Niagara Mohawk Power Corporation
d/b/a National Grid

PROCEEDING ON MOTION OF THE COMMISSION AS TO THE RATES, CHARGES, RULES AND REGULATIONS OF NIAGARA MOHAWK POWER CORPORATION FOR ELECTRIC AND GAS SERVICE

Testimony and Exhibits of:

Electric Infrastructure and Operations Panel
Exhibit __ (EIOP-19), pp 376 – 684:
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Submitted by:
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Exhibit __ (EIOP-19)

Exhibit __ (EIOP-19)

Workpaper:

Report on the Condition of Physical Elements of Transmission and Distribution Systems
Submitted September 30, 2011

REPORT ON THE CONDITION OF PHYSICAL ELEMENTS OF TRANSMISSION AND DISTRIBUTION SYSTEMS

CASE 06-M-0878

PREPARED FOR:

THE STATE OF NEW YORK PUBLIC SERVICE COMMISSION

THREE EMPIRE STATE PLAZA

ALBANY, NY 12223

OCTOBER 1, 2011

nationalgrid

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I. Executive Summary

Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid" or the "Company") submits this fifth annual report on the physical condition of its transmission and distribution ("T&D") facilities in compliance with a requirement imposed by the New York Public Service Commission (PSC) in its September 17, 2007 order in Case 06-M-0878.

The Company's primary focus is the safe and adequate delivery of electricity to businesses, homes, and wholesale customers in its service area and the transmission of electricity through its service area to support regional electricity markets and reliable service of other utilities. This report outlines the Company's results of inspections and analysis on its assets. Presently, the physical elements of National Grid's T&D infrastructure are generally adequate to provide safe and reliable service. However, this report highlights asset and system conditions that require continued monitoring and evaluation. This report also highlights asset and system conditions that require present and future investment to ensure our ability to continue to provide safe and reliable service. The asset and system conditions identified in this report guide the development of the Company's capital and maintenance investment plans. The Company's investment plans are focused on meeting our regulatory and statutory requirements, maintaining the reliability and safety of the system, and reducing the environmental impact of our assets.

This executive summary highlights some of the key results for Asset Condition and System Capacity and Performance. Unless noted otherwise, information in the report is based on system conditions and plans as of June 30, 2011.

I A. Asset Condition Chapter II

The purpose of evaluating the condition of assets is to determine those assets whose condition necessitates their replacement before their performance negatively impacts our ability to provide safe and adequate service. Additionally, an asset's useful service life may include several considerations, including: the safe operation of equipment, obsolescence, and the inability of an asset to operate as designed.

Notably, some elements of the T&D system were installed nearly a century ago and, based upon industry knowledge and experience; certain classes of assets are at or past the end of their projected useful service life. While age is not dispositive of the condition of an asset, it is often used to parse the population of assets to identify areas where condition may be a concern. Similarly, while it is not necessarily the case that every asset should be replaced at the end of its projected service life, in some cases the relative age of National Grid's T&D facilities (i.e., power transformers) increases the likelihood that an element will fail when stressed. Thus, an asset's projected service life is sometimes used to identify assets requiring further engineering analysis and, in asset planning, it is a factor that can help predict the volume of assets that will require replacement in the future.

Transmission System

This section provides a detailed condition report of the Company's transmission assets. Overall, the condition of National Grid's bulk power transmission system (345kV and 230kV) is safe and adequate to provide service, though there are issues in each asset class that present condition and obsolescence concerns. Likewise, the 115kV system is generally safe and adequate for service; however there are specific areas of poor condition that are further discussed in this section. Some specific areas of interest are as follows.

Structures

There are nearly 80 steel structures, predominantly on the 115kV system, that are graded at condition levels that require replacement or reconditioning. The overhead line refurbishment strategy will address these structures. Approximately 270 reject and priority reject poles are identified as pending in the Company's Computapole database. The wood pole strategy or ongoing maintenance will address these poles.

Phase Conductors

Conductor, static wire and splice issues and failures pose significant safety, as well as reliability risks. The overhead line refurbishment strategy provides a systematic long-term approach that will address issues related to conductor condition, shield wires and splices. Since the previous filing of this report, a NERC recommendation, first issued on October 17, 2010 and later updated on November 30, 2010, directed utilities to verify conductor clearances based on maximum operating temperature. It further directed utilities to prioritize the evaluation of circuits on a reliability basis over a 3-year period for all bulk facilities. As a result, the Company has utilized LiDAR information collected from the original conductor clearance strategy to verify clearances and take appropriate action which includes re-rating individual lines, temporary measures such as restrictive fencing, structure modifications or replacement, or relocation of conflicting structures below the affected transmission line.

Substations

Several substations have significant condition issues, including; degradation of equipment, obsolete design and equipment and reliability concerns based upon performance. Accordingly, National Grid has approved substation rebuild strategies for Gardenville and Rome and will develop strategies for Dunkirk, Huntley, Rotterdam, Lockport and Lighthouse Hill. In addition, the Company is undertaking a condition assessment for Boonville and Oneida.

Circuit Breakers

A portion of the 115kV system's oil circuit breakers have been identified as needing replacement due to deterioration. The number of oil circuit breaker trouble reports has been trending upward. Sixty-five percent of the nearly 400 oil circuit breakers in service are between 40 years old and 60 years old and ninety percent of these breakers are used on the 115kV system.

Transformers

There are currently sixty-eight power transformers on the transmission system that have been placed on a "watch list" and are being monitored more closely, which can include increased dissolved gas analysis and diagnostic testing. Additional spare units are in the process of being procured to ensure adequate coverage in the event of a failure.

Protection and Controls
National Grid maintains three different relay types on its system for protection and control; electromechanical, solid state and microprocessor designs. There are approximately 14,000 individual protection relays on the transmission system. Approximately 85% of the relay population are electro-mechanical relays which can expect degradation such as worn contacts and frayed insulation of wiring due to heat. In addition, calibration drift was also found in electromechanical and solid state relays, indicating electrical/mechanical component failures (i.e., capacitors, coils, resistors). Further, in solid state relays, there are problems with card failures and obsolescence.

Other asset groups and details of the performance of these assets are provided in Chapter III, along with programs developed to address concerns relating to these assets.

Sub-Transmission System

Elements of the sub-transmission system include overhead and underground segments. With certain exceptions noted in this report, the physical elements of National Grid's sub-transmission infrastructure are safe and adequate, although many sub-transmission assets have been in service for nearly a century.

Inspection and Maintenance program activities generate asset condition information and remediate asset condition issues. Exhibit 4 summarizes program work on the sub-transmission system.

If a significant number of condition concerns are identified on a particular circuit, a detailed engineering review may be conducted leading to a comprehensive line rehabilitation project. Table II-47 (in Chapter II) contains a list of sub-transmission projects completed from July 1, 2010 to June 30, 2011. Future work is identified in the annual five-year capital investment plan.

Overhead System Assets
National Grid has approximately 59,000 wood poles and 3,000 steel towers on its sub-transmission system. Visual inspections carried out this year up to June 30, 2011 indicate over 400 wood poles are in need of replacement within a one to three year timeframe. Based on visual inspections thus far this year, over 30 steel towers require further maintenance or replacement.

Underground System Assets
Underground cables that have been identified as poor performers and verified as being in poor condition continue to be replaced. There are approximately 1,100 miles of sub-transmission cable. Approximately one-half is more than 47 years old and one-third is more than 60 years old.

Distribution System

This section of the report provides a detailed description of the distribution system asset condition, further divided into overhead and underground system assets. With certain exceptions noted in this report, the distribution system is generally in safe and adequate condition to provide electric service. National Grid continues to gather data and monitor assets in a proactive manner to ensure that any adverse trends are identified.

Inspection and Maintenance program activities generate asset condition information and remediate asset condition issues. Exhibit 5 summarizes program work on the distribution system.

Table II-49 contains a list of overhead system distribution projects completed from July 1, 2010 to June 30, 2011. Table II-51 contains a similar list for underground work. Future work is identified in the annual five-year capital investment plan.

Overhead System Assets

This year, through June 30, approximately 180,000 distribution pole inspections were completed, representing approximately 15 percent of the population. Based on these inspections, less than 2 percent of the inspected poles, approximately 2,350 poles need replacement over the next three years. Typically 2%-4% of poles inspected are identified as needing replacement. This equates to over 6,000 poles identified per year as requiring replacement and these replacements are scheduled within a three year horizon.

This year, through June 30, inspections were completed on approximately 26,000 overhead and 4,767 padmount transformer locations. Based on these inspections, less than one percent of the inspected transformers are candidates for replacement. Additionally, the Distribution Line Transformer Upgrade program replaces overloaded transformers or relieves load via the installation of a second transformer. Between July 1, 2010 and June 30, 2011, 826 transformers were installed as part of the upgrade program.

Between January 1 and June 31, 2011, inspections were completed on over 13,000 cutouts. National Grid has identified potted porcelain cutouts for replacement. In the Inspection and Maintenance program for 2011, cutouts identified as potted porcelain were changed from a Priority Level 3 to a Priority Level 2 to facilitate removal of all potted porcelain cutouts by 2013. Of the 13,000 units inspected this year, 4,331 were identified as potted porcelain. Over the last three inspection cycles, 35,995 potted porcelain cutouts have been identified and 24% of those have been replaced. Over 27,000 identified potted porcelain cutouts remain to be replaced.

Underground System Assets

Between January 1 and June 31, 2011, inspections were completed on 1,327 manholes, 15 vaults and 6,407 handholes. The largest single inspection result for manholes was 414 manholes requiring further grounding within one year (Priority Level 2). For handholes, 19 were repaired within one week (Priority Level 1) while 276 (4%) require maintenance or replacement in one to three years. Inspections also noted 70 locations for further manhole or vault roof inspection by Engineering.

Sub-Transmission and Distribution Substations

This section of the report provides a detailed description of the sub-transmission and distribution substations. While generally adequate for providing safe and reliable service, these systems require investment to address condition related degradation in the areas of (1) primary equipment and (2) secondary protection and control cabling insulation.

Indoor Substations

National Grid has thirty-four (34) 23-4.16kV indoor substations in Buffalo and nine substations in other cities that were built in the 1920s through the 1940s which have been targeted for replacement.[1] These stations present a number of reliability and safety concerns. Fifteen substation rebuilds in Buffalo had been completed, and an additional one station was completed between July 1, 2010 and June 30, 2011. The five-year capital investment plan discusses on-going and proposed indoor substation work for the remaining 27 substations.

Metal-Clad Substations

Metal-clad equipment is prone to water and animal ingress which leads to deterioration and possible failures. The Company has utilized advanced testing techniques based on electro-acoustic detection to identify potential issues. The initial review using this technique identified a number of locations where minor repairs or refurbishments are recommended.

Power Transformers

There are currently fifty-five power transformers on the sub-transmission and distribution system that have been placed on a "watch list" and are being monitored more closely. A contingency plan has been identified for transformers on the watch list.

Circuit Breakers

National Grid has approximately 4,100 circuit breakers and 156 spares on the distribution system. Of these, fifty-six circuit breakers were identified for replacement due to obsolescence or poor condition. Additionally, based upon condition and either obsolescence or poor performance, certain families of breakers are targeted for replacement or refurbishment over the next ten years.

Protection and Controls

Similar to the transmission system, many of the in-service relay systems on the sub-transmission and distribution systems are electro-mechanical types that do not support modern fault recording and analysis, and moreover; a number of these relays are no longer supported by the manufacturer, and replacement parts are no longer available.

Other asset groups and details of the performance of these assets and any programs developed to address concerns relating to these assets are provided in Chapter III.

[1] The original indoor substation strategy count of 26 substations did not include substations completed prior to the strategy, nor substations outside Buffalo.

I B. System Capacity and Performance Chapter III

This chapter describes the condition of the transmission and distribution system as it relates to system capacity and performance. Transmission and distribution system capacity and performance issues arise from causes such as changes in system load, changes in bulk power transfers and improvements to system configuration.

Transmission System

National Grid's transmission system comprises transmission lines and substations operating at 115kV, 230kV and 345kV. National Grid had 4,815 circuit miles of 115kV lines, 504 miles of 230kV, and 683 miles of 345kV. These facilities are extensively interconnected with facilities owned by others in New York, surrounding states, and Canada.

With respect to the capacity related performance of the bulk power transmission system, the New York ISO's 2010 Comprehensive Reliability Plan did not identify any reliability needs for the Company's transmission system. This study's results are designed to ensure adequate capability on the major transmission interfaces to support the resource adequacy standards, but does not address local transmission reliability needs or condition problems.

With respect to local transmission reliability needs, this section discusses specific concerns by geographic area served by National Grid. Planned System Capacity and Performance projects that address these concerns are described for each area and when practical these projects are designed to address multiple concerns. For study purposes, the transmission system is divided into eight geographic study areas. The following are some of the most significant issues currently being addressed by National Grid:

- Vulnerability to transmission line overloading and low voltages in western New York.
- Adequacy of the 115kV system in the area north of Rotterdam and North Troy in eastern New York, especially with respect to service to the new Global Foundries (AMD) manufacturing plant at Luther Forest and the associated area load growth.
- [redacted]

Sub-Transmission and Distribution Systems

National Grid's sub-transmission system comprises lines and substations typically operating at voltages at or below 69kV. National Grid had 269 miles of 69kV lines, 333 miles of 46kV lines, 3,741 miles of 34.5kV lines, 541 miles of 23kV lines and 140 miles of sub-transmission lines below 23kV. The Company's distribution system comprises lines and substations operating at 15kV and below. There are approximately 38,200 miles of overhead primary wire and 7,200 miles of underground primary cable[2] on the system supplying nearly 410,000[3] overhead, padmount and underground transformer locations. Additionally, there are nearly 450 substations providing service to customers.

To develop a capital investment plan that meets system requirements and customer needs as effectively and economically as possible, National Grid utilizes an annual capacity planning assessment that involves identifying thermal capacity constraints or inadequate delivery voltages by assessing the capability of the network to respond to normal conditions and contingencies that might occur.

In order to execute the annual assessment, the delivery system is segregated into 41 planning study areas. Several distribution study areas map to each of the transmission study areas. In this chapter of the report, each transmission study area section will include summaries of each related distribution study area including: a quantification of the capacity issues forecasted, a brief overview of concerns, and a list of project proposals to address forecasted concerns. These project proposals are prioritized and evaluated for inclusion in upcoming capital investment plans.

Project proposals to be implemented over a 15 year planning horizon are detailed within each planning study area. These project recommendations include a wide range of possible solutions, including: simple feeder reconfiguration via switching, upgrading an existing circuit by replacing its limiting element, establishing new feeder ties and/or second substation transformers, and brand new distribution substations supplied by the 115kV transmission system.

[2] National Grid will be reporting user entered cable lengths where available. User entered length is generally considered more accurate than "GIS calculated" lengths. The GIS calculated underground cable length is 7,510 circuit miles, matching previous reports.

[3] As mentioned on page II-89 of this report, transformers were reported in the 2010 Report as 448,700. The new, lower number reported here represents a location count rather than a unit count. Location count matches new standardized reporting and will be used going forward.

I C. Organization of the Filing

The remainder of this document is segmented into three chapters. Chapter II - Asset Condition focuses on the details of physical assets on the system and provides further insights into the condition of those assets as they relate to transmission, sub-transmission and distribution. Chapter III - System Capacity and Performance describes in detail the transmission, sub-transmission and distribution systems regarding capacity, reliability and regulatory needs. Chapter IV includes exhibits which support this Asset Condition report.

II. Asset Condition

This chapter reports on the condition of National Grid's Transmission, Sub-transmission, and Distribution assets. Specifically, the report describes physical condition information, where available, on the age profile of assets and an explanation of how the information is used to identify high risk facilities that may require intervention. Where programs are proposed to address specific problem areas, a description of the proposed remedial actions is provided at the end of each system's asset class section.

II A. Transmission System

This section provides a detailed condition report of the Company's transmission assets. Table II-1 provides an inventory of key system elements.

Table II-1
Transmission Asset Types (115kV and above)

Main Asset	Inventory 2011
Steel Structures (Towers and Poles)	20,320
Wood Poles	35,700
Phase Conductor	18,680 miles
Cables	50 miles
Substations (including transmission line locations with motorized switches)	310
Oil Circuit Breakers	360
SF6 Circuit Breakers	350
Other circuit breakers	1
Transformers	510
Batteries	260
Chargers	340
Surge Arrestors	700
Sensing Devices	830
Reactors	10
Disconnect Switches	1390
- Circuit Switchers	260
Relays	13,650

Summary of Condition Concerns

Steel Structures

There are 78 steel structures (383 in 2010) graded at a level requiring investment (Table II-8). There are currently 266 reject wood poles (18 in 2010) (Table II-13). This new number of reject poles now reflects updated Computapole information compared to just the new poles identified by early CY2010 ground line inspections.

Phase Conductors

Conductors, static wire and splice failures pose safety and reliability concerns. The conductor clearance (SG029) and static wire (SG073) strategies were developed to address these concerns. The overhead line refurbishment strategy (SG080) provides a long-term approach designed to address issues regarding conductor condition, shield wires and splices.

Of all the overhead line refurbishment, static wire and conductor clearance projects listed in this document, only five projects involve 230 or 345kV circuits. The rest are all associated with the older 115kV system.

Substations

A few transmission substations have significant number of asset condition issues which will require major refurbishment projects versus individual asset replacement projects. National Grid has approved substation rebuild strategies for Gardenville 115kV and Rome 115kV and is developing strategies for Dunkirk, Huntley, Rotterdam, Lockport 115kV and Lighthouse Hill 115kV.

Circuit Breakers

The oil circuit breaker population is experiencing degradation requiring additional maintenance and creates system reliability and customer service concerns. A ten year circuit breaker replacement strategy was approved in December 2010 to address 87 Oil Circuit breakers which pose the greatest safety and reliability concerns (Table II-28).

Transformers

National Grid has approximately 510 transformers in service (Table II-29). Table II-31 provides a list of 68 transformers (32 of which are 115kV) that are currently being watched. In some instances, further evaluation is necessary to properly understand the condition. Surveillance and regular DGA sampling will enable the Company to prioritize replacement appropriately.

The sections below contain a detailed analysis of certain transmission system assets.

Transmission Overhead System

Overhead Lines

The Company has over 6,000 circuit miles of transmission overhead lines and many of these overhead line assets have been in service for decades. Overhead line assets experience declining reliability as the effects of environmental, mechanical and electrical degradation results in a failure to meet their original design requirements.

The Overhead Line Refurbishment Strategy assures that the Company's transmission lines meet the governing National Electrical Safety Code (NESC) under which they were constructed, requires mitigation when they have a history of failure, or repairs or replacements that follow good utility practice. This will be accomplished through the replacement of deteriorating structures and line components that do not adhere structurally or electrically to the governing NESC or good utility practice. Line refurbishment will occur following an in-depth condition assessment and engineering evaluation of the lines. Actual physical condition and the severity of equipment deterioration determine whether and when overhead transmission refurbishment will proceed.

Many of the existing candidates for refurbishment were initially screened using the five year average reliability statistics published in the Transmission Network Performance Report. A new screening process is under development. This screening process will likely blend (1) the condition based inspection data from the foot patrols, (2) the line importance factor (LIF)[1], and (3) condition related reliability. This new methodology is expected to be finalized during FY2011/12 and implemented with new "refurbishment" projects initiated in calendar year 2012.

In general, the approach for refurbishing overhead lines involves only the replacement of overhead line component deemed to be in poor condition or failing to meet appropriate NESC requirements. If components are unlikely to last at least 15 years, they may also be replaced when justified by an engineering evaluation considering their incremental cost. Condition is determined by an engineering field inspection and, when appropriate, testing and analysis is also performed. For example, samples of older conductors obtained by field crews may be tested to determine loss of strength and ductility. Ground line inspection data may also be analyzed to determine if the NESC strength requirements are still being met.

Before significant levels of line component replacements are pursued, system re-configuration options are reviewed by Transmission Planning. For example, a line upgrade may be considered if transmission planning studies show (1) that a system re-configuration is a better option than a straight one-for-one in-kind replacement or (2) another line might be cost effectively decommissioned as a result of the upgrade. These type rebuilds also typically undergo the scrutiny of an Article VII process requiring aggregate regulatory as well as public review of potential reconfiguration options.

[1] The LIF is defined as an indicator of the relative importance of a transmission line to the overall system as measured by its potential to impact system reliability and security, and by the number of customers and generation capability the line serves. For load circuits LIF factors include system security, number of customers, stranded load, peak load, generation and congestion. For bulk circuits LIF factors include system security, load flow, generation, and congestion.

Unless noted differently, overhead inventory numbers in this section are based upon Transmission Geographic Information System (GIS) extracts. The age profiles presented are based upon information extracted from the Company's Plant Accounting Records.

Condition and Performance Issues
Transmission lines are inspected on a recurring basis as follows.

- Aerial Visual Patrol: Once each year
- Aerial Infrared Patrol: One to three years which varies based upon voltage
- Ground Based (Foot) Visual Patrol: Once every 5 years
- Wood Pole Inspection and Treatment: Once every 10 years (guideline)
- Steel Tower Footing Inspection and Repair: Once every 20 years (guideline)

For ground based visual patrols, problems are input to an inspection database (Computapole) via a hand held computer. For the aerial visual and aerial infrared patrols, problems are input to the inspection database (Computapole) manually. Each problem is given a priority code as follows:

Table II-2
Priority Codes

Priority Code	Required Response
Level 1	Problem must be repaired/addressed within one week
Level 2	Problem must be repaired/addressed within one year
Level 3	Problem must be repaired/addressed within three years
Level 4	Inspection findings "for information only"
Level P	Problem with a corrective action performed at the time of the inspection process

Exhibit 3 summarizes the Inspection and Maintenance program for 2009, 2010, and June 2011.

Exhibit 6 lists specific condition project and related issues for overhead lines that are in Step 0 (Conceptual Engineering) or Step 2 (Final Engineering):

Remedial Actions Performed and Planned

The Overhead Line Refurbishment Strategy (SG080) established a systematic refurbishment approach for addressing overhead lines. This strategy envisions a major asset replacement program projected over a 25 year period.

The initial set of overhead line refurbishment candidates were selected from a list of least reliable transmission lines based on a five year average. These circuits were subjected to an engineering field survey to identify the existence of physical deterioration and to classify the level of that deterioration (Level 1 through 4). Only circuits with Level 1 through 3 physical deterioration levels identified during the field survey remain candidates for refurbishment. As mentioned earlier, a new screening process is under development. This screening process will likely use (1) condition based inspection data from the foot patrols, (2) the line importance factor (LIF), and (3) condition related reliability. This new methodology is expected to be finalized during FY2011/12 and implemented with new "refurbishment" projects initiated in calendar year 2012.

The following overhead line refurbishment projects are underway or recently completed.[2]

Table II-3
Existing Line Refurbishment Projects

Project Number	Driver Strategy	Title[3]	Voltage	Typical Installation Date (Before)
C03389 & C34193	SG080	Gardenville-Dunkirk 141-142 T1260-T1270 ACR	115kV	1930s
C03417	SG080	Lockport-Mortimer 111 T1530 ACR	115kV	1906
C04718	SG080	Gardenville-Homer Hill 151-152 T1950-T1280 North ACR	115kV	1920s
C21694	SG080	Spier-West 9 T5770 ACR	115kV	1920s
C24359	SG080	Browns Falls-Taylorville 3-4 T3080-T3090 ACR	115kV	1920s
C24361	SG080	Taylorville-Moshier 7 T3340 LER	115kV	1925
C24360	SG080	Coffeen-Black River-Lighthouse Hill 5 T2120	115kV	1940s

[2] Excluding lightning enhancement projects see Table II-8.
[3] Note that ACR stands for Asset Condition [and Reliability] Refurbishment and LER for Life Extension Refurbishment.

The following projects are in conceptual engineering. During this part of the process an engineering condition evaluation, which includes a field survey, will be completed. Based upon this condition assessment, an appropriate refurbishment scope and schedule will be determined.

Table II-4
Line Refurbishment Projects in Conceptual Engineering

Project Number	Driver Strategy	Title	Voltage	Typical Installation Date
C03422	SG080	Lockport-Batavia 112 T1510 ACR	115kV	1930s-40s
C27425	SG080	Gardenville-Homer Hill 151-152 T1950-T1280 South ACR	115kV	1920s
C27422	SG080	Falconer-Homer Hill 153-154 T1160-T1170 ACR	115kV	1930s
C27437	SG080	Taylorville-B 5-6 T3320-T3330 ACR	115kV	1920s-30s
C27436	SG080	Packard - Gardenville 180-182 T1660-T1780 ACR	115kV	1930s
C27429	SG080	Homer Hill-Bennett Rd 157 T1340 ACR	115kV	1950s
C30890	SG080	Porter-Rotterdam 31 T4210 ACR	230kV	1940s
C30889	SG080	Pannell-Geneva 4-4A T1860 ACR	115kV	1900s-1920s
C36164	SG080	Colton - Browns Falls 1-2 T3140-T3150 ACR	115kV	1920s
C39487	SG080	Ticonderoga 2-3 T5810-T5830 SXR [C19530] Completion	115kV	1920s-30s

The following projects are proposed to begin conceptual engineering. As of this time, project scopes, estimated costs, and construction schedules have not been determined. Before formal initiation, the following projects will undergo a new screening process (under development) that is expected to use (1) condition based inspection data from the Computapole inspection patrols, (2) the line importance factor (LIF), and (3) condition related reliability. This methodology is expected to be implemented with new "refurbishment" projects initiated in calendar year 2012.

Table II-5
Planned Line Refurbishment Projects

Project Number	Driver Strategy	Title	Voltage
CNYAS57	SG080	Lake Colby - Lake Placid 3 T3210	115kV
CNYAS60	SG080	Gardenville - Buffalo Sw 145-146 T1210-T1220 ACR	115kV
CNYAS88	SG080	Gardenville - Depew 54 T1230 ACR	115kV
CNYAS75	SG080	Gardenville - Dunkirk 73-74 T1240-T1250 ACR	230kV
CNYAS51	SG080	Huntley - Praxair 46 T1420 ACR	115kV
CNYAS53	SG080	Huntley - Lockport 36-37 T1440-T1450 ACR	115kV
CNYAS56	SG080	Indeck Oswego - Lighthouse Hill 2 T2300 ACR	115kV
CNYAS70	SG080	Lighthouse Hill - Clay 7 T2320 ACR	115kV

CNYAS62	SG080	Dunkirk - Falconer 161 & 162 T1090-T1100	115kV
CNYAS86	SG080	Coffeen - Black River 5 T3120	115kV
CNYAS58	SG080	Hook Road - Elbridge 7 T6150 ACR	115kV
CNYAS48	SG080	Boonville - Porter 1-2 T4020-T4030 ACR	115kV
CNYAS55	SG080	Boonville - Rome 4 T4040 ACR	115kV
CNYAS54	SG080	Boonville - Rome 3 T4060 ACR	115kV
CNYAS77	SG080	Porter - Rotterdam 30 T4200	230kV
CNYAS85	SG080	New Scotland - Alps 2	345kV
CNYAS76	SG080	Rotterdam - Bear Swamp E205 T5630 ACR	230kV
C39521	SG080	Ticonderoga Lines 2-3 T5810-T5830 ACR[4]	115kV
CNYAS50	SG080	Warrensburg - Scofield Road 10 T5880 ACR	115kV
CNYAS87	SG080	Sleight Road - Auburn 3 T2560	115kV

Reliability improvements resulting from the aforementioned overhead line refurbishment strategies will be gradual and long term in nature. When practical, maintenance activities will be implemented in parallel with long term line refurbishment projects with the intent of reducing short term decreases in reliability. An increased focus on the 40 worst performing circuits using the transmission performance considers such as activities as comprehensive aerial inspections, improved grounding and increased infrared inspections. Generally, these are evaluated on a line by line basis for the 40 worst performing circuits.

This overhead line refurbishment strategy targets both wood pole and steel structure lines. Standard refurbishment categories have been established: safety, life extension, and full refurbishments. Life extension refurbishments seek to improve reliability and extend the useful life of a line on the order of 15 years. Safety refurbishments seek to safely secure a line for approximately 5 years until a more comprehensive refurbishment or replacement project can be completed. A safety refurbishment is often pursued when imminent potential safety concerns need to be addressed and will sometimes precede more comprehensive Article VII or Part 102 refurbishments. More comprehensive refurbishments will be based upon condition and typically are targeted to reliably last more than 15 years.

[4] These circuits are currently undergoing a short-term safety refurbishment ahead of a proposed full refurbishment.

New Scotland – Leeds – Pleasant Valley Transmission Corridor

The Company completed a condition assessment report on the transmission corridor between New Scotland – Leeds – Pleasant Valley. [redacted] This report reviewed issues that may impact this corridor's reliability performance such as:

- opportunities for reducing exposure to cascading Type 3A/3B structure failure;
- opportunities for reducing the number of transmission crossings;
- tensile and torsional ductility tests on phase conductors;
- assessment of lightning performance; and
- wind analysis to determine whether the current design criterion is still valid.

The following action items were recommended in the report:

- Conductor Condition – Tests on samples of conductor demonstrated that the conductor for the New Scotland – Leeds – Pleasant Valley lines may remain in-service for the foreseeable future. The Company will continue to monitor the condition of these conductors as opportunities arise in any during future projects on these lines.
- Splice Condition - Infrared measurements should continue on a six month basis. The measurements should be assessed to determine if any actions are necessary to improve line performance.
- Shield Wire Condition - Further attempts should be made to secure shield wire samples for laboratory analysis and any actions should be decided based upon the results. In addition, close-up visual inspections should be performed on all shield wire fittings and that all worn fittings are replaced over the next 3 to 5 years.
- Steelwork and Foundation Condition - The towers should be painted within the next 5 years to maintain their condition. The 15 foundations which have a condition rating of 5 or greater should be replaced within the next 5 years.
- Insulator Condition - Insulator samples should be obtained during maintenance work or future construction projects. Such samples can be used to test insulator basic insulation levels (BIL), surface contamination, overall integrity, and other appropriate tests.
- Exposure to Cascading Structure Failure - The introduction of a dead-end structure at every 16th tower location is recommended. Additionally, a tower "shakedown" (which includes tower climbing inspection and repair of all loose and missing members on towers) should be performed on the remaining structures. (This is being done.)

- Reducing the Number of Transmission Crossings - In order to mitigate the risk of failure at these locations, it is recommended that 14 3A and 3B towers be replaced with steel H-frame suspension structures. Concurrently, the structures at the Hudson River crossing should also be considered for replacement based upon the overall deteriorating condition of these structures.

- Wind Analysis – The analysis of wind speeds in this area determined that the current design specification for withstanding 90 mph winds is adequate in this region.

While these findings continue to be evaluated; some of them have been implemented (such as tower "shakedown" climbing inspections and repairs and infrared inspections of splices). Transmission Planning is also evaluating the merits of installation of a third line for the Leeds-Pleasant Valley part of this transmission corridor. Depending upon the outcome of this evaluation, appropriate recommendations on how to proceed is expected during the conceptual engineering phase of C07918, New Scotland-Leeds 93-94 T5480-T5490 Refurbishment, and C08017, Athens/Leeds-Pleasant Valley 91-92 T5320-T5330 Refurbishment. At that time, SG032 on the design approach for the NY 345kV lines using type 3A-3B towers will be updated. Conceptual Engineering work has been started in FY2011/12. The first part of this effort involves the analysis of wind patterns and speeds to determine the likelihood of these towers to be exposed to winds that could cause structure failures.

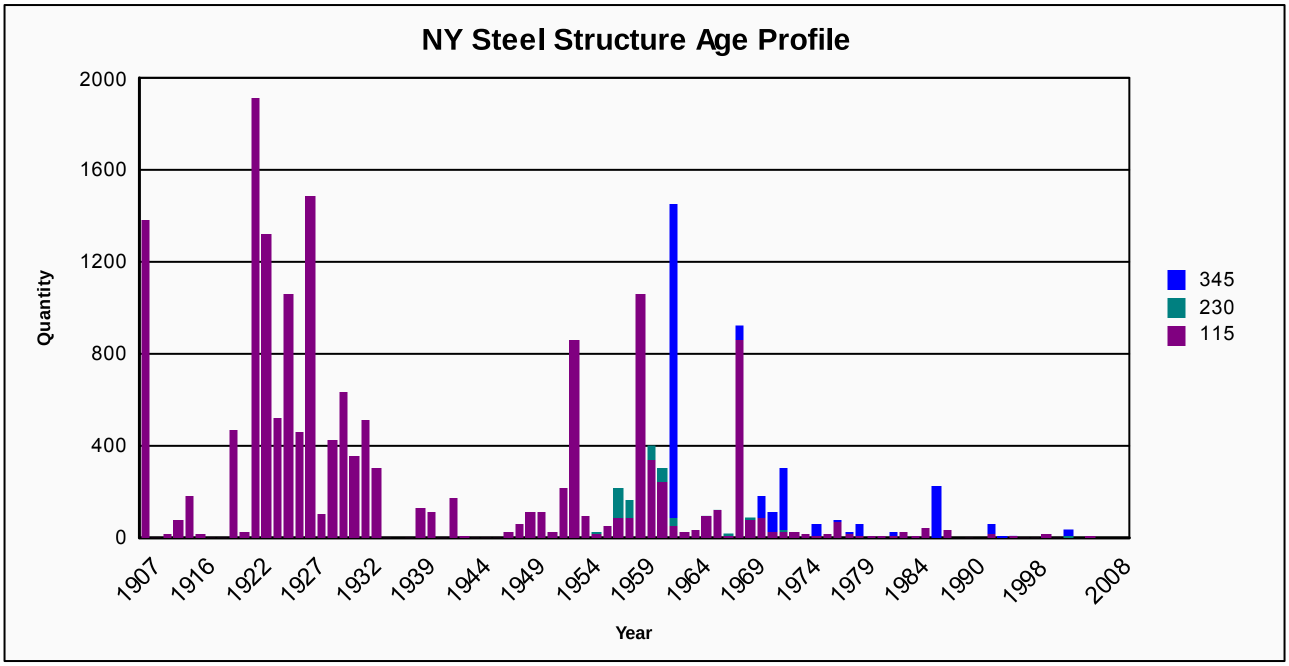
Summary

The Company has identified circuits that require refurbishment to improve their reliability performance or address concerns over reliability performance or safety. The Company has a program in place to assess the condition of the assets and determine the scope of refurbishment from that assessment.

Steel Structures

Based upon plant accounting records, the age distribution of steel structures is given in Figure II-1. A significant portion of these assets are 70 years (installed in 1939) to 103 years (1907) old.

Figure II-1



Prior editions of the asset condition report discussed the ratings of towers in the Mott MacDonald evaluation of towers. From these results, the Company has identified transmission lines primarily consisting of steel towers that will be considered for future refurbishment projects.

Table II-6
Potential Projects Based Upon the Mott MacDonald Aerial Photography Evaluation

LIF Order[5] (Risk Rank)	Circuit IDs		Line
[redacted]	T2090		Clay - Teall #10
[redacted]	T5180	T5230	Greenbush - Hudson #15 & Hudson - Pleasant Valley #12
[redacted]	T2270		Geres Lock - Solvay #2
[redacted]	T2320		Lighthouse Hill - Clay #7
[redacted]	T4260		Terminal - Schuyler #7
[redacted]	T1090	T1100	Dunkirk - Falconer #161 & 162
[redacted]	T1380		Huntley - Gardenville #38
[redacted]	T1850		Packard - Urban(Erie St.) #181
[redacted]	T5070		Bethlehem - Albany #18
[redacted]	T2290		Geres Lock - Tilden #16
[redacted]	T5750	T5760	Spier - Rotterdam #1 & 2

As shown in Table II-6 (above), a number of projects have been tentatively identified for further review and field evaluation.[6] Table II-7 (below) provides recommendations for further work also. However, aerial photographs were not taken on these lines. As of this time, project scopes, estimated costs, and construction schedules have not been determined. This information will be determined during the conceptual engineering process for each project.

Table II-7
Potential Steel Tower Driven (SG018) Refurbishment Based Upon Mott MacDonald Evaluations of Inspection Data

Circuit IDs		Line
T2270		Geres Lock - Solvay #2
T1590	T1600	Mortimer-Pannel 24 & 25

Field inspection data has also been gathered for steel structures and recorded in Computapole. Condition ratings for steel structures are categorized by the following scale:

1-Serviceable
2-Intact
3-Light Corrosion
4-Light Pitting
5-Significant Pitting
6-Very Severe Deterioration

[5] Sequential order is based upon the relative Line Importance Factor (LIF) at the time of the study
[6] These projects are identified as CNYAS in the tables.

Over an approximately 5 year time frame (through mid-July 2011), a total of 13,753 steel structures have current visual grading levels entered into Computapole.

Table II-8
Steel Structure Visual Grades

Steel Towers	Visual Grade	Inspection Results	
Visual Grade	**1**	7,657	55.7%
Visual Grade	**2**	2,246	16.3%
Visual Grade	**3**	2,572	18.7%
Visual Grade	**4**	1,200	8.7%
Visual Grade	**5**	78	0.6%
Visual Grade	**6**	0	0.0%
Total		13,753	

An appropriate priority code (see Table II-2) is also assigned with each visual grade when a steel structure is inspected. Towers in worse condition would be coded visual grades 5 and 6. The Company maintains an open project to replace or repair steel towers with Visual Grade 6 after they are identified.

Recent Computapole inspection results indicate that the overall condition of steel structures in New York may be better than initially assessed (in the 2004 and 2005 steel tower assessments performed by Mott MacDonald). However, transmission lines with significant levels of Visual Grade 4 and 5 should be targeted for a more comprehensive engineering inspection and analysis. This type of analysis frequently uses more thorough analysis considering overall structural integrity and identifies when severe corrosion may be at key support points.

Condition and Performance Issues

Fortunately, steel tower failures do not frequently occur. However, over the last 10 years, a number of steel tower failures on the New York Transmission system attributable to poor condition have occurred which demonstrates the need to evaluate this asset class:

- April 2011 – Tower 133 failed on the T1780 Packard-Gardenville 182 line. This structure failed due to a combination of a bent primary leg member, a detached reinforcement member due to deterioration, and above average winds.

- March 2009 - the T2240 GE–Geres Lock 8 115kV circuit tripped and locked out due to the failure of tower #435. Tower #435 is a square based steel lattice tangent suspension tower. The failed tower was located in a detention pond at a former chemical manufacturing plant in approximately four feet of water. Thus, the base of the tower could not be removed for examination. The water limited the effectiveness of routine inspections and the initiation of appropriate actions. An interim inspection of the structures was done during the replacement of Tower 435 and the line appropriately secured. However, access was limited; a long term project will more comprehensively assess the condition of the remaining structures.

- October 2006 – Steel tower 96 on the T1260-T1270 Gardenville-Dunkirk 141-142 failed due to a combination of a deteriorated steel based and poor weather conditions.

- June 2004 - the 115kV Gardenville-Homer Hill 151 line, tripped and locked out due to failed cross arms on two towers.

- February 2004 - a line mechanic climbing on a tower on the Niagara-Gardenville 180 line nearly fell when a corroded steel support gave way

- September 2003 - National Grid replaced a deteriorated steel tower on the 115kV Gardenville-Homer Hill 151-152 transmission line.

- April 2003 - a tower on the Pannell-Geneva 4-4A 115kV Line in Western NY toppled during an ice storm. Deterioration at the base of the tower contributed to this failure.

Remedial Actions Performed and Planned
As a result of the Mott MacDonald study, the Company's Steel Tower Strategy (SG018) concentrated initially on critical crossings and the circuits believed to be in the worst condition. Based upon engineering field walk-downs conducted by Transmission Line Engineering, Project Funding Order C04636 resulted in a total of 171 structures being replaced throughout upstate New York. These replacements were done in calendar years 2006 through 2009.

The South Oswego- Lighthouse Hill project scope includes 38 structure replacements, some of which are critical crossing structures. Due to outage constraints on these lines, replacement of the critical crossing structures was combined with project C21693 (S. Oswego-Lighthouse Hill Circuits). Interim measures were taken to temporarily reinforce and secure these towers.

Table II-9 shows active refurbishment projects under the Steel Tower Strategy.

Table II-9
Existing SG018 Driven Projects

Project Number	Driver or Strategy	Title[7]	Projected Construction FY
C21376	SG018	Packard-Urban 181 T1850 STR	Safety Refurbishment Only (Completed)
C21692	SG018	Niagara-Packard 191 STR	Cancelled (Note 1)
C21693	SG018	S Oswego - Lighthouse Hill Circuits T2630-T2300-T2220-T2610	In-progress

Note 1 - Funding Project C21692 was cancelled following a ground based engineering field walk down of the Niagara-Packard 191 line which found the steel towers to be in good structural condition. C21376 was reduced to a safety project in anticipation of the

[7] Note that STR stands for Steel Tower Refurbishment and ACR for Asset Condition [and Reliability] Refurbishment.

potential Transmission Planning work on this line. As a result of the cancellation of the Tonawanda and Frontier projects, potential additional work on this line is being considered.

The following projects in Table II-10 are in conceptual engineering:

Table II-10
Existing SG018 Driven Projects in Conceptual Engineering

Project Number	Driver or Strategy	Title	Voltage
C27432	SG018	Mountain-Lockport 103 T1620 and Beck-Lockport 104 T1060 STR	115kV
C27431	SG018	Lockport-Batavia 108 T1500 STR	115kV

During this part of the process an engineering condition evaluation which will include field walk-down will be completed. Based upon this condition assessment, an appropriate refurbishment scope and schedule will be determined. When possible, life extension refurbishment projects will be utilized to minimize overall costs.

The following projects are being considered for initiation of conceptual engineering.

Table II-11
Planned SG018 Driven Projects

Project Number	Strategy	Title	Voltage (kV)
CNYAS63	SG018	Huntley-Gardenville 38 & 39 T1380-T1390 ACR	115
CNYAS66	SG018	Mortimer - Pannell Road 24 & 25 T1600 ACR	115
CNYAS67	SG018	Clay - Teall 10 T2090 ACR	115
CNYAS68	SG018	Geres Lock - Solvay 2 T2270 ACR	115
CNYAS69	SG018	Geres Lock - Tilden 16 T2290 ACR	115
CNYAS70	SG018	Lighthouse Hill - Clay 7 T2320 ACR	115
CNYAS71	SG018	Bethlehem - Albany 18 T5070 ACR	115
CNYAS72	SG018	Greenbush - Hudson 15 T5180 STR - ACR	115
CNYAS73	SG018	Hudson - Pleasant Valley 12 T5230 STR - ACR	115
CNYAS74	SG018	Mohican-Battenkill 15 T5430 ACR	115
QUEUE	SG018	Mountain-Lockport 103 ACR	115
QUEUE	SG018	Terminal - Schuyler 7 T4260 ACR	115
QUEUE	SG018	Packard - Urban(Erie St.) 181 T1850[8]	115
QUEUE	SG018	Spier - Rotterdam 1 & 2 T5750-T5760[9]	115

[8] C21376 was an interim safety refurbishment but long term work is still required
[9] Potential refurbishment follow-up work on the portion of the line not impacted by the Luther Forest initiative

The following prospective project is being considered based upon failure analysis performed by Transmission Line O&M Engineering:

Table II-12
Failure Analysis Driven Steel Tower Projects

Project Number	Failure Analysis	Title	Voltage
QUEUE	FA0033	GE - Geres Lock 8 T2240	115

The Steel Tower Painting and Replacement Strategy (SG052) provides guidance for the painting and replacement of steel structures. In FY2005/06, this strategy looked at the long-term steel tower replacement needs for the remainder of circuits not covered by the Steel Tower Strategy. A 15-year interim painting program was subsequently initiated. This painting program was suspended in FY2009/10 and attempts are being made to resume it. Assuring worker safety during live line painting has been the main driver for suspending this program. The impact on the interim 15-year painting cycle will need to be assessed. However, it is unlikely that the transmission system will be entirely repainted in this timeframe.

In addition to the painting program, Transmission facilities undergo a 20 year footer inspection and repair program. This program systematically inspects foundation above and below grade and repairs damage, primarily on a line-by-line basis.

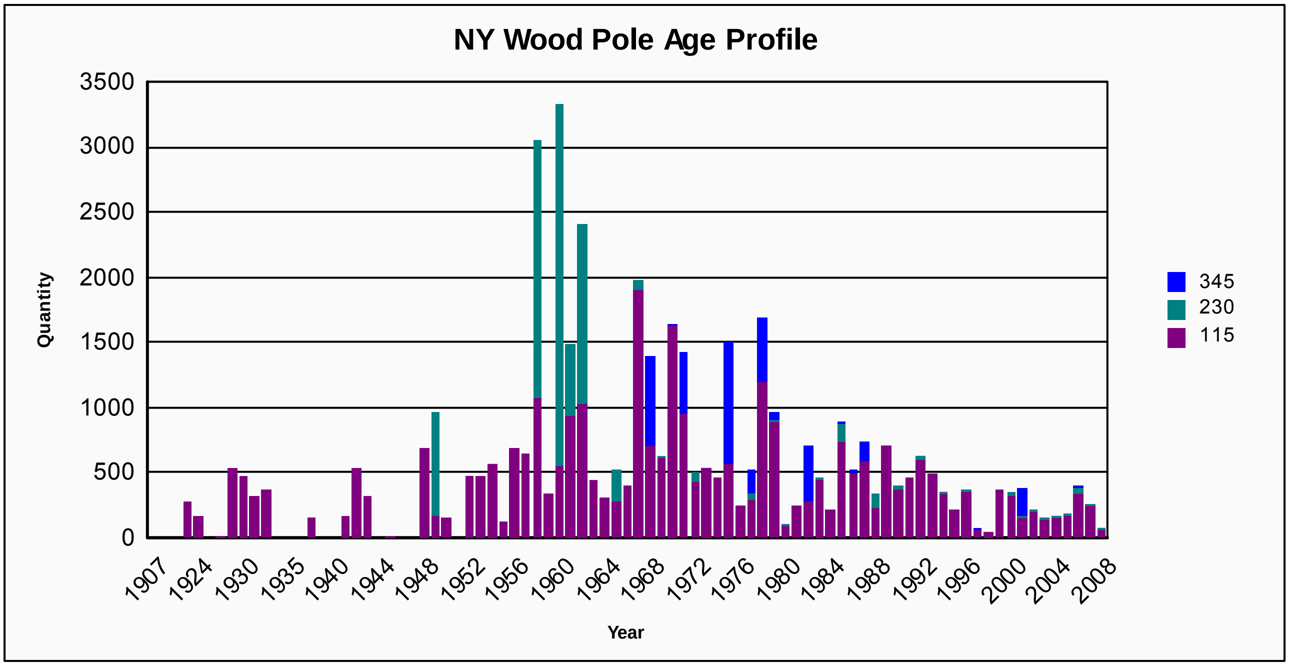
Summary

Deterioration of steel structures continues to present challenges. While structural failures have been relatively rare, these failures pose public safety risks that need to be minimized. The steel tower strategy, steel tower painting and replacement strategy SG052, overhead line refurbishment strategy SG080, and the inspection and maintenance program of the Company provide a multi-faceted and cost effective approach to address these challenges.

Wood Poles

The age profile of transmission wood poles is provided in Figure II-2.

Figure II-2



Condition and Performance Issues

National Grid inspects and treats the ground line of wood poles and structures on a 10 year cycle. In addition, routine visual inspections of the entire structure are conducted once every five years. Wood poles and structures that fail to meet the requirements of the NESC are classified as “rejects.” Severely deteriorated wood poles and structures are classified as “priority rejects.”

In general, reject poles and structures have two-thirds or less of their original design strength. The greatest risk from reject poles and structures is the likelihood of failure during severe weather conditions. Failures can hamper service restoration efforts, increase outage durations and raise public safety concerns.

Priority reject poles and structures potentially can fail during “normal” weather conditions. For this type of reject pole, the residual strength may be below one-third of its original design strength. It is important to replace these poles and structures expeditiously as the safety and reliability risks from priority rejects are significant.

An increasing population of woodpeckers is contributing to an increase in damage on wood poles. A US Geological Survey map shows that the pileated woodpecker population has increased in the Northeast at a rate greater than 1.5% each year from 1966-2003[10]. Wood pole and structure inspection criteria (per Strategy SG009, Version

[10] US Geological Survey (USGS) website: http://www.mbr-pwrc.usgs.gov/bbs/htm03/trn2003/tr04050.htm

2) were implemented at the end of 2007. As woodpecker damaged poles are identified, an appropriate priority code (i.e., maintenance code 526) and repair timeframe (generally within three years) is assigned. Progress is then tracked on an overall basis via Computapole monitoring.

Chemanite treated poles were installed on the Dennison – Colton #4 line in 2004 as a pilot program to ward off woodpeckers. Unfortunately, woodpeckers returned to these poles indicating Chemanite was not a successful solution to this problem.

Below is a brief summary of key pole failures that occurred over recent years:

- April 2011 - structures 62 through 69 on the T1690 Niagara – Lockport 101 Line failed during strong wind gusts. The wood structures were installed around 1982. Structure 63 is believed to have failed due to combination of some deterioration when combined with the strong wind gusts. The other structures failed as a consequence of the first failure.

- July 2010 - six consecutive structures failed on the Black-River Taylorville 1 & 2 T3050-T3060 115kV transmission line failed. Five of these structures (155½, 156, 156½, 157, and 158) were wood structures and one structure (155) was steel. The steel structure was installed in 1925 and the wood structures were installed in 1974. The cause of the structure failure was wood deterioration and wind.

- June 2009 - the T6400 South Oswego–Clay #4 115kV line tripped and locked out due to the static wire making phase contact as the result of a pole top failure.

- February 2009 - a pole fire at structure #574 on the Porter – Rotterdam #30 line lead to a cross-arm failure which resulted in a line lockout.

Deteriorating wood cross arms is a potential issue that is being monitored. Below is a brief summary of recent wood cross-arm failures:

- November 2009 - The T1210 Gardenville-Buffalo River Switch 145 line tripped and locked out at tower #19 due to a cross arm failure. This failure appears to be a one off event since this is the only recorded failure of a cross-arm on this line.

At this time, the frequency of wood cross arm failures is insufficient to warrant an accelerated replacement program.

Remedial Actions Performed and Planned

A comprehensive wood pole management strategy ensures ground line "reject" poles, woodpecker damaged poles, insect, and rotting wood structures are replaced in a timely manner.

Management of the Company's large stock of in-service wood poles requires more than the wood pole management strategy, particularly with increasing average age profile.[11]

Table II-13
Reject Poles Totals (Pending Replacement in Computapole)

Division	Identified Priority Rejects	Identified Rejects	Total
Totals	43	223	266

During CY2009 and CY2010, an assessment of specific pole failures was studied by Transmission Line Operations and Maintenance Engineering:

- An incident analysis (IA) was performed on the T1690 Niagara-Lockport 101 failure. The IA concluded that the most logical conclusion from observations and calculations associated with is that the deterioration in structure 63 created a point of weakness on the line. When the high winds created large transverse loads on the structure it failed and the adjacent structures did not have adequate capacity to share the increased loading on them thus also failed (ultimately, structures 62 through 69). Once the load had been spread adequately to the adjacent structures, the line remained upright.

- Transmission Line Services evaluated the condition of the T6400 South Oswego – Clay 4 pole following the June 2009 failure and determined it to be in good condition. Failure Analysis FA0040, dated July 2009, indicated that this appears to be a one off event and not indicative of a systemic issue with this line.

- Transmission Line Services replaced a pole and cross arm following the T4200 Porter–Rotterdam #30 pole fire. Failure Analysis FA0031, dated March 2009, noted that pole fires "tend to occur after extended periods of wet weather."[12] An accepted theory is that "resultant charging current of the air coupling capacitance between the pole and the phase conductors uses the electrical conductance of the wet pole wood as a path to ground." Current densities tend to be highest near down lead fasteners and unbonded hardware. This can elevate temperatures at these locations resulting in pole fires. Unbonded hardware and down lead fasteners which are spread too far apart are susceptible. A period of heavy soaking rains occurred in this area on February 22, 2009. Extreme pole fires such as this one can result if heating occurs in

[11] As seen in Figure II- 2 (NY Wood Pole Age Distribution) and discussed in Strategy Paper SG009 (version 2)

[12] G. E. Lusk and S.T. Mak, "EHV Wood Pole Fires: Their Causes and Potential Cures," IEEE Transactions on Power Apparatus and Systems, Vol. PAS-95, no. 2, March/April 1976

an area where ample oxygen is present such as at a pole check creating a "Chimney Effect."[13] However, most pole fires are typically minor and some go unnoticed.

- Seven structures (154½ new, 155, 155½, 156, 156½, 157, and 158) were installed to replace the six structures that failed on the Black-River Taylorville 1 & 2 T3050-T3060 115kV transmission line on July 28, 2010. An incident analysis is being completed in regard to this failure and recommended programmatic actions are being developed. A list of wood poles identified out of Computapole is being checked against the wood poles that undergo ground line inspections (by Osmose). Those identified in Computapole but not included in the ground line inspection database are now being scheduled for examination.

Summary

Maintaining a low volume of "reject" poles is important to provide safe and reliable service. Wood pole management strategy seeks to replace "priority rejects" within one year of identification and "rejects" within three years of identification.

The Overhead Line Refurbishment Strategy is complimentary to the wood pole management strategy. Both strategies manage wood pole structures as the wood pole population deteriorates. As the wood pole population ages, the percentage of "rejects" is expected to increase. A separate, comprehensive line refurbishment effort based upon condition of a line is the recommended approach for mitigating an aging wood pole structure population.

[13] Dr. G. L. Johnson and B. F. Walraven, "Tentative 'Cure' for Transmission Pole Fires," Transmission and Distribution, October 1973

Foundations

Computapole field inspection data has been gathered on both steel and concrete foundations. Condition ratings for steel foundation types are categorized by the following scale:

1. Serviceable
2. Intact
3. Light Corrosion
4. Light Pitting
5. Significant Pitting
6. Very Severe Deterioration

Concrete foundations are categorized by the following scale:

1. Serviceable
2. Light deterioration
3. Medium deterioration
4. Severe deterioration
5. Very severe deterioration

It should be noted that the results provided in Tables II-15 and II-16 from standard Computapole field inspections, which are above the ground line, may differ from those inspections performed by the footer inspection and maintenance program which inspect the foundations below the ground line and repair those that are defective.

Table II-14 and II-15 includes inspection results over approximately 5 years (through mid-July 2011) on 13,753 steel structures that had foundation ratings. An appropriate priority code is assigned when a foundation is inspected.

Table II-14
Steel Foundation Inspection Results

Steel Foundations		Inspection Results	
Visual Grade	**1**	5,841	63.0%
Visual Grade	**2**	2,283	24.6%
Visual Grade	**3**	834	9.0%
Visual Grade	**4**	304	3.3%
Visual Grade	**5**	10	0.1%
Visual Grade	**6**	3	0.0%
Total		9,275	

Table II-15
Concrete Foundation Inspection Results

Concrete Foundations		Inspection Results	
Visual Grade	**1**	3,614	80.8%
Visual Grade	**2**	721	16.1%
Visual Grade	**3**	99	2.2%

Visual Grade	**4**	32	0.7%
Visual Grade	**5**	8	0.2%
Total		4,474	

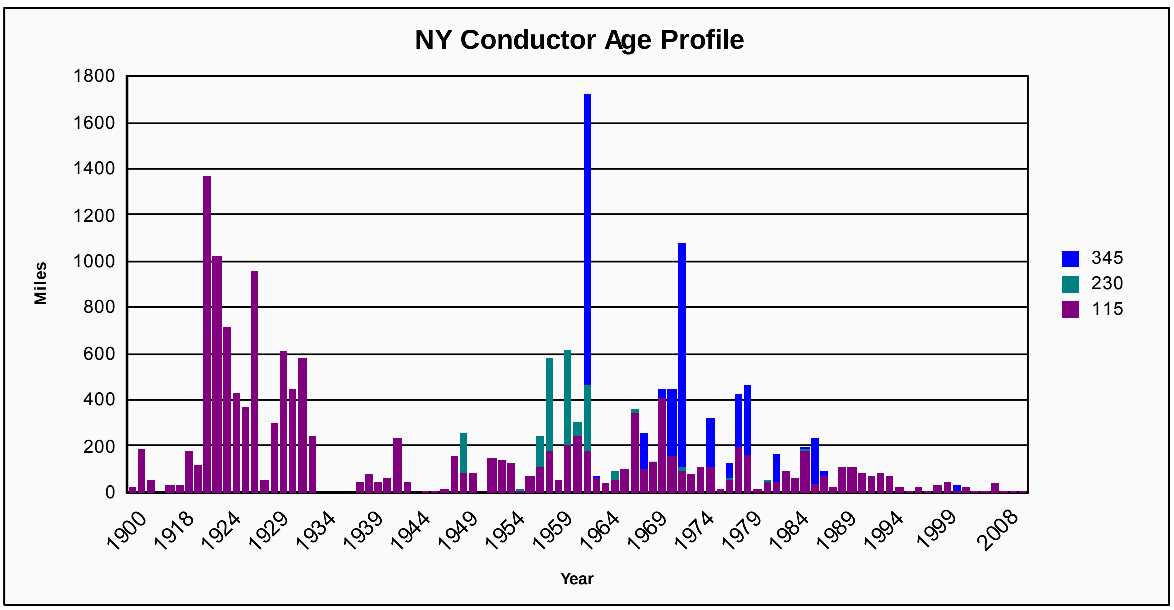
Steel grillage foundation usage started in the 1920s. This type of steel foundation comprises the majority of lattice structure foundation types.[14] However, some of the lattice towers employ a battered type concrete foundation which has a limited amount of concrete exposed above the ground line.[15] The remaining foundations are associated with steel poles and tend to be reinforced concrete—in the order of five to 10 percent.

Phase Conductor and Shield Wire

The phase conductor and shield wire asset group includes conductors, shield wires and splices. There are 18,687 conductor miles across the service territory at voltage levels 115kV and greater based on Company plant accounting records. Specific inventory information regarding miles of static wires and splices are not available at this time.

Figure II-3 shows the age profile of conductors in the service territory by voltage. Many thousands of miles of conductors are between 70 years old (installed in 1939) and 110 years old (1899). The 115kV network is by far the oldest, with the oldest circuits being over 100 years old.

Figure II-3

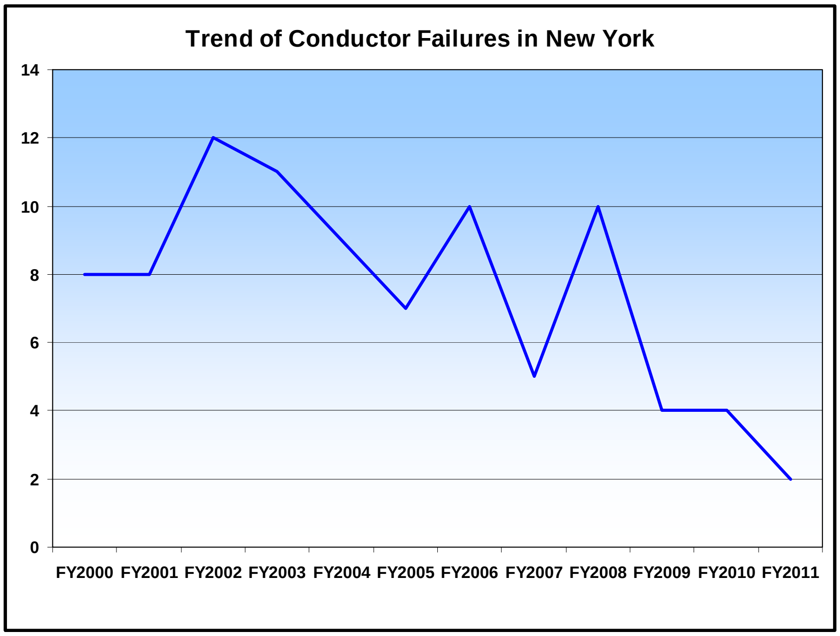


Condition and Performance Issues

The trend of conductor failures from FY1999/00 to FY2010/11 appears to be consistently declining in the direction of fewer failures (Figure II-4).

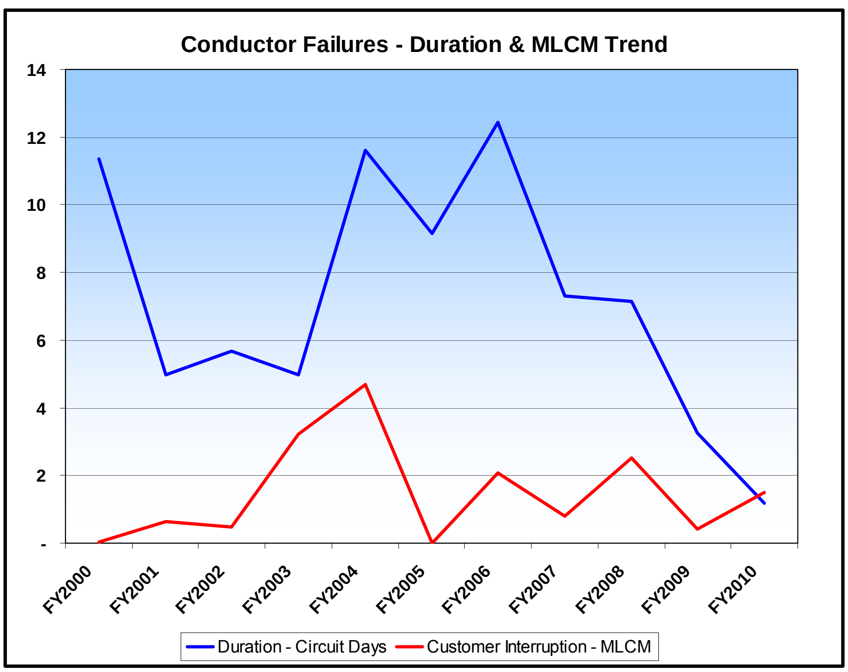
[14] Approximately 80 to 90 percent of steel structures in New York
[15] Approximately five to 10 percent that were constructed prior to the use of the steel grillage design

Figure II-4
Transmission Conductor Failures Long Term Trend



The total outage duration due to conductor failures shown in Figure II-5 broadly follows the trend of failures, but the lost customer minutes trend shows much greater variability.[16]

Figure II-5
Lost Customer Minutes Due to Conductor Failures



[16] Ranging from no loss of customer minutes to significant levels in millions of lost customer minutes, MLCM

The percent contribution to system outages from conductor failures has also risen over the past six years, though this failure mode is still low.

Table II-16 below lists those circuits where more than two phase conductor failures have occurred between FY2007 and FY 2011; this may be an indication that conductor condition might be a concern.

Table II-16
Lines with Multiple Phase Conductor Failures FY2007 to FY2011

ID	Line	Number of Failures
T5760	Spier - Rotterdam 2	4
T1860	Pannell(Sta.122) -Geneva(Border City) 4	2
T4040	Boonville-Rome 4	2
T5940	Feura Bush - North Catskill 2	2

As part of the Northeast Reinforcement Project, reconductoring of some of the Spier-Rotterdam 2 line has occurred and may improve the conductor failures. The Pannell-Geneva 4 line has a refurbishment project in Step 0 (Conceptual Engineering). A placeholder has been allotted for a future assessment of the Boonville-Rome 4 line. The remaining circuit, Feura Bush-North Catskill 2 will be monitored.

Below are summaries of the recent conductor failures that underwent a failure analysis:

- July 2009 - the T5640 Rotterdam – Curry Rd 11 line tripped and locked out due to a conductor failure. Line patrol personnel observed that the conductor broke inside of the suspension clamp at structure #31. Conductor testing is being considered for this line.

- February 2009 - the T1860 Pannell–Geneva #4 115kV circuit tripped and locked out due to a conductor failure. The failure occurred between tower #369 and #370 near a suspension tower attachment point.

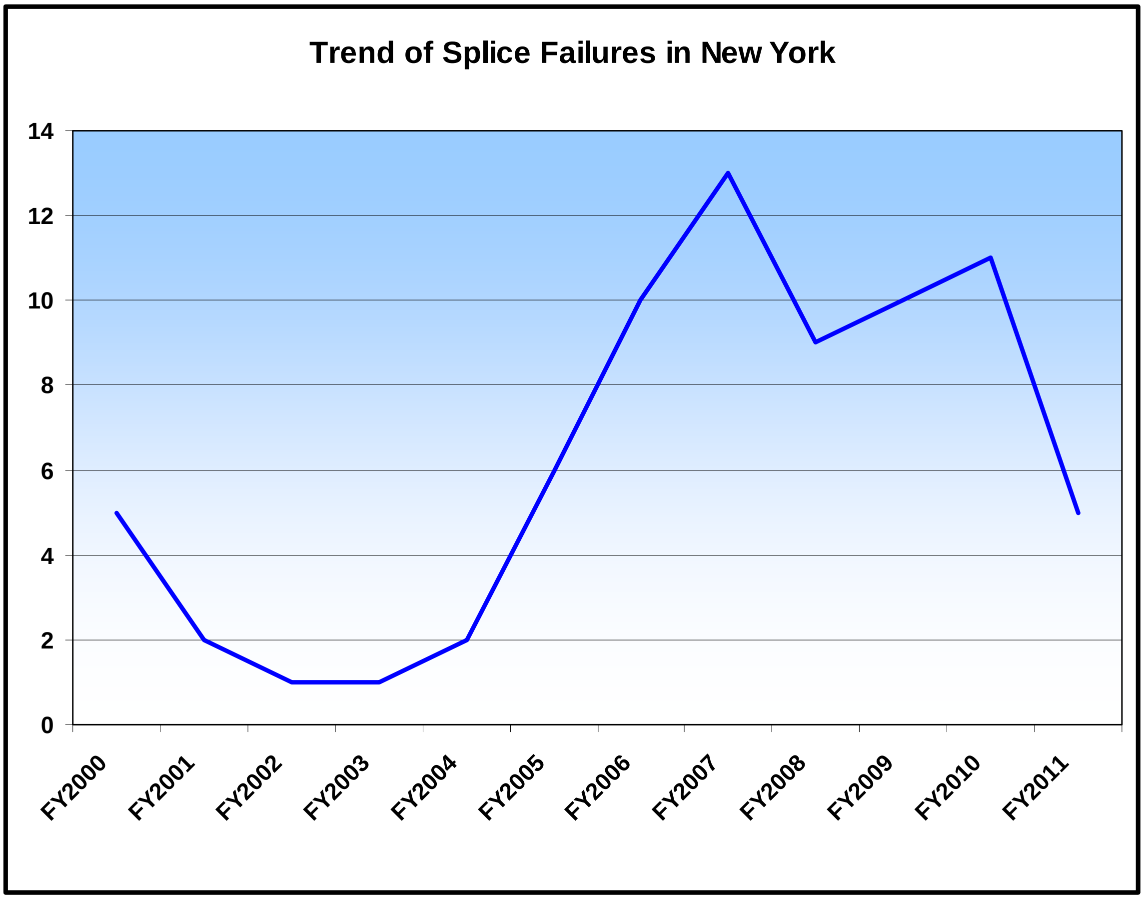
- November 2008 - T1860 Pannell-Geneva 4 line. The conductor failed adjacent to a tee-tap fitting which ties to the NYSEG Geneva tap line. The failure caused a jumper loop splice to pull apart allowing the span from tower #434 to #435 to contact the ground causing the line lockout.

Figure II-6 below shows that splice failures on transmission lines are trending in a decreasing manner from FY2006/07 (FY2007) following a sharp increase from FY2003/04 to FY2006/07.

There are three general types of conductor splices used in the NY transmission system which are used for ACSR (Aluminum Conductor Steel Support), AAC (All Aluminum Conductor), and copper conductor. Over time, expansion and contraction of a splice due to heating and cooling eventually allows for the penetration of oxygen and water. Once water and oxygen are present within the splice, the electrical interface between splice and conductor begins to break down increasing the resistance of the electrical interface. As electrical resistance increases so does the splice temperature. Eventually, the temperature of the splice will begin to rise and lead to failure if undetected. Elevated line operating temperatures and quality of splice installation are also factors that affect splice service life.

The Company has worked to better understand the cause of splice failures. First, infrared inspections continue to be conducted every one to three years, depending upon voltage. Second, a Transmission Line Operations and Maintenance Engineering team has been analyzing condition data and prioritizing repairs. Summaries of the findings are provided later in this section.

Figure II-6



Below are summaries of some of the recent splice failures over the last two years that failure analyses were completed on:

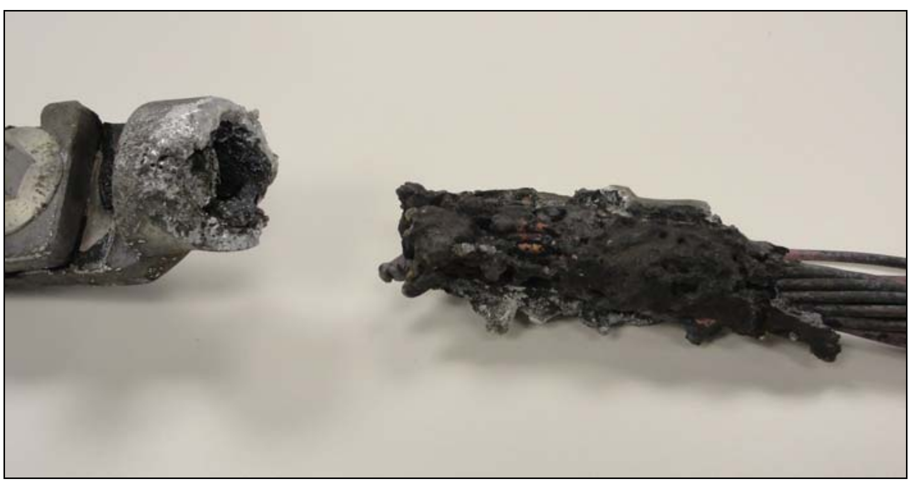
- July 2011 – A splice failed on the T1860 Pannell – Geneva 4 115kV transmission line near structure #356. During an infrared patrol on 6/22/2010, this splice was detected as an 11.6°C delta temperature rise. This fell into the range of "monitor" status during 2010.

- April 2011 - The T5390 Meco – Rotterdam 10 line was taken out of service to repair an open jumper loop at Structure 401. Lineman performing the repair noted that the failed jumper loop and the other two jumper loops at the structure were in poor condition, so all three jumper loops were replaced. The jumper loop was an unusual conductor constructed of three layers of braided copper straps. An aluminum splice was used to transition from the braided copper to the 336.4 ACSR "Merlin" 18/1 conductor used for the main line Infrared inspections in July, 2010 did not reveal any elevated temperatures on the jumper loops at structure #401, nor at any other location on this transmission line.

- March 2011 – A mid-span splice failed on the T1740 Niagara-Packard 192 line near tower 34. The conductor for this transmission line is 1431 MCM AAC "Carnation" 61/0 strand and has been in service for 47 years. The failure occurred at one end of the splice. The conductor burned off approximately 2 inches inside the splice tube. This splice appeared to have been well installed with no underlying defects readily apparent. It is not known why this splice was not identified as deteriorated during the infrared patrols. (This is the second recorded instance of a splice failure on this line. One other splice failure occurred on this line on 2/5/2004. Details of the previous splice failure were not recorded, so it is not known whether the splice was a jumper loop, tee tap or mid-span.)

- April 2010 – A failed loop splice on the T1660 Niagara-Gardenville 180 line causing a trip and line lock-out. Analysis of the failed splice found extensive electrical arc damage and inter-metallic compounding of aluminum and copper (see photos II-1 and II-2 below). It is suggested that aluminum to copper electrical joints age nearly 10 times faster than aluminum to aluminum joints (Bergmann, el al 1996, "Model to Assess the Reliability of Electrical Joints"). Thermal inspections of this line were conducted on August 5, 2009, however no temperature rises were detected that may have indicated declining electrical performance. It is now recommended to avoid the use of aluminum connectors when joining two copper conductors.

Photo II-1
T1660 Failed Loop Splice



- March 2010 – T1870 Quaker Rd-Sleight Road 13 line tripped and locked out at both ends due to a splice failure between structure #239 and #240. Given the age of twist splices on the T1870 Quaker - Sleight Rd 13 and the fact that 5 splices have failed in the last 3 years, the twist splices are most likely beyond there useful life and can no longer operate reliably.

- January 2010 - T1340 Homer Hill–Bennett Road #157 tripped and locked out due to a splice failure between structure #168 and #169. The splice failed at one end where the conductor and splice meet. At one end, 3 of the 6 outer aluminum strands were missing and the single steel core wire showed signs of galvanic protection loss and early onset of corrosion (Photo II-2). Since the line was operating below its thermal rating at the time of failure, the cause of the failure was due to a splice that could no longer perform to its design thermal capacity. Given the age of the conductor at 43 years, it would be expected that the steel core wire would have sufficient galvanization. The fact that the conductor leading from the failed splice was missing 3 outer aluminum strands and displayed signs of corrosion on the steel core wire may be indicative of prior damage that went unnoticed.

Photo II-2
Early onset of Corrosion

Remedial Actions Performed, Regulatory Requirements and Planned Actions
Phase conductor and shield wire remedial actions are discussed in this section. They include addressing substandard conductor clearances as well as condition related challenges. An initial clearance study was completed using ground survey measurements. Subsequent aerial laser surveys have been completed on 75 percent of the transmission system. Analysis of the survey data has been completed on 50 percent of the transmission system. Analysis will continue in parallel with the aerial surveys and is expected to continue for the next two fiscal years.

<u>Conductor Clearance Program</u>

The Transmission Ground Line Clearance Strategy, "Strategy for Transmission Overhead Line Ground Clearance Improvements" (SG029, Version 3) was previously initiated to bring up to code the transmission lines with the highest overall clearance risk first based primarily on safety.

A NERC recommendation, first issued on October 17, 2010 and later updated on November 30, 2010, directed utilities to verify conductor clearances based on maximum operating temperature. It further directed utilities to prioritize the evaluation of circuits on a reliability basis over a 3-year period for all bulk facilities. As a result, the Company has utilized LiDAR information collected from the original conductor clearance strategy to verify clearances and take appropriate action which includes re-rating individual lines, structure modifications or replacement, temporary measures (such as restrictive fencing), or relocation of conflicting structures below the affected transmission line.

As a result, a subsequent strategy was written, SG163. For the A-10 bulk circuits, this Strategy (SG163) supersedes the previous clearance Strategy SG 029 to allow the advancement of the North American Electric Reliability Corporation (NERC) recommendation entitled "Consideration of Actual Field Conditions in Determination of Facility Ratings". For non-bulk circuits, SG163 suspended SG029 Version 3 until NERC requirements are solidified for the remaining transmission lines.

Table II-17 below lists the CCR projects initiated as a result of the recent Conductor Clearance Strategy (SG163).

Table II-17
Conductor Clearance Strategy Projects initiated as of Mid FY2011/2012

Project Number	Driver or Strategy	Line	Voltage (kV)
C31129	SG163	Adirondack-Porter 12 T4010 CCR	230
C31130	SG163	Adiron-Chase-Porter T6340-T6350 CCR	230
C31136	SG163	Volney-Clay 6 T2720 CCR	345
C31137	SG163	Nine Mile One-Clay 8 T2350 CCR	345
C31138	SG163	Scriba-Volney 20 T2540 CCR	345
C31141	SG163	Oswego-LaFayette 17 T2420 CCR	345
C31147	SG163	Clay-Teall 10 T2090 CCR	115
C31153	SG163	Gardenville-Dunkirk 73-74 T1240-T1250 CCR	230
C31156	SG163	Huntley-Gardenville [T1400]-T1410 CCR	230
C34911	SG163	Clay - Dewitt 13 T2060 CCR	345
C34923	SG163	Dewitt - Lafayette 22 T2150 CCR	345
C34924	SG163	Homer City-Stolle Road 37 T6110 CCR	345
C34956	SG163	New Scotland-Alps 2 T5450 CCR	345
C34958	SG163	Packard-Huntley 77-78 T1790-T1800 CCR	230
C34972	SG163	Alps-Berkshire 393 T5030 CCR	345
C39322	SG163	Lighthouse H-Clay 7 T2320 CCR	115
C39344	SG163	Boonville-Porter 1-2 T4020-T4030 CCR	115
C39494	SG163	Beck-Packard 76 T1070 CCR	230
C39903	SG163	Porter-Valley 4 T4240 CCR	115
C40025	SG163	Clay - Dewitt 5 T2050 CCR	115
C40163	SG163	Porter-Schuyler 13 T4220 CCR	115
C40336	SG163	Clay-Woodard 17 T2110 CCR	115
C40463	SG163	Athens-PV 91 T5320 CCR	345
C40523	SG163	Clay-Teall 11 T2100 CCR	115
C40683	SG163	Boonville-Porter 2 T4030 CCR	115
C40705	SG163	Porter-Rotterdam 31 T4210 CCR	230

C40763	SG163	Packard-Huntley 77 T1790 CCR	230
C40764	SG163	Gardenville-Dunkirk 74 T1250 CCR	230
C40765	SG163	Huntley-Gardenville 80 T1410 CCR	230

Conductor Failure Remedial Actions

Specific actions following conductor failures are discussed below.

- T5640 Rotterdam - Curry Rd 11 Conductor failure occurred at a suspension clamp. - The insulators at structure #31 were changed in March 2009. However, the suspension clamp was not changed at this time since there were no indications of a deteriorated connection. The conductor also had an armor type cover which concealed the weakened conductor. It was concluded that conductor arc damage was caused by insulator flashovers due to lightning at locations where suspension clamps loosened. (Five conductor failures have been recorded for the Boonville – Rome 3 and 4 lines since 2005.) The next five year foot patrol inspection is scheduled for 2013. In addition, corona inspections are being considered for this line.

- T1860 Pannell-Geneva 4 - Conductor failure which led to the replacement of a short section of the conductor. Failure Analysis FA0030, dated March 2009, concluded that conductor fatigue due to Aeolian vibration was responsible for the failure. Due to the conductor service life of 87 years and the lack of anti-vibration devices on the line, this failure is most likely indicative of a systemic issue on this line. An assessment of conductor samples from the line, to evaluate tensile strength, steel core wire integrity, and ductility testing is proposed. This testing is scheduled for 2011 or 2012, depending upon outage and resource availability.

T1860 Pannell-Geneva 4 Conductor failure required repair of the conductor and tee-tap fitting. There have been four additional conductor failures on this line recorded since 2004. Failure analysis further indicated that the Pannell – Geneva 4 line is in need of refurbishment work and is being evaluated as part of the overhead line refurbishment program. This project (C30889) is in Step 0.

Shield Wire Remedial Actions

As a result of the Shield Wire Strategy (SG073), the following projects have been initiated:

Table II-18
Initiated SG073 Driven Projects

Project Number	Driver or Strategy	Title	Voltage (kV)
C28676	SG073	Huntley-Gardenville 38-39 T1380-T1390 Shieldwire	115
C28678, C38125	SG073	LaFarge-Pleasant Valley 8 T5080 Shieldwire	115
C28681	SG073	Mountain-Lockport 103 T1620 Shieldwire	115
C28683	SG073	Gardenville-Buffalo 145-146 T1210-T1220 Shieldwire	115
C28706	SG073	Gardenville-Depew 54 T1230 Shieldwire	115
C28707	SG073	Huntley - Lockport 36-37 T1440-T1450 Shieldwire	115
C28709	SG073	Clay-Dewitt 3 T2040 Shieldwire	115
C28710	SG073	Dupont-Packard 183-184 T1120-T1130 Shieldwire	115
C28712	SG073	Walck Road-Huntley 133 T6020 Shieldwire	115
C38125	SG073	LaFarge-PV 8 T5080 Shieldwire Completion	115

The shield wire projects in western New York were re-evaluated due to the cancellation of the Tonawanda and Frontier projects. For example, the scope of the Huntley-Lockport 36-37 T1440-T1450 project was expanded to include the portion of the line that was formerly slated for removal. This was finished in 2010.

Other shield wire replacement projects completed in 2010 include the Mountain-Lockport #103 line and Walck Rd-Huntley #133 line. About 80% of the Lafarge-Pleasant Valley #8 line was completed in 2010 with the remaining portion to be completed between September - December 2011.

Table II-19
Shield Wire Strategy Incorporated into Existing Projects

Project Number	Driver or Strategy	Line	Voltage
C03389, C34193	SG080	Gardenville-Dunkirk 141-142	115
C03417	SG080	Lockport-Mortimer 111	115
C21693	SG018	South Oswego-Nine Mile Unit 1 T2630	115
C28679	SG080	Gardenville-Homer Hill 151-152 T1950-T1280	115

Specific shield wire failure events requiring remedial actions are discussed below.

- T5830 Ticonderoga – Whitehall 3 Shield Wire Failure - One of two Copperweld static wires broke at a clamp (see Photo II-3) between structure #320 and #321 as a result of heavy icing from a storm on February 24, 2010. The failed portion of the static wire was observed as being significantly worn with only 3 of the 7 strands remaining prior to the failure. While the remaining portion of the static wire surface appeared intact, there are several surface corrosion points. Transmission Line Service crews performed a climbing inspection and did not discover any signs of wear at the attachment points on the remaining static wire. A comprehensive inspection of the remaining static wire was inspected on 3/21/2010. While the attachment points appeared to be intact, several instances of corroded wire and one broken strand were observed. One broken conductor strand was also observed at tower #320. These issues will be addressed in the upcoming refurbishment project.

Photo II-3
Clamp Failure on Ticonderoga – Whitehall #3 Shield Wire

- T2040 Clay – Dewitt 3 Shield Wire Failure - As a result of the May 2009 event, the structure was temporarily repaired. Permanent repairs will be performed in the spring of 2012 during a scheduled shield wire replacement project that is starting in September 2011.

Splice Failures Remedial Actions

The following two initiatives activities are helping to address splice failures:

- Critical circuits (bulk lines) continue to receive annual reviews and non-critical lines (usually load lines) are inspected on three year cycles. When a splice is identified as a “hot spot”, it is replaced or repaired.

- A team has been analyzing the condition data and prioritize repairs. Recent failure analyses and recommendations have been included throughout the overhead line section.

Actions and plans resulting from splice failure are discussed below:

- General note - There have been several instances of splice failures during last year (across New York and New England) that were not detected by infrared inspection. As noted in Failure Analysis, FA0087, issued on May 16, 2011, the infrared inspection process has been recently assessed to include such factors as line loading, wind speed and ambient air temperature in an effort to improve hot spot detection rates. The process is now under review to determine its cost effectiveness.

- T1860 Pannell-Geneva 4 - Though the line load data during the 6/22/2010 inspection was not captured, it is possible that the condition of the splice that later failed (in July 2011) would have been adjusted such that replacement would be suggested under the 2011 enhanced criteria.

- T5390 Meco-Rotterdam 10 - Following a jumper loop splice failure in April 2011, this line was spot inspected on May 11th and no other braided loops were found to be installed.

- T5110 Curry Road – Wolf Road 8 Splice Failure - As a result of the July 2009 event, Failure Analysis FA0042, August 2009, recommends avoiding the use of dissimilar metals for electrical joints whenever practical. When this cannot be avoided, it is recommended to use connectors that maximize surface area in order to help extend the service life of dissimilar metal joints.

- T1820 Packard – Huntley 130 Splice Failure - Failure Analysis FA0038, dated June 2009, indicated that this appears to be a one off event and not indicative of a larger issue.

- T5180 Greenbush - Hudson 15 Splice Failure - Failure Analysis FA0036, dated May 2009, recommended monitoring splices with slightly elevated temperature through normal inspection cycles and procedures per EOP T007.

- T1510 Lockport–Batavia 112 Splice Failure - Following the January 2008 failure, new conductor and a splice were installed. Failure Analysis FA0029, dated March 2009, concluded that damage to the conductor at a location roughly 12 inches from the splice is responsible for the failure.

- T1340 Homer Hill – Bennett Rd 157 Splice Failure - Transmission Line crews replaced the splice and installed new conductor following this December 2008 failure. An analysis in March 2009 (Failure Analysis FA0027) indicated that this to be a one-off event initiated by a severe lightning event.

- T1870 Quaker Rd - Sleight Rd 13 Splice Failure - Following the December 2008 splice failure, the line was repaired with a new splice and conductor. Failure Analysis 0026, dated March 2009, concluded that this failure appeared to be a one-off event due to lightning damage.

- T1280 Gardenville–Homer Hill 152 Splice Failure - Failure Analysis FA0025, dated March 2009, note that the age of the lines may indicate that the splices are nearing or possibly beyond their useful life. Two overhead line refurbishment projects will address this concern.

- T1550 Lockport - Mortimer 114 Compression Fitting Failure - This events and one other similar event, do not appear to be a systemic issue. However, the splices may be nearing or beyond their useful life given the age of the line. A recent life extension project has replaced these fittings.

Summary

Conductors, shield wire, and splice issues and failures can pose significant safety, as well as reliability problems. The overhead line refurbishment strategy provides a systematic long-term approach that will address issues related to conductor condition, shield wires and splices. Since the previous filing, a NERC recommendation, first issued on October 17, 2010 and later updated on November 30, 2010, directed utilities to verify conductor clearances based on maximum operating temperature. It further directed utilities to prioritize the evaluation of circuits on a reliability basis over a 3-year period for all bulk facilities. As a result, the Company has utilized LiDAR information collected from the original conductor clearance strategy to verify clearances and take appropriate action which includes re-rating individual lines, structure modifications or replacement, temporary measures (such as restrictive fencing), or relocation of conflicting structures below the affected transmission line.

Insulators and Fittings

This asset group includes glass, porcelain and polymer insulators.

Some polymer insulators are more prone to experience failures due to moisture ingress as a result of design and manufacturing defects. When moisture penetrates the insulator's sheath and reaches into the fiberglass core, this can result in failure due to brittle fracture, a mechanical failure of the fiberglass, or flash-under, an electrical failure mode caused by tracking along or through the fiberglass rod. Catastrophic brittle fracture failures typically result in the conductor dropping from the structure.

Porcelain insulators are widely used on the transmission system. When refurbishments are conducted on transmission lines typically, older than 40 years, existing insulators and fittings are frequently replaced with new ones. A few reasons exist for this decision:

- Older lines frequently have shield wire configurations that provide limited lightning protection resulting in repeated lightning strikes over the years. This causes tracking and flashovers; over time, the ceramic glazing becomes deteriorated reducing both the electrical and structural properties of the insulator.
- Avian use of the transmission lines for perching contributes to insulator contamination; the corrosive nature of the avian waste wears away at the glazing. In addition, the contaminants themselves cause tracking and flashovers; over time, the ceramic glazing comes off reducing both the electrical and structural properties of the insulator.
- In rural areas, insulator strings serve as "target" practice for hunters.
- Over time, exposure to the elements and severe weather wear away at the insulator glazing. Eventually the ceramic glazing wears off reducing both the electrical and structural properties of the insulator.
- Though not a prominent issue, conductor galloping can cause structural damage to an insulator string.

During comprehensive helicopter inspections, insulator damage believe to have resulted from the above causes has been observed on many transmission lines.

Condition and Performance Issues

Below are some recent fittings problems that have been evaluated through failure analyses:

July 2011 – The T5320 Leeds-Pleasant Valley 91 line experienced a compression dead-end conductor clamp failed at tower 412 resulting in a lockout. The outer aluminum tube of the failed compression clamp was marked ALCOA 8130.116 HV 795 M 26/7 and the steel eye was marked 9314 432, both correct for the conductor. Failure Analysis FA0100 determined that the clamp appeared to be adequately compressed and well installed. Examination of the compression clamp showed signs of overheating. The conductor burned off just at the end of the aluminum tube which is typical of this type of failure.

April 2011 - The T5390 Meco – Rotterdam 10 115kV line was taken out of service to repair an open jumper loop at structure 401. Lineman performing the repair noted that the failed jumper loop and the other two jumper loops at the structure were in poor condition, so all three jumper loops were replaced. The jumper loop was an unusual conductor constructed of three layers of braided copper straps. An aluminum splice was used to transition from the braided copper to the 336.4 ACSR “Merlin” 18/1 conductor used for the main line. No hot spots had been detected on this line during the 2010 inspections.

April 2011 - The T4020 Boonville – Porter 1 115kV line locked out to a hardware failure at structure 46. A tree came into contact with the line nearby structure 46. The tree contact jolted the line conductor causing the upper hardware connector to dislodge from the tower and bending the upper arm stay member. The connector is an open hook style which relies upon gravity to keep it in place. Present connector design utilizes a Y-clevis connector which is a closed connector.

Remedial Action Planned

A strategy (SG078) recommending the replacement of all polymer insulators on the transmission system has been approved. It is anticipated that all polymer insulator replacements will be completed over the next few years.

Actions taken and plans resulting from insulator and fitting failures are discussed below:

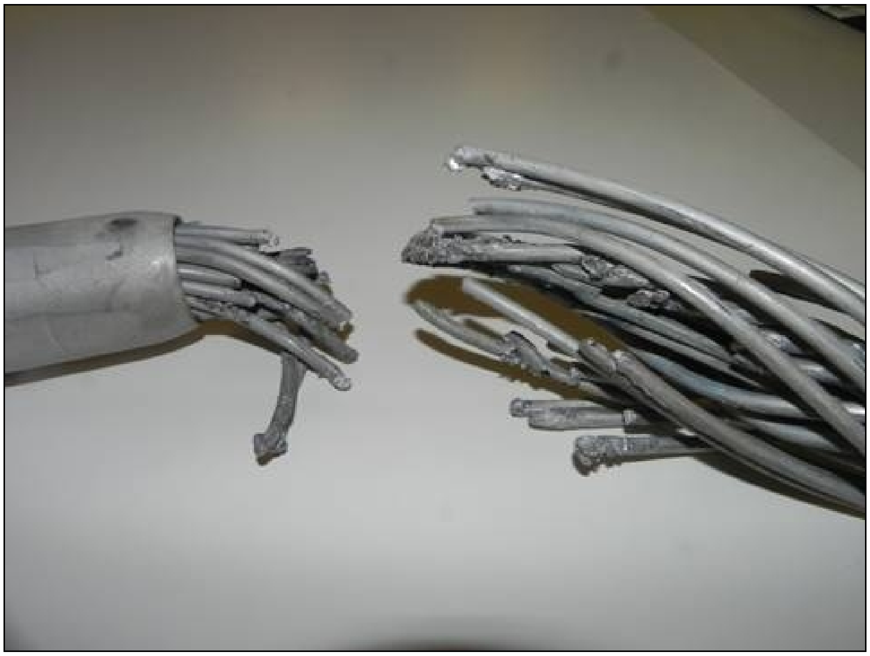
- For line refurbishments, during the field engineering walk-down of the Step 0 process, the insulators and fittings are examined to determine if replacement is needed. Depending upon condition, insulators and/or fittings may be replaced or fortified on a targeted or completed line basis.

- T4020 Boonville – Porter 1 – Failure Analysis FA0089, dated May 2011, stated that while it could be possible to curtail hook detachments through a wholesale replacement of hardware that failed in April 2011, this type of event is quite rare and a wholesale replacement just for this purpose may not be justified. Though no immediate refurbishment projects are planned for this line (other than potential conductor clearance work), given its age a refurbishment project may be planned in the in the 5-15 year timeframe that would address this issue.

- T5390 Meco – Rotterdam 10 - The jumper loop was an unusual conductor constructed of three layers of braided copper straps. An aluminum splice was used to transition from the braided copper to the 336.4 ACSR “Merlin” 18/1 conductor used for the main line. The jumper loop failed at the interface between the braided copper and aluminum splice. Aluminum to copper electrical joints age faster than aluminum to aluminum joints. The line was spot inspected on May 11th and no other braided loops were found to be installed.

- T5320 Leeds – Pleasant Valley 91 – Failure Analysis FA0100, dated July 2011, stated that while it is clear that overheating lead to the failure of the compression clamp due to an increase in electrical resistance, what is not certain is what propagated the breakdown. The large percentage of hot spots detected on the four New Scotland – Leeds – Pleasant Valley lines suggests that there may be global explanation for the high percentage of compression fitting failures. While there may be links between equipment manufacturing and installation as well as the high loads that these lines carry on a daily basis, there is not enough information to draw a sound conclusion at this time. The line was operating well below the thermal rating limits at the time of the failure, so overloading was not a factor that led to the failure. A new infrared inspection procedure will most likely result in more compression fitting replacements, but continued review and investigation of the results should be given to these lines.

Figure II-7
Failed T5320 Compression Clamp



The locations of known polymer insulators are widely scattered throughout the system as shown below in Table II-20.

Table II-20
Failed T5320 Compression Clamps by Type of Structure

Divisions	Region	Number of Circuits	Number of Structures	Dead-End Structures	Angle Structures	Tangent Structures	Duplicate Structures	Replaced Structures
West	Frontier	12	194	37	0	157	0	0
	Genesee	5	33	10	1	22	0	0
	Southwest	6	114	29	1	82	0	2
Central	Central	13	180	8	0	172	0	0
	Mohawk	2	6	2	0	4	0	0
	Northern	15	83	15	4	64	0	0
East	Capital	13	153	57	20	76	0	0
	Northeast	8	349	46	40	261	2	0

A preliminary engineering report was completed at the end of FY2010/11. Final Engineering is being planned over the upcoming year; implementation will be phased over several years.

Summary

The catastrophic failure of a polymer insulator impacts both the reliability and public safety of a line. It will be important to replace polymer insulators with the potential for failure in a systematic way. Final engineering is now planned to replace polymer insulators where they have been identified on structures as a result of Strategy Paper SG079.

When refurbishments are conducted on deteriorated lines, existing insulators and fittings are frequently replaced with new ones to maintain the performance of the line.

Retired and De-energized Overhead Lines

There are a number of retired and de-energized transmission lines across the service territory. The Company is currently considering options to address these assets.

Remediation

The Company is developing a strategy and a prioritization method to address lines that are permanently de-energized. The prioritization will include an assessment of whether or not there is a viable need for the retired assets in the future to address system needs.

Underground Cables and Related Equipment

Cables

National Grid's underground transmission cable network is composed of high pressure fluid filled (HPFF) pipe-type cable operating at 115, 230, and 345kV, and solid dielectric cable systems operating at 115kV. National Grid has 53.3 miles of underground transmission cable in service, of which approximately 80 percent of underground cables are high-pressure fluid filled pipe-type as shown in Table II-21. Further, over one third of the Company's underground cable assets are between 40 and 59 years of age as shown in Figure II-8 and Table II-22.

Table II-21
Underground Cable Miles by Voltage

	115kV	230kV	345kV	Total
HPFF Pipe Type	22.1	20.2	0.7	43.0
Solid Dielectric	10.3	0	0	10.3
Total	**32.4**	**20.2**	**0.7**	**53.3**

Figure II-8
Underground Cable Age Profile

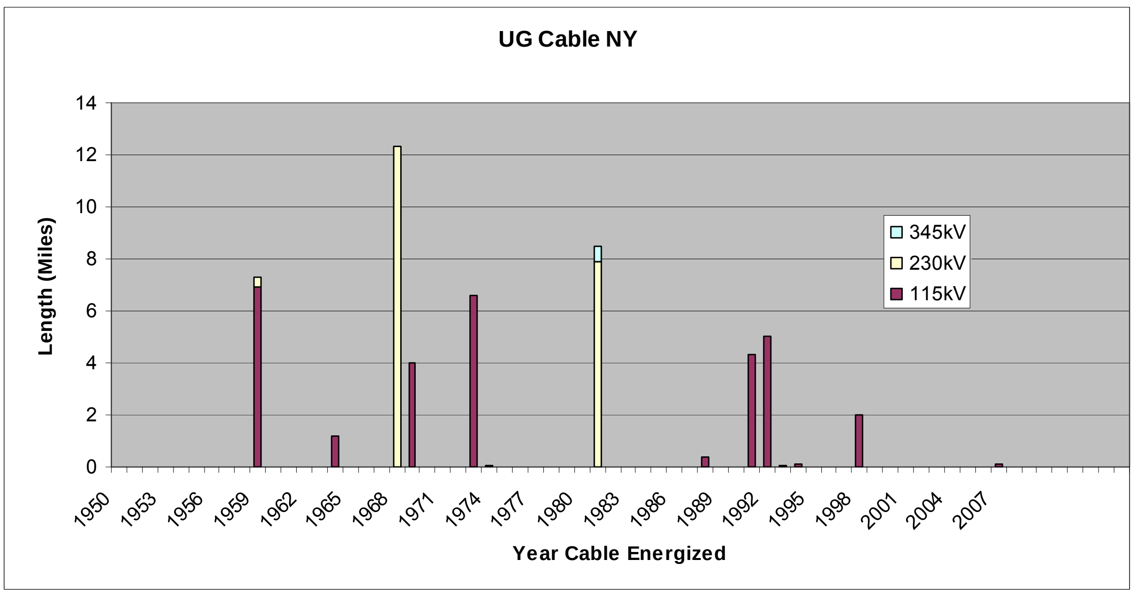


Table II-22
Asset/Age Profile Underground Cables (Circuits)

Asset/Age Profile (Years)	0-19	20-39	40-59	60+	Total
Underground Cables	12	13	11	0	36

Condition and Performance Issues

Pipe Type Cables

High Pressure Fluid Filled (HPFF) pipe type cables consist of paper insulated conductors installed within a steel pipe. The pipe is filled with a dielectric fluid, which is maintained at a nominal pressure of 200 psi. Pressure is maintained on pipe type cables by means of “pressurizing plants” which contain pumps, pressure control valves, a fluid reservoir, and controls and alarms. The steel pipes and fluid reservoirs on a pipe type cable system contain relatively large volumes of dielectric fluid. There are potential environmental risks associated with release of dielectric fluid from these types of cables. While the likelihood of fluid leaks is rare, the consequential release volumes can be significant.

There are two major systems to be monitored on pipe type cable for both environmental integrity of the pipe system and to maintain reliable performance of the cables. They are the cathodic protection systems and the oil pressurizing plants. The cathodic protection system protects the buried steel pipes from corrosion. Routine inspections are performed on the cathodic protection systems including annual surveys to determine that adequate protection exists along the cable routes. Bi-monthly visual and operational (V&O) inspections are also performed on the pressurizing plants.

Regarding pressurizing plant and equipment, a detailed pumping plant condition assessment has begun and is expected to be an on-going effort. This condition assessment is being undertaken by a combination of in-house personnel and external vendors and will form the basis of any future remedial work. Many of the current projects are a result of conditions identified during these assessments.

Table II-23 lists the locations of the pressurizing plants, cables served, manufacturer, and reservoir size.

Table II-23
Pipe Type Cables – Pressurizing Plants, Gas Cabinets, Crossover Assemblies

Station	City	Cables Served	Manufacturer	Reservoir Size (Gal)
Huntley Station	Tonawanda	Huntley-Elm #70	Jerome	15,000
Elm St	Buffalo	Elm-Seneca #71 Elm-Seneca #72 Elm St Bus Tie	Jerome	5,500
Seneca	Buffalo	Elm-Seneca #71 Elm-Seneca #72 Seneca-Gardenville #71 Seneca-Gardenville #72	Jerome	NA - Crossover Cabinet
Gardenville	W. Seneca	Seneca-Gardenville #71 Seneca-Gardenville #72	Jerome	5,500
Rochester Airport - East Portal	Rochester	Rochester #111 Rochester #113 Rochester #114	Jerome	3,500
E. Conklin	Onondaga	Conklin-Bailey #17A Conklin-Bailey #17B 10" Circulation Pipe	Salter	2,500
Teall Ave	Syracuse	Ash-Teall #7 Ash-Teall #8	Jerome	4,000
Temple St	Syracuse	Ash-Temple #9 Temple-Peat #10	Jerome	4,000
Oswego Steam	Oswego	Oswego-S Oswego #3 Oswego-S Oswego #5	Pikwit	4,000
Trinity	Albany	Trinity-Albany Steam #5 Trinity-Albany Steam #9 Riverside-Trinity #18 Riverside-Trinity #19	Pikwit	8,000

The majority of the cable pressurizing plant equipment is of similar vintage to the high pressure fluid filled pipe-type cables on which they are installed. Cable pressurizing plants are electro-mechanical systems. As these systems get older, some age related problems are anticipated on both electrical and mechanical components. Some of these issues can be addressed by targeted component replacements while others may require replacement of the entire pressurizing systems. Specific concerns are discussed in the "Remedial Actions Performed and Planned" portion of this chapter.

Another critical component of any pipe type cable is the cathodic protection system. The cathodic protection system provides protection against corrosion of the steel pipe which can result in fluid leakage and potentially lead to electrical failure. There are two primary types of cathodic protection systems installed on the National Grid pipe type cables. These include the older "Rectifier and Polarizing Resistor" systems, and the more modern "Rectifier and Polarization Cell" systems. The polarization cell is a battery-like device that is used to ground the cable pipe and to allow for a DC voltage to be impressed on the pipe. The polarization cell contains a liquid electrolyte (typically potassium hydroxide). A replacement for the polarization cell that doesn't require use of caustic chemicals has been developed in recent years. This is referred to as a "Solid

State Isolator" (SSI). National Grid has been replacing polarization cells with solid state isolators as deterioration of cells has been identified, or as part of specific cathodic protection system upgrades. Table II-24 provides a list of the type of cathodic protection systems installed on each of the high pressure fluid filled pipe type cable systems.

As a result of ongoing maintenance and inspection programs, National Grid has identified some condition issues with certain cathodic protection systems, Specific concerns are discussed in the "Remedial Actions Performed and Planned" portion of this chapter.

Table II-24
Cathodic Protection System Summary

Cable	Location	Rectifier and Polarizing Resistor	Rectifier and Polarization Cell	Rectifier & Solid State Isolator (SSI)	Notes
Huntley-Elm #70	West			X	
Elm St Bus Tie	West			X	
Elm-Seneca #71	West			X	
Elm-Seneca #72	West			X	
Seneca-Gardenville #71	West			X	
Seneca-Gardenville #72	West			X	
Rochester #111	West			X	
Rochester #113	West			X	
Rochester #114	West			X	
Conklin-Bailey #17A	Central		X		To be converted to SSI
Conklin-Bailey #17B	Central		X		
Ash-Teall #7	Central	X			
Ash-Teall #8	Central	X			
Ash-Temple #9	Central	X			
Temple – Peat #10	Central	X			
Oswego-S Oswego #3	Central	X			
Oswego-S Oswego #5	Central	X			
Trinity-Albany Steam #5	East		X		To be converted to SSI
Trinity-Albany Steam #9	East		X		
Riverside-Trinity #18	East		X		To be converted to SSI
Riverside-Trinity #19	East		X		

Solid Dielectric Transmission Cables
Solid dielectric transmission cables were installed beginning in the late 1980s and continuing to the present. The solid dielectric cables represent a relatively low mile weighted average age profile. National Grid inspects transmission cable terminations and above ground cable equipment as part of the Substation V&O inspections. A small population of transmission cable terminations has been identified recently with cracks and/or fluid leaks. National Grid has replaced damaged terminations, and has raised sensitivity to a potential issue with transmission terminations as part of the V&O inspection process. Manhole inspections are also performed periodically. At this time, with the exception of a limited number of cable termination troubles, the installed solid dielectric transmission cables do not appear to have major condition issues, and the current monitoring is considered sufficient.

Remedial Actions Performed and Planned

Pipe Type Cables
In prior years, concerns were expressed regarding the pump and auxiliary equipment preventative maintenance program. Electric Operating Procedure (EOP T009) was developed to formalize the maintenance requirements of the cable systems. The requirements of this EOP are being incorporated into the Substation & Maintenance AIMMS/CASCADE system for implementation and tracking.

In the 2008 and 2009 Asset Condition reports, the Company identified a pressurizing plant at the Rochester Airport as in a deteriorated condition and presented a possible reliability risk. Conceptual engineering is nearing completion and the design for a replacement plant is currently being planned.

A project to add a pressurizing plant to the Trinity-Albany Steam #5 & #9 circuits is also nearing completion of the conceptual engineering phase to reduce a “common-mode failure” reliability issue with these circuits and with the Riverside-Trinity #18 & #19 circuits.

Additionally, the results of the pressurizing plant condition assessments will be used to prioritize future replacements.

With regard to cathodic protection systems, upgrades and repairs such as replacing the cells with solid state isolators have been on-going for the cathodic protection system on these cables. The type of cathodic protection system identified as “rectifier and polarizing resistor” is considered obsolete. National Grid plans to convert these systems to “Rectifier and Solid State Isolator” systems.

Projects have also been initiated to replace the remaining polarization cells with solid state isolators (refer to Table II-29).

A project to improve the underground equipment in western New York has been initiated and is currently in the engineering phase. The improvements included as part of this project proposes upgrades to the annunciator and alarming systems at the Elm Street, Gardenville, Huntley, and Rochester stations as well as revisions to the protection trip scheme at the Rochester pressurization plant.

A project is underway to replace the Conklin-Bailey rectifier and polarizing resistor system.

During bimonthly inspections of the Trinity-Albany Steam and Riverside-Trinity cathodic protection system, a steady rise in AC levels has been observed as well as a noticeable defacement to the nickel plates. In addition, if was also observed that the color of the acid has a purple tint. These are indications that the cells have reached their end of service life. A project has been initiated to replace the Trinity-Albany Steam and Riverside-Trinity cathodic protection system polarization cells with solid state isolators.

Solid Dielectric Transmission

In 2009, a crack in the top casting of a 115kV cable termination on the North Creek to Warrensburg #5 115kV solid dielectric cable was identified. Recently, a crack in another termination has been identified. A project has been initiated to repair the second termination, inspect the remaining terminations, and determine if additional work will be required. National Grid also experienced fluid leaks on three 115kV solid dielectric cable terminations at the Ash Street substation in Syracuse. The damaged terminations were all replaced. National Grid has a population of approximately 126 terminations of this type installed at 115kV. As previously stated, National Grid has raised sensitivity to a potential issue with these transmission terminations as part of the V&O inspection process. This will enable us to determine whether this is an isolated issue, or whether there is a concern with this type of cable termination.

Summary

National Grid has a small population of HPFF pipe type and solid dielectric transmission cables. No major condition issues have been identified during inspection. However, work on ancillary equipment such as pumping plants, cathodic protection systems, and terminations is being performed to maintain the reliability of the cable systems. The potential issue with solid dielectric cable terminations will continue to be investigated and monitored. These remedial projects, as well as ongoing inspection programs will help maintain the reliability of the cables themselves and reduce the possibility of large consequential costs and long outages for cable repairs.

Transmission Right of Way Vegetation Management

National Grid's Vegetation Management Plan (VMP) seeks to minimize interruptions due to vegetation. Other objectives of the VMP include providing a clear and safe work space and access for maintenance and inspection activities.

National Grid's strategic approach to vegetation management is to establish and maintain rights-of-way that are largely clear of all incompatible vegetation while maintaining a stable low-growing plant community that is pleasing to the eye and beneficial to wildlife. National Grid's strategic approach to manage vegetation adjacent to the right-of-way is to prune and/or remove danger trees and/or hazard trees where property rights allow.

Vegetation management work on transmission and sub-transmission right-of-ways is organized into two programs:

- Right-of-Way Floor Program – management of vegetation within the right-of-way corridor, and;
- Off Right-of-Way Danger Tree Program – management of vegetation adjacent to the right-of-way corridor.

Floor Program

To achieve its vegetation management objectives, National Grid utilizes an Integrated Vegetation Management (IVM) approach which emphasizes selective herbicide use to control incompatible vegetation. IVM integrates the use of various vegetation management methods on both the right-of-way floor and the adjacent utility forest targeting tall growing, undesirable vegetation. The vegetation management methods include the use of herbicide, supplied as a basal application, stump application or foliar application as well as non-herbicide methods; hand cutting; mowing; selective mowing; and selective pruning. IVM is a system of controlling tall growing vegetation in which species are identified, action thresholds considered, possible control options evaluated, and selective, physical, biological and chemical controls considered.

After using the IVM approach for more than two decades, a portion of the "small" shrub community has become too tall and dense in certain areas, invading the mid-span "wire security zone." The shrub community then may hide or mask undesirable tall growing species from the sight of treatment crews and patrols. As shrub communities become denser over time, they restrict access to large areas of the ROW, further increasing the chance of skips or missed stems during treatment. Shrub intrusion into the wire security zone reduces the vegetation free space between the conductor and brush. This increases the risk that as undesirable tree species emerge above the shrub canopy, or "escapes," a stem can quickly grow into the conductor area and cause an interruption. In the last decade, transmission interruptions caused by trees growing into the lines on either the 115kV or the bulk transmission systems were all attributed to the masking of an undesirable stem by a shrub community. Due to this relatively new risk the company has made a recent revision to the Program which includes the removal of shrub communities through mowing and follow-up application of herbicide in selected mid-spans where clearances are judged to be minimal and the shrub communities have become tall and dense.

IVM on the Company's ROWs has been successful, and that success can be directly attributed to the adoption of a long-range management plan. These plans are designed to improve reliability within an ecosystem approach, by fostering the development of low-growing, compatible vegetation, the use of site specific prescriptive application methods, and the adherence to sound cyclical programming guidelines.

IVM is implemented on all ROWs through a cyclical approach. Cycle lengths for the right-of-way floor program range between five to eight years. For 2010, National Grid completed 100% (8,926 acres) of its scheduled IVM work.

Danger Tree Program

The utility forest beyond the maintained right-of-way floor may contain trees tall enough and close enough to electric conductors to be capable of growing or falling into the lines. These trees are classified as danger trees and hazard trees. A danger tree is any tree on or off the right-of-way that if it fell could contact electric lines. A hazard tree is a danger tree which due to species and/or structural defect is likely to fall into the electric facility. National Grid prunes or removes danger trees and hazard trees to reduce the risk of off right-of-way tree-caused interruptions. Trees are pruned to achieve At Time of Vegetation Management (ATVM) clearance distance from vegetation, measured as a radius around the conductor. Danger tree cycles for transmission and sub-transmission line right-of-ways range from five to 16 years. The danger tree work is prioritized and scheduled based on historic interruption history, Line Importance Factor, a statistical risk factor computed using tree height, conductor height and distance to line, and danger tree maintenance cycles. For 2010, National Grid completed 100% (317 miles) of its scheduled transmission sideline danger tree work and 97% (299 miles) of its scheduled sub-transmission sideline danger tree work.

The computed risk factor noted above is quantified using the Optimal Width Calculator (OWC) software licensed to National Grid by Ecological Solutions, Inc. The OWC calculates a Risk Factor based on the variables discussed above. Data was collected in 2004 across the company's 115kV, 230kV and 345kV transmission system to calculate average Risk Factor by voltage class: 345kV risk factor of 0.19, 230kV risk factor 2.3, and 115kV risk factor of 6.19.

Where rights allow or through landowner permissions, National Grid is now considering a widening program on a select group of 115kV ROWs if funding can be justified. The Side Line Tree Risk Assessment and Mitigation Strategies study conducted by National Grid indicates that reduction of the Risk Factor to equal or less than the average Risk Factor for the 115kV voltage class should result in a significant reduction in the Risk Factor for each voltage class. Essentially this approach targets the pruning and removal of danger trees out to a prescribed dimension from the conductor in areas where it will be most effective in reducing risk.

Patrols

The Company conducts a variety of patrols throughout the year to identify hazardous conditions that can compromise reliability of the electric system. National Grid Transmission Forestry personnel conduct one foot patrol and one aerial patrol each year on all 230kV and 345kV ROWs. They also conduct aerial patrols on all 115kV ROWs once every two years (generally one-half of the circuits are patrolled annually). In addition, Operations personnel carry out periodic ground patrols, and annual aerial patrols, of all 115kV and higher circuits. Both of these patrols include identification of vegetation conditions.

Substations

This section will describe the key elements of transmission substations. Specifically, the inventory, condition and performance issues and other information for circuit breakers, disconnect switches, transformers, other equipment and substation rebuilds are discussed.

Substation Equipment Assessments and Asset Condition Codes
A common substation condition assessment approach has been initiated across all Transmission and Distribution substations. This includes, on a targeted basis, a visit to select substations by subject matter experts (SMEs) in the Substation O&M Services department to review the condition of the assets. The result is a report which gives each asset a condition code of 1 through 4, with 1 being acceptable and becoming less acceptable the higher the number, based on manufacturer family, condition, age and other relevant data (Table II-25).

Manufacturer family evaluations such as would apply to GE type FK breakers, are composed of historical "family" performance and engineering judgment and experience of SMEs within the Company. The condition code can be further refined by the site condition assessment described previously on the specific assets and local operations personnel input as to performance and maintenance history.

Aligned with the condition code is an impact code, higher numbers indicate higher impact as a result of failure, which combines with the condition code to provide a risk based framework for asset prioritization. As National Grid develops this approach, asset replacement and maintenance will be ranked based on condition, but prioritized based on risk.

Table II-25
Substation Condition Codes

Code	Classification/Condition	Implication
1 Proactive	Asset expected to operate as designed for more than 10 years	Appropriate maintenance performed; regular inspections performed
2 Proactive	Some asset deterioration or known type/design issues Obsolescence of equipment such that spares/replacement parts are not available System may require a different capability at asset location	Asset likely to be replaced or re-furbished in 5-10 years; increased resources may be required to maintain/operate assets
3 Proactive	Asset condition is such that there is an increased risk of failure Test and assessment identifies definite deterioration which is on going	Asset likely to be replaced or refurbished in less than 5 years; increased resources may be required to maintain/operate assets
4 Reactive	Asset has sudden and unexpected change in condition such that it is of immediate concern; this may be detected through routine diagnostics, including inspections, annual testing, maintenance or following an event	Testing and assessment required to determine whether the asset may be returned to service or may be allowed to continue in service. Following Engineering analysis the asset will be either recoded to 1-2-3 or removed from the system

In subsequent sections of this report, condition codes are used to summarize the status of the asset type population.

Circuit Breakers

There are 726 circuit breakers located in transmission substations. The types of circuit breakers used in the service territory are categorized as gas, oil and vacuum. The majority of circuit breakers in the service territory are 115kV. The following provides a brief summary of each type.

- Gas Circuit Breakers (GCB) – There are 357 (49%) newer technology GCBs. The population of GCBs are all within their anticipated service life with all but the earliest vintage (1979) in excellent condition.

- Oil Circuit Breakers (OCB) – There are 368, (51%) older technology OCBs.[17] The average age of oil circuit breakers is 43 years. Approximately two percent are greater than 60 years old. These circuit breakers are located at the Maplewood, Browns Falls, Battle Hill and Ingham's substations. Strategies are in progress which incorporates their replacement 65 percent of the total population of oil circuit breakers is between 40 and 59 years old and 33 percent are 20 to 39 years old.

- Vacuum Circuit Breakers - There is one vacuum breaker in the system used for 115KV capacitor bank protection at the Homer Hill substation.

[17] Ninety percent, nine percent and one percent of 115kV, 230kV and 345kV circuit breakers respectively

Figure II-9
NY Circuit Breaker Age Profile

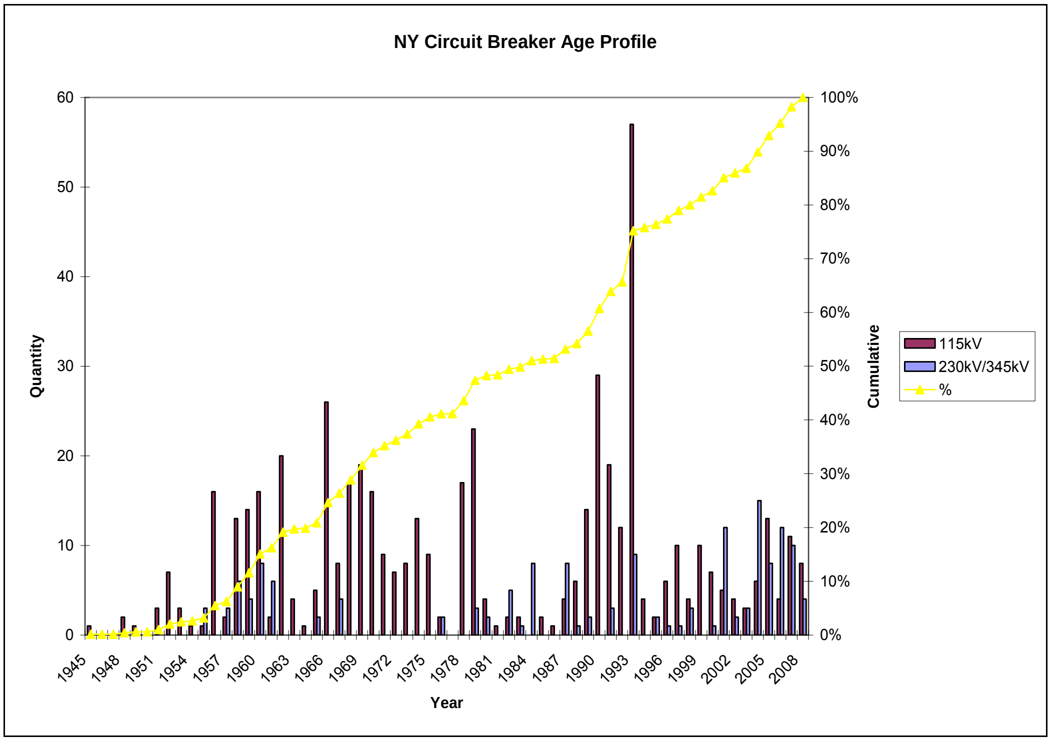


Table II-26
Asset/Age Profile

Asset/ Age Profile (Years)	0-19	20-39	40-59	60+	Total
Oil Circuit Breakers	4	117	239	8	368
Gas Circuit Breakers	275	82	0	0	357

The predicted asset life of oil circuit breakers is 45 years with the earliest onset of poor performance predicted by age 40. The oil circuit breakers were manufactured and installed over a forty-nine year period (from 1945 through to 1994). Based upon known deterioration modes, 173 of the earliest installed circuit breakers would be expected to be currently at, or approaching, the end of their asset life. There is evidence of deterioration through known failure mechanisms and in some cases circuit breakers are being kept in service using serviceable parts from retired equipment. This approach is not considered sustainable.

Due to the key function of interrupting faults carried out by circuit breakers, these assets cannot be allowed to become less reliable. As such, all circuit breakers should be replaced before they fail to operate as designed. Different deterioration modes and life limiting processes become known as switching devices age. Deterioration modes and factors that contribute to the end of life for oil circuit breakers include loss of elasticity of gaskets, allowing water ingress or oil leakage; frost jacking of porcelain to metal joints; excessive wear of moving parts; corrosion; etc. The anticipated asset life of oil circuit breakers is considered to have been reached when the cumulative effects of the life limiting factors results in an unacceptable level of performance and repair is either not possible or not economic.

Condition and Performance Issues
In both Transmission and Distribution, circuit breakers are given a condition code based on manufacturer family and age data. Manufacturer family ratings are based on historical performance of that family. The condition codes are further refined by a visual site surveys and operational tests performed on the specific assets. Circuit breakers are also given a Replacement Priority by applying both technical and specific business criteria as shown in Table II-27. The condition codes define the requirement to replace or refurbish based solely on the condition and performance of the asset while the replacement priorities also include criticality in terms of safety, environmental or reliability consequences of asset failure.

This distinction recognizes that two assets, both with the same condition code, can have a different replacement priority[18] due to the consequence of failure.

Table II-27
Asset/Replacement Priority

Asset/ Replacement Priority	1	2	3	4	Total
Circuit Breakers (2008)	326	114	216	40	696
Circuit Breakers (2009)	480	50	156	22	708
Circuit Breakers (2010)	491	50	156	22	718
Circuit Breakers (2011)	498	50	156	22	726

The Company is improving its knowledge of the asset population's condition issues. As a result, the Company has reassessed replacement priority scores for circuit breaker populations and the number of highest priority units for replacement has been reduced since the 2008 filing.

A review of 'follow-up' work orders shows that in the period from January 2005 thru August 2011 there were 1,709 follow-up work orders created on circuit breakers. Of these, 922 were associated with OCBs. The majority of the remaining follow up work orders, were associated with the replenishment of SF6 gas in GCBs.

Approximately 77 percent of all the follow-up work orders on OCBs are attributable to just three circuit breakers types, namely the Allis Chalmers Type BZO, the Westinghouse Type GM and the General Electric Type FK.

[18] Refer to Report on the Condition of Physical Elements of Transmissions and Distribution Systems- Page III-19, October 1, 2008.

- **Allis Chalmers Type BZO –** The operating mechanisms in this family of breakers, manufactured in the 1950s through 1980s, are showing an increase in accumulator pump and o-ring failures. Design changes and changes in component manufactures over the years require different replacement parts for various vintages and these parts are difficult to obtain. Mechanism wear has resulted in reduced levels of reliability, increased maintenance costs and a number of failures. There are currently 109 Allis Chalmers Type BZO circuit breakers installed on the New York system.

- **Westinghouse GM -** Test results from this family of breakers indicate contact timing problems and questionable insulation integrity. There are currently 38 Westinghouse GM circuit breakers installed on the New York system.

- **General Electric Type FK –** There have been problems with bushing oil leaks and lift rods issues due to moisture ingress with these circuit breakers. In addition lead paint is prevalent in this family of breakers. There are currently 115 General Electric Type FK circuit breakers installed on the New York system.

The average age of SF6 Gas Circuit Breakers is approximately 13 years old. However, there are three Westinghouse 362SFA40 SF6 Gas Circuit Breakers (362kV) that are 32 years old (1979) in service at Dewitt substation and two that are 35 years old (1976) at New Scotland substation. These are the oldest SF6 breakers in the system and experience air leaks in the operating mechanism. This contributes to pole discrepancies which have resulted in reported instances of the breakers failing to close. The SF6 gas leakage has been reduced by using normal breaker maintenance on these five Westinghouse breakers. There are no plans to replace these breakers at this time and maintenance will continue to be performed to lessen the SF6 gas release to the atmosphere. As discussed in the 2009 Asset Condition Report, the last of the Dewitt substation SF6 circuit breakers have been rebuilt which should extend the life of these breakers by 15 to 20 years.

Remedial Actions Performed and Planned

National Grid has a number of strategies in development and planned for the future that will remove the worst condition oil circuit breakers to maintain the reliability of the system. Approximately 130 circuit breakers (of which 109 are at 115kV) have been identified as posing the greatest safety and reliability concerns. The scope of work will include, where necessary, the replacement of circuit breakers along with their associated CTs, PTs, disconnect switches and control cabling.

Common condition issues associated with these breakers include; oil leaks, air leaks, bushing hot spots, high power factors and poor insulation as well as failures of; pressure valves, hoses, gauges, motors, compressors, pulleys, o-rings, control cables, trip coils, close coils, lift rods and contacts.

Table II-28
Potential Breaker Replacement Candidates

Location	Qty	Voltage (kV)	Type
Batavia Station 01	4	115	FK-439 & BZO-115
Homer Hill Switch Structure	6	115	GM-6, FK-439 & BZO
Packard Stataion	11	115	1150GM10000 & BZO-121
Ash Street Station 223	5	115	BZO-115, FK-115 & GM-6
Battle Hill Station 949	3	115	FK-439 & BZO-115
Browns Falls Station 711	6	115	GM-6 & FK-439
Maplewood Station 307	2	115	FK-230
Oneida Station 501	5	115	RHE-64, FK-115 & GM-6
Oswego Switchyard	5	115	FK-439 & FK-115
Porter Station 657	9	230	BZO-230 & FGK-230
Rotterdam Station 138	6	230	RHE-84
Whitehall Station 187	3	115	GM-6
Colton Station 471	7	115	BZO-115, BZO-160, FK-439 & GM-5
Inghams Station 20	9	115	AA10, GM-6 & BZO-121
Lighthouse Hill Station 61	6	115	FK-115 & RHE-64
Rome Station 762	5	115	FK-115, FK-439 & BZO-115
Tilden Station 73	3	115	GM-6
Alcoa Station 902	3	115	FK-439, GM-6 & FK-115
Boonville Station 707	6	115	BZO-115 & GM-6
Cortland Station 502	4	115	FK-115, FK-439 & GO-3A
Dunkirk Station	5	230	2300GW
New Gardenville Station	9	230	2300GW & FGK-230
Huntley Station	8	230	FK-439, 2300GW & FK-115
New Scotland Station 325	3	345	FGK-345
North Troy Station 123	5	115	GM-6B & FK-115
Temple Station 243	4	115	GM-6B
Terminal Station 651	3	115	FK-115
Woodard Station 233	3	115	FK-115
Yahnundasis Station 646	3	115	FK-439
Curtis Street 224	2	115	FK-439
Schuyler Station 663	2	115	FK-115
Golah Station	3	115	FK-115 & FK-439
Teal Avenue Station	2	115	FK-439

Summary

As can be seen from the above information, the transmission circuit breaker population is aging and showing signs of degradation. Failure to address the issues will increase the amount of maintenance required puts system reliability and customer service at risk.

Disconnect Switches

There are approximately 1,393 disconnect switches in upstate New York.

Condition and Performance Issues

All disconnect switches are monitored during annual thermo-vision checks and bi-monthly visual inspections. Disconnect motor mechanisms are also inspected on a 24 month schedule.

A number of disconnect switches were identified as being inoperable, difficult to adjust due to mechanical and electrical wear, having manual operating linkage problems, vulnerable to hot spots, or having lubrication problems. In the past year, National Grid's transmission system has experienced disconnect switch failures at the Kensington Terminal, Whitehall, and Gabriels substations.

However, due to the relatively minor function of disconnects there are, with the exception of Porter 230kV, no proactive plans for their replacement or refurbishment. A failure to operate is operationally inconvenient, but generally poses no system or safety risk. Disconnect switches will typically be replaced at the same time as their associated circuit breaker replacement (as previously noted) or when defective units are identified by operations personnel through the Problem Identification Worksheet (PIW) process.

A description of disconnect switches with condition issues are provided below.

- ITE MO-10 Disconnects – 115kV, 230kV, 345kV - There are nineteen of these disconnects in the service territory. These disconnects, installed between 1970 and 1984, have experienced a higher than normal rate of required hot spot repairs. The oldest two (1970) are at Bristol Hill substation.

    - Seven disconnect switches located at the Elbridge substation
    - Six disconnect switches located at Dewitt substation
    - The remaining ITE disconnect switches at Elm substation (3) and Reynolds Rd. substation (1).

- General Electric RF-2 Disconnects – 115kV & 230kV - Eighteen sets of GE RF-2 disconnect switches are currently installed on the 115kV & 230kV bus at Porter substation. These were installed in 1962. Several others have required repair using serviceable parts from retired switches.

- Haefly-Trench Disconnects- 115kV - Twelve sets of these vertically mounted gang operated switches have had insulator failure at various locations. The insulators are post type and failed where the porcelain and cap are bonded together.

- Westinghouse Type V Disconnect switches -115kV - These disconnect switches are either inoperable or limited to manual operation at Curtis Street, Packard, Huntley, and New Gardenville substations. They have experienced motor, gear box, and adjustment problems due to mechanical wear, operating linkage problems, bearing problems due to lubrication issues, and insulators failing due to water ingress and thermal action.

- R&IE Type TTR-49 – 115kV & 230kV - There are six R&IE Type TTR-49 disconnect switches located in the Packard 230kV yard and seven sets located at the Adams Switch station. These disconnects are old and in poor overall condition.

- Flying Ground Switches - This type of switch is primarily utilized in the Western Division (17 switches in service in the Buffalo area & two switches in service in the Albany area) as a transformer protective device and is manufactured by Haefly Trench and Delta Star. They are used as part of the transformer protection package where they apply a bolted fault to the system such that the relays at remote stations can sense it and isolate the station. These switches were installed in the mid to late 1950s and have experienced decreased operating times due to worn linkages and mechanism components. Further, these switches subject the transmission system to a second fault and interrupt more of the system than necessary. The time to operate the ground switch to initiate the line relays to remove the fault increases the amount of time the transformer is subjected to the fault possibly increasing damage to the transformer as well as increasing the likelihood of recordable events. Re-opening the ground switch to re-cock after an operation is also difficult due to adjustment problems. The units to be replaced are at Ridge Station, North Angola, Buffalo Station #55, Buffalo Station #54, Buffalo Station #61, Buffalo Station #129, Buffalo Station #60, Buffalo Station #78 and Trinity substation.

Remedial Actions Performed and Planned

- ITE MO-10 Disconnects – 115kV, 230kV, 345kV - These disconnect switches are monitored through annual thermo-vision inspections. Problems are corrected individually when identified. There were 7 sets of these replaced since the 2009 Annual Condition Filing.

- General Electric RF-2 Disconnect switches – 115kV & 230kV -. The #51 disconnects at Porter substation presently require repair and are being monitored.

- Haefly-Trench Disconnect switches - 115kV - A review was performed in August 2008 that will be the basis for a possible replacement project at Alcoa, Colton, Norfolk, and Parishville substations.

- Westinghouse Type V Disconnect switches -115kV – Generally, any issues on these disconnect switches are being addressed as they are identified. The disconnect switches at Huntley and Gardenville substations will be replaced with future station rebuild projects.

- R&IE Type TTR-49 – 115kV & 230kV - Issues with these disconnect switches are being addressed as they are identified.

- Flying Ground Switches - The most problematic switch, #3 at Ridge substation, was replaced, tested, and commissioned in July 2010. A strategy was approved in September 2009 to replace the remaining flying ground switches.

Many of the most problematic disconnect switches are being addressed in conjunction with their associated breaker replacement strategies and substation rebuilds.

Circuit Switchers

There are sixty-six S&C Type G and Mark II circuit switches in-service. In 2001 S&C Electric Company discontinued replacement component support for Type G and Mark II models. There is a lack of spare parts for these switches and increasing operational problems are being experienced in the system. The replacement of a circuit switcher generally requires the bus to be switched out to isolate the circuit switcher because there is typically no disconnect between the bus and the circuit switcher. The consequences of not doing this work will result in higher operation and maintenance costs as well as higher replacement costs under damage failure as opposed to a planned and scheduled replacement program.

A strategy was approved to replace thirty-nine of these circuit switches at the most critical locations. Also approved in the strategy are the purchase of 3 spare circuit switchers and one mobile circuit switcher to help mitigate the reliability and safety concerns associated with the remaining twenty-seven switches being left in service. These will be reviewed annually to review replacement priority and the possibility of expanding the strategy to include some of the remaining switches.

Summary

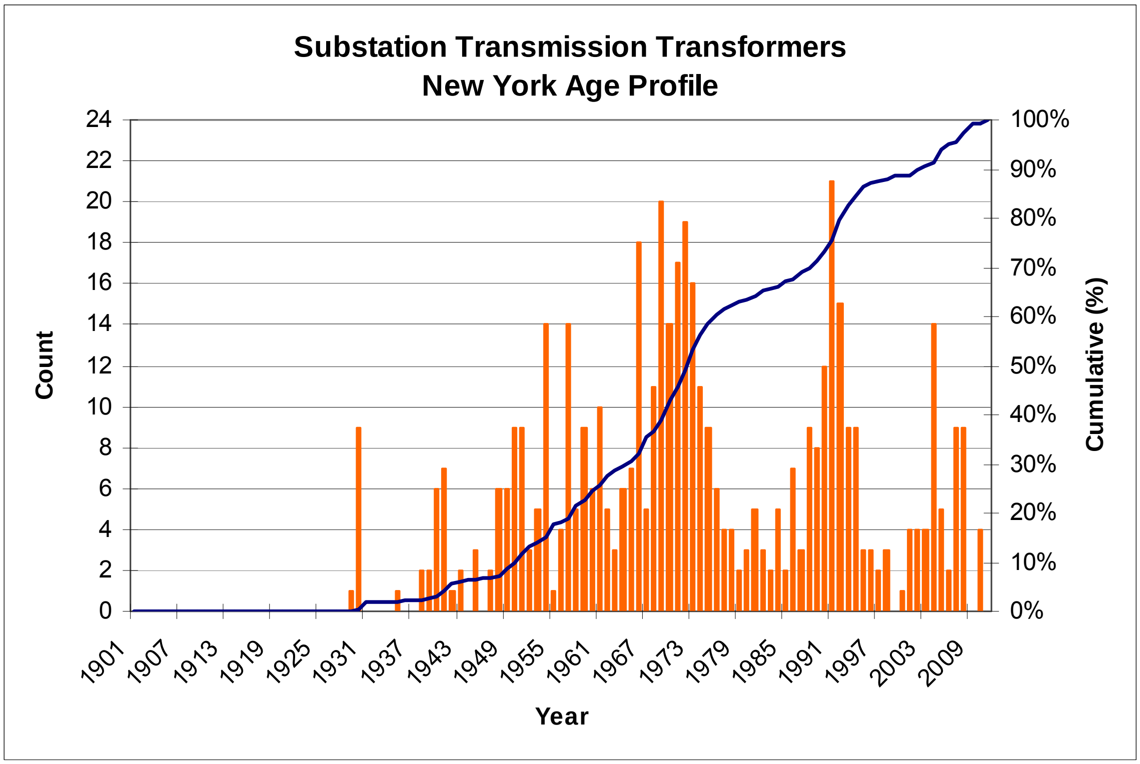
In general, disconnect switches do not impact reliability, however, certain types present potential safety hazards when the older porcelain insulators supporting the disconnect switch live parts fail. This failure mode typically occurs while the switch is being operated and may cause sections of the switch to fall towards the operator. The Company will continue to use the 'lead asset' approach to identifying replacement candidates and as such disconnect switches will typically be replaced in conjunction with their associated circuit breakers. In addition, they may be replaced individually through the PIW process or routine inspections.

Flying grounds are no longer considered a suitable method of fault clearance. Their arrangement introduces additional faults on the transmission system, creates a hazard to personnel, and may lead to additional transformer failures.

Transformers

The transmission system has a transformer population of 510 units of various manufacture, type, and power rating at primary voltages greater than 69kV. An age profile is provided in Figure II-10. There are currently 13 system spares for our transmission transformer fleet.

Figure II-10
NY Transformer Age Profile



The numbers of transformers organized by age group are shown in Table II-29.[19]

Table II-29
Transformer Age Profile

Age (Yrs)	0 - 19	20 - 39	40 - 59	60 -79	80 >	Total
# Transformers	100	151	174	59	10	494

Twenty-six percent of the total population of transformers is greater than 50 years old and the average age of the transformers on the system is 35 years. Transformers installed in the 1950s and 1960s are approaching the end of their useful life based on known deterioration modes.

[19] Sixteen units are without age data.

By 2021 the volume of transformers that may be in poor condition consistent with vintage could rise to 202 units. Although it is our standard practice to assess the condition and risk associated with each transformer, power transformer age, by itself, is a useful proxy to indicate which transformers may be less able to perform their function through accumulated deterioration. Paper insulation deteriorates with time and thermal loading history. As the paper degrades, the ability of the paper insulation to withstand mechanical forces is reduced and the mechanical integrity of the transformer is compromised when subjected to through faults or internal faults. In addition, the paper deterioration may lead to shrinkage of the winding packs thereby, reducing the mechanical stability of the transformer.

Given the possible substantial impact of power transformer failures on the transmission system, and the extensive lead times and disruption to normal operations, National Grid pursues a comprehensive approach to risk management of transformers. This includes thorough and regular reviews of the population and the generation of a 'watch list' of suspect and higher impact transformers for more frequent observation and review. National Grid also reviews each transformer individually to determine both condition and likely risks to the system before making a determination as regards to replacement or refurbishment requirements. Further, the Company is expanding its fleet of spare transformers to ensure there is adequate availability of units in the event of a failure given the long lead time for this equipment.

Condition and Performance Issues
It is National Grid's maintenance practice to perform Dissolved Gas Analysis (DGA) on transmission transformers annually. DGA is an online test and is a cost effective condition assessment tool that detects anomalous behaviors within transformers which may indicate a developing fault. Analysis of this data is performed using the IEEE Standard C57.104.1991. Suspect units are placed on an enhanced sampling schedule. Power factor tests are performed on the transformers and their associated bushings, and an assessment of the load tap-changer is performed during routine maintenance. Additional transformer testing such as Winding Impedance, Leakage Reactance, Transformer Turns Ratio (TTR), Excitation, and Sweep Frequency Response Analysis (SFRA) may be recommended if a review of DGA results indicate that anomalous results need to be investigated further.

Table II-30 provides condition codes for 2011 based on the most recent review. In 2011, twenty-four transformers were identified as condition code 4 due to elevated combustible gasses, poor transformer design, inadequate thermal capability[20] or no known available spares. In addition, these units are aging and may be better served by replacement rather than maintenance or repair. One of the units experienced an internal fault and will be removed from the system in a controlled manner.

Table 111-30
Transformer Condition Codes

Year	Code	1	2	3	4	Total
2011	TRF	442	25	19	24	510

[20] Transformers are designed to operate at certain thermal temperatures. If a unit is heavily loaded, this may exceed its thermal capability.

Most of the transformers that are condition 4 transformers are single-phase units, and if identified for future replacement, will be replaced with three-phase units.

The transformer condition codes are described as follows:

- Condition Code 1 – The transformer is expected to operate as designed for more than 10 years;
- Condition Code 2 – There is some deterioration or known type/design issues. There is obsolescence of equipment such that spares or replacement parts are not available. The system may require a different capability at the asset location;
- Condition Code 3 – The transformer condition is such that there is an increased risk of failure. Test and assessment identifies definite deterioration which is ongoing;
- Condition Code 4 – The transformer has sudden and unexpected change in condition such that it is of immediate concern; this may be detected through routine diagnostics, including inspections, annual testing, maintenance or following an event.

A transformer with a condition code 4 is not automatically replaced, but may receive additional diagnostic testing and evaluation to further ascertain its condition. As a result of the further review, the transformer may be revised to a lower condition code.

Remedial Actions Performed

The transformer watch list is based on condition and operational information, and is used to monitor those transformers which are of concern and to plan for a rapid replacement of the unit if its condition worsens. Table II-31 provides a list of transformers that are currently being watched. In some instances, further evaluation is necessary to properly understand the condition. Surveillance and regular DGA sampling will enable the Company to prioritize replacement appropriately.

There are 68 transformers identified in the 2011 “watch list”. Of the 34 identified in the 2010 Asset Condition Report requiring further evaluation, 16 units have been removed from the list based on acceptable test results and a favorable review by the company. Eighteen units remain on the present watch list and an additional 50 have been added totaling 68 to be watched. Many of the transformers have several condition issues, and they are categorized as follows:

- Twenty-six units have deteriorated winding insulation all of them are in poor condition consistent with vintage, two have experienced moisture ingress, and one unit contains elevated combustible gases.
- Thirty units are displaying elevated gasses. Twelve of the thirty units contain Acetylene, which is an indicator of high temperature arcing. Levels of Acetylene are typically present when a through fault occurs and will remain in the oil until the oil is degasified. Increasing levels of Acetylene are investigated immediately. Of these twelve units, most all contain stable levels of Acetylene, but continue to be monitored. Of the thirty units displaying elevated gasses, four also have wet oil and wet winding insulation, while five are of a poor design. Four units have hot spots, one unit has mechanical issues and four units have elevated gasses but have been stable for several years.

- Seven units are displaying signs of partial discharge due to elevated Hydrogen, while four of the seven units also have contaminated winding insulation.

- Three units have wet insulation and oil, while one also is of a poor design while the other is near end of life.

- One unit has mechanical issues with the Load Tap Changer (LTC).

- One unit experienced an internal fault; further diagnostic testing confirmed a turn-to-turn failure in one phase of the winding.

Since the 2010 filing, three transformers failed unexpectedly while in service. All three units where replaced with system spares.

- East Dunkirk Station 63 transformer number 2 suffered a high energy internal fault affecting phase C. A system spare was installed and a new system spare has been approved for purchase.

- Station 129 – Brompton Road transformer number 1 experienced an internal fault verified by a DGA sample and electrical testing. The load was transferred to an adjacent transformer. A system spare was installed, and a new system spare has been approved for purchased.

- Bethlehem Station 21 transformer suffered an internal failure on phase C. A system spare was installed, and a new system spare has been approved for purchase.

As a result of the latest transformer review, the number two transformer at North Akron Station was identified as having sudden elevated combustible gasses. An immediate DGA was pulled to confirm the previous test result, and plans were made to perform off-line electrical testing. The results indicated a turn-to-turn fault on one phase. Plans are being made to remove the unit from service and install a system spare. Another system spare is in the process of being approved for purchase.

Table II-31
List of Transmission Transformers on Watch

Substation	Equipment Description	Max MVA	High Side kV	Low Side kV	Tertiary kV	Age	Condition Code
Altamont	Bank 1	[redacted]	115	34	4.8	59	4
Altamont	Bank 1	[redacted]	115	34	4.8	59	4
Altamont	Bank 1	[redacted]	115	34	4.8	59	4
Edic	4 LTC TRF	[redacted]	345	115	13.8	28	4
Greenbush Station 78	3 LTC TRF	[redacted]	115	34.5	13.8	56	3
Harper	30 LTC TRF	[redacted]	115	12		62	3
Harper	40 LTC TRF	[redacted]	115	12		67	3
Hoosick	Bank 1	[redacted]	115	34	13.8	37	4
Hoosick	Bank 1	[redacted]	115	34	13.8	37	4
Hoosick	Bank 1	[redacted]	115	34	13.8	37	3
Huntley Station	120 LTC TRF	[redacted]	115	23.8		14	3
Kensington Terminal	4 LTC TRF	[redacted]	115	23		56	2
Kensington Terminal	5 LTC TRF	[redacted]	115	23		44	2
Lighthouse Hill #61	6B	[redacted]	115	34.5		59	3
McIntyre	2	[redacted]	115	23		49	2
Mohican	Bank 1	[redacted]	115	34	13.8	60	4
Mohican	Bank 1	[redacted]	115	34	13.8	60	4
Mohican	Bank 1	[redacted]	115	34	13.8	60	4
New Gardenville	4 LTC TRF	[redacted]	230	120	13.8	53	4
New Gardenville	3 LTC TRF	[redacted]	230	120	13.8	53	4
New Krumkill Station 421	1 LTC TRF	[redacted]	115	13.8		38	4
North Akron Station	2 TRF	[redacted]	115	34.5		57	4
North LeRoy Station 04	2 Trf	[redacted]	115	13.8		57	4
Oneida	4 LTC TRF	[redacted]	115	13.8		44	2
Porter Station 657	1 LTC Auto	[redacted]	230	115	13.8	52	4
Porter Station 657	2 LTC Auto	[redacted]	230	115	13.8	52	4
Rotterdam	7 LTC TRF	[redacted]	230	115	13.8	45	3
Rotterdam	8 LTC TRF	[redacted]	230	115	13.8	38	3
Rotterdam	Bank 4	[redacted]	115	34	13.8	63	3
Rotterdam	Bank 4	[redacted]	115	34	13.8	63	3
Rotterdam	Bank 4	[redacted]	115	34	13.8	56	3
Scofield Road Station 450	1 LTC TRF	[redacted]	115	13.8		42	3
Seneca Terminal	3 LTC TRF	[redacted]	115	23		72	3
Seneca Terminal	4 LTC TRF	[redacted]	115	23		72	3
Seneca Terminal	2 LTC TRF	[redacted]	115	23		71	2
Seneca Terminal	5 LTC TRF	[redacted]	115	23		60	2
Solvay 57	Bank 2	[redacted]	115	34		80	4

Substation	Equipment Description	Max MVA	High Side kV	Low Side kV	Tertiary kV	Age	Condition Code
Solvay 57	Bank 2	[redacted]	115	34		80	4
Solvay 57	Bank 2	[redacted]	115	34		80	4
Solvay 57	Bank 4	[redacted]	115	34		81	3
Solvay 57	Bank 3	[redacted]	115	34		71	2
Solvay 57	Bank 3	[redacted]	115	34		71	2
Solvay 57	Bank 3	[redacted]	115	34		71	2
Solvay 57	Bank 4	[redacted]	115	34		71	2
Solvay 57	Bank 4	[redacted]	115	34		61	2
Solvay 57	Bank 1	[redacted]	115	34		80	2
Solvay 57	Bank 1	[redacted]	115	34		80	2
Solvay 57	Bank 1	[redacted]	115	34		80	2
Teall Avenue	Bank 1	[redacted]	115	34		80	4
Teall Avenue	Bank 1	[redacted]	115	34		80	4
Teall Avenue	Bank 1	[redacted]	115	34		80	4
Teall Avenue	Bank 2	[redacted]	115	34		65	2
Teall Avenue	Bank 2	[redacted]	115	34		65	2
Teall Avenue	Bank 2	[redacted]	115	34		65	2
Teall Avenue	Bank 3	[redacted]	115	34		69	2
Teall Avenue	Bank 3	[redacted]	115	34		69	2
Teall Avenue	Bank 3	[redacted]	115	34		69	2
Teall Avenue	Bank 4	[redacted]	115	34		69	2
Teall Avenue	Bank 4	[redacted]	115	34		69	2
Teall Avenue	Bank 4	[redacted]	115	34		69	2
Terminal Station	2 LTC TRF	[redacted]	115	13.8		48	2
Vail Mills Station 392	3 TRF	[redacted]	115	69		38	3
Valley Sta 594	3-A	[redacted]	115	46		56	2
Whitaker Station 296	1 LTC TRF	[redacted]	115	13.8		33	4
Woodlawn	Bank 2	[redacted]	115	34	13.2	60	4
Woodlawn	1 LTC TRF	[redacted]	115	34.5	13.2	53	3
Woodlawn	Bank 2	[redacted]	115	34	13.2	60	3
Woodlawn	Bank 2	[redacted]	115	34	13.2	60	3

Summary

The in-service failure of a large power transformer can have significant operational and safety impacts especially where a tank breach and oil fire is concerned. The transformer population is routinely monitored and units with abnormal DGA levels and other condition issues will be subject to further testing and analysis. In addition, additional spare transformers have been ordered to ensure adequate coverage in the event of a transformer failure.

Battery Systems

Battery and charger systems provide the power to operate the substation relay and control systems which allow the station breakers to operate as designed. National Grid has a battery replacement policy requiring the replacement of all battery sets that are 20 years old or sooner if battery conditions through testing and inspection dictate as per National Grid Substation Maintenance Standards. The 20 year asset life is based on industry best practice and our experience in managing battery systems. Fifty-five battery sets will be over twenty years old between 2010 and 2016 as shown in Figures II-11 & 12 and Tables II-32 and 33.

Figure II-11
Battery Age Profile

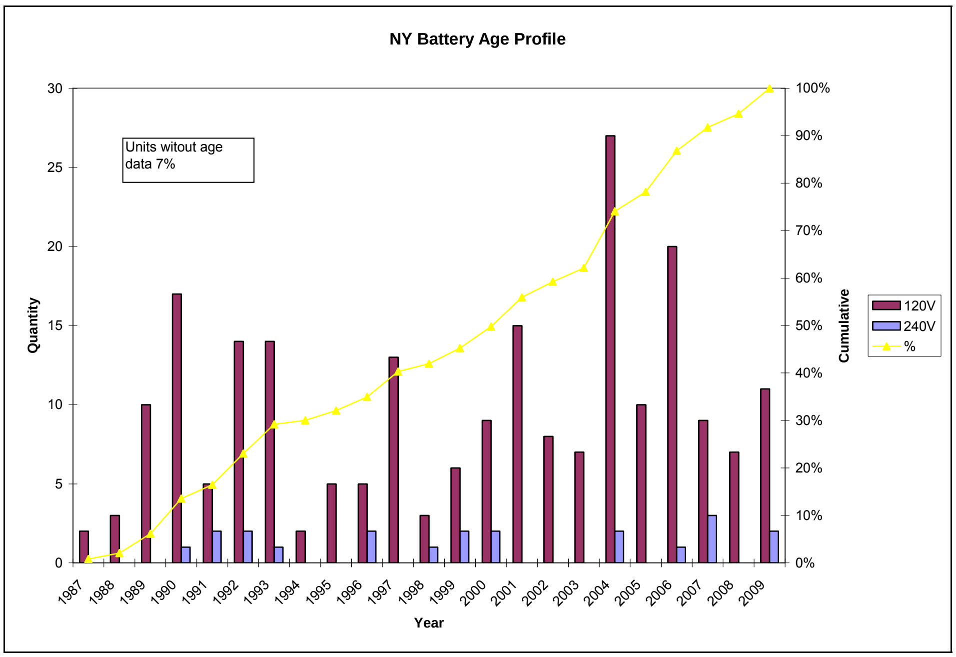


Figure II-12
Charger Age Profile

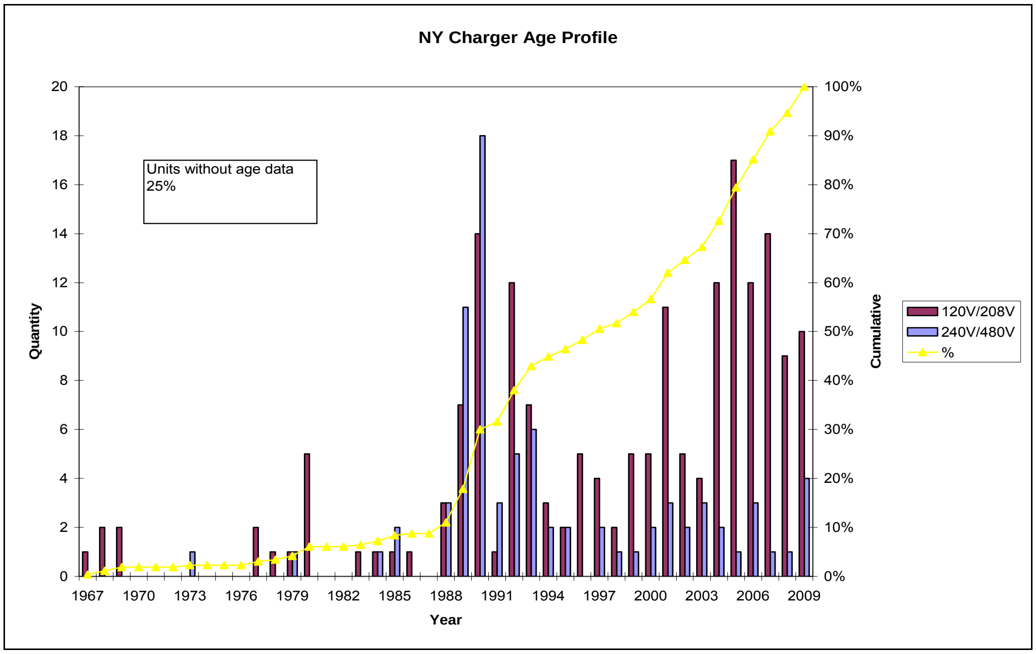


Table II-32
Asset/Age Profile

Asset/ Age Profile (Years)	0-4	5-9	10-14	15-19	20+	Total
Batteries[21]	63	70	37	58	15	243
Chargers[22]	72	49	24	71	47	263

Table II-33
Asset/Replacement Priority

Asset/ Replacement Priority	1	2	3	4	Total
Batteries[23]	134	22	17	86	259

[21] Batteries without age data is 17.
[22] Chargers without age data is 86.
[23] Less than one percent is without age replacement data.

Remedial Actions Performed
Between January 1, 2010 and July 31, 2011 the Company performed 210 inspections of battery and charger sets. The Company also performed 46 monthly inspections in New York Bulk Power Stations per NPCC D3 Bulk Power Battery Inspections.

Thirty five batteries and/or chargers have been replaced at the following substations from January 1, 2010 to July 31, 2011 according to the maintenance resource management tool Cascade that tracks equipment installations:

Brockport , Lapp , Machias, Mumford, North Akron, North LeRoy, Curtis Street, Malone, McIntyre, Terminal Station, Dewitt, Trenton, Woodard, Leeds(#1 & #2), Feura Bush, Trinity, Fairfield, Corning, Fire House Road, Stoner, Marshfield, North Troy, Butternut, Queensbury, Church Street, Scofield Road, Pinebush, Rotterdam, Center Street, Teal Avenue, Milton Avenue, Lawrence Avenue, Clinton, Bartell Road and New Scotland (#1 & #2).

Summary
The requirement for a safe and reliable DC battery system is paramount. A long term Battery Replacement Strategy Paper was approved by the Company in 2009. Battery systems will now have a planned replacement schedule or as condition warrants. Not adopting a planned replacement approach for battery systems will, in the longer term, lead to failures to trip and extended duration faults on the power system with the consequential likelihood of system instability.

Surge Arrestors

There are 691 surge arrestors at 115kV and above installed in the service territory. However, installation dates are largely incomplete as surge arrestors were typically classified as part of transformer installations. Available information suggests that up to 79 percent of surge arrestors are silicon carbide (SiC) type with a large volume estimated to be over thirty years-old.

Condition and Performance Issues
Due to condition and technology, SiC surge arrestors may no longer be effective. SiC gapped surge arrestors were manufactured and installed up to the mid 1980s. The technology is based on non-linear SiC resistors with a series controlled spark gap. The spark gap is in a controlled environment and provides the trigger to activate the arrestors into operation. Although effective, this design is now obsolete and no longer manufactured due to developments in new technology. Metal oxide (MOV) gap-less surge arrestors have replaced the SiC resistors and are now the preferred method to control lightning and switching over-voltages. The lightning protection capability of MOV arrestors is superior to SiC and they reduce the likelihood of damage to adjacent equipment and also reduce the risk to personnel from lightning and switching over-voltages.

In the past year, National Grid's transmission system has experienced surge arrester failures at the Buffalo Station #54 (08/18/2010), Seneca (03/26/2010), Dewitt (03/02/2010), Edic (02/19/2010), Bartell (11/18/2009), Greenbush (10/02/2009), Oakfield (09/30/2009), and Fly Road (09/17/2009) substations. The vast majority of these surge arrestor failures were silicon carbide type. Currently, the lifetime of a silicon carbide surge arrestor is anticipated by National Grid to be approximately 20 to 25 years. The integrity of SiC beyond this time frame cannot be guaranteed due to concerns over pollution performance, poor mechanical reliability (e.g. poor seals, internal corrosion, etc) and difficulty of monitoring the condition of the series gaps. Industry sources recommend that all silicon carbide arrestors in service over 13 years be replaced due to moisture ingress. Manufacturer's data suggests that moisture ingress is the direct cause in 86 percent of failures.

Remedial Actions Performed and Planned

SiC surge arrestors will be replaced with MOV surge arrestors when they fail, and when a transformer is being relocated or placed in service from storage. When a surge arrestor fails, any remaining non-MOV arrestors protecting a transformer or station bus shall be replaced at the same time. This is a more efficient program but requires toleration of SiC failure risk for longer periods of time. We reviewed programmatic replacement of SiC surge arrestors but concluded that this approach is not practical or efficient. Surge arrestors are co-located with their associated transformer and outage constraints would make the planned proactive replacement extremely difficult.

Relays

National Grid maintains electro-mechanical, solid state and microprocessor relay types on the transmission system for protection and control. The table below identifies the number of relays by type currently deployed on the transmission system.

Table II-34
Count of relays by type

Design Type	# of Relays	% of Total
Electro-mechanical	11,306	83
Solid State	574	4
Microprocessor	1,772	13
Total	**13,652**[24]	**100%**

Electro-mechanical relays range from 20 to 70 years old while solid state relays range between 20 to 30+ years. These devices are subject to environmental factors such as temperature cycling in the typical control house. Over time, these factors tend to adversely affect relay operational characteristics (accuracy and reliability) and therefore their lifespan. Solid state relays are susceptible to failures due to material decomposition of their discrete components such as resistors, capacitors and semiconductors. In some cases, repairs can be made, but normally, the entire circuit board or relay must be replaced. Repairs are difficult because manufacturers typically no longer support these families of relays.

Condition and Performance Issues

National Grid performs periodic testing of protective relays to ensure that the relay operates correctly and the overall protection scheme functions as designed. In addition to calibration and inspection of protective relays, communication systems utilizing leased lines, power line carrier and fiber are tested. The periodic testing results continue to

[24] In the 2010 Asset Condition Filing a total of 15,804 relays were reported. The Company verified and updated historical records for the relay population in the transfer to a new electronic database system known as CASCADE rather than the prior system AIMS.

validate our assessment that certain relay families and communication systems are at or near their end-of-life.

On average, 20 percent of National Grid's relay packages (all types) are tested yearly based on scheduled maintenance intervals. Issues identified by this scheduled testing include worn contacts, frayed insulation of wiring and Calibration drift. The testing has also identified electrical component failures i.e., capacitors, coils, resistors. The test results would show values out of their tolerance window.

Currently, relays are replaced based upon condition and performance issues and may also be replaced in conjunction with breaker or transformer replacements and station rebuilds for efficiency. Since the condition filing in 2010, National Grid has replaced approximately 91 relays. For a population of 14,000 relays, replacing on the order of 100 per year would result in a complete turnover every 140 years, well beyond the life expectancy of any relay. At this replacement rate, a significant number of relays would remain in service 60 to 90 years which may cause degradation in reliability performance. In addition, some of the earlier solid-state relays may need to be planned for replacement during this period (assuming an asset life of 15 to 20 years).

National Grid has developed an asset health review for protection systems to prioritize and implement replacement. The review has identified specific relay models that are problematic, obsolete or no longer supported by the manufacturer. Most of the relays in this group are vintage electro-mechanical and solid state relays. On this basis, National Grid estimates that approximately 5 percent[25] of electro-mechanical and solid state relays on the transmission system will be replaced over a period of 5 to10 years.

The Company has a Telecommunications infrastructure in place to support tele-protection systems for operation of the high speed transmission protection systems. The communications infrastructure is currently provided by a mix of internal and external facilities. Internally, the Company uses private fiber, power line carrier and microwave systems. Externally we use third party leased telephone lines from outside providers. In addition to replacement of communications equipment on condition, older analog communication channels need to be upgraded to digital to take advantage of modern digital protection and control devices.

Remedial Actions Performed and Planned

Since the 2010 Asset Condition report, National Grid has inspected and performed maintenance on 1,500 relay packages and replaced 91 relays on the transmission system.

As noted earlier, National Grid initiated a study to identify the worst performing relay families which include electro-mechanical and solid-state relays. The study reviewed the population of relay families for those relays that are at end-of-life, are functionally obsolete, are known to have family reliability concerns, or are considered obsolete because technical support and spare parts are no longer available from the manufacturer.

[25] Determined from the NY relay replacement study where 245 relays are prioritized for replacement.

The study identified about 245 relays and 36 communication packages requiring replacement. A strategy paper SG157 has been approved to replace the relays under a five to ten year program. In general, the replacement plan will be implemented on a line-by-line basis. When replacements are being done at a Bulk Power Station, NPCC A5 criteria will be reviewed.

For relay packages only replacements, the relay package upgrade will be installed in the existing control building. The relay package for a particular line or equipment will be identified and the scope of work will be defined to minimize the impact on the operational system. The new protection panel will be designed to fit into the position existing panels.

In some existing stations, a new control room may be required if the control room is in poor condition or can not meet the NPCC A5 criteria for bulk power stations. Additional factors such as limited space available for future expansion and new panels not meeting fire protection and security code, structural infirmity, poor HVAC performance for relays, etc. may trigger a need for a new control building. In these cases, all the relay packages installed in the old control room will be updated and replaced.

A separate strategy is under development to address new control rooms. The strategy is evaluating an approach whereby a prefabricated, control house, complete with pre-wired relay panels, can be ordered and delivered to a site and connected to the primary equipment. This approach, which will typically be utilized with station rebuild projects, has the advantage of replacing an entire control house worth of relays at once; and reduce the need for internal control house wiring which is time consuming and can be error prone. The equipment selected for the control house will adhere to the latest standards to ensure interoperability with other equipment so that advanced protection schemes can be applied. The IEC61850 data model will be investigated for future relay systems. National Grid will be initiating two projects to evaluate the applicability of IEC61850 compliant devices for both Transmission and Distribution substations in the hopes of leveraging the data model across all its substations.

National Grid continues to review and recommend upgrades to its communications infrastructure supporting the tele-protection of its transmission system. There is currently a heavy reliance on third party leased lines however further deployments of these lines is problematic due to higher costs and longer lead times associated with high voltage protection devices installed to prevent fault current being introduced into the communication circuits. The Company continues to investigate upgrading our internal communications infrastructure to support digital technologies for tele-protection as well as other applications. The upgrades may likely result in new fiber and microwave deployments in addition to the leasing of fiber strands or capacity in existing third party infrastructure. It is expected that any new architecture will evolve over time.

Summary

National Grid's protection and control systems date back many years and certain aspects of the system are showing its age. With the advent of digital technologies, we can upgrade our facilities resulting in greater capability and increased reliability. Our first priority is to identify the worst performers and establish the appropriate remedial action. Secondly, we are reviewing solutions that enable the "Smart Grid" with interoperability and increased insight into the stability of the electric transmission system.

Micro-processor based multi-function relays are an ideal choice for a cost effective method to implement the transmission system protection. The upgrading of old protection systems with micro-processor relays can offer the following features and benefits:

- Micro-processor relays have proven good quality and high availability.
- Improved sensitivity. The executing or comparator component of old relays can only be operated at certain levels.
- A micro-processor relay which replaces multiple discrete relays results in reduced CT secondary burdens.
- Greater protection and control functionality, self monitoring and the ability to record oscillographic information and Sequence of Events.
- Easy integration via network communications.
- Lower maintenance costs.

By replacing electro-mechanical and early generation solid state protection relays with technologically advanced integrated digital relays, performance, functionality and maintenance issues should see significant improvement.

Digital Fault Recorders (DFR)

National Grid currently has 20 digital fault recorders deployed that capture and store data from the power system during times of instability or system anomalies. The data is then downloaded to perform post-event analysis. The analysis yields detailed information about the state of the system before, during and after the event. Because of their benefits in understanding system incidents the Company has a strategy to increase the use of digital fault recorders on the system. Since 2004, the Company has added 11 new DFRs and replaced 2 of the existing units. Within the last year, the Elbridge DFR installation has been completed. Engineering is complete for the Huntley DFR replacement with an expected installation by March 31, 2012. Once Huntley is closed out the DFR Replacement Strategy will be complete and there will be 25 digital fault recorders deployed throughout the service territory.

Condition and Performance Issues

There have been no performance issued to date; however, the older DFRs are requiring more maintenance. At this time, the newer digital fault recorders have experienced good reliability. The newer units do not have sufficient operational history to project long term reliability of these devices but we would expect them to have approximately the same reliability as microprocessor relays since they are built on the same platform. We are experiencing increased maintenance on the seven older DFRs due to age related condition issues. These devices are based on an older platform and have spinning disk drives for storage.

As DFRs are not connected to any control devices, a failure will have no direct impact to system reliability. In the event there is a system anomaly and a DFR is not functional, it may be possible to determine the cause and source of some events by using data from recorders at remote locations.

Remedial Actions Performed and Planned

National Grid has been awarded funding under the American Recovery and Reinvestment Act (ARRA) as a sub-awardee to NYISO and in collaboration with other Transmission Owners in the state to deploy Phasor Measurement Units (PMU) that provide data relating to electric system stability. The Federal funding (DoE FOA-0000058) provides 50 percent of the cost of deploying PMUs at up to twelve transmission substation locations. The deployments will occur over a three year period with an effective start date of July, 2010.

As PMU capability can easily be added to newer DFRs, we expect to upgrade several DFRs to deliver PMU data and, where necessary, add stand-alone PMUs in cases where existing DFRs are of an older vintage.

Summary

The collection of digital fault information will increase the ability to identify the location and nature of system failures. The data can help engineers understand the waveforms of specific types of system events and use that knowledge to help categorize failures that would otherwise be unknown. The DFR data can also help determine the location of a system event so that respondents can more quickly respond to the area to identify failed or damaged equipment.

Remote Terminal Units (RTU)

NERC Recommendation 28, released in response to the August 2003 blackout, requires the use of more modern, time-synchronized data recorders. Many in-service RTUs do not satisfy this requirement and obsolete RTUs will not work with the modern Energy Management Systems ("EMS") the Company expects to implement in the first quarter of 2012.

There are approximately 550 operating RTUs under the Company's control, of which 158 transmission and distribution units are being replaced under an ongoing RTU replacement program (SG002). To date 87 projects are complete and 71 either in engineering or waiting to be installed.

Condition and Performance Issues

The RTUs are being replaced under this program for the following reasons:

- The target RTUs do not meet the criteria outlined in NERC Recommendation 28,[26] which places the Company at risk for being unable to provide synchronized system data during a system emergency.

- The target RTUs and equipment are obsolete and in most cases no longer supported by the manufacturer. Replacement parts are either difficult to obtain or unavailable.[27] Failure of the RTU may be un-repairable, requiring a complete

[26] North American Electric Reliability Council (NERC) "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations," April 5, 2004 Page-162

[27] SG002 – Revised Asset Replacement Strategy for RTUs, October 31, 2005.

unplanned replacement at short notice. This situation could occur when data from the failing RTU is most critical, such as during system events, resulting in reduced reliability performance.

- Test equipment is obsolete and cannot be readily obtained or maintained. The PC based test equipment required for maintenance was acquired in the early 1990s [redacted]

- The target RTUs are not suitable for future integration of new substation devices and technology. The equipment does not have and cannot be modified to provide the capabilities required for modern supervisory control and data acquisition.[28] This type of functionality is becoming standard to meet current reliability needs.

Remedial Actions Performed and Planned

The new RTUs being installed will provide more timely and reliable data than their predecessors. In the event of a minor or major system disturbance that may affect either the ability of the system to withstand further contingencies or customers directly, accurate data received in a timely manner is a necessity in the restoration process. Data received from the new RTUs will quickly identify key devices that have failed or have been affected by the event. The data will expedite isolation of the problem, reduce the duration of the outage and in some cases avoid expansion of the outage to other system components.

[28] SG002 – Revised Asset Replacement Strategy for RTUs, October 31, 2005.

Station Rebuilds

Station rebuilds are appropriate where the number of asset related issues within the station are such that they require a comprehensive plan for replacement to achieve cost efficiency and maintain the reliability of the system. Where a station rebuild is proposed, the Company will seek creative and innovative solutions that will avoid solutions in which the estimated costs exceed the potential benefits and consider all appropriate alternatives. It should be noted that certain station rebuilds will occur within the same footprint while others will essentially be green field construction in an adjoining location to the existing station.

Gardenville (Project C05156)

Gardenville is a 230/115kV complex south of the Buffalo area with two 115kV stations in close proximity referred to respectively as New Gardenville and Old Gardenville which both serve regional load. New Gardenville was built between 1959 and 1969 and has some minor to moderate asset issues. Old Gardenville feeds regional load via eleven 115kV lines and was built in the 1930s. It has serious asset condition issues including, but not limited to: control cable, circuit breaker, disconnect and foundation problems.

The station has had no major updates since it was built. Since 2004 there have been instances of busses tripping due to breakers not tripping for faults or other control issues. [redacted] Furthermore, there have been instances where lines have either tripped or failed to reclose due to bad wiring or other control issues. The worst condition control cables have been attended to in a separate project, but these are not considered to be permanent solutions. Rather, they are meant to correct control cable issues until all the cables can be addressed in a station rebuild.

The foundations at Old Gardenville are in extremely poor condition with more than half degraded and some even in full failure mode. This includes many structure foundations affecting the integrity of the structures themselves. Some circuit breaker foundations are in very poor condition raising the potential than an oil circuit breaker could move on its pad during a severe fault and lead to further damage and/or safety issues.

At New Gardenville there are 19 oil circuit breakers anticipated to be either at or above their interrupting rating by 2013. [redacted]

Due to low voltage problems on the 230kV system in the area, three 75MVAR capacitor banks are needed at the station. Mobile capacitor banks currently in service at Huntley have been recommended to be moved to Gardenville.

Strategy paper SG 112 to rebuild the Gardenville 115kV Station was approved on March 10, 2009 and is due to begin detailed engineering in FY12

Dunkirk (Project C05155)

Dunkirk Station is a joint substation shared at Dunkirk Steam Station, a Coal generation plant owned by NRG, and National Grid. The substation serves as an interconnection to the electrical grid at the 230, 115 & 34.5kV levels. The plant was originally constructed in the early 1950s by Niagara Mohawk as the owner of generation, transmission and distribution assets. National Grid's major equipment includes four transformers: two new 230/120/13.2kV 125MVA autotransformers and two 115/34.5kV 41.7MVA transformers supplying four 230kV, five 115kV and two 34.5kV lines as well as NRG's station service. National Grid retains ownership of most of the 230kV and 115kV switch yard; however, the controls are located in the generation control room owned by NRG.

There are many asset condition issues at the Dunkirk substation. The foundations are in poor condition in the 230kV yard, including many structure foundations, affecting the integrity of the structure itself. See Photo II-4.

Photo II-4
230kV Structure Foundation at Dunkirk

Some circuit breaker foundations are in very poor condition raising the possibility that an oil circuit breaker (OCB) could move during a severe fault leading to more damage and/or cause safety issues.

The five 230kV oil circuit breakers are Westinghouse type GW design (1958 through 1961) and have reached the end of their useful life. The 230kV Westinghouse Type O bushings are a concern as the power factor and capacitance results are trending upwards.

The 230/120/13.2kV autotransformers differential relaying is in need of upgrading to address inadequate relaying (presently there is no tertiary differential). The 230, 115 & 34.5kV disconnects have become more problematic and are at the end of their life. The 230kV bushing potential devices (BPDs) have become problematic as they age and the remaining BPDs will likely have to be replaced in the near future. Fencing around the yard is not compliant with National Grid standards and requires repair at the base or a berm built up to prevent animal entrance.

The control cable system in the 230kV yard is of particular concern. It is clear that the conduit system carrying control wires has degraded to the point that the integrity of the control wires has been compromised. Control wires inside the plant have also seen insulation degradation. In some cases, the wiring is so poor that troubleshooting abilities are limited for fear of handling control wires with degraded insulation. Grounds, alarms or breaker mis-operations happen more frequently during periods of heavy rain, indicating poor insulation below ground.

Within the last four years National Grid has replaced both 230-120-13.2kV 125MVA GE autotransformers with new ABB 230-120-13.2kV 125MVA autotransformers and all 115kV OCB's with new SF6 breakers, foundations and control cable.

The plant was originally constructed with generation and transmission distribution assets combined including station service, battery, relaying, alarm / annunciation, control and communications. All troubleshooting, maintenance testing, equipment replacement and upgrades require excellent knowledge of the plant operation. NRG and National Grid must maintain good lines of communication and shared updated prints to preserve operation continuance. The separation of assets would help avoid inadvertent trips to the generators and / or line breakers or any possible equipment failures.

There are parallel efforts underway to address these issues. In the short term, a project was approved to install a new cable trench in the 230kV yard in 2009 and was completed in the summer of 2010. Control cables deemed faulty can be replaced using these new facilities. Conceptual engineering has been completed for a new control house and completely separate assets rebuilt within the existing yard. Other equipment, such as disconnects and potential transformers deemed to be at end of life will be replaced in place during a project to install a second bus tie breaker scheduled for 2016 - 2017.

Rome Substation

The 115kV system at the Rome Station experiences periods of low voltage particularly if the tie-breaker is opened. The latest station condition assessment was performed 10/16/2008 and significant asset health concerns were noted: the 115kV disconnects are degraded and often fail upon operation; 115kV instrument transformers were built in the 1930s and have heavily weakened foundations; batteries and chargers have failed during bus outages; the control house has asbestos and deteriorated windows and doors; and the steel structure is heavily corroded with degraded footers illustrated in Photo II-5 below.

Photo II-5
Deteriorated Rome Station Structures and Foundations

The 115kV radial Levitt-Rome #8 line feeds approximately 100MW of load in the surrounding area and has had several outages resulting in lost customer minutes due to slow closing breakers which in prior condition assessments have been noted to have rusting and compressor oil leaks.

Furthermore, station property near the north bus section has been under environmental remediation the past several years due to a former coke plant at the site that produced natural gas which ultimately contaminated the site. Moving assets currently located in the North yard further from the site remediation and Mohawk River side of the yard would reduce the Company's exposure to involving them in future environmental clean-up plans.

A strategy paper SG123 proposing a station rebuild within the footprint of the current yard was approved in January 2010. Sanctioning was approved for the ordering of materials in August 2011 and sanction for final design is expected for November 2012. The solution includes moving the South bus capacitor bank, building a new control house and new north bus, relocating 115kV lines such that Rome - Oneida #1 and Levitt - Rome #8 terminate at the south bus and Boonville - Rome #3 and Boonville - Rome #4 terminate at the north bus, replacing assets deemed in poor condition in the south yard, and adding a line bypass switch between the Levitt-Rome #8 and Rome-Oneida #1 lines to reduce line outages due to substation faults or planned maintenance at the station. Targeted in service date for the new substation is fall of 2014.

Rotterdam (Projects C32849 & C34850)
Rotterdam is a large substation with 230kV, 115kV, 69kV, 34.5kV, and 13.2kV sections spread out over multiple tiers on a hillside [redacted] The 230kV yard has had performance issues and one catastrophic failure of a Federal Pacific Electric ("FPE") breaker. These breakers, pictured in Photo II-6, have horizontal rotational contacts inside their tank as compared to vertical lift contacts in newer style oil circuit breakers. FPE breakers are no longer manufactured and spare parts are not available. There are two spare SF6 gas circuit breakers stored at Rotterdam to replace the FPE breakers if one were to fail at this station.

Photo II-6
Federal Pacific 230kV Breakers at Rotterdam

Two of the three 230kV auto transformers (#7 & #8) are proposed for future replacement. This family of Westinghouse transformers have shown a higher than normal failure mode in the industry due to their design (specifically, due to T beam heating and static electrification). The internal design leads to “hot spots” in the transformer windings that generate hot metal gases that could lead to transformer failure.

All of the Thyrite (Silicon Carbide) style of surge arrestors in the 230kV yard should be replaced with the newer MCOV (Metal Oxide) style arrestors (refer to Surge Arrester section above). This will improve the voltage performance of the arrestors that protect the station equipment.

Many of the 115kV breakers and disconnect switches are showing signs of degradation and have had issues in the past with equipment damage or not operating correctly. The concrete foundations supporting the breakers and structures, the differential, and voltage supply cabinets are all in very bad shape and require repair or replacement. Some need attention now and others within the next 5 years.

A master plan for the site was developed to address the sequence the station should be rebuilt with an emphasis on the overall station needs, stability and reliability, maintenance and future upgrade possibilities. The master plan identified that rebuilding the 115kV yard first would provide the best value and most flexibility for rebuilding and reconfiguring the 230kV yard in the future. Improvements expected by rebuilding the 115kV yard first, include the reduction in the number of transmission line crossings, easier access and maintainability, and greater operating reliability and efficiency.

There are many factors that will help determine the appropriate configuration of the 230kV yard in the future that are still being identified and studied, therefore it is premature to recommend a 230kV rebuild alternative at this time. Studies need to be performed to determine which voltage classes should remain at the station, retired, or relocated, to simplify the overall rebuild project to minimize costs.

Lockport (Project C35464)
Lockport is a major 115KV transmission Station with thirteen 115kV transmission lines tying through the East and West Bus sections. This station is critical to the 115kV system operations of western New York. The overall condition of the station yard and control room is poor. Work is required on control cable duct banks, breaker operators, structure painting and concrete equipment foundations that are significantly deteriorated.

Lockport was originally part of the 25 cycle system dating back to the 1910's. There are still 25 cycle oil filled equipment remaining at the station including an oil circuit breaker and three transformers. The equipment has been determined to be non-PCB and sanction request approval for a project to drain the oil and retire the equipment is being proposed in October 2011.

The structures are severely rusted and in need of painting before the steel is compromised. Photo II-7 illustrates the typical steel condition at the Station. Column and breaker foundations are also in deteriorated condition and need to be repaired with several potentially needing full replacements.

Photo II-7
Deteriorated Steel Structures at Lockport

The original manhole and duct system for control cables is in degraded condition which have caused control wire shorts, battery grounds and unwanted circuit breaker operations. Station maintenance crews are restricted in performing repairs due to the overall condition of the duct bank because single control cables cannot be replaced without adversely affecting adjacent control cables in the same ducts.

There are two new 115kV SF6 Breakers while the remaining forty-year old 115kV, oil filled, BZ0 breakers show exterior rust and oil stains. Three of the 115kV oil breakers have continued hydraulic mechanism leaks common to the BZO style breakers. Failures of hydraulic system components have been notably increasing. Each of the oil BZO breakers has bushing potential devices which have been another source of failure.

Transformer #60 is a 115-12kV 7.5MVA transformer manufactured in 1941 which supplies Lockport's station service and Race Street Line 751. Race Street Line 751 is tied to the Race Street seasonal hydraulic unit. An alternate station service should be provided should TR #60 or station service fail.

The control room building is also in very poor condition and requires paint and floor repairs. Existing peeling paint is likely lead contaminated. It is an oversized building with continued maintenance costs for the original roof and the intricate brickwork. It contains a 90 ton overhead crane in the old 25 cycle frequency changer portion of the building which is presently used only to store old cable. The control house roof was repaired in the 1990's and brick pointing was also done to limit deterioration within the last 5 years. The old 25 cycle control circuitry has been disconnected with the DC battery to eliminate potential source of battery ground problems. Rodents are a frequent problem and signs of control wire damage are evident.

Line 103 & Line 104 transfer trip communication equipment needs to be upgraded and is a continuous source of problems. The communication equipment should be relocated to the communication building adjacent to the microwave tower on site. This would then allow for the demolition of the frequency changer building independent of the main building.

Conceptual engineering to rebuild the station in place was completed in June 2010. The project has been deferred for further consideration in FY2017.

Lighthouse Hill (C31662)

[redacted]

The condition of the station is fair to poor depending on the specific assets being considered. An integrated plan has never been developed for the station since numerous relay upgrades have been performed without any improvements to the station itself. The disconnect switches are in very poor and hazardous condition with failed insulators and repairs appear to work only temporarily due to the design configuration. Most of the oil circuit breakers (OCBs) are in fair condition, but several are obsolete and would pose a challenge to significantly repair.

The seven OCBs are located 200ft from the Salmon River located about 70ft below the grade elevation. The station is located a mile up stream of the NY State wildlife fish hatchery. Although the risk is low, any significant oil spill in the station would have a significant environmental impact. There is also the risk of a flooding event at the station given its elevation and proximity to the river.

The 6B transformer has a history of gassing and replacement should be considered in the next few years. It is included on the transformer watch list in Table II-31.

Another significant issue at the station is that the land is owned by Brookfield Power and operated as a shared facility under a contractual agreement. The hydro station was previously owned by Niagara Mohawk. Not having direct access to Brookfield's control room at Lighthouse Hill is not an ideal situation for National Grid [redacted] See Photo II-8 illustrating the proximity of the site to the Salmon River.

Photo II-8
Brookfield's Generating Station at the Lighthouse Hill Site

Conceptual engineering for a new substation, relocated to a greenfield site along an adjacent road in the clearing near the transmission right-of-way and away from any flooding risk, was completed June 2010.

Huntley

In 2005, NRG (the owners of the Huntley Generating Station) announced the retirement of the four 115kV connected generators at Huntley. Due to this, the Company began planning for area reinforcements which included the construction of the Tonawanda substation. For the period 2006 – 2009 National Grid continually reviewed available load data and confirmed that reinforcements were still necessary.

In 2010 new load data showed the economic recession had adversely impacted the Western New York area with significant reductions in load and future load forecasts. This started a comprehensive review of the area reinforcement plan which found no N-0, N-1 or N-1-1 thermal or voltage contingencies in the Huntley area through the year 2025. Justification for the Company's Tonawanda substation and Frontier Rebuild projects no longer existed (though other previously identified projects in the Frontier, Genesee and Southwest region are still needed).).In 2011 updated load data was reviewed and analyses again found no N-0, N-1 or N-1-1 contingencies in the Huntley area.

Based on the condition of assets at the Huntley Station and circuits in the region, the Company updated its plan in lieu of the Tonawanda substation and Frontier Rebuild projects which were cancelled. It was decided to proceed with condition based improvements at the Huntley substation and some area transmission lines (the line refurbishments will be modified, if necessary, to address potential long term capacity needs).

National Grid started the process to investigate the Huntley substation asset condition in 2010 to identify station needs. Among them were the requirement for a permanent capacitor bank at the Huntley 115kV bus to replace the mobile banks currently there, improve the grounding in the switchyard, remove all of National Grid's controls, batteries and communications equipment from inside the Huntley Generating Station to a control house in the yard (both 115kV & 230kV), adding a second station service supply, refurbishing the existing oil circuit breakers, replace the potential transformers, install new CCVT's for 115kV and 230kV relaying, and refurbishing the 230kV cable pumping plant.

The permanent capacitor bank at Huntley is expected to be sanctioned in September 2011. Conceptual engineering evaluating the different alternatives addressing Huntley's needs was completed November 2010.

Boonville

The Boonville substation is degraded due to age and design. The station was constructed in the 1950's and originally designed as a switching station for several 115kV transmission lines and the single source of the radial 46kv line to Alder Creek, White Lake, Old Forge, Eagle Bay and Raquette Lake. The use has not changed with the exception of the addition of a 23kV terminal for hydro generation.

The structural steel and foundations are deteriorated. The foundations have deteriorated due to the poor station drainage. The station was built alongside highway 12D in a farm field. Over the years it has ended up at an elevation lower than the highway and farm fields leaving drainage to no longer exist. This drainage issue is also present in the underground manhole and conduit system. The water surface level at the station causes the underground control cables to continuously be under water leading to their deterioration.

Electrically the station was designed with minimal redundancy and has antiquated relaying protection. The design has the single source transformer for the 46kV line to the Old Forge area connected off the south 115kV bus with no alternate method to supply the transformer if the south bus is out of service. The 115kV to 46kV transformer was replaced in the 1990's, but is still the only source and can not be maintained properly due to outage restrictions. With no distribution at Boonville there is little need for a mobile sub connection. But there is a spare transformer for the 115/46kV TB#3 located at the station.

All of the electrical components at the station such as oil breakers, oil filled potential transformers and switches require replacement. The station control building is of brick design and needs reconditioning. The size of the building has also become an issue with the addition of EMS and relay upgrades over time. Also, the station perimeter fencing needs replacement on 3 sides.

II B. Sub-Transmission System

This section provides the condition of elements of the sub-transmission system including overhead and underground segments[29]. National Grid gathers data and monitors assets in a proactive manner to improve asset information, to ensure that any increasing trends in asset condition causing reliability issues are identified and to ensure that the system is fit for purpose.

Chapter 4, Exhibit 4 contains the second quarter, 2011, summarized results from the Inspection and Maintenance program for sub-transmission activities from January 1, 2009 through June 30, 2011. Program activities generate asset condition information and remediate asset condition issues. The table does not include the quantities of assets found in acceptable condition.

On-going and planned work is identified in the annual, five-year capital investment plan report.

Table II-35 summarizes the key overhead and underground sub-transmission assets.

Table II-35
Sub-Transmission Asset Types and Inventory

Sub-Transmission Main Assets	Inventory
Towers/Poles	63,400
Line Circuit Miles	4,800
Underground Cable Circuit Miles	1,100

The overhead information in this table is based on a helicopter survey, as first mentioned in the 2009 asset condition report. Underground information is based on paper records. Data conversion from the survey and records into GIS is on-going; with one of three divisions (Eastern) completed. The asset inventory will be maintained in GIS once the data conversion is complete. All new work is being entered into GIS for the Eastern Division. Inspection and Maintenance program work and survey data will be used to update the GIS data once the data conversion is complete.

[29] The discussion in this chapter is limited to overhead and underground line assets; substation assets defined as sub-transmission are covered in a Section D of Chapter II.

Overhead System

Table II-36 provides a breakdown of the sub-transmission system structures.

Table II-36
Tower/Pole Types

Asset	Inventory
Steel Lattice Towers	3,173
Wood Poles	58,978
Steel Poles	464
Unknown Type	736
Total	**63,351**

The figures in this chart were obtained via helicopter survey. Tower structure type could not always be determined from the original helicopter survey. Converting the data to GIS required a more through review. The review and on-going work in the Inspection and Maintenance program are expected to reduce the number of "Unknown Type" structures in future asset condition reports.

Steel Towers and Steel Poles
Table II-37 shows a more detailed breakdown of the Inspection and Maintenance program results for sub-transmission steel towers and poles. The visual grading system described previously for transmission structures is also used for sub-transmission towers.

Table II-37
Sub-Transmission Steel Towers and Steel Poles Inspection Results[30]

Level	Loose Bolts	Structural Damage	Tower Legs Broken	Vegetation on Towers	Total	Percentage Codes Completed
2009 Summary						
1	0	0	0	0	0	-
2	0	2	1	0	3	100%
3	5	3	0	2	10	20%
2010 Summary						
1	0	0	0	0	0	-
2	0	0	0	0	0	-
3	1	1	0	0	2	0%
2011 Progress to Date (01/01/11 to 06/31/11)						
1	0	0	0	0	0	-
2	0	2	1	0	3	0%
3	3	27	0	33	63	0%

In addition to the I&M program, supplemental inspections are performed by the Engineering group and contractors to determine design fixes for the towers in the most

[30] Assets inspected include steel structures and poles.

deteriorated condition. An additional 25 towers have been reviewed and are planned to be replaced before or during FY13. Footing inspections on some lines have also been undertaken with reinforcing and painting planned for selected lines.

Wood Poles

Table II-38 shows a more detailed breakdown of the Inspection and Maintenance program results for sub-transmission wood poles. The most frequent four asset condition codes are shown in the table. A summary of all categories is shown in Exhibit 4.

Table II-38
Sub-Transmission Wood Pole Inspection Results[31]

Level	Visual Rotting	Wood Pecker	Insects	Leaning Pole	Total	Percentage Code Completed
2009 Summary						
1	0	0	0	0	0	-
2	15	23	0	2	40	100%
3	335	223	47	32	637	28%
2010 Summary						
1	0	0	0	0	0	-
2	14	8	0	0	22	86%
3	378	64	28	9	479	2%
2011 Progress to Date (01/01/11 to 06/31/11)						
1	0	0	0	0	0	-
2	64	20	0	0	84	86%
3	343	110	45	8	506	10%

Interruptions caused by pole related issues are not significant as most pole problems are safety and environment related. While the Company has not experienced a large number of pole failures, National Grid plans to maintain or improve the pole age profile in order to mitigate any possible future increases in failure rates as condition of the poles become worse. Poles are replaced based on condition as identified through the inspection and maintenance process described above. Additional poles may be added based on field walk-downs performed by engineering or based on helicopter aerial surveys which identify rotted pole tops.

Overhead Conductors

There are approximately 4,800 circuit miles of sub-transmission conductor. In the near term, a program to replace conductors based on asset condition will be phased out after on-going refurbishment projects are completed and this work is transitioned to the Inspection and Maintenance program[32] or where reliability or performance warrants replacement. Reconductoring will also be performed when poles are replaced or relocated if conductors are identified as being near their thermal limit or identified to be in poor condition.

[31] The total and percentages in this table represent the four most frequent codes in this table only. All categories of wood pole asset condition codes are found in Exhibit 4.
[32] Page II-91, 2011 Transmission and Distribution Capital Investment Plan Report.

Overhead Line Removals

A number of sub-transmission lines have been retired in place and projects to remove the de-energized facilities are typically initiated if and when the condition of the line warrants maintenance or repair. The annual five-year capital investment plan report lists on-going removal projects to remove sub-transmission lines that are no longer in service. Table II-47 identifies completed sub-transmission projects since the last asset condition report.

Sub-Transmission Automation

On-going work in the sub-transmission automation program is listed in the five-year capital investment plan report. All work is on schedule. Two projects in the Western Division have been completed since the last asset condition report.

Rights-Of-Way Widths

National Grid has extensive sub-transmission overhead line facilities on cross-country rights-of-way. A critical factor in the reliability of the sub-transmission assets is the relatively narrow width of the ROW as well as the relatively low height of the conductors making the danger tree issue very important. A ROW widening program designed to address danger trees adjacent to sub-transmission rights-of-way was initiated in the mid 1990s. Approximately 1,500 miles of the 2,600 miles of sub-transmission ROWs were widened through 1998. Beginning in late 2005, National Grid renewed the sub-transmission widening program which continues where property rights or landowner permissions allow.

In 2010, 151 miles of widening was completed. Per unit costs for this program vary based on various attributes such as tree density, topography and land use. As we draw closer to the end of the program the costs per unit continue to increase due to these physical constraints in many cases becoming more restrictive. The company will continue with the program until all ROWs are completed while monitoring costs to ensure practical benefits will be achieved.

The most current reliability data will be used to maintain and prioritize the list of widening candidates in conjunction with the encroachment reports from helicopter surveys and forester knowledge of the condition of the line. Sub-transmission lines, once completed are placed on regular cycles for floor maintenance and danger/hazard tree reviews. Some lines have easement restrictions that prevent establishment of an optimal right-of-way width. Where necessary, the Company will investigate the acquisition of rights where permissions are not currently granted.

Underground Cables

There are approximately 1,100 miles of sub-transmission underground cable. Planned cable replacements are driven by cable condition and performance history. Approximately one-half of the population is more than 47 years old and one-third is more than 60 years old. The underground sub-transmission system consists primarily of paper-insulated lead-covered (PILC) and ethylene propylene rubber (EPR) type cables. There are also some Low Pressure Gas Filled (LPGF) type cables in the underground system.

The sub-transmission underground cable asset replacement program replaces cables that are in poor condition, have had a history of failure, or of a type known to have performance issues. Candidates for replacement are also evaluated based on loading considerations.

Cable Condition and Performance Issues

Cable failures are tracked, but do not usually have an impact on reliability as the sub-transmission underground system is networked and individual cable failures will not necessarily lead to an interruption of customers. Locations with frequent failures are targeted for cable replacement. In 2011, some aerial cables that were 30-60 years old and had experienced past faults were replaced with newer Hendrix and Kerite aerial cables and new overhead conductor.

Remedial Actions Performed
Table II-39 contains completed sub-transmission projects since the last asset condition report that are not in the Inspection and Maintenance category.

Table II-39
Completed Sub-Transmission Projects as of July 31, 2011

Division	Line Name	kV	Scope
Central	Lowville - Boonville 22	23	Refurbishment
East	Maplewood - Latham 9	34.5	Refurbishment
East	Vischer - Woodlawn	34.5	Refurbishment and partial relocation
West	Kenmore – Winspear 630/631	23	Replace approx 0.5 miles aerial cable with Hendrix cable
Central	Alder Creek - Old Forge 23	46	7 miles relocation for NYSDOT road work
West	N. Leroy - Attica 208	34.5	Refurbishment
East	Rotterdam – Schoharie-Middleburg	69	Relocate structures due to creek problems
Central	Trenton - Whitesboro 25	46	Reconductor 6 miles and rebuild
West	General Mills - Ridge 611-613 Arrestors	34.5	Add lightning arrestors every 2-3 structures
West	Chau Co. Landfill Tap 859	34.5	5 mile new 34.5kV line for non utility generator
East	Shore Road - Rosa Road (Glenridge) 5	34.5	NYSDOT relocation
Central	Alder Creek - Old Forge 23	46.	Alder Creek bypass
West	Line 26H tap to Unifrax	23	Second tap to customer in Tonawanda
East	Great Escape Tap	34.5	Build new line to customer in Glens Falls
Central	Whitesboro/Pleasant-Schuyler	46	Replace towers due to deteriorated condition and damage
West	Youngmann 605/606	34.5	Rebuild
East	Fulton County Landfill	69	Tap to new non-utility generator
Central	NYSTA Trenton - Whitesboro 25	46	Relocation for NYS Thruway
West	Lockport - Maple Road L92E and L92W Removal	34.5	Removal of a portion of the line
East	McClellan - Bevis #11	34.5	Replace 0.9 miles underground and 0.5 miles aerial cable and poles
Central	Alder Creek - Old Forge 23/Old Forge - Raquette Lake 22	46	Old Forge bypass
East	Newtonville - Patroon 16	34.5	Refurbishment
West	Batavia - Attica 206	34.5	Pole replacement
West	Medina - Albion 305	34.5	Refurbishment
East	Market Hill-Amsterdam 11	69	Remove tap to Mohasco lower mill
East	Johnstown – Market Hill	69	Remove tap to Mohasco upper mill

II C. Distribution System

This section provides the condition of assets in the distribution system including overhead and underground assets.[33] National Grid continues to gather data and monitor assets in a proactive manner to improve asset information, identify trends in asset condition causing reliability issues, and ensure that the system is safe and adequate to provide electric service. Because the population of certain assets in this system is very large, even a small portion of the population requiring maintenance or replacement can become a significant annual management issue.

Chapter 4, Exhibit 5 contains the Second Quarter, 2011, Inspection and Maintenance Report summarizing program results from January 1, 2009 to June 30, 2011. Program activities generate asset condition information and remediate asset condition issues. The report does not include quantities of assets found in acceptable condition. More detailed analysis of asset condition for certain assets follows below.

On-going and planned work is identified in the annual five-year capital investment plan report.

Table II-40[34] is an inventory of distribution overhead and underground system assets. National Grid continues to improve our asset reporting methodology, data collection and data. In an effort to standardize our reporting, the table is now in the same format as, and based on, the Asset Inventory Report, a new, weekly report posted internally at National Grid. The new reporting is based on information available in the asset data warehouse. This year, the table includes an explanation of the variance to last year's report. Of significance, the new reporting is by location rather than units (except for elbows). Each location can contain more than one unit. As an example, a count of "one" transformer location can include one single-phase distribution transformer or three single-phase distribution transformers that comprise a three phase bank. The data in the tables is reported directly from the asset data warehouse, has not been rounded, and the precision of the information should not be assumed to the degree of significant digits.

[33] The discussion in this section excludes substation assets, which are covered in a separate section of this chapter.

[34] The table is based on the weekly Distribution Asset Installation Counts published 8-2-11. The report was not available last year. This weekly report does not include Primary Conductor and Primary Underground Cable, which were obtained by a separate query as of July 31, 2011.

Table II-40
Summarized Distribution Line Asset In Service Quantities

Asset (Note 1)		Quantity (Note 2)	2010 Report	Comment
Blade Cutout	OH	13,778	Note 3	
Capacitor	OH	4,868	4,800	
Elbow	UG	32,907	-	Not Reported
Fuse Cutout	OH	164,798	Note 3	
Handhole	UG	70,252	-	Not Reported
In Line Fuse	OH	289	Note 3	
Manhole	UG	11,979	Note 4	Previous report incl. pullboxes
Line Regulator	OH	2,179	3,460	Note 2
Pole	OH	1,236,362	1,234,400	
Pullbox	UG	5,010	Note 4	Was incl. in manhole count
Line Reclosers	OH	1,256	1,170	Increase from recloser program
Switch Bypass	OH	3,428	-	Not Reported
Switchgear	UG	3,079	3,100	
Switch Overhead	OH	23,958	-	Not Reported
Switch Underground	UG	58	-	Not Reported, Not OFCs
Transformer Overhead	OH	331,642	Note 5	
Transformer Underground	UG	66,167	Note 5	
Ratio Transformer OH	OH	12,364	Note 5	
Ratio Transformer UG	UG	117	Note 5	
Vault	UG	1,780	1,800	

Note 1: The weekly inventory report, as posted on National Grid's intranet, includes streetlight structures, pads and oil fused cutouts (OFCs). Streetlight structures and pads were removed from this table because of data quality. OFCs were removed because they have all been replaced in New York.

Note 2: Except for elbows, the new reporting is by location rather than units.

Note 3: All cutouts were combined in the 2010 asset condition report. They are separated here to match the weekly inventory report. Also, the 2010 report was a unit count, while this year's table is a location count, also to match the weekly inventory report.

Note 4: Manholes were reported combined with pullboxes in the 2010 Report as 16,900. The combined count of manholes and pullboxes in this report is 16,989.

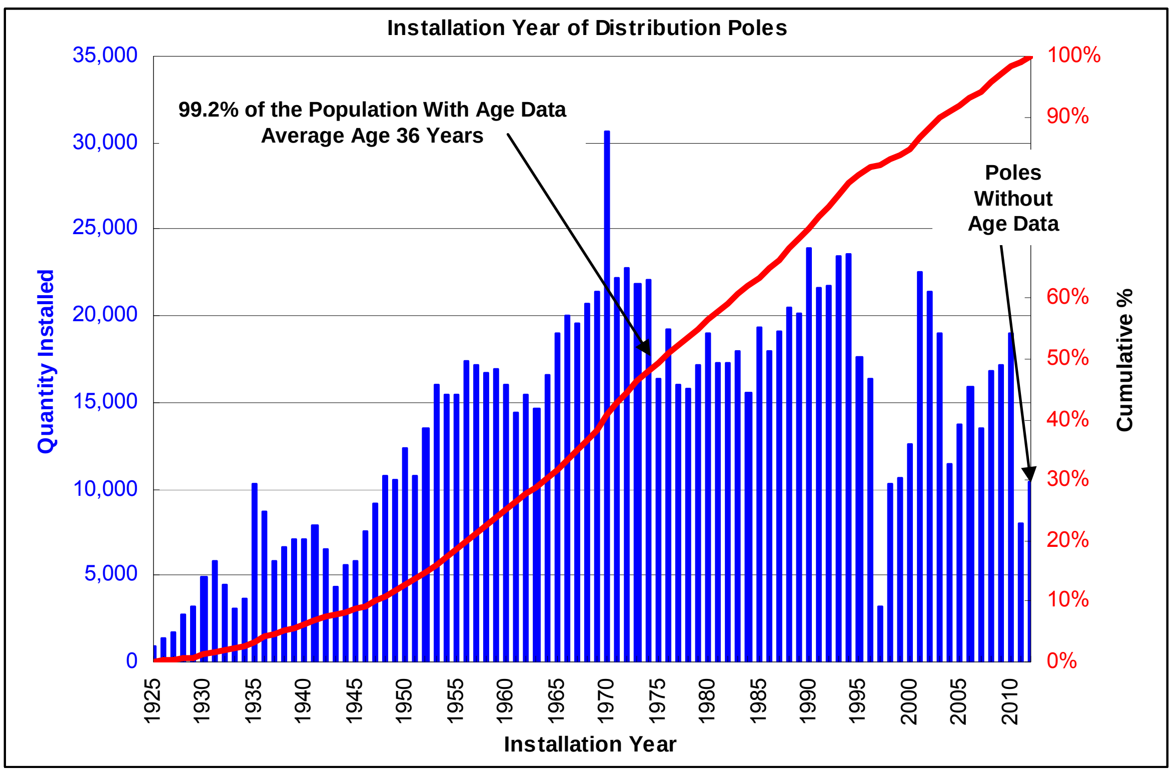
Note 5: Transformers were reported combined in the 2010 Report as 448,700. The combined count of transformers in this report would be 410,290. The 2010 report was a unit count rather than a location count.

Overhead System Assets

Wood Poles

Distribution structures include poles, system grounding, anchors and guying, crossarms, and riser pole equipment. There are approximately 1.23 million distribution poles on the system with an average age of 36 years (Figure II-13). Distribution structures are in generally good condition, with more than 98 percent of structures inspected found in acceptable condition. The following information addresses all poles regardless of material[35]. Some of the distribution assets are also attached to transmission and/or sub-transmission structures. The condition of those structures is discussed in either the transmission or sub-transmission section of this report rather than this section, as the distribution component is ancillary to the structure.

Figure II-13
Age Profile of Distribution Poles[36]



[35] Fewer than 1,000 (0.08 percent) of distribution poles are made of a material other than wood (i.e. concrete, fiberglass, or steel).
[36] 10,394 poles without age data were listed. Poles with installation dates prior to 1925 are included as without age data.

Condition and Performance Issues

In Exhibit 5, the Distribution Overhead Facilities, Poles, Pole Condition heading summarizes the results of the Inspection and Maintenance program. Table II-41 shows a more detailed breakdown of the program results, including the four most frequent maintenance codes found.

Table II-41
Distribution Wood Pole Inspection Results[37]

Level	Visual Rotting - Top	Visual Rotting - Ground	Leaning Pole	Wood Pecker	Other	Total	Percentage Completed
2009							
1	4	3	0	0	7	14	100%
2	534	664	104	96	162	1,560	100%
3	3,824	1,647	1,038	101	5,152	7,968	44%
2010							
1	3	12	0	0	11	26	100%
2	960	924	145	116	136	2,281	79%
3	3,968	1,707	357	0	1,463	7,495	15%
2011 (01/01/11 to 6/30/11)							
1	3	3	0	0	9	15	94%
2	956	305	375	117	54	1,807	2%
3	689	196	0	0	728	1,613	1%

Between January 1 and June 30, 2011, inspections were completed on approximately 182,000 distribution poles, representing 15 percent of the population. Based on inspection codes[38] approximately 2,350 poles (1.67%) are candidates[39] for replacement over the next three years. The majority of the listed codes will not result in pole replacement. Multiple asset condition codes can be recorded for each pole.

[37] The four most frequent codes are shown on this table. Exhibit 5, Distribution Overhead Facilities, Poles, Pole Condition heading summarizes all the wood pole asset condition codes.

[38] The following asset condition codes were considered as most likely resulting in pole replacement: 110 - Broken/Severely Damaged, 111 - Visual Rotting Ground Line, 113 - CuNap Treated, 114 - Woodpecker Holes, 116 - Visual Rotting Pole Top, 801 - Osmose Identified Priority Pole and 802 - Osmose Indentified Reject Pole.

[39] Poles identified through the inspection program are referred to as candidates because a small percentage may be double counted due to missing GIS ID data in the Computapole database and early replacements of Level 3 poles due to other construction projects.

Figures II-14 and II-15 compare the installation year profiles of poles inspected this year (to June 30, 2011) against poles that are candidates for replacement based on those same inspection results[40]. This profile is consistent with past years. A small percentage of the poles inspected were candidates for replacement, typically those poles between 50 and 80 years old.

Figure II-14
Install Year Profiles of Poles Inspected Versus Replacement Candidates

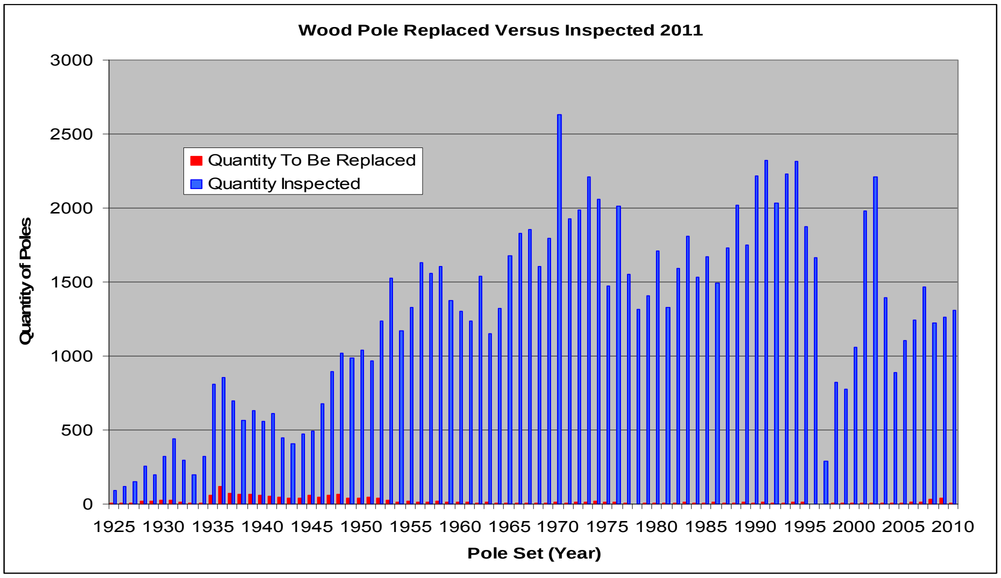
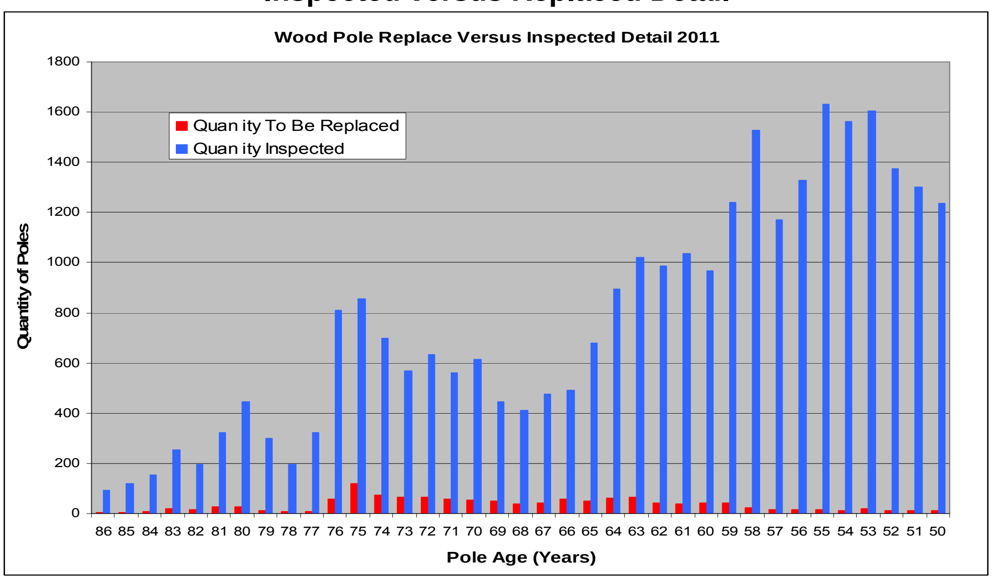


Figure II-15
Inspected versus Replaced Detail



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[40] The following asset condition codes were considered as most likely resulting in pole replacement: 110 - Broken/Severely Damaged, 111 - Visual Rotting Ground Line, 113 - CuNap Treated, 114 - Woodpecker Holes, 116 - Visual Rotting Pole Top, 801 - Osmose Identified Priority Pole and 802 - Osmose Indentified Reject Pole. The poles considered candidates for replacement also had the following Priority Level codes: 1 (one week), 2 (one year), 3 (three years), P (performed during inspection), 9 (temporary repair) and 7 (emergency).

Remedial Actions Performed
Remedial action performed as part of the Inspection and Maintenance program is contained in Exhibit 5. As shown in Table II-50, a total of 16,607 poles were installed on the distribution system, including poles installed as part of the Inspection and Maintenance program and for other reasons such as new business.

Table II-42 shows the Inspection and Maintenance program results specific to distribution wood poles, further broken down by codes considered to require replacement. There can be multiple codes recorded per pole. The total inspected poles minus the number of codes recorded represents the minimum number of poles where no issues were recorded.

Table II-42[41]
Distribution Wood Poles Replace and Repair Codes

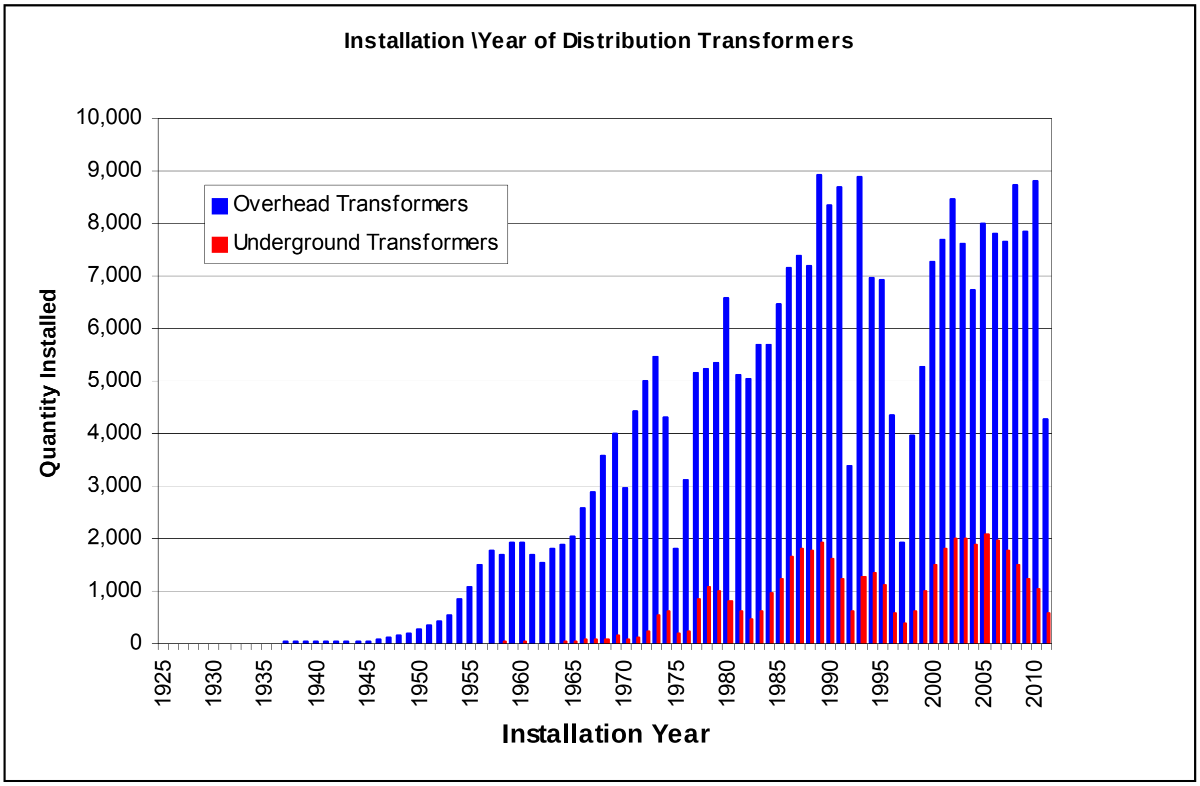
Level	Replace Codes			Repair Codes		
	Number of Poles	Percent Codes vs. Inspections	Percent Completed	Number of Poles	Percent Codes vs. Inspections	Percent Completed
2009 Summary						
1	14	0.01%	100%	0	0.00%	
2	1,442	0.54%	100%	118	0.04%	100%
3	5,691	2.15%	39%	2,277	0.86%	58%
Total	264,723					
Total - Codes	255,181	96%				
2010 Summary						
1	22	0.01%	100%	4	0.00%	100%
2	2,127	0.91%	78%	154	0.07%	90%
3	5,904	2.53%	13%	1,591	0.68%	21%
Total	233,011					
Total - Codes	233,209	96%				
2011 Progress to Date (6/30/2011)						
1	10	0.01%	90%	6	0.00%	100%
2	1,421	1.05%	2%	386	0.27%	5%
3	919	2.70%	1%	694	0.49%	1%
Total	140,408					
Total - Codes	136,972	98%				

[41] The replace codes used for this table are: 110 - Broken/Severely Damaged, 111 - Visual Rotting Ground Line, 113 - CU NAP Treated, 114 - Woodpecker Holes, 116 - Visual Rotting Pole Top, 801 - Osmose Priority Pole, and 802 - Osmose Reject Pole.

Distribution Overhead and Padmounted Transformers

As shown in Table II-40, there are approximately 382,000 overhead and 68,000 padmounted transformer locations. Figure II-16 shows the installation year profile data on a per unit basis. The average age of overhead transformers is 22 years for the 77 percent of the transformers with age data. The average age of underground transformers is 17 years for the 69 percent of the transformers with age data. Underground transformers include padmounted transformers and transformers located in manholes.

Figure II-16
Age Profile of Distribution Transformers[42]



Condition and Performance Issues

For overhead transformers, the results of the Inspection and Maintenance program are found in Exhibit 5, under the Distribution Overhead Facilities, Pole Equipment, Transformers heading. Exhibit 5 also contains a separate "Distribution Pad Mounted Transformers" table. An estimated 26,000 overhead and 4,767 padmounted transformers were inspected in 2011, respectively.

Remedial Actions Performed

Remedial action performed as part of the Inspection and Maintenance program is contained in Exhibit 5. Table II-43 shows program results specific to distribution

[42] 89,692 overhead transformers and 21,126 underground transformers without age data are not shown. Transformers with installation dates prior to 1925 are included as without age data.

overhead transformers, further broken down by codes considered to require replacement.

Table II-43[43]
Distribution Overhead Transformer Replace and Repair Codes

	Replace Codes		Repair Codes	
Level	**Number of Codes**	**Percent Codes Completed**	**Number of Codes**	**Percent Codes Completed**
2009 Summary				
1	5	100%	0	
2	217	100%	5,455	100%
3	54	61%	1,808	69%
2010 Summary				
1	3	100%	0	
2	196	91%	7,350	86%
3	56	11%	1,307	63%
2011 Summary (6/30/11)				
1	2	100%	0	100%
2	94	0%	3,153	5%
3	0		1,156	0%

The majority of the Priority Level 2 and Priority Level 3 maintenance codes reported were for 157 - Improper or Missing Bond, and for 156 - Non Standard Installation, respectively.

In addition to the Inspection and Maintenance program, the separate Distribution Line Transformer Upgrade program replaces overloaded transformers. Table II-44 shows the quantity of replaced transformers by division.

Table II-44
Distribution Line Transformer Upgrade Program
July 1, 2010 to June 30, 2011

Division	Funding Project	Quantity Replaced
East	C15828	318
Central	C14846	200
West	C10967	308

As shown in Table II-50, 9,169 overhead distribution transformer units were installed under various programs such as Inspection and Maintenance, Distribution Line Transformer Upgrade and new business activities. Table II-52 shows that 1,218 padmounted transformer units were installed.

[43] The "replace" maintenance codes used for this table are: 150 - Weeping Oil, and 151 - Bushings Broken/Cracked.

Conductors

There are approximately 38,200 circuit miles of primary overhead distribution conductor[44]. No age profile data is available for conductors because age data was not recorded on system maps until after the implementation of GIS in 2000.

Condition and Performance Issues

In 2011, approximately 3,314 circuit miles were inspected. In Exhibit 5, the Distribution Overhead Facilities, Conductor, Primary Wires/Broken Ties heading summarizes the results of the Inspection and Maintenance program for primary conductor. In 2011, the majority of the Priority Level 1 maintenance codes (94%) were for 127 - Primary on Crossarm. Priority Level 2 maintenance codes were typically for 207 - Primary on Crossarm (54%) and 141 - Damaged Conductor/Broken Strands (21%). Priority Level 3 maintenance codes were typically for 146 - Improper Sag (78%).

As shown on Table II-45, the primary conductor is in generally good condition with approximately one priority code recorded per 22 circuit miles inspected so far in 2011.

Table II-45
Recorded Maintenance Codes Per Circuit Mile Inspected

Year	Circuit Mile Inspected	Percent of System	Conductor Codes[45]	Miles Per Code[46]
2009	8,218	21%	468	18
2010	7,240	19%	394	18
2011 (to 6/30/2011)	3,314	9%	148	22

Remedial Actions Performed

Remedial action performed as part of the Inspection and Maintenance program is contained in Exhibit 5. As shown in Table II-50, a total of 169 circuit miles of new conductor was installed on the distribution system, including conductor installed as part of the Inspection and Maintenance program, the Engineering Reliability Review program, the Planning Criteria program and new business. Specific projects completed under other programs are found in Table II-49.

[44] The conductor length is as of September 1, 2011 and represents the most accurate data available today. Numbers are changing as National Grid normalizes data query methods.
[45] The Conductor Codes used for this table are the same as used for Exhibit 5, Distribution Overhead Facilities, Conductors, Broken Wire/Broken Ties heading: 127 - Primary on Arm, 140 - Insufficient Ground Clearance, 141 - Damaged Conductors/Broken Strands, 145 - Damaged Stirrups/Connector, 146 - Improper Sag, 286 - Spur Tap Not Fused, and 402 - Infrared Problems Splice.
[46] Worst case scenario assuming one code per mile. Any span can have multiple codes.

Cutouts

There are approximately 178,865 cutout locations on the distribution system. This number is different than last years report, which counted cutout units. The cutout location count maps to standardized reporting and will be used going forward. Aside from potted porcelain cutouts, this asset remains in good condition with only 0.2% of Priority Level 1 maintenance codes reported this calendar year.

Condition and Performance Issues

Potted porcelain cutouts have been identified for replacement due to a mechanical failure mode and potential hazard associated with them as described in the Potted Porcelain Cutout Strategy. The strategy to replace potted porcelain cutouts has been included in the Inspection and Maintenance program. Beginning in the 2011 inspection cycle, the Company changed the Inspection and Maintenance program priority level for potted porcelain cutouts (maintenance code 281) from Priority Level 3 to Priority Level 2 in an effort to remove of all potted porcelain cutouts by 2013.

The summarized results of the Inspection and Maintenance program for cutouts can be found in Exhibit 5 under the heading Distribution Overhead Facilities, Pole Equipment, Cutouts.

In the past three years of the Inspection and Maintenance program, maintenance code 281 - Cutout Potted Porcelain was the majority (98%) of reported cutout related codes. The Priority Level 1 codes for 280 - Defective Cutout were at 32, 45 and 24 units in years 2009, 2010 and 2011, respectively. Of the approximately 13,000 cutouts inspected this calendar year to June 30, 2011, only 24 units (0.2%) were Level 1.

Remedial Actions Performed

Remedial action performed as part of the Inspection and Maintenance program is provided in Exhibit 5. As shown on Table II-46, the Inspection and Maintenance program has identified 35,955 potted porcelain cutouts in the last three inspections cycles and replaced 24% percent of them.

Table II-46
Potted Porcelain Cutout [47] in the Inspection and Maintenance Program

	2009		2010		2011[48]		Total	
Status	**Units**	**%**	**Units**	**%**	**Units**	**%**	**Units**	**%**
Replaced	6,915	39%	1,623	12%	110	3%	8,648	24%
Pending	10,866	61%	12,220	88%	4,221	97%	27,307	76%
Total	17,781		13,843		4,331		35,955	

[47] Potted Porcelain Cutouts are captured by maintenance code 281.
[48] As of June 30, 2011.

Switchgear

There are approximately 3,100 switchgear on the system. Switchgear are generally in good condition with only a minimal number of issues discovered from the Inspection and Maintenance program.

Condition and Performance Issues

There is no unique heading in Exhibit 5 for switchgear. Switchgear related maintenance codes are under various headings in the Distribution Underground Facilities table.

Between January 1, 2011 and June 30, 2011, inspections were completed on an estimated 166 switchgear. There were no Priority Level 1 maintenance codes reported. During that period, three Priority Level 2 maintenance codes were reported: (2) for 652 - Base Broken/Damaged and (1) for 656 - Door Broken/Damaged. There were also (13) Priority Level 3 maintenance code reports for 647 - Excessive Vegetation. This is consistent with previous years.

Remedial Actions Performed

Between January 1, 2011 and June 30, 2011, none of the Priority Level 2 and 3 work has been done. Priority Level 4 work was completed, with 98 switchgear repaired during inspection for code 660 - Missing Nomenclature. As shown in Table II-50, a total of 71 switchgear units were installed on the distribution system.

Capacitors

There are approximately 4,900 capacitor banks on the distribution system providing approximately 160MVAr of reactive support. Capacitor banks are in generally good condition based on the number of maintenance codes recorded during inspections.

Condition and Performance Issues
There is no unique heading for distribution line capacitors in Exhibit 5. Capacitor related activity is reported under various headings in the Distribution Overhead Facilities table.

Between January 1, 2011 and June 30, 2011, inspections were completed on an estimated 351 capacitor banks. Table II-47 shows the inspection results.

Table II-47
Capacitor Inspection Results[49]

Level	Animal Guard Missing	Improper / Missing Bonding	LA Missing/ Blown	Blown Fuse	Missing Ground	Total	Percent Complete
2009							
1	0	0	0	0	0	0	-
2	0	0	0	37	11	48	100%
3	591	44	50	0	0	685	46%
2010							
1	0	0	0	0	0	0	-
2	0	0	0	49	30	79	94%
3	545	68	51	0	0	664	16%
2011 (01/01/11 to 6/30/11)							
1	0	0	0	0	0	0	-
2	0	0	0	31	30	61	3%
3	331	21	31	0	0	383	1%

The need to install animal guards is most common code recorded against capacitor banks during inspection. The lack of animal guards on capacitor banks does not significantly impact system reliability but are installed to protect the equipment.

Remedial Actions Performed
Table II-47 above shows the remedial action performed under the Inspection and Maintenance program. Capacitor maintenance is performed within the Inspection and Maintenance Program. Additionally, small capital projects are budgeted to address feeder level capacity and voltage support issues on the distribution system. As shown in Table II-50, a total of 165 capacitor units were installed on the distribution system, including those related to asset condition, feeder loading and voltage support. These small projects are discussed in the System Condition section of the report.

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[49] Capacitor banks are not shown as a separate category in the Inspection and Maintenance program quarterly reports (also attached as Chapter 4, Exhibit 5 of this report).

Regulators/Reclosers/Sectionalizers

There are approximately 1,300 reclosers, 2,200 voltage regulator locations, and 55 sectionalizers on the distribution system. Reclosers and regulators are generally in good condition, with only a minimal number of issues identified in the inspection program. Sectionalizers will be removed from service when they can no longer be maintained or they no longer meet the needs of distribution system.

Condition and Performance Issues

There are no unique headings for this equipment in Exhibit 5. The equipment is reported under various headings in the Distribution Overhead Facilities table.

An estimated 103 reclosers were inspected this calendar year through June 30, 2011. There were no Priority Level 1 and 2 maintenance codes reported. There were (23) Priority Level 3 maintenance codes: (17) for 195 - Animal Guard Missing, and (5) for 196 - Lightning Arrester Blown/Missing/Improper. Since 2009, there have been no Priority Level 1 maintenance codes reported for reclosers. Since 2009, the majority (84%) of all maintenance codes are Priority Level 3 for 195 - Animal Guard Missing.

An estimated 175 line regulators were inspected this calendar year to June 30, 2011. In 2011, only Priority Level 3 maintenance codes were reported: (98) for 176 - Animal Guard Missing, (8) for 177 - LA Blown/Missing/Improper, and (2) for 175 - Improper/Missing Ground. This was consistent with past years, with 176 - Animal Guard Missing accounting for 92% of the maintenance codes reported for regulators.

Remedial Actions Performed

In addition to the five-year inspection cycle, regulators, reclosers and sectionalizers are inspected semi-annually as part of National Grid's standard maintenance procedures. As shown in Table II-50, a total of 169 and 108 units of line recloser and line regulator were installed, respectively. These installations include reclosers installed as part of the Recloser Application Strategy to improve feeder reliability. Table II-48 shows reclosers installed as part of the Recloser Application Program by division.

Table II-48
Recloser Application Program
July 1, 2010 to June 30, 2011

Division	Funding Project	Quantity Installed
East	C13146	34
Central	C13145	37
West	C19068	34

Table II-49
Completed Distribution Overhead Work July 1, 2010 to June 30, 2011

Division	Funding Number	Project Name	Program or Strategy
Western	C06474	Transfer Milpine to Station 210	
Western	C28606	F5769/5763 Rebuild r/o Floradale	
Western	C28625	F20871 rebuild ties F4768/F2569	
Western	C28652	Delameter F9352 new ties w/18251,53	
Western	C28718	E.Batavia 2855 - N.Leroy 0456 Tie	
Western	C28720	N.Eden 8251 Tie w/ F8861 & F8862	
Western	C28870	Station 21 - Split F2173	
Western	C29181	06679 Station 79 - F7961 Relief	
Western	C29182	06680 Station 79 - F7962 Relief	
Western	C32390	NW-Batavia Sub Dist. Line Cap Banks	
Western	C32510	Brockport Feeder Capacitors	
Western	C33331	Evangola State Park - Ratio Relief	
Western	C36427	JPP Wiltsie Rd	
Western	CD0045	09418 Cuba F0561 - Spring St - Reloc	
Western	CD0212	11219 Barker F7863 - Wire Replacement	Conductor Replacement
Eastern	C07438	Chestertown 52 - Duell Hill Rd.	Eng Reliability Review
Eastern	C07482	Battenkill 57 - Rebuild/Convert	
Eastern	C10324	Scotia 25572 & Front 52 - New Tie	
Eastern	C17962	Schroon 51 - Rebuild Route 74	Feeder Health Review
Eastern	C26876	05582 Corinth 52 - Eastern Ave. Rebuild	Eng Reliability Review
Eastern	C26877	Guy Park - substation retirement	Eng Reliability Review
Eastern	C28176	Scofield 53 - Hadley/Harrisburg Rds	Eng Reliability Review
Eastern	C28791	Krumkill 51 Russell Rd convert	Eng Reliability Review
Eastern	C28834	Menands 53 - Menands Rd Tree Wire	
Eastern	C28843	Church St 04358 exten.	
Eastern	C29424	Battenkill 56 - Tie to Weibel 51	
Eastern	C29429	05536 Chestertown 52-Schroon River Rd	
Eastern	C29430	Corinth 52 - Hudson River Crossing	Conductor Replacement
Eastern	C29434	Middleburg 51 - Tie to Schoharie	Eng Reliability Review
Eastern	C29438	Scofield Rd 53 - Tie to Corinth 51	Eng Reliability Review
Eastern	C31198	Amsterdam 54 - Belldons/Langely Road	Eng Reliability Review
Eastern	C31602	Bolton 52 - Convert Valley Woods Rd	
Eastern	C32171	Amsterdam 32654 - extension	
Eastern	C35729	Brook Road 55 - Murray Road	Regulatory Fdr. Improve.
Eastern	C34189	Dist Transfers McClelland Bevis #6	
Eastern	C36114	WARRENSBURG 52 Dartmouth Rd JPP	
Eastern	CD0010	Hudson 53 - Rhinebeck Hudson Rd Tra	
Eastern	CD0064	09337 Borden Rd Citizens JPP WR 9790203	
Eastern	CD0142	11186 Reynolds Rd 33453 - Williams Road Conversion	
Eastern	CD0143	11148 Burdeck 26554 - Duanesburg Road Conversion	

Division	Funding Number	Project Name	Program or Strategy
Central	C15729	N. Syracuse Install Capacitors FY09/10	Eng Reliability Review
Central	C15732	06327 NR-Gilpin Bay 95661-Hoel Pond	Conductor Replacement
Central	C28545	LeMoyne Ave Rebuild	Feeder Health Review
Central	C28607	Lehigh 66952 Tie With Colosse 32151	
Central	C28608	06194 McGraw 69 Low Volt. Improvement	Regulatory Fdr. Improve.
Central	C28618	Valley 59476 Rebuild Rasbach Rd	
Central	C28816	Chittenango Relief	
Central	C28832	Bartell 56 Orangeport	
Central	C28847	Fairdale Load Relief	
Central	C28849	Phoenix Load Relief	
Central	C28850	Tinker Tavern Step Down	
Central	C28852	Starr 53 Step Down	
Central	C31128	Hindsdale Feeder Relief	
Central	C31200	Richards Rd. Relocation	Regulatory Fdr. Improv.
Central	CD0104	11096 Colosse 32151 - Stray Voltage	Conductor Replacement
Central	CD0105	10841 Teall Ave 54 - Edwards Ave Ratio Conversion	Conductor Replacement
Central	CD0186	11325 Whitaker Sw 8106 Repair	
Central	CD0293	09/01/1111109 Southwood 54 - Reconductor	
Central	C35088	MV- Hawthorne Rd Rebuild	
Central	C35564	Correct Outages to Mexico H20	Regulatory Fdr. Improve.

Table II-50
Distribution Overhead Equipment Installed July 1, 2010 to June 30, 2011

Equipment	Project Type	Unit Quantity
Wood Poles (Units)	Blanket	7,931
	Program	5,948
	Specific	2,728
	Total	**16,607**
Overhead Transformers (Units)	Blanket	6,101
	Program	2,089
	Specific	979
	Total	**9,169**
Primary Conductor (Circuit Miles)	Blanket	69
	Program	18
	Specific	82
	Total	**169**
Capacitor Banks (Locations)	Blanket	124
	Program	5
	Specific	36
	Total	**165**
Line Reclosers (Units)	Blanket	29
	Program	126
	Specific	14
	Total	**169**
Line Regulators (Units)	Blanket	105
	Program	0
	Specific	3
	Total	**108**
Switchgear (Units)	Blanket	44
	Program	0
	Specific	27
	Total	**71**

Vegetation Management

The Company's Distribution Vegetation Management (VM) Program consists of two reliability based components - cycle pruning and hazard tree mitigation. The main purpose of these programs is to create and maintain clearance between energized distribution conductors and vegetation, primarily tree limbs. In addition, the hazard tree program is intended to minimize the frequency and damaging affect of large tree and large limb failures from along side and above the company's overhead primary distribution assets. This program assists in the Company's effort to provide reliable service to customers and meet regulatory targets.

The cycle pruning program, nearly two-thirds of the distribution VM budget, has a base length of 5 year, which was based on the general length of the growing season and the growth characteristics of the predominant tree species. We perform vegetation pruning maintenance using this cycle and adjust for actual field growth conditions to yield an average 5 year cycle with a range of circuit schedules from 4 to 6 years. For 2010, 7005.9 miles were completed for the annual cycle pruning program.

Stable and consistent circuit pruning provides a measure of reliability maintenance and is important in maintaining public safety regarding climbable trees and tree/wire contact risks. In addition, consistent circuit pruning improves line crew accessibility therefore improving efficiency in restoration and maintenance and in addition enhances the accuracy and efficiency of the line inspection process.

The hazard tree program uses tree interruption prediction modeling based on historic tree interruption data. This model takes into account customers served, events per three phase mile, customers interrupted per event and cost to reduce the number of customers interrupted. The ranking provides a primary listing of circuits which are then field reviewed by arborists to develop a final list of circuits expected to provide the most efficient and effective mitigation. Once a circuit is chosen, an industry leading risk ranking assessment protocol is followed dividing the circuits into prioritized segments based on number of customers served. Tree failure risk according to the circuit segmentation is mitigated accordingly. For example, the highest risk area, the main line portion of the circuit, where future tree failures may cause a breaker operation (lock-out) for the entire feeder receive the highest inspection intensity for hazard tree mitigation. For 2010, hazard tree mitigation work was performed on 36 poor performing circuits.

Underground System Assets

National Grid's underground distribution system includes primary and secondary cables, secondary network cables, network protectors and transformers, manholes, vaults, and handholes. The Inspection and Maintenance Program inspected 7,750 underground locations including 7,407 handholes, 1,327 manholes and 15 vaults between January 1, 2011 and June 30, 2011. Items inspected include the condition of the underground structures themselves, and the condition of equipment within the structure, such as cables, splices, and network protectors. Padmounted transformers and switchgear are inspected with the overhead system and are included in the Overhead System Assets section above. Network system assets, a small portion of the underground system, is detailed in a separate section below.

Exhibit 5 contains the Inspection and Maintenance program quarterly report from 2011 Second Quarter summarizing program results from January 1, 2009 to June 30, 2011. The Distribution Underground Facilities section relates to underground system assets. Program activities generate asset condition data and remediate asset issues. The quarterly report does not include quantities of assets found in acceptable condition.

Primary Underground Cables

There are approximately 7,200 circuit miles of distribution cable in the distribution system. The underground distribution system consists primarily of paper-insulated lead-covered (PILC) and ethylene propylene rubber (EPR) type cables. There are also some cross-linked polyethylene (XLPE) type cables in the underground system. Planned cable replacements are driven by cable condition and performance history. Though actual cable life can vary widely, the Company generally expects distribution cables to have a nominal life expectancy of 40 years.

Condition and Performance Issues
In Exhibit 5, the Distribution Underground Facilities, Primary Cable heading[50] summarizes the results of the inspection and maintenance program.

Remedial Actions Performed
Remedial action performed as part of the Inspection and Maintenance program is shown in Exhibit 5, Distribution Underground Facilities. Table II-51 shows completed underground system work. Table II-52 shows that 134 circuit miles of underground cable was installed as for various reasons including new business.

Several underground cable projects are under construction. In the Syracuse University Hill area, 13.2kV underground distribution cables are fully loaded with additional loading expected. Three new underground distribution cables are under construction. The project scope includes approximately 6,700 feet of new duct bank, 10 manholes, and over 14,000 circuit feet of new cable. In Buffalo, new underground cable and associated manhole and duct system is being installed to accommodate the Indoor Substation Program.

[50] The Primary Cable heading reports maintenance codes for 611 - Cable/Joint Leaking and 654 - Cable Not Bonded resulting from underground system inspection.

Manholes, Vaults and Handholes

There are an estimated 11,979 manholes, 1,780 vaults in the system and 70,252 handholes in the underground system.

Condition and Performance Issues

There were 1,327 manholes and 15 vaults were inspected up to June 30, 2011. The results of the Inspection and Maintenance program can be found in Exhibit 5, Distribution Underground Facilities.
I
In 2011, all Priority Level 1 maintenance codes were completed as follows: (20) for 600 - Handhole Broken/Damaged; and (1) for 621 Manhole Ring/Cover Repair/Replace. This type of work is consistent with past results. As noted below, there is was also a significant amount of work that was completed during inspection and listed as Priority Level P - performed during inspection.

The program also noted manhole and vault locations for further roof inspection by Engineering: 86 in 2010 and 70 in 2011.

Up to June 30, 2011, 763 Priority Level 2 maintenance codes have been reported as follows: (185) for 600 - Handholes Broken/Damaged; (414) for 610 - Manholes Ground Rods Missing, (1) for Manhole Cable/Joint Leaking; (27) for Manhole Cable Bonding/Grid Defective; (32) for Manhole Improper Grading and (104) for Manhole Rerack. All Level 2 and Level 3 work is pending.

Remedial Actions Performed ~~and Planned~~

Remedial work performed as part of the Inspection and Maintenance program can be found in Exhibit 5. Up to June 30, 2011, 375 maintenance codes were considered Priority Level P and performed during inspection. These included the following significant issues: (2) for 611 - Manhole Cable/Joint Leaking; (1) for Manhole Cable Bond/Grid Defective; and (1) for Vault Sump Pump Broken. The majority of Level P repairs performed during inspections involved replacing nomenclature on manholes, vaults, and handholes.

Table II-51 shows completed underground system work.

Table II-51
Completed Distribution Underground as of June 31, 2011

Division	Funding Number	Project Name	or Strategy
Western	C29030	Batavia 01 - UG Cable Recond.	
Eastern	C34084	Hollandale Apts. Cable Replacement	
Eastern	C28814	Arbor Hill URD - Riverside 28858	UG Cable Replacements
Eastern	C32693	06842 V-72 Howard St Replace Vault Roof	
Eastern	C34025	Southwick Meadows URD Loop Feed	
Eastern	C33915	V-198 Albany NY Roof Replacement	
Eastern	C33914	V-500 Troy NY Roof Replacement	
Eastern	C34606	Bridlewood URD - Clifton Park	
Eastern	C33913	V537 Troy NY Roof Replacement	
Eastern	C33912	V582 Schenectady NY Roof Repl	
Eastern	C28527	V-66 James St. Roof Replacement	
Eastern	C35508	V-170 Albany NY Roof Replacement	
Eastern	C29108	V-2206 Vault conversion to manhole	
Eastern	C29109	V-2207 Vault conversion to manhole	UG Structures & Equip.
Central	C26601	06167 Lysander Getaway 55 Replacement	

Table II-52
Distribution Underground Equipment Installed July 1, 2010 to June 30, 2011

Equipment	Project Type	Unit Quantity
Primary Underground Cable (Circuit Miles)	Blanket	85
	Program	6
	Specific	43
	Total	**134**
Padmounted Transformers (Units)	Blanket	900
	Program	78
	Specific	240
	Total	**1,218**

Network Systems

National Grid's network system is not extensive, supplying 9,498 customers. The system is diverse, spread out among many communities. Table II-53 lists the networks including location (City & Division), peak load, number of supply substations, substation names, number of supply feeders and number of network protectors (on Grid or in Spot Networks).

Table II-53
Network Listing

City (Network)	Division	Peak Load (MVA)	# of Supply Substations	Substation Names	# of Supply Feeders	# of Network Protectors (NWP)	# of NWP on General Network	# of NWP in Spots Networks	Studied since 2008
Cortland	Central	2.1	2	Cortland, Miller St.	3	11	11	0	No
Syracuse (Ash St.)	Central	32.3	1	Ash St.	10	130	92	38	Yes
Syracuse (Temple St.)	Central	20.3	1	Temple St.	7	76	24	52	Yes
Utica	Central	9.15	1	Terminal St.	4	36	25	11	Yes
Watertown	Central	4.9	1	Mill St.	5	24	22	2	Yes
Albany	East	31	2	Riverside, Trinity	10	116	84	32	Yes
Albany (34.5kV)	East	14.2	2	Riverside, Partridge	5	32	0	32	Yes
Glens Falls	East	4	2	Glens Falls, Henry St.	4	12	12	0	No
Schenectady	East	16	1	Front St.	5	54	45	9	No
Troy	East	14	1	Liberty St.	8	39	33	6	Yes
Buffalo (Broadway)	West	0.3	1	Seneca Terminal	3	7	4	3	No
Buffalo (Elm St.)	West	109	1	Elm St.	16	261	139	122	Yes
Niagara Falls	West	0.3	1	Gibson	3	10	10	0	No

Condition and Performance Issues
There is no unique heading for network equipment in Exhibit 5. This equipment is reported under various Distribution Underground Facilities headings. Vaults containing network equipment is included in the Manholes, Vaults and Handholes section above.

Table II-54 contains a summary of the results from the Inspection and Maintenance System on two Network System assets, network protectors and network transformers.

Table II-54
Network System Assets Inspection Results

Level	Network Protector		Network Transformer			Other[51]	Total
	Barrier Broken	Oil Leak	Bushing Broken /Cracked	Low Oil	Oil Weeping		
2009 Summary							
1	-	-	-	-	-	1	1
2	-	-	3	3	2	1	9
3	-	-	-	-	-	-	-
4	-	-	-	-	-	23[52]	23
P[53]	-	7	3	7	6	31	54
Total	-	7	6	10	8	56	87
2010 Summary							
1	-	-	-	-	-	-	-
2	1	-	1	2	3	2	9
3	-	-	-	-	-	-	-
4	-	-	-	-	-	58	58
P	-	-	-	-	-	13	13
Total	1	-	1	2	3	73	80
2011 Summary							
1							
2							
3							
4							
P							
Total							

To June 30, 2011, 15 vaults had been inspected with no maintenance codes related to network transformers and protectors reported. Maintenance codes found were related to the vault structure and are included in the manhole and vault section above.

[51] Other maintenance codes are not expected to affect reliability: 633 Network Protector Worn/Damaged Gasket, 638 Network Transformer Missing Ground, 639 Network Transformer Missing Nomenclature, and 643 Network Transformer Rusted/Peeling Paint.
[52] This value composed of maintenance code 643 Network Transformer Rusted/Peeling Paint.
[53] Level P work was done during the inspection.

Network assets are typically inspected on a shorter cycle than required for the Inspection and Maintenance program. National Grid Standard Maintenance Procedure SMP421.01.2 requires extensive visual inspections of network protectors and transformers annually. Depending on the network protector style, diagnostic overhauls are required every two to five years including cleaning, adjusting, lubricating and replacing broken or worn parts. Network protectors are also operationally tested annually, with improperly functioning units replaced or repaired. According to an internal scorecard, 1,342 manholes and vaults were inspected so far in 2011, with many containing network equipment.

Remedial Actions Performed

Remedial action performed on vaults containing network equipment is covered above in the Manholes, Vaults and Handholes section. Work specific to network vaults include replacing vault ceilings: six in the Eastern Division, thirteen in the Central Division and two in the Western Division.

So far this calendar year, 31 network protectors and 27 network transformers have been replaced.

Arc Hazard Analysis

The 2012 edition of the National Electric Safety Code requires a detailed analysis to determine the effective rating of clothing or a clothing system to be worn by employees working on or near network protectors with nominal voltages ranging from 251V to 1000V. The Company is currently completing derailed arc hazard analysis on these systems, and studying potential engineering controls and work practices which may be utilized to reduce arc energy and exposure levels.

II D. Distribution and Sub-Transmission Substations

In this section, National Grid will describe those substations which contain Distribution or Sub-Transmission assets. The information presented here begins at the station level, specifically those being rebuilt or replaced, and then reviews individual assets.

A summary of the equipment types and populations for key substation assets is provided in Table II-55.

Table II-55
Substation Asset Inventory

Main Asset	Inventory
Substations	423
Circuit Breakers	3,985
Power Transformers	779
Batteries/Chargers	209
Surge Arresters	1,100
Sensing Devices	2,245
Voltage Regulators/Reactors	674
Capacitor Banks	61

Substation Inspections and Work Orders
Substation Visual and Operational Inspections (V&O's) are performed bi-monthly on each substation. V&O's are considered preventive maintenance since inspections identify defects in substation equipment for appropriate mitigation. Annual levels of Follow Up work orders which proactively address substation conditions have risen over time while Trouble Maintenance has fallen.

Substation Equipment Assessments and Asset Condition Codes
As explained in the 2010 Asset Condition Report, the Company has initiated a substation condition assessment approach across all substations which classify substations by condition and impact codes as shown in Table II-56.

Table II-56
Substation Condition Codes

Code	Classification/Condition	Implication
1 Proactive	Asset expected to operate as designed for more than 10 years	Appropriate maintenance performed; regular inspections performed
2 Proactive	Some asset deterioration or known type/design issues Obsolescence of equipment such that spares/replacement parts are not available System may require a different capability at asset location	Asset likely to be replaced or re-furbished in 5-10 years; increased resources may be required to maintain/operate assets
3 Proactive	Asset condition is such that there is an increased risk of failure Test and assessment identifies definite deterioration which is on going	Asset likely to be replaced or refurbished in less than 5 years; increased resources may be required to maintain/operate assets
4 Reactive	Asset has sudden and unexpected change in condition such that it is of immediate concern; this may be detected through routine diagnostics, including inspections, annual testing, maintenance or following an event	Testing and assessment required to determine whether the asset may be returned to service or may be allowed to continue in service. Following Engineering analysis the asset will be either recoded to 1-2-3 or removed from the system

In subsequent sections of this report, condition codes are used to summarize the status of the asset type population.

Indoor Substations

Indoor substations were built in the 1920's through 1940's and are considered obsolete. The outmoded design does not meet accepted safety practices such as guarding, the equipment and protection schemes no longer perform functionally to interrupt faults, and the protection and control systems have been superseded by new technology. Some indoor substation equipment is also in poor and/or overloaded condition. There are twenty -six indoor substations in Buffalo, five in Niagara Falls, one in Brighton, one in Albany and one in Gloversville.

By law, the City of Buffalo has limited distribution voltage to 4.16kV. Distribution within the City is often backyard construction. Given the local requirements and cost of conversion, converting the load is not a preferred option. The Niagara Falls indoor substations are supplied from an underground 11.5kV system. That system and the substations that supply it are of the same vintage and poor condition as the indoor substations. Several 115-13.2kV substations and feeders have been construction in the area, so conversion is an option being considered.

Condition and Performance Issues

Key safety issues associated with the obsolete Buffalo Style indoor substation design are:

- The 23kV Condit oil switches do not have the appropriate fault interrupting capability.
- The operation of the 23kV Condit oil switch and the 4.16kV oil circuit breakers require the operator to stand next to the switch or breaker.
- The protective relay scheme does not provide detection for certain faults, and has inappropriate blocking, which may lead to catastrophic equipment failure.
- The obsolete equipment does not meet current requirements for fault interrupting capability, operating interfaces and personnel safety.
- Breakers have no provision for proper safety grounding.

Key reliability and customer issues associated with the obsolete Buffalo Style indoor substations are:

- The existing protection scheme has limited the ability to connect some customer loads, can not be upgraded, and must be replaced.
- Wear of 4.16kV breaker operating mechanisms has caused mis-operations.
- The probability of failure increases with equipment age.
- In some locations, transformer banks are overloaded and poor ventilation in transformer bays has led to transformer overheating.
- The 23kV substation supply is overloaded on contingency.
- Given the obsolete protection scheme and equipment, equipment failures can escalate and cause extended customer outages.

Remedial Actions Performed

Between July 1, 2010 and June 30, 2011, the Buffalo #23 substation has been completed. Including last year, sixteen Buffalo indoor substations have been rebuilt.

Work remains on-going at the following substations: Buffalo #29, Buffalo #43 and Buffalo #52.

The annual five-year capital investment plan identifies on-going and planned work.

<u>Metal-Clad Substations</u>

Metal-clad equipment is prone to water and animal ingress which leads to failures from moisture, dust or animals. V&O surveys help detect such degradation but do not identify poorly performing electrical equipment unless there is significant deterioration or failure, such identification being more likely with electro-acoustic detection techniques.[54]

An initial review using this technique identified a number of locations for further action. Accordingly, the North Troy and Springfield substations were identified and have recently been replaced.

Condition and Performance Issues
A further selection of metal-clad stations were assessed using electro-acoustic techniques leading to identification of deterioration at Ash Street, which is presently in preliminary engineering for replacement. Progress continues on Market Hill Station 324, Ballston Station 352 and Altamont Station 283.

Table II-57 identifies those metal-clad stations which are of most concern with respect to performance and risk mitigation.

Table II-57
Metal-Clad Substations with Performance Issues

Station ID	Station Description	Watch
NY09-1730	Market Hill Station 324	In progress
NY09-0190	Ballston Station 352	In progress
NY08-0140	Ash Street	Preliminary engineering
NY09-0100	Altamont Station 283	In progress

Overall, the use of the electrical partial discharge survey has been beneficial, with probable failures avoided and action plans in place for deteriorated equipment. The Company continues to survey metal-clad equipment to provide base line information on the assets and for individual cases involving suspect assets.

Remedial Actions Performed
Replacement of Springfield and North Troy substation metal-clads have been completed. The metal-clad at Guy Park Station 239 has been retired. As indicated in Table II-74, other stations are being engineered at present.

Further electro-acoustic surveys are planned to support on going preventive maintenance and V&O surveys.

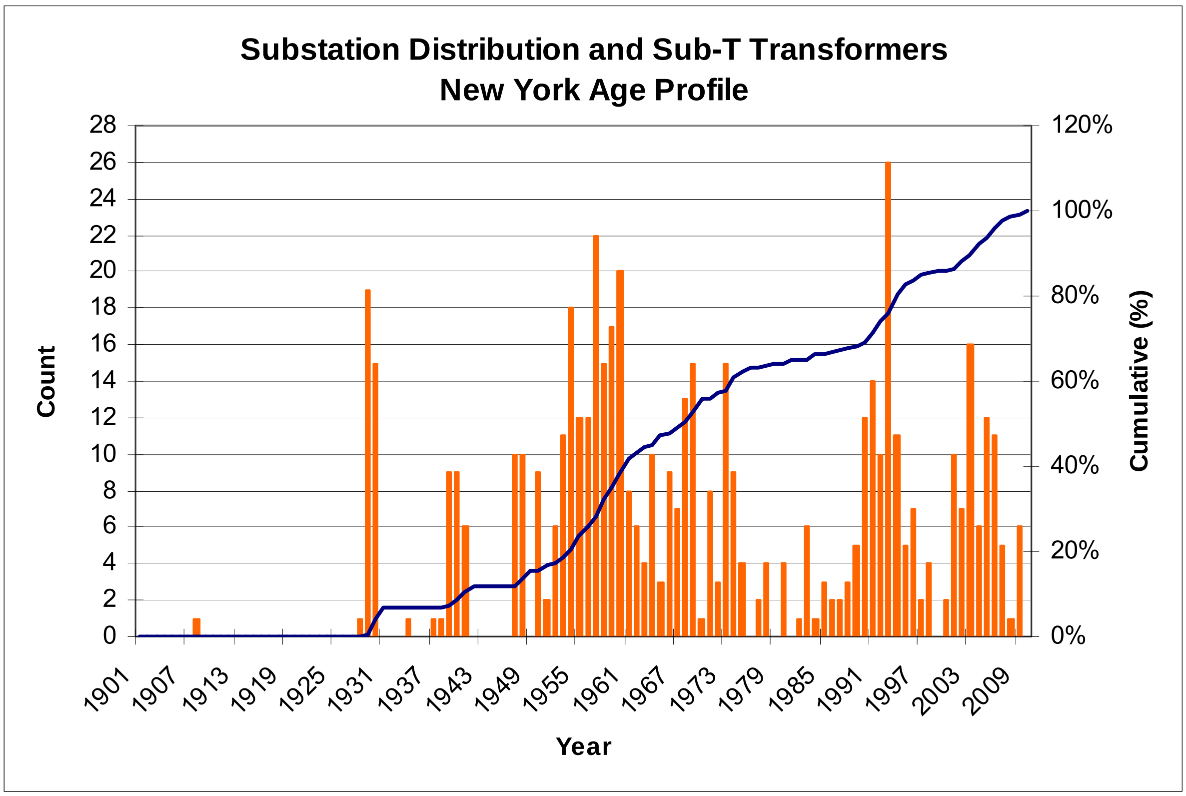
[54] A simple visual inspection does not pick up issues with hidden insulation or surface tracking effects. By using sensors to detect anomalous sound (acoustic) waves or electric signals in the metal-clad it is possible to detect equipment condition before it reaches a point to cause a failure.

Power Transformers

National Grid has 779 distribution power transformers plus 21 spares with primary voltages 69kV and below. The population of power transformers is generally sound, with some exceptions discussed in this section. Most power transformers range in size from less than 1MVA[55] to about 20MVA and may have several MVA ratings depending on available cooling options – pumps for oil circulation and fans to assist with heat transfer.

The average age of the distribution power transformer population is 39 years, which is displayed in Figure II-17. There are 235 power transformers greater than 50 years of age based on nameplate data stored in the Cascade database.[56] However, 30 percent of the total population of transformers have no year of manufacture indicated in the Cascade database, which implies that there may be a further 237 units greater than 50 years of age.

Figure II-17
Age Profile of Transformers



As explained in last year's Asset Condition Report, power transformer age, by itself, is a useful proxy to indicate which transformers may be less able to perform their function

[55] Mega Volt Amp – an indication of the maximum power, or load, which may flow through a transformer; MVA is given on the transformer nameplate as a rating for the transformer. Larger MVA transformers also tend to be physically larger units.
[56] Asset Information and Maintenance Management System

through accumulated deterioration. Power transformer paper insulation deteriorates with time and thermal loading history. The deterioration is cumulative and irreversible and thus cannot be addressed via maintenance. As the paper degrades, the ability of the paper insulation to withstand mechanical forces is reduced and the mechanical integrity of the transformer is compromised when subjected to through faults or internal faults. In addition, the paper deterioration may lead to shrinkage of the winding packs thereby, reducing the mechanical stability of the transformer.

Given the possible substantial impact of power transformer failures on the distribution system, and the extensive lead times and disruption to normal operations, National Grid pursues a comprehensive approach to risk management of transformers. This includes thorough and regular reviews of the population, procuring an appropriate number of spare units, and the generation of a 'watch list' of suspect and higher impact transformers for more frequent observation and review. National Grid also reviews each transformer individually to determine both condition and likely risks to the system before making a determination as regards to replacement or refurbishment requirements.

Condition and Performance Issues

It is National Grid's maintenance practice to perform a Dissolved Gas Analysis (DGA) on distribution power transformers rated 2.5MVA to 15MVA every two years and units rated above 15MVA annually. In addition, DGA may be performed more frequently on suspect units to monitor the condition more closely, as happens with transformers which are being closely monitored, sampling and analysis may be quarterly, monthly or more often. This information is used to determine the current condition of the transformers and the likely degradation over time, along with significant input from subject matter experts.

Table II-75 provides condition codes and the current condition codes for 2010 and 2011 year-to-date based on this review. In 2011, ten transformers were identified as condition code 4 due to elevated gasses, poor insulation test results, inadequate thermal capability[57] and no known available spares. In addition, these units are mature in age and may be better served by replacement rather than maintenance or repair. One of the units experienced an internal fault and will be removed from the system in a controlled manner.

In comparison to 2010, five transformers were added to condition code 4 based on field and engineering experience related to operational problems, insulation contamination and deterioration, and a sudden elevation in key gasses.

The transformer at our Chautaqua Station failed unexpectedly. It appears that loading exceeded the emergency rating of the transformer. A mobile substation was installed as the emergency response, and a larger MVA transformer has been placed on order.

[57] Transformers are designed to operate at certain thermal temperatures. If a unit is heavily loaded, this may exceed its thermal capability.

Table II-58
Condition Code of Transformers

Year	Code	1	2	3	4	Grand Total
2010	TRF	749	44	17	5	815
2011	TRF	723	30	16	10	779

A transformer with condition code 4 is not automatically replaced. The transformer may receive more frequent DGA sampling and review. Most code 4 units will be revised to a lower condition code following a review, but it is possible that they will be replaced. The description of condition codes can be found in Table 111-58.

Remedial Actions Performed

The transformer watch list is based on condition and operational information. The watch list is used to monitor those transformers which are of concern to assess how their condition develops, and if need be, plan for rapid replacement of the unit. For example, transformers which are subject to a through fault, as may be initiated by a lightning strike, may:

- fail instantaneously as a result of internal stresses generated by the through fault;
- start to deteriorate from through faults weakening the transformer over time; or
- generate diagnostic gases which are measured to determine degradation and which may subsequently stabilize.

There were 22 transformers identified in the “watch list” in the 2010 Asset Condition Report and one unit has been removed. The transformer at Avon Station 43 was removed from the list and is considered stable based on recent DGA and oil test results.

Twenty-one units remain on the present watch list, and an additional thirty-four have been added totaling 55 transformers to be watched. The condition issues associated with these units are as follows:

- Twenty-six units have deteriorated winding insulation. In addition, two are overheating, while four show signs of contamination in the oil and windings. Furthermore, nineteen of the twenty-five units are near their end of life being greater than 69 years of age.
- Eighteen of the units have elevated combustible gasses. Two of the units are also overloaded, and three have contaminated windings. One unit has a hot spot, and another is wet and the insulation is thermally degraded. However, the gassing is stable on two of the eighteen units, but they will continue to be monitored. One unit has issues with the Load Tap Changer (LTC).
- Eight units have elevated hydrogen. Hydrogen is an indicator of partial discharge. Three of the eight units also contain moisture and contaminated windings. Another unit is old and near its end of life.

- Two units contain moisture and show signs of contaminated winding insulation. One unit has mechanical deformation consisting of a wavy core and a loose yoke.

The 2011 transformer review identified 55 transformers to watch. A review of possible transformer spares and mobile capability has been performed and documented for the transformers on the list. In addition, the ability to perform field ties and operate units as an open delta on single-bank units with delta high side windings[58] are reviewed for a possible solution if a problem arises. Further, an increase in DGA sampling will occur, where needed, to closely monitor the transformer condition.

Table II-59 provides the current list of the 55 transformers that are on the "watch list".

[58] The three high voltage windings are connected in a delta formation rather than a grounded wye formation.

Table II-59
List of Distribution and Sub-Transmission Transformers on "Watch"

Station Location	Equipment Description	MVA	Voltage	Age	Condition Code
Brighton Ave. Sta. 8	Bank 1	2	34.5-4.16 kV 2 MVA	79	4.00
Brighton Ave. Sta. 8	Bank 1	2	34.5-4.16 kV 2 MVA	79	4.00
Brighton Ave. Sta. 8	Bank 1	2	34.5-4.16 kV 2 MVA	79	4.00
Brighton Ave. Sta. 8	Bank 2	2	34.5-4.16 kV 2 MVA	79	4.00
Brighton Ave. Sta. 8	Bank 2	2	34.5-4.16 kV 2 MVA	79	4.00
Brighton Ave. Sta. 8	Bank 2	2	34.5-4.16 kV 2 MVA	79	4.00
Chrisler Avenue Station 257	2 LTC TRF	3	34.5-4.16 kV 3/3.65 MVA	52	3.00
Collins Station 83	1 LTC TRF	3.75/4.69	34.5-4.8 kV	29	2.00
Cuyler Station 24	Bank 1	0.2	34.5-4.16 kV .2 MVA	80	3.00
Cuyler Station 24	Bank 1	0.2	34.5-4.16 kV .2 MVA	80	3.00
Cuyler Station 24	Bank 1	0.2	34.5-4.16 kV .2 MVA	80	3.00
Cuyler Station 24	Bank 2	0.2	34.5-4.16 kV .2 MVA	80	3.00
Cuyler Station 24	Bank 2	0.2	34.5-4.16 kV .2 MVA	80	3.00
Cuyler Station 24	Bank 2	0.2	34.5-4.16 kV .2 MVA	80	3.00
Delmar Station 279	2 LTC TRF	11	34.5-4.8 kV 5/6.25 MVA	49	2.00
Eagle Harbor Station 92	1 TRF	2.5	34.5-4.8 kV 2.5 MVA D-D	?	3.00
East Syracuse	1 LTC TRF	6.3	34.5-4.16 kV 5/6.3 MVA	53	2.00
Elm Street Station	2 GRD TRF	22.5	23 kV 22.5 MVA	42	2.00
Elm Street Station	1 GRD TRF	22.5	23 kV 22.5 MVA	42	2.00
Fisher Avenue Station 270	1 LTC TRF	6.25	34.5-13.8 kV 5/6.25 MVA	39	3.00
French Creek Station 56	1 TRF	3.75	34.5-13.8 kV 3.75 MVA	36	3.00
Glens Falls Hospital Station 414	2 TRF	3.2	34.5-4.16 kV 2.83/3.2 MVA	35	2.00
Glenwood Station 227	1 LTC TRF	6.25	34.5-4.16 kV 5/6.25 MVA	49	3.00
Golah Station	3 TRF	7.5	69-34.5 kV 7.5 MVA	71	2.00
Hudson Falls Station 88	2 TRF	5	34.5-13.8 kV 5 MVA	21	2.00
Karner Station 317	2 LTC TRF	6.25	34.5-4.16 kV 5/6.25 MVA	75	2.00
Karner Station 317	1 LTC TRF	6.25	34.5-4.16 kV 5/6.25 MVA	50	2.00
Lenox Station 513	1 LTC TRF	6.25	13.2-4.16 kV 5/6.25 MVA	46	2.00
Liberty Street Sta 94	2 LTC TRF	5	34.5-4.16 kV 5 MVA	55	2.00
McCrea Street Station 272	1 LTC TRF	3.75	34.5-4.8 kV 3/3.75 MVA	59	2.00
Mill Street Station 748	1 LTC TRF	6.25	23-4.8 kV 5/6.25 MVA	54	4.00
Mill Street Station 748	2 LTC TRF	6.25	23-4.8 kV 5/6.25 MVA	54	2.00
Mill Street Station 748	3 LTC TRF	6.25	23-4.8 kV 5/6.25 MVA	54	2.00
Miller Street Station 117	Bank 1	3.1	34.5-4.8	69	2.00
Miller Street Station 118	Bank 1	3.1	34.5-4.9	69	2.00
Miller Street Station 119	Bank 1	3.1	34.5-4.10	69	2.00
Newtonville Station 305	2 LTC TRF	5.6	34.5-4.16 kV 5/5.6 MVA	47	3.00
Oak Hill Station 62	1 TRF	2.5	34.5-4.8 kV 2.5 MVA		3.00
Rock City Station 623	4 LTC TRF	7	46-4.16 kV 5.6/7 MVA	55	4.00
Shore Road Station 281	1 LTC TRF	6.3	34.5-4.8 kV 5/6.25 MVA	52	2.00
State Street Station 954	1 LTC TRF	3.75	23-4.8 kV 3/3.75 MVA	55	2.00
State Street Station 954	2 LTC TRF	3.75	23-4.8 kV 3/3.75 MVA	55	2.00
Station 025	2 TRF	2.5	23-4.16 kV 2.5 MVA		2.00

Station Location	Equipment Description	MVA	Voltage	Age	Condition Code
Station 034	1 TRF	2.5	23-4.16 kV 2.5 MVA	79	2.00
Station 037	2 TRF	2.5	23-4.16 kV 2.5 MVA	79	2.00
Station 037	4 TRF	2.5	23-4.16 kV 2.5 MVA	81	2.00
Station 038	4 TRF	2.5	23-4.16 kV 2.5 MVA	79	2.00
Station 040	1 LTC TRF	4.8	23-4.16 kV 3.75/4.8 MVA	30	3.00
Station 056	3 LTC TRF	3.13	23-4.16 kV 2.5/3.13	53	4.00
Station 056	4 LTC TRF	2.5/3.1	23-4.16 kV 2.5/3.1 MVA	109	3.00
Station 057	2 LTC TRF	5.3	23-4.16 kV 3.75/4.2/4.7/5 MVA	36	2.00
Station 124 - Almeda Ave	4 LTC TRF	3.75	34.5-4.16 kV 3.75 MVA	47	3.00
Station 124 - Almeda Ave	2 LTC TRF	5.25	34.5-4.16 kV 5.25 MVA	47	2.00
Station 124 - Almeda Ave	1 LTC TRF	4.687	34.5-4.16 kV 4.687 MVA	47	2.00
Summit Station 347	1 TRF	10.5	69-4.8 kV 7.5/8.4/10.5 MVA	40	2.00

Programs are in place to replace substation power transformers. Of the 55 transformers identified to be watched, all have been identified for future replacement or retirement over the next fifteen years and have been prioritized based on condition and risk. Table 111-60 describes transformers that will be addressed within five years.

Table 111-60
Transformers to be Replaced

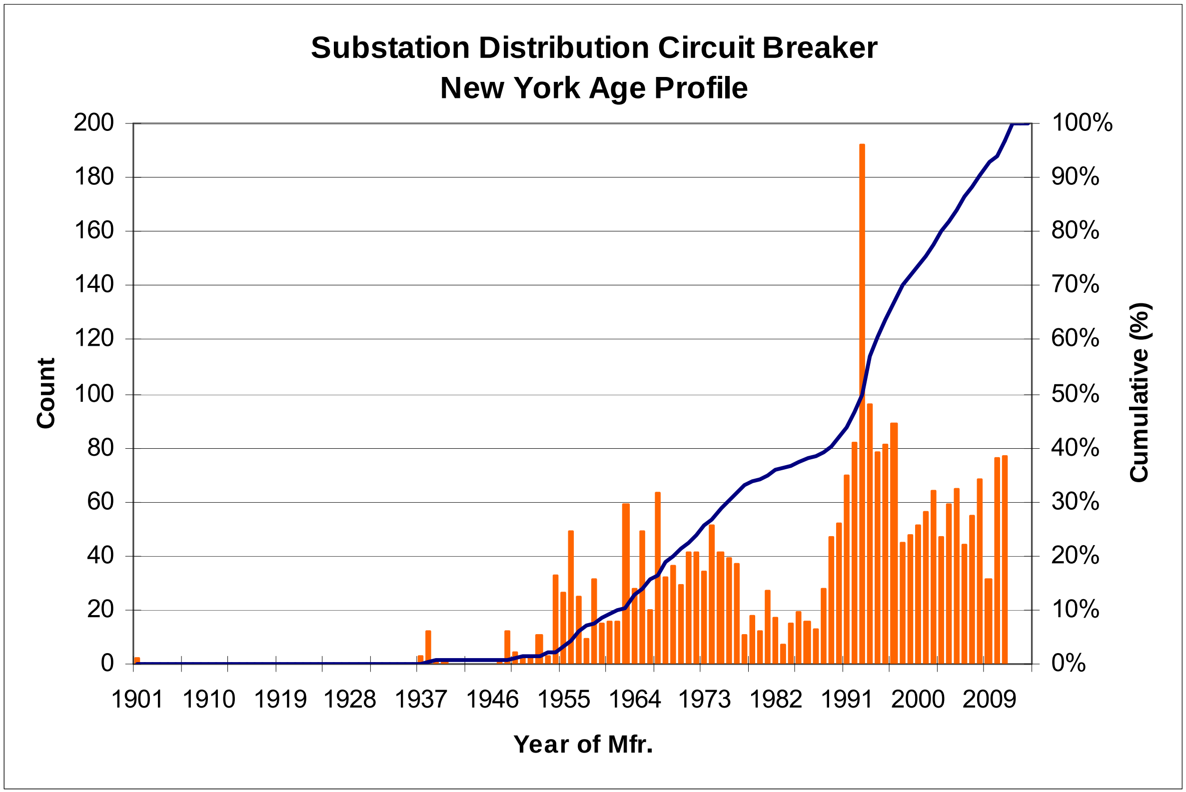
Station Location	MVA	Status
Fisher Avenue Station 270	6.25	Conceptual Engineering
Cuyler Avenue Station 24 (Qty 6)	2	Conceptual Engineering
Brighton Avenue Station 8 (Qty 6)	2	Conceptual Engineering

Although transformer replacements are based on condition and risk, a cautious approach is used to determine the appropriate number of transformers needing replacement on a per year basis.

Circuit Breakers

National Grid has 3,985 circuit breakers and 165 spares on the distribution system per Cascade, with an average age of 33 years as shown in Figure II-18. The substation circuit breaker population is generally sound and reliable; however, there are certain units which will be addressed as described below.

Figure II-18
Age Profile of Circuit Breakers



Condition and Performance Issues

There are relatively few gas circuit breakers (GCB) in the breaker population, but similar numbers of Air Magnetic Circuit Breakers (AMCB), Oil Circuit Breakers (OCB) and Vacuum Circuit Breakers (VCB) as shown in Table II-61. This analysis of breakers includes breakers, reclosers and switches.

Table II-61
Breakers Types

Breaker Type	Percentage of Total Population 2010	Percentage of Total Population 2011
AMCB	27.0%	25.5%
GCB	3.5%	3.6
OCB	31.0%	28.6
VCB	38.5%	38.9

Older breakers though inherently not less reliable due to age, are more difficult to maintain, may not meet the specifications needed for modern electrical systems and may not be supported in terms of replacements or spare parts.

The approach for breaker condition coding was based on engineering judgment and experience, and was supported by discussion with local operations staff and Subject Matter Experts (SMEs) in O&M Services. Condition codes have been applied to the operating population as shown in Table II-62.

Table II-62
Condition Code of Circuit Breakers

Condition Code	1	2	3	4	Grand Total
2010 Count	2196	1686	221	0	4,103
2011 Count	2162	1662	161	0	3,985

The change in total breaker population is a result of a complete review of the asset group and additions/removals to population due to construction. The decrease in Code 3 breakers reflects the approach to particular asset families described below. The description of the condition codes can be found in Table 111-72.

Actions Performed
Eighty-four breakers have been added to the system or replaced; 22 breakers were added to the system in 2010 and 62 were added through July 2011.

Certain types of breakers with condition codes 2 and 3 are targeted for replacement/refurbishment over the next ten years due to either obsolescence or poor performance. They are listed in Table II-63. In addition, the following quantities of the targeted breakers were removed from the system:

- Thirteen General Electric Type AM;
- Five Westinghouse Type DHP;
- Forty-one ITE Type HK;
- One ITE Type KS.

The quantities have been updated in the below table.

Table II-63
Circuit Breakers to be Replaced/Refurbished

Type or Family	Quantity	Average Age (Years)
Condit (code 3)	36	82
Federal Pacific (code 3)	19	48
General Electric Type AM (7 - code 2, 7 code 3)	14	43
General Electric Type VIR (code 3)	2	33
ITE Type HK (73 - code 2, 43 code 3)	116	36
ITE Type KS (code 2)	38	40

Type or Family	Quantity	Average Age (Years)
McGraw-Edison Type VSA (code 2)	2	21
Westinghouse Type DHP (code 2)	72	35

Replacements are prioritized based upon potential impact from failure. Therefore, some breakers with condition code 2 may be replaced prior to some with condition code 3 due to the higher impact associated with the failure of the code 2 assets.

Protection and Controls

Relays Condition

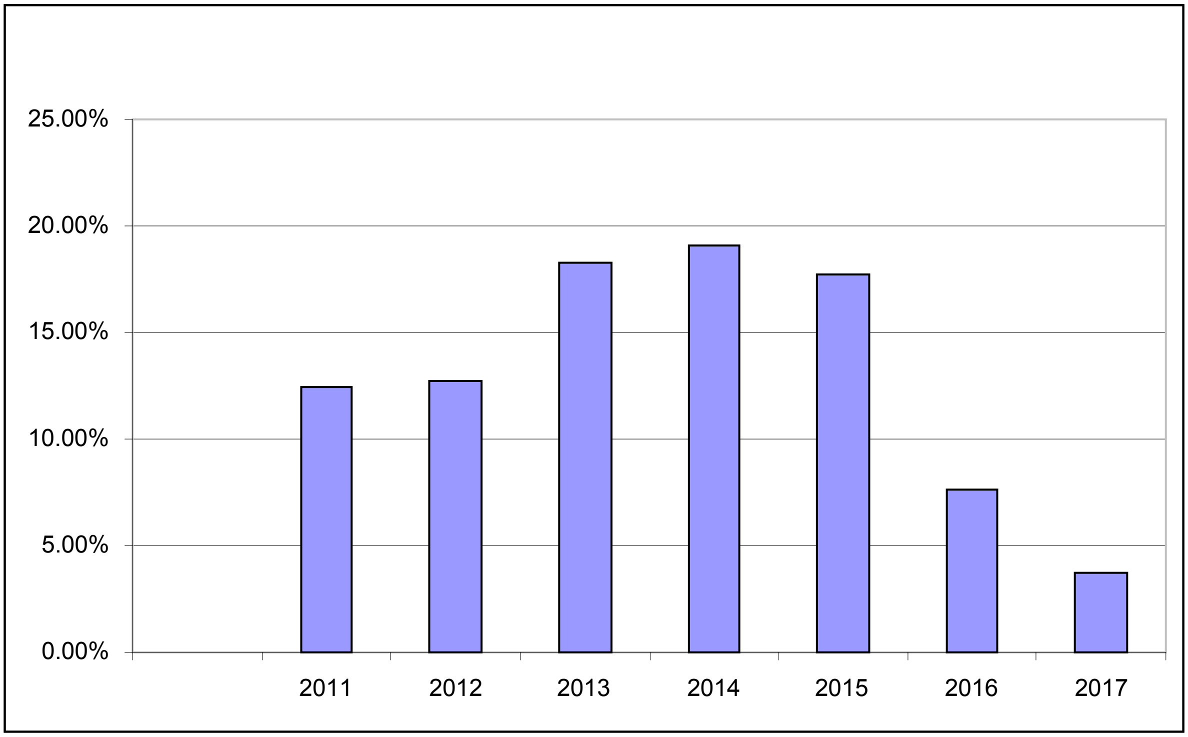
The following table indicates the number and type of relays currently installed on the sub-transmission and distribution systems.

Table II-64
Sub-Transmission and Distribution Relay Inventory

Class	Sub-Transmission	Distribution
Electro-mechanical	5,787	11,846
Microprocessor	974	1772
Solid State	34	0

The Company is testing between 15 – 20 percent of the relay population annually. The year on year variation occurs because of operational requirements, for example, a relay package may be tested earlier than its due date because of new installations/removals/substation rebuilds, or relay settings are changed. Each time a change is made to the relay setting, the relay is re-calibrated and the calibration date is automatically reset. When a relay is tested and fails, it will either be repaired or replaced.

Figure II-19
Forecast % of relay population to be tested (by Year)



The 2011 data shows testing through part of the year. The Company expects to complete testing on an additional 5% of relays during the remainder of 2011.

Actions Performed

As explained in 2010, National Grid has completed an assessment of existing protective relaying and substation control systems considered critical. A technical strategy for a replacement program was approved in 2010 and project sanctioning is currently underway.

National Grid will continue to assess the relay protection systems on the distribution and sub-transmission systems and adjust, upgrade, and/or replace protection and control systems as needed to provide safe and adequate operation of the network. The assessment will occur annually as part of a comprehensive annual asset health review. The recommendations of next year's relay replacement plans will take into account any new issues.

In summary, National Grid's protection and control systems rely on older technologies which have created issues in the operation of the system. With the advent of digital technologies, facilities can be upgraded to gain greater capability and increased reliability. We have identified the worst performers and are currently working on remedial actions.

Digital multifunction relays are an ideal choice for a cost-effective method to implement transmission system protection. The upgrading of old protection systems with digital relays can offer the following features and benefits:

- improved quality and high availability;
- Improved sensitivity of monitoring equipment;
- A Digital relay can replace multiple discrete relays resulting in reduced CT secondary burdens;
- Greater protection and control functionality, self monitoring and the ability to record oscillographic information and Sequence of Events;
- Lower maintenance costs; and
- Easy integration to the Distributed Control System via network communications.

Installation of Remote Terminal Units (RTUs)

Currently, 42 percent of the 441 New York distribution substations have SCADA. The total number of stations that need SCADA in New York is estimated to be 160. Four RTU installations have been completed at Southwood #34, Tully Center #278, Prospect Hill #411 and Butternut substations. The RTU installation at Fort Gage #319 has been cancelled due to possible retirement of this station.

Engineering has been completed, and installations planned in New York to install remote terminal units (RTU), wiring, control, and data acquisition capability at the substations listed below:

- Richmond #32
- Barker #78
- Chautauqua #57
- New Krumkill #42
- Selkirk #149
- Schuylerville #39
- Middleburg #390
- French Creek
- Niles
- Ballina
- Lehigh

Engineering is completed at Glenwood #277, but the RTU installation is on hold due to operational issues which must be resolved.

Obsolete Remote Terminal Units (RTUs)

There are approximately 550 operating RTUs under the Company's control, of which 158 transmission and distribution units are being replaced under an ongoing RTU replacement program (SG002). To date 87 projects are complete and 71 either in engineering or waiting to be installed.

See Section A (Transmission), page II-70 for more information on RTU replacements.

Batteries and Chargers

The current population of batteries is in sound condition. If a battery system has reached the end of its expected life, it undergoes a condition assessment and a decision is made on replacement of the unit.

Table II-65 provides current condition codes for the battery population.

Table II-65
Condition of Battery Population

TYPE	1	2	3	4	Grand Total
BATT	140	55	14	0	209

Actions Performed
Eight station batteries and chargers have been replaced all in 2010 with more planned for 2011. Thirty-one batteries have been decommissioned since the previous report.

National Grid has a battery replacement policy requiring the replacement of all battery sets that are 20 years old or sooner if battery condition through testing and inspection dictate as per National Grid Substation Maintenance standards. The 20 year asset life is based on industry best practice and our experience in managing battery systems.

Where needed, the battery charger is replaced at the same time as the battery system.

Other Substation Assets

Assets described here would be addressed individually should their condition dictate a rapid response, or while addressing maintenance, replacement or refurbishment ongoing at the same station. Information about other substation assets is generated through V&O Inspections and through feedback from Company personnel when they visit the site.

Substation Structures and Foundations

Generally substation structures are sound, but some significant issues at particular stations may be identified and require remedial action.

Surge Arresters

There are no significant issues with relation to surge arresters in distribution substations.

Cap-Pin Insulators

Cap and pin insulators have a history of failure especially when they are used as an insulator for hook-stick type disconnect switches. Insulators are replaced when they are identified as a risk, or as part of on going work at a particular substation.

Sensing Devices

The term sensing devices is used to identify current transformers (CTs) and Voltage Transformers (VTs) / Potential Transformers (PTs). As indicated in Table II-66 below, the population of sensing devices has remained fairly static at approximately 2,240 units, which are generally in good condition.

Sensing devices are inspected regularly as part of visual and operational (V&O) checks and through annual Infra-Red (IR) inspections. Replacement focuses on any sensing device regardless of manufacturer which appears to be weeping or has external cracks as these conditions can lead to moisture ingress, potentially resulting in failure of the device.

GE Type Butyl PTs and CTs that are more than 30 years old are replaced when the opportunity arises as they are known to be less reliable than the general population.

Table II-66
Condition Codes of Sensing Devices

TYPE	1	2	3	4	Grand Total
2010	1,824	412	0	0	2,236
2011	1,833	412	0	0	2,245

Capacitor Banks and Switches

Table II-67 provides the distribution capacitor bank population, showing that the bulk of the population is in good condition. No activity has occurred with capacitor banks since the last report.

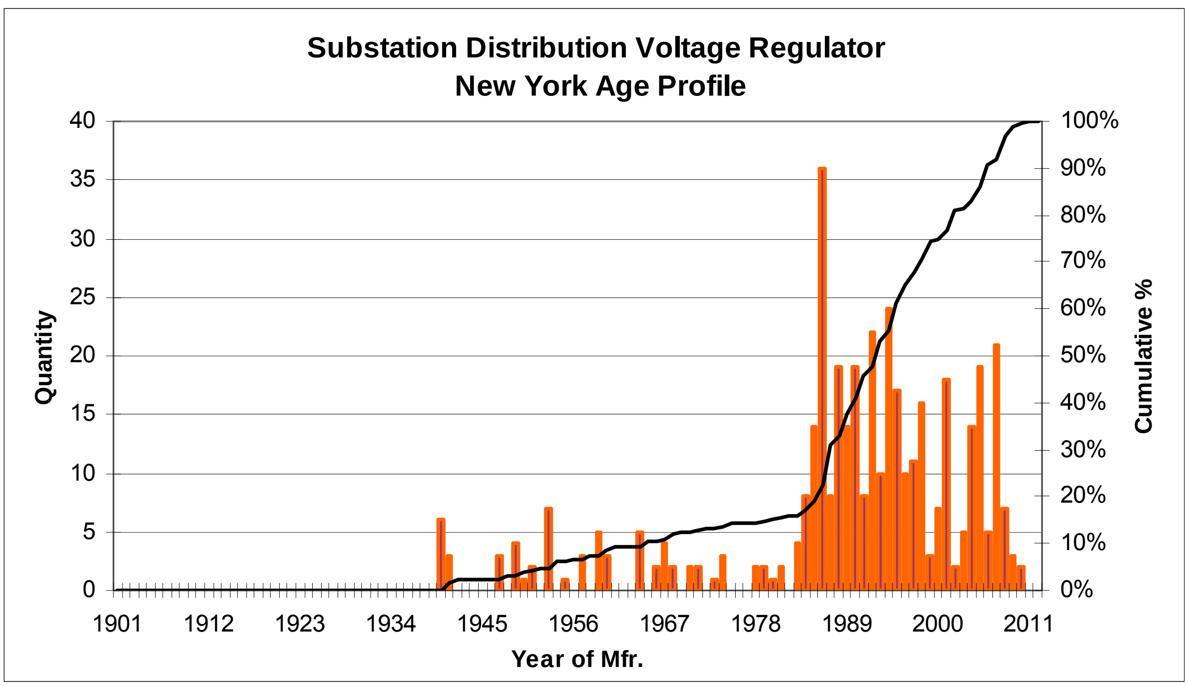
Table II-67
Capacitor Bank Condition Code

TYPE	1	2	3	4	Grand Total
CAP	60	1	0	0	61

Reactors and Regulators

Regulators and reactors provide voltage control and power flow management capability. There are approximately 674 regulators, and 139 spares in distribution and sub-transmission substations. The average age of the operating regulator population is 27 years, however 38% do not have an age, therefore, the average age may be older. The regulator age profile is shown in Figure II-20 below).

Figure II-20
New York Regulator Age Profile



There are approximately 20 air-core substation reactors. Eight are four years old and the remaining reactors are much older, but are missing age data information due to the fact that manufacturers did not provide manufacture dates on their nameplates on older units. In addition, reactors with a concrete base tend to be more than 40 years old.

Condition and Performance Issues

Regulators of specific manufacturer and design that are considered to be less reliable are listed in Table II-68. There has been a high failure rate of Siemens JFR regulators purchased between 1988 and 1993. The most common failure mode is burning and failure of the moveable or stationary contacts. The General Electric IRS and IRT Induction regulators and the Westinghouse IRT regulators also have known switching problems, parts are obsolete, and are less likely to sustain a through fault when compared to more modern type regulators.

Voltage regulators are monitored via V&O inspections and infrared surveys. Other problematic regulators may be identified from these inspections and PIW submission.

Table II-68
Voltage Regulator Types

Manufacturer	Type	Count
Siemens	JFR (Code 2)	11
GE	IRS/IRT (Code 2)	94[59]

Air core reactors rated 23kV at Seneca Station in Buffalo have deteriorating concrete bases which are being addressed through the Seneca Reactor Program. The program details are in the planning stages.

Air-cooled reactors are monitored via V&O inspections and infrared surveys. Older concrete base type reactors are problematic but do not result in adverse reliability consequences. Replacement of these reactors will be based on condition, age and opportunity. Table II-69 summarizes asset conditions for regulators and reactors.

Table II-69
Condition Code of Regulators and Reactors

TYPE	1	2	3	4	Grand Total
VREG	500	171	1	2	674
REAC	20	0	0	0	20

Actions Performed

All voltage regulators receive regular maintenance per Company standards. In addition, there is an approved strategy in effect to replace Siemens JFR and GE IRS/IRT Voltage Regulators. Approximately 31 regulators have been retired due to station rebuilds or station retirements. Twelve voltage regulators were replaced with newer modern step regulators due to damage or failure.

A Reactor (Non-transformer) Strategy has also been approved. As part of the strategy, nine air core reactors located at Seneca substation are due to be replaced. The units have concrete frames that are deteriorating and breaking apart. Since the coils are wound around the frame, this weakens their condition and may cause a problem if a system disturbance occurs.

[59]Westinghouse IRT is the same design as the General Electric IRT

III. System Capacity and Performance

III A. Introduction

Network Review Process

This chapter reports on the principal capacity and reliability issues on the transmission, sub-transmission and distribution systems. The Company performs system-wide and regional analysis of capacity and performance issues, which are evaluated along side asset condition issues to form an effective mitigation plan. When practical, these projects are designed to address multiple concerns. For study purposes, the transmission system is divided into eight transmission study areas. Each of the transmission study areas are further divided into forty-three distribution study areas.

Effective planning of the transmission and distribution system to best serve customer needs requires the Company to consider and evaluate issues on a system-wide, regional and local basis. For example, system-wide planning is needed to address power flows throughout the transmission system so that future demands are met and to ensure adequate facilities to transport power from generators within and outside of the Company's service territory. Likewise, a system-wide view is necessary to evaluate the ability to maintain reliable service during specified contingencies, including during the transfer of power through the service territory by others. System-wide planning is characterized by long-term forecasts of overall system demand, regional growth patterns within the service territory, and proposed generation interconnections.

In comparison, regional planning is necessary to ensure that transmission facilities are placed close enough to load centers such that expected demand growth in specific areas can be accommodated efficiently and reliably. Regional planning is characterized by greater volatility of customer additions/reductions, demand requirements, and more specific information of growth locations and performance issues. Forecasts of customer actions and demands generally do not extend more than five to seven years. Regional planning information serves as an input to system-wide planning efforts.

Local planning deals with the discrete portions of the electric delivery system and is driven by the need to ensure distribution facilities are adequate and flexible enough to meet individual customer requirements, local customer mix, and on-going population drift (i.e., urban to suburban, rural to suburban, suburban to urban). Local planning is characterized by short-term forecasts, and emergent and unforeseen customer needs, i.e. spot load additions. Details at the local planning level are input to the regional planning effort.

The Company also integrates asset health assessments into its planning efforts. Long term plans are often developed to replace related assets. These asset replacement plans can provide solutions to system limitations noted in the planning studies. Clearly, eliminating equipment based reliability, safety or faulty operational condition assists system planners in meeting their goals of providing a system to meet customer capacity and performance requirements.

The network review process assesses potential risks and impacts to system reliability. It analyzes and assesses asset condition, performance and capabilities of individual assets and the entire system, and determines future system risks. Network review includes studies of the current and future ability of the system to meet demand, reliability performance reviews, operational feedback, and benchmarking. Several contributing departments carry out the work in the network review. Through this structure, National Grid distinguishes and provides a high level of focus on its transmission and distribution assets and on two distinct needs. First, load-related investments that are driven primarily by the need to satisfy the changing needs of our customers, e.g., load growth, new business and generator requirements. Second, investments required to maintain the condition and improve the effectiveness of the assets. A more detailed description of these types of investments is provided below.

Load-related investment, also known as customer driven investment, is required to serve changes in the pattern of generation and demand through direct interaction with customers through connection applications and through the need to ensure that the interconnected T&D system fulfills certain system security requirements given existing levels of generation and demand. The system security requirements to which National Grid is obliged to adhere are governed by operating and planning standards set out by the various reliability organizations that are involved with the power system in New York.[1] Because the need for these projects is determined by forces largely outside National Grid's control, National Grid has little leeway over their timing.

Non load-related investment includes replacing assets whose condition has deteriorated in order to maintain the reliability, safety or environmental performance of the network. While these issues drive the need for non load-related projects, the timing of these projects is more within the control of National Grid. This investment is also referred to as asset-driven investment.

Every investment will not fall cleanly into one type of investment or the other, nor do all investments resolve a single capacity, performance or asset condition issue. The respective planning and asset strategy organizations ensure that transmission and distribution system investments are coordinated between asset condition and customer driven investments, and between the two systems. All investments are integrated to form a single system plan, known as the T&D Capital Investment Plan.[2]

[1] Organizations impacting reliability decisions include: North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Council (NPCC), the New York State Electric Reliability Council (NYSERC), and the New York Independent System Operator (NYISO).

[2] Case 06-M-0878, Niagara Mohawk Power Corporation Transmission and Distribution Capital Investment Plan (most recently, the "2011 Plan"), updated Feb 7, 2011.

Wide Area Protection Coordination

The Wide Area Protection Coordination Project is an in depth study of National Grid's protective relaying systems across the 115kV, 230kV and 345kV transmission system. Recognizing that the traditional approach to protective relaying coordination was on a per-project rather than system-wide basis, the Wide Area Coordination Project was initiated to improve the accuracy of power system models used for protection coordination. This ensured a solid foundation on which to make the necessary protective relay changes associated with the capital investment program.

The initial phase of the project included updating the short circuit model of all 115kV, 230kV and 345kV transmission lines, and all power transformers connected at these voltages. Self and mutually coupled overhead line impedances were also re-calculated based on actual physical characteristics. Transformer impedances were recalculated based on test data, connections and phasing. Relaying data was collected, verified and added to the model. Relay types studied included distance, overcurrent, and fault detectors utilized for distance relay supervision. Breaker failure and high speed protection schemes were analyzed utilizing fiber optic, power line carrier or audio tone communications.

Computer macros were developed specifically for this project based on industry standards and extensive best practice interviews with National Grid's protection engineering subject matter experts. The macros allow automated simulation of relay sensitivity and coordination, utilizing a 'sequence of events' approach under various fault conditions and contingencies. This is followed by intensive interpretation and analysis of the resulting data to identify improperly set relay elements and develop correct settings. The project is currently underway with some early discrepancies identified associated with line impedances and coordination between devices.

It is expected that interpretation and analysis of the 230kV and 345kV systems will be complete in 2012 with all issues of relay sensitivity and coordination errors identified along with proposed solutions. New relay settings will then be developed and/or new equipment identified as needed. Longer term plans are to continue with automated simulation, interpretation and corrective action for the 115kV system.

Under Frequency Load Shedding

Under frequency load shedding schemes are employed as a means to shed large quantities of load under emergency conditions in an effort to avoid wide area black outs. Historically, the Company has planned to shed load in two frequency blocks in the event of an under-frequency condition: 10% of system peak load would be shed in the event that the frequency falls to 59.3 Hz, and an additional 15% of system peak load in the event that the frequency falls further to 58.8 Hz. In 2009, the Northeast Power Coordinating Council (NPCC) through its Regional Reliability Reference Directory #12, enacted a requirement to modify the scope of the frequency response schemes from two frequency blocks to six frequency blocks. Transmission Owners are expected to implement the new scheme within a six-year period. In addition to defining new frequency set points, the response time of the relay schemes will be adjusted. Each frequency block should be armed to trip with an average total relay clearing time of 300ms.

The NPCC provided a six-year schedule to complete the plan and requires participating entities to report, through their respective ISO, annual progress against this schedule. To date, the Company has implemented relay settings changes that have successfully met requirements for the end of the first year (June 2010). Additional relay changes to meet the second year's requirements are in progress were completed in July 2011. Engineering is underway to define the changes for the remaining four years of the program and are expected to be completed by June 2012. The complexity of the changes increases as the program progresses due to challenges with: (1) dispersing the load shedding blocks geographically within our territory, (2) replacing incompatible electromechanical relays with microprocessor relays, (3) preventing overlap of the under frequency load shedding scheme with the manual load shed scheme which would reduce the expected benefits of each scheme during severe system emergencies. The development of these plans requires close coordination of staff from T&D planning, Regional Control Centers, Protection Engineering, Substation Engineering, and the Protection and Telecom Operations groups. The Company believes that the majority of the changes can be implemented with revised settings on existing relays, and is confident the modifications can be implemented per the required schedule or sooner.

Summer Preparedness

The hot weather months of summer are generally the period of time in which the majority of National Grid's electric facilities are most stressed from a capacity perspective. Preparing for these stresses is a critical element of the Company's operational efforts to maintain reliable service for customers. Following annual distribution capacity assessments, engineering and operations personnel work jointly to identify the short-term constraints on the system and discuss both mitigation and response plans for potential contingency scenarios at varying load levels. The results have been documented in the 2011 summer preparedness plan which was completed in March 2011 and submitted to Staff on March 31, 2011. The plan discussed potentially overloaded assets serving distribution load in a normal configuration.

In the summer of 2011, New York peak load reached 101% of forecasted peak demand based on 90/10 criteria. This was 3% higher than the summer of 2010 peak. A review of reliability performance (SAIFI) over the course of the peak load week (July 17 – 23) was conducted to quantify the impact of the system under the stresses of high load demand. The overall SAIFI during this week was 11% above the three-year average for the same period of previous years. In response, Summer 2012 preparedness activities include a review of ratio/step down transformer loading, upgrades to several feeders, and recommendations for voltage conversions.

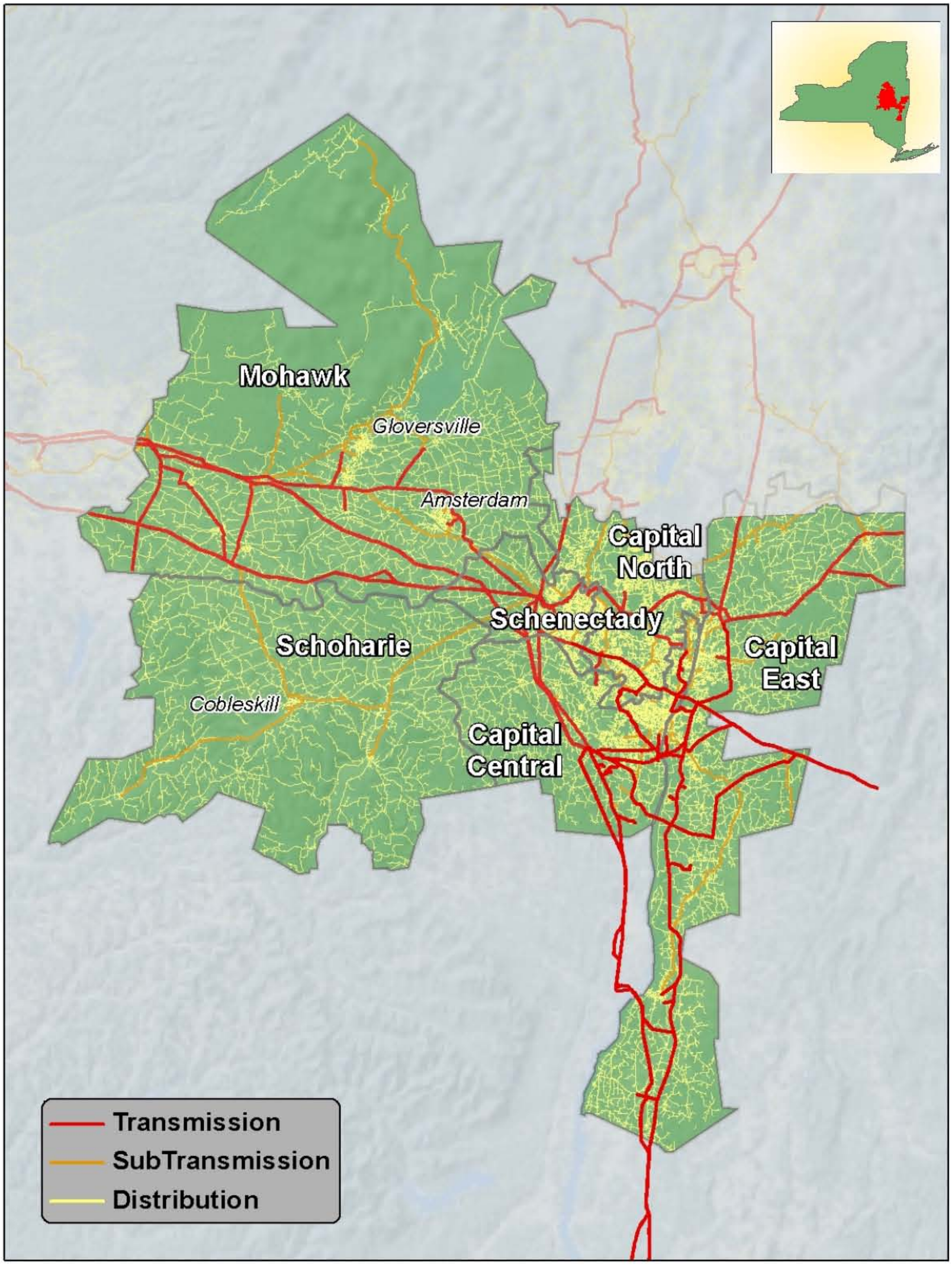
Zonal and Regional Analyses

For regional analysis, the Company's service territory is divided into eight transmission planning study areas as shown in Exhibit 1. Within the eight transmission planning study areas, the sub-transmission and distribution networks are further subdivided into 43 distribution study areas.

Each of the transmission study areas is described separately below in the following format:

- Area Summary
  - Area Description
  - Area Load Forecast
- Capacity Issues
  - Forecasted Overloads
  - Overloaded Distribution Feeder Map
  - Proposed Generator Interconnects

III B. Capital and Hudson Valley Transmission Planning Study Area



Area Summary

Key drivers behind the transmission capacity related projects in this study area include the following:

- Load growth in the area, and in the adjacent Northeast study area, will trigger potential post-contingency overloads of several 115kV lines and also the Rotterdam #7 230-115kV autotransformer. Some of these may occur at 2011 summer load levels, and others develop over the next 5-10 years as the load increases.
- Fault current levels have increased, requiring the replacement of overdutied breakers at two stations.
- Load growth will also cause post contingency voltages to drop below planning criteria levels at certain locations; timing depends on where and how quickly the load grows.

Key sub-transmission and distribution drivers include the following:

- DeLaet's Landing is a proposed Underground Commercial Development (UCD) in the City of Rensselaer with a full build out of 19MW. The developer has requested service for an initial phase which represents 2MW.
- Projects such as the substation expansions at Reynolds Rd. and Sycaway substations are supporting general load growth in the area, including the expansion of RPI Tech Park.

Area Description

The Capital and Hudson Valley study area is connected to the Utica/Rome study area in the west, the New England system in the east, and the Central Hudson Gas and Electric (CHG&E) and Consolidated Edison (ConEd) systems in the south. The transmission system consists primarily of 115kV and 345kV transmission lines. There are also several 230kV lines emanating from Rotterdam Substation. The Capital and Hudson Valley study area is the east end of the Central-East interface [redacted]

National Grid has three 345-115kV transformers in the region; two at New Scotland and one at Reynolds Road. There are three existing and one planned 230-115kV transformers at Rotterdam. [redacted]

Within the Capital and Hudson Valley study area, there are six Distribution study areas: Capital-Central, Capital-East, Capital-North, Mohawk, Schenectady and Schoharie.

The Capital-Central study area serves approximately 88,400 customers. The study area encompasses the greater Albany area, including a mixture of commercial customers heavily concentrated in downtown Albany, and industrial and residential customers spread across downtown to the suburban areas. The primary distribution system in Capital-Central is predominantly 13.2kV with pockets of 4.16kV primarily in the City of Albany and 4.8kV south of the City of Albany. Most 4kV distribution substations are supplied from the local 34.5kV sub-transmission system, whereas most 13.2kV distribution substations are supplied from the local 115kV transmission system.

The Capital-East study area serves approximately 88,200 customers. The study area is located east of the Hudson River, with the center approximately adjacent to Albany. This area extends approximately from Valley Falls in the north to Tivoli in the south. The larger load concentrations are in the cities of Rensselaer and Troy and in the towns along US Route 9. There is a 345kV source into the area at Reynolds Road substation and a 115kV corridor running in a north-south direction supplying approximately 90% of the distribution load in the area. There is also a 34.5kV sub-transmission system in the central area with the 115kV sources from Greenbush, North Troy, Hudson and Hoosick substations. In addition, there is scattered generation on the 34.5kV system in the area.

The Capital-North study area serves approximately 80,900 customers. The study area encompasses the suburban area north of the City of Albany, including a mixture of industrial, commercial and residential customers throughout Colonie, Cohoes, Watervliet, Clifton Park, Halfmoon, Waterford, Niskayuna, and Ballston. The primary distribution system in Capital-North is predominantly 13.2kV with a few pockets of 4.16kV in the Newtonville area and 4.8kV in the Town of Ballston. All 4kV distribution substations are supplied from the 34.5kV sub-transmission system, whereas most 13.2kV distribution substations are supplied from the 115kV transmission system. Maplewood and Patroon substations are the main sources for the 34.5kV sub-transmission system in this area, which is operated in loop configuration. Along with these facilities, a group of hydro and cogeneration power plants located along the Mohawk River (School St, Crescent, Vischer Ferry, Colonie Landfill, etc) form the backbone of the local 34.5kV sub-transmission system. In addition to supplying power to all 4kV and a few 13.2kV distribution substations, the 34.5kV sub-transmission system serves several industrial customers such as Mohawk Paper, Honeywell, Norlite, and Cascade Tissue. Major distribution customers in this area include the Albany International Airport, which is supplied by feeders from Forts Ferry, Sand Creek, Wolf Rd. and Inman Rd. substations.

The Mohawk study area serves approximately 55,600 customers. The study area includes the city of Amsterdam and the rural areas west of the city. This area is comprised of mostly residential customers and farms with some commercial and industrial customers located in areas such as the City of Amsterdam, Gloversville, Johnstown, Northville, and Canajoharie. The primary distribution system in Mohawk is predominantly 13.2kV with areas of 4.16kV (Gloversville and Johnstown areas) and 4.8kV (Canajoharie). Most 4kV distribution substations are supplied from the 23kV and 69kV sub-transmission system, whereas most 13.2kV distribution substations are supplied from the 115kV transmission system.

The Schenectady study area serves approximately 58,100 customers. The study area is defined by the region that includes the City of Schenectady and the surrounding suburban areas. This area includes a mixture of industrial, commercial and residential customers spread across downtown to suburban areas such as Niskayuna, Glenville, and Rotterdam. The primary distribution system in Schenectady area is predominantly 13.2kV with a few pockets of 4.16kV (Schenectady, Scotia and Rotterdam areas). All 4kV distribution substations are supplied from the local 34.5kV sub-transmission system, whereas most 13.2kV distribution substations are supplied from the local 115kV transmission system. In addition, the downtown areas of Schenectady are served by a general network that is supplied by the Front Street Substation. Rotterdam, Woodlawn and Rosa Rd. are the main sources for the local 34.5kV sub-transmission system, which is operated in loop configuration.

The Schoharie study area serves approximately 21,500 customers. The study area is defined by the region west and south of Schenectady that include towns and villages along the I-88 and Rt. 20 corridors such as Delanson, Schoharie, Cobleskill, Schenevus, and Sharon Springs. This area is mostly rural comprised mainly of residential customers and farms with few commercial and industrial customers. The primary distribution system in Schoharie is predominantly 13.2kV with areas of 4.8kV (Cobleskill, Worcester, and Schenevus areas). Most distribution substations in this region are supplied from the local 23kV and 69kV sub-transmission system. Marshville and Rotterdam are the main sources for the local 69kV sub-transmission system which is operated in loop configuration. The 69kV sub-transmission system supplies power to both 4kV and 13.2kV distribution substations, besides a few industrial and commercial customers, such as Guilford Mills and SUNY Cobleskill. The existing 23kV sub-transmission system in Schoharie, which supplies power to East Worcester, Worcester, and Schenevus substations, is operated in radial configuration from Summit substation.

Chapter 4, Exhibit 2 contains the list of electrical transmission and sub-transmission lines and substations in this transmission study area.

Area Load Forecast
The Capital Hudson Valley study area load forecast is part of (about 80%) the Zone F forecast. The summary of the load forecast thru 2020 is detailed in the tables below. For the last five years (2021 to 2026) in the Plan the growth rates are assumed the same as 2016 to 2020.

Table III-1

Albany - Glen Falls Region (NYISO Zone F) - SUMMER													
		SUMMER PEAKS (MWs)								TEMPs			
Year	**Month**	**Actual**		**50/50**		**90/10**		**95/5**		**Actual**	**50/50**	**90/10**	**95/5**
2001	8	2,004		1,882		1,995		2,009		84.0	80.1	83.5	84.0
2002	8	1,970	-1.7%	1,896	0.7%	2,011	0.8%	2,025	0.8%	82.0	80.1	83.5	84.0
2003	6	2,020	2.5%	2,000	5.5%	2,117	5.3%	2,132	5.2%	81.0	80.1	83.5	84.0
2004	8	1,930	-4.5%	1,982	-0.9%	2,102	-0.7%	2,117	-0.7%	78.0	80.1	83.5	84.0
2005	8	2,087	8.2%	2,086	5.2%	2,208	5.0%	2,223	5.0%	80.0	80.1	83.5	84.0
2006	8	2,196	5.2%	2,033	-2.5%	2,158	-2.3%	2,173	-2.2%	85.0	80.1	83.5	84.0
2007	8	2,069	-5.8%	2,112	3.9%	2,239	3.8%	2,255	3.7%	79.0	80.1	83.5	84.0
2008	6	2,106	1.8%	1,994	-5.6%	2,123	-5.2%	2,139	-5.1%	83.0	80.1	83.5	84.0
2009	8	2,040	-3.2%	2,079	4.3%	2,211	4.1%	2,227	4.1%	79.0	80.1	83.5	84.0
2010	7	2,245	10.1%	2,120	2.0%	2,254	1.9%	2,270	1.9%	83.0	80.1	83.5	84.0
2011		-		2,177	2.7%	2,313	2.6%	2,330	2.6%	-	80.1	83.5	84.0
2012		-		2,187	0.5%	2,326	0.6%	2,344	0.6%	-	80.1	83.5	84.0
2013		-		2,190	0.1%	2,331	0.2%	2,349	0.2%	-	80.1	83.5	84.0
2014		-		2,205	0.7%	2,348	0.7%	2,367	0.8%	-	80.1	83.5	84.0
2015		-		2,223	0.8%	2,369	0.9%	2,387	0.9%	-	80.1	83.5	84.0
2016		-		2,242	0.9%	2,390	0.9%	2,409	0.9%	-	80.1	83.5	84.0
2017		-		2,260	0.8%	2,411	0.9%	2,430	0.9%	-	80.1	83.5	84.0
2018		-		2,278	0.8%	2,431	0.8%	2,451	0.9%	-	80.1	83.5	84.0
2019		-		2,296	0.8%	2,451	0.8%	2,471	0.8%	-	80.1	83.5	84.0
2020		-		2,313	0.8%	2,471	0.8%	2,492	0.8%	-	80.1	83.5	84.0

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	0.7%	0.8%	0.9%	0.9%
Compound Avg. 5 yr ('04 to '08)	0.8%	-0.1%	0.1%	0.1%
Compound Avg. 9 yr ('02 to '10)	1.3%	1.3%	1.4%	1.4%
Compound Avg. 5 yr ('06 to '10)	1.5%	0.3%	0.4%	0.4%
Compound Avg. 5 yr ('11 to '15)		**1.0%**	**1.0%**	**1.0%**
Compound Avg. 5 yr ('16 to '20)		**0.8%**	**0.9%**	**0.9%**
Compound Avg. 10 yr ('11 to '20)		**0.9%**	**0.9%**	**0.9%**

Table III-2

Albany - Glen Falls Region (NYISO Zone F) - WINTER													
		WINTER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	1	1,669		1,676		1,750		1,766		12.0	9.3	(2.0)	(2.0)
2002	12	1,695	1.5%	1,737	3.6%	1,810	3.5%	1,826	3.4%	12.0	9.3	(2.0)	(2.0)
2003	1	1,803	6.4%	1,729	-0.4%	1,803	-0.4%	1,819	-0.4%	1.0	9.3	(2.0)	(2.0)
2004	12	1,877	4.1%	1,881	8.8%	1,954	8.4%	1,970	8.3%	4.0	9.3	(2.0)	(2.0)
2005	1	1,813	-3.4%	1,769	-6.0%	1,842	-5.8%	1,858	-5.7%	1.0	9.3	(2.0)	(2.0)
2006	12	1,665	-8.2%	1,736	-1.8%	1,810	-1.8%	1,826	-1.7%	17.0	9.3	(2.0)	(2.0)
2007	12	1,747	4.9%	1,834	5.6%	1,907	5.4%	1,924	5.4%	23.0	9.3	(2.0)	(2.0)
2008	1	1,738	-0.5%	1,713	-6.6%	1,786	-6.4%	1,802	-6.3%	3.0	9.3	(2.0)	(2.0)
2009	12	1,705	-1.9%	1,780	3.9%	1,853	3.8%	1,869	3.7%	19.0	9.3	(2.0)	(2.0)
2010	1	1,638	-3.9%	1,668	-6.3%	1,741	-6.1%	1,757	-6.0%	16.0	9.3	(2.0)	(2.0)
2011		-		1,775	6.5%	1,849	6.2%	1,865	6.1%	-	9.3	(2.0)	(2.0)
2012		-		1,772	-0.2%	1,845	-0.2%	1,861	-0.2%	-	9.3	(2.0)	(2.0)
2013		-		1,770	-0.1%	1,844	-0.1%	1,860	-0.1%	-	9.3	(2.0)	(2.0)
2014		-		1,776	0.3%	1,849	0.3%	1,865	0.3%	-	9.3	(2.0)	(2.0)
2015		-		1,783	0.4%	1,856	0.4%	1,872	0.4%	-	9.3	(2.0)	(2.0)
2016		-		1,790	0.4%	1,864	0.4%	1,880	0.4%	-	9.3	(2.0)	(2.0)
2017		-		1,797	0.4%	1,871	0.4%	1,887	0.4%	-	9.3	(2.0)	(2.0)
2018		-		1,804	0.4%	1,877	0.4%	1,893	0.4%	-	9.3	(2.0)	(2.0)
2019		-		1,810	0.4%	1,884	0.3%	1,900	0.3%	-	9.3	(2.0)	(2.0)
2020		-		1,817	0.4%	1,890	0.3%	1,906	0.3%	-	9.3	(2.0)	(2.0)

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	0.6%	0.3%	0.3%	0.3%
Compound Avg. 5 yr ('04 to '08)	-0.7%	-0.2%	-0.2%	-0.2%
Compound Avg. 9 yr ('02 to '10)	-0.2%	-0.1%	-0.1%	-0.1%
Compound Avg. 5 yr ('06 to '10)	-2.0%	-1.2%	-1.1%	-1.1%
Compound Avg. 5 yr ('11 to '15)		**1.3%**	**1.3%**	**1.3%**
Compound Avg. 5 yr ('16 to '20)		**0.4%**	**0.4%**	**0.4%**
Compound Avg. 10 yr ('11 to '20)		**0.9%**	**0.8%**	**0.8%**

Capacity Issues

Forecasted Overloads

The following tables identify forecasted system capacity issues and potential in this study area.

Table III-3

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Transmission Capital Hudson Valley Study Area							
[redacted]	345	[redacted]	2011	[redacted]	[redacted]		[redacted]
Maplewood R15 Breaker	115	115kV faults at or near Maplewood	2011	FLT794	113% overduty	CNYPL25	The replacement of R15 breaker is scheduled to be completed in FY14 in Capital Investment Plan.
New Scotland-Long Lane #7	115	Loss of Long Lane generation	2011	sum11_90-10_UC4200	101% LTE	CNYPL1 1-2	This violation depends on upstate-downstate transfers. When Central-East and UPNY-ConEd are heavily loaded, the underlying 115kV system between New Scotland and Pleasant Valley also becomes stressed.

[3] Results in violation of NERC and NPCC criteria.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							Studies are in progress and solutions are being investigated for this contingency. Until a permanent solution is completed, an operational solution may be used to address this issue: Ramp down Feura Bush by 100MW. A permanent capital solution under consideration is to reconductor the #7 line. A conductor clearance project is also planned on this line.
Wolf Rd.-Menands #10	115	Stuck Breaker at Rotterdam (R82)	2011	sum25+LF_90-10_SarAdj	119% LTE and 101% STE, voltages below 0.90 pu around Front St.		There are more than 20 contingencies that result in overloads on this line for most of the summer peak cases. Solutions are being investigated. One potential solution involves a capital project and an operational adjustment. Similar to the #31 overload solution, close the normally open Firehouse Rd. 1388 Switch. This can be done either by building a switching station at three terminal point of Grooms Rd-Forts Ferry #13 line, or by upgrading the existing protection equipment to allow three terminal operation. Closing 1388 Switch improves the voltages in the Front St area. Stimulus Capacitor Banks is another project that would provide voltage support to the area. In addition, the operational adjustment is to throwover Ruth Rd. from #8 line to #12 line permanently. This will

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							help avoid STE violation on #10 line. The mitigation measure until a capital solution is implemented is to throw over the load on #8 line to #12 line immediately after the contingency and shed 50MW load around Front St.
New Scotland-Feura Bush #9	115	Double Circuit tower outage of #3 and #17 lines	2011	sum15+LF_1200Redis_SarAdj	123% LTE and 101% STE		When the #3 and #17 lines are lost due to double circuit tower contingency, the #9 line gets overloaded. Studies are in progress and solutions are being investigated for this contingency. Until a permanent solution is completed, an operational solution may be used to address this issue: Ramp down Feura Bush by 40MW. Permanent capital solutions are under consideration. The first solution is to reconductor #9 line to improve its rating. The second solution is to separate #3 and #17 lines to avoid double circuit outage. A conductor clearance project is also proposed on this line.
Rotterdam #7 Transformer	230-115	Loss of Rotterdam #6 +#8 230-115kV Transformer	2012	CY07 & CY08 ATRA	140% SLTE and 124% SSTE	C31326, C31419	Addition of Eastover Road 230-115kV Station resolves this condition. Similar contingencies/conditions also affect the Rotterdam #6 and #8 230-115kV Transformers, which are relieved by the addition of Eastover Road. Cases studied had local generation in service.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							The contingency combinations noted are the worst case, however six contingencies - all combinations of two 230-115kV transformers at Rotterdam - also cause overloads on the remaining 230-115kV transformer at Rotterdam. Any of these contingencies during the summer operating season could require the shedding of up to 800MW of load to relieve the remaining 230-115kV transformer at Rotterdam. A statistical analysis of the most recent summer load profile for eastern NY shows any of these six contingencies could require the shedding of hundreds of megawatts of load for 43% of the days during the summer operating season by 2012. The addition of Eastover Road also prevents at least one single contingency overload: loss of the Rotterdam 77G 115kV bus which would overload the Rotterdam-Woodlawn #35 115kV circuit by 2012. This consideration alone would avoid over twenty million dollars for the reconductoring of Line #35, which would be necessary without Eastover Road.
Rotterdam-Woodlawn	115	Rotterdam 77G	2012	CY07 & CY08	100% SLTE		Addition of Eastover Road 230-115kV. This

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
#35		115kV Bus		ATRA			row illustrates an important N-1 concern which is relieved with the addition of Eastover Road in addition to the 230-115kV post-contingency overloads described above.
Five circuit breakers at North Troy: R3, R5, R10, R14, and R16)	115	115kV faults at/near North Troy	2012	CY08 ATRA	Breakers at ~100% interrupt capability	C34523	Replace five 115kV breakers at North Troy with 63kA breakers. The addition of Eastover Road 230-115kV station is a related driver.
Menands-Riverside #3	115	Double Circuit Tower outage of 2 and 31 lines	2013	sum15+LF_NE-NY_SarAdj	130% LTE and 110% STE		There are 10 more contingencies that result in overloads on this line for 7 different cases. Solutions are being investigated. The first option is to increase the rating of the line by upgrading the limiting elements. The second option is to eliminate double circuit contingency by separating #2 and #31 lines. The mitigation measure until the capital solution goes in service is to open #3 line when it is over STE and shed 40MW load off of substations between Curry Rd. and Menands.
State Campus-Menands #15	115	Outage of Krumkill-Albany #7 line	2013	sum15+LF_NE-NY_SarAdj	118% LTE		There are 5 contingencies that result in overloads on this line for most of the summer peak cases. Solutions are being investigated. Since this is an N-1 violation, a potential solution is to reconductor the line. The mitigation measure until a capital solution is implemented is to shed 30MW load around New Krumkill and McKownville substations.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Altamont-New Scotland #20, Rotterdam-Altamont #17 and Rotterdam-New Scotland #19	115	Stuck Breaker at Rotterdam (R83)	2014	sum25+LF_90-10_SarAdj	140% LTE and 116% STE		There are more than 20 contingencies that result in overloads on this line and also on #17 and #19 lines for most of the summer peak cases. Solutions are being investigated. This overload is sensitive to the load growth in Saratoga area due to Luther Forest development. The first option is to increase the ratings of #17, #19, and #20 lines. The second option is to add a series cap bank to the Rotterdam-New Scotland #13 line to shift the flow to #13 line. The third option is to add series reactors to #17 and #19 lines to limit the flow on these lines. Note that in addition to the load growth in Saratoga area, this contingency is also sensitive to the addition of fourth 230:115kV transformer at Rotterdam. Without the fourth bank, the violations will be worse. The mitigation measure until a capital solution is implemented is to shed 170MW load around Voorheesville, Altamont, Burdeck St, Rotterdam, Curry Rd, and Front St.
Reynolds Road #2 Transformer	345-115	[redacted]	2015	sum15+LF_1200Redis_LowSarGrowth	112% LTE and other thermal violations in the area		[redacted] No violations observed if the #4 line can be kept in-service. Studies are in progress and solutions are being investigated for this N-1-1 contingency. Until a

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
		[redacted]					permanent solution is completed, an operational solution may be used to address this issue: Shed 270MW in Albany area to bring all thermal violations just below 100% LTE. A permanent capital solution under consideration is to add a bus tie breaker and move the #4 line at NS substation to 33G bus. This way #4 line will not be lost for stuck breaker contingencies at New Scotland.
Arsenal-Reynolds #31 and Rotterdam-Curry Rd. #11	115	Stuck Breaker at Menands (R81)	2015	sum25+LF_90-10_SarAdj	108% LTE of #31 and 138% LTE (114% STE) of #11		There are 3 contingencies that result in overloads on this line for 3 different cases. Solutions are being investigated. As a potential solution, close the normally open Firehouse Rd.1388 switch. This can be done either by building a switching station at three terminal point of Grooms Rd.-Forts Ferry #13 line, or by upgrading the existing protection equipment to allow three terminal operation. In addition, throw over the load on Curry Rd.-Wolf Rd .#8 line to Woodlawn-State Campus #12 line to avoid Rotterdam-Curry Rd. #11 overloads. The mitigation measure until a capital solution is implemented is to throw over the load on #8 line to #12 line immediately after the contingency and shed 30MW load around Inman Road.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Menands-Reynolds #2	115	Stuck Breaker at Riverside (R81)	2015	sum15+LF_NE-NY_SarAdj	106% LTE		This overload depends on NE-NY transfers. High NE-NY transfers increase east to west flows in Albany system. Studies are in progress and solutions are being investigated for this contingency. Until a permanent solution is completed, two operational solutions may be used to address this issue: The first is to back down NE-NY transfers within 15 minutes of LTE violation. The second is to shed 30MW around the Menands substation. Permanent capital solutions are under consideration. The first option is to increase the thermal rating of the line. The second option is to add the second bus tie breaker at Riverside.
Maplewood-Menands #19	115	Outage of Rotterdam-Front St #16 line	2015	sum25+LF_90-10_SarAdj	117% LTE, voltages below 0.90 pu around Front St.		There are more than 10 contingencies that result in overloads on this line for most of the summer peak cases. Solutions are being investigated. The first option is to reconductor #19 line and add 50MVAr reactive compensation at Front St. The second option is to close the normally open Firehouse Rd. 1388 Switch. This can be done either by building a switching station at three terminal point of Grooms Rd.-Forts Ferry #13 line, or by upgrading the existing protection equipment to allow three terminal operation. The Stimulus Cap Bank

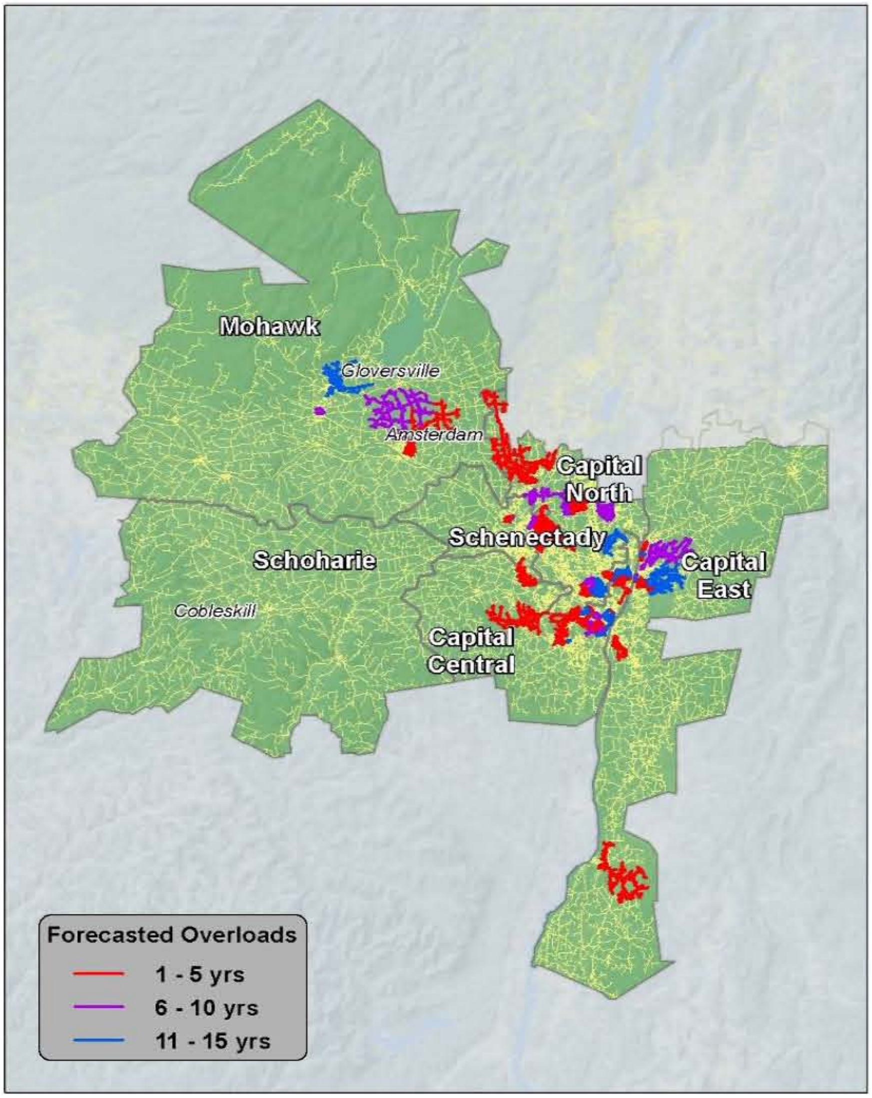
Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							project will also improve the voltages in Front St area. The mitigation measure until a capital solution is implemented is to shed 40MW load around Front St.
North Catskill-Milan #T7	115	N-1-1: Outage of Milan-PV #10 line followed by HURLEY 115 A bus fault	2015	sum15+LF_1200Redis_SarAdj	Voltage Collapse		This N-1-1 contingency results in voltage collapse around North Catskill. Central Hudson load will be affected from this contingency. Discussions continue with Central Hudson to address this contingency.
Feura Bush-North Catskill #2	115	Stuck Breaker at Hurley (R30353)	2017	sum20+LF_90-10_SarAdj	116% LTE	CNYPL11-1R, CNYPL11-3, CNYPL11-4	Potential problem for future years. There are 10 more contingencies that result in overloads on the same line for two different base cases. Continue to monitor the problem. Currently, discussing #2 line reconductoring with Central Hudson as a potential solution. Project to be initiated later.
Rotterdam #7 Transformer	230-115	Loss of Rotterdam #6 +#8 230-115kV Transformer	2018	CY07 & CY08 ATRA	100% SLTE		Addition of a fourth Rotterdam 230-115kV transformer. The need for this will be evaluated with respect to load growth beyond 2013 in eastern NY.
Rotterdam 230kV bus	230	Rotterdam 99H bus fault	2020	sum20+LF_90-10_SarAdj	0.93 pu		There are two recommended projects to add reactive compensation to the eastern NY system. The first one is the Stimulus Capacitor Bank project, which will add 286MVArs. The in-service date for Stimulus Capacitors is December 2012 and the project is already in preliminary

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							engineering stage. The second project is NRRP, which can add up to 250MVArs depending on the need. NRRP received internal approval from management. However, the exact locations of the NRRP capacitor banks will be determined later based on the need. These two projects together should address the voltage issues at Rotterdam.
Sub-Transmission and Distribution Capital Central Study Area							
New Krumkill substation 42151 Feeder	13.2	Exceed Summer Normal Rating	2011	-	103% of SN	CNE016	The recommended solution is to install a 900kVAR capacitor bank on the feeder.
Sub-Transmission and Distribution Capital East Study Area							
Sycaway substation Transformer T1	115/ 13.2	MWHr for loss of transformer	existing	-	480MWHr	C26418 C28022	The recommended solution is the addition of a second transformer and two feeders at Sycaway substation.
Reynolds Rd. substation Transformer T3	115/ 13.2	Exceed Summer Normal Rating	2012	-	101% of SN	C26419 C28023	The recommended solution is the addition of a second transformer and metal-clad switchgear at Reynolds Rd. substation.
Liberty substation 9450 Feeder	4.16	Exceed Summer Normal Rating	2010	-	102% of SN	C28786	The recommended solution is to reconductor the limiting element, the underground getaway.
Reynolds Rd. substation Transformer T3	115/ 13.2	Exceed Summer Normal Rating	2012	-	101% of SN	C26419 C28023	The recommended solution is the addition of a second transformer and metal-clad switchgear at Reynolds Rd. substation.
Sub-Transmission and Distribution Capital North Study Area							
Inman Rd. substation Transformer T2	115/ 13.2	MWHr for loss of transf.	existing	-	523MWHr	C28770 C28772 C30765	The recommended solution is the addition of a second transformer at Inman Rd. substation.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Sub-Transmission and Distribution Mohawk Study Area							
Northville substation	13.2	Low Voltage	existing	-	Low voltage	C07477	The recommended solution is to rebuild and convert the North Shore Rd. along the Great Sacandaga Lake.
Sub-Transmission and Distribution Schenectady Study Area							
Rosa Rd. substation 13756 Feeder	13.2	Exceed Summer Normal Rating	2019	-	100% of SN	C32070	The recommended solution is to reconductor the limiting element, the underground getaway.
Sub-Transmission and Distribution Schoharie Study Area							
None							
Sub-Transmission and Distribution Various Locations in Capital and Hudson Valley Study Area							
DOE funded Capacitor Banks	34.5 / 13.2	-	2012	-	-	-	The plan is to install 221MVArs or 77% of the total National Grid assignment in the Capital Region. The compensation plan will allocate 160MVArs to the distribution system and 61MVARS to the sub-transmission system

Forecasted Overloaded Distribution Feeder Map

The following map shows the Distribution feeders which are forecasted to be overloaded in the next 1-5, 6-10 and 11-15 year timeframe. The forecast overload is based on 100% of summer normal rating.



Proposed Generator Interconnections

In the Capital and Hudson Valley study area, a Flywheel generation project is proposed to interconnect to the transmission system through the NYISO OATT Attachment Z Small Facility Interconnection Procedures for Small Generator Interconnection Projects (20MW or less). The project has a proposed size of 20MW, and would connect to the Stephentown (NYSEG) 115kV substation near Stephentown, New York. National Grid's Greenbush 115kV substation will require a System Facilities Upgrade due to this interconnection.

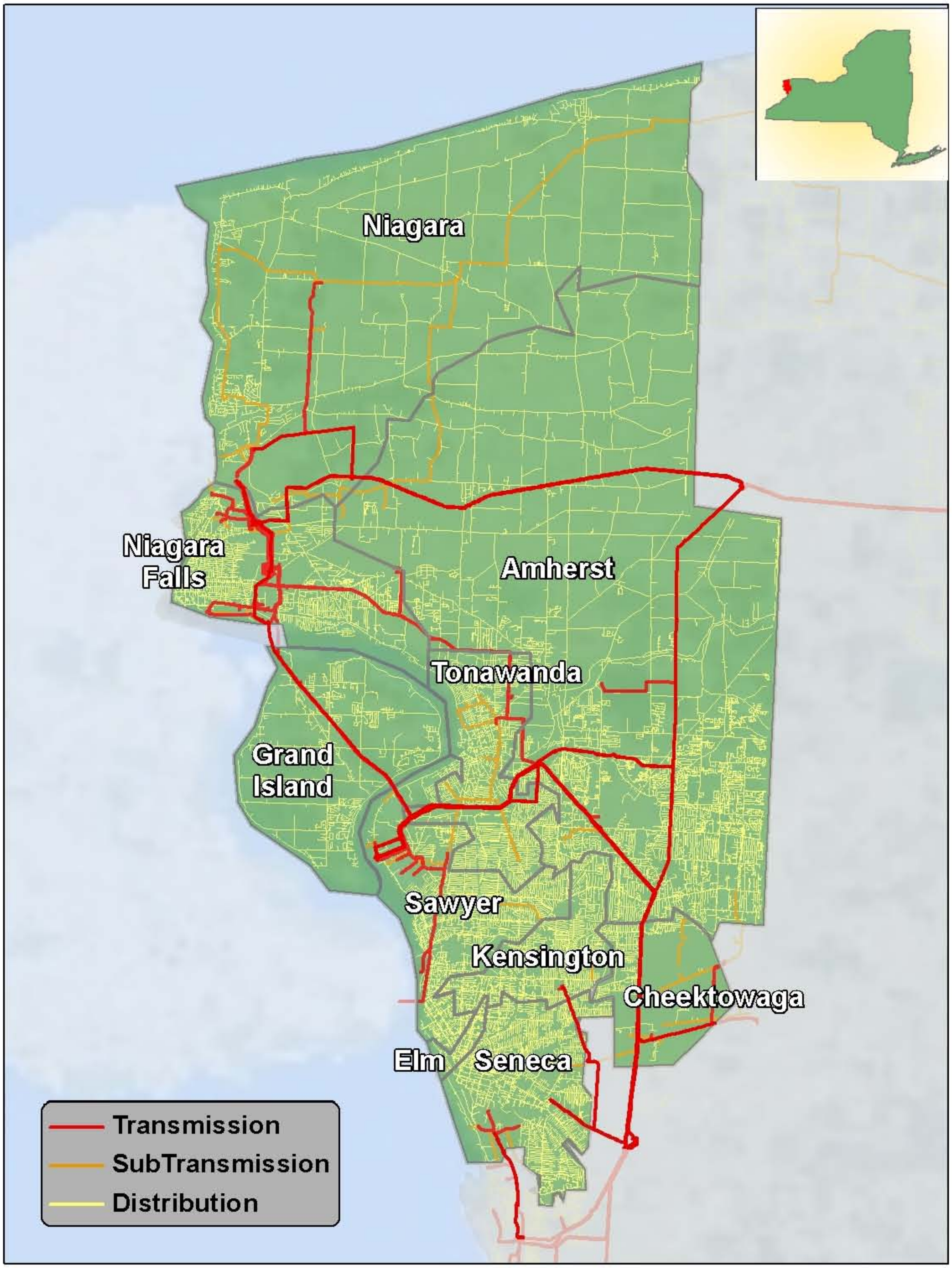
The projects listed below provide only for the interconnection to the National Grid system, and do not ensure that the full output of the generators can be accommodated at all times. National Grid's transmission plans do not provide for full deliverability of all generation unless appropriate funding is provided by the generators consistent with NYISO processes.

Table III-4

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation /Corrective Action
Greenbush substation	115	---	2012*	---	Stephentown Flywheel Generator	C37144 C37144R	Install DTT at Greenbush substation, and reimbursable portion

*Note: The Need Year for a generator project is when the generator plans to be connected to the system and does not indicate that a system need exists.

III C. Frontier Transmission Planning Study Area



Area Summary

The principal drivers for transmission projects in this area, from a capacity and asset condition perspective, are:

- Low post-contingency voltages at Huntley and Gardenville.
- Fault current levels that result in overdutied breakers at Gardenville.
- [redacted]
- High post-contingency 115kV line loadings on lines extending south and east from Niagara, Packard, and Gardenville.
- The proposed rebuild of Old Gardenville Station to address station configuration issues as well as asset condition issues and the replacement of obsolete relays. The project is currently in preliminary engineering with major construction anticipated to commence in FY14.

Key sub-transmission and distribution drivers include the following:

- Reliability issues and load growth in the Amherst area. There is approximately 10MVA of new load identified in the area. The new Frankhauser Substation will alleviate these issues.
- 5 to 10MW of load growth by the new Buffalo Niagara Medical Campus will be served by Elm Street substation.
- Area loading requiring the upgrade of multiple Buffalo area substations, including Buffalo Station 56 and Buffalo Station 127.
- Indoor substations are an asset condition issue and there are several replacement projects in progress.

Area Description

The Frontier transmission study area includes assets within NYISO Zone A. The area includes assets as far east as Lockport, the Niagara and Buffalo areas and the system stretching south to Gardenville. The system consists primarily of 115kV and 230kV double circuit transmission lines. [redacted]

Within the Frontier study area there are ten Distribution study areas: Amherst, Cheektowaga, Elm, Grand Island, Kensington, Niagara, Niagara Falls, Sawyer, Seneca and Tonawanda.

The Amherst study area serves approximately 58,900 customers. The study area is located east of Tonawanda and Niagara, and north of the City of Buffalo and encompasses the towns of Amherst, Pendleton, Wheatfield, Wilson and Lewiston. The Erie Canal divides the study area and may present challenges in creating new feeder ties and recommended supply expansion. The primary distribution system in Amherst is predominantly 13.2kV and

4.16kV, with Buffalo Station 138 supplying two 4.8kV distribution feeders. The area substations are supplied by the 115kV transmission system with the exception of Buffalo Station 58 and Buffalo Station 124, which are supplied by 34.5kV sub-transmission lines originating from Youngman Terminal Station and Buffalo Station 67, which is supplied by the 34.5kV sub-transmission lines originating from Walden substation.

The Cheektowaga study area serves approximately 8,000 customers. The area is located east of the City of Buffalo. There are several stations in this area that are supplied by 115kV transmission lines. Walden is the largest and has two transformers that serve the 34.5kV sub-transmission system. Dale Rd. Substation is 115-13.2kV, while Buffalo substations 61 and 154 are 115 - 4.16kV. The remaining substations in the area are 34.5-4.16kV. Buffalo Substation 146 has a 34.5 - 4.8kV and a 34.5 - 13.2kV transformer.

The Elm study area serves approximately 1,700 customers and is part of the City of Buffalo. It contains the downtown area as well as surrounding urban areas with a mix of residential, commercial and industrial loads. Elm Street Substation is a 230-23kV station that supplies the Buffalo network as well as the sub-transmission supply to several distribution stations. The Buffalo network has approximately 120MW of load. Most of the load is served by a low voltage AC general network which is supplied by multiple paralleled transformers with multiple 23kV supply cables thus providing very high reliability.

The Grand Island study area serves approximately 8,000 customers. The study area is made up of Grand Island which is between the City of Buffalo and Niagara Falls. It is primarily suburban and rural residential with areas of commercial and industrial parks. There are two National Grid substations supplied from 115kV lines with distribution feeders at 13.2kV.

The Kensington study area serves approximately 37,100 customers. There are eighty 4.8kV feeders, all fed from thirty eight 23-4.8kV transformers and nineteen 23kV sub-transmission lines. The Kensington Substation has four 115-23kV transformers, and provides the supply to the 23kV sub-transmission system. This substation is located in the City of Buffalo and the study area contains significant amounts of underground distribution mainlines and overhead laterals. The Kenmore Terminal Station supplies several smaller commercial customers and the South Campus of the SUNY at Buffalo.

The Niagara study area serves approximately 12.400 customers. The study area encompasses the towns of Lewiston, Porter, and Wilson. The study area is bordered to the west by Niagara River, to the North by Lake Ontario, and to the south by Power Reservoir. Area distribution is served primarily at 4.8kV and supplied by a 34.5kV sub-transmission network. The 34.5kV sub-transmission network operates in a loop system that is supplied by both Mountain and Sanborn 115-34.5kV substations.

The Niagara Falls study area serves approximately 38,700 customers. The study area is bordered to the north, south, and west by the Niagara River. The Power Reservoir also borders the area to the north, east of the Niagara River. Interstate 190 runs from the north to the south along the eastern section of the study area. The Amtrak rail runs from the east to the west along the northern section of the area. The Niagara Falls International Airport lies east of the city. These boundaries limit feeder ties and distribution supply expansion in the area. The area is supplied primarily by the 115kV transmission system, however, a 12kV sub-transmission system is supplied by Harper and Gibson substations. Distribution load is served by 13.2kV, 4.8kV, and 4.16kV circuits.

The Sawyer study area serves approximately 62,500 customers. The study area contains portions of the City of Buffalo and the Town of Tonawanda. Most of the load is served by underground 4kV cables served from 23kV supply cables and multiple, paralleled transformers.

The Seneca study area serves approximately 48,400 customers. The study area is the southeast section of Buffalo. It is served primarily from the Seneca Terminal Station which has four 115-23kV transformers and serves 25 supply lines at 23kV. The majority of distribution stations are served by four supply cables and have four 23-4.16kV transformers. As with all of the City of Buffalo, all distribution load is served at 4.16kV.

The Tonawanda study area serves approximately 41,300 customers. The study area encompasses the City of North Tonawanda as well as a portion of the City and Town of Tonawanda. Bordering the western section of the area is the Niagara River. Ellicott Creek flows parallel to Tonawanda Creek in the northern part of the town of Tonawanda, with a confluence just east of the Niagara River. The eastern section of the area is bordered by the Town of Amherst and forming the southern border is the Village of Kenmore and the City of Buffalo. The area is served primarily by the 115kV transmission system and the 23kV sub-transmission system. Distribution voltage is served primarily by 4.16kV feeders.

Chapter 4 Exhibit 2 contains the list of electrical transmission lines, sub-transmission lines and substations in this transmission study area.

Area Load Forecast
The Frontier Transmission Study Area load forecast is included in the West Region (NYISO Zone A & B) forecast. The summary of the load forecast thru 2020 is detailed in the tables below. For the last five years (2021 to 2026) in the Plan the growth rates are assumed the same as 2016 to 2020.

Table III-5

West Region (NYISO Zone A&B) – SUMMER														
		SUMMER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	7	2,270		2,231		2,322		2,340		80.2	78.3	82.0	82.4
2002	7	2,325	2.4%	2,253	1.0%	2,344	0.9%	2,362	0.9%	82.0	78.3	82.0	82.4
2003	8	2,176	-6.4%	2,216	-1.6%	2,307	-1.6%	2,325	-1.6%	76.4	78.3	82.0	82.4
2004	6	2,124	-2.4%	2,204	-0.6%	2,295	-0.5%	2,312	-0.5%	75.4	78.3	82.0	82.4
2005	8	2,339	10.1%	2,310	4.9%	2,402	4.7%	2,419	4.6%	79.2	78.3	82.0	82.4
2006	8	2,355	0.7%	2,258	-2.2%	2,350	-2.2%	2,367	-2.1%	81.8	78.3	82.0	82.4
2007	8	2,264	-3.9%	2,208	-2.2%	2,299	-2.2%	2,317	-2.1%	81.0	78.3	82.0	82.4
2008	7	2,193	-3.1%	2,197	-0.5%	2,288	-0.5%	2,306	-0.5%	78.4	78.3	82.0	82.4
2009	8	2,124	-3.2%	2,085	-5.1%	2,176	-4.9%	2,194	-4.9%	80.0	78.3	82.0	82.4
2010	7	2,235	5.2%	2,140	2.6%	2,231	2.5%	2,249	2.5%	82.2	78.3	82.0	82.4
2011		-		2,243	4.8%	2,334	4.6%	2,352	4.6%	-	78.3	82.0	82.4
2012		-		2,260	0.8%	2,351	0.7%	2,369	0.7%	-	78.3	82.0	82.4
2013		-		2,274	0.6%	2,365	0.6%	2,383	0.6%	-	78.3	82.0	82.4
2014		-		2,284	0.4%	2,375	0.4%	2,393	0.4%	-	78.3	82.0	82.4
2015		-		2,292	0.4%	2,383	0.4%	2,401	0.4%	-	78.3	82.0	82.4
2016		-		2,300	0.4%	2,391	0.3%	2,409	0.3%	-	78.3	82.0	82.4
2017		-		2,308	0.4%	2,400	0.3%	2,417	0.3%	-	78.3	82.0	82.4
2018		-		2,316	0.3%	2,407	0.3%	2,425	0.3%	-	78.3	82.0	82.4
2019		-		2,324	0.3%	2,415	0.3%	2,433	0.3%	-	78.3	82.0	82.4
2020		-		2,331	0.3%	2,422	0.3%	2,440	0.3%	-	78.3	82.0	82.4

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.5%	-0.2%	-0.2%	-0.2%
Compound Avg. 5 yr ('04 to '08)	0.2%	-0.2%	-0.2%	-0.2%
Compound Avg. 9 yr ('02 to '10)	-0.2%	-0.5%	-0.4%	-0.4%
Compound Avg. 5 yr ('06 to '10)	-0.9%	-1.5%	-1.5%	-1.5%
Compound Avg. 5 yr ('11 to '15)		**1.4%**	**1.3%**	**1.3%**
Compound Avg. 5 yr ('16 to '20)		**0.3%**	**0.3%**	**0.3%**
Compound Avg. 10 yr ('11 to '20)		**0.9%**	**0.8%**	**0.8%**

Table III-6

West Region (NYISO Zone A&B) – WINTER													
		WINTER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	1	2,115		2,130		2,163		2,166		17.0	12.8	3.6	2.6
2002	12	2,131	0.7%	2,143	0.6%	2,175	0.6%	2,179	0.6%	16.2	12.8	3.6	2.6
2003	1	2,113	-0.8%	2,107	-1.7%	2,140	-1.6%	2,143	-1.6%	11.2	12.8	3.6	2.6
2004	12	2,112	0.0%	2,082	-1.2%	2,115	-1.1%	2,119	-1.1%	4.4	12.8	3.6	2.6
2005	12	2,103	-0.4%	2,103	1.0%	2,136	1.0%	2,139	1.0%	12.8	12.8	3.6	2.6
2006	12	2,038	-3.1%	2,084	-0.9%	2,116	-0.9%	2,120	-0.9%	25.8	12.8	3.6	2.6
2007	2	2,039	0.1%	2,016	-3.3%	2,049	-3.2%	2,052	-3.2%	6.4	12.8	3.6	2.6
2008	2	2,016	-1.1%	2,005	-0.6%	2,037	-0.5%	2,041	-0.5%	9.6	12.8	3.6	2.6
2009	12	1,991	-1.2%	2,028	1.2%	2,061	1.1%	2,064	1.1%	23.2	12.8	3.6	2.6
2010	1	1,959	-1.6%	1,982	-2.3%	2,015	-2.2%	2,018	-2.2%	19.2	12.8	3.6	2.6
2011		-		2,064	4.1%	2,097	4.1%	2,100	4.1%		12.8	3.6	2.6
2012		-		2,077	0.6%	2,110	0.6%	2,113	0.6%		12.8	3.6	2.6
2013		-		2,088	0.5%	2,121	0.5%	2,124	0.5%		12.8	3.6	2.6
2014		-		2,097	0.4%	2,129	0.4%	2,133	0.4%		12.8	3.6	2.6
2015		-		2,104	0.4%	2,137	0.4%	2,141	0.4%		12.8	3.6	2.6
2016		-		2,112	0.4%	2,145	0.4%	2,148	0.4%		12.8	3.6	2.6
2017		-		2,120	0.4%	2,152	0.4%	2,156	0.4%		12.8	3.6	2.6
2018		-		2,127	0.3%	2,160	0.3%	2,163	0.3%		12.8	3.6	2.6
2019		-		2,134	0.3%	2,167	0.3%	2,170	0.3%		12.8	3.6	2.6
2020		-		2,141	0.3%	2,173	0.3%	2,177	0.3%		12.8	3.6	2.6

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.7%	-0.9%	-0.8%	-0.8%
Compound Avg. 5 yr ('04 to '08)	-0.9%	-1.0%	-1.0%	-1.0%
Compound Avg. 9 yr ('02 to '10)	-0.8%	-0.8%	-0.8%	-0.8%
Compound Avg. 5 yr ('06 to '10)	-1.4%	-1.2%	-1.2%	-1.2%
Compound Avg. 5 yr ('11 to '15)		**1.2%**	**1.2%**	**1.2%**
Compound Avg. 5 yr ('16 to '20)		**0.3%**	**0.3%**	**0.3%**
Compound Avg. 10 yr ('11 to '20)		**0.8%**	**0.8%**	**0.8%**

Capacity Issues

Forecasted Overloads

The following tables identify forecasted system capacity issues and potential solutions in this study area.

Table III-7

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Transmission Frontier Study Area							
54 (Gardenville-Erie)	115	Line 181	2011	Summer 2011	116% of LTE	C31463	The contingency combination noted is the worst-case contingency for this violation. Other contingencies include DCT 181+182, 705, 903 and Gardenville bus sections. 0.3 miles of Gardenville-Erie #54 is being reconductored with 795 ACSR
195 (Niagara-Packard)	115	193+194 DCT outage	2011	Summer 2013	122% of STE, 143% of LTE	C29945	The contingency combination noted is the worst-case contingency for this violation. Another contingency that also causes this overload is a bus fault at Packard. The recommended solution is to reconductor 195 with 2156 ACSS by 2013. A temporary solution would be to reduce generation on the Niagara West 115kV bus by about 250MW
[redacted]	115	[redacted]	2011	[redacted]	[redacted]	C24012	[redacted]

[4] Results involve violation of NERC, NPCC and NYSRC criteria.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							[redacted]
Gardenville 115kV TB #3, TB #4	115	N-1-1 Contingency: TB#2 outage followed by Gardenville 230kV bus fault[5]	2011	Summer 2011	100% if STE, 140% of LTE	Asset Strategy	The contingency combinations noted are worst-case contingencies for this violation. These overloads will be addressed by Asset Strategy's station rebuild project. A recommended solution as part of the rebuild project is to replace the existing transformer banks with new 333MVA banks
Niagara-Lockport circuits (101, 102)	115	Lockport 115 Bus 2	2012	Summer 2011, 2015	114% of LTE	C38705	Operational change requires 104 to be closed at Mountain and Lockport, 103 opened at Mountain. Additional planning recommendations include replacing limiting elements at Lockport and Mountain stations
181 (Packard-Urban)	115	180+182 DCT	2015	Summer 2015	112% of LTE		The contingency combination noted is the worst-case contingency for this violation. Other contingencies include single and double circuit Gardenville line outages. The recommended solution is to bus the retired #105 (Beck-

[5] Results involve violation of NPCC and NYSRC criteria.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							Terminal C) line with the #181 line and reconductor 1.10 miles of #181
[redacted]	230	[redacted]	2015	[redacted]	[redacted]	C38922	[redacted]
Huntley Area Voltages	115	129/130 DCT outage	2015	Summer 2020	0.88 pu (0.90) for 2020	C37522	The recommended solution is to install two 75MVAr permanent 115kV capacitor banks at Huntley, replacing the existing portable 52.5MVAr units. A temporary solution would be to put Oxbow Power and Indeck Yerkes generators in service
[redacted]	345	[redacted]	2015	[redacted]	[redacted]		[redacted]

[6] Results involve violation of NPCC criteria.
[7] Results involve violation of NPCC and NYSRC criteria.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Gardenville Circuit Breakers (14 number)	115	SLGF at Gardenville Bus 1	2015	Summer 2015	105% of breaker duty	Asset Strategy	The contingency noted is the worst-case contingency for this violation. Other contingencies include SLGF on lines originating in the Frontier Region. These over-duties will be addressed by Asset Strategy's station rebuild project. A recommended solution as part of the rebuild project would be to replace the existing breakers with new 63kA breakers
Sub-Transmission and Distribution Amherst Study Area							
Buffalo Station 54 5469 Feeder	4.16	Exceed Summer Normal Rating	existing	-	104% of SN	C28931 C28929 C30005	The recommended solution is to install a new 115 / 13.2kV substation at Frankhauser Rd. with four distribution feeders.
Buffalo Station 54 5473 Feeder	4.16	Exceed Summer Normal Rating	existing	-	109% of SN	C28931 C28929 C30005	The recommended solution is to install a new 115 / 13.2kV substation at Frankhauser Rd. with four distribution feeders.
Buffalo Station 54 Transformer T1 or T2	115/ 4.16	Exceed Summer Emergency Rating	Existing	-	147% of SE	C28931 C28929 C30005	The recommended solution is to install a new 115 / 13.2kV substation at Frankhauser Rd. with four distribution feeders.
Buffalo Station 124 Transformer T1-T4	34.5/ 4.16	Exceed Summer Emergency Rating for loss of one transformer	Existing	-	114% of SE	C28931 C28929 C30005	The recommended solution is to install a new 115 / 13.2kV substation at Frankhauser Rd. with four distribution feeders.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Maple Rd. substation Transformer T1 or T2	115/ 13.2	Exceed Summer Emergency Rating	Existing	-	100% of SE	C28931 C28929 C30005	The recommended solution is to install a new 115 / 13.2kV substation at Frankhauser Rd. with four distribution feeders.
Sweet Home Rd. substation Transformer T1 or T2	115/ 13.2	Exceed Summer Emergency Rating	Existing	-	100% of SE	C28931 C28929 C30005	The recommended solution is to install a new 115 / 13.2kV substation at Frankhauser Rd. with four distribution feeders.
Shawnee Rd. substation Transformer T1	115/ 13.2	MWHr for loss of transformer	existing	-	290MWHr	C36059	The recommended solution is to install a second transformer and one feeder at Shawnee Rd. substation.
Walmore Rd. substation Transformer T1	115/ 13.2	MWHr for loss of transformer	existing	-	241MWHr	C36566 C36579	The recommended solution is to install a new feeder at Military Rd. substation after the substation transformer upgrades at Military Rd. substation and Lockport Rd. substation are completed.
Buffalo Station 54 5461 Feeder	4.16	Exceed Summer Normal Rating	2012	-	102% of SN	C28931 C28929 C30005	The recommended solution is to install a new 115 / 13.2kV substation at Frankhauser Rd. with four distribution feeders.
Buffalo Station 54 5468 Feeder	4.16	Exceed Summer Normal Rating	2012	-	100% of SN	C28931 C28929 C30005	The recommended solution is to install a new 115 / 13.2kV substation at Frankhauser Rd. with four distribution feeders.
Sweet Home Rd. substation 22457 Feeder	13.2	Exceed Summer Normal Rating	2012	-	101% of SN	C28931 C28929 C30005	The recommended solution is to install a new 115 / 13.2kV substation at

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							Frankhauser Rd. with four distribution feeders.
Buffalo Station 54 5464 Feeder	4.16	Exceed Summer Normal Rating	2012	-	100% of SE	CNW016	The recommended solution is to reconductor the limiting element, the underground getaway.
Buffalo Station 54 5469 Feeder	4.16	Exceed Summer Normal Rating	2012	-	100% of SE	CNW016	The recommended solution is to reconductor the limiting element, the underground getaway.
Buffalo Station 54 5473 Feeder	4.16	Exceed Summer Normal Rating	2012	-	100% of SE	CNW016	The recommended solution is to reconductor the limiting element, the underground getaway.
Sub-Transmission and Distribution Cheektowaga Study Area							
None							
Sub-Transmission and Distribution Elm Study Area							
None							
Sub-Transmission and Distribution Grand Island Study Area							
Grand Island substation feeder 6453	13.2	Exceed Summer Normal Rating	existing	-	134% of SN	C29044	New feeder, 20954 from Buffalo Station 209, was constructed.
Sub-Transmission and Distribution Kensington Study Area							
None							
Sub-Transmission and Distribution Niagara Study Area							
Youngstown substation Transformer T1	34.5/4.8	Exceed Summer Normal Rating	existing		105% of SN	C29049	The recommended solution is to upgrade the Youngstown substation

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							transformer.
Wilson substation Transformer T1	34.5/ 4.8	Exceed Summer Normal Rating	existing		107% of SN	C35743	The recommended solution is to upgrade the Wilson substation transformer.
Sub-Transmission and Distribution Niagara Falls Study Area							
Lockport Rd substation Transformer T1	115/ 13.2	MWHr for loss of transformer	existing	-	290MWHr	C36057	The recommended solution is to install a second transformer at Lockport Rd substation.
Military Rd substation Transformer T1	115/ 13.2	MWHr for loss of transformer	existing	-	306MWHr	C36056	The recommended solution is to Install a second transformer at Military Rd substation.
Walmore Rd substation	13.2	MWHr for loss of transformer	2015	-	241MWHr	C36566 C36579	Distribution line work associated with creating feeder ties with Lockport Rd substation Feeders and Military Rd. substation feeders.
Beech St substation 8164 Feeder	4.16	Exceed Summer Normal Rating	2020	-	100% of SN	CNW016	The recommended solution is to Install a capacitor bank on Beech St substation 8164 Feeder to provide reactive support and thermal capacity
Military Rd substation 21053 Feeder	13.2	Exceed Summer Normal Rating	2021	-	100% of SN	CNW016	The recommended solution is to Install a capacitor bank on Military Rd substation 21053 Feeder to provide reactive support and thermal capacity.
Sub-Transmission and Distribution Sawyer Study Area							
Sawyer substation 1-H Feeder	23	Exceed Summer Normal Rating	existing	-	112% of SN	C28892	The recommended solution is to reconductor the limiting sections of

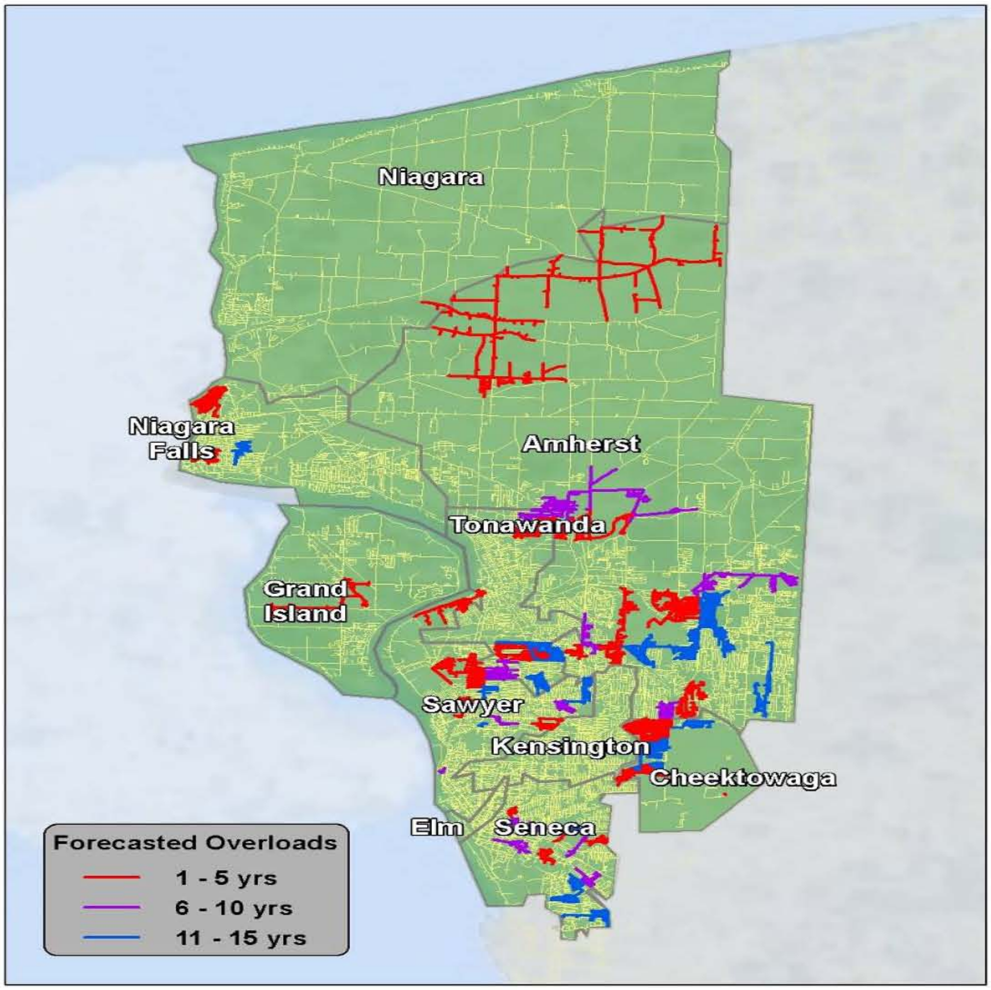
Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							the underground feeder, approximately 12,000 feet.
Sawyer substation 2-H Feeder	23	Exceed Summer Normal Rating	existing	-	130% of SN	C28892	The recommended solution is to reconductor the limiting sections of the underground feeder, approximately 12,000 feet.
Sawyer substation 3-H Feeder	23	Exceed Summer Normal Rating	existing	-	140% of SN	C28892	The recommended solution is to reconductor the limiting sections of the underground feeder, approximately 12,000 feet.
Sawyer substation 13-H Feeder	23	Exceed Summer Normal Rating	existing	-	153% of SN	C28892	The recommended solution is to reconductor the limiting sections of the underground feeder, approximately 12,000 feet.
Sawyer substation 11-H	23	Exceed Summer Normal Rating	existing	-	110% of SN	C28893	The recommended solution is to reconductor the limiting sections of the underground feeder.
Buffalo Station 56 TransformersT1, T2, T3 and T4	23/ 4.16	Exceed Summer Normal Rating	existing	-	104% of SN		The recommendation is to upgrade these 2.5MVA transformers to 5MVA units.
Buffalo Station 24 2462 Feeder	4.16	Exceed Summer Normal Rating	2011	-	109% of SN		The recommended solution is to reconductor the limiting element, the underground getaway and first common duct section.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Buffalo Station 24 2463 Feeder	4.16	Exceed Summer Normal Rating	2011	-	114% of SN		The recommended solution is to reconductor the limiting element, the underground getaway and first common duct section.
Buffalo Station 24 2469 Feeder	4.16	Exceed Summer Normal Rating	2011	-	111% of SN		The recommended solution is to reconductor the limiting element, the underground getaway and first common duct section.
Buffalo Station 24 2473 Feeder	4.16	Exceed Summer Normal Rating	2011	-	100% of SN		The recommended solution is to reconductor the limiting element, the underground getaway and first common duct section.
Buffalo Station 126 12662 Feeder	4.16	Exceed Summer Normal Rating	2012	-	100% of SN	CNW016	The recommended solution is to reconductor the limiting element, the underground getaway.
Sub-Transmission and Distribution Seneca Study Area							
Seneca substation 1-S Feeder	23	Exceed Summer Normal Rating	existing	-	102% of SN	C29100	The recommended solution is to replace the limiting element, the series reactors.
Seneca substation 2-S Feeder	23	Exceed Summer Emergency Rating	existing	-	111% of SE	C29100	The recommended solution is to replace the limiting element, the series reactors.
Seneca substation 3-S Feeder	23	Exceed Summer Emergency Rating	existing	-	117% of SE	C29100	The recommended solution is to replace the limiting element, the series reactors.
Seneca substation 19-S Feeder	23	Exceed Summer Emergency Rating	existing	-	112% of SE	C29100	The recommended solution is to replace the limiting element, the series reactors.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Seneca substation 31-S Feeder	23	Exceed Summer Emergency Rating	existing	-	125% of SE	C29100	The recommended solution is to replace the limiting element, the series reactors.
Seneca substation 17-S Feeder	23	Exceed Summer Emergency Rating	existing	-	110% of SE	PPM# 09754	The recommended solution is to replace the limiting element, the series reactors.
Sub-Transmission and Distribution Tonawanda Study Area							
Buffalo Station 127 Transformers T1, T2 and T3	23/ 4.16	Exceed Summer Normal Rating	2011	-	100% of SN	C29186	The recommended solution is to add a second transformer at Buffalo Station 214. Loading at Buffalo Stations 56, 57 and 74 will also be reduced.

Forecasted Overloaded Distribution Feeder Map

The following table shows the distribution feeders which are forecasted to be overloaded in the next 1-5, 6-10 and 11-15 year timeframe. The forecast overload is based on 100% summer normal rating.



Proposed Generator Interconnections

In the Frontier transmission study area there is one wind farm generation project that is proposing to interconnect to the transmission through the NYISO OATT Attachment Z Small Facility Interconnection Procedures for Small Generator Interconnection Projects (20MW or less).

This Steel Winds III project has a proposed total of 15MW of renewable generation connecting to the Frontier transmission study area 115kV transmission system near Lackawanna, New York.

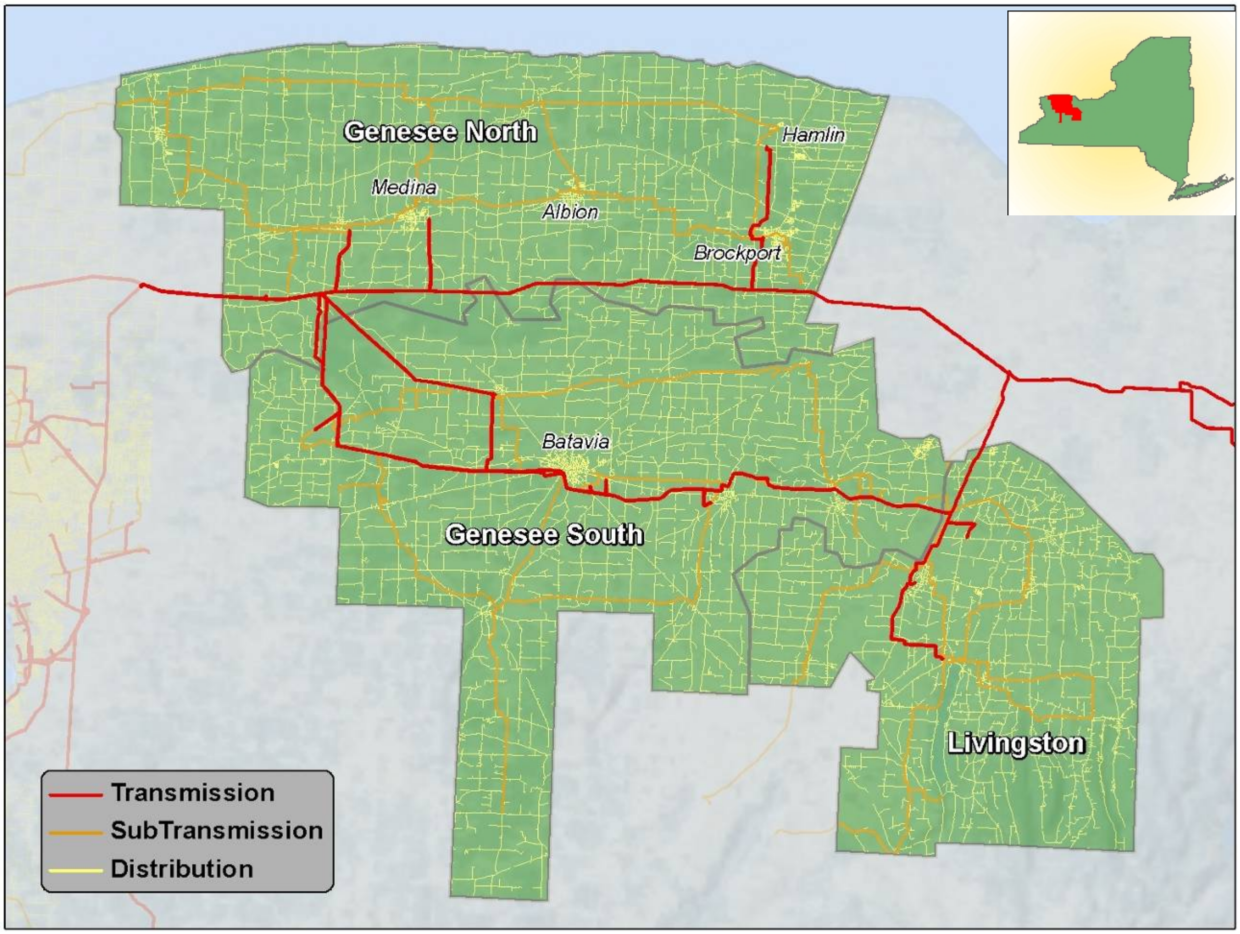
The projects listed below provide only for the interconnection to the National Grid system, and do not ensure that the full output of the generators can be accommodated at all times. National Grid's transmission plans do not provide for full deliverability of all generation unless appropriate funding is provided by the generators consistent with NYISO processes.

Table III-8

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation /Corrective Action
NG-NM 11 A substation	115	---	2012*	---	Steel Winds III wind farm interconnection	CNYX73 CNYX73R	RTU, metering and relay upgrades for Steel Winds III 15MW wind farm, and reimbursable portion

*Note: The Need Year for a generator project is when the generator plans to be connected to the system and does not indicate that a system need exists.

III D. Genesee Transmission Planning Study Area



Area Summary

Key transmission projects in the Genesee study area have the following drivers:

- Low post-contingency voltages in the area in general and at Golah in particular for current load levels.
- Low post-contingency voltages developing in the 2015 to 2025 time frame in the Batavia and Brockport areas as a result of load growth.
- Heavy post-contingency conductor loadings in the Batavia Station (existing loads), on the Lockport-Batavia #107 line (load growth, 2015) and on the Mortimer-Hook Rd. #1 line (load growth, 2025).

Key sub-transmission and distribution drivers include the following:

- There are multiple load at risk issues in the area
- Capacity issues are being addressed with the East Golah, Sheppard Rd. and West Albion substation expansions.

Area Description

The Genesee transmission study area includes National Grid assets within NYISO Zone B. The area includes assets as far west as Lockport and as far east as Mortimer. The system consists of several 115kV circuits between Lockport and Mortimer stations. Three circuits go directly from Lockport to Mortimer, three circuits go from Lockport to Batavia and several circuits in series connect Batavia and Golah. Today one 115kV line and one 69kV line travel between Mortimer and Golah.

[redacted]

[redacted] At Robinson Rd., a 230-115kV transformer is connected to the Niagara – Robinson #64 and Robinson – Stolle #65 230kV circuits.

This area also includes some of the assets stretching between Mortimer in the Western Region and Elbridge in the Central Region.

Within the Genesee Study area, there are three Distribution study areas: Genesee North, Genesee South and Livingston.

The Genesee North study area serves approximately 44,300 customers. There are a total of 51 distribution feeders that supply customers in this area. There are twenty 13.2kV feeders, with four being supplied from 34.5-13.2kV transformers, and the rest are fed from 115-13.2kV transformers. The thirty one 4.8kV feeders are all fed from 34.5-4.8kV transformers. There are ten 34.5kV sub-transmission lines that supply the distribution step down transformers in the area.

The Genesee South study serves approximately 37,100 customers. The study area is defined by the region that includes the City of Batavia and the surrounding towns and villages. It is located east of Buffalo and southwest of the City of Rochester. The primary distribution system voltages in Genesee South are 13.2kV and 4.8kV. Most of the 13.2kV system is fed from the area 115kV transmission system. The rest of the 13.2kV system, as well as the 4.8kV system, are fed from a 34.5kV sub-transmission system supplied out of the North Akron, Batavia, North Leroy, and Oakfield substations. There are several customers supplied directly from the sub-transmission system.

The Livingston study area serves approximately 21,700 customers. The study area is made up of Livingston County which is south of Rochester and east of Batavia. The primary distribution system voltages in Livingston are 13.2kV and 4.8kV. Most of the area is fed from a 34.5kV sub-transmission system supplied out of the Golah and North Lakeville substations. There is also one 13.2kV station fed directly from the 115kV and some 69kV sub-transmission in the area.

Chapter 4, Exhibit 2 contains the list of electrical transmission and sub-transmission lines and substations in this Transmission study area.

Area Load Forecast
The Genesee Transmission Study Area load forecast is included in the West Region (NYISO Zone A & B) forecast. The summary of the load forecast thru 2020 is detailed in the tables below. For the last five years (2021 to 2026) in the Plan, the growth rates are assumed to be the same as 2016 to 2020.

Table III-9

West Region (NYISO Zone A&B) – SUMMER													
		SUMMER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	7	2,270		2,231		2,322		2,340		80.2	78.3	82.0	82.4
2002	7	2,325	2.4%	2,253	1.0%	2,344	0.9%	2,362	0.9%	82.0	78.3	82.0	82.4
2003	8	2,176	-6.4%	2,216	-1.6%	2,307	-1.6%	2,325	-1.6%	76.4	78.3	82.0	82.4
2004	6	2,124	-2.4%	2,204	-0.6%	2,295	-0.5%	2,312	-0.5%	75.4	78.3	82.0	82.4
2005	8	2,339	10.1%	2,310	4.9%	2,402	4.7%	2,419	4.6%	79.2	78.3	82.0	82.4
2006	8	2,355	0.7%	2,258	-2.2%	2,350	-2.2%	2,367	-2.1%	81.8	78.3	82.0	82.4
2007	8	2,264	-3.9%	2,208	-2.2%	2,299	-2.2%	2,317	-2.1%	81.0	78.3	82.0	82.4
2008	7	2,193	-3.1%	2,197	-0.5%	2,288	-0.5%	2,306	-0.5%	78.4	78.3	82.0	82.4
2009	8	2,124	-3.2%	2,085	-5.1%	2,176	-4.9%	2,194	-4.9%	80.0	78.3	82.0	82.4
2010	7	2,235	5.2%	2,140	2.6%	2,231	2.5%	2,249	2.5%	82.2	78.3	82.0	82.4
2011		-		2,243	4.8%	2,334	4.6%	2,352	4.6%	-	78.3	82.0	82.4
2012		-		2,260	0.8%	2,351	0.7%	2,369	0.7%	-	78.3	82.0	82.4
2013		-		2,274	0.6%	2,365	0.6%	2,383	0.6%	-	78.3	82.0	82.4
2014		-		2,284	0.4%	2,375	0.4%	2,393	0.4%	-	78.3	82.0	82.4
2015		-		2,292	0.4%	2,383	0.4%	2,401	0.4%	-	78.3	82.0	82.4
2016		-		2,300	0.4%	2,391	0.3%	2,409	0.3%	-	78.3	82.0	82.4
2017		-		2,308	0.4%	2,400	0.3%	2,417	0.3%	-	78.3	82.0	82.4
2018		-		2,316	0.3%	2,407	0.3%	2,425	0.3%	-	78.3	82.0	82.4
2019		-		2,324	0.3%	2,415	0.3%	2,433	0.3%	-	78.3	82.0	82.4
2020		-		2,331	0.3%	2,422	0.3%	2,440	0.3%	-	78.3	82.0	82.4

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.5%	-0.2%	-0.2%	-0.2%
Compound Avg. 5 yr ('04 to '08)	0.2%	-0.2%	-0.2%	-0.2%
Compound Avg. 9 yr ('02 to '10)	-0.2%	-0.5%	-0.4%	-0.4%
Compound Avg. 5 yr ('06 to '10)	-0.9%	-1.5%	-1.5%	-1.5%
Compound Avg. 5 yr ('11 to '15)		**1.4%**	**1.3%**	**1.3%**
Compound Avg. 5 yr ('16 to '20)		**0.3%**	**0.3%**	**0.3%**
Compound Avg. 10 yr ('11 to '20)		**0.9%**	**0.8%**	**0.8%**

Table III-10

West Region (NYISO Zone A&B) - WINTER													
		WINTER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	1	2,115		2,130		2,163		2,166		17.0	12.8	3.6	2.6
2002	12	2,131	0.7%	2,143	0.6%	2,175	0.6%	2,179	0.6%	16.2	12.8	3.6	2.6
2003	1	2,113	-0.8%	2,107	-1.7%	2,140	-1.6%	2,143	-1.6%	11.2	12.8	3.6	2.6
2004	12	2,112	0.0%	2,082	-1.2%	2,115	-1.1%	2,119	-1.1%	4.4	12.8	3.6	2.6
2005	12	2,103	-0.4%	2,103	1.0%	2,136	1.0%	2,139	1.0%	12.8	12.8	3.6	2.6
2006	12	2,038	-3.1%	2,084	-0.9%	2,116	-0.9%	2,120	-0.9%	25.8	12.8	3.6	2.6
2007	2	2,039	0.1%	2,016	-3.3%	2,049	-3.2%	2,052	-3.2%	6.4	12.8	3.6	2.6
2008	2	2,016	-1.1%	2,005	-0.6%	2,037	-0.5%	2,041	-0.5%	9.6	12.8	3.6	2.6
2009	12	1,991	-1.2%	2,028	1.2%	2,061	1.1%	2,064	1.1%	23.2	12.8	3.6	2.6
2010	1	1,959	-1.6%	1,982	-2.3%	2,015	-2.2%	2,018	-2.2%	19.2	12.8	3.6	2.6
2011		-		2,064	4.1%	2,097	4.1%	2,100	4.1%		12.8	3.6	2.6
2012		-		2,077	0.6%	2,110	0.6%	2,113	0.6%		12.8	3.6	2.6
2013		-		2,088	0.5%	2,121	0.5%	2,124	0.5%		12.8	3.6	2.6
2014		-		2,097	0.4%	2,129	0.4%	2,133	0.4%		12.8	3.6	2.6
2015		-		2,104	0.4%	2,137	0.4%	2,141	0.4%		12.8	3.6	2.6
2016		-		2,112	0.4%	2,145	0.4%	2,148	0.4%		12.8	3.6	2.6
2017		-		2,120	0.4%	2,152	0.4%	2,156	0.4%		12.8	3.6	2.6
2018		-		2,127	0.3%	2,160	0.3%	2,163	0.3%		12.8	3.6	2.6
2019		-		2,134	0.3%	2,167	0.3%	2,170	0.3%		12.8	3.6	2.6
2020		-		2,141	0.3%	2,173	0.3%	2,177	0.3%		12.8	3.6	2.6

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.7%	-0.9%	-0.8%	-0.8%
Compound Avg. 5 yr ('04 to '08)	-0.9%	-1.0%	-1.0%	-1.0%
Compound Avg. 9 yr ('02 to '10)	-0.8%	-0.8%	-0.8%	-0.8%
Compound Avg. 5 yr ('06 to '10)	-1.4%	-1.2%	-1.2%	-1.2%
Compound Avg. 5 yr ('11 to '15)		**1.2%**	**1.2%**	**1.2%**
Compound Avg. 5 yr ('16 to '20)		**0.3%**	**0.3%**	**0.3%**
Compound Avg. 10 yr ('11 to '20)		**0.8%**	**0.8%**	**0.8%**

Capacity Issues

Forecasted Overloads

The following tables identify forecasted system capacity issues and potential solutions in this study area.

Table III-11

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Transmission Genesee Study Area							
Entire Area Voltages	115	Lockport Stuck Bus Tie Breaker	2011	Summer 2011	0.80 pu (0.90)	C31482	The recommended solution is to add a second bus tie breaker in series with the existing one to prevent the outage. Risk estimated to be present 210 hours per summer for 2011 loads. While project is being implemented, risk can be reduced by dispatching Seneca Power generation or fully corrected by shedding load.
Golah Voltages	115	Line #110 or Mortimer bus Fault	2011	Summer 2011	0.83 pu (0.90) for line outage, 0.65 pu (0.90) for bus fault	C24629, C24631, C24631	The recommended solution is to convert 69kV line #109 to 115kV operation, creating two lines between Mortimer and Golah. This will also require modifications of Mortimer and Golah stations. Risk estimated to be present 110 hours per summer for 2011 loads. While project is being implemented, risk can be reduced, but not eliminated by dispatching Seneca Power generation or fully corrected by shedding load.
Batavia Bus	115	All lines in	2011	Summer 2011	100% of Summer Normal Rating	C31479	Historical data shows that bus has been near its thermal limit with all lines in service. The recommended solution to address this is replacement of the limiting bus conductor.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							While project is being implemented, risk can be reduced by dispatching Seneca Power generation or fully corrected by shedding load.
Farmington	115	Outage of #2 or #4 line	2011	Summer 2011	NYSEG Reliability		This is a reimbursable project that is being done at the request of NYSEG. NYSEG is concerned with the reliability of service being provide to Farmington and has proposed to add breakers to split the #2 and #4 lines. NYSEG and National Grid are still in discussions on the solution.
Batavia Voltages	115	N-1-1 Contingency: Sta 80 Transformer followed by Lockport bus fault	2015	Summer 2015	0.88 pu (0.90) for 2015	C31478	The recommended solution is to install a second 27MVAr capacitor at Batavia. This problem becomes an N-1 issue for 2020 and the voltage would be worse for N-1-1 outage in 2020. Was also present for other N-1-1 combinations. While project is being implemented, risk can be fully corrected by dispatching Seneca Power generation.
Lockport – Batavia #107	115	#108 or #112	2015	Summer 2015	100% LTE	C31480, C31481	The recommended solution is to replace the limiting conductor and terminal equipment at Lockport. While project is being implemented, risk can be reduced by dispatching Seneca Power generation or fully corrected by shedding load.
Mort-Hook Rd. #1	115	DCT: 2+7	2020	Summer 2020	100% of LTE	CNYPL 33	To prevent this double circuit tower outage, an in line breaker will be

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							added to the Mortimer – Elbridge #2 line. While project is being implemented, risk can be corrected by shedding load. Project is expected to be completed before need develops.
Brockport Voltage	115	Mortimer bus fault	2025	Summer 2025	0.87 pu (0.90)		The recommended solution is to correct the power factor of the distribution loads in the Brockport area, primarily using feeder correction. Before this solution is initiated, Non-wires alternatives are planned to be reviewed. This will not occur until closer to the need date to allow the technology and its implementation to evolve. While project is being implemented, risk can be corrected by shedding load.
Batavia Voltage	115	Lockport bus fault	2025	Summer 2025	0.88 pu (0.90)		The recommended solution is to correct the power factor of the distribution loads in the Batavia area, primarily using feeder correction. Before this solution is initiated, Non-wires alternatives are planned to be reviewed. This will not occur until closer to the need date to allow the technology and its implementation to evolve. . While project is being implemented, risk can be reduced by dispatching Seneca Power generation or fully corrected by shedding load.
Sub-Transmission and Distribution Genesee North Study Area							

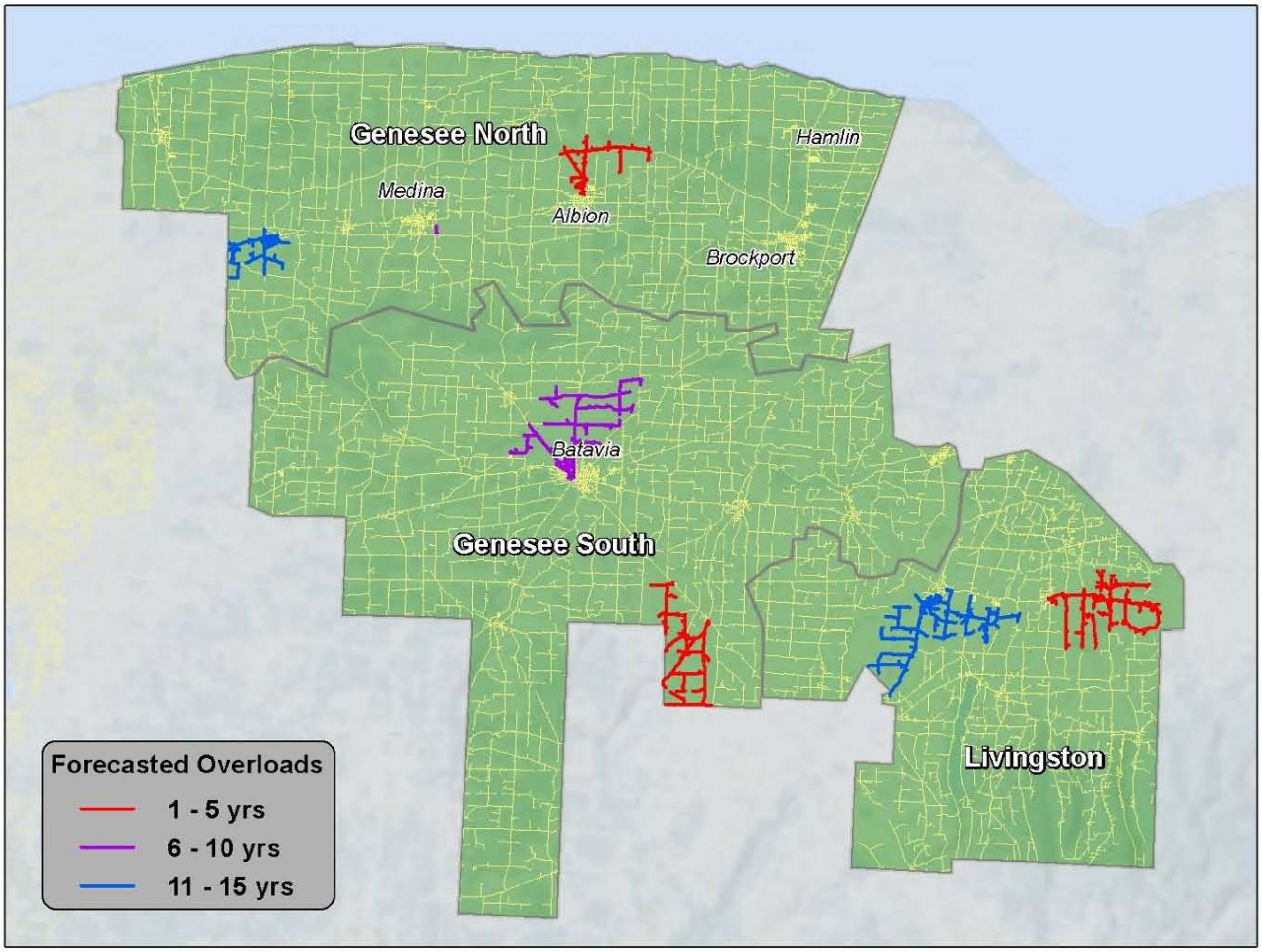
Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
West Albion substation T1 Transformer	34.5 /13.2	Exceed Summer Normal Rating	existing	-	102% of SN	C32346	The recommended solution is the addition of a second transformer at West Albion substation.
West Hamlin substation Transformer T1	115/ 13.2	MWHr for loss of transformer	existing	-	330MWHr	-	A long term solution needs to be developed
Shelby substation 7657 Feeder	13.2	Exceed Summer Normal Rating	2018	-	100% of SN	C32344	The recommended solution is to reconductor the limiting element, the underground getaway.
Butts Rd. substation T1 Transformer	34.5 /13.2	Exceed Summer Normal Rating	2021	-	100% of SN	-	The recommended solution are feeder load transfers.
Brockport substation TransfirmerT4 & T5	115/ 13.2	MWhr for loss of transformer		-	MWhr	-	A long term solution needs to be developed.
Sub-Transmission and Distribution Genesee South Study Area							
Sheppard Road substation Transformer T1	34.5 /13.2	Exceed Summer Normal Rating	existing	-	119% of SN	C15765	The solution under construction is the addition of a second transformer at Sheppard Road substation.
North Leroy substation Transformer T2	115/ 13.2	Exceed Summer Normal Rating	existing	-	110% of SN	C29180	The recommended solution is to upgrade the existing transformer bank. A temporary solution has been initiated to transfer 1.75MVA of load from the North Leroy substation 0455 Feeder to the Mumford substation 5052 Feeder.
Sub-Transmission and Distribution Livingston Study Area							

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Avon substation Transformer T1	34.5 / 4.8	Exceed Summer Normal Rating	existing	-	111% of SN	C06765 C27062	The permanent solution under construction is the installation of a second transformer at East Golah substation and two new feeders.
Lima substation Transformer T1	34.5 / 4.8	Exceed Summer Normal Rating	existing	-	115% of SN	C06765 C27062	The permanent solution under construction is the installation of a second transformer at East Golah substation and two new feeders.
East Golah substation Transformer T1	115/ 13.2	Exceed Summer Normal Rating	existing	-	100% of SN	C06765 C27062	The permanent solution is the installation of a second transformer (T1) at East Golah substation and two new feeders.
East Golah substation 5152 Feeder	13.2	Exceed Summer Normal Rating	existing	-	100% of SN	C06765 C27062	The permanent solution is the installation of a second transformer at East Golah substation and two new feeders.
Mumford substation Transformer T1	115/ 13.2	MWHr for loss of transformer	existing	-	384MWHr	-	A permanent solution needs to be developed.
Geneseo and Lakeville substations		Exceed Summer Normal Rating	existing	-	100% of SN	-	Mobile substation 7W has been installed at Genesee Station 197 to relieve Geneseo and Lakeville substations. A permanent solution needs to be developed.
#217 Sub-Transmission Line	34.5	N-1 Contingency Load at Risk	existing	-	116% of SE	-	A possible solution is to upgrade the limiting element, 5.4 miles of 2/0 Cu overhead conductor. A permanent solution is being developed.
#224 Sub-Transmission Line	34.5	N-1 Contingency Load at Risk	existing	-	116% of SE	-	The possible solution is to reconductor the limiting element, 3.2 miles of #4 Cu overhead conductor. A permanent solution is being developed.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
#116 Transmission Line	115	Contingency Voltage Issues	existing	-	0.82 pu.	C36080 C36079	The recommended solution is to add 3.6MVAR capacitor banks at the Lakeville and Livonia substations.
Lima substation 3662 Feeder	4.8	Exceed Summer Normal Rating	2017	-	100% of SN	C06765 C27062	The permanent solution is the installation of a second transformer at East Golah substation and two new feeders.

Forecasted Overloaded Distribution Feeder Map

The following map shows the distribution feeders which are forecasted to be overloaded in the next 1-5, 6-10 and 11-15 year timeframe. The forecast overload is based on 100% of summer normal rating.



Proposed Generator Interconnections

In the Genesee transmission study area there is one wind farm generation project that is proposing to interconnect to the transmission through the NYISO OATT Attachment X Large Facility Interconnection Procedures for Large Generator Interconnection Projects (greater than 20MW).

The Alabama Ledge Wind farm project has a proposed total of 79MW of renewable generation connecting to the Genesee Area 115kV transmission system near Batavia, New York.

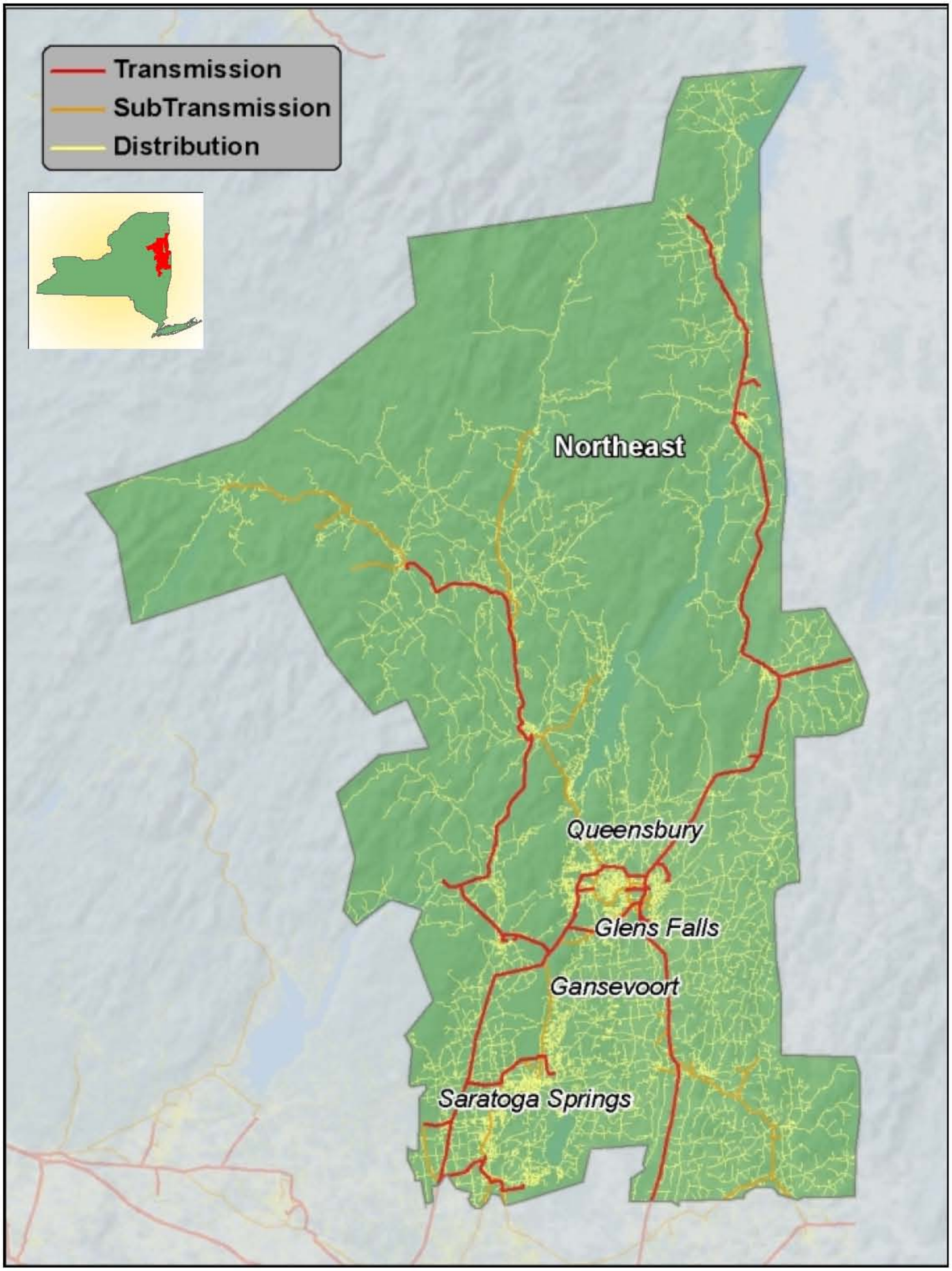
The projects listed below provide only for the interconnection to the National Grid system, and do not ensure that the full output of the generators can be accommodated at all times. National Grid's transmission plans do not provide for full deliverability of all generation unless appropriate funding is provided by the generators consistent with NYISO processes.

Table III-12

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation /Corrective Action
Lockport –Batavia #112 115kV line	115	---	2014*	---	Alabama Ledge wind farm interconnection	CNYX63 CNYX63R	RTU, metering and relay upgrades for Alabama Ledge 79MW wind farm, and reimbursable portion

*Note: The Need Year for a generator project is when the generator plans to be connected to the system and does not indicate that a system need exists.

III E. Northeast Transmission Planning Study Area



Area Summary

The principal driver for the transmission and distribution capacity projects in this area is load growth associated with the Luther Forest industrial load and the general area distribution load growth that is stimulated by the economic impact of the Luther Forest development during the period from 2012-2019. In particular, increased capacity is required to avoid 115kV line overloads and to support adequate system post-contingency voltage levels. In addition, an expansion of Ogden Brook substation is proposed for area load growth.

A major driver of asset condition work in the area is the impact of the 2006 floods which damaged Canajoharie substation. Feeder upgrades in the area are in progress that will allow for the retirement of this station.

Area Description

The Northeast study area serves approximately 144,200 customers. The study area extends approximately 90 miles north along the western border of Vermont, from Cambridge in the south to Westport in the north and extends approximately 45 miles to the west at its widest point to Indian Lake. The area incorporates the southeastern section of the Adirondack Park. Much of the area load is concentrated in the southern portion of the study area, along Interstate I-87 and US Route 9, particularly in the Towns of Ballston Spa, Saratoga Springs and Glen Falls. Some of the areas offer summer recreation and see a spike in load during the summer months.

The 115kV system runs primarily in a north-south direction on both sides of Lake George. There is a single radial line, east of Lake George, which runs north from Whitehall substation, which extends to the NYSEG system and also continues north to the Port Henry substation. The western 115kV radial line extends from Spier Falls substation to North Creek substation in the Adirondack Park. There is an extensive 34.5kV system in the northwestern section of the study area supplying smaller towns along interstate I-87 and Route 28.

In the Northeast study area there is one Distribution study area, also called Northeast. The Northeast distribution study area has a total of 111 distribution feeders that supply customers in this area. There are eighty seven 13.2kV feeders, with twenty-five being supplied from 34.5-13.2kV transformers, and the rest supplied by 115-13.2kV transformers; Thirty-five 34.5kV sub-transmission lines that supply the distribution step down transformers in the area; Ten 4.8kV feeders with six supplied by 34.5-4.8kV transformers: Fourteen 4.16kV feeders all supplied by 34.5-4.16kV transformers.

Chapter 4, Exhibit 2 contains the list of electrical transmission and sub-transmission lines and substations in this transmission study area.

Area Load Forecast

The Northeast Study Area load forecast comprises approximately 20% of the Albany-Glens Falls Region (NYISO Zone F) forecast. The summary of the load forecast thru 2020 is detailed in the tables below. For the last five years (2021 to 2026) of the Plan, the growth rates are assumed to be the same as 2016 to 2020.

In addition to the area forecast, a forecast specific to the greater Saratoga area has been performed. An area, represented by about 200MW of the load in this study area, is expected to have considerably larger growth (approximately 5% annually) with respect to the rest of the load in the Northeast study area for 2011-2015. The addition of Global Foundries is also not included in the zonal forecast below, which is expected to reach 73MW within five years. Also, a 16MW expansion at Irving Tissue is not included in the zonal forecast below, which is expected within five years.

Table III-13

Albany - Glen Falls Region (NYISO Zone F) – SUMMER													
		SUMMER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	8	2,004		1,882		1,995		2,009		84.0	80.1	83.5	84.0
2002	8	1,970	-1.7%	1,896	0.7%	2,011	0.8%	2,025	0.8%	82.0	80.1	83.5	84.0
2003	6	2,020	2.5%	2,000	5.5%	2,117	5.3%	2,132	5.2%	81.0	80.1	83.5	84.0
2004	8	1,930	-4.5%	1,982	-0.9%	2,102	-0.7%	2,117	-0.7%	78.0	80.1	83.5	84.0
2005	8	2,087	8.2%	2,086	5.2%	2,208	5.0%	2,223	5.0%	80.0	80.1	83.5	84.0
2006	8	2,196	5.2%	2,033	-2.5%	2,158	-2.3%	2,173	-2.2%	85.0	80.1	83.5	84.0
2007	8	2,069	-5.8%	2,112	3.9%	2,239	3.8%	2,255	3.7%	79.0	80.1	83.5	84.0
2008	6	2,106	1.8%	1,994	-5.6%	2,123	-5.2%	2,139	-5.1%	83.0	80.1	83.5	84.0
2009	8	2,040	-3.2%	2,079	4.3%	2,211	4.1%	2,227	4.1%	79.0	80.1	83.5	84.0
2010	7	2,245	10.1%	2,120	2.0%	2,254	1.9%	2,270	1.9%	83.0	80.1	83.5	84.0
2011		-		2,177	2.7%	2,313	2.6%	2,330	2.6%	-	80.1	83.5	84.0
2012		-		2,187	0.5%	2,326	0.6%	2,344	0.6%	-	80.1	83.5	84.0
2013		-		2,190	0.1%	2,331	0.2%	2,349	0.2%	-	80.1	83.5	84.0
2014		-		2,205	0.7%	2,348	0.7%	2,367	0.8%	-	80.1	83.5	84.0
2015		-		2,223	0.8%	2,369	0.9%	2,387	0.9%	-	80.1	83.5	84.0
2016		-		2,242	0.9%	2,390	0.9%	2,409	0.9%	-	80.1	83.5	84.0
2017		-		2,260	0.8%	2,411	0.9%	2,430	0.9%	-	80.1	83.5	84.0
2018		-		2,278	0.8%	2,431	0.8%	2,451	0.9%	-	80.1	83.5	84.0
2019		-		2,296	0.8%	2,451	0.8%	2,471	0.8%	-	80.1	83.5	84.0
2020		-		2,313	0.8%	2,471	0.8%	2,492	0.8%	-	80.1	83.5	84.0

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	0.7%	0.8%	0.9%	0.9%
Compound Avg. 5 yr ('04 to '08)	0.8%	-0.1%	0.1%	0.1%
Compound Avg. 9 yr ('02 to '10)	1.3%	1.3%	1.4%	1.4%
Compound Avg. 5 yr ('06 to '10)	1.5%	0.3%	0.4%	0.4%
Compound Avg. 5 yr ('11 to '15)		**1.0%**	**1.0%**	**1.0%**
Compound Avg. 5 yr ('16 to '20)		**0.8%**	**0.9%**	**0.9%**
Compound Avg. 10 yr ('11 to '20)		**0.9%**	**0.9%**	**0.9%**

Table III-14

Albany - Glen Falls Region (NYISO Zone F) – WINTER													
		WINTER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	1	1,669		1,676		1,750		1,766		12.0	9.3	(2.0)	(2.0)
2002	12	1,695	1.5%	1,737	3.6%	1,810	3.5%	1,826	3.4%	12.0	9.3	(2.0)	(2.0)
2003	1	1,803	6.4%	1,729	-0.4%	1,803	-0.4%	1,819	-0.4%	1.0	9.3	(2.0)	(2.0)
2004	12	1,877	4.1%	1,881	8.8%	1,954	8.4%	1,970	8.3%	4.0	9.3	(2.0)	(2.0)
2005	1	1,813	-3.4%	1,769	-6.0%	1,842	-5.8%	1,858	-5.7%	1.0	9.3	(2.0)	(2.0)
2006	12	1,665	-8.2%	1,736	-1.8%	1,810	-1.8%	1,826	-1.7%	17.0	9.3	(2.0)	(2.0)
2007	12	1,747	4.9%	1,834	5.6%	1,907	5.4%	1,924	5.4%	23.0	9.3	(2.0)	(2.0)
2008	1	1,738	-0.5%	1,713	-6.6%	1,786	-6.4%	1,802	-6.3%	3.0	9.3	(2.0)	(2.0)
2009	12	1,705	-1.9%	1,780	3.9%	1,853	3.8%	1,869	3.7%	19.0	9.3	(2.0)	(2.0)
2010	1	1,638	-3.9%	1,668	-6.3%	1,741	-6.1%	1,757	-6.0%	16.0	9.3	(2.0)	(2.0)
2011		-		1,775	6.5%	1,849	6.2%	1,865	6.1%	-	9.3	(2.0)	(2.0)
2012		-		1,772	-0.2%	1,845	-0.2%	1,861	-0.2%	-	9.3	(2.0)	(2.0)
2013		-		1,770	-0.1%	1,844	-0.1%	1,860	-0.1%	-	9.3	(2.0)	(2.0)
2014		-		1,776	0.3%	1,849	0.3%	1,865	0.3%	-	9.3	(2.0)	(2.0)
2015		-		1,783	0.4%	1,856	0.4%	1,872	0.4%	-	9.3	(2.0)	(2.0)
2016		-		1,790	0.4%	1,864	0.4%	1,880	0.4%	-	9.3	(2.0)	(2.0)
2017		-		1,797	0.4%	1,871	0.4%	1,887	0.4%	-	9.3	(2.0)	(2.0)
2018		-		1,804	0.4%	1,877	0.4%	1,893	0.4%	-	9.3	(2.0)	(2.0)
2019		-		1,810	0.4%	1,884	0.3%	1,900	0.3%	-	9.3	(2.0)	(2.0)
2020		-		1,817	0.4%	1,890	0.3%	1,906	0.3%	-	9.3	(2.0)	(2.0)

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	0.6%	0.3%	0.3%	0.3%
Compound Avg. 5 yr ('04 to '08)	-0.7%	-0.2%	-0.2%	-0.2%
Compound Avg. 9 yr ('02 to '10)	-0.2%	-0.1%	-0.1%	-0.1%
Compound Avg. 5 yr ('06 to '10)	-2.0%	-1.2%	-1.1%	-1.1%
Compound Avg. 5 yr ('11 to '15)		**1.3%**	**1.3%**	**1.3%**
Compound Avg. 5 yr ('16 to '20)		**0.4%**	**0.4%**	**0.4%**
Compound Avg. 10 yr ('11 to '20)		**0.9%**	**0.8%**	**0.8%**

Area Issues - Capacity

Forecasted Overloads
The following tables identify forecasted system capacity issues and potential solutions in this study area.

Table III-15

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Transmission Northeast Study Area							
Spier-Rotterdam #1/#2 Double Circuit	115	Loss of South end of #1/#2 Double Circuit	2012	CY07 & CY08 ATRA	125% SLTE, and 103% of SSTE	C31418	Addition of a new Spier-Rotterdam 115kV on separate structures from existing #1/#2, and bussing of existing #1/#2 to create two high capacity circuits between Spier and Rotterdam.
Mohican-Battenkill #15	115	Loss or Opening of Rotterdam 115kV R1 with Indeck Corinth Gen Out of Service.	2012	CY07 & CY08 ATRA	113% SLTE	C34528	Reconductor/rebuild #15.
Various Stations in Northeast Region	115, 34.5	Loss of LF/ Battenkill-Eastover Rd #3/#10 115kV South End; for example.	2013-2019	CY07 & CY08 ATRA	<90% Voltage	C35773	Add reactive compensation to various stations in Northeast Region to improve post-contingency voltage performance. Conceptually 250MVAR total of reactive compensation through 2019. Timing/locations to be evaluated with respect to load growth beyond 2012 in Northeast Region of eastern NY.
Luther Forest-Rotterdam (Ballston #2	115	Loss of LF/Battenkill-Eastover Rd #3/#10 South	2013	CY07 & CY08 ATRA	106% SLTE	C35771	Reconductor 3.9 miles of existing #2 tap; between Main Tap and Ballston.

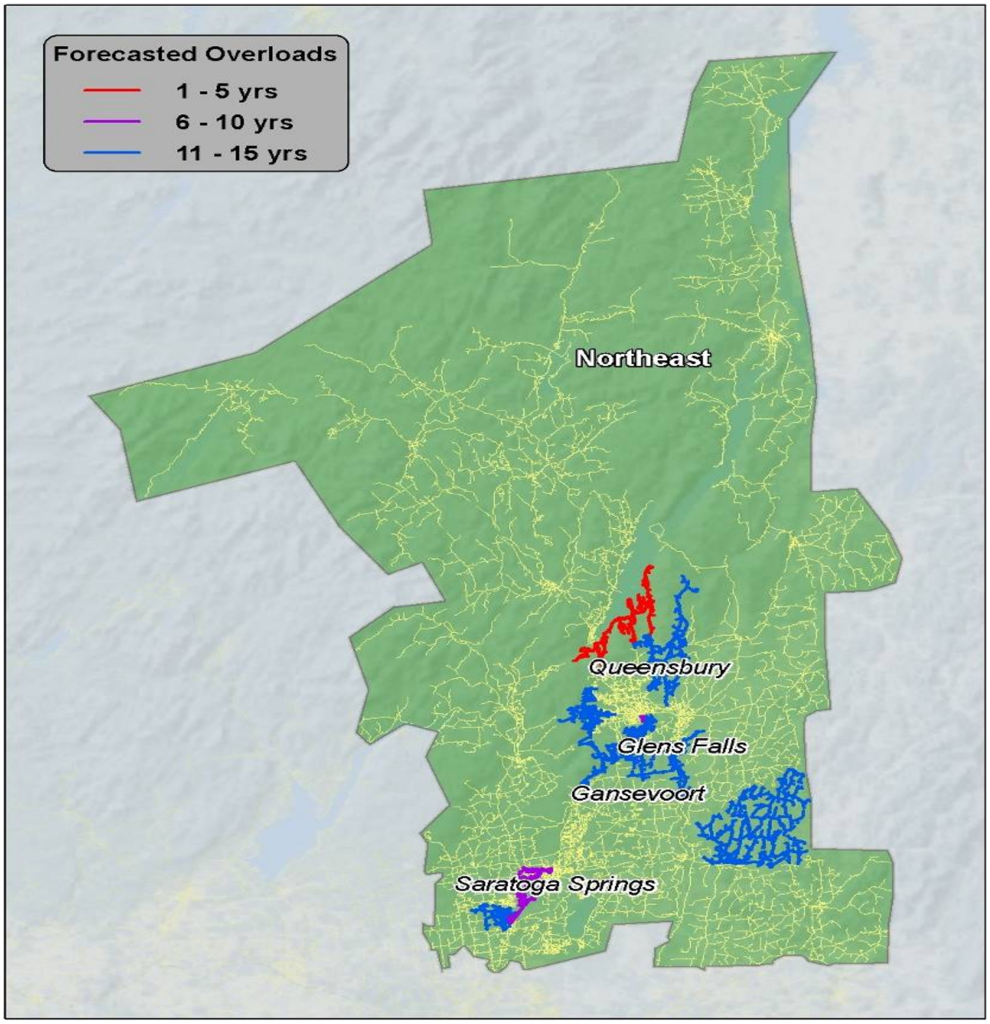
Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Tap: Main Tap-Ballston)		End Double Circuit					
Luther Forest-Rotterdam (Ballston #2 Tap: Main Tap-Ballston)	115	Loss of LF/Battenkill-Eastover Rd #3/#10 South End Double Circuit	2017	CY07 & CY08 ATRA	101% SLTE	C35771	Reconductor 5.1 miles of existing #2 tap; between Ballston and Malta. Need to be evaluated with respect to load growth in eastern NY beyond 2015.
Eastover Road-Luther Forest	115	Loss or Opening of Rotterdam 115kV R1 with Indeck Corinth Gen Out of Service.	2017	CY07 & CY08 ATRA	101% SLTE	C35771	Reconductor 10.4 miles of affected circuit. Need to be evaluated with respect to load growth in eastern NY beyond 2015.
Mohican-Butler #18	115	Loss or Opening of Rotterdam 115kV R1 with Indeck Corinth Gen Out of Service.	2019	CY07 & CY08 ATRA	101% SLTE	C35771	Reconductor 3.5 miles of affected circuit. Need to be evaluated with respect to load growth in eastern NY beyond 2015.
Sub-Transmission and Distribution Northeast Study Area							
Port Henry substation 38551 Feeder Step down Transformer p. 241 Route 9N	13.2/ 4.8	Exceed Summer Normal Rating	existing	-	142% of SN	C18991	The recommended solution is to convert a portion of the 4.8kV step down area.
Ballston substation Transformer T1	115/ 13.2	MWHr for loss of transformer	existing	-	250MWHr	C33012 C33013	The recommended solution is to install a second transformer, switchgear, two station capacitor banks and two feeders at Ballston substation. A condition assessment is also proposed at Ballston to identify

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							other asset condition issues (see later).
Battenkill substation 34257 Feeder	13.2	Low Voltage	existing	-	Low Voltage	C07482	The recommended solution is to convert the existing 4.8kV stepdown area in the Village of Greenwich.
Ogden Brook substation Transformer T1	115/ 13.2	Exceed Summer Normal Rating	existing	-	110% of SN	C32598 C32597 C34783	The recommended solution is to install a second transformer, switchgear and feeder at Ogden Brook substation.
Ogden Brook substation 42354 Feeder	13.2	Exceed Summer Normal Rating	2011	-	100% of SN	C32598 C32597	The recommended solution is to install a second transformer, switchgear and feeder at Ogden Brook substation.
DOE Funded Capacitor Banks	34.5 / 13.2	-	2012	-	-	-	The plan is to install approximately 65MVArs or 23 % of the total National Grid assignment in the Northeast Region. The compensation plan will allocate 50MVArs to the distribution system and 15MVARS to the sub-transmission system.
Ogden Brook substation 42352 Feeder	13.2	Exceed Summer Normal Rating	2012	-	100% of SN	C32598 C32597	The recommended solution is to install a second transformer, switchgear and feeder at Ogden Brook substation.
South St. substation Transformer T1	34.5/ 13.2	Exceed Summer Normal Rating	2014	-	100% of SN	C36448	The project was show in the 2011 CIP beginning in FY 2013. Distribution

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							Planning has resolved the issue by other means and the project will be cancelled.
Queensbury substation Transformers T1 and T2	115/ 13.2	MWHr for loss of transformer	2015	-	526MWHr	T00035 C36822	The recommended solution is to upgrade the existing 2-115-13.2kV, 22.4MVA transformers to 2-33MVA transformers at Queensbury substation.
Burgoyne substation	115/ 13.2	MWHr for loss of transformer	2017	-	288MWhr	C32959	The recommended solution is to install a second transformer, extend bus structure, and add capacitor banks and new getaways at Burgoyne substation.
French Mountain	34.5/ 13.2	Exceed Summer Normal Rating	2022	-	100% of SN	T00023 C36614 C36451 C36453	The recommended solution is install a new French Mountain - Build 34.5kV to 13.2kV station with 4 feeders. This includes reconductoring approximately 5 miles of #2 and #8 34.5kV lines with 336.4AL.

Forecasted Overloaded Distribution Feeder Map

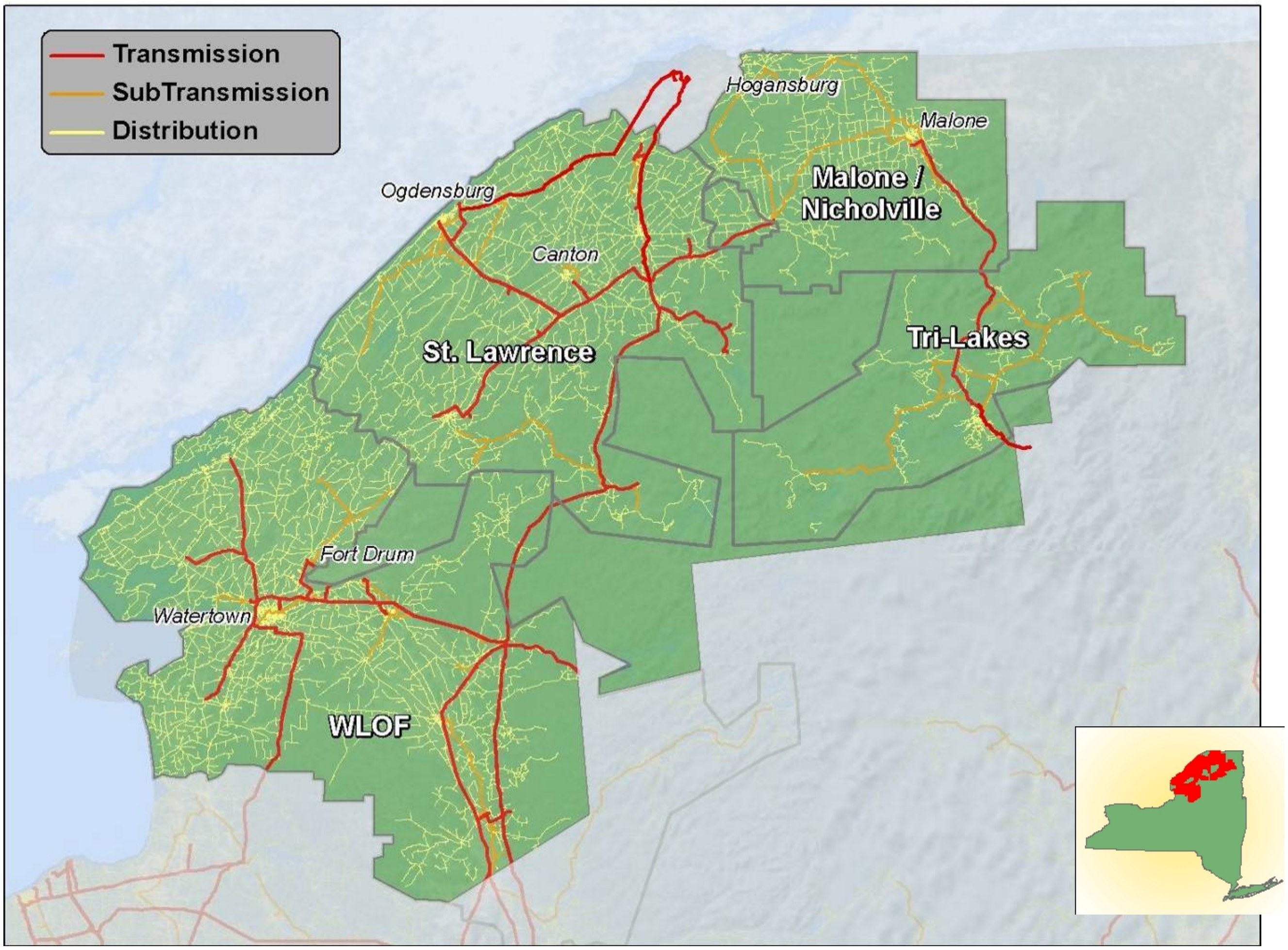
The following map shows the distribution feeders which are forecasted to be overloaded in the next 1-5, 6-10 and 11-15 year timeframe. The forecast overload is based on 100% summer normal rating.



Proposed Generator Interconnections

There are no proposed generator interconnections in this study area that have progressed to the point of meriting inclusion in the plan and the creation of a project number.

III F. Northern Transmission Planning Study Area



Area Summary

Key drivers behind the transmission capacity related projects in this study area include the following:

- Fault current levels that trigger replacement of overdutied breakers at ALCOA.
- The interconnection of several wind generation projects.

Key sub-transmission and distribution drivers include the following:

- The Little-River State St. 23kV sub-transmission system has seen increased customer expansion in recent years and has been the driver of capacity work.

A potential major driver for the area is the North Country Power Authority (NCPA) takeover of the electrical system in portions of St. Lawrence and Franklin Counties.

Area Description
The Northern transmission study area includes the 115kV transmission facilities in the Northern Region and the northeast portion of the Mohawk Valley Region.

The backbone of the 115kV Northern area system runs from National Grid ALCOA substation to Boonville substation. The major substations along the 115kV transmission corridor are Browns Falls, Colton, Dennison and Taylorville.

The Jefferson/Lewis county area is bounded by the #5 – #6 Lighthouse Hill-Black River lines to the west and the #5 – #6 Boonville-Taylorville lines to the east. The Ogdensburg-Gouverneur area is served by the #7 Colton-Battle Hill, #8 Colton-McIntyre and the #13 ALCOA-North Ogdensburg 115kV lines. The #1 – #2 Taylorville-Black River lines and the #3 Black River-Coffeen support the load in the Watertown area. The Thousand Island region is served by the #4 Coffeen-Thousand Island 115kV radial line. The Colton-Malone #3, Malone-Lake Colby #5, and Willis-Malone #1 (NYPA) 115kV lines serves the Tri Lakes region. The Akwesasne #21 115kV Tap served from the Reynolds/GM #1 (NYPA) 115kV line supplies part of the Nicholville - Malone area.

Within the Northern study area, there are four distribution study areas: Nicholville-Malone, St. Lawrence, Tri-Lakes and WLOF (Watertown, Lowville and Old Forge). The Nicholville - Malone study area serves approximately 18,500 customers. There are total of twenty seven feeders (twenty 4.8kV and seven 13.2kV feeders) in the study area. The distribution substations are primarily supplied from the 34.5kV system with exception of Malone 13.2kV and Akwesasne 4.8kV substations that are served by the 115kV system. The main supplies for the 34.5kV sub-transmission system are Akwesasne, Malone, and Nicholville substations. It is operated as a radial system due to loading issues although the system is constructed as a loop design. There are also two hydroelectric facilities connected to the system (Macomb and Chasm substations).

The St. Lawrence area serves approximately 44,100 customers. There are twenty-six 4.8kV feeders and thirty 13.2kV feeders in the study area. The distribution substations are supplied from 23kV and 34.5kV sub-transmission lines with exception of four substations, Corning, Higley, North Gouverneur and Ogdensburg substations that are served from the 115kV system. The main supplies for the 23kV sub-transmission system are Balmat, Little River, McIntyre, Mine Rd. and Norfolk substations. Brown Falls substation is the main supply for the 34.5kV sub-transmission system.

The Tri Lakes area serves approximately 11,300 customers. There are twenty nine 4.8kV, two 2.4kV feeders and six 13.2kV feeders in the study area. Most of the distribution substations are supplied from the 46kV sub-transmission system with the exception of Lake Colby and Ray Brook substations that are served from the 115kV system. The supply for 46kV sub-transmission system in the area is Lake Colby substation. There are two municipal electric companies supplied via the 46kV sub-transmission in the Tri-Lakes area, Lake Placid and Tupper Lake.

The WLOF area serves approximately 81,300 customers with a peak load of 253MW. The study area has thirty six 4.8kV feeders and thirty nine 13.2kV feeders. The distribution substations are primarily supplied from the 23kV and 46kV sub-transmission system with the exception of a few substations that are served from the 115kV system. The main sources to the 23kV sub-transmission system are Black River, Coffeen, Indian River, North Carthage and Taylorville substations. The main supply for the 46kV sub-transmission system is Boonville substation.

Chapter 4, Exhibit 2 contains the list of electrical transmission and sub-transmission lines and substations in this transmission study area.

Area Load Forecast
The Northern Study Area load forecast is included in the East-North Central Region (NYISO Zone D & E) forecast. The summary of the load forecast thru 2020 is detailed in the tables below. For the last five years (2021 to 2026) in the Plan the growth rates are assumed the same as 2016 to 2020.

Table III-16

East-North Central (NYISO Zone D&E) - SUMMER														
		SUMMER PEAKS (MWs)								TEMPs				
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	8	963		977		1,032		1,036		-	77.7	82.5	83.0
2002	8	930	-3.3%	881	-9.8%	936	-9.3%	940	-9.3%	83.5	77.7	82.5	83.0
2003	6	945	1.6%	971	10.2%	1,026	9.6%	1,030	9.6%	77.0	77.7	82.5	83.0
2004	7	837	-11.5%	853	-12.2%	908	-11.5%	912	-11.5%	78.5	77.7	82.5	83.0
2005	6	910	8.8%	886	3.9%	941	3.6%	945	3.6%	81.5	77.7	82.5	83.0
2006	8	919	1.0%	858	-3.2%	913	-3.0%	917	-3.0%	83.0	77.7	82.5	83.0
2007	6	903	-1.7%	904	5.4%	959	5.1%	963	5.0%	81.5	77.7	82.5	83.0
2008	7	904	0.1%	938	3.7%	993	3.5%	997	3.5%	77.0	77.7	82.5	83.0
2009	8	866	-4.2%	865	-7.8%	920	-7.4%	924	-7.3%	77.5	77.7	82.5	83.0
2010	7	939	8.4%	880	1.7%	935	1.6%	939	1.6%	82.0	77.7	82.5	83.0
2011		-		905	2.9%	960	2.7%	964	2.7%	-	77.7	82.5	83.0
2012		-		906	0.1%	961	0.1%	965	0.1%	-	77.7	82.5	83.0
2013		-		923	1.9%	978	1.8%	982	1.8%	-	77.7	82.5	83.0
2014		-		919	-0.4%	975	-0.4%	978	-0.4%	-	77.7	82.5	83.0
2015		-		911	-0.9%	967	-0.8%	970	-0.8%	-	77.7	82.5	83.0
2016		-		906	-0.6%	961	-0.5%	965	-0.5%	-	77.7	82.5	83.0
2017		-		907	0.0%	962	0.0%	966	0.0%	-	77.7	82.5	83.0
2018		-		907	0.1%	962	0.1%	966	0.1%	-	77.7	82.5	83.0
2019		-		908	0.1%	963	0.0%	967	0.0%	-	77.7	82.5	83.0
2020		-		908	0.0%	963	0.0%	967	0.0%	-	77.7	82.5	83.0

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.9%	-0.6%	-0.6%	-0.6%
Compound Avg. 5 yr ('04 to '08)	-0.9%	-0.7%	-0.7%	-0.7%
Compound Avg. 9 yr ('02 to '10)	-0.3%	-1.2%	-1.1%	-1.1%
Compound Avg. 5 yr ('06 to '10)	0.6%	-0.1%	-0.1%	-0.1%
Compound Avg. 5 yr ('11 to '15)		**0.7%**	**0.7%**	**0.7%**
Compound Avg. 5 yr ('16 to '20)		**-0.1%**	**-0.1%**	**-0.1%**
Compound Avg. 10 yr ('11 to '20)		**0.3%**	**0.3%**	**0.3%**

Table III-17

East-North Central (NYISO Zone D&E) – WINTER														
		WINTER PEAKS (MWs)								TEMPs				
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	1	944		960		981		984		19.0	8.0	(7.0)	(9.0)
2002	1	856	-9.3%	871	-9.3%	892	-9.1%	895	-9.0%	18.0	8.0	(7.0)	(9.0)
2003	1	850	-0.7%	835	-4.1%	857	-4.0%	860	-3.9%	(2.5)	8.0	(7.0)	(9.0)
2004	1	1,029	21.0%	1,004	20.3%	1,026	19.7%	1,029	19.7%	(9.0)	8.0	(7.0)	(9.0)
2005	12	927	-9.9%	917	-8.7%	939	-8.5%	942	-8.5%	1.0	8.0	(7.0)	(9.0)
2006	1	827	-10.8%	828	-9.7%	849	-9.5%	852	-9.5%	8.5	8.0	(7.0)	(9.0)
2007	12	905	9.4%	925	11.8%	947	11.5%	950	11.4%	22.0	8.0	(7.0)	(9.0)
2008	1	884	-2.3%	878	-5.1%	900	-5.0%	902	-5.0%	3.5	8.0	(7.0)	(9.0)
2009	1	854	-3.4%	841	-4.2%	863	-4.1%	866	-4.1%	(1.0)	8.0	(7.0)	(9.0)
2010	2	793	-7.1%	806	-4.2%	827	-4.1%	830	-4.1%	16.5	8.0	(7.0)	(9.0)
2011		-		843	4.6%	864	4.5%	867	4.5%	-	8.0	(7.0)	(9.0)
2012		-		850	0.9%	872	0.9%	875	0.9%	-	8.0	(7.0)	(9.0)
2013		-		858	0.9%	879	0.9%	882	0.8%	-	8.0	(7.0)	(9.0)
2014		-		852	-0.6%	874	-0.6%	877	-0.6%	-	8.0	(7.0)	(9.0)
2015		-		846	-0.7%	867	-0.7%	870	-0.7%	-	8.0	(7.0)	(9.0)
2016		-		843	-0.3%	865	-0.3%	868	-0.3%	-	8.0	(7.0)	(9.0)
2017		-		844	0.1%	866	0.1%	869	0.1%	-	8.0	(7.0)	(9.0)
2018		-		845	0.1%	867	0.1%	870	0.1%	-	8.0	(7.0)	(9.0)
2019		-		846	0.1%	867	0.1%	870	0.1%	-	8.0	(7.0)	(9.0)
2020		-		846	0.0%	868	0.0%	871	0.0%	-	8.0	(7.0)	(9.0)

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.9%	-1.3%	-1.2%	-1.2%
Compound Avg. 5 yr ('04 to '08)	0.8%	1.0%	1.0%	1.0%
Compound Avg. 9 yr ('02 to '10)	-1.9%	-1.9%	-1.9%	-1.9%
Compound Avg. 5 yr ('06 to '10)	-3.1%	-2.6%	-2.5%	-2.5%
Compound Avg. 5 yr ('11 to '15)		**1.0%**	**0.9%**	**0.9%**
Compound Avg. 5 yr ('16 to '20)		**0.0%**	**0.0%**	**0.0%**
Compound Avg. 10 yr ('11 to '20)		**0.5%**	**0.5%**	**0.5%**

Area Issues - Capacity

Forecasted Overloads

The following tables identify forecasted system capacity issues and potential solutions in this study area.

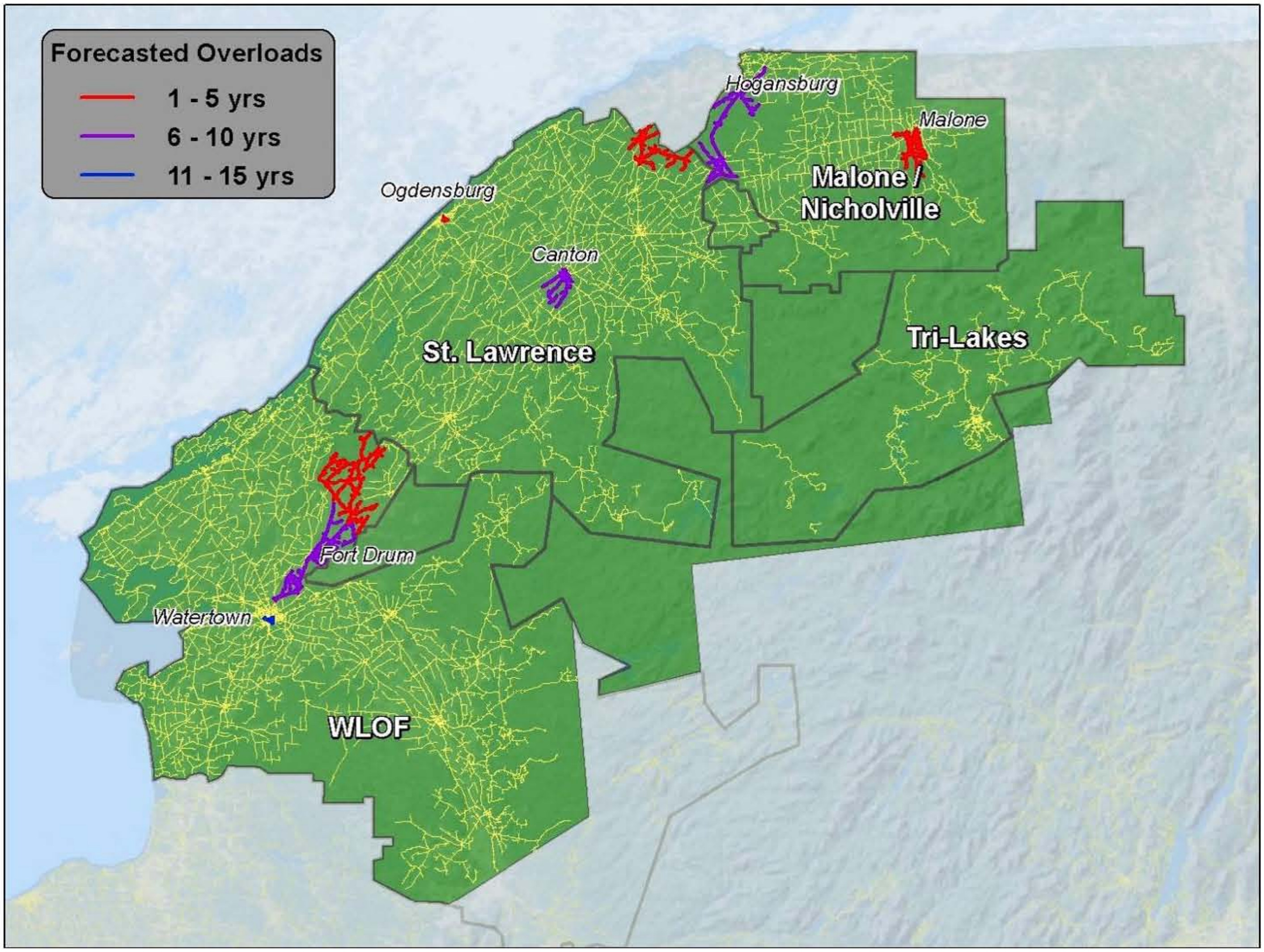
Table III-18

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Transmission Northern Study Area							
(3)-115kV circuit breakers NG ALCOA substation	115	3-ph L-G fault	2012	ASPEN OneLiner NYISO 2007 ATBA 2012 ATRA	Overduty (107%)	C30545	The recommended solution is to replace (3)-115kV 25 kAIC Oil circuit breakers with (3)-115kV 50 kAIC circuit breakers at NG ALCOA substation.
Lake Colby 115kV SVC	115	N-1-1 Contingency Lake Colby 115kV SVC and Willis-Malone #1 115kV Line	2012	FERC 2008 and 2013 Winter	Voltage below 0.86 pu.	C32260	The recommended solution is a spare 115-15kV transformer and thyristor controlled reactor (TCR) component of the Lake Colby SVC.
Sub-Transmission and Distribution Nicholville Malone Study Area							
None							
Sub-Transmission and Distribution St. Lawrence Study Area							
Parrishville substation Transformer T1	2.4/ 4.8	Exceed Summer Normal Rating	2024	-	100% of SN	C36564	The recommended solution is to upgrade Parishville Substation transformer.
Sub-Transmission and Distribution Tri-Lakes Study Area							
None							
Sub-Transmission and Distribution WLOF Study Area							

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
North Carthage substation 81652 Step Down Transformer p. 81 County Rt. 26	4.8	Exceed Summer Normal Rating	existing	-	162% of SN	C34803	The recommended solution is to convert a portion of the 4.8kV step down area.
S. Philadelphia substation	23/ 4.8	Exceed Summer Normal Rating	2020	-	100% of SN	C24030	The recommended solution is to upgrade S. Philadelphia Substation transformer.

Forecasted Overloaded Distribution Feeder Map

The following map shows the Distribution feeders which are forecasted to be overloaded in the next 1-5, 6-10 and 11-15 year timeframe. The forecast overload is based on 100% summer normal rating.



Proposed Generator Interconnections

In the Northern study area there are four wind farm generation projects that are proposing to interconnect to the transmission system through the NYISO OATT Attachment X Large Facility Interconnection Procedures for Large Generator Interconnection Projects (greater than 20MW).

There is a proposed total of 421MW of renewable generation connecting to the Northern study area 115kV transmission system near Watertown, New York. The proposed wind farm projects Cape Vincent (210MW), Clayton (132MW) and St. Lawrence (79MW) are connecting to the Coffeen-Thousand Island #4 115kV line. The Tug Hill 79MW wind farm project is connecting to the Boonville-Taylorville #5 115kV line near Lowville, New York.

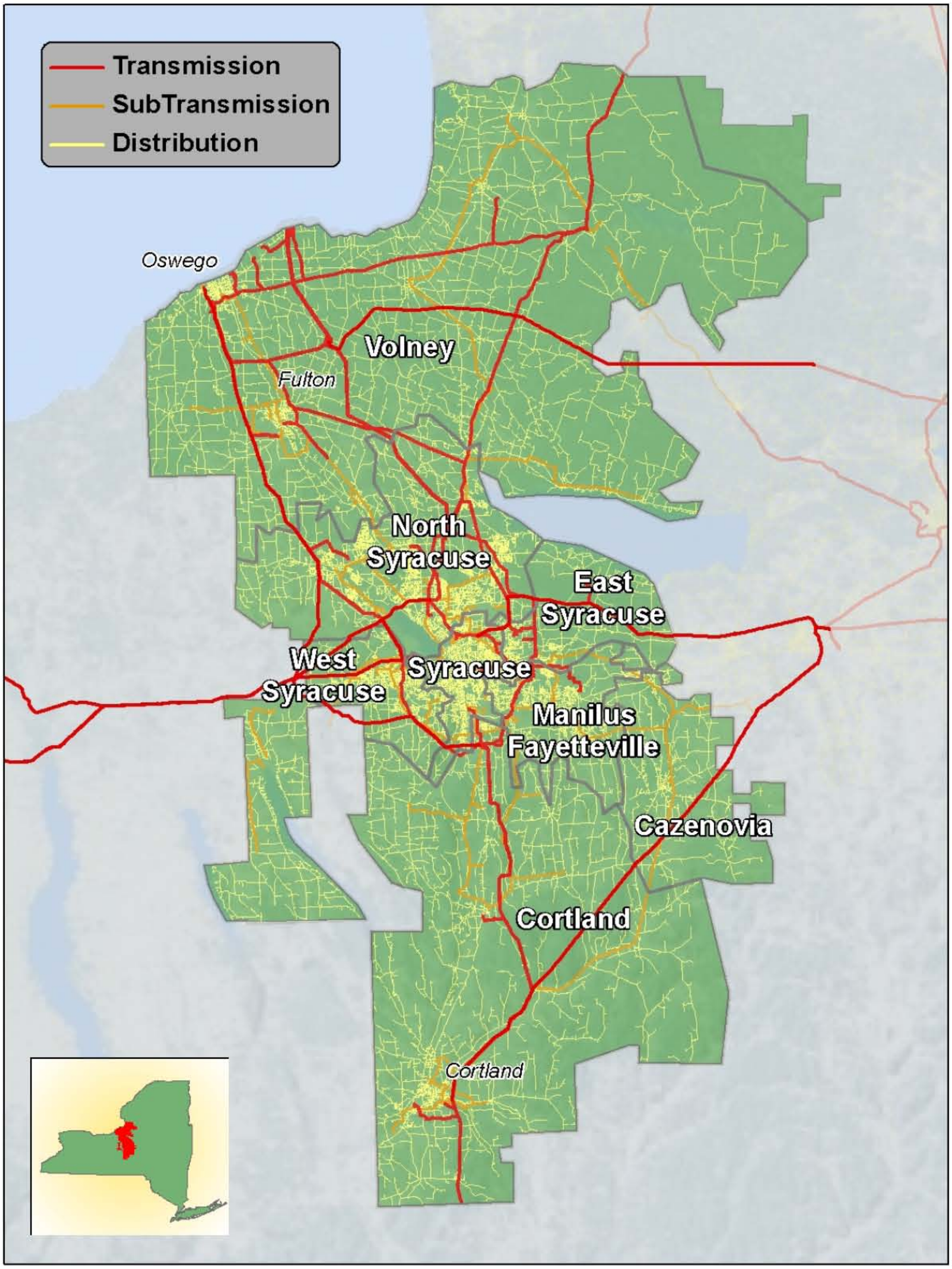
The projects listed below provide only for the interconnection to the National Grid system, and do not ensure that the full output of the generators can be accommodated at all times. National Grid's transmission plans do not provide for full deliverability of all generation unless appropriate funding is provided by the generators consistent with NYISO processes.

Table III-19

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation /Corrective Action
Coffeen-Thousand Islands #4	115	---	2013*	---	Cape Vincent wind farm interconnection	CNYX60 CNYX60R	RTU, metering and relay upgrades for Cape Vincent 210MW wind farm, and reimbursable portion
Coffeen-Thousand Islands #4	115	---	2013*	---	St. Lawrence wind farm interconnection	CNYX55 CNYX55R CNYX56 CNYX56R	Loop in, loop out, RTU, metering, relay upgrades for St. Lawrence 79MW wind farm, and reimbursable portion
Coffeen-Thousand Islands #4	115	---	2014*	---	Clayton wind farm interconnection	CNYX70 CNYX70R CNYX71 CNYX71R	Loop in, loop out, RTU, metering, relay upgrades for Clayton 132MW wind farm, and reimbursable portion
Boonville-Taylorville #5	115	---	2014*	---	Tug Hill wind farm interconnection	CNYX61 CNYX61R CNYX62 CNYX62R	Loop in, loop out, RTU, metering, relay upgrades for Tug Hill 79MW wind farm, and reimbursable portion

*Note: The Need Year for a generator project is when the generator plans to be connected to the system and does not indicate that a system need exists.

III G. Syracuse Oswego Cortland Transmission Planning Study Area



Area Summary

The drivers behind the transmission capacity related projects in the Syracuse Oswego Cortland (SOC) study area are:

- [redacted]
- Fault current levels have been identified in excess of the interrupting capability of breakers at six different substations in the area.
- [redacted]

Key sub-transmission and distribution drivers include the following:

- Load growth in the Syracuse University and the North Syracuse areas are major drivers of distribution capacity work.
- The condition of the Ash St. substation is an asset condition driver.
- From a reliability perspective, this is the lead area for the distribution automation pilot including one sub-transmission line and six distribution circuits. This is also the area of the Trip Saver single phase recloser pilot.

Area Description

The SOC study area includes the 345kV and 115kV transmission facilities in the Central Region and all of the 115kV and above transmission facilities around the Oswego Complex area, including the 345kV Scriba and Volney stations.

The SOC area is bordered by Elbridge substation in the West, Cortland substation in the South, Oneida substation in the East, and Clay substation in the North. [redacted] This area also includes some of the assets stretching between Mortimer and Elbridge.

Within the SOC study area, there are eight Distribution Study areas: Cazenovia, Cortland, East Syracuse, Manilus-Fayetteville, North Syracuse, Syracuse, Volney and West Syracuse.

The Cazenovia study area serves approximately 6,500 customers. The study area is a very rural region, with the Village of Cazenovia and the Cazenovia Industrial Park being the only large loads. The distribution system consist one 34.5-13.2kV, and four 34.5-5kV substations. The only physical constraint is the Cazenovia Lake and the residential load which is spread around the Cazenovia Lake.

The Cortland study area serves approximately 32,800 customers. The study area is defined by the region that includes the city of Cortland and the surrounding towns and villages. It is located in central New York between Syracuse and Binghamton. The primary distribution system voltages in Cortland are 13.2kV and 4.8kV. Most of the area is fed from a 34.5kV sub-transmission system supplied out of the Cortland and Labrador substations.

The East Syracuse study area serves approximately 16,000 customers. The study area is an industrial suburb of the City of Syracuse. The distribution system consists of one 115-34.5kV, three 115-13.2kV and three 34.5-4.8kV substations. The transmission supply is adequate and the only physical barriers are Interstate 690 and Interstate 481 going through the area. Customers are served via fifteen 13.2kV feeders and eleven 4.8kV feeders.

The Manlius Fayetteville study area serves approximately 22,400 customers. The study area is a residential suburb of Syracuse. The distribution system consists of one 115-34.5kV, four 115-13.2kV and one 34.5-4.8kV substation. Most new load additions to the area are residential developments.

The North Syracuse study area serves approximately 65,800 customers. The study area is the northern suburb of the City of Syracuse. It has experienced the majority of the new housing which has been built in the Syracuse metropolitan area. The distribution system consists of one 115-34.5kV, eight 115-13.2kV and five 34.5-4.8kV stations. The physical barriers in the North Syracuse area are the two interstates highways, I-81 and I-90.

The Syracuse Study Area serves approximately 58,100 customers. The study area is made up of the City of Syracuse in central New York as well as the Village of Skaneateles about 20 miles southwest of the city. The primary distribution system voltages in Syracuse are 13.2kV and 4.16kV. There is also a 12kV network fed out of Ash St. substation. Most of the area is fed from a 34.5kV sub transmission system supplied by Ash St, Elbridge, Solvay, Teall Ave., and Tilden substations. There is also some 13.2kV fed directly from the 115kV transmission system.

The Volney study area serves approximately 53,800 customers. The study area includes the cities of Oswego and Fulton. The distribution system consists of four 115-34.5kV, seven 115-13.2kV, five 34.5-13.2kV and nine 34.5-5kV substations. A physical barrier in this area is the Oswego River, which is also a canal.

The West Syracuse study area serves approximately 21,000 customers. The study area is a suburb west of the City of Syracuse. The distribution system consists of one 115-34.5kV, two 115-13.2kV, three 34.5-5kV substations and five 5kV substations.

Chapter 4, Exhibit 2 contains the list of electrical transmission and sub-transmission lines and substations in this transmission study area.

Area Load Forecast

The SOC Study Area load forecast is included in the Syracuse Region (NYISO Zone C) forecast. The summary of the load forecast thru 2020 is detailed in the tables below. For the last five years (2021 to 2026) in the Plan the growth rates are assumed the same as 2016 to 2020.

Syracuse Region (NYISO Zone C) - SUMMER														
		SUMMER PEAKS (MWs)								TEMPs				
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	7	1,284		1,294		1,390		1,397		80.0	79.6	84.0	84.0
2002	8	1,207	-6.0%	1,119	-13.6%	1,214	-12.6%	1,222	-12.6%	84.0	79.6	84.0	84.0
2003	8	1,110	-8.0%	1,150	2.8%	1,246	2.6%	1,254	2.6%	76.0	79.6	84.0	84.0
2004	6	1,122	1.0%	1,222	6.2%	1,318	5.8%	1,325	5.7%	79.0	79.6	84.0	84.0
2005	8	1,256	12.0%	1,198	-2.0%	1,294	-1.8%	1,301	-1.8%	82.0	79.6	84.0	84.0
2006	8	1,321	5.2%	1,218	1.6%	1,314	1.5%	1,321	1.5%	84.0	79.6	84.0	84.0
2007	8	1,247	-5.6%	1,272	4.5%	1,368	4.1%	1,375	4.1%	80.0	79.6	84.0	84.0
2008	6	1,295	3.9%	1,215	-4.5%	1,310	-4.2%	1,318	-4.2%	85.0	79.6	84.0	84.0
2009	8	1,131	-12.7%	1,125	-7.4%	1,221	-6.8%	1,229	-6.8%	79.0	79.6	84.0	84.0
2010	7	1,219	7.8%	1,116	-0.8%	1,212	-0.8%	1,219	-0.8%	83.0	79.6	84.0	84.0
2011		-		1,167	4.6%	1,263	4.2%	1,270	4.2%	-	79.6	84.0	84.0
2012		-		1,187	1.7%	1,283	1.6%	1,290	1.6%	-	79.6	84.0	84.0
2013		-		1,212	2.1%	1,307	1.9%	1,315	1.9%	-	79.6	84.0	84.0
2014		-		1,225	1.1%	1,321	1.0%	1,328	1.0%	-	79.6	84.0	84.0
2015		-		1,234	0.7%	1,330	0.7%	1,338	0.7%	-	79.6	84.0	84.0
2016		-		1,241	0.6%	1,337	0.5%	1,344	0.5%	-	79.6	84.0	84.0
2017		-		1,248	0.5%	1,344	0.5%	1,351	0.5%	-	79.6	84.0	84.0
2018		-		1,255	0.5%	1,350	0.5%	1,358	0.5%	-	79.6	84.0	84.0
2019		-		1,263	0.6%	1,358	0.6%	1,366	0.6%	-	79.6	84.0	84.0
2020		-		1,271	0.6%	1,366	0.6%	1,374	0.6%	-	79.6	84.0	84.0

ZONE C (Syracuse Region) - SUMMER	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	0.1%	-0.9%	-0.8%	-0.8%
Compound Avg. 5 yr ('04 to '08)	3.1%	1.1%	1.0%	1.0%
Compound Avg. 9 yr ('02 to '10)	-0.6%	-1.6%	-1.5%	-1.5%
Compound Avg. 5 yr ('06 to '10)	-0.6%	-1.4%	-1.3%	-1.3%
Compound Avg. 5 yr ('11 to '15)		**2.0%**	**1.9%**	**1.9%**
Compound Avg. 5 yr ('16 to '20)		**0.6%**	**0.5%**	**0.5%**
Compound Avg. 10 yr ('11 to '20)		**1.3%**	**1.2%**	**1.2%**

Table III-21

Syracuse Region (NYISO Zone C) - WINTER														
		WINTER PEAKS (MWs)								TEMPs				
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	1	1,006		1,033		1,060		1,065		22.0	9.9	(1.5)	(4.0)
2002	12	1,047	4.2%	1,068	3.4%	1,095	3.3%	1,100	3.3%	19.0	9.9	(1.5)	(4.0)
2003	1	1,051	0.3%	1,035	-3.2%	1,061	-3.1%	1,067	-3.1%	3.0	9.9	(1.5)	(4.0)
2004	12	1,102	4.9%	1,075	3.9%	1,101	3.8%	1,107	3.8%	(2.0)	9.9	(1.5)	(4.0)
2005	1	1,068	-3.1%	1,048	-2.5%	1,074	-2.5%	1,080	-2.5%	1.0	9.9	(1.5)	(4.0)
2006	12	1,022	-4.3%	1,064	1.6%	1,090	1.5%	1,096	1.5%	28.0	9.9	(1.5)	(4.0)
2007	12	1,030	0.8%	1,061	-0.3%	1,087	-0.3%	1,093	-0.3%	23.0	9.9	(1.5)	(4.0)
2008	12	1,084	5.2%	1,093	3.1%	1,119	3.0%	1,125	3.0%	14.0	9.9	(1.5)	(4.0)
2009	1	1,065	-1.7%	1,054	-3.6%	1,080	-3.5%	1,086	-3.5%	5.0	9.9	(1.5)	(4.0)
2010	1	958	-10.1%	985	-6.5%	1,012	-6.4%	1,017	-6.3%	22.0	9.9	(1.5)	(4.0)
2011		-		1,022	3.7%	1,048	3.6%	1,054	3.6%	-	9.9	(1.5)	(4.0)
2012		-		1,042	2.0%	1,069	1.9%	1,074	1.9%	-	9.9	(1.5)	(4.0)
2013		-		1,061	1.8%	1,087	1.7%	1,093	1.7%	-	9.9	(1.5)	(4.0)
2014		-		1,072	1.0%	1,098	1.0%	1,103	1.0%	-	9.9	(1.5)	(4.0)
2015		-		1,079	0.7%	1,105	0.7%	1,111	0.7%	-	9.9	(1.5)	(4.0)
2016		-		1,085	0.6%	1,112	0.6%	1,117	0.6%	-	9.9	(1.5)	(4.0)
2017		-		1,092	0.6%	1,118	0.6%	1,124	0.6%	-	9.9	(1.5)	(4.0)
2018		-		1,099	0.6%	1,125	0.6%	1,131	0.6%	-	9.9	(1.5)	(4.0)
2019		-		1,107	0.7%	1,133	0.7%	1,139	0.7%	-	9.9	(1.5)	(4.0)
2020		-		1,114	0.7%	1,140	0.7%	1,146	0.6%	-	9.9	(1.5)	(4.0)

Syracuse Region (NYISO Zone C) - WINTER	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	1.1%	0.8%	0.8%	0.8%
Compound Avg. 5 yr ('04 to '08)	0.6%	1.1%	1.1%	1.1%
Compound Avg. 9 yr ('02 to '10)	-0.5%	-0.5%	-0.5%	-0.5%
Compound Avg. 5 yr ('06 to '10)	-2.2%	-1.2%	-1.2%	-1.2%
Compound Avg. 5 yr ('11 to '15)		**1.8%**	**1.8%**	**1.8%**
Compound Avg. 5 yr ('16 to '20)		**0.6%**	**0.6%**	**0.6%**
Compound Avg. 10 yr ('11 to '20)		**1.2%**	**1.2%**	**1.2%**

Capacity Issues

Forecasted Overloads

The following tables identify forecasted system capacity issues and potential solutions in this study area.

Table III-22

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Transmission Syracuse Oswego Cortland Study Area							
[redacted]	345	[redacted]		[redacted]	[redacted]		[redacted]
[redacted]	345	[redacted]	2011	[redacted]	[redacted]		[redacted]

[8] Results in violation of NERC and NPCC criteria
[9] Results in violation of NERC and NPCC criteria

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							[redacted]
Ash Street substation	115	3 Phase fault	2011	NYISO 2012	Over Duty (112%)	CNYPL26	Replace breakers with higher rated units
Oswego substation	115	3 Phase fault	2011	NYISO 2012	Over Duty (130%)	CNYPL26	Replace Breakers with higher rated units (asset condition issues also exist at the station as referred to in the Asset table below)
Teall substation	115	3 Phase fault	2011	NYISO 2012	Over Duty (125%)	CNYPL26	Replace Breakers with higher rated units
Temple substation	115	3 Phase fault	2011	NYISO 2012	Over Duty (111%)	CNYPL26	Refurbish Breakers to increase rating
[redacted]	345	[redacted]	2011	[redacted]	[redacted]	C28708	[redacted]
[redacted]	345	[redacted]	2011	[redacted]	[redacted]	C28708	[redacted]

10 Results in violation of NERC and NPCC criteria
11 Results in violation of NERC and NPCC criteria

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
State St (Auburn) – Elbridge #5	115	BO: Quaker2 or Quaker-Sleight #13	2011	Summer 2015	110% LTE, 101% STE		This problem was identified in the 2010 study of the Mortimer – Elbridge area and will be addressed by a proposed NYSEG project. While project is being implemented, risk can be reduced by dispatching generation in the Finger Lakes region (Milliken) or fully corrected by shedding NYSEG load in the Auburn area.
Geres Lock – Solvay line #2	115	Dewitt TB#2 + Geres Lock – Solvay #14	2012	2010 FERC base case, adjusted to 2011 loading	117% of STE (145MVA)	CNYPL28	Recommended reconductoring. Transmission Network Operations has been informed of the contingencies which cause this overload, in order to operationally mitigate this issue until project completion. Demand-Side management is being considered as a means of deferring the need date of this project. Candidate for integration with CNYS68 &C34971 Only the most extreme contingency is listed, however multiple contingencies result in this overload.
[redacted]	115	[redacted]	2012	[redacted]	[redacted]	CNYPL28	[redacted]

[12] Results in violation of NERC and NPCC criteria.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							[redacted]
[redacted]	115	[redacted]	2012	[redacted]	[redacted]	CNYPL28	[redacted]
Sub-Transmission and Distribution Cazenovia Study Area							
None							
Sub-Transmission and Distribution Cortland Study Area							
Delphi substation T1 Transformer	115-13.2	Exceed Summer Normal Rating	2013	-	101% of SN	C36166	The recommended solution is to upgrade the T1 transformer.
Sub-Transmission and Distribution East Syracuse Study Area							
East Malloy substation T1 Transfor	115-13.2	MWHr for loss of transformer	existing	-	281MW Hr	C36188	The recommended solution is to add a second substation transformer at East Malloy substation.

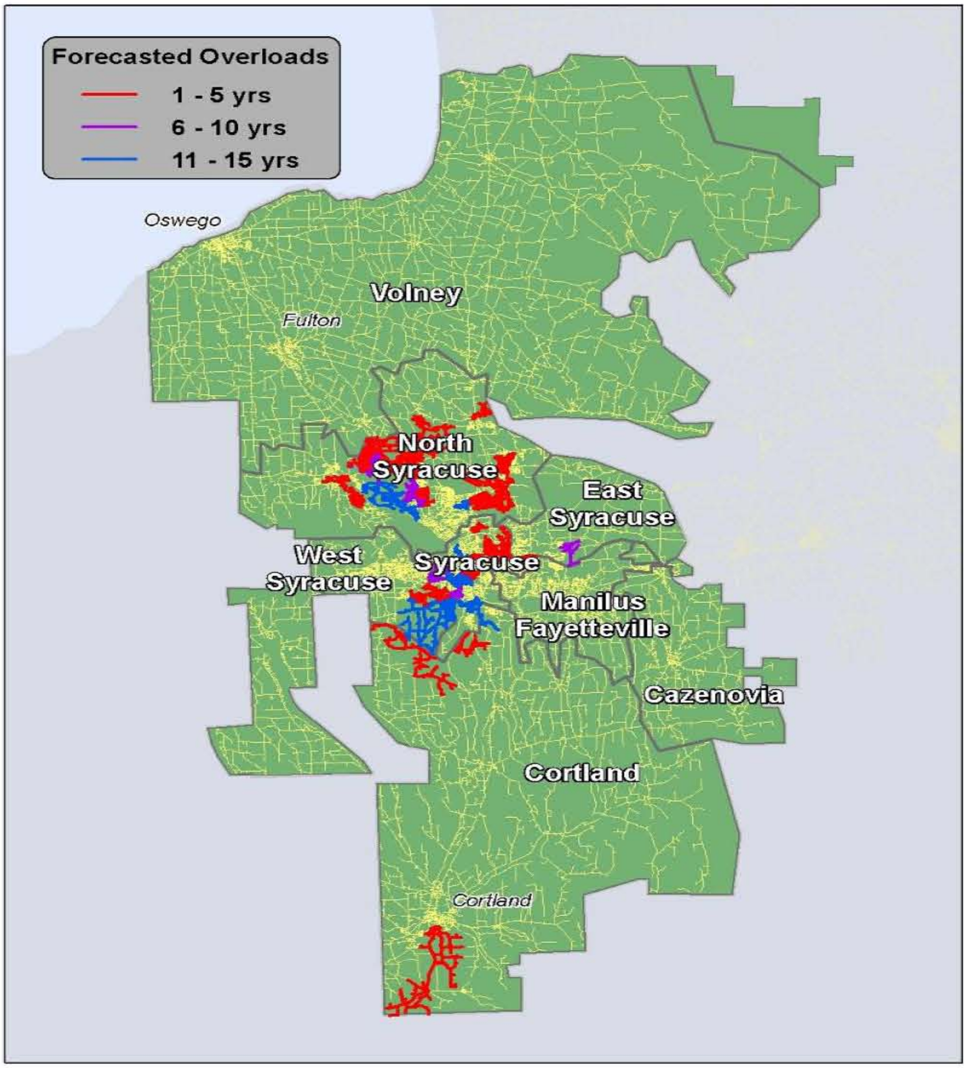
13 Results in violation of NERC and NPCC criteria.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
mer							
Bridge St. substation T1 Transformer	115-13.2	MWHr for loss of transformer	existing	-	266MW Hr	C36185	The recommended solution is to add a second substation transformer at Bridge St. substation.
Fly Rd. substation T1 Transformer	115-13.2	MWHr for loss of transformer	existing	-	311MW Hr	C36189	The recommended solution is to add a second substation transformer at Fly Rd. substation.
Sub-Transmission and Distribution Manilus-Fayetteville, Study Area							
Duguid substation T1 Transformer	115-13.2	MWHr for loss of transformer	2017	-	260MW Hr	C36843 C36854 C36844	The recommended solution is to add a second substation transformer at Duguid substation.
Sub-Transmission and Distribution North Syracuse Study Area							
Belmont substation 26052 Feeder Step Down Transformer	13.2 - 4.8	Exceed Summer Normal Rating	existing	-	150% of SN	C30584	The recommended solution is to convert a portion of the 4.8kV step down area.
Belmont substation T1 and T2 Transformers		MWHr for loss of transformer	existing	-	223MW Hr	C36983, C36985 C28831 C30506	The recommended solution is to install a new substation – Wetzel Rd.
Euclid substation T1 and T2 Transformers		MWHr for loss of transformer	existing	-	283MW Hr	C36983, C36985 C28831 C30506	The recommended solution is to install a new substation – Wetzel Rd.
Pine Grove substation T1 and T2 Transformers		MWHr for loss of transformer	existing		336MW Hr	C36983, C36985 C28831 C30506	The recommended solution is to install a new substation – Wetzel Rd.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Lysander substation 29755 Feeder	13.2	Exceed Summer Normal Rating	2011	-	102% of SN	C26601	The recommended solution is to replace the limiting section, the underground getaway cable.
Sub-Transmission and Distribution Syracuse Study Area							
Temple substation 24348 Feeder	13.2	Exceed Summer Normal Rating	existing	-	143% of SN	C36682	The recommended solution is to install three new 13.2kV feeders at Temple substation.
Temple Substation 24351 Feeder	13.2	Exceed Summer Normal Rating	existing	-	110% of SN	C36682	The recommended solution is to install three new 13.2kV feeders at Temple substation.
Temple substation 24359 Feeder	13.2	Exceed Summer Normal Rating	existing	-	164% of SN	C36682	The recommended solution is to install three new 13.2kV feeders at Temple substation.
Temple substation 24344 Feeder	13.2	Exceed Summer Normal Rating	2019	-	100% of SN	C36682	The recommended solution is to install three new 13.2kV feeders at Temple substation.
Sub-Transmission and Distribution Volney Study Area							
Paloma substation T1 Transformer	115-13.2	Exceed Summer Normal Rating	existing	-	104% of SN	C32495	The recommend solution is the installation of a second transformer at Paloma substation.
Phoenix substation 5164 Feeder	4.8	Exceed Summer Normal Rating	existing		110% of SN	C28905	The recommended solution is to upgrade the limiting section, 800' of 1/0 Cu overhead conductor.
Sub-Transmission and Distribution West Syracuse Study Area							
Milton Ave. substation T1 Transformer	115-13.2	Exceed Summer Normal Rating	2015	-	100% of SN	C32496	The recommended solution is to install a second transformer and two feeders at Harris Rd. substation.
Harris Rd. substation T1 Transf.	115-13.2	MWHr for loss of transformer	2016	-	240MW Hr	C32496	The recommended solution is to install a second transformer and two feeders at Harris Rd. substation.

Forecasted Overloaded Distribution Feeder Map

The following map shows the Distribution feeders which are forecasted to be overloaded in the next 1-5, 6-10 and 11-15 year timeframe. The forecast overload is based on 100% of summer normal rating.



Proposed Generator Interconnections

In the SOC SO OATT Attachment X Large Facility Interconnection Procedures for Large Generator Interconnection Projects (greater than 20MW). The Nine Mile III Uprate is a proposed 168MW increase of the generating capability connecting to the 345kV transmission system near Oswego, New York.

The proposed Green Power – Cody Rd. 10MW wind farm project is proposing to interconnect to the transmission through the NYISO OATT Attachment Z Small Facility Interconnection Procedures for Small Generator Interconnection Projects (20MW or less) near Madison, NY.

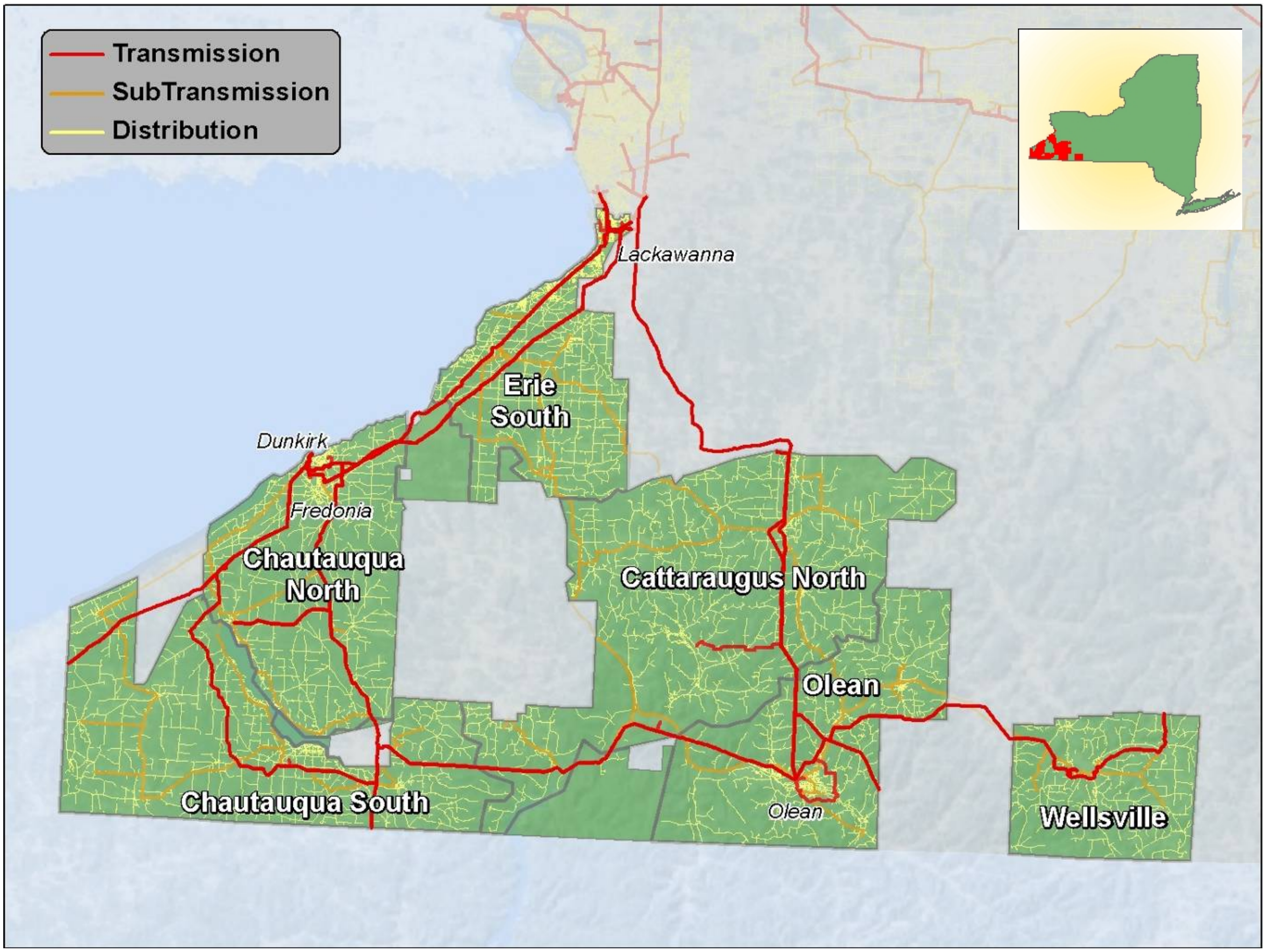
The projects listed below provide only for the interconnection to the National Grid system, and do not ensure that the full output of the generators can be accommodated at all times. National Grid's transmission plans do not provide for full deliverability of all generation unless appropriate funding is provided by the generators consistent with NYISO processes.

Table III-23

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation /Corrective Action
Nine Mile III Uprate	345	---	2013*	---	Nine Mile III Uprate interconnection	CNYX67 CNYX67R	RTU, metering and relay upgrades for Nine Mile III Uprate (additional 168MW), and reimbursable portion
Fenner-Cortland#3	115	---	2015*	---	Green Power Cody Rd. wind farm interconnection	CNYX68 CNYX68R CNYX69 CNYX69R	Loop in, loop out, RTU, metering, relay upgrades for Green Power-Cody Rd. 10MW wind farm, and reimbursable portion

*Note: The Need Year for a generator project is when the generator plans to be connected to the system and does not indicate that a system need exists.

III H. Southwest Transmission Planning Study Area



Area Summary

The driver behind the transmission capacity related projects in the Southwest study area is:

- A wide range of contingencies can result in voltages well below criteria at various locations in this study area. The vulnerability of the area to these voltage issues is significantly amplified if certain key generators are not operating.

Key sub-transmission and distribution drivers include the following:

- The 34.5kV sub-transmission system that consists of several very long loops that traverse through rugged territory.

Area Description

The Southwest transmission study area includes the system as far north as Gardenville station, east into Wellsville and the system stretching south into Pennsylvania. The transmission system consists primarily of 115kV and 230kV double circuit transmission lines. [redacted] National Grid

[redacted]

Within the Southwest study area, there are six Distribution study areas: Cattaraugus – North, Chautauqua - North, Chautauqua – South, Erie - South, Olean and Wellsville.

The North Cattaraugus Study area serves approximately 14,700 customers. There are seven 13.2kV feeders, five of which are fed via two-115-13.2kV transformers at the Valley substation. The remaining two-13.2kV feeders are fed from 34.5-13.2kV transformers at the Price Corners and Reservoir substations. There are also twenty 4.8kV feeders, all supplied by 34.5-4.8kV transformers at various area substations. There are seven 34.5kV sub-transmission lines that provide supply for the 34.5-4.8kV transformers and a minimal number of industrial customers that are supplied directly from the 34.5kV system. There are several NYSEG substations and municipal electric departments supplied from the 34.5kV system.

The North Chautauqua study area serves approximately 26,100 customers. There are ten 4.8kV feeders, which are all fed from 34.5-4.8kV transformers. There are also twenty 13.2kV distribution feeders with all but one fed by 115-13.2kV transformers at various substations in the area. One 13.2kV feeder is supplied by a 34.5-13.2kV transformer at the West Portland substation. There are also eight 34.5kV sub-transmission lines which provide the supply to the 34.5-4.8kV step-down transformers in the area.

The Chautauqua South study area serves approximately 17,000. Customers are supplied by twenty 4.8kV delta feeders, which are all fed from 34.5-4.8kV transformers. There are four 13.2kV feeders with three fed by the Baker Street 115-13.2kV transformer and one fed by the French Creek 34.5-13.2kV transformer. There are five 34.5kV sub-transmission lines that are supplied from Hartsfield and South Dow 115kV substations.

The Erie South study area serves approximately 36,800 customers. The study area includes the Buffalo outer harbor area and those areas south of the City of Buffalo with approximately half the feeders served at 13.2kV. The 115kV system supplies the 13.2kV stations. The rest of the feeders operate at 4.8kV or 4.16kV.

The Olean study area serves approximately 18,700 customers. There are twenty distribution feeders that provide service to area customers. There are eight 4.8kV feeders supplied by 34.5-4.8kV transformers at various stations. Eleven of the area's twelve 13.2kV feeders are fed from 115-13.2kV transformers. The remaining single feeder is served from a 34.5-13.2kV transformer at the Vandalia substation.

The Wellsville study area serves approximately 4,400 customers. This study area is a small rural region located near the Pennsylvania border and is supplied by the 115/34kV Andover and Nile substations. There are two 34.5kV supply lines in the area. Load is served by 5 substations serving nine 4.8kV feeders.

Chapter 4, Exhibit 2 contains the list of electrical transmission and sub-transmission lines and substations in this transmission study area.

Area Load Forecast
The Southwest Study Area load forecast is included in the West Region (Zone A & B) forecast. The summary of the load forecast thru 2020 is detailed in the tables below. For the last five years (2021 to 2026) in the Plan the growth rates are assumed the same as 2016 to 2020.

Table III-24

West Region (NYISO Zone A&B) – SUMMER													
		SUMMER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	7	2,270		2,231		2,322		2,340		80.2	78.3	82.0	82.4
2002	7	2,325	2.4%	2,253	1.0%	2,344	0.9%	2,362	0.9%	82.0	78.3	82.0	82.4
2003	8	2,176	-6.4%	2,216	-1.6%	2,307	-1.6%	2,325	-1.6%	76.4	78.3	82.0	82.4
2004	6	2,124	-2.4%	2,204	-0.6%	2,295	-0.5%	2,312	-0.5%	75.4	78.3	82.0	82.4
2005	8	2,339	10.1%	2,310	4.9%	2,402	4.7%	2,419	4.6%	79.2	78.3	82.0	82.4
2006	8	2,355	0.7%	2,258	-2.2%	2,350	-2.2%	2,367	-2.1%	81.8	78.3	82.0	82.4
2007	8	2,264	-3.9%	2,208	-2.2%	2,299	-2.2%	2,317	-2.1%	81.0	78.3	82.0	82.4
2008	7	2,193	-3.1%	2,197	-0.5%	2,288	-0.5%	2,306	-0.5%	78.4	78.3	82.0	82.4
2009	8	2,124	-3.2%	2,085	-5.1%	2,176	-4.9%	2,194	-4.9%	80.0	78.3	82.0	82.4
2010	7	2,235	5.2%	2,140	2.6%	2,231	2.5%	2,249	2.5%	82.2	78.3	82.0	82.4
2011		-		2,243	4.8%	2,334	4.6%	2,352	4.6%	-	78.3	82.0	82.4
2012		-		2,260	0.8%	2,351	0.7%	2,369	0.7%	-	78.3	82.0	82.4
2013		-		2,274	0.6%	2,365	0.6%	2,383	0.6%	-	78.3	82.0	82.4
2014		-		2,284	0.4%	2,375	0.4%	2,393	0.4%	-	78.3	82.0	82.4
2015		-		2,292	0.4%	2,383	0.4%	2,401	0.4%	-	78.3	82.0	82.4
2016		-		2,300	0.4%	2,391	0.3%	2,409	0.3%	-	78.3	82.0	82.4
2017		-		2,308	0.4%	2,400	0.3%	2,417	0.3%	-	78.3	82.0	82.4
2018		-		2,316	0.3%	2,407	0.3%	2,425	0.3%	-	78.3	82.0	82.4
2019		-		2,324	0.3%	2,415	0.3%	2,433	0.3%	-	78.3	82.0	82.4
2020		-		2,331	0.3%	2,422	0.3%	2,440	0.3%	-	78.3	82.0	82.4

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.5%	-0.2%	-0.2%	-0.2%
Compound Avg. 5 yr ('04 to '08)	0.2%	-0.2%	-0.2%	-0.2%
Compound Avg. 9 yr ('02 to '10)	-0.2%	-0.5%	-0.4%	-0.4%
Compound Avg. 5 yr ('06 to '10)	-0.9%	-1.5%	-1.5%	-1.5%
Compound Avg. 5 yr ('11 to '15)		**1.4%**	**1.3%**	**1.3%**
Compound Avg. 5 yr ('16 to '20)		**0.3%**	**0.3%**	**0.3%**
Compound Avg. 10 yr ('11 to '20)		**0.9%**	**0.8%**	**0.8%**

Table III-25

West Region (NYISO Zone A&B) - WINTER													
		WINTER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	1	2,115		2,130		2,163		2,166		17.0	12.8	3.6	2.6
2002	12	2,131	0.7%	2,143	0.6%	2,175	0.6%	2,179	0.6%	16.2	12.8	3.6	2.6
2003	1	2,113	-0.8%	2,107	-1.7%	2,140	-1.6%	2,143	-1.6%	11.2	12.8	3.6	2.6
2004	12	2,112	0.0%	2,082	-1.2%	2,115	-1.1%	2,119	-1.1%	4.4	12.8	3.6	2.6
2005	12	2,103	-0.4%	2,103	1.0%	2,136	1.0%	2,139	1.0%	12.8	12.8	3.6	2.6
2006	12	2,038	-3.1%	2,084	-0.9%	2,116	-0.9%	2,120	-0.9%	25.8	12.8	3.6	2.6
2007	2	2,039	0.1%	2,016	-3.3%	2,049	-3.2%	2,052	-3.2%	6.4	12.8	3.6	2.6
2008	2	2,016	-1.1%	2,005	-0.6%	2,037	-0.5%	2,041	-0.5%	9.6	12.8	3.6	2.6
2009	12	1,991	-1.2%	2,028	1.2%	2,061	1.1%	2,064	1.1%	23.2	12.8	3.6	2.6
2010	1	1,959	-1.6%	1,982	-2.3%	2,015	-2.2%	2,018	-2.2%	19.2	12.8	3.6	2.6
2011		-		2,064	4.1%	2,097	4.1%	2,100	4.1%		12.8	3.6	2.6
2012		-		2,077	0.6%	2,110	0.6%	2,113	0.6%		12.8	3.6	2.6
2013		-		2,088	0.5%	2,121	0.5%	2,124	0.5%		12.8	3.6	2.6
2014		-		2,097	0.4%	2,129	0.4%	2,133	0.4%		12.8	3.6	2.6
2015		-		2,104	0.4%	2,137	0.4%	2,141	0.4%		12.8	3.6	2.6
2016		-		2,112	0.4%	2,145	0.4%	2,148	0.4%		12.8	3.6	2.6
2017		-		2,120	0.4%	2,152	0.4%	2,156	0.4%		12.8	3.6	2.6
2018		-		2,127	0.3%	2,160	0.3%	2,163	0.3%		12.8	3.6	2.6
2019		-		2,134	0.3%	2,167	0.3%	2,170	0.3%		12.8	3.6	2.6
2020		-		2,141	0.3%	2,173	0.3%	2,177	0.3%		12.8	3.6	2.6

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.7%	-0.9%	-0.8%	-0.8%
Compound Avg. 5 yr ('04 to '08)	-0.9%	-1.0%	-1.0%	-1.0%
Compound Avg. 9 yr ('02 to '10)	-0.8%	-0.8%	-0.8%	-0.8%
Compound Avg. 5 yr ('06 to '10)	-1.4%	-1.2%	-1.2%	-1.2%
Compound Avg. 5 yr ('11 to '15)		**1.2%**	**1.2%**	**1.2%**
Compound Avg. 5 yr ('16 to '20)		**0.3%**	**0.3%**	**0.3%**
Compound Avg. 10 yr ('11 to '20)		**0.8%**	**0.8%**	**0.8%**

Capacity Issues

Forecasted Overloads

The following tables identify forecasted system capacity issues and potential solutions in this study area.

Table III-26

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Transmission Southwest Study Area							
Southwest Region Voltages	115	151+152	2011	Summer 2007, 2013	Less than 0.75 pu (0.90) for 2013	C31457	The contingency combination noted is the worst-case contingency for this violation. Other contingencies include 153+154 DCT and bus faults at Dunkirk and Falconer. The recommended solution is to install a second 27MVAr 115kV capacitor banks at Homer Hill in addition to the construction of the Southwest station. A temporary solution would be to run units at Jamestown and Indeck Olean
Southwest Region Voltages	115	151+152	2011	Summer 2007, 2013	Less than 0.75 pu (0.90) for 2007	C24015, C24016	The contingency combination noted is the worst-case contingency for this violation. Other contingencies include 153+154 DCT and bus faults at Dunkirk and Falconer. The recommended solution is to construct a new 345/115kV station near Homer Hill station tying into the Homer City-Stolle Road 345kV line #37 and the Gardenville-Homer Hill 115kV lines #151 and #152. An operational measure during the implementation of the project is to utilize generation at Indeck Olean and the city of Jamestown. Line #157, which is normally open, could also

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							be closed to provide support to the system
Southwest Region Voltages	115	N-1-1 Contingency: SW TB followed by Dunkirk bus fault	2011	Summer 2007, 2013	Less than 0.75 pu (0.90) for 2007	C24017	The contingency combination noted is the worst-case contingency for this violation. Other contingencies include double circuit outages followed by bus faults at Dunkirk or Falconer. The recommended solution is to reconductor 6 miles of the Falconer-Warren 115kV #171 circuit. An operational solution before reconductoring would be to run generating units at Jamestown and Indeck Olean
Dunkirk 115kV substation	115	Bus fault at Dunkirk with bus tie failure	2011	Summer 2011	0.76 pu (0.90)	C31459	The recommended solution is the addition of a second 115kV bus tie breaker in series with the existing breaker to prevent a breaker failure from interrupting both bus sections. A temporary solution before the upgrade would be to run generating units at Jamestown and Indeck Olean
Dunkirk-Falconer 115kV region	115	Bus fault at 115kV Dunkirk station	2011	Summer 2011, 2015	Voltage deviation of over 10%		The contingency combination noted is the worst-case contingency for this violation. Other contingency includes opening of the Dunkirk breaker at #161. The recommended solution is to improve the load power factor in the region by applying up to 25MVAr of reactive support to Bennett Road, Baker Street, Berry Road, Roberts Road, East Dunkirk and Hartfield stations. This is also noted in the following sections of this table.

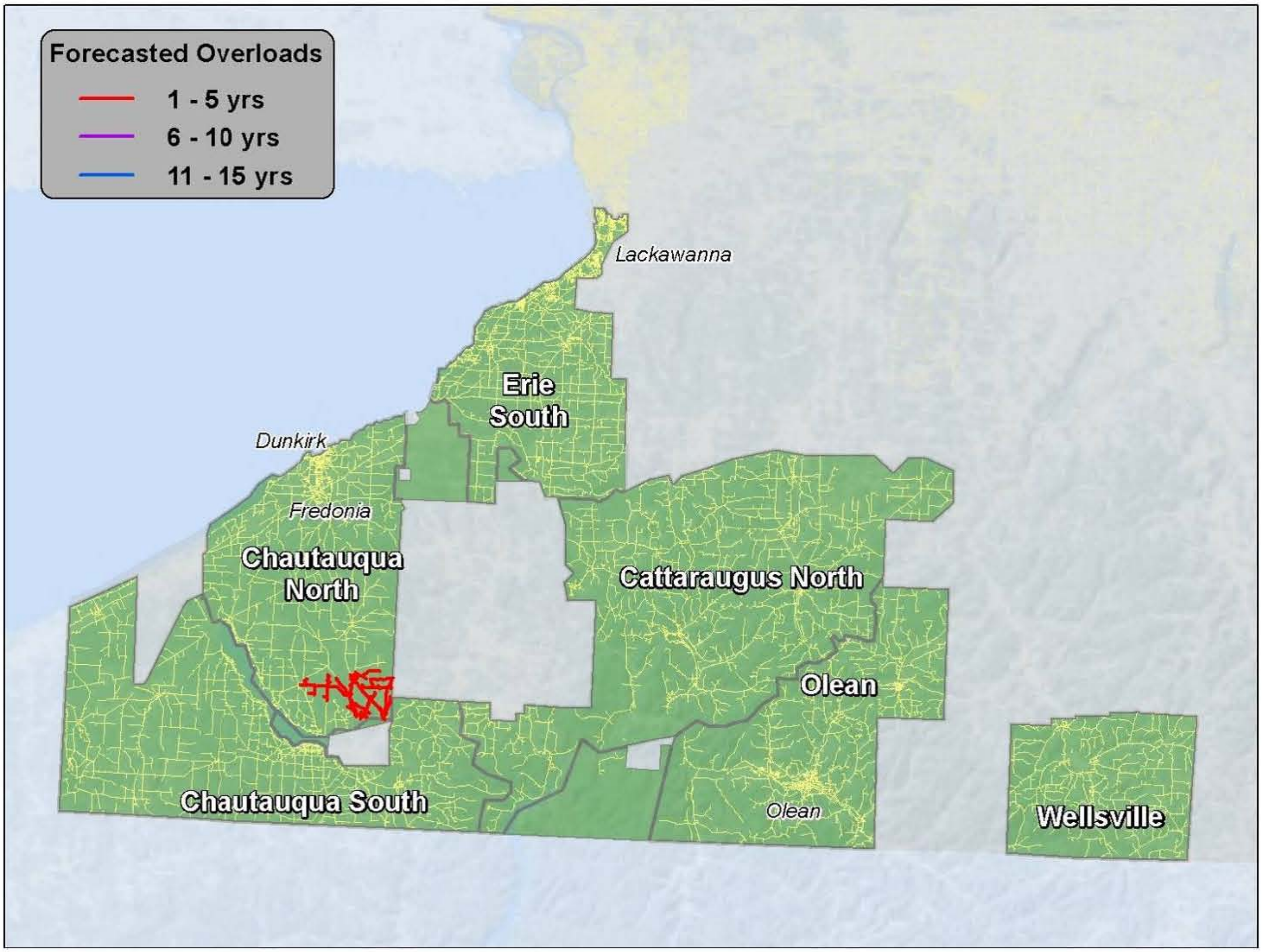
Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Homer Hill Area Voltages	115	151+152 DCT	2011	Summer 2007, 2013	Less than 0.75 pu (0.90) for 2013		The contingency combination noted is the worst-case contingency for this violation. Other contingencies include 153+154 DCT and bus faults at Dunkirk and Falconer. The recommended solution is to close the normally open #157 line after the completion of construction of the Southwest station. A temporary solution would be to run units at Jamestown and Indeck Olean
Dunkirk 230-115kV Transformer	115	N-1-1 Contingency: 68 followed by DCT 73+74	2013	Summer 2013	115% of LTE		The recommended solution is to reduce the amount of generation on the 230kV bus at Dunkirk to correct all issues. Any future replacement of the transformers would result in an increase to the area capability. A partial solution to the mitigate the overload is possible as a result of reconductoring of 141/142 lines by Asset Strategy
161, 162 Reactors (Dunkirk-Falconer)	115	N-1-1 Contingency: 161 reactor outage followed by Dunkirk Bus 1 failure	2015	Summer 2015	0.70 pu (0.90)		The recommended solution is to reduce Jamestown load after the second contingency or before the contingency by bringing area generation in service.
157 (Homer Hill – Bennett)	115	# 37 (345kV) from Homer City to Stolle	2024	Summer 2025	101% of LTE		No recommendation is provided at this time as the problem is in the last five years of our the current 15-year planning horizon. The issue will continue to be monitored in future studies.
Sub-Transmission and Distribution Cattaraugus North Study Area							
None							

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Sub-Transmission and Distribution Chautauqua North Study Area							
Ellicott substation 6561 Feeder	4.8	Exceed Summer Normal Rating	existing	-	109% of SN	C32340	Replace the existing regulators at Ellicott substation, which is the limiting element.
Dunkirk-Falconer 115kV region	115	Bus fault at 115kV Dunkirk station	2011	-	Voltage deviation of over 10%	C32367	The recommended solution is to improve the load power factor in the region by installing capacitor banks on feeders supplied from the Bennett Rd. substation.
Sub-Transmission and Distribution Chautauqua South Study Area							
Chautauqua substation Transformer T1	34.5 - 4.8	Exceed Summer Emergency Rating	Existing		114% of SE	PPM 17227-	Transformer failed on July 21. Replace with 7.5/9.375MVA transformer as a short term solution. A long term plan is under development.
Dunkirk-Falconer 115kV region	115	Bus fault at 115kV Dunkirk station	2011	-	Voltage deviation of over 10%	C32354	The recommended solution is to improve the load power factor in the region by installing a 3.6MVAR station capacitor bank at Baker St. substation and 900kVAR capacitor banks on Baker St. substation feeders. Feeder correction will also be added to address the power factor at other stations.
Panama substation Transformer T1	34.5 - 4.8	Exceed Summer Normal Rating	2022	-	100% if SN	C32306	The recommended solution is to upgrade the Panama substation transformer and regulators. This plan will be reconsidered with the failure of Chautauqua T1 and the need for a long term area solution.
Sub-Transmission and Distribution Erie South Study Area							
North Collins substation Transformer T1	34.5 / 4.8	Exceed Summer Normal Rating	existing	-	109% of SN	C29026	The recommended solution is to upgrade the existing North Collins substation transformer.
Eden Center substation Transf T1	34.5 / 4.8	Exceed Summer Normal Rating	existing	-	102% of SN	C32331	The recommended solution is to upgrade the existing Eden Center substation transformer.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Buffalo Station 139 Station Transformers T1 and T2	115/ 4.16	MWHr for loss of transformer	2013	-	240MW Hr	C36639	The recommended solution is to upgrade the existing Buffalo Station 139 transformers.
Buffalo Station 55 Transformers T1 and T2	115/ 4.16	MWHr for loss of transformer	2017	-	240MW Hr	C36644	The recommended solution is to upgrade the existing Buffalo Station 55 transformers.
Sub-Transmission and Distribution Olean Study Area							
Cuba Lake substation T1	34.5 / 4.8	Exceed Summer Normal Rating	existing	-	113% of SN	C36616	The recommended solution is to upgrade the existing Cuba Lake substation transformer.
Sub-Transmission and Distribution Wellsville Study Area							
None							

Forecasted Overloaded Distribution Feeder Map

The following map shows the Distribution feeders which are forecasted to be overloaded in the next 1-5, 6-10 and 11-15 year timeframe. The forecast overload is based on 100% of summer normal rating.



Proposed Generator Interconnections
In the Southwest area there are four wind farm generation projects that are proposing to interconnect to the transmission through the NYISO OATT Attachment X Large Facility Interconnection Procedures for Large Generator Interconnection Projects (greater than 20MW).

There is a proposed total of 381MW of renewable generation connecting to the Southwest Area 230kV and 115kV transmission system near Chautauqua & Cattaraugus, New York. The proposed wind farm projects include Allegany (Everpower) (79MW), Ball Hill (99MW), New Grange (79MW) and Ripley Westfield (124MW).

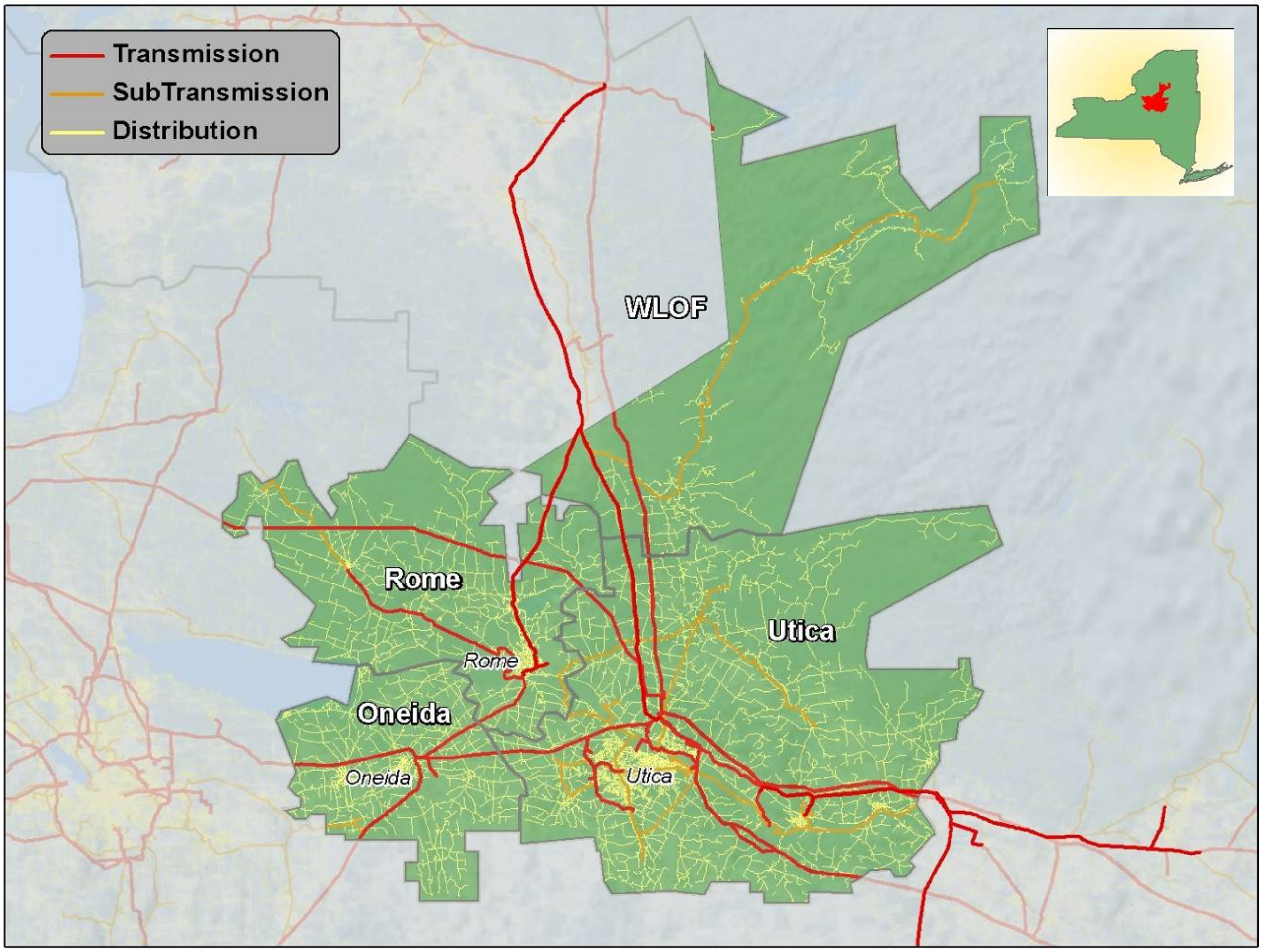
The projects listed below provide only for the interconnection to the National Grid system, and do not ensure that the full output of the generators can be accommodated at all times. National Grid's transmission plans do not provide for full deliverability of all generation unless appropriate funding is provided by the generators consistent with NYISO processes.

Table III-27

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation /Corrective Action
Dunkirk-Falconer #161	115	---	2014*	---	New Grange wind farm interconnection	CNYX65 CNYX65R CNYX66 CNYX66R	Loop in, loop out, RTU, metering, relay upgrades for New Grange 79MW wind farm, and reimbursable portion
Dunkirk-South Ripley #68	230	---	2015*	---	Ripley Westfield wind farm interconnection	CNYX77 CNYX77R CNYX81 CNYX81R	Loop in, loop out, RTU, metering, relay upgrades for Ripley Westfield 124MW wind farm, and reimbursable portion
Homer Hill – Dugan Rd #155	115	---	2016*	---	Allegany (Everpower) wind farm interconnection	CNYX78 CNYX78R CNYX79 CNYX79R	Line Tap and substation for Allegany (Everpower) 79MW wind farm, and reimbursable portion
Gardenville-Dunkirk #74	230		2016*		Ball Hill wind farm interconnection	CNYX74 CNYX74R CNYX75 CNYX75R	Loop in, loop out, RTU, metering, relay upgrades for Ball Hill 79MW wind farm, and reimbursable portion

*Note: The Need Year for a generator project is when the generator plans to be connected to the system and does not indicate that a system need exists.

III I. Utica Rome Transmission Planning Study Area



Area Summary

The drivers behind the transmission capacity related projects in this study area are:

- [redacted]
- Other issues found in this area are addressed by operational solutions.

The drivers behind the sub-transmission and distribution capacity related projects in this study area are:

- Load growth at the Rome Hospital has been a driver of distribution capacity work.

Area Description

The Utica-Rome transmission study area includes the 115kV and above transmission system with the northern boundaries at Boonville and Lighthouse Hill substations, west at Oneida, and east at Inghams substation.

Within the Utica Rome Study area, there are four Distribution study areas: Oneida, Rome, Utica and WLOF (Watertown, Lowville and Old Forge).

The Oneida study area serves approximately 21,200 customers. The study area includes the City of Oneida and the Village of Canastota. In the City of Oneida the Oneida Hospital has dual distribution supplies. Across the street from the hospital is the H.P.Hood Dairy Products Inc. facility which represents 4MVA of the load and also has dual distribution supplies. The Village of Canastota which is located in western section of the Oneida area has several large commercial and industrial customers including Canastota Industrial Park, Owl Wire and Cable, Inc and Die Molding Inc. A geographic constraint is the distance to other substations and the lack of feeder ties. There have been improvements to feeder ties between the Oneida and Peterboro substations. Developing these ties was challenging due to Interstate 90 which is located between the two substations.

The Rome area serves approximately 27,500 customers. There are thirty 4.8kV feeders and seventeen 13.2kV feeders in the study area. All distribution substations are supplied from the 115kV system. As a result there are no sub-transmission lines in the area.

The Utica study area serves approximately 91,100 customers. The study area includes the City of Utica. The distribution system consist of four 115-46kV, ten 115-13.2kV, four 46-13.2kV and seven 46- 5kV substations.

The WLOF study area serves approximately 81,300 customers. There are thirty-six 4.8kV feeders and thirty nine 13.2kV feeders. The distribution substations are primarily supplied from the 23kV and 46kV sub-transmission system with the exception of a few substations served by the 115kV system. The main sources to the 23kV sub-transmission system are Black River, Coffeen, Indian River, North Carthage and Taylorville substations. The main supply for the 46kV sub-transmission system is Boonville substation.

Chapter 4, Exhibit 2 contains the list of electrical transmission and sub-transmission lines and substations in this transmission study area.

Area Load Forecast

The Utica Rome Study Area load forecast is included in the East-North Central Region (NYISO Zone D & E) forecast. The summary of the load forecast thru 2020 is detailed in the tables below. For the last five years (2021 to 2026) in the Plan the growth rates are assumed the same as 2016 to 2020.

Table III-28

East-North Central Regions (NYISO Zone D&E) - SUMMER													
		SUMMER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	8	963		977		1,032		1,036		-	77.7	82.5	83.0
2002	8	930	-3.3%	881	-9.8%	936	-9.3%	940	-9.3%	83.5	77.7	82.5	83.0
2003	6	945	1.6%	971	10.2%	1,026	9.6%	1,030	9.6%	77.0	77.7	82.5	83.0
2004	7	837	-11.5%	853	-12.2%	908	-11.5%	912	-11.5%	78.5	77.7	82.5	83.0
2005	6	910	8.8%	886	3.9%	941	3.6%	945	3.6%	81.5	77.7	82.5	83.0
2006	8	919	1.0%	858	-3.2%	913	-3.0%	917	-3.0%	83.0	77.7	82.5	83.0
2007	6	903	-1.7%	904	5.4%	959	5.1%	963	5.0%	81.5	77.7	82.5	83.0
2008	7	904	0.1%	938	3.7%	993	3.5%	997	3.5%	77.0	77.7	82.5	83.0
2009	8	866	-4.2%	865	-7.8%	920	-7.4%	924	-7.3%	77.5	77.7	82.5	83.0
2010	7	939	8.4%	880	1.7%	935	1.6%	939	1.6%	82.0	77.7	82.5	83.0
2011		-		905	2.9%	960	2.7%	964	2.7%	-	77.7	82.5	83.0
2012		-		906	0.1%	961	0.1%	965	0.1%	-	77.7	82.5	83.0
2013		-		923	1.9%	978	1.8%	982	1.8%	-	77.7	82.5	83.0
2014		-		919	-0.4%	975	-0.4%	978	-0.4%	-	77.7	82.5	83.0
2015		-		911	-0.9%	967	-0.8%	970	-0.8%	-	77.7	82.5	83.0
2016		-		906	-0.6%	961	-0.5%	965	-0.5%	-	77.7	82.5	83.0
2017		-		907	0.0%	962	0.0%	966	0.0%	-	77.7	82.5	83.0
2018		-		907	0.1%	962	0.1%	966	0.1%	-	77.7	82.5	83.0
2019		-		908	0.1%	963	0.0%	967	0.0%	-	77.7	82.5	83.0
2020		-		908	0.0%	963	0.0%	967	0.0%	-	77.7	82.5	83.0

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.9%	-0.6%	-0.6%	-0.6%
Compound Avg. 5 yr ('04 to '08)	-0.9%	-0.7%	-0.7%	-0.7%
Compound Avg. 9 yr ('02 to '10)	-0.3%	-1.2%	-1.1%	-1.1%
Compound Avg. 5 yr ('06 to '10)	0.6%	-0.1%	-0.1%	-0.1%
Compound Avg. 5 yr ('11 to '15)		**0.7%**	**0.7%**	**0.7%**
Compound Avg. 5 yr ('16 to '20)		**-0.1%**	**-0.1%**	**-0.1%**
Compound Avg. 10 yr ('11 to '20)		**0.3%**	**0.3%**	**0.3%**

Table III-29

East-North Central Regions (NYISO Zone D&E) - WINTER													
		WINTER PEAKS (MWs)								TEMPs			
Year	Month	Actual		50/50		90/10		95/5		Actual	50/50	90/10	95/5
2001	1	944		960		981		984		19.0	8.0	(7.0)	(9.0)
2002	1	856	-9.3%	871	-9.3%	892	-9.1%	895	-9.0%	18.0	8.0	(7.0)	(9.0)
2003	1	850	-0.7%	835	-4.1%	857	-4.0%	860	-3.9%	(2.5)	8.0	(7.0)	(9.0)
2004	1	1,029	21.0%	1,004	20.3%	1,026	19.7%	1,029	19.7%	(9.0)	8.0	(7.0)	(9.0)
2005	12	927	-9.9%	917	-8.7%	939	-8.5%	942	-8.5%	1.0	8.0	(7.0)	(9.0)
2006	1	827	-10.8%	828	-9.7%	849	-9.5%	852	-9.5%	8.5	8.0	(7.0)	(9.0)
2007	12	905	9.4%	925	11.8%	947	11.5%	950	11.4%	22.0	8.0	(7.0)	(9.0)
2008	1	884	-2.3%	878	-5.1%	900	-5.0%	902	-5.0%	3.5	8.0	(7.0)	(9.0)
2009	1	854	-3.4%	841	-4.2%	863	-4.1%	866	-4.1%	(1.0)	8.0	(7.0)	(9.0)
2010	2	793	-7.1%	806	-4.2%	827	-4.1%	830	-4.1%	16.5	8.0	(7.0)	(9.0)
2011		-		843	4.6%	864	4.5%	867	4.5%	-	8.0	(7.0)	(9.0)
2012		-		850	0.9%	872	0.9%	875	0.9%	-	8.0	(7.0)	(9.0)
2013		-		858	0.9%	879	0.9%	882	0.8%	-	8.0	(7.0)	(9.0)
2014		-		852	-0.6%	874	-0.6%	877	-0.6%	-	8.0	(7.0)	(9.0)
2015		-		846	-0.7%	867	-0.7%	870	-0.7%	-	8.0	(7.0)	(9.0)
2016		-		843	-0.3%	865	-0.3%	868	-0.3%	-	8.0	(7.0)	(9.0)
2017		-		844	0.1%	866	0.1%	869	0.1%	-	8.0	(7.0)	(9.0)
2018		-		845	0.1%	867	0.1%	870	0.1%	-	8.0	(7.0)	(9.0)
2019		-		846	0.1%	867	0.1%	870	0.1%	-	8.0	(7.0)	(9.0)
2020		-		846	0.0%	868	0.0%	871	0.0%	-	8.0	(7.0)	(9.0)

	Actual	50/50	90/10	95/5
Compound Avg. 7 yr ('02 to '08)	-0.9%	-1.3%	-1.2%	-1.2%
Compound Avg. 5 yr ('04 to '08)	0.8%	1.0%	1.0%	1.0%
Compound Avg. 9 yr ('02 to '10)	-1.9%	-1.9%	-1.9%	-1.9%
Compound Avg. 5 yr ('06 to '10)	-3.1%	-2.6%	-2.5%	-2.5%
Compound Avg. 5 yr ('11 to '15)		**1.0%**	**0.9%**	**0.9%**
Compound Avg. 5 yr ('16 to '20)		**0.0%**	**0.0%**	**0.0%**
Compound Avg. 10 yr ('11 to '20)		**0.5%**	**0.5%**	**0.5%**

Capacity Issues

Forecasted Overloads

The following tables identify forecasted system capacity issues and potential solutions in this study area.

Table III-30

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
Transmission Utica Rome Study Area							
Inghams-Fairfield line #3	115	Double circuit (Porter-Rotterdam 230kV/Edic-Fraser C345kV)[14]	existing	2011	115.2% of LTE (135.2MVA)		STE rating for line #3 is 145MVA. All the overloads can be mitigated by reducing generation at Fairfield Wind. NERC and NPCC criteria stated the line loadings shall be within applicable emergency limits post-contingency. NERC TPL standards footnote a) indicated applicable ratings may include Emergency ratings applicable for short durations… TGP28 requires automatic action if loading exceeds STE but under LTE. This violation will be considered in the Inghams SPS modification study.
Lehigh bus	115	Open R10 at Oneida without fault	existing	2011	Voltage at 0.88pu		This will be addressed by the Rome Station Rebuild which is addressing both capacity and asset condition issue. It is projected to be completed by FY14/15. Until then Operators will monitor and shed

[14] Results in violation of NERC and NPCC criteria.

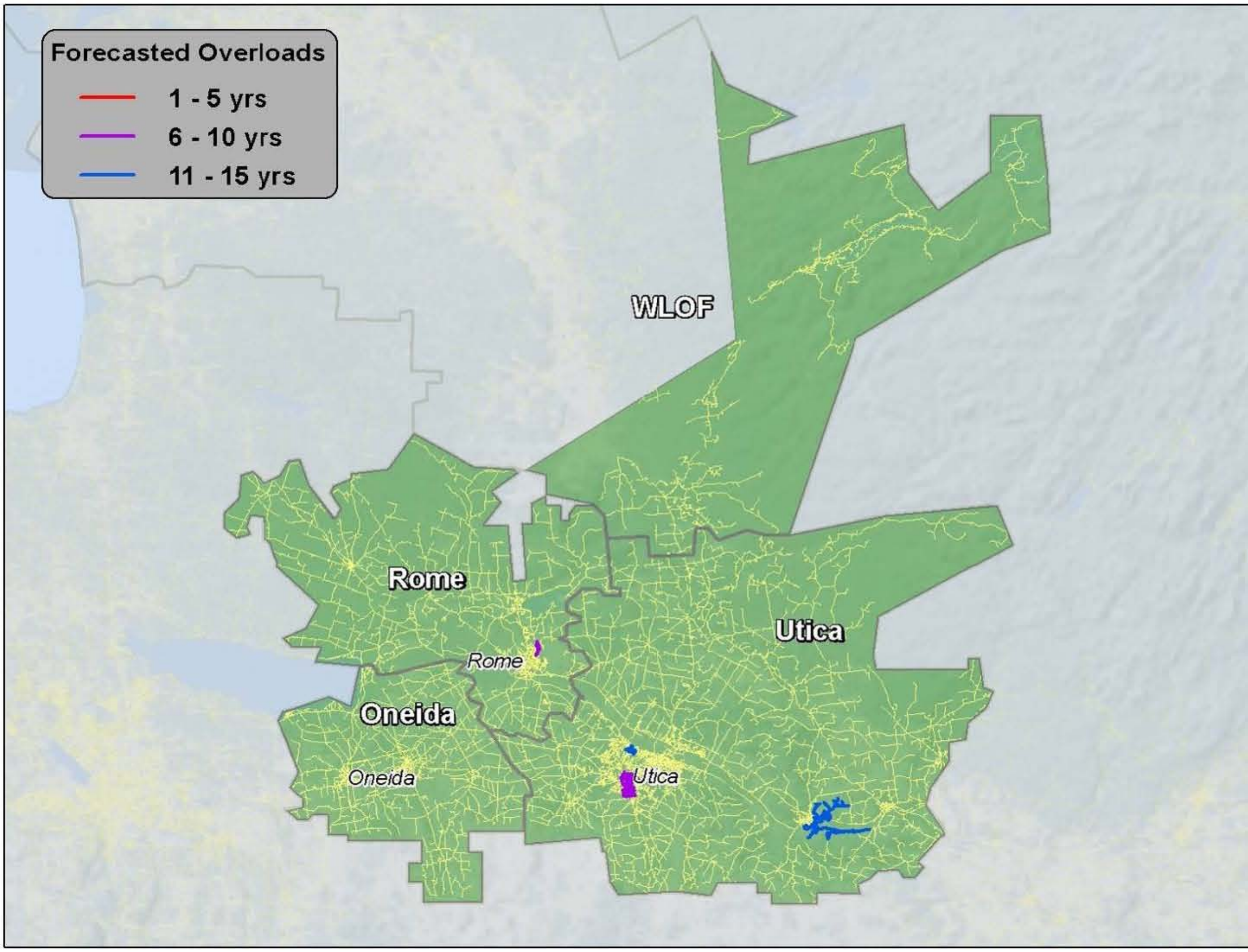
Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
							load, if necessary.
Camden Wire bus	115	Loss of line section from Rome-Turning Stone	existing	2011	Voltage at 0.88pu		This will be addressed by the Rome Station Rebuild project which is addressing both capacity and asset condition issue. It is projected to be completed by FY14/15. Until such time Operators will monitor and shed load, if conditions warrant.
Deerfield transformer; Schuyler transformer#1, #2, Yahnundasis Transformer #1	115-46	Loss of Porter-Yahnundasis #3 followed by loss of Oneida – Yahnundasis #7[15]	existing	2011	Worst Transf. overload 133% of LTE; voltages at 0.6pu		About 30MW total load at Yahnundasis, Chadwicks area will have to be dropped to restore the voltage to acceptable levels and relieve the overloads under this N-1-1 contingency event.
[redacted]	115	[redacted]	existing	2011	[redacted]		[redacted]
Inghams SPS, Inghams substation	115		existing	2011	Inghams SPS modification due to Fairfield Wind interconnection; PAR out of range under		Work is still ongoing to develop a solution. Solutions will be looked at from reliability point of view in conjunction with the Inghams station upgrade due to asset condition. Currently proposed

[15] Results in violation of NERC and NPCC criteria.
[16] Results in violation of NERC and NPCC criteria.

Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation / Corrective Action
					certain N-1 condition;		for 2019 to 2021.
Valley Transformer #1 115/46kV, Boonville – Griffiss #4	115	Loss of Boonville – Rome #3 followed by loss of Oneida – Rome #1	2025	2025	103.2% of LTE		This is an incremental impact from the BES bright line definition. Solution was not looked at.
Sub-Transmission and Distribution Oneida Study Area							
None							
Sub-Transmission and Distribution Rome Study Area							
Madison substation 65471 Feeder	4.8	N/A	2012	-	Customer Load Growth	C15910 C36851	Convert Rome Hospital load from Madison substation 65471 Feeder to Rome substation 76255 Feeder.
Sub-Transmission and Distribution Utica Study Area							
None							
Sub-Transmission and Distribution WLOF -MV Study Area							
South Philadelphia substation Transformer T1	23-4.8	Exceed Summer Normal Rating	2010	-	100% of SN	C24030	Upgrade the South Philadelphia substation Transformer.

Forecasted Overloaded Distribution Feeders

The following map shows the Distribution feeders which are forecasted to be overloaded in the next 1-5, 6-10 and 11-15 year timeframe. The forecast overload is based on 100% of summer normal rating.



Proposed Generator Interconnections
In the Utica Rome New York area there are two wind farm generation projects that are proposing to interconnect to the transmission through the NYISO OATT Attachment X Large Facility Interconnection Procedures for Large Generator Interconnection Projects (greater than 20MW).

There is a proposed total of 190MW of renewable generation connecting to the Utica Rome Area 230kV and 115kV transmission systems near Madison and Herkimer, New York. The proposed Jordanville (150MW) wind farm project is connecting to the Porter-Rotterdam #30 230kV line and West Hill (40MW) wind farm is connecting to Oneida-Fenner #8 115kV.

The projects listed below provide only for the interconnection to the National Grid system, and do not ensure that the full output of the generators can be accommodated at all times. National Grid's transmission plans do not provide for full deliverability of all generation unless appropriate funding is provided by the generators consistent with NYISO processes.

Table III-31

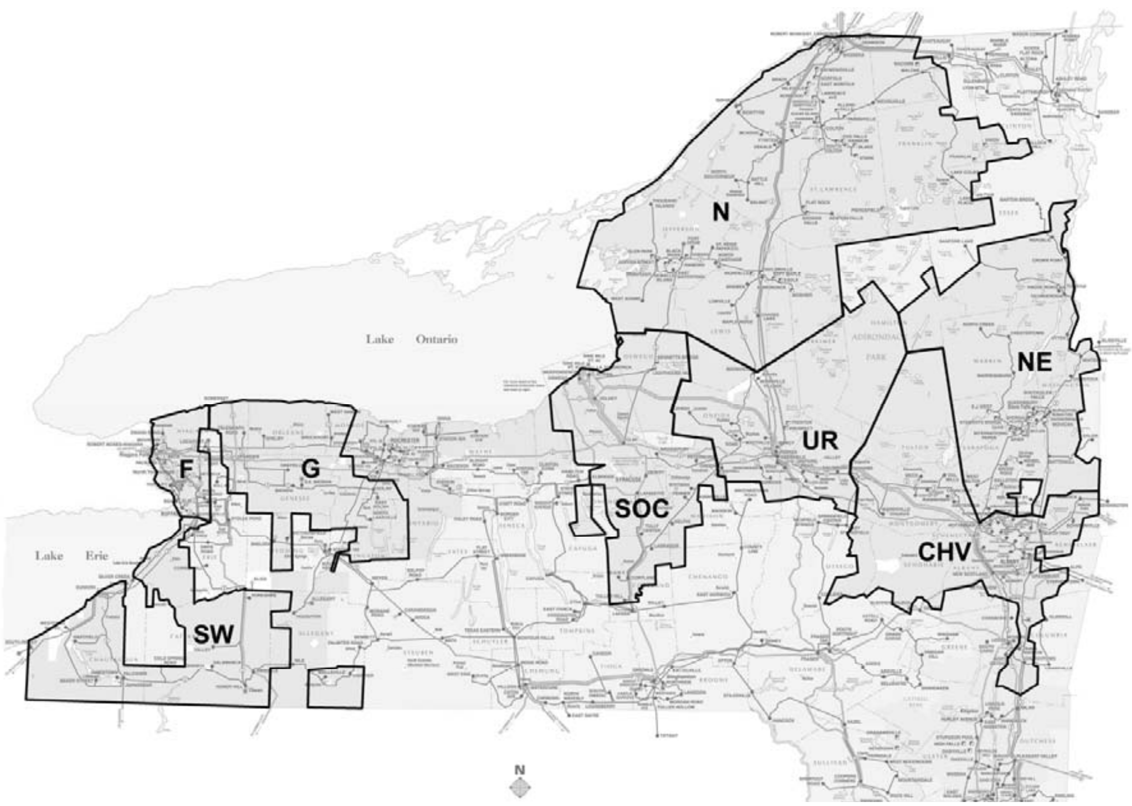
Impacted Asset	kV	Contingency	Need Year	Power Flow Case	Driving Issue	Project Number (s)	Comments / Mitigation /Corrective Action
Oneida-Fenner #8	115	---	2013*	---	West Hill wind farm interconnection	CNYX53 CNYX53R CNYX54 CNYX54R	Loop in, loop out, RTU, metering, relay upgrades for West Hill 40MW wind farm, and reimbursable portion
Porter-Rotterdam #30	230	---	2014*	---	Jordanville wind farm interconnection	CNYX49 CNYX49R CNYX50 CNYX50R	Loop in, loop out, RTU, metering and relay upgrades for Jordanville 150MW wind farm, and reimbursable portion

*Note: The Need Year for a generator project is when the generator plans to be connected to the system and does not indicate that a system need exists.

IV. Exhibits

The following contains the exhibits referenced in the Report.

Exhibit 1 - Transmission Planning Study Areas



National Grid Transmission Planning New York Study Areas					
West		Central		East	
F	Frontier	SOC	Syracuse/Oswego/Cortland	NE	Northeast
G	Genesee	N	Northern	CHV	Capital and Hudson Valley
SW	Southwest	UR	Utica/Rome		

Exhibit 2 - Electric Assets by Transmission Study Area

Capital and Hudson Valley Study Area

Electrical Facilities			
Substations			
Albany Steam	E. Schodack 447	Leeds 377	Rosa Rd. 137
Alps 417	East Springfield 477	Liberty St. 94	Rotterdam 138
Altamont 283	East Worcester 60	Long Lane 504	Russell Rd 228
Amsterdam 326	Elnora 344	Lynn St 320	Ruth Rd. 381
Athens	Elnora 442	Maplewood 307	Sand Creek Rd. 452
Avenue A 291	Elsmere 407	Market Hill 324	Schenevus 261
Ballston 12	Emmet 256	Marshville 299	Schodack 451
Bennington Paperboard	Ephratah 18	Mayfield 356	Schoharie 234
Bethlehem 21	Everett Rd. 420	McClellan St. 304	School St.
Blue Stores 303	Feura Bush 503	McKownville 327	Scotia 255
Boyntonville 333	Fire House Rd. 449	Mechanicville 971	Selkirk 149
Brunswick 264	Forts Ferry 459	MECO 318	Seminole 339
Buckley Corners 454	Front St. 360	Menands 101	Seventh Ave. 244
Burdeck St 265	Genesee St	Menands-Partridge St	Sharon 363
Campus 1	Gilmantown Rd 154	Middleburg 390	Shore Rd. 281
Campus 2	Gloversville 72	Nassau 113	St. Johnsville 335
Canajoharie 31	Grand St 433	New Scotland	Stoner 358
Caroga Lake 219	Greenbush 78	New Krumkill 421	Stuyvesant 35
Castleton 36	Grooms Rd. 345	Newark St. 300	Summit 347
Central Ave. 235	Guy Park 239	Newtonville 305	Swaggertown Rd. 364
Center St. 379	Hemstreet 328	North Troy #123	Sycaway 372
Charlton 222	Hill St. 311	Northville 332	Tibbets Ave. 292
Charley Lake 41	Hoag 221	Old Krumkill	Trinity Riser 404
Chrisler Ave. 257	Hoosick 314	Oathout 402	Trinity 164
Clay Hill 251	Hudson 87	Partridge St. 128	Unionville 276
Church St. 43	Inman Rd. 370	Patroon 323	Vail Mills 392
Clinton 366	Johnson Rd. 352	Pinebush 371	Valkin 427
Cobleskill 214	Johnstown 61	Prospect Hill 413	Voorheesville 178
Colvin Ave. 313	Juniper 446	Quail Hollow 457	Watt St. 230
Commerce Ave. 434	Karner 317	Randall Rd. 463	Weaver St. 245
Corliss Park 338	Krumkill 238	Rensselaer 132	West Milton
Curry Rd. 365	Lansingburg 93	Reynolds Rd. 334	Wells 208
Delanson 269	Latham 282	Rifle Range 458	Wolf Rd. 344
Delaware Ave. 330		River Rd. 444	Woodlawn 188
Delmar 279		Riverside 288	Worcester 189
Depot 425		Rock City Falls 404	

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage

T5000	Arsenal - Reynolds Road #31	main line	115
T5000-1 Tap	Arsenal - Reynolds Road #31	A-RR #31 - Rensselaer Waste Water tap	115
T5000-2 Tap	Arsenal - Reynolds Road #31	A-RR #31 - GE Healthcare tap	115
T5010	Albany - Greenbush #1	main line	115
T5020	Albany - Greenbush #2	main line	115
T5030	Alps - Berkshire #393	main line	345
T5040	Altamont - New Scotland #20	main line	115
T5040-1 Tap	Altamont - New Scotland #20	A-NS #20 - Voorheesville Tap	115
T5060	Battenkill - North Troy #10	main line	115
T5060-1 Tap	Battenkill - North Troy #10	B-NT #10 - Mulberry (NYSEG) Tap	115
T5070	Bethlehem - Albany #18	main line	115
T5080	LaFarge Building Materials - Pleasant Valley #8	main line	115
T5080-1 Tap	LaFarge Building Materials - Pleasant Valley #8	LBM-PV #8 - Buckley Corners	115
T5080-2 Tap	LaFarge Building Materials - Pleasant Valley #8	LBM-PV #8 - Blue Stores Tap	115
T5090	Churchtown - Pleasant Valley #13	main line	115
T5090-1 Tap	Churchtown - Pleasant Valley #13	C-PV #13 - Blue Stores Tap	115
T5110	Curry Road - Wolf Road #8	main line	115
T5110-1 Tap	Curry Road - Wolf Road #8	CR-WR #8 - Ruth Road Tap	115
T5110-2 Tap	Curry Road - Wolf Road #8	CR-WR #8 - Sand Creek Tap	115
T5120	Firehouse Road - North Troy #15	main line	115
T5120-1 Tap	Firehouse Road - North Troy #16	FR-NT #15 - GE Silicone Tap	115
T5120-2 Tap	Firehouse Road - North Troy #15	FR-NT #15 - Prospect Hill Tap	115
T5130	Front St. - Rosa Road #11	main line	115
T5140	G.E. R&D - Inman Road #20	main line	115
T5140-1 Tap	G.E. R&D - Inman Road #20	GERD-IR #20 - Elnora Tap	115
T5170	Schodack - Churchtown #14	main line	115
T5170-1 Tap	Schodack - Churchtown #14	S-C #14 - Valkin Tap	115
T5180	Greenbush - Hudson #15	main line	115
T5180-1 Tap	Greenbush - Hudson #15	G-H #15 - Trans Canada Tap	115
T5180-2 Tap	Greenbush - Hudson #15	G-H #15 - ValkinTap	115
T5190	Greenbush - Stephentown #993	main line	115
T5200	Grooms Road - Inman Road #15	main line	115
T5220	Hoosick - Bennington #6	main line	115

T5230	Hudson - Pleasant Valley #12	main line	115
T5230-1 Tap	Hudson - Pleasant Valley #12	H-PV #12 - Adm Milling Tap	115
T5280	Long Lane - LaFarge Building Materials #6	main line	115
T5290	Johnson Road- Maplewood #12	main line	115
T5300	Krumkill - Albany #7	main line	115
T5310	Leeds - Hurley Avenue #301	main line	345
T5320	Athens - Pleasant Valley #91	main line	345
T5330	Leeds - Pleasant Valley #92	main line	345
T5340	Maplewood - Arsenal #15	main line	115
T5350	Maplewood - Menands #19	main line	115
T5370	McKownville - Krumkill #8	main line	115
T5390	Meco - Rotterdam #10	main line	115
T5390-1 Tap	Meco - Rotterdam #10	M-R #10 - Center St. Tap	115
T5390-2 Tap	Meco - Rotterdam #10	M-R #10 - Church St. Tap	115
T5390-3 Tap	Meco - Rotterdam #10	M-R #10 - Amsterdam Tap	115
T5400	Menands - Reynolds Road #2	main line	115
T5400-1 Tap	Menands - Reynolds Road #2	M-RR#2 - GE Healthcare tap	115
T5410	Menands - Riverside #3	main line	115
T5410-1 Tap	Menands - Riverside #3	M-R #3 - Albany County Waste Tap	115
T5420	Milan - Pleasant Valley #10	main line	115
T5450	New Scotland - Alps #2	main line	345
T5460	New Scotland - Bethlehem #4	main line	115
T5470	New Scotland - Long Lane #7	main line	115
T5470-1 Tap	New Scotland - Long Lane #7	NS-LL#7 - Owens Corning Tap	115
T5470-2 Tap	New Scotland - Long Lane #7	NS-LL#7 - MG Industries Tap	115
T5470-3 Tap	New Scotland - Long Lane #7	NS-LL#7 - BOC GasTap	115
T5470-4 Tap	New Scotland - Long Lane #7	NS-LL#7 - GE Plastics Tap	115
T5480	New Scotland - Leeds #93	main line	345
T5490	New Scotland - Leeds #94	main line	345
T5500	New Scotland - Feura Bush #9	main line	115
T5500-1 Tap	New Scotland - Feura Bush #9	NS-FB #9 - Owens Corning Tap	115
T5500-2 Tap	New Scotland - Feura Bush #9	NS-FB #9 - MG Industries Tap	115
T5500-3 Tap	New Scotland - Feura Bush #9	NS-FB #9 - GE Plastics Tap	115
T5520	North Catskill - Milan #T7	main line	115

T5530	North Troy - Hoosick #5	main line	115
T5530-1 Tap	North Troy - Hoosick #5	NT-H #5 - Boyntonville Tap	115
T5540	North Troy - Reynolds Road #16	main line	115
T5540-1 Tap	North Troy - Reynolds Road #16	NT-RR #16 - Sycaway Tap	115
T5550	North Troy - Wynantskill #14	main line	115
T5550-1 Tap	North Troy - Wynantskill #14	NT-W #14 - Sycaway Tap	115
T5560	Reynolds Road - Alps #1	main line	345
T5570	Reynolds Road - Greenbush #9	main line	115
T5580	Riverside - Reynolds Road #4	main line	115
T5580-1 Tap	Riverside - Reynolds Road #4	R-R #4 - Greenbush Tap	115
T5590	Riverside - Trinity #18	main line	115
T5600	Riverside - Trinity #19	main line	115
T5610	Rosa Road - G.E.(R&D) #14	main line	115
T5620	Rotterdam - Altamont #17	main line	115
T5620-1 Tap	Rotterdam - Altamont #17	R-A #17 - Burdeck St. Tap	115
T5630	Rotterdam-Bear Swamp E205	main line	230
T5640	Rotterdam - Curry Road #11	main line	115
T5650	Rotterdam - Front St. #16	main line	115
T5660	Rotterdam - G.E. #14	main line	115
T5670	Rotterdam - G.E. #15	main line	115
T5680	Rotterdam - New Scotland #13	main line	115
T5690	Rotterdam - New Scotland #19	main line	115
T5690-1 Tap	Rotterdam - New Scotland #19	R-NS #19 - Burdeck St. Tap	115
T5690-2 Tap	Rotterdam - New Scotland #19	R-NS #19 - Voorheesville Tap	115
T5700	Rotterdam - Woodlawn #35	main line	115
T5700-1 Tap	Rotterdam - Woodlawn #35	R-W #35 - Pinebush Tap	115
T5750-7 Tap	Spier - Rotterdam #1	S-R #1 - Swaggertown Tap	115
T5760-6 Tap	Spier - Rotterdam #2	S-R #2 - Swaggertown Tap	115
T5790	State Campus - Menands #15	main line	115
T5790-1 Tap	State Campus - Menands #15	SC-M #15 - Patroon Tap	115
T5790-2 Tap	State Campus - Menands #15	SC-M #15 - Everett Tap	115
T5800	Stoner - Rotterdam #12	main line	115
T5800-1 Tap	Stoner - Rotterdam #12	S-R #12 - Vail Mills Tap	115
T5800-2 Tap	Stoner - Rotterdam #12	S-R #12 – Church St. Tap	115
T5800-3 Tap	Stoner - Rotterdam #12	S-R #12 - Amsterdam Tap	115

T5840	Trinity - Albany #5	main line	115
T5850	Trinity - Albany #9	main line	115
T5920	Woodlawn - State Campus #12	main line	115
T5920-1 Tap	Woodlawn - State Campus #12	W-SC #12 - Pinebush Tap	115
T5920-2 Tap	Woodlawn - State Campus #12	W-SC #12 - Ruth Road Tap	115
T5920-3 Tap	Woodlawn - State Campus #12	W-SC #12 - Sand Creek Tap	115
T5930	Wynantskill - Reynolds Road #13	main line	115
T5940	Feura Bush - North Catskill #2	main line	115
T5940-1 Tap	Feura Bush - North Catskill #2	FB-NC #2 - BOC GAS Tap	115
T5960	Coastal Technology - Greenbush #16	main line	115
T5980	New Scotland - Albany #8	main line	115
T5980-1 Tap	New Scotland - Albany #8	NS-A #8 - Air Products Tap	115
T5990	New Scotland - Feura Bush #3	main line	115
T6000	Reynolds Road - Feura Bush #17	main line	115
T6010	Wolf Road - Menands #10	main line	115
T6010-1 Tap	Wolf Road - Menands #10	WR-M #10 - Everett Tap	115
T6090	Greenbush - Schodack #13	main line	115
T6160	Leeds - Athens #95	main line	345
T6360	Grooms Road - Forts Ferry #13	main line	115
T6360-1 Tap	Grooms Road - Forts Ferry #13	GR-FF #13 - Fire House Tap	115
T6370	Forts Ferry - Johnson Rd #14	main line	115
T6380	CESTM - Patroon #6	main line	115
T6390	McKownville - CESTM #2	main line	115
T6490-1Tap	Luther Forest - North Troy #308	LT-NT #308 - Mullberry (NYSEG) Tap	115

The following lines have portions in both the Capital Hudson Valley and Utica Rome transmission study areas:

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T4070	Edic - New Scotland #14	main line	345
T4130	Marcy - New Scotland #18	main line	345
T4200	Porter-Rotterdam #30	main line	230
T4210	Porter-Rotterdam #31	main line	230

The following transmission line has portions in both the Capital Hudson Valley and Northeast transmission study areas:

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T5750	Spier - Rotterdam #1	main line	115
T5760	Spier - Rotterdam #2	main line	115
T6060R	Mohican - North Troy #3	main line	115
T6490	Luther Forest - North Troy #308	main line	115

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
10	Emmet	McCellan St	34.5
13	Emmet	Woodlawn	34.5
5	Karner	Patroon	34.5
5	Knolls	Vischer	34.5
1	Lynn St	Woodlawn	34.5
11	McCellan St	Bevis Hill	34.5
1	Rosa Rd	Knolls	34.5
2	Rosa Rd.	Bevis Hill	34.5
32	Rotterdam	Scotia	34.5
34	Rotterdam	Lynn St	34.5
36	Rotterdam	Weaver	34.5
6	Scotia	Rosa Rd.	34.5
3	Vischer	Woodlawn	34.5
9	Weaver St.	Emmet	34.5
14	Woodlawn	Karner	34.5
5	Cobleskill	Summit	69
6	Cobleskill	Schoharie	69
16	Marshville	Sharon	69
18	Rotterdam	Schoharie	69
3	Schenevus	Summit	23
17	Sharon	Cobleskill	69
3	Amsterdam	Schenectady International	69
7	Amsterdam	Ephratah	69
8	Canajoharie	Marshville	69
3	Gloversville	Hill St.	69
6	Gloversville	Canajoharie	69
4	Hill St.	Meco	69
8	Johnstown	Market Hill	69
11	Market Hill	Amsterdam	69
7	Mayfield	Meco	69
9	Mayfield	Vail Mills	69

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
12	Meco	Johnstown	69
8	Northville	Mayfield	69
4	Schenectady International	Rotterdam	69
2	Ephratah	Caroga	23
1	Northville	Wells	23
2	Wells	Gilmantown Rd.	23
7	Central Ave	Patroon	34.5
11	Latham	Newtonville	34.5
2	Maplewood	Liberty St	34.5
5	Maplewood	Norton	34.5
9	Maplewood	Latham	34.5
13	Maplewood	Liberty St	34.5
18	Maplewood	Menands	34.5
16	Newtonville	Patroon	34.5
3	Patroon	Krumkill	34.5
4	Patroon	Colvin Ave	34.5
5	Shore	Rosa	34.5
17	Crescent	School St	34.5
20	Crescent	North Troy	34.5
5	Greenbush	Castleton	34.5
6	Greenbush	Nassau	34.5
8	Greenbush	Snyders Lake	34.5
8	Hoosick	Clay Hill	34.5
4	Lansingburg	Seventh Ave	34.5
8	Liberty	Tibbits	34.5
5	Liberty	Seventh Ave	
9	Nassau	Hudson	34.5
1	North Troy	Lansingburg	34.5
2	North Troy	Tibbits	34.5
7	North Troy	Tibbits	
19	North Troy	School St	34.5
20	North Troy	Crescent	
10	Rensselaer	Greenbush	34.5
11	Rensselaer	Greenbush	34.5
2	Tibbits	North Troy	34.5
7	Tibbits	North Troy	34.5
8	Tibbits	Liberty St	34.5
10	RPI	Tibbits	34.5
5	Seventh Ave	Liberty	34.5
2	Altamont	Voorheesville	34.5
10	Bethlehem	Avenue A	34.5
13	Bethlehem	Rensselaer	34.5
5	Bethlehem	Selkirk	34.5

Sub-Transmission Lines			
Circuit ID	From	To	Voltage (kV)
1	Bethlehem	Voorheesville	34.5
2	Colvin Ave	Partridge St	34.5
9	Colvin Ave	Seminole	34.5
14	Delaware	Bethlehem	34.5
37	Delaware	South Mall	34.5
6	Delmar	Bethlehem	34.5
9	Krumkill	Delmar	34.5
8	Menands	Central Ave	34.5
32	Menands	Genesee	34.5
9	Menands	Liberty St	34.5
27	Menands	Riverside	34.5
36	Menands	South Mall	34.5
6	Newark	Maplewood	34.5
17	Norton	Menands	34.5
5	Partridge	Avenue A	34.5
9	Partridge	Riverside	34.5
39	Partridge	Riverside	34.5
16	Riverside	Albany Medical Center	34.5
36	Riverside	Albany Medical Center	34.5
10	Riverside	Dewitt Apts	34.5
35	Riverside	South Mall	34.5
38	Riverside	South Mall	34.5
8	Riverside	Times Union Center	34.5
14	Riverside	Times Union Center	34.5
8	School	Newark	34.5

Frontier Study Area

Electrical Facilities			
Substations			
Alameda Ave 124	Main Street	Buffalo St 161	Buffalo St 46
Amherst	Maple Road 140	Buffalo St 162	Buffalo St 47
Ayer Rd 211	Martin Road 139	Buffalo St 201	Buffalo St 48
Beech Ave 81	Military Road 210	Buffalo St 202	Buffalo St 49
Brompton Rd 129	Milpine 96	Buffalo St 203	Buffalo St 51
Buffalo Ave 215	Mountain	Buffalo St 204	Buffalo St 52
Burt 171	Mountain Switching Str	Buffalo St 208	Buffalo St 53
Col Ward Pump 50	New Gardenville	Buffalo St 21	Buffalo St 56
Dale Rd 213	New Walden	Buffalo St 22	Buffalo St 57
Delaware Rd 127	Newfane 170	Buffalo St 23	Buffalo St 59
Dupont 133	Niagara Falls Blvd 130	Buffalo St 24	Buffalo St 63
E Cambria 100	Oakwood Ave 138	Buffalo St 24a	Buffalo St 66
Eight Ave 80	Oakwood 232	Buffalo St 25	Buffalo St 67
Electric Ave 55	Old Gardenville	Buffalo St 26	Buffalo St 68
Eleventh St 82	Packard	Buffalo St 27	Buffalo St 74
Elm	Phillips Rd Switching St	Buffalo St 28	Buffalo St 77
Galleria Switching St	Park Club Lane 219	Buffalo St 29	Buffalo St 78
George Urban 154	Ransomville 89	Buffalo St 30	Buffalo St 79
Getzville 60	Ridge 142	Buffalo St 31	Buffalo St 157
Gibson 106	Roberts 155	Buffalo St 32	Stephenson Ave 84
Grand Island 64	South Newfane 71	Buffalo St 33	Summit Park 97
Harbor Front 212	Sanborn	Buffalo St 34	Swann Rd 105
Harlem Rd 58	Sawyer Ave	Buffalo St 35	Sweet Home Rd 224
Harper	Seneca Shops 207	Buffalo St 36	Tonawanda Creek 206
Huntley	Seneca Terminal 447	Buffalo St 37	Walck Rd
Huth Rd 61	Shawnee Rd 76	Buffalo St 38	Walmore Rd 217
Kenmore Terminal	Buffalo St 121	Buffalo St 39	Waterfront 205
Kensington Terminal	Buffalo St 122	Buffalo St 40	Welch Ave 83
Lewiston Hts 86	Buffalo St 126	Buffalo St 41	Wilson 93
Lewiston 87	Buffalo St 132	Buffalo St 42	Young Street 214
Lockport Rd 216	Buffalo St 146	Buffalo St 43	Youngman 1
Lockport	Buffalo St 157	Buffalo St 44	Youngstown 88
Long Rd 209	Buffalo St 160	Buffalo St 45	

The transmission lines located in the Frontier transmission study area are provided in the table below:

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T1010	Adams - Packard 187	main line	115
T1010-1 Tap	Adams - Packard #187	A-P #187 Niagara Falls Wastewater Tap	115
T1010-2 Tap	Adams - Packard #187	A-P #187 Carbo-Wash. Mills Tap	115
T1010-3 Tap	Adams - Packard #187	A-P #187 Occidental Chemical Tap	115
T1010-4 Tap	Adams - Packard #187	A-P #187 Great Lakes Carbon Tap	115
T1010-5 Tap	Adams - Packard #187	A-P #187 Pyron Tap	115
T1010-6 Tap	Adams - Packard #187	A-P #187 Dupont Tap	115
T1010-7 Tap	Adams - Packard #187	A-P #187 Buffalo Av. 215 Tap	115
T1020	Adams - Packard 188	main line	115
T1020-1 Tap	Adams - Packard #188	A-P #188 Niagara Falls Wastewater Tap	115
T1020-2 Tap	Adams - Packard #188	A-P #188 Carbo-Wash. Mills Tap	115
T1020-3 Tap	Adams - Packard #188	A-P #188 Occidental Chemical Tap	115
T1020-4 Tap	Adams - Packard #188	A-P #188 Great Lakes Carbon Tap	115
T1020-5 Tap	Adams - Packard #188	A-P #188 Pyron Tap	115
T1020-6 Tap	Adams - Packard #188	A-P #188 Dupont Tap	115
T1020-7 Tap	Adams - Packard #188	A-P #188 Buffalo Av. 215 Tap	115
T1030	Airco - Buffalo River 147	main line	115
T1030-1 Tap	Airco - Buffalo River #147	A-BR #147 Co-Steel Recycling Tap	115
T1060	Beck - Lockport 104	main line	115
T1060-1 Tap	Beck - Lockport #104	B-L #104 - Mountain Switch Struc. Tap	115
T1060-2 Tap	Beck - Lockport #104	B-L #104 - Swann Road 105 Tap	115
T1070	Beck-Packard 76	main line	230
T1120	DuPont - Packard #183	main line	115
T1120-1 Tap	DuPont - Packard #183	D-P #183 - Carbon Graphite Tap	115
T1120-2 Tap	DuPont - Packard #183	D-P #183 - Harper Tap	115
T1120-3 Tap	DuPont - Packard #183	D-P #183 - Olin (NYPA) Tap	115
T1130	DuPont - Packard #184	main line	115
T1130-1 Tap	DuPont - Packard #184	D-P #184 - Carbon Graphite Tap	115
T1130-2 Tap	DuPont - Packard #184	D-P #184 - CH Resources Co-Gen Tap	115
T1130-3 Tap	DuPont - Packard #184	D-P #184 - Harper Tap	115
T1130-4 Tap	DuPont - Packard #184	D-P #184 - Olin (NYPA) Tap	115
T1140	Elm Street-Gardenville #71	main line	230
T1150	Elm Street-Gardenville #72	main line	230
T1190	Gardenville - Bethlehem #149	main line	115
T1190-1 Tap	Gardenville - Bethlehem #149	G-B #149 Harbor Front 212 Tap	115
T1190-2 Tap	Gardenville - Bethlehem #149	G-B #149 Ford Tap	115
T1190-3 Tap	Gardenville - Bethlehem #149	G-B #149 Bethlehem SWS	115
T1200	Gardenville - Bethlehem #150	main line	115
T1200-1 Tap	Gardenville - Bethlehem #150	G-B #150 Bethlehem SWS	115
T1200-2 Tap	Gardenville - Bethlehem #150	G-B #150 Harbor Front 212 Tap	115
T1210	Gardenville - Buffalo River Switch	main line	115

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltag e**
	#145		
T1210-1 Tap	Gardenville - Buffalo River Switch #145	G-B #145 St Lawrence Cement Tap	115
T1210-3 Tap	Gardenville - Buffalo River Switch #145	G-B #145 Ridge Station 142 Tap	115
T1210-4 Tap	Gardenville - Buffalo River Switch #145	G-B #145 Great Lakes MDF	115
T1220	Gardenville - Buffalo River Switch #146	main line	115
T1220-1 Tap	Gardenville - Buffalo River Switch #146	G-B #146 Ridge Station 142 Tap	115
T1230	Gardenville - Depew #54	main line	115
T1230-1 Tap	Gardenville - Depew #54	G-D #54 - American Standard Tap	115
T1230-2 Tap	Gardenville - Depew #54	G-D #54 - Walden (NYSEG) Tap	115
T1230-3 Tap	Gardenville - Depew #54	G-D #54 - Walden Station 69 Tap	115
T1230-4 Tap	Gardenville - Depew #54	G-D #54 - Cooper Industries Tap	115
T1230-5 Tap	Gardenville - Depew #54	G-D #54 - Veridian (Calspan) Tap	115
T1230-6 Tap	Gardenville - Depew #54	G-D #54 - Buffalo Tungsten Tap	115
T1290	Gardenville - Seneca #81	main line	115
T1300	Gardenville - Seneca #82	main line	115
T1300-1 Tap	Gardenville - Seneca #82	G-S #82 Station 155 Tap	115
T1370	Huntley-Elm Street #70	main line	230
T1380	Huntley - Gardenville #38	main line	115
T1380-1 Tap	Huntley - Gardenville #38	H-G #38 Station 129 Tap	115
T1380-2 Tap	Huntley - Gardenville #38	H-G #38 Amherst Term Station Tap	115
T1380-3 Tap	Huntley - Gardenville #38	H-G #38 Maple Station 140 Tap	115
T1380-4 Tap	Huntley - Gardenville #38	H-G #38 Station 54 Tap	115
T1380-5 Tap	Huntley - Gardenville #38	H-G #38 Station 61 Tap	115
T1380-6 Tap	Huntley - Gardenville #38	H-G #38 Urban Station 154 Tap	115
T1380-7 Tap	Huntley - Gardenville #38	H-G #38 Walden Station Tap	115
T1380-8 Tap	Huntley - Gardenville #38	H-G #38 Dale Road Station 213 Tap	115
T1390	Huntley - Gardenville #39	main line	115
T1390-1 Tap	Huntley - Gardenville #39	H-G #39 FMC Tap	115
T1390-2 Tap	Huntley - Gardenville #39	H-G #39 Station 129 Tap	115
T1390-3 Tap	Huntley - Gardenville #39	H-G #39 Amherst Term Station Tap	115
T1390-4 Tap	Huntley - Gardenville #39	H-G #39 Maple Station 140 Tap	115
T1390-5 Tap	Huntley - Gardenville #39	H-G #39 Station 54 Tap	115
T1390-6 Tap	Huntley - Gardenville #39	H-G #39 Station 61 Tap	115
T1390-7 Tap	Huntley - Gardenville #39	H-G #39 Urban Station 154 Tap	115
T1390-8 Tap	Huntley - Gardenville #39	H-G #39 Dale Road Station 213 Tap	115
T1400	Huntley-Gardenville #79	main line	230
T1400-1 Tap	Huntley-Gardenville #79	H-G #79 Amherst Station SUNY Tap	230
T1400-2 Tap	Huntley-Gardenville #79	H-G #79 Sawyer Avenue Tap	230
T1410	Huntley-Gardenville #80	main line	230
T1410-1 Tap	Huntley-Gardenville #80	H-G #80 Amherst Station SUNY Tap	230
T1410-2 Tap	Huntley-Gardenville #80	H-G #80 Sawyer Avenue Tap	230
T1420	Huntley - Praxair #46	main line	115

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T1420-1 Tap	Huntley - Praxair #46	H-L#46 - FMC Tap	115
T1420-2 Tap	Huntley - Praxair #46	H-L#46 - Dunlop Tire Tap	115
T1420-3 Tap	Huntley - Praxair #46	H-L#46 - Dupont Tap	115
T1420-4 Tap	Huntley - Praxair #46	H-L#46 - Chevy Tap	115
T1420-5 Tap	Huntley - Praxair #46	H-L#46 - Kenmore Term Station Tap	115
T1420-6 Tap	Huntley - Praxair #46	H-L#46 – American Brass Tap	115
T1420-7 Tap	Huntley - Praxair #46	H-L#46 - Encogen Tap	115
T1420-8 Tap	Huntley - Praxair #46	H-L#46 - CNP Station 18 Tap	115
T1420-9 Tap	Huntley - Praxair #46	H-L#46 - Buffalo Sewer Auth. Tap	115
T1430	Huntley - Praxair #47	main line	115
T1430-1 Tap	Huntley - Praxair #47	H-L#47 - Dunlop Tire Tap	115
T1430-2 Tap	Huntley - Praxair #47	H-L#47 - Dupont Tap	115
T1430-3 Tap	Huntley - Praxair #47	H-L#47 - Chevy Tap	115
T1430-4 Tap	Huntley - Praxair #47	H-L#47 - Kenmore Term Station Tap	115
T1430-5 Tap	Huntley - Praxair #47	H-L#47 – American Brass Tap	115
T1430-6 Tap	Huntley - Praxair #47	H-L#47 - Encogen Tap	115
T1430-7 Tap	Huntley - Praxair #47	H-L#47 - Buffalo Sewer Auth. Tap	115
T1440-1 Tap	Huntley - Lockport #36	H-L #36 - Station 138 Tap	115
T1440-2 Tap	Huntley - Lockport #36	H-L #36 - Station 206 Tap	115
T1440-3 Tap	Huntley - Lockport #36	H-L #36 - Ayer Rd Station 211 Tap	115
T1440-4 Tap	Huntley - Lockport #36	H-L #36 - Young Station 214 Tap	115
T1440-5 Tap	Huntley - Lockport #36	H-L #36 - Sweethome Station 224 Tap	115
T1450-1 Tap	Huntley - Lockport #37	H-L #37 - Station 138 Tap	115
T1450-2 Tap	Huntley - Lockport #37	H-L #37 - Station 206 Tap	115
T1450-3 Tap	Huntley - Lockport #37	H-L #37 - Ayer Rd Station 211 Tap	115
T1450-4 Tap	Huntley - Lockport #37	H-L #37 - Sweethome Station 224 Tap	115
T1470	Kensington - Gardenville #44	main line	115
T1470-1 Tap	Kensington - Gardenville #44	K-G #44 American Axle Tap	115
T1480	Kensington - Gardenville #45	main line	115
T1480-1 Tap	Kensington - Gardenville #45	K-G #45 American Axle Tap	115
T1620-1 Tap	Mountain - Lockport #103	M-L #103 Swann Road 105 Tap	115
T1620-2 Tap	Mountain - Lockport #103	M-L #103 Shawnee Station 76 Tap	115
T1630	Mountain - Niagara #120	main line	115
T1640	Mountain - Niagara #121	main line	115
T1650	Mountain - Niagara #122	main line	115
T1660	Niagara - Gardenville #180	main line	115
T1660-1 Tap	Niagara - Gardenville #180	N-G #180 - Long Road Station 209 Tap	115
T1670	Niagara - Gibson #197	main line	115
T1670-1 Tap	Niagara - Gibson #197	N-G #197 - Ferro Electronics Tap	115
T1670-2 Tap	Niagara - Gibson #197	N-G #197 - Global Metals Tap	115
T1670-3 Tap	Niagara - Gibson #197	N-G #197 - UCAR Carbon Tap	115
T1670-4 Tap	Niagara - Gibson #197	N-G #197 - Lockport Road 216 Tap	115
T1680	Niagara - Gibson #198	main line	115
T1680-1 Tap	Niagara - Gibson #198	N-G #198 - Ferro Electronics Tap	115
T1680-2 Tap	Niagara - Gibson #198	N-G #198 - Global Metals Tap	115
T1680-3 Tap	Niagara - Gibson #198	N-G #198 - UCAR Carbon Tap	115

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T1680-4 Tap	Niagara - Gibson #198	N-G #198 - Lockport Road 216 Tap	115
T1690-1 Tap	Niagara - Lockport #101	N-L #101Sanborn Station Tap	115
T1700-1 Tap	Niagara - Lockport #102	N-L #102 Sanborn Station Tap	115
T1700-2 Tap	Niagara - Lockport #102	N-L #102 Shawnee Station 76 Tap	115
T1710	Niagara-Packard #61	main line	230
T1720	Niagara-Packard #62	main line	230
T1730	Niagara - Packard #191	main line	115
T1740	Niagara - Packard #192	main line	115
T1750	Niagara - Packard #193	main line	115
T1760	Niagara - Packard #194	main line	115
T1770	Niagara - Packard #195	main line	115
T1780	Packard - Gardenville #182	main line	115
T1780-1 Tap	Packard - Gardenville #182	P-G #182 - Long Road 209 Tap	115
T1780-2 Tap	Packard - Gardenville #182	P-G #182 - Niagara Falls Blvd. Station 130 Tap	115
T1780-3 Tap	Packard - Gardenville #182	P-G #182 - ECWA RF Ball Pump Tap	115
T1780-4 Tap	Packard - Gardenville #182	P-G #182 - Youngmann Term Tap	115
T1780-5 Tap	Packard - Gardenville #182	P-G #182 - Park Club Lane 219Tap	115
T1780-6 Tap	Packard - Gardenville #182	P-G #182 - Walden Sun Tap	115
T1780-7 Tap	Packard - Gardenville #182	P-G #182 - American Standard Tap	115
T1790	Packard-Huntley #77	main line	230
T1800	Packard-Huntley #78	main line	230
T1810	Packard - Walck Road #129	main line	115
T1810-1 Tap	Packard - Walck Road #129	P-W #129 - Military Rd. Sta. 210 Tap	115
T1810-2 Tap	Packard - Walck Road #129	P-W #129 - Milpine Sta. 96 Tap	115
T1810-3 Tap	Packard - Walck Road #129	P-W #129 - Summit Park Sta. 97 Tap	115
T1810-4 Tap	Packard - Walck Road #129	P-W #129 - Bergholtz Switch Str. Tap	115
T1820	Packard - Huntley #130	main line	115
T1820-1 Tap	Packard - Huntley #130	P-H #130 - Military R. Sta. 210 Tap	115
T1820-2 Tap	Packard - Huntley #130	P-H #130 - Milpine Sta. 96 Tap	115
T1820-3 Tap	Packard - Huntley #130	P-H #130 - Summit Park Sta. 97 Tap	115
T1820-4 Tap	Packard - Huntley #130	P-H #130 - Bergholtz Switch Str. Tap	115
T1820-5 Tap	Packard - Huntley #130	P-H #130 - Sta. 78 Tap	115
T1830	Packard - Union Carbide Met. (Linde) #185	main line	115
T1830-1 Tap	Packard - Union Carbide Met. (Linde) #185	P-U #185 - Cascades NF Inc Tap	115
T1830-2 Tap	Packard - Union Carbide Met. (Linde) #185	P-U #185 - American Refuel Tap	115
T1830-3 Tap	Packard - Union Carbide Met. (Linde) #185	P-U #185 - Occidental Chemical Tap	115
T1840	Packard - Union Carbide Met. (Linde) #186	main line	115
T1840-1 Tap	Packard - Union Carbide Met. (Linde) #186	P-U #186 - Cascades NF Inc Tap	115
T1840-2 Tap	Packard - Union Carbide Met. (Linde) #186	P-U #186 - American Refuel Tap	115

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltag e
T1840-3 Tap	Packard - Union Carbide Met. (Linde) #186	P-U #186 - Occidental Chemical Tap	115
T1850	Packard - Urban(Erie St.) #181	main line	115
T1850-1 Tap	Packard - Urban(Erie St.) #181	P-U #181 - Niagara Falls Blvd Station 130 Tap	115
T1850-2 Tap	Packard - Urban(Erie St.) #181	P-U #181 - ECWA RF Ball Pump Tap	115
T1850-3 Tap	Packard - Urban(Erie St.) #181	P-U #181 - Youngman Term Tap	115
T6020	Walck Road - Huntley #133	main line	115
T6020-1 Tap	Walck Road - Huntley #133	W-H #133 Youngs Station 214 Tap	115
T6020-2 Tap	Walck Road - Huntley #133	W-H #133 Station 78 Tap	115
T6260	Bell Aero - Bergholtz #99	main line	115
T6260-1 Tap	Bell Aero - Bergholtz #99	B-B #99 Carborundum Tap	115
T6260-2 Tap	Bell Aero - Bergholtz #99	B-B #99 Walmore Rd Tap	115
TNYSEG-1 Tap	Urban-Erie 922 (NYSEG)	U-E 922(NYSEG) - Veridian Tap	115

The following transmission lines have portions in both the Frontier and Genesee transmission study areas:

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T1440	Huntley - Lockport #36	main line	115
T1450	Huntley - Lockport #37	main line	115
T1620	Mountain - Lockport #103	main line	115
T1690	Niagara - Lockport #101	main line	115
T1700	Niagara - Lockport #102	main line	115

The following transmission lines have portions in both the Frontier and Southwestern transmission study areas:

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T1240	Gardenville-Dunkirk #73	main line	230
T1250	Gardenville-Dunkirk #74	main line	230
T1260	Gardenville - Dunkirk #141	main line	115
T1270	Gardenville - Dunkirk #142	main line	115
T1280	Gardenville - Homer Hill #152	main line	115
T1950	Gardenville - Homer Hill #151	main line	115

The sub-transmission lines located in the Frontier transmission study area are provided in the table below:

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
605	Youngmann Terminal	Buffalo Station 58 Tap	34.5
605	Buffalo Station 58 Tap	Buffalo Station 124	34.5
605	Buffalo Station 58 Tap	Buffalo Station 58	34.5
606	Youngmann Terminal	Buffalo Station 58 Tap	34.5
606	Buffalo Station 58 Tap	Buffalo Station 124	34.5
606	Buffalo Station 58 Tap	Buffalo Station 58	34.5
701	Aero Commerce Park	Buffalo Station 67	34.5
701	Walden	Amherst	34.5
702	Walden	Ledyard Sw. Struct.	34.5
703	Walden	Galleria	34.5
1-E	Elm Station	Emerg. Hosp	23
2-E	Elm Station	Dunn Tire Park	23
3-E	Elm Station	--------	23
4-E	Elm Station	Station 48	23
5-E	Elm Station	Station 38	23
6-E	Elm Station	Station 38	23
7-E	Elm Station	Station 41	23
8-E	Elm Station	Station 41	23
9-E	Elm Station	Station 41	23
10-E	Elm Station	Dunn Tire Park	23
16-E	Elm Station	Station 34	23
17-E	Elm Station	Station 34	23
18-E	Elm Station	Station 34	23
23-E	Elm Station	Station 38	23
27-E	Elm Station	Station 34	23
35-E	Elm Station	Station 41	23
1-K	Kensington Station	Station 68	23
2-K	Kensington Station	Station 68	23
3-K	Kensington Station	Station 68	23
4-K	Kensington Station	Station 68	23
5-K	Kensington Station	SUNY Buffalo	23
6-K	Kensington Station	SUNY Buffalo	23
7-K	Kensington Station	Clearing Niagara	23
8-K	Kensington Station	Meyer Memorial Hosp	23
9-K	Kensington Station	Station 32	23
9-K	Station 32	Station 157	23
10-K	Kensington Station	Station 26	23
11-K	Kensington Station	Station 26	23
12-K	Kensington Station	Station 26	23
13-K	Kensington Station	Station 32	23

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
13-K	Station 32	Station 28	23
14-K	Kensington Station	Station 26	23
15-K	Kensington Station	Station 26	23
21-K	Kensington Station	Station 22	23
22-K	Kensington Station	Station 22	23
23-K	Kensington Station	Station 22	23
33-K	Kensington Station	Station 22	23
401	Youngstown 88	Lewiston 87	34.5
401	Lewiston 87	Mountain	34.5
402	Ransomville 89	Wilson 93	34.5
402	Wilson 93	Burt 171	34.5
402	Burt 171	Phillips Rd	34.5
403	Youngstown 88	Model City Landfill Tap	34.5
403	Model City Landfill Tap	Ransomville 89	34.5
403	Ransomville 89	Sanborn	34.5
404	Mountain	Lewiston Heights 86	34.5
404	Lewiston Heights	Niagara Stone Tap	34.5
404	Niagara Stone Tap	Graph Tap	34.5
404	Graph Tap	Graph	34.5
404	Graph Tap	Sanborn	34.5
405	Lewiston Heights	Mountain	34.5
52	Harper	Welch Ave 83	12.0
53	Harper	Welch Ave 83	12.0
54	Harper	Welch Ave 83	12.0
55	Harper	Welch Ave 83	12.0
60	Harper	Eighth Street 80	12.0
61	Harper	Eighth Street 80	12.0
62	Harper	Welch Ave 83	12.0
63	Harper	Welch Ave 83	12.0
65	Harper	Eighth Street 80	12.0
653	Harper	Stephenson Ave 85	12.0
654	Harper	Stephenson Ave 85	12.0
655	Harper	Stephenson Ave 85	12.0
71	Gibson	P24	12.0
71	P24	P31	12.0
71	P31	General Abrasive	12.0
71	P31	Titanium	12.0
73	Gibson	Globar	12.0
73	Globar	Beech Street 81	12.0
1-H	Sawyer	Station 22	23
2-H	Sawyer	Station 22	23
3-H	Sawyer	Station 22	23
4-H	Sawyer	Station 201	23

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
5-H	Sawyer	Station 201	23
6-H	Sawyer	Station 37	23
7-H	Sawyer	Station 48A	23
8-H	Sawyer	Station 48A	23
9-H	Sawyer	Station 33	23
10-H	Sawyer	Station 26	23
11-H	Sawyer	Station 26	23
12-H	Sawyer	Station 26	23
13-H	Sawyer	Station 22	23
14-H	Sawyer	Station 26	23
15-H	Sawyer	Station 26	23
16-H	Sawyer	Station 160	23
17-H	Sawyer	Station 160	23
18-H	Sawyer	Station 160	23
19-H	Sawyer	Station 37	23
20-H	Sawyer	Station 33	23
21-H	Sawyer	TOPS	23
22-H	Sawyer	Station 48A	23
26-H	Sawyer	Station 56	23
26-H	Station 56	Kenmore Mercy Hosp	23
27-H	Sawyer	Station 161	23
28-H	Sawyer	Station 56	23
28-H	Station 56	Kenmore Mercy Hosp	23
29-H	Sawyer	Station 48	23
33-H	Sawyer	Station 126	23
34-H	Sawyer	Station 126	23
35-H	Sawyer	Station 33	23
35-H	Station 33	Station 204	23
36-H	Sawyer	Switch 578	23
1-S	Seneca Station	Station 46	23
2-S	Seneca Station	Station 46	23
3-S	Seneca Station	Station 46	23
19-S	Seneca Station	OLV Hosp.	23
31-S	Seneca Station	Station 46	23
31-S	Station 46	OLV Hosp.	23
4-S	Seneca Station	Station 48	23
5-S	Seneca Station	Station 48	23
6-S	Seneca Station	Station 38	23
23-S	Seneca Station	Station 38	23
7-S	Seneca Station	Station 42	23
8-S	Seneca Station	Station 42	23
9-S	Seneca Station	Station 42	23
13-S	Seneca Station	Buffalo Color	23

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
14-S	Seneca Station	Buffalo Color	23
30-S	Seneca Station	Station 41	23
32-S	Seneca Station	Scrap Property	23
33-S	Seneca Station	Scrap Property	23
10-S	Kensington Station	Seneca Station	23
11-S	Kensington Station	Seneca Station	23
12-S	Kensington Station	Seneca Station	23
15-S	Kensington Station	Seneca Station	23
16-S	Seneca Station	Station 34	23
17-S	Seneca Station	Station 34	23
18-S	Seneca Station	Station 34	23
27-S	Seneca Station	Station 34	23
601	Buffalo Station 78	Buffalo Station 77 Tap	23
601	Buffalo Station 78	Buffalo Station 77 Tap	23
601	Buffalo Station 77 Tap	Buffalo Station 77	23
601	Buffalo Station 77 Tap	Buffalo Station 74 Tap	23
601	Buffalo Station 74 Tap	Buffalo Station 74	23
601	Buffalo Station 74 Tap	Buffalo Station 57	23
601	Buffalo Station 57	Buffalo Station 127 Tap	23
601	Buffalo Station 127 Tap	Buffalo Station 127	23
601	Buffalo Station 127 Tap	Buffalo Station 63	23
602	Buffalo Station 78	Buffalo Station 77 Tap	23
602	Buffalo Station 78	Buffalo Station 77 Tap	23
602	Buffalo Station 77 Tap	Buffalo Station 77	23
602	Buffalo Station 77 Tap	Buffalo Station 74 Tap	23
602	Buffalo Station 74 Tap	Buffalo Station 74	23
602	Buffalo Station 74 Tap	Buffalo Station 57	23
602	Buffalo Station 57	Buffalo Station 127 Tap	23
602	Buffalo Station 127 Tap	Buffalo Station 127	23
602	Buffalo Station 127 Tap	Buffalo Station 63	23
603	Buffalo Station 78	Buffalo Station 77 Tap	23
603	Buffalo Station 78	Buffalo Station 77 Tap	23
603	Buffalo Station 77 Tap	Buffalo Station 77	23
603	Buffalo Station 77 Tap	Buffalo Station 74 Tap	23
603	Buffalo Station 74 Tap	Buffalo Station 74	23
603	Buffalo Station 74 Tap	Buffalo Station 57	23
603	Buffalo Station 57	Buffalo Station 127 Tap	23
603	Buffalo Station 127 Tap	Buffalo Station 127	23
603	Buffalo Station 127 Tap	Buffalo Station 63	23
604	Buffalo Station 77 Tap	Buffalo Station 77	23
604	Buffalo Station 77 Tap	COLORFORMS Inc.	23
622	Buffalo Station 78	Buffalo Station 122 Tap	23
622	Buffalo Station 122 Tap	Buffalo Station 79	23

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
622	Buffalo Station 122 Tap	Buffalo Station 122	23
623	Buffalo Station 78	Buffalo Station 122 Tap	23
623	Buffalo Station 122 Tap	Buffalo Station 79	23
623	Buffalo Station 122 Tap	Buffalo Station 122	23
624	Buffalo Station 78	Waste Water Tap	23
624	Waste Water Tap	Buffalo Station 79	23
624	Waste Water Tap	Waste Water	23

Genesee Study Area

Electrical Facilities			
Substations			
Albion 80	E. Golah 51	Livonia 37	Sheppard 29
Attica 12	E. Newstead 6	Lyndonville 95	Soursprings Switch
Avon 43	Eagle Harbor 92	Medina	South Newfane #71
Barker 78	Elba 20	Middleport 77	Southland 84
Basom 15	Gasport 90	Mortimer	Station 197
Batavia 01	Geneseo 55	Mumford 50	Telegraph Road
Brockport 74	Golah	N. Akron	University #81
Burt #171	Groveland 41	N. Leroy 04	Waterport 73
Butts Road 72	Hemlock 38	Newfane 170	West Albion 79
Byron 18	Industry 47	North Lakeville	West Hamlin 82
Caledonia 44	Iroquois Rock	Oakfield 03	Wethersfield 23
Canawagus	Knapp Rd. 226	Orangeville 19	Willow Specialties 24
Conesus 52	Lakeville 40	Richmond 32	York Center 53
Corfu 22	Lapp 26	Royalton 98	
Darien 16	Lima 36	Rush 34	
Dolomite 9	Linden 21	SE Batavia	
E. Batavia 28	Livingston 130	Shelby 76	

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T1000	Brunner - Sour Springs 118	main line	115
T1000-1 Tap	Brunner - Sour Springs #118	B-SS #118 - Shelby Tap	115
T1040	Alabama - Telegraph 115	main line	115
T1050	Batavia - Southeast Batavia 117	main line	115
T1050-1 Tap	Batavia - Southeast Batavia #117	B-SEB #117 Oatka Dairy Tap	115

T1320	Golah - North Lakeville #116	main line	115
T1320-1 Tap	Golah - North Lakeville #116	G-NL #116 - E. Golah Tap	115
T1320-2 Tap	Golah - North Lakeville #116	G-NL #116 - Kraft Foods Tap	115
T1490	Lockport - Batavia #107	main line	115
T1490-1 Tap	Lockport - Batavia #107	L-B #107 - Alabama Switch Struc. Tap	115
T1490-2 Tap	Lockport - Batavia #107	L-B #107 - Akron Village Tap	115
T1490-3 Tap	Lockport - Batavia #107	L-B #107 - East Batavia Tap	115
T1500	Lockport - Batavia #108	main line	115
T1500-1 Tap	Lockport - Batavia #108	L-B #108 - North Akron Tap	115
T1510	Lockport - Batavia #112	main line	115
T1510-1 Tap	Lockport - Batavia #112	L-B #112 - Oakfield Tap	115
T1520	Lockport - Hinman #100	main line	115
T1530	Lockport - Mortimer #111	main line	115
T1530-1 Tap	Lockport - Mortimer #111	L-M #111 - Alabama Switch Tap	115
T1530-2 Tap	Lockport - Mortimer #111	L-M #111 - Sour Springs Switch Tap	115
T1530-3 Tap	Lockport - Mortimer #111	L-M #111 - University Sta. 81 Tap	115
T1530-4 Tap	Lockport - Mortimer #111	L-M #111 - Brockport Tap	115
T1530-5 Tap	Lockport - Mortimer #111	L-M #111 - West Hamlin Tap	115
T1540	Lockport - Mortimer #113	main line	115
T1540-1 Tap	Lockport - Mortimer #113	L-M #113 - Sour Springs Switch Tap	115
T1540-2 Tap	Lockport - Mortimer #113	L-M #113 - University Sta. 81 Tap	115
T1540-3 Tap	Lockport - Mortimer #113	L-M #113 - Brockport Tap	115
T1540-4 Tap	Lockport - Mortimer #113	L-M #113 - West Hamlin Tap	115
T1550	Lockport - Mortimer #114	main line	115
T1550-1 Tap	Lockport - Mortimer #114	L-M #114 - Sheldon/ Telegraph Road Tap	115
T1550-2 Tap	Lockport - Mortimer #114	L-M #114 - Sour Springs Switch Tap	115
T1560	Mortimer - Hook Road #1	main line	115

T1560-1 Tap	Mortimer - Hook Road #2	M-HR #1 - Lawler Tap (NYPA)	115
T1560-2 Tap	Mortimer - Hook Road #3	M-HR #1 - Hogan Road Tap (NYPA)	115
T1570-1 Tap	Mortimer - Elbridge #2	M-E #2 - Lawler Tap (NYPA)	115
T1570-2 Tap	Mortimer - Elbridge #2	M-E #2 - Hogan Road Tap (NYPA)	115
T1580	Mortimer - Golah #110	main line	115
T1590	Mortimer - Pannell Road #24	main line	115
T1590-1 Tap	Mortimer - Pannell Road #24	M-P #24 - Pittsford Tap	115
T1600	Mortimer - Pannell Road #25	main line	115
T1600-1 Tap	Mortimer - Pannell Road #25	M-P #25 - Pittsford Tap	115
T1610	Mortimer(Sta.82) - Quaker(Sta.121) #23	main line	115
T1610-1 Tap	Mortimer(Sta.82) - Quaker(Sta.121) #23	M-Q #23 - Pittsford Tap	115
T1860	Pannell(Sta.122) -Geneva(Border City) #4	main line	115
T1860-1 Tap	Pannell(Sta.122) -Geneva(Border City) #4	P-G #4 - Farmington Tap	115
T1870	Quaker Road(Sta.121) - Sleight Road #13	main line	115
T1890	Southeast Batavia - Golah #119	main line	115
T1890-1 Tap	Southeast Batavia - Golah #119	SB-G #119 - East Batavia Tap	115
T1930	Mortimer - Sta.23 & Sta.33 #901	main line	115

The following transmission lines have portions in both the Genesee and Frontier study areas:

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T1440	Huntley - Lockport #36	main line	115
T1450	Huntley - Lockport #37	main line	115
T1620	Mountain - Lockport #103	main line	115
T1690	Niagara - Lockport #101	main line	115
T1700	Niagara - Lockport #102	main line	115

The following transmission line has portions in both the Genesee and Central study areas:

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T1570	Mortimer - Elbridge #2	main line	115

Sub-Transmission Lines			
Circuit ID	Circuit ID	Circuit ID	Circuit ID
301	Phillips Road	Medina	34.5
302	Telegraph Road	Medina	34.5
303	Telegraph Road	Medina	34.5
304	Phillips Road	Telegraph Road	34.5
305	Medina	Albion	34.5
306	Waterport	Albion	34.5
307	Waterport	Brockport	34.5
308	Albion	Brockport	34.5
310	Brockport	Owens Illinois	34.5
312	Gasport	Telegraph Road	34.5
213	Caledonia	Golah	34.5
203	North Leroy	Caledonia	34.5
209	Attica	Wethersfield	34.5
208	North Leroy	Attica	34.5
206	Batavia	Attica	34.5
225	North Akron	Attica	34.5
223	Batavia	North Leroy	34.5
219	Oakfield	Batavia	34.5
201	Oakfield	Caledonia	34.5
227	North Akron	Oakfield	34.5
204	I2R Element	North Akron	34.5
205	I2R Element	North Akron	34.5
218	N. Lakeville	Ridge	34.5
224	N. Lakeville	Hemlock	34.5

226	N. Lakeville	Richmond	34.5
217	Golah	N. Lakeville	34.5
216	Golah	N. Lakeville	34.5
109	Mortimer	Golah	69
853	Golah	S. Perry	69

Northeast Study Area

Electrical Facilities			
Substations			
Amsterdam 326	Clinton 366	Knapp Road 432	Schoharie 234
Ashley 331	Cobleskill 214	Malta 443	Schroon Lake 429
Ballston 12	Comstock 48	Market Hill 324	Schuylerville 39
Battenkill 342	Corinth 285	Marshville 299	Scofield Rd. 450
Bay Street 233	Crown Point 249	Mayfield 356	Sharon 363
Bennett Switching St	Delanson 269	McCrea St. 272	Smith Bridge 464
Birch Ave. 322	East Worcester 60	Meco 318	South St. 297
Bolton 284	EJ West 38	Middleburg 390	Spier Falls
Brook Rd. 369	Ephratah 18	Mohican 247	St Johnsville 335
Burgoyne 337	Farnan Rd. 476	North Creek 122	Stoner 358
Butler 362	Fort Gage 319	North River	Summit 347
Cambridge 29	French Mountain	Northville	Ticonderoga 163
Canajoharie 31	Gilmantown Rd 154	Ogden Brook 423	Union St 376
Carboy Switching St	Glens Falls 75	Otten 412	Vail Mills 392
Caroga 219	Grand Street 433	Pallette Stone 385	Warrensburg 321
Cedar 453	Guy Park 239	Port Henry 385	Weibel Ave. 415
Cement Mt 455	Hague Rd. 418	Pottersville 424	Wells 208
Center Street 379	Hastings Switching St 439	Queensbury 295	West Milton
Charley Lake 254	Henry St. 316	Randall Road 463	Whitehall 187
Charlton 222	Hill 311	Riparius 293	Wilton 329
Cherry Valley 41	Hudson Falls 88	Rock City Falls 404	Worcester 189
Chestertown 42	Indian Lake 310	Saratoga 142	
Church Street 43	Johnstown 61	Schenevus 261	

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T5100	Clinton - Marshville #12	main line	115
T5240	Inghams - East Springfield #7	main line	115
T5250	Inghams - Meco #15	main line	115
T5250-1 Tap	Inghams - Meco #15	I-M#15 - Clinton Tap	115

T5260	Inghams - St. Johnsville #6	main line	115
T5260-1 Tap	Inghams - St. Johnsville #6	I-SJ #6 - Beardslee Tap	115
T5270	Inghams - Stoner #9	main line	115
T5270-1 Tap	Inghams - Stoner #9	I-S #9 - Center Street Tap	115
T5270-2 Tap	Inghams - Stoner #9	I-S #9 - Fage Dairy Tap	115
T5430	Mohican - Battenkill #15	main line	115
T5430-1 Tap	Mohican - Battenkill #15	M-B #15 - Irving Tissue Tap	115
T5440	Mohican - Butler #18	main line	115
T5440-1 Tap	Mohican - Butler #18	M-B #18 - GF Cement Tap	115
T5440-2 Tap	Mohican - Butler #18	M-B #18 - Finch Pruyn Tap	115
T5440-3 Tap	Mohican - Butler #18	M-B #18 - S. Glens Falls Energy Tap	115
T5710	Spier - Butler #4	main line	115
T5730	Spier - Queensbury #5	main line	115
T5730-1 Tap	Spier - Queensbury #5	S-Q #5 - Ogden Brook Tap	115
T5740	Spier - Queensbury #17	main line	115
T5740-1 Tap	Spier - Queensbury #17	S-Q #17 Sherman Island Tap	115
T5740-2 Tap	Spier - Queensbury #17	S-Q #17 Ogden Brook Tap	115
T5750-1 Tap	Spier - Rotterdam #1	S-R #1 - Weibel Ave Tap	115
T5750-2 Tap	Spier - Rotterdam #1	S-R #1 - Smith Bridge Tap	115
T5750-3 Tap	Spier - Rotterdam #1	S-R #1 - Brook Road Tap	115
T5750-4 Tap	Spier - Rotterdam #1	S-R #1 - West Milton Tap	115
T5750-5 Tap	Spier - Rotterdam #1	S-R #1 - Ballston Tap	115
T5750-6 Tap	Spier - Rotterdam #1	S-R #1 - Malta Sub Tap	115
T5760-1 Tap	Spier - Rotterdam #2	S-R #2 - Weibel Ave Tap	115
T5760-2 Tap	Spier - Rotterdam #2	S-R #2 - Smith Bridge Tap	115
T5760-3 Tap	Spier - Rotterdam #2	S-R #2 - Brook Road Tap	115
T5760-4 Tap	Spier - Rotterdam #2	S-R #2 - Ballston Tap	115
T5760-5 Tap	Spier - Rotterdam #2	S-R #2 - Malta Sub Tap	115
T5770	Spier - West #9	main line	115
T5770-1 Tap	Spier - West #9	S-W #9 - IP Corinth Tap	115
T5770-2 Tap	Spier - West #9	S-W #9 - Stewart's Bridge Tap	115
T5770-3 Tap	Spier - West #9	S-W #9 - Scofield Road Tap	115
T5770-4 Tap	Spier - West #9	S-W #9 - Palmer Curtis Tap	115
T5780	St. Johnsville - Marshville #11	main line	115
T5810	Ticonderoga - Republic #2	main line	115
T5810-1 Tap	Ticonderoga - Republic #2	R-T #2 - Hague Road Sub Tap	115
T5810-2 Tap	Ticonderoga - Republic #2	R-T #2 - Lachute Hydro Tap	115
T5810-3 Tap	Ticonderoga - Republic #2	R-T #2 - IP Ticonderoga Tap	115
T5810-4 Tap	Ticonderoga -	R-T #2 - Crown Point Tap	115

	Republic #2		
T5810-5 Tap	Ticonderoga - Republic #2	R-T #2 - Port Henry Tap	115
T5820	Ticonderoga - Hague Road #4	main line	115
T5830	Ticonderoga - Whitehall #3	main line	115
T5830-1 Tap	Ticonderoga - Whitehall #3	T-W #3 - Otten Tap	115
T5870	Warrensburg - North Creek #5	main line	115
T5880	Warrensburg - Scofield Road #10	main line	115
T5890	Whitehall - Blissville #7	main line	115
T5900	Whitehall - Mohican #13	main line	115
T5900-1 Tap	Whitehall - Mohican #13	W-M #13 - Comstock (NYSEG) Tap	115
T5900-2 Tap	Whitehall - Mohican #13	W-M #13 - Comstock Tap	115
T5900-3 Tap	Whitehall - Mohican #13	W-M #13 - Burgoyne Tap	115
T5900-4 Tap	Whitehall - Mohican #13	W-M #13 - Adirondack Resources Tap	115
T5910	Whitehall - Cedar #6	main line	115
T5910-1 Tap	Whitehall - Cedar #6	W-C #6 - Great Meadow Tap	115
T5910-2 Tap	Whitehall - Cedar #6	W-C #6 - Burgoyne Tap	115
T5950	Indeck Corinth - Spier #18	main line	115
T5970	Queensbury - Cedar #10	main line	115
T6070	Spier - Mohican #7	main line	115
T6410R	Ticonderoga - Sanford Lake (retired)	main line	115
T6480-1 Tap	Mohican - Luther Forest #3	M-NT #3 - Hemstreet Tap	115
T6480-2 Tap	Mohican - Luther Forest #3	M-NT #3 - Mulberry (NYSEG) Tap	115
T6580	Global Foundries - Luther Forest #111	main line	115
T6590	Global Foundries - Luther Forest #222	main line	115
T6480	Mohican - Luther Forest #3	main line	115

The following transmission line has portions in both the Northeast and Capital-Hudson Valley study areas:

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T5750	Spier - Rotterdam #1	main line	115
T5760	Spier - Rotterdam #2	main line	115

T6060R	Mohican - North Troy #3	main line	115
T6490	Luther Forest - North Troy #308	main line	115

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
1	Dahowa	Cement Mountain	34.5
1	North Creek	Indian Lake	34.5
1	Mohican	Hudson Falls	34.5
2	Cement Mountain	Cambridge	34.5
2	Chestertown	North Creek	34.5
2	Fort Gage	Queensbury	34.5
3	Hoosick	Cambridge	34.5
3	Chestertown	Schroon	34.5
3	Fort Edwards	Hudson Falls	34.5
3	Glens Falls	Henry St.	34.5
3	Spier	Brook Rd.	34.5
4	Adirondack Hydro Hudson Falls	Mohican	34.5
5	Glens Falls	Ashley	34.5
5	Cement Mountain	Battenkill	34.5
6	Ballston	Mechanicville	34.5
6	Schuylerville	Battenkill	34.5
6	Spier	Corinth	34.5
6	Warrensburg	Chestertown	34.5
7	AHDC Middle Falls	Cement Mountain	34.5
7	Chestertown	North Creek	34.5
7	Queensbury	Bay St.	34.5
8	Ballston	Shore Rd.	34.5
8	Hoosick	Clay Hill	34.5
8	Spier	Glens Falls	34.5
8	Glens Falls	Spier	34.5
8	Warrensburg	Fort Gage	34.5
9	Queensbury	Warrensburg	34.5
9	Warrensburg	Queensbury	34.5
9	West Milton	Ballston	34.5
10	Glens Falls	Bay St.	34.5
10	Saratoga	Ballston	34.5
11	Brook Rd.	Ballston	34.5
11	Mohican	Glens Falls	34.5
11	Glens Falls	Mohican	34.5
12	Glens Falls	Mohican	34.5
12	Mohican	Glens Falls	34.5
12	Spier	Saratoga	34.5
14	Queensbury	Henry St.	34.5
17	Hudson Falls	McCrea St.	34.5

Northern Study Area

Electrical Facilities			
Substations			
Akwesasne 825	Dennison 960	Lisbon 963	Ogdensburg 938
Antwerp	Dexter 726	Little River 955	Parishville 939
Ausable Forks 846	E. Norfolk 913	Loon Lake 837	Paul Smith's 834
Balmat 904	E. Oswegatchie 982	Lowville 733	Piercefield 829
Battle Hill	E. Watertown 817	Lyme 733	Port Leyden
Black River	Edwards 916	Malone 895	Portage St. 754
Bloomingdale 841	Elm St. 898	McAdoo 914	Raybrook 839
Bombay 897	Emeryville	McIntyre	Riverview 847
Brady 957	Fine	Merrillville 838	S. Philadelphia 764
Brasher 851	Fort Covington 896	Mill St. 748	Sewalls Island 766
Bremen 815	Franklin Falls 843	Mine Rd.	Silver Lake 845
Brier Hill 953	Gabriels 835	Moira 859	Spencers Corner 863
Brown Falls	Gilpin Bay 956	Morristown 933	St. Regis 977
Carthage 717	Hammond 370	N. Bangor 864	Star Lake
Chasm Falls 852	Heuvelton	N. Carthage 816	State St. 954
Coffeen 760	Higley 924	N. Governeur 983	Sunday Creek 876
Collinsville 716	Hogansburg 855	N. Lawrence 861	Taylorville
Colony	Indian River 323	Newton Falls	Thousand Islands 814
Colton 909	Lake Clear 833	Nicholville 860	Tupper Lake 830
Corning	Lake Colby 927	Norfolk	Union 844
David 979	Lawrence Ave. 976	North Ogdensburg 878	W. Adams 875
Dekalb 984	Leray 813	Norwood 936	Westville 885
Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T3000	Alcoa - Dennison #12	main line	115
T3020	Battle Hill - Balmat #5	main line	115
T3020-1 Tap	Battle Hill - Balmat #5	BH-B #5 - Zinco Tap	115
T3020-2 Tap	Battle Hill - Balmat #5	BH-B #5 - Gouverneur Talc Co. Tap	115
T3030	Colton - Battle Hill #7	main line	115

T3030-1 Tap	Colton - Battle Hill #7	C-BH #7 Little River Tap	115
T3030-2 Tap	Colton - Battle Hill #7	C-BH #7 Pyrites Tap	115
T3030-3 Tap	Colton - Battle Hill #7	C-BH #7 Dekalb Tap	115
T3050	Black River - North Carthage #1	main line	115
T3050-1 Tap	Black River - North Carthage #1	BR-NC #1 - Kamine-Carthage Co-Gen Tap	115
T3050-2 Tap	Black River - North Carthage #1	BR-NC#1 - Climax Co-Gen Tap	115
T3060	Black River - Taylorville #2	main line	115
T3060-1 Tap	Black River - Taylorville #2	BR-T #2 - Fort Drum Co-Gen Tap	115
T3060-2 Tap	Black River - Taylorville #2	BR-T #2 - Fort Drum #1 Tap	115
T3060-3 Tap	Black River - Taylorville #2	BR-T #2 - Deferiet Paper Tap	115
T3060-4 Tap	Black River - Taylorville #2	BR-T #2 - North Carthage Tap	115
T3070	Browns Falls - Newton Falls Pap. Co. #6	main line	115
T3080	Browns Falls - Taylorville #3	main line	115
T3090	Browns Falls - Taylorville #4	main line	115
T3100	Boundary Road - Dennison #1	main line	115
T3100-1 Tap	Boundary Road - Dennison #1	BR-D #1 - Rosemount Tap (CE)	115
T3100-2 Tap	Boundary Road - Dennison #1	BR-D #1 - McConnell Tap (CE)	115
T3100-3 Tap	Boundary Road - Dennison #1	BR-D #1 - Aldophus Tap (CE)	115
T3100-4 Tap	Boundary Road - Dennison #1	BR-D #1 - Courtaulds Tap (CE)	115
T3100-5 Tap	Boundary Road - Dennison #1	BR-D #1 - Loyalist Tap (CE)	115
T3110	Boundary Road - Dennison #2	main line	115
T3110-1 Tap	Boundary Road - Dennison #2	BR-D #2 - Rosemount Tap (CE)	115
T3110-2 Tap	Boundary Road - Dennison #2	BR-D #2 - McConnell Tap (CE)	115
T3110-3 Tap	Boundary Road - Dennison #2	BR-D #2 - Aldophus Tap (CE)	115
T3110-4 Tap	Boundary Road - Dennison #2	BR-D #2 - Courtaulds Tap (CE)	115
T3110-5 Tap	Boundary Road - Dennison #2	BR-D #2 - Loyalist Tap (CE)	115
T3110-6 Tap	Boundary Road - Dennison #2	BR-D #2 - ICI Plant Tap (CE)	115
T3120	Coffeen - Black River #3	main line	115
T3120-1 Tap	Coffeen - Black River	C-BR #3 - Glen Park Hydro	115

	#3	Tap	
T3120-2 Tap	Coffeen - Black River #3	C-BR #3 - Air Brake Tap	115
T3130	Coffeen - West Adams #2	main line	115
T3140	Colton - Browns Falls #1	main line	115
T3150	Colton - Browns Falls #2	main line	115
T3160	Colton - Carry (Stark) #9	main line	115
T3160-1 Tap	Colton - Townline #9	C-T #9 - South Colton Hydro Tap	115
T3160-2 Tap	Colton - Townline #9	C-T #9 - Five Falls Hydro Tap	115
T3160-3 Tap	Colton - Townline #9	C-T #9 - Rainbow Hydro Tap	115
T3160-4 Tap	Colton - Townline #9	C-T #9 - Blake Hydro Tap	115
T3160-5 Tap	Colton - Townline #9	C-T #9 - Carry Tap	115
T3170	Colton - Malone #3	main line	115
T3170-1 Tap	Colton - Malone #3	C-M #3 - Allens Falls Hydro Tap	115
T3170-2 Tap	Colton - Malone #3	C-M #3 - Nicholville Tap	115
T3180	Dennison - Colton #4	main line	115
T3180-1 Tap	Dennison - Colton #4	D-C #4 - Norfolk Tap	115
T3180-2 Tap	Dennison - Colton #4	D-C #4 - Mead Paper Tap	115
T3180-3 Tap	Dennison - Colton #4	D-C #4 - Lawrence Ave. Tap	115
T3180-4 Tap	Dennison - Colton #4	D-C #4 - Sugar Island Hydro Tap	115
T3180-5 Tap	Dennison - Colton #4	D-C #4 - Unionville / Hewittville Hydros Tap	115
T3190	Dennison - Colton #5	main line	115
T3190-1 Tap	Dennison - Colton #5	D-C #5 - Lawrence Ave Tap	115
T3190-2 Tap	Dennison - Colton #5	D-C #5 - Hannawa Falls Tap	115
T3200	Fort Drum - Black River #9	Not a tap (main line)	115
T3200-1 Tap	Fort Drum - Black River #9	FD-BR #3 - Indian River Tap	115
T3210	Lake Colby - Lake Placid #3	main line	115
T3210-1 Tap	Lake Colby - Lake Placid #3	LC-LP #3 - Ray Brook Tap	115
T3230	Malone - Lake Colby #5	main line	115
T3250	McIntyre - Corning #6	main line	115
T3270	M.E.F. - Alcoa #3	main line	115
T3280	McIntyre - Colton #8	main line	115
T3280-1 Tap	McIntyre - Colton #8	M-C #8 - Ogdensburg Tap	115
T3280-2 Tap	McIntyre - Colton #8	M-C #8 - McAdoo Sub Tap	115
T3280-3 Tap	McIntyre - Colton #8	M-C #8 - Little River Tap	115

T3290	North Gouverneur - Battle Hill #8	main line	115
T3300	Ogdensburg - McIntyre #2	main line	115
T3320	Taylorville - Boonville #5	main line	115
T3330	Taylorville - Boonville #6	main line	115
T3330-1 Tap	Taylorville - Boonville #6	T-B #6 - Northbrook Energy Tap	115
T3330-2 Tap	Taylorville - Boonville #6	T-B #6 - Moose River Hydro Tap	115
T3330-3 Tap	Taylorville - Boonville #6	T-B #6 - Lyonsdale Hydro/ Burrows Tap	115
T3330-4 Tap	Taylorville - Boonville #6	T-B #6 - Lyonsdale Co-Gen Tap	115
T3340	Taylorville - Moshier #7	main line	115
T3340-1 Tap	Taylorville - Moshier #7	T-M #7 - Eagle Tap	115
T3340-2 Tap	Taylorville - Moshier #7	T-M #7 - Sunday Creek Tap	115
T3350	Thousand Islands - Coffeen #4	main line	115
T3350-1 Tap	Thousand Islands - Coffeen #4	TI-C #4 - Lyme Tap	115
T3360	Willis - Malone #1	main line	115
T3380	Alcoa - North Ogdensburg #13	main line	115
T3390	East Oswegatchie - North Gouverneur #1	main line	115
T3400	North Ogdensburg - McIntyre #9	main line	115
T3410	O.E.F. - North Ogdensburg #1	main line	115
T6180	Corning - Battle Hill #4	main line	115
T6180-1 Tap	Corning - Battle Hill #4	C-B #4 - McAdoo Tap	115
T6180-2 Tap	Corning - Battle Hill #4	C-B #4 - Dekalb Tap	115
T6210	Raymondville - Norfolk #1	main line	115
T6210-1 Tap	Raymondville - Norfolk #1	R-N #1 - APC Paper Tap	115
T6270	North Carthage - Taylorville #8	main line	115
T6340	Adirondack-Chases Lake #13	main line	230
TNYPA-1 Tap	Moses-Reynolds-GM MRG1 (NYPA)	M-R-G MRG1 (NYPA) - Akwesasne Tap	115

The following transmission line has portions in both the Northern and Central transmission study areas:

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T2120	Coffeen - Black River -	main line	115

	Lighthouse Hill #5		
T3040	Black River - Lighthouse Hill #6	main line	115

The following transmission line has portions in both the Northern and Mohawk transmission study areas:

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T4010	Adirondack-Porter #12	main line	230
T6350	Chases Lake-Porter #11	main line	230

Sub-Transmission Lines			
Circuit ID	From	To	Voltage (kV)
21	Nicholville	North Bangor	34.5
22	Spencer Corners	Bombay	34.5
23	Nicholville	Bombay	34.5
23	Malone	Chasm Falls	34.5
24	Malone	Spencer Corners	34.5
26	Malone	Spencer Corners	34.5
26	Akwesasne	Fort Convington	34.5
23	Akwesasne	Nicholville	34.5
30	Lake Clear	Lake Colby	46
31	Lake Colby	Franklin	46
34	Union Falls	Franklin	46
35	Union Falls	Lake Clear	46
36	Union Falls	Ausable Forks	46
37	High Falls	Union Falls	46
38	Lake Clear	Tupper Lake	46
39	Piercefield	Tupper Lake	46
21	Colony	Browns Falls	34.5
22	Browns Falls	Newton Falls	34.5
22	Colony	South Edwards	34.5
2	Emeryville	Gouverneur Talc. Co.	23
21	McIntyre	David	23
21	Norfolk	Norwood	23
23	Emeryville	Mine Rd.	23
23	McIntyre	Heuvelton	23
24	Balmat	Emeryville	23
24	McIntyre	Hammond	23
25	Lisbon	Heuvelton	23
26	State St.	Little River	23
27	Balmat	Fowler	23
28	Mine Rd.	Colony	23
21	Old Forge	Raquette Lake	46
22	Boonville	Alder Creek	46
23	Alder Creek	Old Forge	46
21	Carthage	High Falls	23

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
21	Mill St.	Black River	23
21	South Philadelphia	Thersa	23
22	Black River	Black River Hydro	23
22	Carthage	Taylorville	23
22	Lowville	Boonville	23
23	Beaver Falls	Taylorville	23
24	Carthage	North Carthage	23
24	Leray	Black River	23
24	South Philadelphia	Antwerp	23
24	Taylorville	Effley	23
25	Belfort	Taylorville	23
25	Coffeen	Dexter	23
25	South Philadelphia	Indian River	23
26	Carthage	Copenhagen	23
26	Coffeen	Mill St.	23
26	High Falls	Taylorville	23
27	Deferiet	Herrings	23
28	Herring	Carthage	23
29	Deferiet	North Carthage	23

Southwest Study Area

Electrical Facilities			
Substations			
Andover 09	Delameter Rd. 93	Ischua Switching St.	Reservoir
Angola Switch St	Delevan 11	Knights Creek 06	Ridge 142
Ashville Switch St	Dugan Rd. 22	Lakeview Rd.182	Ripley 53
Baker St.	Dunkirk	Langford 180	Roberts Rd. 154
Bemus Point	E. Dunkirk 63	Levant 98	Shaleton
Bennett Rd. 99	E. Otto 28	Machias 13	Sherman 54
Berry Rd. 153	Eden Center 88	Maplehurst 04	Sinclairville 72
Brigham Rd	Eden Switching St	N. Angola	South Dow
Buffalo Station 139	Ellicott 65	N. Ashford 36	South Randolph
Buffalo Station 149	Falconer	N. Chautauqua 78	South Wellsville 23
Busti 68	Farmersville 27	N. Collins 92	Steamburg 17
Cassadaga 61	Findley Lake 71	N. Eden 82	Stow 52
Cattaraugus 15	Finley Rd Switching St	N. Olean 30	Valley 44
Chautaqua 05	Franklinville 24	New Road Switching St	Vandalia 104
Cloverbank 91	French Creek	Niles	W. Olean 33
Clymer 55	Frewsburg 69	Oak Hill 62	W. Portland 151
Collins 83	Greenhurst 60	Panama 70	W. Salamanca 16
Cuba 05	Harborfront 212	Petrolia 19	W. Valley 25
Cuba Lake 37	Hartfield 79	Poland 66	West Perrysburg 181
Dake Hill Switching St	Homer Hill	Price Corners	Whitesville 101
Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T1080	Dunkirk - Falconer 160	main line	115
T1080-1 Tap	Dunkirk - Falconer #160	D-F #160 – Westfield Village Tap	115
T1080-2 Tap	Dunkirk - Falconer #160	D-F #160 - Columbia Gas Tap	115
T1080-3 Tap	Dunkirk - Falconer #160	D-F #160 - Cummins Tap	115
T1090	Dunkirk - Falconer 161	main line	115
T1090-1 Tap	Dunkirk - Falconer #161	D-F #161 - Willowbrook Switch Tap	115

T1090-2 Tap	Dunkirk - Falconer #161	D-F #161 - Special Metals Tap	115
T1090-3 Tap	Dunkirk - Falconer #161	D-F #161 - Ludlum Tap	115
T1090-4 Tap	Dunkirk - Falconer #161	D-F #161 – Roberts Road Tap	115
T1090-5 Tap	Dunkirk - Falconer #161	D-F #161 - East Dunkirk Tap	115
T1100	Dunkirk - Falconer #162	main line	115
T1100-1 Tap	Dunkirk - Falconer #162	D-F #162 - Willowbrook Switch Tap	115
T1100-2 Tap	Dunkirk - Falconer #162	D-F #162 - Ludlum Tap	115
T1100-3 Tap	Dunkirk - Falconer #162	D-F #162 – Bennett Road Tap	115
T1100-4 Tap	Dunkirk - Falconer #162	D-F #162 – Roberts Road Tap	115
T1100-5 Tap	Dunkirk - Falconer #162	D-F #162 - East Dunkirk Tap	115
T1110	Dunkirk-South Ripley #68	main line	230
T1160	Falconer - Homer Hill #153	main line	115
T1160-1 Tap	Falconer - Homer Hill #153	F-HH #153 - South Dow Street Tap	115
T1160-2 Tap	Falconer - Homer Hill #153	F-HH #153 - Carrs Corner Switch Tap (NYSEG)	115
T1160-3 Tap	Falconer - Homer Hill #153	F-HH #153 - Salamanca-Frank St. Tap	115
T1160-4 Tap	Falconer - Homer Hill #153	F-HH #153 - Salamanca-Rochester Tap	115
T1170	Falconer - Homer Hill #154	main line	115
T1170-1 Tap	Falconer - Homer Hill #154	F-HH #154 - South Dow Street Tap	115
T1170-2 Tap	Falconer - Homer Hill #154	F-HH #154 - Carrs Corners Switch Tap (NYSEG)	115
T1170-3 Tap	Falconer - Homer Hill #154	F-HH #154 – Salamanca-Frank St. Tap	115
T1170-4 Tap	Falconer - Homer Hill #154	F-HH #154 – Salamanca-Rochester Tap	115
T1180	South Ripley-Erie #69	main line	230
T1260-1 Tap	Gardenville -	G-D #141 Martin Road Station	115

	Dunkirk #141	139 Tap	
T1260-2 Tap	Gardenville - Dunkirk #141	G-D #141 Station 55 Tap	115
T1260-3 Tap	Gardenville - Dunkirk #141	G-D #141 Cloverbank Station 91Tap	115
T1260-4 Tap	Gardenville - Dunkirk #141	G-D #141 Shaleton Station 81 Tap	115
T1260-5 Tap	Gardenville - Dunkirk #141	G-D #141 Delameter Station 93 Tap	115
T1260-6 Tap	Gardenville - Dunkirk #141	G-D #141 North Angola Tap	115
T1260-7 Tap	Gardenville - Dunkirk #141	G-D #141 Silver Creek (NYSEG) Tap	115
T1270-1 Tap	Gardenville - Dunkirk #142	G-D #142 Martin Road Station 139 Tap	115
T1270-2 Tap	Gardenville - Dunkirk #142	G-D #142 Station 55 Tap	115
T1270-3 Tap	Gardenville - Dunkirk #142	G-D #142 Ford Tap	115
T1270-4 Tap	Gardenville - Dunkirk #142	G-D #142 Cloverbank Station 91Tap	115
T1270-5 Tap	Gardenville - Dunkirk #142	G-D #142 Delameter Station 93 Tap	115
T1270-6 Tap	Gardenville - Dunkirk #142	G-D #142 Bennett Road Station 99 Tap	115
T1270-7 Tap	Gardenville - Dunkirk #142	G-D #142 North Angola Tap	115
T1270-8 Tap	Gardenville - Dunkirk #142	G-D #142 Silver Creek (NYSEG) Tap	115
T1280-1 Tap	Gardenville - Homer Hill #152	G-HH #152 Springville Station Tap	115
T1280-2 Tap	Gardenville - Homer Hill #152	G-HH #152 Cobble Hill Tap	115
T1280-3 Tap	Gardenville - Homer Hill #152	G-HH #152 Machias Tap	115
T1280-4 Tap	Gardenville - Homer Hill #152	G-HH #152 Ischua Switch Tap	115
T1330	Hartfield - Moons Switches #159	main line	115
T1340	Homer Hill - Bennett Road #157	main line	115
T1340-1 Tap	Hartfield - Moons Switches #159	HH-BR #157 - Dugan Road Tap	115
T1340-2 Tap	Homer Hill - Bennett Road #157	HH-BR #157 - Wellsville Tap	115
T1350	Homer Hill - Dugan Road	main line	115

	#155		
T1350-1 Tap	Homer Hill - Dugan Road #155	HH-DR #155 - West Olean Tap	115
T1350-2 Tap	Homer Hill - Dugan Road #155	HH-DR #155 - Cooper-Power Sys. Tap	115
T1360	Homer Hill - West Olean #156	main line	115
T1360-1 Tap	Homer Hill - West Olean #156	HH-WO #156 - Dresser Tap	115
T1460	Homer Hill - Indeck Olean #166	main line	115
T1900	Valley (Station 44) - Ischua Switch #158	main line	115
T1910	Willowbrook Switch - Brigham #164	main line	115
T1950-1 Tap	Gardenville - Homer Hill #151	G-HH #151 Springville Station Tap	115
T1950-2 Tap	Gardenville - Homer Hill #151	G-HH #151 Cobble Hill Tap	115
T1950-3 Tap	Gardenville - Homer Hill #151	G-HH #151 Arcade Village (Muni) Tap	115
T1950-4 Tap	Gardenville - Homer Hill #151	G-HH #151 Machias Tap	115
T1950-5 Tap	Gardenville - Homer Hill #151	G-HH #151 Ischua Switch Tap	115
T6080	Falconer - Warren #171	main line	115
T6110	Homer City - Stolle Road#37	main line	345
T6450	Archade - Homer Hill #167	main line	115

The following transmission lines have portions in both the Southwestern and Frontier transmission study areas:

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T1240	Gardenville-Dunkirk #73	main line	230
T1250	Gardenville-Dunkirk #74	main line	230

T1260	Gardenville - Dunkirk #141	main line	115
T1270	Gardenville - Dunkirk #142	main line	115
T1280	Gardenville - Homer Hill #152	main line	115
T1950	Gardenville - Homer Hill #151	main line	115

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
803	Dake Hill	Machias	34.5
801	Delvan	Machias	34.5
816	Dake Hill	West Salamanca	34.5
804	Cold Spring	West Salamanca	34.5
802	Machias	Maplehurst	34.5
817	North Ashford	Nuclear Fuels	34.5
815	Bagdad	Dake Hill	34.5
856	Shaleton	North Angola	34.5
857	North Angola	Bagdad	34.5
862	North Angola	Bagdad	34.5
861	North Angola	North Ashford	34.5
851	Dunkirk	West Portland	34.5
852	Dunkirk	Hartfield	34.5
866	West Portland	Hartfield	34.5
859	Hartfield	South Dow	34.5
867	West Portland	Sherman	34.5
855	Hartfield	Sherman	34.5
863	Sherman	Ashville	34.5
854	Hartfield	Ashville	34.5
865	South Dow	Poland	34.5
860	North Eden	Eden	34.5
805	West Salamanca	Homer Hill	34.5
809	Homer Hill	Ceres	34.5
811	Homer Hill	Nile	34.5
541	Andover	South Wellsville	34.5
812	Nile	South Wellsville	34.5

Syracuse Oswego Cortland Study Area

Electrical Facilities			
Substations			
Ash St. 223	Drumlins 132	Labrador 230	Sandy Creek 66
Baily 313	Duguid 265	Lafayette 301	Scriba 319
Ballina 221	E. Fulton 100	Lake Rd. Two 299	Seneca Hill 206
Bartell 325	E. Molloy Rd. 151	Lords Hill 66	Sentinel Heights 128
Belmont 260	E. Pulaski 324	Lorings 276	Seventh North 231
Brewerton 07	E. Syracuse 27	Lysander 297	Solvay 57
Bridge St. 295	E. Conklin 314	Mallory 125	Sorrell Hill 269
Bridgeport 168	Elbridge 312	McGraw 228	South Bay 60
Brighton Ave. 08	Euclid 267	Messina 42	South Oswego 254
Bristol Hill 109	Fabius 55	Mexico 43	Southwood 244
Buckabee Mears 300	Fairdale 135	Midler 145	Springfield 167
Buckley 140	Fairmount 118	Miller St. 117	Starr Rd. 334
Butternut 255	Fay Street 103	Milton Ave. 266	Stiles 58
Camillus 10	Fayette St. 28	Minoa 44	Teall Ave. 72
Cardiff 13	Fayetteville 14	Nestle Company 245	Temple St. 243
Carr 387	Fisher Ave. 270	New Haven 256	Third St. 216
Carrier 268	Fly Rd. 261	Niles 294	Truxton 74
Cazenovia 220	FMR Carlyle 268	Oswego Steam	Tuller Hill 246
Central Square 15	Galeville 213	Paloma 254	Tully Center 278
Chittenango 16	Geres Lock 30	Parish 49	Varick 207
Cicero 17	Gilbert Mills 247	Park Street 144	Volney 296
Clay 229	Glenwood 227	Peat Street 250	W. Monroe 274
Cleveland 11	Granby Center 293	Pebble Hill 290	W. Cleveland 326
Colosse 321	Hancock #2 138	Perryville 50	West Oswego 209
Constantia 19	Hancock 137	Phoenix 51	Westvale 133
Cortland 502	Harris Road 235	Pine Grove 59	Whitaker 296
Crouse Hinds 239	Headson 146	Pompey 120	Wine Creek 283
Curtis St 224	Hinsdale 218	Pulaski 68	Woodard 233
Cuyler 24	Homer 129	Rathburn 160	
Delphi 262	Hopkins 253	Ridge Rd. 219	
Dewitt 241	Jamesville Recloser 152	Rock Cut 286	
Dorwin 26	Jewett 291	Sand Rd. 131	

The transmission lines located in the Central transmission study area are provided in the table below.

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T2000	Ash - Teall #7	main line	115
T2010	Ash - Teall #8	main line	115
T2020	Ash - Temple	main line	115

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
	#9		
T2030	Auburn (State St.) - Elbridge #5	main line	115
T2040	Clay - Dewitt #3	main line	115
T2040-1 Tap	Clay - Dewitt #3	C-D #3 - Bartell Tap	115
T2040-2 Tap	Clay - Dewitt #3	C-D #3 - Pine Grove Tap	115
T2040-3 Tap	Clay - Dewitt #3	C-D #3 - New Venture Gear Tap	115
T2040-4 Tap	Clay - Dewitt #3	C-D #3 - Fly Road Tap	115
T2040-5 Tap	Clay - Dewitt #3	C-D #3 - Butternut Tap	115
T2050	Clay - Dewitt #5	main line	115
T2050-1 Tap	Clay - Dewitt #5	C-D #5 - Duguid Tap	115
T2060	Clay - DeWitt #13	main line	345
T2090	Clay - Teall #10	main line	115
T2090-1 Tap	Clay - Teall #10	C-T #10 - Bartell / Pine Grove Tap	115
T2090-2 Tap	Clay - Teall #10	C-T #10 - E. Malloy	115
T2100	Clay - Teall #11	main line	115
T2100-1 Tap	Clay - Teall #11	C-T #11 - Euclid Tap	115
T2100-2 Tap	Clay - Teall #11	C-T #11 - Hopkins Tap	115
T2110	Clay - Woodard #17	main line	115
T2110-1 Tap	Clay - Woodard #17	C-W #17 - Euclid Tap	115
T2110-2 Tap	Clay - Woodard #17	C-W #17 - OCWA Tap	115
T2130	Cortland - Lapeer #1	main line	115
T2130-1 Tap	Cortland - Lapeer #1	C-L #1 - Tuller Hill Tap	115
T2140	Curtis Street - Teall #13	main line	115
T2140-1 Tap	Curtis Street - Teall #13	CS-T #13 - Lysander Tap	115
T2140-2 Tap	Curtis Street - Teall #13	CS-T #13 - Anheuser Busch Tap	115
T2140-3 Tap	Curtis Street - Teall #13	CS-T #13 - Belmont Tap	115
T2140-4 Tap	Curtis Street - Teall #13	CS-T #13 - Sorrell Hill Tap	115
T2140-5 Tap	Curtis Street - Teall #13	CS-T #13 - Crouse Hinds Tap	115
T2140-6 Tap	Curtis Street - Teall #13	CS-T #13 - Hopkins Tap	115
T2150	DeWitt - LaFayette #22	main line	345
T2160	Dewitt - Tilden #19	main line	115
T2170	Elbridge - Geres Lock #3	main line	115

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T2180	Elbridge - Geres Lock #18	main line	115
T2180-1 Tap	Elbridge - Geres Lock #18	E-GL #18 - Milton Tap	115
T2190	Elbridge - Geres Lock #19	main line	115
T2190-1 Tap	Elbridge - Geres Lock #19	E-GL #19 - Milton Tap	115
T2200	Elbridge - Woodard #4	main line	115
T2200-1 Tap	Elbridge - Woodard #4	-W #4 - Belmont Tap	115
T2220	FitzPatrick - Lighthouse Hill #3	main line	115
T2220-1 Tap	FitzPatrick - Lighthouse Hill #3	F-LH #3 - Scriba Tap	115
T2220-2 Tap	FitzPatrick - Lighthouse Hill #3	F-LH #3 - New Haven Tap	115
T2230R	Fulton Co-Gen - Clay #4	main line	115
T2240	General Electric - Geres Lock #8	main line	115
T2240-1 Tap	GE (Electronics Park) - Geres Lock #8	GE-GL #8 - Solvay Muni. Bridge St. Tap	115
T2240-2 Tap	GE (Electronics Park) - Geres Lock #8	GE-GL #8 - Solvay Muni. Matthews Ave. Tap	115
T2260	Geneva (Border City) - Elbridge #15	main line	115
T2260-1 Tap	Geneva (Border City) - Elbridge #15	G-E #15 - Hyatt Road Tap	115
T2270	Geres Lock - Solvay #2	main line	115
T2270-1 Tap	Geres Lock - Solvay #2	GL-S #2 - Solvay Muni. Matthews Ave. Tap	115
T2270-2 Tap	Geres Lock - Solvay #2	GL-S #2 - Crucible Steel	115
T2280	Geres Lock - Solvay #14	main line	115
T2280-1 Tap	Geres Lock - Solvay #14	GL-S #14 - Solvay Muni. Bridge St. Tap	115
T2280-2 Tap	Geres Lock - Solvay #14	GL-S #14 - TriGen Tap	115
T2280-3 Tap	Geres Lock - Solvay #14	GL-S #14 - Crucible Steel	115
T2290	Geres Lock -	main line	115

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
	Tilden #16		
T2300	Indeck Oswego - Lighthouse Hill #2	main line	115
T2300-1 Tap	Indeck Oswego - Lighthouse Hill #2	IO-LHH #2 Wine Creek Tap	115
T2300-2 Tap	Indeck Oswego - Lighthouse Hill #2	IO-LHH #2 Alcan Tap	115
T2300-3 Tap	Indeck Oswego - Lighthouse Hill #2	IO-LHH #2 Scriba Tap	115
T2300-4 Tap	Indeck Oswego - Lighthouse Hill #2	IO-LHH #2 New Haven Tap	115
T2300-5 Tap	Indeck Oswego - Lighthouse Hill #2	IO-LHH #2 Schoeller Paper / E Pulaski Tap	115
T2310R	LaFayette - Oakdale #4 (36)	main line	345
T2320	Lighthouse Hill - Clay #7	main line	115
T2350	Nine Mile Point Unit One - Clay #8	main line	345
T2360	Nine Mile Pt. #1 - FitzPatrick #4	main line	115
T2370	Nine Mile Point Unit One - Scriba #9	main line	345
T2380	Nine Mile Pt. #2 - Scriba #5	main line	115
T2390	Nine Mile Pt. #2 - Scriba #6	main line	115
T2410-1 Tap	Oneida - Fenner #8	O-F #8 - Whitman Tap	115
T2420	Oswego - LaFayette #17	main line	345
T2430	Oswego - South Oswego #3	main line	115
T2440	Oswego - South Oswego #5	main line	115
T2450	Oswego - South Oswego #8	main line	115
T2470	Oswego - Volney #11	main line	345
T2480	Oswego - Volney #12	main line	345
T2520	Peat - Dewitt #7	main line	115
T2520-1 Tap	Peat - Dewitt #7	P-D #7 - Bridge St. Tap	115
T2520-2 Tap	Peat - Dewitt #7	P-D #7 - Headson Tap	115

Transmission Lines			
Circuit ID	Circuit Name	Main Line / Tap Name	Voltage
T2540	Scriba - Volney #20	main line	345
T2550	Scriba - Volney #21	main line	345
T2560	Sleight Road - Auburn (State St.) #3	main line	115
T2580	South Oswego - Curtis St. #10	main line	115
T2590R	South Oswego - Fulton Co-Gen #7	main line	115
T2600	South Oswego - Geres Lock #9	main line	115
T2600-1 Tap	South Oswego - Geres Lock #9	SO-GL #9 - Clear water pump Tap	115
T2600-2 Tap	South Oswego - Geres Lock #9	SO-GL #9 - Anheuser Busch Tap	115
T2600-3 Tap	South Oswego - Geres Lock #9	SO-GL #9 - Lysander Tap	115
T2600-4 Tap	South Oswego - Geres Lock #9	SO-GL #9 - Sorrell Hill Tap	115
T2610	South Oswego - Indeck(Oswego) #6	main line	115
T2610-1 Tap	South Oswego - Indeck(Oswego) #6	SO- I #6 - Paloma Tap	115
T2610-2 Tap	South Oswego - Indeck(Oswego) #6	SO- I #6 - Wine Creek Tap	115
T2610-3 Tap	South Oswego - Indeck(Oswego) #6	SO- I #6 – Hammermill Tap	115
T2630	South Oswego - Nine Mile Pt.#1 #1	main line	115
T2630-1 Tap	South Oswego - Nine Mile Pt.#1 #1	SO-NMP1 #1 - ALCAN Tap	115
T2630-2 Tap	South Oswego - Nine Mile Pt.#1 #1	SO-NMP1 #1 - Paloma Tap	115
T2630-3 Tap	South Oswego - Nine Mile Pt.#1 #1	SO-NMP1 #1 - Lake Road #2 Tap	115
T2640	SUNY Cortland - Cortland #2	Not a tap (main line)	115
T2640-1 Tap	SUNY Cortland - Cortland #2	C-SC #2 - Buckbee Mears Tap	115
T2640-2 Tap	SUNY Cortland - Cortland #2	C-SC #2 - Borg Warner Tap	115

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T2650	Teall - Dewitt #4	main line	115
T2650-1 Tap	Teall - Dewitt #4	T-D #4 - East Malloy Tap	115
T2650-2 Tap	Teall - Dewitt #4	T-D #4 - New Venture Gear / Coolidge Ventures Tap	115
T2650-3 Tap	Teall - Dewitt #4	T-D #4 - Butternut Tap	115
T2650-4 Tap	Teall - Dewitt #4	T-D #4 - Fly Road Tap	115
T2660	Teall - Carr Street #6	main line	115
T2660-1 Tap	Teall - Carr Street #6	T-CS #6 - Carrier Tap	115
T2660-2 Tap	Teall - Carr Street #6	T-CS #6 - Bristol Myers Squibb #1 Tap	115
T2660-3 Tap	Teall - Carr Street #6	T-CS #6 - Bristol Myers Squibb #2 Tap	115
T2670	Teall - Oneida #2	main line	115
T2680	Teall - Oneida #5	main line	115
T2680-1 Tap	Teall - Oneida #5	T-O #5 - Bridgeport Tap	115
T2690	Temple - Dewitt #10	main line	115
T2690-1 Tap	Temple - Dewitt #10	T-D #10 Bridge St. Tap	115
T2690-2 Tap	Temple - Dewitt #10	T-D #10 Headson Tap	115
T2700	Temple - SU/Gas #11	main line	115
T2710	Tilden - Cortland #18	main line	115
T2720	Volney - Clay #6	main line	345
T2740	Carr Street - Dewitt #15	main line	115
T2740-1 Tap	Carr Street - Dewitt #15	CS-D #15 - Bristol-Myers Squibb #1 Tap	115
T2740-2 Tap	Carr Street - Dewitt #15	CS-D #15 - Bristol-Myers Squibb #2 Tap	115
T2750	Clay - General Electric (Electronics Park) #14	main line	115
T2760	Independence - Scriba #25	main line	345
T2770	O.C.R.R.A. - Tilden #15	main line	115
T2770-1 Tap	O.C.R.R.A. - Tilden #15	O-T #15 – Rock Cut Rd Tap	115
T6030	Independence - Clay #26	main line	345
T6120	Geres Lock - Onondaga Co-Gen #12	main line	115

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T6130	Geres Lock - WPS Empire State Co-Gen #11	main line	115
T6140	Fenner - Cortland #3	main line	115
T6140-1 Tap	Fenner - Cortland #3	F-C #3 - Fenner Oneida Co-Op (NYPA) Tap	115
T6140-2 Tap	Fenner - Cortland #3	F-C #3 - Labrador Tap	115
T6150	Hook Road - Elbridge #7	main line	115
T6150-1 Tap	Hook Road - Elbridge #7	HR - E #7 – Farmington Tap (NYSEG)	115
T6150-2 Tap	Hook Road - Elbridge #7	HR - E #7 - Hamilton Road Tap (NYSEG)	115
T6400	South Oswego - Clay #4	main line	115
T6400-1 Tap	South Oswego - Clay #4	SO-C #4 NY Chocolate Tap	115
T6400-2 Tap	South Oswego - Clay #4	SO-C #4 - NE Biofuels Tap	115
T6400-3 Tap	South Oswego - Clay #4	SO-C #4 - Owens Illinois Tap	115
T6400-4 Tap	South Oswego - Clay #4	SO-C #4 - Sealright Tap	115
T6470	Lafayette - Clarks Corners #4 (46)	main line	345

The following transmission line has portions in both the Central and Genesee Regions:

Transmission Lines			
Circuit ID	**Circuit Trunk Name**	**Main Line / Tap Name**	**Voltage**
T1570	Mortimer - Elbridge #2	main line	115

The following transmission line has portions in both the Central and Mohawk transmission study areas:

Transmission Lines			
Circuit ID	**Circuit Trunk Name**	**Main Line / Tap Name**	**Voltage**
T4280	Volney - Marcy #19	**Not a tap (main line)**	345

The following transmission line has portions in both the Central and Northern transmission study areas:

Transmission Lines

Circuit ID	Circuit Trunk Name	Main Line / Tap Name	Voltage
T2120	Coffeen - Black River - Lighthouse Hill #5	main line	115
T3040	Black River - Lighthouse Hill #6	main line	115

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
30	From	To	34.5
33	Ash St.	Burnet	34.5
25	Ash St.	Burnet	34.5
29	Ash St.	Carousel	34.5
24	Ash St.	Carousel	34.5
23	Ash St.	McBride	34.5
28	Ash St.	McBride	34.5
37	Ash St.	Solvay	34.5
38	Brighton	Tilden	34.5
39	Brighton	Tilden	34.5
38	Fayette	Ash St.	34.5
36	Fayette	Ash St.	34.5
37	Fayette	Solvay	34.5
20	Fayette	Solvay	34.5
22	McBride	Brighton	34.5
25	McBride	Brighton	34.5
33	McBride	University	34.5
26	McBride	University	34.5
27	Solvay		34.5
23	Solvay		34.5
25	Teall		34.5
28	Teall	Ley Creek Treat Plant	34.5
22	Teall	Syracuse China	34.5
33	Solvay		34.5
24	Mallory	Cicero	34.5
28	Woodard		34.5
29	Woodard		34.5
26	Woodard	Baldwinsville	34.5
32	Woodard	Crouse Hinds	34.5
32	Woodard	Teall	34.5
27	Teall		34.5
27	Woodard	Ash St.	34.5
28	Pebble Hill	Rathbun	34.5
38	Minoa	Whitman	34.5
33	Headson	Tilden	34.5
26	Headson	Minoa	34.5
28	Headson	Pebble Hill	34.5
34	Minoa	Whitman	34.5

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage (kV)**
29	Burnet Ave.	Headson	34.5
31	Teall		34.5
30	Teall	Headson	34.5
31	Elbridge	Marcellus	34.5
509	Elbridge	Jewett	34.5
33	Niles Tap		34.5
21	Harris Rd.	Tilden	34.5
20	Harris Rd.	Tilden	34.5
34	Solvay	Harris Rd	34.5
35	Solvay	Harris Rd	34.5
22	Solvay		34.5
20	Solvay		34.5
21	Cortland	Cortland	34.5
23	Cortland	Cortland	34.5
39	Cortland	Cortland	34.5
32	Labrador	Rathbun	34.5
24	Pebble Hill	Tilden-Tully Tap	34.5
30	Tilden	Tully Tap	34.5

Utica Rome Study Area

Electrical Facilities			
Substations			
Alder Creek 701	Inghams 20	Poland 621	Turin 653
Arnold 656	Lehigh 669	Porter 657	Turning Stone 640
Boonville 707	Lenox 513	Raquette Lake 398	Valley 594
Cavanaugh Rd. 616	Lighthouse Hill 61	Rock City 623	Voorhees 83
Chadwicks 668	Levitt 665	Rome 762	Walesville 331
Clinton 604	Madison 654	Salisbury 678	Watkins Road 528
Conkling 652	Middleville 666	Schuyler 663	West Herkimer 676
Debalso 684	Old Forge 383	Sherman 333	Whitman 671
Deerfield 606	Oneida 501	So. Washington 614	White Lake 399
Eagle Bay 382	Oriskany 648	Stittville 670	Whitesboro 632
Edic 662	Peterboro 514	Terminal 651	Yahnundasis 646
Frankfort 677	Pleasant 664	Trenton 627	

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T2800	Watkins Road - Inghams #2	main line	115
T2800-1 Tap	Watkins Road - Inghams #2	WR-I #2 - Salisbury Tap	115
T4020	Boonville - Porter #1	main line	115
T4020-1 Tap	Boonville - Porter #1	B-P #1 - Stittville Tap	115
T4030	Boonville - Porter #2	main line	115
T4030-1 Tap	Boonville - Porter #2	B-P #2 - Stittville Tap	115
T4030-2 Tap	Boonville - Porter #2	B-P #2 - Boonville Muni. Tap	115
T4040	Boonville - Rome #4	main line	115
T4040-1 Tap	Boonville - Rome #4	B-R #4 - Madison Tap	115
T4040-2 Tap	Boonville - Rome #4	B-R #4 - Revere Copper & Brass Tap	115
T4060	Boonville - Rome #3	main line	115
T4060-1 Tap	Boonville - Rome #3	B-R #3 - Griffis AVA Tap	115
T4060-2 Tap	Boonville - Rome #3	B-R #3 - Madison Tap	115
T4080	Edic - Porter #10	main line	115
T4090	Edic-Porter #17	main line	230
T4100	Edic - Porter #20	main line	115
T4110	Levitt - Rome #8	main line	115
T4110-1 Tap	Levitt - Rome #8	L-R #8 - Lehigh Tap	115
T4110-2 Tap	Levitt - Rome #8	L-R #8 - Camden Wire Tap	115
T4110-3 Tap	Levitt - Rome #8	L-R #8 - Voorhees Ave Tap	115
T4110-4 Tap	Levitt - Rome #8	L-R #8 - Rome Cable Tap	115
T4140	Oneida - Oneida Energy (Sterling) #4	main line	115
T4150	Oneida - Porter #7	main line	115
T4150-1 Tap	Oneida - Porter #7	O-P #7 - Cavanaugh Road Tap	115
T4150-2 Tap	Oneida - Porter #7	O-P #7 - Walesville Tap	115
T4160	Oneida - Yahnundasis #6	main line	115
T4160-1 Tap	Oneida - Yahnundasis #6	O-Y #6 - Sherrill Power & Light Tap	115

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T4170	Porter - Deerfield #8	main line	115
T4180	Porter - Deerfield #9	main line	115
T4190	Porter - Watkins Road #5	main line	115
T4190-1 Tap	Porter - Watkins Road #5	P-WR #5 - Deerfield Tap	115
T4220	Porter - Schuyler #13	main line	115
T4230	Porter - Terminal #6	main line	115
T4230-1 Tap	Porter - Terminal #6	P-T #6 - Utica Convertors Tap	115
T4240	Porter - Valley #4	main line	115
T4250	Rome - Oneida #1	main line	115
T4260	Terminal - Schuyler #7	main line	115
T4270R	Valley - Inghams #3	main line	115
T4290	Yahnundasis - Chadwicks #1	main line	115
T4290-1 Tap	Yahnundasis - Chadwicks #1	Y-C #1 - Special Metals Tap	115
T4300	Yahnundasis - Porter #3	main line	115
T4300-1 Tap	Yahnundasis - Porter #3	Y-P #3 - Utica Corp (Halsley) Tap	115
T4300-2 Tap	Yahnundasis - Porter #3	Y-P #3 - Walesville Tap	115
T4300-3 Tap	Yahnundasis - Porter #3	Y-P #3 - Debalso Tap	115
T4300-4 Tap	Yahnundasis - Porter #3	Y-P #3 - Conmed Tap	115
T6050	Watkins Road - Ilion Municipal Co-Gen #8	main line	115
T6050-1 Tap	Watkins Road - Ilion Municipal Co-Gen #8	WR-I #8 - Murphy Station Co-Gen Tap	115
T6560	Valley - Fairfield #12	main line	115
T6570	Fairfield - Inghams #3	main line	115
T6570-1 Tap	Fairfield - Inghams #3	F-I #3 - Salisbury Tap	115

The following line has portions in both the Utica/Rome and Syracuse/Oswego/Cortland transmission study areas:

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T2410	Oneida - Fenner #8	main line	115

The following lines have portions in both the Utica/Rome and Capital Hudson Valley transmission study areas:

Transmission Lines			
Circuit ID	**Circuit Name**	**Main Line / Tap Name**	**Voltage**
T4070	Edic - New Scotland #14	main line	345
T4130	Marcy - New Scotland #18	main line	345
T4200	Porter-Rotterdam #30	main line	230
T4210	Porter-Rotterdam #31	main line	230

Sub-Transmission Lines			
Circuit ID	**From**	**To**	**Voltage**
22	Deerfield	Schuyler	46
26	Deerfield	Whitesboro	46
26	Pleasant	Schuyler	46
21	Schuyler	Valley	46
24	Schuyler	Valley	46
21	Trenton	Deerfield	46
27	Trenton	Deerfield	46
24	Trenton	Middleville	46
23	Trenton	Prospect	46
25	Trenton	Whitesboro	46
26	Valley	Inghams	46
27	Valley	Inghams	46
29	Whitesboro	Schuyler	46
29	Whitesboro	Homogenous Metals Tap	46
27	Yahnundasis	Clinton	46
25	Yahnundasis	Pleasant	46
24	Yahnundasis	Westmoreland	46
23	Yahnundasis	Whitesboro	46

Exhibit 3 - Transmission Inspection and Maintenance Report
Second Quarter 2011 (June 30, 2011)

Summary of Deficiencies and Repair Activity Resulting from the Inspection Process - Transmission											
Transmission Facilities	2009			2010				2011			
Priority Level	I	II	III	I	II	III	Temp Repairs	I	II	III	Temp Repairs
Repair Expected	Within 1 week	Within 1 year	Within 3 years	Within 1 week	Within 1 year	Within 3 years	Within 90 days	Within 1 week	Within 1 year	Within 3 years	Within 90 days
Towers/Poles											
Steel Towers											
Number of Deficiencies	0	7	80	0	12	45	0	0	1	25	0
Repaired in Time Frame	0	7	25	0	12	13	0				
Repaired - Overdue											
Not Repaired - Not Due	0	0	55	0	0	32	0	0	1	25	0
Not Repaired - Overdue											
Poles											
Number of Deficiencies	0	55	742	0	35	637	0	0	58	528	3
Repaired in Time Frame	0	48	252	0	27	20	0	0	1	9	0
Repaired - Overdue	0	7	0	0	1	0	0				
Not Repaired - Not Due	0	0	490	0	4	617	0	0	57	519	3
Not Repaired - Overdue				0	3	0	0				
Anchors/Guy Wire											
Number of Deficiencies	1	9	256	0	9	123	0	0	2	59	0
Repaired in Time Frame	1	8	30	0	7	10	0	0	0	16	0
Repaired - Overdue	0	1	0								
Not Repaired - Not Due	0	0	226	0	2	113	0	0	2	43	0
Not Repaired - Overdue											
Crossarm/Brace											
Number of Deficiencies	3	14	128	0	13	84	0	0	6	33	0
Repaired in Time Frame	3	11	27	0	12	8	0	0	1	0	0
Repaired - Overdue	0	3	0								
Not Repaired - Not Due	0	0	101	0	0	76	0	0	5	33	0
Not Repaired - Overdue				0	1	0	0				
Grounding System											
Number of Deficiencies	0	3	296	0	25	192	0	0	2	36	0
Repaired in Time Frame	0	3	128	0	2	37	0				
Repaired - Overdue											
Not Repaired - Not Due	0	0	168	0	23	155	0	0	2	36	0
Not Repaired - Overdue											
Conductors											
Cable											
Number of Deficiencies	4	2	51	0	2	6	0	4	3	30	1
Repaired in Time Frame	4	2	6	0	1	0	0	4	0	0	1
Repaired - Overdue											
Not Repaired - Not Due	0	0	45	0	1	6	0	0	3	30	0
Not Repaired - Overdue											
Static/Neutral											
Number of Deficiencies	6	2	43	0	4	21	0	0	1	43	0
Repaired in Time Frame	6	2	1	0	3	0	0	0	1	1	0
Repaired - Overdue											
Not Repaired - Not Due	0	0	42	0	1	21	0	0	0	42	0
Not Repaired - Overdue											
Insulators											
Number of Deficiencies	0	21	425	1	42	193	0	4	23	254	0
Repaired in Time Frame	0	20	161	1	38	22	0	4	1	16	0
Repaired - Overdue	0	1	0								
Not Repaired - Not Due	0	0	264	0	4	171	0	0	22	238	0
Not Repaired - Overdue											
Miscellaneous											
Right of Way Condition											
Number of Deficiencies	0	0	31	0	0	6	0	0	0	1	0
Repaired in Time Frame	0	0	31	0	0	6	0				
Repaired - Overdue											
Not Repaired - Not Due								0	0	1	0
Not Repaired - Overdue											
Temporary Repairs											
Number of Temp Repairs				0	0	0	6				
Repaired in Time Frame				0	0	0	2				
Repaired - Overdue				0	0	0	3				
Not Repaired - Not Due											
Not Repaired - Overdue				0	0	0	1				

Summary of Deficiencies and Repair Activity Resulting from the Inspection Process - Transmission											
Transmission Facilities	2009			2010				2011			
Priority Level	I	II	III	I	II	III	Temp Repairs	I	II	III	Temp Repairs
Repair Expected	Within 1 week	Within 1 year	Within 3 years	Within 1 week	Within 1 year	Within 3 years	Within 90 days	Within 1 week	Within 1 year	Within 3 years	Within 90 days
Other											
Number of Deficiencies	1	31	31	9	37	38	0	3	12	8	0
Repaired in Time Frame	1	31	1	9	30	2	0	3	0	0	0
Repaired - Overdue											
Not Repaired - Not Due	0	0	30	0	5	36	0	0	12	8	0
Not Repaired - Overdue				0	2	0	0				
Transmission Facilities Total											
Total											
Number of Deficiencies	15	144	2083	10	179	1345	6	11	108	1017	4
Repaired in Time Frame	15	132	662	10	132	118	2	11	4	42	1
Repaired - Overdue	0	12	0	0	1	0	3				
Not Repaired - Not Due	0	0	1421	0	40	1227	0	0	104	975	3
Not Repaired - Overdue				0	6	0	1				

Exhibit 4 - Sub-Transmission Inspection and Maintenance Results
Up To Second Quarter 2011 (June 30, 2011)

Sub-Transmission Facilities	2009			2010			2011		
Priority Level	I	II	III	I	II	III	I	II	III
Repair Expected	One Week	One Year	Three Years	One Week	One Year	Three Years	One Week	One Year	Three Years
Towers/Poles									
Steel Towers									
Number of Deficiencies	0	3	10	0	0	2	0	3	63
Repaired	0	3	2	0	0	0	0	0	0
Not Repaired	0	0	8	0	0	2	0	3	63
Wood Poles									
Number of Deficiencies	0	49	675	0	27	483	0	87	508
Repaired	0	49	193	0	23	9	0	8	0
Not Repaired	0	0	482	0	4	474	0	79	508
Anchors/Guy Wire									
Number of Deficiencies	4	1	28	0	1	2	2	2	10
Repaired	4	1	1	0	1	0	2	1	0
Not Repaired	0	0	27	0	0	2	0	1	10
Crossarm/Brace									
Number of Deficiencies	3	14	105	0	10	53	0	4	46
Repaired	3	14	10	0	9	3	0	0	0
Not Repaired	0	0	95	0	1	50	0	4	46
Grounding System									
Number of Deficiencies	0	1	59	0	0	30	0	2	12
Repaired	0	1	5	0	0	0	0	0	0
Not Repaired	0	0	54	0	0	30	0	2	12
Conductors									
Conductor									
Number of Deficiencies	4	1	28	0	1	2	2	2	10
Repaired	4	1	1	0	1	0	2	1	0
Not Repaired	0	0	27	0	0	2	0	1	10
Static/Neutral									
Number of Deficiencies	12	2	33	0	1	3	0	1	4
Repaired	12	2	0	0	1	0	0	0	0
Not Repaired	0	0	33	0	0	3	0	1	4
Insulators									
Number of Deficiencies	0	8	198	0	11	74	0	4	46
Repaired	0	8	69	0	11	16	0	0	0
Not Repaired	0	0	129	0	0	58	0	4	46
Miscellaneous									
Right of Way Condition									
Number of Deficiencies	0	0	19	0	0	5	0	0	1
Repaired	0	0	19	0	0	5	0	0	0
Not Repaired	0	0	0	0	0	0	0	0	1
Temporary Repairs									
Number of Deficiencies	12	2	33	0	1	3	0	1	4
Repaired	12	2	0	0	1	0	0	0	0
Not Repaired	0	0	33	0	0	3	0	1	4
Other									
Number of Deficiencies	1	4	12	0	10	19	0	3	6
Repaired	1	4	0	0	10	2	0	0	0
Not Repaired	0	0	12	0	0	17	0	3	6
Sub-Transmission Facilities Total									
Total									
Number of Deficiencies	36	85	1200	0	62	676	4	109	710
Repaired	36	85	300	0	57	35	4	10	0
Not Repaired	0	0	900	0	5	641	0	99	710

Exhibit 5 - Distribution Inspection and Maintenance Report
Second Quarter 2011 (June 30, 2011)

Summary of Deficiencies and Repair Activity Resulting from the Inspection Process - Distribution

Distribution Overhead Facilities	2009			2010				2011			
Priority Level	I	II	III	I	II	III	Temp Repairs	I	II	III	Temp Repairs
Repair Expected	Within 1 week	Within 1 year	Within 3 years	Within 1 week	Within 1 year	Within 3 years	Within 90 days	Within 1 week	Within 1 year	Within 3 years	Within 90 days
Poles											
Pole Condition											
Number of Deficiencies	14	1565	8002	26	2281	7495	33	13	1420	1321	32
Repaired in Time Frame	9	1373	3511	25	1526	1039	30	12	20	8	19
Repaired - Overdue	5	192	0	1	122	0	3				
Not Repaired - Not Due	0	0	4491	0	403	6456	0	1	1400	1313	12
Not Repaired - Overdue				0	230	0	0	0	0	0	1
Grounding System											
Number of Deficiencies	24	2286	12428	50	3617	8253	0	28	1810	525	0
Repaired in Time Frame	24	2239	6228	50	3142	2048	0	18	77	3	0
Repaired - Overdue	0	47	0	0	34	0	0				
Not Repaired - Not Due	0	0	6200	0	433	6205	0	10	1733	522	0
Not Repaired - Overdue				0	8	0	0				
Anchors/Guy Wire											
Number of Deficiencies	1	4221	2717	3	2093	5104	13	1	434	4027	10
Repaired in Time Frame	1	4138	1267	3	1789	507	12	1	2	11	4
Repaired - Overdue	0	83	0	0	51	0	0				
Not Repaired - Not Due	0	0	1450	0	194	4597	0	0	432	4016	6
Not Repaired - Overdue				0	59	0	1				
Cross Arm/Bracing											
Number of Deficiencies	17	594	3138	41	735	2994	0	16	449	16	4
Repaired in Time Frame	16	570	1501	41	596	366	0	16	23	0	2
Repaired - Overdue	1	24	0	0	9	0	0				
Not Repaired - Not Due	0	0	1637	0	115	2628	0	0	426	16	2
Not Repaired - Overdue				0	15	0	0				
Riser											
Number of Deficiencies	0	1128	852	2	1235	538	0	4	609	344	2
Repaired in Time Frame	0	1108	394	2	1056	104	0	4	95	2	0
Repaired - Overdue	0	20	0	0	18	0	0				
Not Repaired - Not Due	0	0	458	0	157	434	0	0	514	342	2
Not Repaired - Overdue				0	4	0	0				
Conductors											
Primary Wire/Broken Ties											
Number of Deficiencies	81	279	116	104	203	87	2	35	73	10	3
Repaired in Time Frame	74	272	73	104	169	9	2	34	6	0	2
Repaired - Overdue	7	7	0								
Not Repaired - Not Due	0	0	43	0	34	78	0	1	67	10	1
Not Repaired - Overdue											
Secondary Wire											
Number of Deficiencies	21	203	844	24	134	592	7	40	148	356	2
Repaired in Time Frame	21	200	524	24	111	77	7	38	5	1	1
Repaired - Overdue	0	3	0	0	2	0	0	2	0	0	0
Not Repaired - Not Due	0	0	320	0	21	515	0	0	143	355	1
Not Repaired - Overdue											
Insulators											
Number of Deficiencies	20	273	3593	18	219	295	2	8	149	127	2
Repaired in Time Frame	20	262	1836	17	177	30	1	8	13	2	2
Repaired - Overdue	0	11	0	1	2	0	0				
Not Repaired - Not Due	0	0	1757	0	35	265	0	0	136	125	0
Not Repaired - Overdue				0	5	0	1				
Pole Equipment											
Transformers											
Number of Deficiencies	5	5673	1882	3	7547	1363	1	2	2565	896	0
Repaired in Time Frame	4	5617	1303	3	5702	806	1	2	115	3	0
Repaired - Overdue	1	56	0	0	361	0	0				
Not Repaired - Not Due	0	0	579	0	1269	557	0	0	2450	893	0
Not Repaired - Overdue				0	215	0	0				
Cutouts											
Number of Deficiencies	32	137	10019	45	70	7260	2	20	2382	0	0
Repaired in Time Frame	32	132	3735	45	59	686	2	19	13	0	0
Repaired - Overdue	0	5	0	0	1	0	0	1	0	0	0
Not Repaired - Not Due	0	0	6284	0	10	6574	0	0	2369	0	0

Summary of Deficiencies and Repair Activity Resulting from the Inspection Process - Distribution											
Distribution Overhead Facilities	2009			2010				2011			
Priority Level	I	II	III	I	II	III	Temp Repairs	I	II	III	Temp Repairs
Repair Expected	Within 1 week	Within 1 year	Within 3 years	Within 1 week	Within 1 year	Within 3 years	Within 90 days	Within 1 week	Within 1 year	Within 3 years	Within 90 days
Not Repaired - Overdue											
Lightning Arrestors											
Number of Deficiencies	0	2	1678	0	4	1267	0	0	49	258	0
Repaired in Time Frame	0	2	762	0	4	155	0				
Repaired - Overdue											
Not Repaired - Not Due	0	0	916	0	0	1112	0	0	49	258	0
Not Repaired - Overdue											
Other Equipment											
Number of Deficiencies	1	2009	1414	1	1061	1298	0	0	636	738	0
Repaired in Time Frame	1	2001	499	1	970	159	0	0	76	7	0
Repaired - Overdue	0	8	0	0	2	0	0				
Not Repaired - Not Due	0	0	915	0	86	1139	0	0	560	731	0
Not Repaired - Overdue				0	3	0	0				
Miscellaneous											
Trimming Related											
Number of Deficiencies	38	0	5841	20	0	2006	0	17	0	790	0
Repaired in Time Frame	38	0	1087	20	0	347	0	17	0	1	0
Repaired - Overdue											
Not Repaired - Not Due	0	0	4754	0	0	1659	0	0	0	789	0
Not Repaired - Overdue											
Temporary Repairs											
Number of Temp Repairs				0	0	0	13				
Repaired in Time Frame				0	0	0	8				
Repaired - Overdue				0	0	0	5				
Not Repaired - Not Due											
Not Repaired - Overdue											
Other											
Number of Deficiencies	0	8	14	0	1	0	0				
Repaired in Time Frame	0	8	14								
Repaired - Overdue											
Not Repaired - Not Due				0	1	0	0				
Not Repaired - Overdue											
Distribution Overhead Facilities Total											
Total											
Number of Deficiencies	254	18378	52538	337	19200	38552	73	184	10724	9408	55
Repaired in Time Frame	240	17922	22734	335	15301	6333	63	169	445	38	30
Repaired - Overdue	14	456	0	2	602	0	0	3	0	0	0
Not Repaired - Not Due	0	0	29804	0	2758	32219	0	12	10279	9370	24
Not Repaired - Overdue				0	539	0	2	0	0	0	1

Summary of Deficiencies and Repair Activity Resulting from the Inspection Process - Underground											
Distribution Underground Facilities	2009			2010				2011			
Priority Level	I	II	III	I	II	III	Temp Repairs	I	II	III	Temp Repairs
Repair Expected	Within 1 week	Within 1 year	Within 3 years	Within 1 week	Within 1 year	Within 3 years	Within 90 days	Within 1 week	Within 1 year	Within 3 years	Within 90 days
Underground Structures											
Damaged Cover											
Number of Deficiencies	0	9	60	0	12	85	0	1	1	26	0
Repaired in Time Frame	0	9	37	0	2	36	0	1	0	0	0
Repaired - Overdue											
Not Repaired - Not Due	0	0	23	0	10	49	0	0	1	26	0
Not Repaired - Overdue											
Damaged Structure											
Number of Deficiencies	57	575	20	30	569	14	0	20	266	2	0
Repaired in Time Frame	51	573	11	30	434	1	0	20	5	0	0
Repaired - Overdue	6	2	0								
Not Repaired - Not Due	0	0	9	0	135	13	0	0	261	2	0
Not Repaired - Overdue											
Damaged Equipment											
Number of Deficiencies	0	17	1	1	15	0	0	0	1	0	0
Repaired in Time Frame	0	16	1	1	12	0	0				
Repaired - Overdue	0	1	0								
Not Repaired - Not Due				0	3	0	0	0	1	0	0
Not Repaired - Overdue											
Conductors											
Primary Cable											
Number of Deficiencies	0	13	0	0	49	0	0	0	5	0	0
Repaired in Time Frame	0	12	0	0	28	0	0				
Repaired - Overdue	0	1	0								
Not Repaired - Not Due				0	21	0	0	0	5	0	0
Not Repaired - Overdue											
Secondary Cable											
Number of Deficiencies	9	0	0	3	0	0	0				
Repaired in Time Frame	9	0	0	3	0	0	0				
Repaired - Overdue											
Not Repaired - Not Due											
Not Repaired - Overdue											
Racking Needed											
Number of Deficiencies	0	140	0	0	303	0	0	0	124	0	0
Repaired in Time Frame	0	131	0	0	167	0	0				
Repaired - Overdue	0	9	0								
Not Repaired - Not Due				0	136	0	0	0	124	0	0
Not Repaired - Overdue											
Miscellaneous											
Temporary Repairs											
Number of Temp Repairs											
Repaired in Time Frame											
Repaired - Overdue											
Not Repaired - Not Due											
Not Repaired - Overdue											
Other											
Number of Deficiencies	2	768	238	0	834	138	0	0	509	56	0
Repaired in Time Frame	2	766	59	0	632	13	0				
Repaired - Overdue	0	2	0								
Not Repaired - Not Due	0	0	179	0	202	125	0	0	509	56	0
Not Repaired - Overdue											
Distribution Underground Facilities Total											
Total											
Number of Deficiencies	68	1522	319	34	1782	237	0	21	906	84	0
Repaired in Time Frame	62	1507	108	34	1275	50	0	21	5	0	0
Repaired - Overdue	6	15	0								
Not Repaired - Not Due	0	0	211	0	507	187	0	0	901	84	0
Not Repaired - Overdue											

Pad Mount Transformers	2009			2010				2011			
Priority Level	I	II	III	I	II	III	Temp Repairs	I	II	III	Temp Repairs
Repair Expected	Within 1 week	Within 1 year	Within 3 years	Within 1 week	Within 1 year	Within 3 years	Within 90 days	Within 1 week	Within 1 year	Within 3 years	Within 90 days
Pad Mount Tansformers											
Damaged Structure											
Number of Deficiencies	6	118	98	11	119	43	0	1	37	6	0
Repaired in Time Frame	6	114	40	11	96	3	0	1	3	0	0
Repaired - Overdue	0	4	0								
Not Repaired - Not Due	0	0	58	0	23	40	0	0	34	6	0
Not Repaired - Overdue											
Damaged Equipment											
Number of Deficiencies	0	0	3								
Repaired in Time Frame	0	0	2								
Repaired - Overdue											
Not Repaired - Not Due	0	0	1								
Not Repaired - Overdue											
Cable Condition											
Number of Deficiencies											
Repaired in Time Frame											
Repaired - Overdue											
Not Repaired - Not Due											
Not Repaired - Overdue											
Oil Leak											
Number of Deficiencies	5	68	0	2	41	0	0	0	10	0	0
Repaired in Time Frame	5	65	0	2	25	0	0				
Repaired - Overdue	0	3	0								
Not Repaired - Not Due				0	16	0	0	0	10	0	0
Not Repaired - Overdue											
Off Pad											
Number of Deficiencies	9	156	0	23	105	0	0	4	56	0	0
Repaired in Time Frame	9	153	0	23	89	0	0	4	5	0	0
Repaired - Overdue	0	3	0								
Not Repaired - Not Due				0	16	0	0	0	51	0	0
Not Repaired - Overdue											
Lock/Latch/Penta											
Number of Deficiencies											
Repaired in Time Frame											
Repaired - Overdue											
Not Repaired - Not Due											
Not Repaired - Overdue											
Miscellaneous											
Temporary Repairs											
Number of Temp Repairs				0	0	0	1				
Repaired in Time Frame				0	0	0	1				
Repaired - Overdue											
Not Repaired - Not Due											
Not Repaired - Overdue											
Other											
Number of Deficiencies	0	7	1526	0	3	881	0	0	1	361	0
Repaired in Time Frame	0	6	185	0	2	8	0				
Repaired - Overdue	0	1	0								
Not Repaired - Not Due	0	0	1341	0	1	873	0	0	1	361	0
Not Repaired - Overdue											
Pad Mount Total											
Total											
Number of Deficiencies	20	349	1627	36	268	924	1	5	104	367	0
Repaired in Time Frame	20	338	227	36	212	11	1	5	8	0	0
Repaired - Overdue	0	11	0								
Not Repaired - Not Due	0	0	1400	0	56	913	0	0	96	367	0
Not Repaired - Overdue											

Exhibit 6 - Transmission Projects Between Step 0 and Step 2

This exhibit contains specific asset condition related projects and related issues for overhead lines that are between Step 0 (Conceptual Engineering) or Step 2 (Final Engineering).

Niagara/Packard-Gardenville #180-182 T1660-T1780 ACR (C27436)

Total length: Niagara to Gardenville (Lines 180/182, 182/62, 182/54), approx. 36 miles; Packard to Tonawanda (Lines 180 and 182), approx. 23 miles; Tonawanda to Gardenville (Lines 182/92, 182/54), approx. 13 miles.

Conductor Types:

- Niagara-Packard 180; varies - 1431 AAC “Carnation”, 795 AAC “Arbutus”, 400 CU, and 500 CU
- Packard-Tonawanda 180/182; varies - 795 ACSR “Drake”, 795 ACSR “Coot”, and 500 CU
- Packard-Tonawanda 180/105; 795 ACSR “Coot”
- Packard-Tonawanda 182/92; 500 CU
- Tonawanda-Urban 182/92; varies - 636 ACSR “Kingbird”, 795 ACSR “Coot”, and 400 CU
- Urban-Gardenville 182/54; varies - 636 ACSR “Kingbird”, 795 ACSR “Coot”, and 400 CU

Total number of structures: 417
Number of wood structures: 20
Number of steel pole/structures: 397
Types of structures: Lattice towers, flex towers, wood poles, and steel poles.
Estimated circuit age: 1930’s
LIF Group: T1660 is in Group 8 and T1780 is in Group 9 (Ranges from 1 to 10, the higher the number the more important)

- This project is currently in Step 0 conceptual engineering.
- As part of this process, an extensive engineering field walk down is being completed to confirm the existence of physical deterioration and to classify the level of that deterioration. This information will be used to determine the scope of the project and establish a schedule.
- Conductor and shield wire testing has been scheduled to help determine the appropriate scope.
- Significant deterioration exists throughout the 182 circuit.
- Structure 133 failed April 28, 2011, due to deterioration combined with high winds.

<u>Gardenville-Dunkirk 141-142 T1260-T1270 ACR (C03389)</u>
Total length: Approximately 45 miles
Conductor Types: Varies – 250 kcm CU, 400 CU, 4/0 CU, 336 kcm ACSR, and 636 kcm AAC, and 795 ACSR.
Total number of structures: 586 structures
Number of wood structures: 27 structures
Number of steel structures: 559 structures (of which are 322 Ritter-Conley Flexible Towers with Z cross members)
Types of structures: Double circuit, primarily steel (Z type flex), structures
Estimated circuit age: 1930s vintage
LIF Group: T1260 is Group 10 and T1270 is Group 10

- Failure Analysis No. 7 (FA0007), provided by Transmission Line Operations & Maintenance Engineering (TLOME), concluded the connectors and splices require replacement based upon poor condition.
- Failure Analysis FA0051 documented a failed jumper loop during a winter storm on December 9, 2009. TLOME indicated that this failure "was likely due to fault current from another, earlier fault. AMPACT connectors have historically shown an elevated potential for failure when subjected to fault current."
- An engineering field walk down was conducted on these two circuits in 2007.
- Conductor testing was completed in August 2011; the conductor was determined to be adequate to remain in service.

- The following options are being reviewed at this time:

1. Option 1: Reconductor with 795 kcm
   - Full replacement of 322 Ritter-Conley Flexible Towers due to increased loading associated with reconductoring, in addition to deteriorated condition.
   - Full replacement of eight "standard" flexible structures for clearance
   - Installation of two new structures to meet clearance between dead-end structures
   - Square Based Lattice Steel Tower Modifications:
     - Ninety eight lattice steel towers require replacement of the top to incorporate a second shield wire
     - Thirty two structures need cross members repaired
     - Thirty four structures need repairs to base
2. Option 2: Reconductor with 477 kcm
   - Similar scope to Option 2.
3. Option 3: Life extension (approximately 15 years) without reconductoring routes (this eliminates much of the need for structure replacements to add a second shield wire)
   - Combination of maintenance and capital improvements that will extend the operational life of these circuits by about 15 years
   - Cost effective improvements to improve reliability (without major structure reconfigurations) such as the replacement of all insulators and fittings
   - Replace significantly deteriorated structures and keep those structures suitable for 15 or more years of operation
4. Alternate routes
   - Costs have not been determined in detail but appear to be more expensive at this time

- Based upon conductor testing results, Option 3 is the most likely option to be pursued at this time.

Gardenville-Homer Hill #151-152 T1950-T1280 ACR South (C27425)
Total length: Approximately 83 miles (45 miles from Homer Hill to Str. 200)
Conductor Types: Varies - 336.4 ACSR "Oriole", 795 ACSR "Coot", and 4/0 7-strand CU
Total number of structures: 433
Number of wood structures: 24
Number of steel structures: 409
Types of structures: Primarily double circuit steel flex towers (280) and semi strain square base steel towers (73).
Estimated circuit age: 1920's
LIF Group: T1950 is in Group 8 and T1280 is in Group 8

- This project is currently in the Step 0 process of the Project Management Playbook, or conceptual engineering.
- Based upon an engineering field walk that was done in 2009, Transmission Line Engineering predicts that the conductor will fail testing.
- Conductor shows signs of deterioration (located in an industrialized area, historical pollutants are believed to have been higher than normal). The Transmission Line Engineering field evaluation noted 427 conductor splices on the line; 224 splices on #151 and 203 splices on #152.

<u>Lockport-Mountain/Beck#103-104 T1620-T1060 Steel Tower Refurbishment (STR) (C27432)</u>
Total length: Approximately 19 miles for Beck-Lockport 104 and 20 miles for Mountain-Lockport 103 (17 miles are double circuited)
Conductor Types: Varies: Mountain-Lockport 103; 636 AAC “Orchid” 37/0, 795 AAC “Arbutus” 37/0, 636 ACSR “Kingbird” 18/1, 795 ACSR “Coot”36/1, 400 CU 19-strand. Beck-Lockport 104; 636 AAC “Orchid” 37/0, 795 AAC “Arbutus” 37/0, 636 ACSR “Kingbird” 18/1, 795 ACSR “Coot” 36/1, 400 CU 19-strand, and 500 CU
Total number of structures: 219
Number of wood structure units: 20
Number of steel structure units: 199
Types of structures: Predominately double circuited, with steel tower structures (including 100 lattice and 99 flex suspension) and wood structures.
Estimated circuit age: 1930’s
LIF Group: T1620 is in Group 9 and T1060 is in Group 6

- This project is currently in the Step 0 process of the Project Management Playbook, or conceptual engineering.
- Conductor and shield wire testing has been scheduled to help determine the appropriate scope.
- Engineering field walk-down was completed and looked at both steel and wood structures.
- Condition based engineering information is being analyzed by Transmission Line Engineering. However, the following preliminary assessment has been made:
  - Approximately 16 wood structures are deemed as “reject equivalents”
  - Approximately 6 steel structures are deemed as “reject equivalents”
  - Most of the steel structures can be re-used but (1) the insulators & fittings should be replaced and (2) maintenance type painting is recommended.

<u>Lockport-Batavia #112 T1510 ACR (C03422)</u>
Total length: Approximately 34 miles
Conductor Types: Varies - 250 Copper 19-Strand, 795 ACSR “Coot” 36/1, 336.4 ACSR “Linnet” 26/7, 428 AAC 19-Strand, and 636 AAC “Orchid”
Total number of structures: 369
Number of wood structure units: 156
Number of steel structure units: 213
Types of structures: Steel towers (178 of which are tri-leg towers) and wood pole structures (111 of which are single pole with davit arms).
Estimated circuit age: 1930-1940’s
LIF Group: 8

- This project is currently in the Step 0 process of the Project Management Playbook, or conceptual engineering.
- As part of this process, an extensive engineering field walk down is being completed to identify the existence of physical deterioration and to classify the level of that deterioration. This information will be used to determine the scope of the project and establish a schedule.
- Conductor and shield wire testing has been scheduled to help determine the appropriate scope.

<u>Lockport-Mortimer #111 115 kV, T1530 ACR (C03417)</u>
Total length: Approximately 56 miles (with 2,000 feet of underground near the Rochester Airport)
OHL Conductor Types: Varies – includes "Coot" 795 kcm ACSR 36/1, "Orchid" 636 kcm AL 37/0, 428 kcm Aluminum 19/0, 477 AAC, and 250 CU 19/0.
UG Conductor: 1250 CU
Total number of structures: 618 structures
Number of wood structure units: 71
Number of steel structure units: 547 (including 2 substation take-off structures)
Types of structures: Single circuit, primarily steel structures (523 of which are aeromotor or windmill style steel structures)
Estimated circuit age: 1906
LIF Group: 8

- An Article VII filing, submitted on December 30, 2009 (Case 09T0870), provides a detailed description of the existing and proposed facility changes.
- The Environmental Management and Construction Plan (EM&CP) was filed on April 27, 2011.
- An engineering field walk down verified that a high majority of the 100+ year old steel structures have reached end of life.
- Due to the structural condition of this line and overall safety concerns, construction work will begin on this line as soon as the necessary regulatory reviews and approvals are completed.
- Construction is targeted to begin at the end of CY2011.

<u>Pannell-Geneva #4-4A T1860 ACR (C30889)</u>
Total length: Approximately 25 miles
Conductor Types: 795 kcmil ACSR "Coot" and 336.4 kcmil ACSR "Oriole"
Total number of structures: 269
Number of wood structure units: 3
Number of steel structure units: 266
Types of structures: Predominantly bussed structures (consisting of steel towers, Blaw Knox dead-end towers, wood pole structures, flex towers, and a steel pole).
Estimated circuit age: 1900 to 1920's
LIF Group: 5

- This project is currently in the Step 0 process of the Project Management Playbook, or conceptual engineering.
- In April 2003, tower 188 on the Pannell-Geneva 4-4A 115kV Line in Western NY toppled during an ice storm. Deterioration at the base of the tower contributed to this failure.
- Failure Analyses FA0021 and FA0030 document condition concerns on this line.
- An engineering field walk-down identified a number of condition problems on this line.
- Conductor and shield wire testing has been scheduled to help determine the appropriate scope.

<u>Taylorville-Boonville #5-6 T3320-T3330 ACR (C27437)</u>
Total length: Approx. T3320/31 miles and T3330/37 miles
Conductor Type: 4/0 copper
Total number of structures: 311
Number of wood structure units: 181
Number of steel structure units: 130
Types of structures: Primarily steel lattice towers (127) and double circuit wood pole structures (174 2-pole structures).
Estimated circuit age: Late 1920's to early 1930's
LIF Group: T3320 is Group 7 and T3330 is Group 6

- A field engineering walk-down was conducted in 2009:
  - In general, lattice towers are in serviceable condition. Sixty-two of the lattice towers have buckled or distorted bracing members, which will need to be further evaluated for possible replacement and/or repair.
  - Three structures have at least one concrete foundation with sections of spelled and deteriorated concrete, which will require repair.
  - The insulators on 248 structures appear to be new and in good condition, and do not need to be replaced. The insulators on 62 structures will be replaced because 16 structures have original insulators, 8 have horizontal post insulators, and 38 structures have polymer insulators.
- The taps vary in age and condition and generally consist of wood structures most of which were installed in the mid-1950s. Based upon engineering judgment most of these would probably fail NESC strength requirements within 10 years. However, a detailed PLS (Power Line Systems, Inc.) Pole modeling evaluation has not been performed at this time.
- Conductor and shield wire testing in 2010 indicated that the conductor passed testing may be left in service (on the order of 10 or more years) while the shield wire requires replacement.
- Transmission Planning does not require a system reconfiguration.
- This project completed the conceptual design process and is out of Step 0.
- Proposed scope of work includes the installation of the following (on the mainline):
  - Approximately 33.5 miles of 3/8" E.H.S. steel shield wire
  - 3 double circuit wood pole steel davit arm structure
  - 48 steel davit arms and suspension assemblies at 8 structure locations
  - Two additional discs to suspension assemblies at 206 structure locations
  - 234 suspension assemblies at 39 suspension structure locations
  - 96 strain assemblies at 16 strain structure locations
  - Improved grounding
- The condition of the taps off of the T3320-T3330 circuits vary. However, wood structures dominate these taps and have a shorter asset lifecycle than steel structures. Due to the poor condition of the Lyons Falls Tap, Lyonsdale Burrow Tap, and New Bremen Loop, they should have a number of structures replaced. At this time, shield wire replacement is being recommended on the Lyonsdale Burrows Tap
- The Kraft tap is in good condition with post insulators.

Taylorville-Moshier #7 T3340 Life Extension Refurbishment LER (C24361)
Total length: Approximately 11 miles
Conductor Types: Varies - 336.4 kcm ACSR codename "Linnet", 3/0 ACSR codename "Pigeon" and 4/0 CU
Total number of structures: 99
Number of wood structure units: 9
Number of steel structure units: 90
Type(s) of structures: Primarily steel towers (of which 64 are flex towers and 26 lattice steel towers)
Estimated circuit age: 1925
LIF Group: 8

- Originally slated as a lightning improvement project (i.e., insulator & hardware replacement with grounding improvements), the engineering field walk-down determined that a more thorough refurbishment was required.
- Conductor testing was completed and the results indicated that conductor replacement is not required at this time. This refurbishment has now been classified as a Life Extension Refurbishment.
- Since preliminary engineering is not completed and final engineering still in the future, a detailed description of each facility or unit planned for replacement cannot be provided at this time. However, the following conceptual highlights can be noted at this time:

    - Replace 5 deteriorated wood pole structures and 3 steel flex structures.
    - Replace insulators and hardware on all structures
    - Repair 4 deteriorated concrete foundations
    - Replace 3/8" steel shield wire (11 miles).
    - Replace crossarm hangers on 62 steel structures.
    - Install/Improve grounding and signage as required.

Porter-Rotterdam #31 T4210 ACR (C30890)
Total length: Approximately 72 miles (note first 12 miles are supported on steel pole structures, dual circuit with NYSEG-owned 345 kV circuit)
Conductor Types: 1431 kcmil ACSR and 795 kcmil ACSR conductor
Total number of structures: 698
Number of wood structure units: 610
Number of steel structure units: 88
Types of structures: steel poles and wood H-frames
Estimated circuit age: 1940-1950's
- This project is currently in the Step 0 process of the Project Management Playbook, or conceptual engineering.
- The Porter-Rotterdam 31 transmission line is under evaluation for potential upgrade from 230 kV to 345 kV. Any recommendations will be submitted to the New York ISO Congestion Assessment and Resource Integration Studies (CARIS) for review.
- Any proposal work on this line will take into consideration the potential for this type of system reconfiguration.

Ticonderoga-Republic 2 and Ticonderoga-Whitehall 3 115 kV, T5810-T5830 Safety at Critical Crossing Refurbishment (SXR2) (C39487 and CNYAS82)

Total length: Approximately 20(#2) and 23 (#3) miles
Conductor Types: Ticonderoga-Republic #2; 336.4 kcmil ACSR, 30/7, "Oriole" and 4/0 Copper conductors. Ticonderoga-Whitehall #3; 336.4 kcmil ACSR, "Oriole," and 30/7 conductors.
Total number of structures: 413
Number of wood structure units: 343
Number of steel structure units: 70
Types of structures: Single circuit, primarily consisting of wood pole H-frame structures and steel lattice towers
Estimated circuit age: 1920-1930's
LIF Group: T5810 is Group 7 and T5830 is Group 4

- This is a refurbishment project based on current condition, safety concerns at critical crossings, and reliability experience of the T5810 and T5830 circuits. Due to urgent safety concerns, a fast track safety refurbishment was pursued. This primarily focuses on the replacement of deteriorated structures near roadways, navigable waterways, and railroads along with addressing substandard conductor clearance issues.
- During the engineering field walk-down conducted in 2007 by Transmission Line Engineering, significant deterioration of the wood structures was observed.
- For the Ticonderoga-Republic 2 line, over 60 wood structures will be replaced and for the Ticonderoga-Whitehall 3 line, approximately 45 wood structures will be replaced. In addition, this refurbishment replaces another non-switch structure with a switch to sectionalize a NYSEG interface.
- This safety refurbishment is for entire 40 miles of these two lines which provide a radial supply to distribution stations north of Whitehall. It primarily focuses on replacement of deteriorated structures near or at their end of life near roadways, navigable waterways, and railroads along with substandard conductor clearances. In addition, another non-switch structure will be replaced with an air break switch to sectionalize a NYSEG interface.
- The safety project to date replaced 98 transmission line structures (preliminary information) as part of C19530 which was completed with live-line work methods.
- C19530 started this safety refurbishment in FY2010/11 and C39487 will conclude this safety refurbishment in FY2012/13.
- Conductor and shield wire testing is planned for during the safety refurbishment to assist with the long-term option analysis.
- CNYAS82 is a placeholder for a future long-term refurbishment, or reconfiguration, of these two transmission lines.

The following lines are included as placeholders, but will be re-evaluated once the new screening criteria are finalized:

Dunkirk-Falconer 161-162 T1090-T1100 (CNYAS49)
Total length: Approximately 36 miles
Conductor Types: Varies **-** 636 AAC "Orchid" 37/0, 795 ACSR "Coot" 36/1, and 4/0 ACSR 6/1
Total number of structures: 369
Number of wood structures: 21
Number of steel structures: 348
Types of structures: Double circuit steel tower and wood pole structures
Estimated circuit age: 1920-30's

Indeck Oswego-Lighthouse Hill #2 T2300 (CNYAS56)
Total length: Approximately 28 miles
Conductor Types: 4/0 copper, 336.4 kcmil ACSR "Linnet", and 795 kcmil ACSR "Coot".
Total number of structure units: Approximately 262
Number of wood structure units: 15
Number of steel structure units: 247
Types of structures: Steel towers, steel poles, and wood 2-pole structures
Estimated circuit age: 1920's