linden VFT is scheduled at 296 MW into NY

2.4. Voltage Analysis

2.4.1. Methodology

The voltage analysis was conducted using the Siemens PTI PSS®E (Rev. 30) Software package in conjunction with the NYISO Voltage Contingency Analysis Procedure (VCAP). The 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 criteria (Exhibit A-3 of NYISO Emergency Operation Manual [13], formerly known as OP-1 criteria), 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 power flow cases with increasing transfer levels was created for each interface from the 2015 summer peak load base case by applying generation shifts similar to the ones used for the thermal analysis. The VCAP program evaluated the system response to the contingencies specific to each interface, which are NPCC transmission design criteria or NERC Category B and C contingencies. In addition to the design criteria contingencies, 45 contingencies (NERC Category B and C contingencies) expected to produce the most severe system impacts were evaluated in the voltage-constrained transfer limit analysis. Selection of these severe contingencies is based on an assessment of cumulative historical power system analysis, actual system events, and analysis of planned changes to the system.

Normal (pre-contingency) operating procedures consistent with the NYISO Transmission and Dispatching Operation Manual [14] are applied to the CATR base case. The effects of existing and planned control devices such as generator exciters, Static VAr Compensators (SVCs), Flexible AC Transmission System (FACTS) devices, high-voltage DC controls, and power system stabilizers were evaluated in the CATR.

In this analysis, load is modeled as constant power in all NYCA zones except the Con Edison service territory in both the pre-contingency and post-contingency power flows. The Con Edison voltage-varying load model is used to model the Con Edison load in all cases.

The reactive power of generators is regulated, within the capabilities of the units, to a scheduled voltage in both the pre-contingency and post-contingency power flows.

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

In accordance with NYISO normal (pre-contingency) operating practice, SVC and FACTS devices are held at or near zero reactive power output in the pre-contingency power flows, but are allowed to regulate voltage, within their capabilities, in the post-contingency power flows in accordance with NYISO Transmission and Dispatching Operation Manual. Inertial pickup is assumed for contingencies involving a loss of generation or HVdc connections to Québec.

As the transfer across an interface is increased, the voltage-constrained transfer limit is determined to be the lesser of: (a) the pre-contingency power flow at which the post-contingency voltage falls below the OP-1 post-contingency limit; or (b) 95% of the pre-contingency power flow 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 some automatic response of the system following the contingency, but before system operator actions are initiated.

During voltage-constrained transfer analysis, all generation and transmission facilities are considered to be available. For some interfaces, the voltage transfer limits could be sensitive to certain generation and transmission facility conditions (e.g. key generator commitment, SVC device and switched shunt availability). There are no considerations for these types of sensitivities during this voltage transfer analysis.

The voltage-constrained transfer limits were evaluated for the Dysinger East, West Central, Volney East, Central East, UPNY-SENY, UPNY-ConEd and Sprain Brook – Dunwoodie South Interfaces. There was no attempt to calculate the maximum voltage-constrained transfer limit for these interfaces. The Moses South and LIPA Import Interfaces are historically thermally limited; therefore, given the minimal changes in those areas, the voltage transfer limits were not evaluated.

2.4.2. Results

The pre-contingency voltage profile and the simulation of the New York State BPTF response to contingencies were found to be acceptable. Reactive Power resources were included to ensure adequate reactive resources are available to meet system requirements. The CATR demonstrates the New York State BPTF system meets Table I for Category A, B, and C of NERC TPL Reliability Standards with respect to voltage performance. New York State BPTF system security is maintained by limiting power transfers according to the determined voltage-constrained transfer limits.

The increase in the Dysinger East and West Central voltage transfer limits are mainly due to the incorporation of the Local Transmission Plan projects, which includes a 200 MVAr SVC at Station 124 in Rochester.

The slight voltage transfer limit increase in Central East is mainly due to decreased reactive power demand in the area load center and additional generation in the lower Hudson Valley. The effects on Volney East are closely tied to Central East, and therefore similar results are observed.

UPNY-ConEd and Sprain Brook – Dunwoodie South interface limits are higher than those in the 2005 CATR and 2009 ATR due to additional generation facilities in the lower Hudson Valley and New York City.

The voltage transfer limits for open interfaces are summarized in Table 2.4.1. Detailed results including closed interfaces and evaluated contingencies are presented in Appendix G.

Table 2.4.1 Summary of Voltage-Constrained Transfer Limits

Interface	2005 Comprehensive Review (Study Year 2010)	2009 Intermediate Review (Study Year 2014)	2010 Comprehensive Review (Study Year 2015)
Dysinger East	2725(1)	2750	2950(2) 2975(1)
West Central	1100(1)	1600	1650(2) 1725(1)
Volney East	4075(3)	N/A	5025(4)
Central East	3025(3)	3050	3175(5) 3225(6)
UPNY-SENY	4850(7)	6100	6150(7)(A)
UPNY-ConEd	4900(8)	5325	5475(8)(A)
Sprain Brook Dunwoodie-South	4675(9)	5275	5350(8)(A)(B)

Notes:

1. **95% of PV nose occurs for L/O Ginna**
2. **Station 80 345 kV bus voltage post-contingency low limit for breaker failure 3508 at station 80 (L/O Kin-Roch-Pann)**
3. **95% of PV nose occurs for L/O tower 34/42 southern Ckt.**
4. **95% of PV nose occurs for stuck breaker at Edic 345 (L/O Fitz-Edic 345 and Edic-N.Scot 345)**
5. **Edic 345 kV bus voltage post-contingency low limit for breaker failure R3108 at Marcy (L/O Volney-Marcy 345 & Edic-Marcy 345)**
6. **95% of PV nose occurs for L/O northern Marcy South double circuit (L/O Marcy-Coopers 345 and Edic-Fraser 345)**
7. **Pleasant Valley 345 kV bus voltage post-contingency low limit for L/O tower 34/42 southern Ckt.**
8. **95% of PV nose occurs for L/O Tower 67/68 (Ladentown 345 kV)**
9. **Dunwoodie 345 kV bus voltage post-contingency low limit for L/O Ravenswood #3**

A. Ramapo PAR1 and PAR2 are scheduled at 500 MW each into New York

B.

- Sherman Creek PAR1 and PAR2 are scheduled at 200 MW each into NYC.
- Parkchester PAR1 and PAR2 are scheduled at 245 MW each into NYC.
- Dunwoodie No. PAR1 and PAR2 are scheduled at 115 MW each into NYC.
- Dunwoodie So. PAR1 and PAR2 are scheduled at 120 and 115 MW respectively into NYC.

2.5. Stability Analysis

2.5.1. Methodology

The NYISO performed the normal design criteria (NERC Category B and C contingencies) stability analysis on four summer peak stability margin cases (UPNY margin, Central margin, Western margin, and Moses margin) and a light load case. For each summer peak case except light load case, the flows on the affected interfaces were tested at a value of at least 10 % above the more restrictive of the emergency thermal or voltage transfer limit in accordance with NYISO Transmission Planning Guideline #3-0.

The UPNY-SENY and UPNY-ConEd open interfaces of the UPNY margin case are loaded at 6650 MW and 6170 MW, respectively. This case has the Oswego Complex generation dispatched at an output of 5330 MW and 1200 MW of import from Hydro Quebec (supplied by Beauharnois hydro generation). The Chateauguay HVdc poles were taken out of service to exclude the dynamic benefit of the HVdc controls.

The Central margin case also has the Oswego Complex generation dispatched at an output of 5330 MW and 1200 MW of import from Hydro Quebec (supplied by Beauharnois hydro generation) with the Chateauguay HVdc poles out of service. The Central East and UPNY-SENY open interfaces of the Central margin case are loaded at 3235 MW and 5135 MW, respectively.

The Western margin case was loaded to the following open interface levels: Dysinger East 3075 MW, West Central 1715 MW, OH-NY 1150 MW and HQ-NY 1200 MW (Chateauguay HVdc 720 MW, AC 480 MW).

The Moses margin case has the Moses South open interface loaded to 3000 MW, HQ-NY loaded to 1930 MW (Chateauguay HVdc 980 MW, AC 950 MW), and the St Lawrence L33/34 PARs scheduled at 250 MW each.

The light load case uses a load level of 55% of the peak load and Central East and Moses South open interface flows of 1880 MW and 625 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 data used in this analysis was developed from the 2009 NPCC Base Case Development library. The real power load models used for various Planning Areas were: (1) constant current (power varies with the voltage magnitude) for Hydro Québec, New Brunswick, MRO, RFC, SERC, and SPP; (2) constant impedance (power varies with the square of the voltage magnitude) for New York and New England; (3) 50% constant current/50% constant impedance for Ontario and Nova Scotia, and

Cornwall; and (4) 90% constant current/10% constant impedance for FRCC. Reactive load was modeled as constant impedance for FRCC, MRO, RFC, SERC, SPP, and all NPCC Areas except Hydro Quebec, which uses a 13% constant current and 87% constant impedance model for reactive load.

2.5.2. Results

From Table 2.6.1, Central East is the only stability-limited interface in NYCA when tested at transfers 10% above the more restrictive of the thermal or voltage emergency transfer limit. The marginal stability limit case was determined with a flow of 3225 MW across Central East; the system becomes unstable for multiple contingencies at higher transfers. Accounting for a 10% safety margin, Central East is determined to be stability limited at 2900 MW. The system was stable at the tested margin transfer level for all other interfaces.

The CATR demonstrates the New York State BPTF system meets Table I for Category A, B, and C of NERC TPL Reliability Standards with respect to stability. New York State BPTF system security is maintained by limiting power transfers according to the determined stability limits. The CATR performed dynamic stability simulations for those Category B and C contingencies expected to produce the more severe system results or impacts based on examination of actual system events and assessment of changes to the planned system. Table H.1 of Appendix H lists the 145 design criteria contingencies that were evaluated and a determination of the overall system response as being stable or unstable. All contingencies were stable and damped.

2.6. N-1-1: Non-Simultaneous Loss of Two or More Bulk Power System Elements

NPCC and NYSRC Design Criteria also apply after any critical generator, transmission circuit, transformer, series or shunt compensating device or HVdc pole has already been lost, assuming that the Planning Coordinator Area generation and power flows are adjusted between outages by the use of ten-minute reserve and where available, phase angle regulator control and HVdc control. N-1-1 contingency analysis was performed for the 2010 ATR by modeling critical facility outages followed by testing of NPCC and NYSRC Design Criteria contingencies (consistent with NERC Categories B and C) while monitoring applicable limits of the New York State BPTF. The N-1-1 analysis for the NYCA is comprised of five parts:

Part 1: Zones A, B, C

Part 2: Zones D, E, F

Part 3: Zones G, H, I

Part 4: Zone J

Part 5: Zone K

A complete list of the N-1 and N-1-1 contingencies that were tested is included in Appendix I.

2.6.1. Methodology

N-1-1 contingency analysis of the NYCA was performed using the N-1-1 analysis tool of Siemens PTI PSS®E version 32 software package. Individual N-1 cases were created by removing a critical generator, transmission circuit, transformer, series or shunt compensating device, or HVdc pole from the base case (N-1) in accordance with NPCC Transmission Design Criteria and NYSRC Reliability Rules. Using the automated process a set of corrective actions was developed to eliminate violations in the post-contingency cases for each N-1 case, such that when design contingencies (NERC Category B or C contingencies) were tested on the N-1 case, there were no post-contingency thermal or voltage violations on the New York BPTF.

2.6.2. N-1 Power flow Cases

Starting with the 2015 summer peak load base case, 176 N-1 cases were created. After the N-1 facility was taken out-of-service the automated process applied corrective action adjustments to the case, if necessary, so the N-1 case was within normal thermal facility ratings and pre-contingency voltage limits. N-1 cases were created for each of the 176 N-1 outages in this manner.

2.6.3. N-1-1 Contingency Testing

Contingency analysis was performed on each of the N-1 cases. A second list of contingencies (N-1-1 contingencies) was used for this purpose. The N-1-1 contingency list included the most severe design contingencies including stuck breaker, tower failure, and loss of generation contingencies. All N-1-1 contingencies were tested and then an automated process would develop a set of corrective actions to remove any post-contingency thermal violations. These corrective actions would then be applied to the N-1 case and the N-1-1 contingencies tested again. This process would be repeated until a single set of corrective actions was derived for each of the N-1 outage cases until no post-contingency thermal violations following any of the N-1-1 contingencies occurred.

2.6.4. Results

Corrective actions were identified for each N-1 facility outage condition such that there were no post-contingency thermal or voltage violations on the New York State BPTF following any N-1-1 contingency combination. These results indicate that sufficient ten-minute reserve, phase angle regulator control, and HVdc control is available within the New York Control Area to allow the projected demand to be supplied following two non-simultaneous contingencies. The complete N-1-1 results and list of corrective actions are provided in Appendix I.

2.7. Summary

Table 2.6.1 at the end of this section provides a summary of the normal and emergency transfer limits for the open transmission interfaces used in NYISO transmission planning studies. The corresponding transfer limits of closed interfaces are also provided in the appendices. These results confirm that the base case meets criteria, and by limiting power transfers consistent with the transfer limits reported here, the security of the New York State BPTF will be maintained and projected demand will be supplied in accordance with NERC Reliability Standards, NPCC Transmission Design Criteria, and NYSRC Reliability Rules.

Table 2.6.1 Transfer Limit Comparison

Interface	2005 Comprehensive Review (Study Year 2010)				2009 Intermediate Review (Study Year 2014)				2010 Comprehensive Review (Study Year 2015)			
	Normal (MW)		Emergency (MW)		Normal (MW)		Emergency (MW)		Normal (MW)		Emergency (MW)	
Dysinger East	2725	VX	2725	VX	2750	VX	2750	VX	2700	T	2775	T
West Central	1275	VX	1275	VX	1600	VX	1600	VX	1425	T	1500	T
Volney East	4025	T	4075	VX	3875	T	4625	T	4600	T	5025	VX
Moses South	1550	T	2025	T	2325	T	2625	T	2475	T	2675	T
Central East	2850	T	2900	S	2775	T	3050	V	2900	S	2900	S
Total East	5450	T	5525	S	6120	T	6825	S	5725	T	5975	T
UPNY-SENY	4575	T	4850	VX	5325	T	6025	T	5250	T	5900	T
UPNY-ConEd	4575	V	4900	VX	5325	VX	5325	VX	5375	T	5475	VX
Sprain Brook Dunwoodie South	4675	V	4675	V	5250	T	5275	VX	5350	VX	5350	VX
Long Island Import	2050	T	2100	T	2050	T	2100	T	1950	T	2675	T

Notes:

1) Transfer limits expressed in MW and rounded down to nearest 25 MW point.
2) Thermal and voltage limits apply under summer peak load conditions.
3) Emergency limits account for more restrictive voltage collapse limit.
4) Transfer limits for all-lines-in condition.
5) 2010 CATR transfer limits assume a 1000 MW base schedule on the Ramapo PARs.
6) 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. Short Circuit Analysis

3.1. Description of the Short Circuit Base Case

The NYISO 2015 Statewide Short Circuit representation dated September 22, 2010, Revision 2a, was used for this study. The data was reviewed and updated by the NYCA Transmission Owners and project developers. The neighboring system representations (e.g., PJM, ISO-NE and Ontario) were updated with the latest available planning models.

3.2. Methodology

The short circuit analysis was conducted using the ASPEN OneLiner program. The short circuit assessment was performed in accordance with NYISO Guideline for Fault Current Assessment (SC Guideline) [14].

The SC Guideline requires that key assumptions used under this methodology 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. All generator internal voltages are set at 1.0 PU and no phase displacement due to load (i.e., use Flat Gen voltage profile, which now referred to as "a linear network solution" voltage profile),

i. Apply the following faults:

    - Three line to Ground,
    - Double line to ground,
    - Single line to ground.

Three line, two line, and single line to ground faults were applied to the buses included in the New York State BPTF. The highest of these three faults was compared against the respective station lowest circuit breaker rating to determine whether or not the circuit breaker may be over-duty.

In many situations, a high bus fault duty does not automatically mean that each circuit breaker rated lower than the bus fault will be over-duty. Only an Individual Breaker Analysis (IBA) can provide a true fault current that a particular breaker will see. NYISO does not have a universal IBA methodology defined; therefore each Transmission Owner uses its own internal methodology. When no internal methodology is defined, the NYISO used the standard, conservative methodology in which the breaker in question is the last breaker opened to clear the fault regardless of the voltage level.

The lowest circuit breaker ratings shown for each of the selected substations were also obtained from the New York facility owners. The ratings shown are the nameplate symmetrical rating, the de-rated symmetrical value as determined by the owner, or the approximate symmetrical value converted from a total current basis. Circuit breakers rated on a total current basis were converted to an approximate symmetrical current rating by using the nominal voltage of the substation. Advanced circuit breaker rating techniques (e.g., asymmetrical current analyses, de-rating for reclosing, and de-rating for age) were not implemented by the NYISO for this screening analysis; however, some of the breaker interrupting ratings supplied by the transmission owners may include these methodologies.

3.3. Results

Based on the study results, there are four buses owned by National Grid with over-duty breakers, as summarized in Table 4.1. A complete list of results is provided in Appendix J. National Grid has informed NYISO that plans are in place to make the necessary facility upgrades to mitigate any breaker over-duty. Breaker replacements at Volney 345 kV will be complete in 2012 and at Scriba 345 kV in 2014; breaker replacements at Porter 115 kV will be complete in 2015 and the Porter 230 kV breaker replacements will be complete in 2016. In addition, Scriba 345 kV breakers R230 and R925 are scheduled to be replaced in 2014 by the facility owner.

Table 3.3.1 2010 ATR Over-duty Breaker Summary Table

Station	**kV**	**Number of Over-duty Breaker(s)**	**Breaker ID**
Scriba	345	6	R100, R200, R210, R250, R90, R945
Volney	345	2	R200, R210
Porter	230	9	R110, R120, R15, R170, R25, R320, R825, R835, R845
Porter	115	10	R10, R130, R20, R30, R40, R50, R60, R70, R80, R90

4. Extreme Contingency Assessment

4.1. Methodology

Analysis of the NYCA extreme contingencies (NERC Category D) was performed using Siemens PTI PSS®E and PSS®MUST software package. Each contingency was simulated to evaluate the New York State BPTF transient stability, voltage, and thermal response consistent with NPCC Design Criteria and NYSRC Reliability Rules.

4.1.1. Pre-Contingency Power Flow Base Case

All extreme contingencies start with the same initial conditions. Since extreme contingencies are considered very low probability events, they were not tested on the summer peak case used for normal contingency testing. Instead, a power flow case was developed starting from the summer peak base case and reducing the NYCA load by approximately 20%. The generation dispatch of the NYCA system was modified so that transfer levels on the NYCA intra-Area interfaces were at or above the 75th percentile of expected transfer levels.

4.1.2. Dynamics Simulation

In order to test the ability of the system to return to a stable operating point after an extreme contingency, the NYISO performs dynamic simulations. The simulation was first initialized to the pre-contingency power flow conditions and then run to 0.1 seconds before altering the system configuration. For no-fault contingencies, this was a simple case of removing an element from service. In the case of a contingency that included a fault, several events change the system in sequence to match breaker actions. All simulations assume that generators with an angle separation greater than 300 degrees from the rest of system will trip during post-contingency transient. After an inspection of the simulation plots and dynamic simulation log files for each contingency, a determination was made whether or not the system remains stable after the event. The plots are included in Appendix L.

4.1.3. Post-Contingency Power Flow Analysis

Power flow simulations were performed via Siemens PTI PSS®MUST software package to determine voltage impacts and line overloads with the new (post-contingency) system configuration. This procedure required that each element taken out of service in the dynamics simulation be taken out of service for the post-contingency power flow.

4.2. Extreme Contingency Analysis

Extreme contingencies for NYCA were developed for conformance to NERC TPL-004-0 Reliability Standard, section 5.6 of NPCC Directory #1, and requirement B-R4 of the NYSRC Reliability Rules. A total of 41 extreme contingencies including loss of entire substations, loss of entire generation plants, loss of all circuits along a transmission right-of-way, and loss of a gas pipeline were evaluated. Most of the contingencies simulated were stable and showed no thermal overloads over the STE rating or significant voltage violations or deviations on the BPTF. Some contingencies showed voltage violations, significant voltage drops, and/or thermal overloads on the underlying 115/138 kV sub-transmission system, but these conditions were local in nature. The analysis indicated that there are wind generators which would trip due to low voltage or generator frequency protection; however the impact of these trips is local and does not affect the stability performance of the Bulk Power System. Table 4.2.1 summarizes the results of the extreme contingency analysis. Appendices I and J contain the summarized power flow results and the stability plots of selected contingencies, respectively. A few significant contingencies are discussed below.

In 2002-03, Levitan & Associates, Inc. (LAI) performed a resource assessment study of pipeline deliverability to serve the coincident natural gas requirements of power generators and local distribution companies (LDCs) in the greater Northeast. This work was undertaken for the NYISO as well as PJM, ISO-New England, and the ISO of Ontario. Emphasis in the Multi-Region Gas Study was placed on the ability of the consolidated network of interstate pipelines and storage facilities to sustain natural gas service to power generators under a number of postulated gas-side and electric-side contingency events. Since the Multi-Region Gas Study was completed in 2003, several significant infrastructure projects have been proposed and / or completed in and around the New York Control Area (NYCA). The majority of these pipeline and storage facility improvements reflect the need to modify traditional supply pathways into the market center in response to changing production profiles from western Canada, the Gulf Coast, and, more recently, from the Rocky Mountains. Several new pipeline supply expansion projects have been formulated by incumbent pipelines serving New York State in response to abundant natural gas reserves in the Marcellus Shale formation in Pennsylvania, West Virginia and New York.

In the 2010 pipeline infrastructure assessment, LAI expands on prior research conducted for NYISO in the Multi-Region Gas Study. Research goals and objectives were fourfold: first, to delineate the new and proposed pipeline projects and facility improvements affecting natural gas infrastructure and deliverability across NYCA; second, to identify the expected natural gas requirements of gas-fired generators in NYISO on a peak electric day, that is, during the peak cooling season; third, to postulate gas-side contingency events that would seriously impair natural gas service to generators in NYISO, including gas-fired generators behind the citygate on the New York Facilities System (NYFS); and, fourth, to quantify an upper limit of gas-fired generation deemed at-risk in the event such low probability / high impact gas-side contingencies were to occur during the peak cooling season. The complete NYCA Pipeline Study is in Appendix Q.

Four potential gas-side contingencies were discussed in the study, three of which were related to either New York City or Long Island. New York City and Long Island are required by the NYSRC Local Reliability Rules I-R3 and I-R5 to be operated so that the loss of a single gas facility does not result in the loss of electric load on their respective systems. Periodic assessments are performed by the Transmission Owners and reviewed by the NYISO and NYSRC to ensure compliance with these rules. Recent loss of gas/minimum oil burn (LOG-MOB) studies indicated compliance with the current rules.

The forth potential gas-side contingency impacts upstate generation. If a catastrophic failure were to occur at a compressor station, four downstream plants totaling 380 MW of generation could conceivably be at risk. This generation is distributed broadly across upstate New York and therefore such a loss would not result in BPTF security violations. NYCA has enough generation reserve (greater than 1200 MW) to cover such a single loss-of-source event.

4.2.1. EC01 Loss of Niagara Ties between NYCA and Ontario

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 7.5 MW towards Ontario. Removing these ties shows no significant voltage deviations or thermal overloads, and no first-swing stable issue.

However, this contingency showed low amplitude un-damped oscillations among NYCA generators. This is due to the high level of Western New York (WNY) export in this case. These oscillations become less severe by decreasing Niagara generation to reduce the western New York export below 1100 MW.

4.2.2. EC12 Three-Phase Fault at Marcy with delayed clearing

This contingency is a three phase fault at Marcy 345 kV on the Marcy-Volney #19 line (VU-19). A stuck breaker develops at Marcy, requiring backup clearing of the fault by tripping the Edic-Marcy 345 kV UE1-7 line. 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 west-east 345 kV paths supplying Central East.

The dynamic simulation showed first-swing stability issues in the Oswego complex, which includes Nine Mile #1 & #2, Fitzpatrick and six Independence units, became first-swing unstable. In that extreme contingency a total of over 4000 MW of generation tripped due to first-swing instability. The remainder of the bulk power system remained stable.

However, the first-swing instability issue can be mitigated by adjusting the terminal voltage setting of Oswego complex units. If the voltage settings can be coordinated such that VAR output is distributed among the Oswego complex units, the first-swing stability problem will not be observed for the tested condition.

There may be some other measures to mitigate this extreme contingency such as re-dispatching Oswego complex units, reducing the three phase fault clearing time, or replacing the current breaker with independent pole tripping breaker.

4.2.3. EC30 Three-Phase Fault at Moses with delayed clearing

This contingency is a three-phase fault at Moses 230 kV on the Moses-Massena MMS-2 line. A stuck breaker develops at Moses, requiring backup clearing by opening one of the Moses 230/115 kV transformer banks. The effect of this contingency is to leave a three phase fault on the Moses 230 kV bus for 12.5 cycles.

This event resulted in the first-swing instability of 16 Moses-St. Lawrence units and the Saranac Energy plant; a total of over 1100 MW of generation tripped at those locations. The remainder of the bulk power system remained stable. NYCA has enough generation reserve (1200 MW) to cover the 1100 MW loss of generation due to this extreme contingency. No significant voltage deviations or thermal overloads were observed.

4.2.4. EC10 Loss of Oakdale Substation

For the loss of Oakdale substation, the power flow simulation trips 345, 230, 115 and 34.5 kV buses, resulting in numerous low voltage conditions on the 115 and 34.5 kV system. This condition was confined to the local distribution networks served through the Oakdale station. The impact of this extreme contingency was worsened by generation retirements within those networks removing dynamic VAr support from the area. No system stability issues were observed.

4.3. Extreme Contingency Summary

As stated in the NPCC Directory #1, 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 review, the system response to extreme contingencies was comparable to the previous reviews. This indicates that the strength of the planned interconnected power systems is not expected to deteriorate in the near future.

Table 4.2.1 Extreme Contingency Analysis Summary

Extreme Contingency	Stable/ Unstable (first swing)	Oscillation Damped (small signal)	OP-1 Violations	Facilities (kV) Above 90% STE Loading				
				765	500	345	230	138/115
EC01 – L/O NY-ON TIES AT NIAGARA	S	N	-	-	-	-	-	-
EC02 - L/O NIAGARA STATION & GENERATION PLANT	S	Y	-	-	-	-	2	1
EC03 - L/O R.O.W. WEST OF ROCHESTER	S	Y	-	-	-	-	-	13
EC04 - L/O ROW EAST OF ROCHESTER	S	Y	-	-	-	-	-	-
EC05 - L/O WATERCURE SUBSTATION	S	Y	-	-	-	-	-	-
EC06 - L/O R.O.W. NORTH OF VOLNEY	S	Y	3	-	-	-	-	-
EC07 - L/O R.O.W. SOUTH OF VOLNEY	S	Y	-	-	-	-	-	-
EC08 - L/O CLAY SUBSTATION	S	Y	-	-	-	-	-	-
EC09 - L/O LAFAYETTE SUBSTATION	S	Y	-	-	-	-	-	-
EC10 - L/O OAKDALE SUBSTATION	S	Y	-	-	-	-	-	7
EC11 - L/O R.O.W. NORTH OF ADIRONDACK	S	Y	-	-	-	-	-	-
EC12 - L/O MARCY-VOLNEY AND MARCY-EDIC	S(A)	Y	-	-	-	-	-	-
EC13 - L/O EDIC SUBSTATION	S	Y	-	-	-	2	-	3
EC14 - L/O R.O.W. SOUTH OF UTICA	S	Y	-	-	-	-	-	7
EC15 - L/O R.O.W. EAST OF UTICA	S	Y	-	-	-	2	-	3
EC16 - L/O FRASER SUBSTATION	S	Y	-	-	-	-	-	-
EC17 - L/O R.O.W. WEST OF ROTTERDAM	S	Y	-	-	-	2	-	14
EC18 - L/O NEW SCOTLAND SUBSTATION	S	Y	-	-	-	2	-	2
EC19 - L/O LEEDS SUBSTATION	S	Y	1	-	-	1	-	13
EC20 - L/O FISHKILL SUBSTATION	S	Y	-	-	-	-	-	-

Extreme Contingency	Stable/ Unstable (first swing)	Oscillation Damped (small signal)	OP-1 Violations	Facilities (kV) Above 90% STE Loading				
				765	500	345	230	138/115
EC21 - L/O ROSETON SUBSTATION AND GENERATION	S	Y	-	-	-	-	-	-
EC22 - L/O RAMAPO SUBSTATION	S	Y	-	-	-	-	-	-
EC23 - L/O BUCHANAN SUBSTATION	S	Y	-	-	-	-	-	-
EC24 – L/O R.O.W WEST BUCHANAN	S	Y	-	-	-	-	-	-
EC25 - L/O MILLWOOD SUBSTATION	S	Y	-	-	-	-	-	-
EC26 - L/O R.O.W. SOUTH OF MILLWOOD	S	Y	-	-	-	-	-	-
EC27 - L/O ASTORIA GENERATION	S	Y	-	-	-	-	-	-
EC28 - L/O RAVENSWOOD GENERATION	S	Y	-	-	-	-	-	-
EC29 - L/O NORTHPORT SUBSTATION AND GENERATION	S	Y	-	-	-	-	-	-
EC30 - 3PH/STK @MOSES 230 / MASSENA-MOSES 765/230 MMS-2	S(B)	Y	-	-	-	-	-	-
EC31 - 3PH/STK @EDIC 345 ON EDIC-FRASER	S	Y	-	-	-	-	-	-
EC32 - 3PH/STK @EDIC 345 ON EDIC-NSCOT, CLR@FITZ345	S	Y	-	-	-	-	-	-
EC33 - 3PH@ ROCHESTER 345KV ON ROCHESTER-PANNELL RP-1	S	Y	-	-	-	-	-	-
EC34 – L/O ROCKPORT SUBSTATION AND GENERATION PLANT	S	Y	-	-	-	-	-	-
EC35 - 3PH/STK@EDIC345KV FITZ-EDIC #FE-1/BKUP CLR@N.SCOT345	S	Y	-	-	-	-	-	-
EC36 – 3PH @ RAMAPO 345 (STUCK)	S	Y	-	-	-	-	-	2
EC37 – L/O SILLS RD SUBSTATION AND CAITHNESS GENERATION	S	Y	-	-	-	-	-	-

Extreme Contingency	Stable/ Unstable (first swing)	Oscillation Damped (small signal)	OP-1 Violations	Facilities (kV) Above 90% STE Loading				
				765	500	345	230	138/115
EC38 – L/O NEWBRIDGE 138 STATION	S	Y	-	-	-	-	-	-
EC39 – L/O WEST 49 345 STATION	S	Y	-	-	-	-	-	-
EC40 – L/O GOWANUS 345 STATION	S	Y	-	-	-	-	-	-
EC41 – L/O ASTORIA 345 STATION, ASTORIA ENERGY II & BERRIANS GT III	S	Y	-	-	-	-	-	-

S – Stable

U – Unstable

A. Nine Mile #1 & #2, Fitzpatrick, Oswego #5 & #6, and 6 Independence units are first-swing unstable. There are total of over 4000 MW generation in NYCA tripped due to first-swing instability.
B. Saranac Energy and Moses units are first-swing unstable. There are total of over 1100 MW units in NYCA tripped due to first-swing instability.

5. Review of Extreme System Condition Assessment

NPCC Directory #1 and NYSRC Reliability Rules require assessment of extreme system conditions, which have a low probability of occurrence, such as loss of major gas supply and peak load level resulting from extreme weather conditions.

5.1. Extreme Weather Condition Assessment

To satisfy the requirement of assessing the peak load condition resulting from the extreme weather conditions, a power flow case was developed from the summer peak base case with the load increased by 5.5% to meet the extreme weather forecast load (90/10 forecast). This load reflects weather conditions that are expected to occur no more than once in ten years. The weather conditions were based on weather observations since 1975.

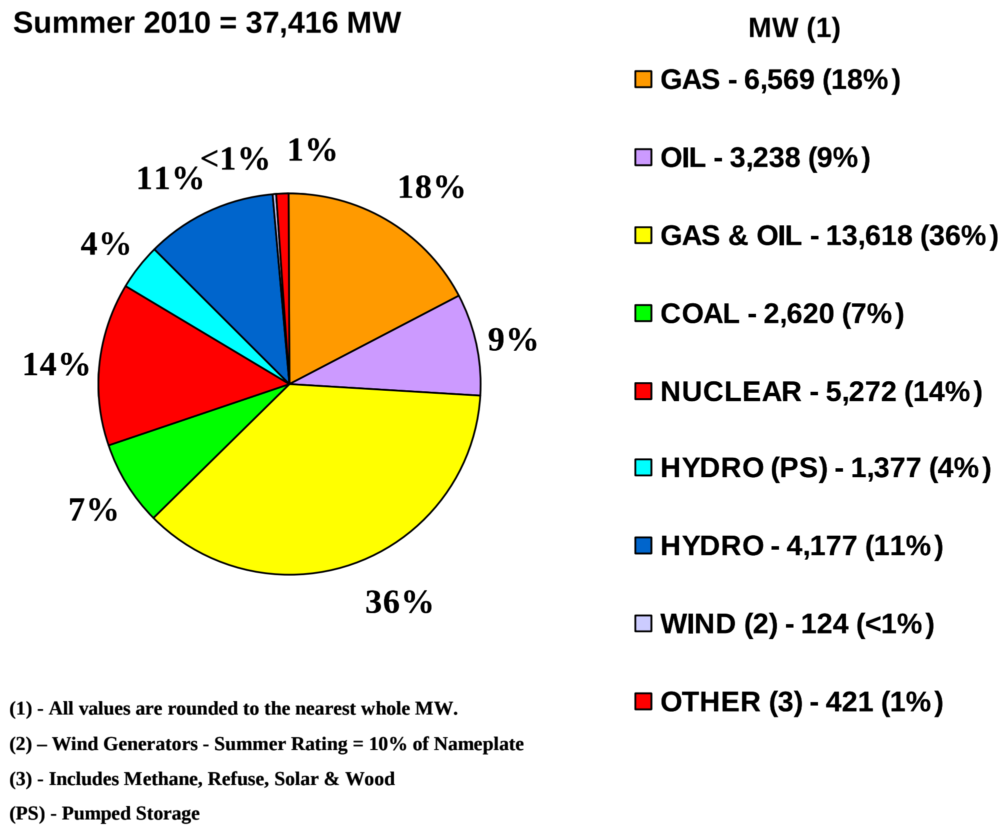
All design criteria contingencies (NERC Categories B and C) on the New York State BPTF were tested with the extreme system condition base case. Thermal and voltage contingency analysis was performed using the Siemens PTI PSS®MUST program utilizing the AC Contingency Analysis activity, monitoring all 115 kV and above buses or branches for post-contingency bus voltage limits and LTE thermal ratings. Several critical design contingencies expected to produce the most severe results were selected for stability testing on this extreme system condition case. For most contingencies, no significant voltage violations, thermal overloads or stability issues were observed under this extreme weather condition. Analysis did reveal that a BPTF double circuit tower contingency in Rockland County produced line loadings in excess of equipment ratings on the sub-transmission system; however, no violation of reliability criteria occurred on the New York State BPTF. The local Transmission Owner has operating procedures and plans in place to address the local area non-BPTF issues.

The power flow analysis results and stability plots are reported in Appendix K.

5.2. Loss of Gas Supply Assessment

Natural gas-fired generators 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 generation capacity has a balance of fuel mix which provides operational flexibility and reliability. Many generation plants have dual fuel capability. Figure 1 presents the fuel mix as it existed as of year end 2009. As indicated in Figure 1, 18% of generating capacity is fueled by natural gas only, 36% of generating capacity is fueled by oil and natural gas, and the rest is fueled by oil, coal, nuclear, hydro and other.

Figure 5.2.1 NYCA Capability by Fuel Type



For this assessment, the power flow base case was developed by assuming all gas only units are not available due to gas supply shortage. The extreme condition of natural gas fuel shortage is more likely to occur during the winter peak demand period, thus the base case models winter peak demand levels (approximately 80% of the summer peak load) assuming NYCA gas-only units are not available.

All design criteria contingencies were tested on this loss of gas supply base case. Thermal and voltage contingency analysis was performed using the Siemens PTI PSS®MUST program utilizing the AC Contingency Analysis activity, monitoring all 115 kV and above buses or branches for post-contingency bus voltage limits and LTE thermal ratings. Several critical design contingencies were selected for stability testing on this extreme system condition case. No significant voltage violations, thermal overloads or stability issues were observed for this extreme condition.

The power flow analysis results and stability plots are reported in Appendix L.

New York City and Long Island are required by the NYSRC Local Reliability Rules I-R3 and I-R5 to be operated so that the loss of a single gas facility does not result in the loss of electric load on their respective systems. Periodic assessments are performed by the

Transmission Owners and reviewed by the NYISO and NYSRC to ensure compliance with these rules. Recent loss of gas/minimum oil burn (LOG-MOB) studies indicated compliance with the current rules.

A review of the nature of the network of gas supplies and fuel diversity in the rest of New York State indicated no significant changes from the previous Comprehensive Review.

6. Review of Special Protection Systems

A review of the special protection systems (SPSs) in the New York Control Area (NYCA) was conducted. The CATR evaluated the effects of existing and planned protection systems, including any back-up or redundant systems. This review evaluated the designed operation and possible consequences of failure or misoperation of SPSs within NYCA that are due to stability issues. These SPSs include transmission cross-tripping schemes for the Chateauguay-Massena 765 kV circuit (MSC-7040) and generation rejection schemes for units at Moses, Niagara, Oswego and Bowline Point. A complete list of the SPSs in New York is provided in Appendix N.

6.1. Methodology

Simulations were conducted for several actions that could occur for each SPS. The first was a test of 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 crosstrip 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 & N. The SPS Stability Simulation Summary Table in Appendix N indicates which powerflow case was used for each SPS evaluation.

6.2. Results

The Type II SPS (#39), that currently rejects Bowline unit #2 following the loss of both Y88 and W72 345 kV lines from Ladentown (extreme contingency) to prevent all of the Bowline output from being directed through the 138 kV system, was stable for correct operation and misoperation of the SPS, but showed undamped oscillations for the failure of the SPS to operate. Since the initiating contingency is an extreme contingency, this SPS should continue to be classified as Type II. The previous CATR evaluated this SPS including the impact of rejecting a proposed Bowline #3 plant, which has since been removed from the NYISO interconnection queue.

The SPS (#40) that rejects generation at Oswego is for protection against extreme contingencies (Type II). Extreme contingencies are tested by adjusting the transfer levels to approximately the 75th percentile of the expected maximum transfer levels. This test was conducted with a Central East interface level of 2600 MW or more.

National Grid has indicated that all 345 kV breakers at Clay and Volney stations have been replaced with independent pole trip capability (IPT) which resulted in revising applicable contingencies with the new clearing sequence. This makes the extreme contingency stability fault less severe as the three phase (3PH) stuck breaker fault evolves into a single line to ground fault instead of staying on as a 3PH fault for a longer duration. This test was conducted with the Oswego Complex dispatched near full output (5330 MW) and Central East interface flow of approximately 2600 MW. The simulation of the SPS was stable for correct operation, misoperation and failure to operate with the new clearing sequence at a Central East interface flow of 2600 MW. Further testing of the failure of the SPS to operate showed that the Volney R935 three phase breaker failure fault was not stable when the Central East interface flow was above 2700 MW with Oswego Complex at full output. Since this SPS correctly protects against instability for extreme contingencies, it should remain classified as Type II.

The simulation of the Type I SPS (#41) 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 (#43) that rejects generation at St. Lawrence for local design contingencies was stable for correct operation, failure to operate, and misoperation. While the results for the conditions tested indicate that this SPS could be considered a Type III, no change in type is requested at this time.

The simulation of the Type I SPS (#50) that rejects generation at Niagara for local design contingencies was stable for correct operation, failure to operate and misoperation of the SPS following normal and extreme contingencies. While the results for the conditions tested indicate that this SPS could be considered a Type III, no change in type is requested at this time.

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

7. Review of Dynamic Control Systems

In 1991-1992, the JWG-1 performed an evaluation and classification of the DCS that existed in NPCC, "Final Report on NPCC Dynamic Control Systems" [16]. As part of this Comprehensive Review, the classifications of the DCS which are in NYCA were reassessed. Existing and proposed control systems in NYCA are listed in Tables 7.1 and 7.2 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 7.1 Existing Dynamic Control Systems in NYCA

DYNAMIC CONTROL SYSTEM	TYPE
Chateauguay HVdc Controls CSP LVCL Bang-Ramp	 Type III Type III 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 Exciter (Saranac Energy)	Type III
North End PSS (Saranac Energy)	Type III
Independence Exciter	Type III
Independence PSS	Type III
Bethlehem Exciter	Type III
Bethlehem PSS	Type III

DYNAMIC CONTROL SYSTEM	TYPE
East River Exciter	Type III
East River PSS	Type III
NYPA Astoria CC Exciter (NYPA Astoria CC)	Type III
NYPA Astoria CC PSS (NYPA Astoria CC)	Type III

Table 7.2 Proposed Dynamic Control Systems in NYCA

DYNAMIC CONTROL SYSTEM	TYPE
CPV Valley Exciter	Type III
CPV Valley PSS (steam turbine only)	Type III

7.1. Methodology

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

Moses South Margin Case: Moses South scheduled at 3000 MW, MSC-7040 (HQ-NY) above 1900 MW

UPNY Margin Case: Central East scheduled at 2970 MW, Oswego Complex above 3200 MW

Generation levels and interface megawatt flows of these cases are listed in Appendix D. The case in which the system is stressed closest in proximity to the device being tested was assigned to each device, then the DCS was disabled and a fault applied. Table O-1 in Appendix O 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.

7.2. Results

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

8. Review of Exclusions from NPCC Basic Criteria

The NPCC Directory #1 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 therefore none were reviewed. Furthermore, NYISO does not anticipate requesting any exclusion in the near future.

9. Review of Additional NYSRC Requirements

Previous sections in this report have addressed NYSRC Reliability Rules B-R1 (Section 2.3), B-R2 (Section 2.4), B-R3 (Section 2.5), B-R4 (Section 4), B-R7 (Section 3), and K-R3 (Section 5). This section addresses additional requirements unique to NYSRC which have not already been addressed in previous sections.

9.1. System Restoration Assessment B-R5

Stony Ridge is a new 100 MW load-serving tap on the existing Hillside – Avoca 230 kV (68) line, which is on the current NYISO System Restoration Plan. The Stony Ridge 230 kV tap will be evaluated for the NYISO System Restoration Plan when Stony Ridge is in-service.

To mitigate overdutied breakers resulting from the addition of Astoria Energy II or Berrians III projects, the existing Gowanus 345 kV Series Reactors (SR) R41 and R42 are placed in-service, which are bypassed in the current NYISO System Restoration Plan. The NYISO System Restoration Plan may be updated placing the series reactors in-service after the addition of Astoria Energy II or Berrians III.

Bayonne Energy Center is a new power plant that will interconnect at Gowanus 345 kV substation. As a result of this interconnection, the Gowanus substation will be reconfigured from two straight buses to a ring bus. The NYISO System Restoration Plan will be updated accordingly when these facility modifications occur.

9.2. Local Rules Consideration I-R1 through I-R5

The NYSRC has adopted local reliability rules that apply to the New York City and Long Island zones to protect the reliable delivery of electricity for specific electric system characteristics and demographics relative to these zones. At the beginning of every year, before conducting its annual studies, the NYISO requests information from the local Transmission Owners on changes in local system conditions that would impact the NYSBPS. The base case conditions are described in section 2 of this report and summaries are included in the appendices which illustrate the application of the following local rules to the system model used in the assessments:

I-R1 Operating Reserves/Unit Commitment, I-R2 Locational Reserves (New York City)

Local operating reserve rules are considered in the development of the base cases used for all reliability assessments.

I-R3 Loss of Generator Gas Supply (New York City), I-R5 Loss of Generator Gas Supply (Long Island)

Specific loss of generator gas supply studies are performed by ConEdison and LIPA and reviewed by the NYISO. The planned system is expected to be compatible with local rules regarding loss of generator gas supply.

I-R4 Thunderstorm Watch (New York City)

Proposed facilities included in this assessment do not impact the Thunderstorm Watch contingency list.

10. Overview Summary of System Performance

The eight assessments presented in this report are summarized here. In the first and second assessments, the NYISO conducted power flow and stability analyses to evaluate the thermal, voltage and stability performance of the New York State BPTF for normal contingencies (NPCC or NYSRC Design Criteria or NERC Categories B and C) contingencies as defined in the NERC TPL Reliability Standards, NPCC Directory #1, and NYSRC Reliability Rules. Thermal and voltage performance was evaluated under peak load and high transfer conditions. In addition, stability performance was evaluated on a system that modeled transfers that exceeded the normal limits. Overall, the system performance during transfer limit analysis and the system performance simulated during dynamic stability analysis were acceptable. By limiting power transfers consistent with the transfer limits reported in this review, the security of the New York State BPTF will be maintained and projected demand will be supplied in accordance with NERC Reliability Standards, NPCC Transmission Design Criteria, and NYSRC Reliability Rules.

The third assessment evaluated the fault duty at each bus in the short-circuit representation. The analysis indicates four BPTF buses may experience over-duty breakers for the conditions tested. The applicable owners are responsible for making the necessary facility upgrades as part of their internal planning processes.

In the fourth assessment, the NYISO conducted power flow and stability analyses to evaluate the performance of the Bulk Power System for low probability extreme (NERC Category D) contingencies as defined in the NPCC Directory #1 and NYSRC Reliability Rules. The stability analysis results indicate that the interconnected power systems would be stable for the extreme contingencies tested and for the system conditions tested. The power flow 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 first-swing instability of a group of units; however, the Bulk Power System would remain stable if the unstable units are tripped. There are also a few extreme contingencies which may cause a loss of local load within an area due to low voltage or first-swing instability of isolated generators. Overall, the results are comparable to the previous CATR and no serious consequences were identified.

The fifth assessment evaluated the extreme system conditions. No significant thermal, voltage or stability problems were found for normal contingencies under the tested condition of loss of major gas supply. For the tested extreme weather condition, there are no BPTF thermal, voltage or stability problems for all design contingencies.

The sixth assessment was a review of SPSs in NYCA. The testing of the SPSs showed similar results to the previous CATR since the system near the existing SPSs has not changed. While two SPSs may be reclassified, there are no changes to SPS types required.

The seventh assessment was a review of DCS. Since the previous CATR, there is one proposed Type III classification addition to DCS in NYCA. The expected year 2015 system conditions in the vicinity of existing DCS in the NYCA has not changed significantly, therefore the analysis of DCS showed no adverse impact to the system. The assessment confirmed the current classifications of all DCS including the proposed additional DCS that they may remain or be classified as Type III

The eighth assessment evaluated the exclusions from NPCC *Basic Criteria*. NYISO does not have any such exclusion at this time therefore none were reviewed. Furthermore, NYISO does not anticipate requesting any exclusion in the near future.

11. Conclusion

The analysis in this Comprehensive ATR indicates that the New York State Bulk Power Transmission Facilities, as planned through the year 2015, conform to the reliability criteria described in the NYSRC Reliability Rules, NPCC Directory #1 "Design and Operation of the Bulk Power System", and applicable NERC Reliability Standards. The CATR confirms that no additional upgrades are necessary to meet the performance requirements of the NYSRC Reliability Rules, NPCC Directory #1, or NERC TPL Reliability Standard Categories A, B, and C of Table I.

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