New York State Transmission Assessment and Reliability Study (STARS)
Phase 1 Study Report – “As Is” Transmission System

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STARS PHASE I SUMMARY

The New York State Transmission Assessment and Reliability Study Working Group[1] (STARS WG) commissioned a Long Term Transmission Planning study for the electric transmission system within the State of New York. The results from this study are intended to be used by individual New York Transmission Owners (NYTOs) for developing a coordinated and well planned transmission system to meet the overall NYCA reliability requirements over a study horizon of about 20 years into the future.

Presently, the New York Independent System Operator (NYISO) has in-place a Comprehensive System Planning Process (CSPP) encompassing both reliability and economic analyses which are conducted over a 10-year planning horizon:

i) Comprehensive Reliability Planning Process (CRPP)
ii) Congestion Analysis and Resource Integration Study (CARIS).

The CRPP has two parts; a) a Reliability Needs Assessment (RNA) and b) a Comprehensive Reliability Plan (CRP), which identifies the resources needed on the bulk power system to meet applicable Reliability Rules, including sufficient resource capacity to meet the New York State Reliability Council's (NYSRC) Loss-of-Load Expectation (LOLE) criterion[2].

The CARIS is an economic process which identifies the highest congested bulk power elements based on the analysis of both historic and projected congestion. In the first part of the CARIS, a benefit/cost analysis of generic generation, transmission and demand-side solutions is performed; and in the subsequent part, developers may submit specific transmission solutions for analysis to determine their eligibility for cost recovery under the NYISO Tariff.

However, identifying the most economical and effective solutions for a mature power system (which is characterized by slower load growth and aging facilities) that exist in the State of New York requires a longer time horizon than the 10 year period of CSPP. More specifically, the longer time horizon is necessary for several reasons, such as, to:

i) evaluate whether a new transmission voltage or technology is necessary and economical
ii) incorporate the need to replace aging infrastructure (transmission lines and substations)
iii) address various existing limited rights-of-way and siting issues
iv) consider effective integration of renewable resources
v) meet varying reliability needs across the NYCA system in a coordinated manner
vi) consider emerging technological and regulatory issues, such as plug in electric vehicles, under a reasonable number of potential future scenarios

The above six factors are overlapping in nature. Considering all of these factors at the same time will expand the possibilities to a large number of alternatives and options. As the number of alternatives increase, the amount of effort required for analyses increases substantially.

[1] Central Hudson Gas & Electric Corporation ("Central Hudson"), Consolidated Edison Company Of New York, Inc. ("Con Edison"), Long Island Power Authority ("LIPA"), National Grid ("National Grid"), New York Power Authority ("NYPA"), New York State Electric And Gas Corporation ("NYSEG"), Orange & Rockland Utilities, Inc. ("O&R") and Rochester Gas & Electric Corporation ("RGE")
[2] LOLE criterion is 1 day in ten years or an annual statewide LOLE of no greater than 0.1 days/year

Study Approach: Although the longer time horizon is needed because of the issues stated above, it introduces other significant issues. One of the most difficult issues, for long-range transmission planning under open market conditions, is the great uncertainty associated with new generation plants/units, including location, size, type etc. If a new transmission project is built[3] and the new generation does not materialize at the location or in its anticipated size (or capacity); then the new transmission becomes a stranded or under utilized asset. In the case of reverse situation, the transmission becomes limiting, thereby potentially affecting the reliability and economics (congestion) of the power system. Similar issues with respect to the degree of penetration and the location of demand side resources also exist. ***In light of these uncertainties, the most practical approach is to postulate various Scenarios of future resource development and to determine a range of transmission solutions or projects for the pre-defined Scenarios.*** Even though the Scenario approach considerably increases the amount of effort required for the analyses, using carefully considered Scenarios combined with appropriate sensitivity evaluations will assist in defining the transmission capacity requirements for meeting the reliability criterion.

Inclusion of aged facilities and renewable resource development to identify a robust mix of prudent transmission alternatives requires further analyses. Hence, STARS WG divided this study into three phases:

1. **Phase I** – Identify the need for additional transfer capability to meet state-wide LOLE (with the existing transmission system).
2. **Phase II** – Identify the most suitable and cost effective transmission alternatives to meet the previously determined additional transfer capability while considering aged infrastructure and integration of renewable resources.
3. **Phase III** – Perform additional sensitivity analyses and assessments

This Summary presents the results of Phase-I only.

Load Levels: In any planning study the starting point is to define a base forecasted load level. The load growth for the past 30 years has been uneven; similarly there is a high degree of uncertainty regarding future electric load within the state. Rather than expending a lot of time and effort on arriving at a precise timing for a given forecasted load level; this study looks at a particular future load level for NY State of 40,816MW for the **Horizon Year (about year 2030)**. This level of load may happen earlier or later**,** depending upon the load growth that actually occurs. An example of higher load growth is a high penetration of plug-in electrical vehicles. Conversely, a slower load growth will be due to aggressive Energy Conservation and Efficiency Programs, Distributed Generation etc. A load level of 37,130MW for the **Intermediate Year** (about half-way of the planning horizon) was assumed. As a reference, the summer peak load for the year 2009 was 30,844 MW; whereas the record peak load of 33,939MW occurred during the summer of 2006.

Capacity Expansion Scenarios: The STARS-WG formulated four Scenarios, as a “mix and match” of Regional and Statewide Generation coupled with Low and High Import possibilities (Table 1). Thus, the four Scenarios (#1 through #4) span a wide range of future generation development possibilities and thus define boundaries or “book-end” possibilities.

Further, with the Renewable Portfolio Standards (RPS) goals of the state in mind; two additional Scenarios (#5 and #6) explicitly including higher levels of wind generation have also been

[3] This includes uprating, upgrading and/or undersizing and over-sizing of transmission additions.

included. The total new generation capacity added by the Horizon Year for each scenario is based on the installed capacity reserve margin of 16.5% (IRM) that was in effect when the Study started, translating to 5,015MW for Scenarios #1 through #4. Due to lower and different capacity factors associated with on-land and off-shore wind farms as well as non-coincidence of the maximum wind generation with the system peak load, the total new generation installed capacity requirement (to equal the effective or UCAP requirement of scenario's #1 thru' #4) is 6,834MW for Scenario #5 and 7,740MW for Scenario #6.

The recent change of IRM from 16.5% to 18% may be viewed as an additional generation requirement for a given load level or a lower load level for a given generation capacity. In this study, the various scenarios assume a given level of generation and the need for additional transmission was evaluated by using a Probabilistic Reliability Criterion (LOLE). The identified needs for the Horizon Year may be viewed to advance by a couple of years, when one considers an 18% IRM vs. the 16.5% assumed in the study. Thus, the results of the Phase-I Study are not affected by this change in the IRM requirement, except for possible timing of identified needs.

Table-1: Capacity Expansion Scenarios

	Future Capacity Scenario	Internally Located Capacity (as percentage of incremental capacity requirement)	Externally Located Capacity Imports(as percentage of incremental capacity requirement)	Location of Externally Located Capacity Imports (as percentage of incremental capacity requirement)
1	Downstate Capacity	85% Zones H-K	15%	10% ISONE (Zone K) 5% PJM (Zone J)
2	Upstate Capacity	50% Zones A-F	50%	25% PJM (Zones A/C) 25% HQ (Zone D)
3	Statewide Capacity -Low Imports	90% Zones A-K	10%	3.3% ISONE (Zone F/G) 3.3% PJM (Zone J) 3.3% HQ (Zone D)
4	Statewide Capacity - High Imports	25% Zones A-K	75%	25% PJM (Zones I/J/K) 50% HQ (Zones D)
Scenarios With Wind Resources for 25% Energy				
5	Downstate Capacity Renewables located downstate	85% Zones H-K	15%	10% ISONE (Zone K) 5% PJM (Zone J)
6	Upstate Capacity 50% of renewable capacity located upstate; 50% external	50% Zones A-F	50%	25% PJM 25% HQ

Reliability Criterion: The resource adequacy reliability criterion for New York State bulk electricity system is a LOLE of one day in 10 years or 0.1 days per year. Emergency assistance available from the external areas (PJM, ISO-NE, Ontario and Hydro-Quebec) is included for the calculation of LOLE. These external areas are also assumed, consistent with the NYISO RNA assumptions, to achieve the target resource reliability criterion (LOLE of 1 day in ten years) on a multi-area or interconnected operation basis.

Methodology: The main methodology for this Phase-I Study is to determine the transmission capacity requirements for various scenarios to meet the above mentioned LOLE. The primary tool used for LOLE calculation in this study is GridView[4]. In this model a full representation of the transmission network (as in the PSS/E power flow cases including external areas) is used. In addition to the detailed transmission network representation, the GridView model contains various constraints for transmission lines, interfaces, contingency constraints, monitored lines, nomograms and emergency operating procedures (EOP).

Transfer Limits: The Interface Transfer Limits for both Cross-State and External areas (Table-2) were computed for the existing transmission topology and the intermediate year conditions; which are close to the NYISO 2009 RNA assumptions and findings. These limits are used in the Gridview model for the LOLE calculations.

Table-2: Emergency Transfer Limits for LOLE Calculations for the existing transmission (Intermediate Year)

Interface	Limit MW
Dysinger East	2,504 (V)
West Central	1,134 (V)
Moses South	1,971 (V)
Volney East	3,952 (V)
Total East (Closed)	6,270 (V)
Central East	2,604 (V)
Central East + Fraser-Gilboa	2,916 (V)
CE Group	4,587 (V)
F to G	3,485 (T)
UPNY-SENY Open	5,124 (T)
UPNY-ConEd Open	5,392 (V)
Millwood South Closed	8,161 (V)
Dunwoodie South Plan	5,780 (T)
I to J	4,460 (T)
I to K (Y49/Y50) with Y49 flow set to 637 MW	1,238 (T)
I to K (Y49/Y50) with Y49 flow set to 637 MW and Y50 RateA=653 MVA	1,293 (T)
I to J+K	5,413 (V)
LI Import (with LIPA imports maximized)	2,851 (T)
LI Import (with LIPA imports maximized and Y50 RateA=653 MVA)	2,905 (T)
Marcy South	1,686 (V)
(T) = Thermally-constrained	
(V) = Voltage-constrained	

[4] GridView is ABB's reliability analysis and market simulation software using Monte Carlo simulations. Gridview results benchmarked are very close to the values from GE Multi-Area-Reliability Simulation Program used by NYSRC and NYISO for LOLE studies.

Calculated LOLE for the Six Scenarios: The LOLE index was calculated for each of the six scenarios (Table-3). For Scenarios #1 and #5; the calculated LOLE values show that the postulated generation expansion plans combined with the existing transmission capability can meet the target reliability index of 0.1day/year. It may be recalled that for these two scenarios, most (85%) of the new generation capacity was added in the down-state load zones. In Scenario #3 the new generation (90%) was distributed proportionally to each zone and resulted in an LOLE somewhat above the target level. Scenario #4 with a heavy emphasis on imports (75% of new capacity) shows that LOLE criterion cannot be met with the existing transmission system. The Scenarios #2 and #6 (with 50% of generation in the upstate zones and the other 50% from external imports) have the highest LOLE of the generation expansion scenarios studied and hence reliability criterion cannot be met with the existing transmission system. The LOLE value for Scenario #6 (similar to Scenario#2, but with more wind) is a bit higher, because the installed generation capacity considered for Wind Scenarios is in the up-state zones. Similar comparison can be made between LOLEs for Scenarios #1 and #5.

Table-3: Calculated LOLE values for Six Scenarios (Horizon Year)
With the existing transmission

	NYCA LOLE (days/year)
Scenario 1	0.06
Scenario 2	1.68
Scenario 3	0.20
Scenario 4	0.44
Scenario 5	0.07
Scenario 6	1.82

Additional Transmission Capacity for Scenario #s 2, 3, 4 and 6: The study results have shown that the reliability criterion is met for Scenarios #1 & #5. However, the LOLEs for Scenario #s 2, 3, 4 and 6 are above the desired value. In order to estimate the additional transmission capacity needed to reduce the LOLE values to 0.1day/year the GridView simulations were repeated for these four Scenarios to determine the additional transmission MW needed for each of the Interfaces (shown in Table 4) to achieve the reliability criterion. Because Scenarios #5&#6 are similar to Scenarios #1&#2, results for only the four primary scenarios are shown in this table. The values in green color show the lowest non-zero value of the need, the red color the highest values and the black color for in-between values.

The MW need for each scenario (shown in each column) should be interpreted to be simultaneous, i.e. all the interface transfer limits need to be increased to the levels shown. In other words, increasing only one or a few of the interfaces to the shown MW levels is not sufficient to achieve the LOLE criterion. On the other hand, it may not be reasonable to upgrade all the Interfaces for all the Scenarios to the highest values shown in red color because these limits define the book ends and any future development will likely be somewhere within these boundaries.

Table-4: Additional Transmission Capacity Need for the 4 Scenarios
(Horizon Year)

	Additional Transfer Capability (MW) Need			
	Scenario #1	**Scenario #2**	**Scenario #3**	**Scenario #4**
CE Group	0	**1,460**	**150**	**1,185**
UPNY-SENY	0	**1,735**	**249**	**702**
Volney East	0	**1,314**	**492**	**648**
Central East	0	**1,047**	**279**	**1,106**
I to J	0	**1,135**	**386**	**424**
Y49Y50	0	**752**	**159**	**972**
F to G	0	**1,171**	**187**	**399**
Total East	0	**1,274**	0	**456**
West Central	0	**265**	**316**	**192**
Marcy South	0	**435**	**15**	**257**
Moses South	0	0	0	**228**
HQ - D	0	0	0	**550**

The values in Table 4 are shown to a precision of one MW. For practical purposes, the values will be rounded when considering the MW need in Phase II when transmission alternatives are being analyzed for those scenarios which require transmission reinforcements.

Transition from Phase I to Phase II: The actual expansion of the NYCA transmission grid should be adapted to account for the constantly evolving load growth, location and magnitude of future resource capacity additions, and assumed emergency assistance from neighboring control areas. For example, additional resource capacity assumed Downstate (Scenario 1) was shown to mitigate or eliminate the need for transmission expansion for the study horizon (without consideration of aged infrastructure which is a Phase II consideration). Conversely resource capacity assumed for Upstate (Scenario 2) showed a need to expand the transmission system to satisfy system reliability requirements. The reliability needs along with the aging infrastructure needs and the delivery of renewable resources will be considered within the next phase of the study. As with any study of this type, time will tell which scenario reflects more accurately the location of new generation and/or demand side resources. However, since timescales for constructing transmission reinforcements are in the five to ten year time horizons for large scale improvements, it will be necessary to identify those projects that can provide the overall best values for the state when considering all of the needs. Since generation expansion assumptions have a major impact on scenario analysis, and there have been some major changes in base generation assumptions since the start of this study, Phase II will update the power flow base case with likely new generation to be installed in the state in the next 5 years based on how far along they are in the NYISO interconnection process. The updated power flow base case with economic dispatch will be used for determination of new Interface Transfer Limits in Phase II part of the study.

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1 INTRODUCTION

The New York Strategic Transmission Assessment and Reliability Study Working Group[5] (STARS WG) commissioned a Long Term Transmission Planning study for the New York State's electric transmission system. During this study, several issues such as reliability, economical alternatives, political and regulatory initiatives, integration of renewable resources were taken into consideration. The results from this analysis are intended for developing a coordinated and well planned transmission system expansion as well as investments to be made by individual New York Transmission Owners (NYTOs) to meet the overall NYCA reliability requirements over the next 20 years.

During the vertically integrated utility structure, the location of new generation sites was fairly well defined and transmission was planned to bring the power from generation plants to load centers. Also, the transmission capability was built on the basis of deterministic planning criteria (most familiar n-1 and others) under the most plausible transmission stress (i.e. generation dispatch) conditions. However, the deregulation and the open market operation have changed these two fundamental assumptions of transmission planning.

One of the big challenges of long-range transmission planning in the open market arena is the great uncertainty of the location of new generation plant/unit, its size, type etc.

Recognizing this aspect, as well as meet various regulatory requirements (State and Federal), New York Independent System Operator (NYISO) has two processes in place;

i) Comprehensive Reliability Planning Process (CRPP)
ii) Congestion Analysis and Resource Integration Study (CARIS).

The CRPP is a long-range (10-year planning horizon) reliability assessment of both resource adequacy and transmission security of the bulk power system in the State of New York. The Comprehensive System Planning Process (CSPP) encompasses the existing CRPP (technical) as well as the Congestion Analysis and Resource Integration Study (CARIS) for economic aspects. Based on the CRPP, an annual Reliability Needs Assessment (RNA) is undertaken by NYISO. The latest completed RNA (in early 2009) was for identifying and meeting the future reliability requirements, up to the year 2018.

However, identifying the most economical and effective solutions requires a much longer view (time horizon), especially for a mature power system such as the one that exists in the State of New York. A long-term view for transmission planning is necessary to:

[5] Central Hudson Gas & Electric Corporation ("Central Hudson"), Consolidated Edison Company Of New York, Inc. ("Con Edison"), Long Island Power Authority ("LIPA"), National Grid ("National Grid"), New York Power Authority ("NYPA"), New York State Electric And Gas Corporation ("NYSEG"), Orange & Rockland Utilities, Inc. ("O&R") and Rochester Gas & Electric Corporation ("RGE")

i) evaluate whether a new transmission voltage or technology is necessary and economical
ii) incorporate the need to replace aging infrastructure (transmission lines and substations)
iii) address various limited rights-of-way and sitting issues
iv) consider effective integration of renewable resources
v) meet varying reliability needs across the NYCA system in a coordinated manner
vi) consider emerging technological and regulatory issues, such as plug in electric vehicles, under a reasonable number of potential future scenarios

The above six factors are overlapping in nature. For example a new transmission voltage requirement may be due to the new generation proposed at a specific location, or a combination with an aging transmission line requiring replacement and/or limited right-of-way. Considering all these factors at the same time will expand the possibilities to a large number alternatives and options. As the number of alternatives increase, the amount of effort for analyses increases substantially. Further, the results obtained may complicate the identification of prudent transmission alternatives. Hence, STARS WG divided this study into three phases:

1 **Phase I** – Identify the need for additional transfer capability to meet state-wide LOLE (as is transmission system).
2 **Phase II** – Identify the most suitable and cost effective transmission alternatives to meet the previously determined additional transfer capability
3 **Phase III** – Perform sensitivity analyses and assessments

A conceptual view of this study is shown in Figure 1-1.

This report presents the analyses and results of Phase-I only. Study Approach and basic assumptions are described in Section 2. Then the remaining sections are divided into two parts. In the first part the power flow models, emergency transfer limit calculations and security analysis results are discussed. In the second part, the capacity models, LOLE calculations and the Transfer Capability Needs for meeting the NYCA Reliability Criterion of 0.1day/yr are presented. The Phase-I study results are summarized and presented at the front of this report.

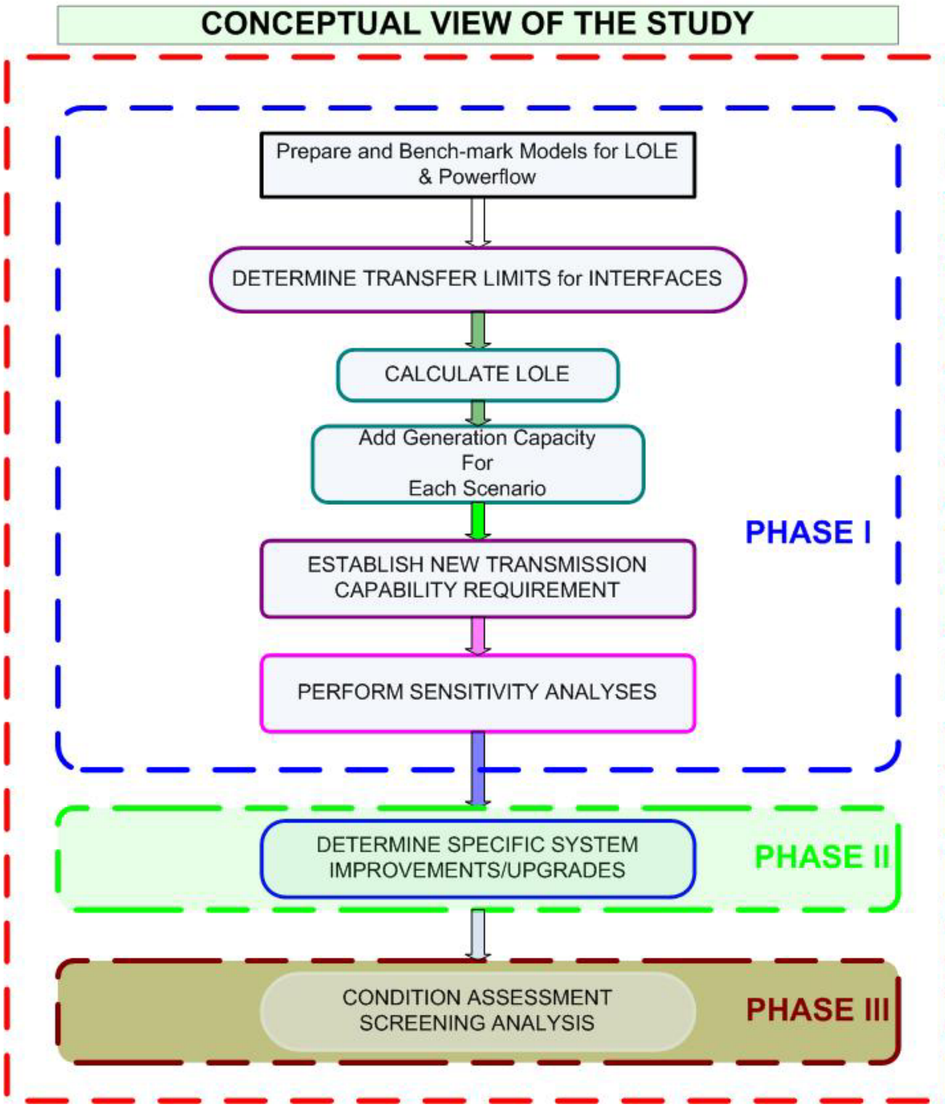

Figure 1-1: Three Phases of the Study

2 STUDY APPROACH

Adequacy (Reliability) is the ability of an electric system to supply and deliver the total quantity of electricity demand at any given time taking into account scheduled and unscheduled outages of system elements. Adequacy considers the transmission systems, generation resources and other capacity resources, such as demand response. Adequacy assessments are performed on a probabilistic basis to capture the randomness of system element outages. A system is adequate if the probability of not having sufficient transmission and generation to meet expected demand is better (equal to or less) than the reliability criterion or target. The reliability criterion or metric used is Loss of Load Expectation (LOLE). The New York State bulk electricity system is planned to meet an LOLE of one day in 10 years or 0.1 days per year. Thus, the main study methodology is to determine whether the future system meets this reliability target and if not what is required from transmission point of view.

In order to span a sufficiently long time horizon, this study looks at approximately twenty years ahead called **Horizon Year** for planning purposes. Depending upon the load forecast used and its attendant assumptions, the time horizon is about 2028 – 2030 range; earlier timing for a higher load growth (plug-in electrical vehicles as an example) and later timing for a slower load growth (Aggressive Energy Conservation and Efficiency Programs, Distributed Generation etc.).

At the same time, it is also important to address the needs in the near term and coordinate both the long term and near term needs. Hence, the study also addresses the needs for the **Intermediate Year** (next ten year period of about 2018-2020 range), with the same load growth caveat. A very good example of a coordinated implementation of a transmission project is building an overhead line for a higher voltage level (a very efficient utilization of right-of-way), but operating at a lower voltage level until the substation upgrade is needed so that the corresponding investment is deferred.

One of the most difficult issues, for long-range transmission planning under open market conditions, is the great uncertainty associated with new generation plants/units, including location, size, type etc. If a new transmission project is built[6] and the new generation does not materialize at the location or in its anticipated size (or capacity); then the new transmission becomes a stranded or under utilized asset. In the case of reverse situation, the transmission becomes limiting, there by affecting the reliability and economics (congestion) of the power system.

The most practical approach for this type of situation is to postulate various Scenarios and determine a range of solutions or projects. Even though the Scenario approach increases the amount of effort required for the analyses considerably; using carefully considered Scenarios combined with appropriate

[6] This includes uprating, upgrading and/or undersizing and over-sizing of transmission additions.

sensitivity evaluations will assist in decision making. A primary advantage of the Scenario approach is its ability to clarify which new projects are:

i) essential or must-build
ii) suitable for most Scenarios if not all
iii) suitable for specific Scenarios
iv) encompass a range between the most suitable to the least.

The goal is to making this type of classification at the end of Phase-III effort.

The STARS-WG formulated four Scenarios, as a "mix and match" of Regional and Statewide Generation coupled with Low and High Import possibilities, as shown in Figure 2-1. Thus, the four Scenarios (#1 thru' #4) span a wide range of all possibilities of future generation development and thus define "book-end" possibilities as defined in Table 2-1. Further, the New York State Renewable Portfolio Standards (RPS) requires 25% of the energy to be supplied from Renewable Resources. In Scenarios #2 and #4, the import from Hydro-Qubec is 25% or more and this mainly being a hydro generation is a renewable resource. The remaining two Scenarios #1 and #2 have been modified to define Scenarios #5 & #6 by explicitly including Renewables, assumed to mainly consist of Wind Generation, for the purposes of this Study.

2.1 Load Levels

The coincident and non-coincident peak loads and energy assumptions for the Intermediate and Horizon Years are shown in Table 2-2. NYCA coincident peak demand is 37,130 MW[7] shown in Table 2-2 for the Intermediate Year. Also, this load level approximately corresponds to the econometric load forecast of 37,784 MW mentioned in Table 4-9 of the 2009 RNA Report. For the horizon year, the zonal and NYCA demands are based on the average annualized 10 year long term growth rate in the study scope document. The coincident system peak load level for the horizon year is 40,816 MW as shown in Table 2-2.

[7] Table I-2c, *2008 Load and Capacity Report - Gold Book*

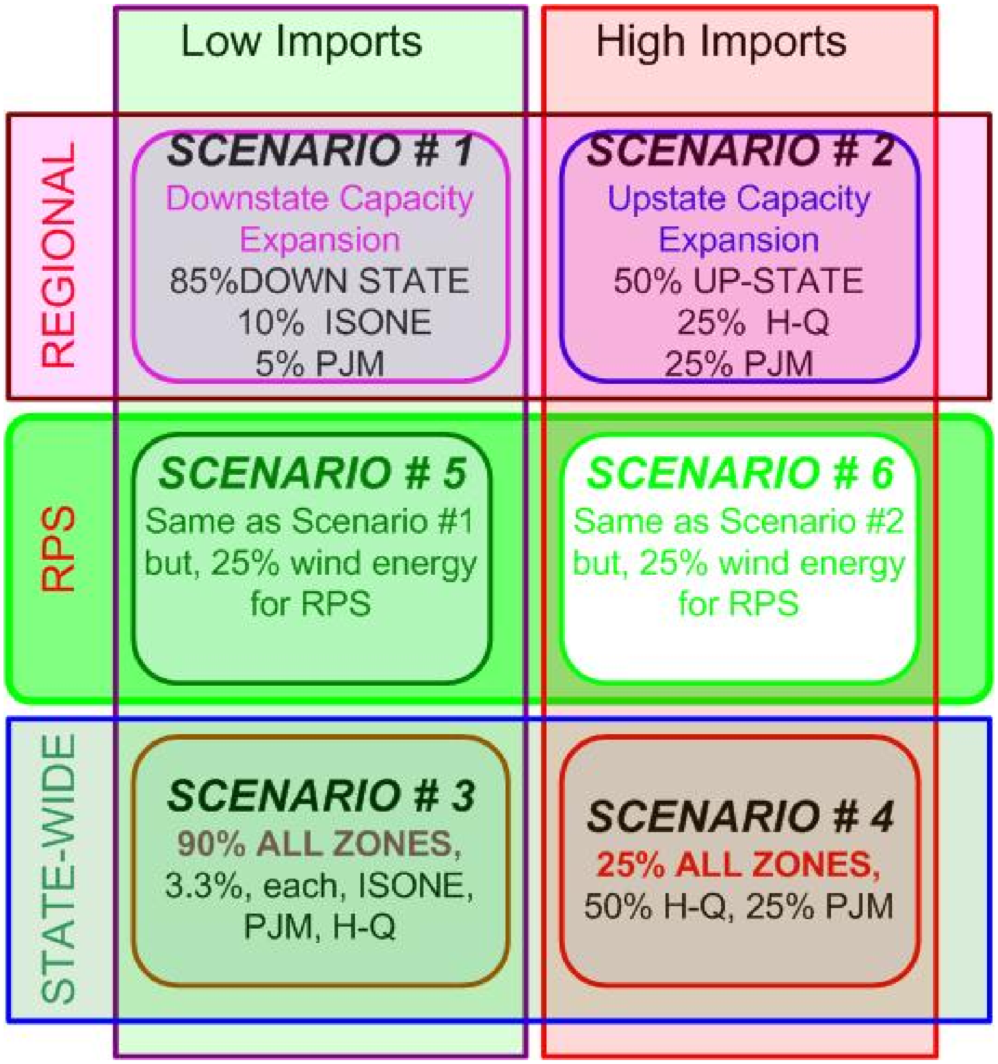

Figure 2-1: Depiction of Six Scenarios

Table 2-1: Capacity Expansion Scenarios

	Future Capacity Scenario	Internally Located Capacity (as percentage of incremental capacity requirement)	Externally Located Capacity Imports(as percentage of incremental capacity requirement)	Location of Externally Located Capacity Imports (as percentage of incremental capacity requirement)
1	Downstate Capacity	85% Zones H-K	15%	10% ISONE (Zone K) 5% PJM (Zone J)
2	Upstate Capacity	50% Zones A-F	50%	25% PJM (Zones A/C) 25% HQ (Zone D)
3	Statewide Capacity -Low Imports	90% Zones A-K	10%	3.3% ISONE (Zone F/G) 3.3% PJM (Zone J) 3.3% HQ (Zone D)
4	Statewide Capacity - High Imports	25% Zones A-K	75%	25% PJM (Zones I/J/K) 50% HQ (Zones D)
Scenarios With Wind Resources for 25% Energy				
5	Downstate Capacity Renewables located downstate	85% Zones H-K	15%	10% ISONE (Zone K) 5% PJM (Zone J)
6	Upstate Capacity 50% of renewable capacity located upstate; 50% external	50% Zones A-F	50%	25% PJM 25% HQ

Table 2-2: NYISO Zonal Load Levels

Zone	Intermediate Year			Horizon Year		
	Coincident peak (MW)	Non coincident Peak (MW)	Annual Energy (GWh)	Coincident peak (MW)	Non coincident Peak (MW)	Annual Energy (GWh)
A	2,875	2,960	17,404	3,123	3,215	18,904
B	2,139	2,210	11,155	2,365	2,444	12,334
C	3,090	3,157	18,260	3,323	3,395	19,638
D	895	973	7,499	971	1,056	8,137
E	1,486	1,544	8,601	1,600	1,662	9,259
F	2,566	2,627	13,292	2,868	2,937	14,858
G	2,627	2,655	12,327	2,948	2,980	13,834
H	707	738	3,066	782	816	3,390
I	1,645	1,664	6,998	1,753	1,774	7,459
J	13,085	13,086	62,979	14,326	14,327	68,951
K	6,015	6,095	25,981	6,757	6,847	29,186
NYCA	**37,130**		**187,562**	**40,816**		**205,949**

2.2 Generation Capacity

The capacity value in the 2009 RNA study (Table 3-7) for the Intermediate Year is 40,452MW. With 2,084 MW of Special Case Resources (SCR), the total resources available would be 42,536MW. The zonal breakdown at the system peak is shown in Table 2-3.

Table 2-3: Zonal Capacity for Intermediate Year

Zone	Capability (MW) at Peak	SCR&EOP (MW)	Total Resources (MW)
A	4,664	503	5,167
B	733	210	943
C	6,774	221	6,995
D	1,685	144	1,829
E	955	104	1,059
F	3,804	204	4,008
G	2,934	130	3,064
H	2,116	10	2,126
I	1	100	101
J	9,206	1,098	10,304
K	6,598	417	7,015

The NYCA installed capacity for the Horizon Year was calculated with Installed Reserve Margin (IRM) of 16.5%. In Table 2-4, the NYCA installed capacity and new capacity addition requirements are summarized for the first four Scenarios (#1 thru' #4). Individual zonal capacity additions are described in the next section.

Table 2-4: NYCA Capacity Requirement for the Horizon Year (Scenarios 1 to 4)

	MW
System Peak	40,816
IRM of 16.5% of System Peak	6,735
Load + Reserve	47,551
SCR	2,084
Total Resources	45,467
Year 2018 Capacity	40,452
New Capacity Requirement	5,015

Scenarios #5 & #6 explicitly include Renewables, assumed to mainly consist of Wind Generation, for the purposes of this Study. The total new capacity required with wind is calculated on the basis of the following assumptions:

1. The effective reserve margin of 16.5% is same as that used for other Scenarios.

2. Twenty-five percent (25%) of the additional energy (18,387 GWh) required for the load growth is met by new wind resources.

3. Also, make-up of 2,511GWh from wind resource and other renewables in the Intermediate Year is necessary.

4. Hence, the total additional renewable energy requirement is 7,108GWh.

5. The wind profiles for the terrestrial and off-shore wind generation are assumed to have 26.8% and 34.4% capacity factor, respectively.

6. The Capacity Credits for new terrestrial and off-shore wind generation are assumed to be 10% and 30% respectively (to be consistent with Tariff definitions).

The new generation capacity requirements are 6,828MW (for Scenario #5) and 7,740MW (Scenario #6). Scenario#5 has mostly off-shore wind development with higher capacity factor as compared Scenario#6 which has mostly land based wind parks.

2.3 New Generation for Six Scenarios for Horizon Year

The new capacity requirement of 5015MW for the first four Scenarios (#1 thru' #4) was allocated according to the Scenario definition in Table 2-1. Further, the additional generation was allocated to each zone in proportion to the zonal load. Generic 250MW units with 6% forced outage rate (FOR) are assumed for the new generation, unless only smaller amounts are indicated. The new generation units assumed for the four Scenarios are shown in Table 2-5.

For Scenarios #5 and #6, with substantial wind generation, the new conventional generation units (250MW size) and the wind generation allocation by zones are shown in Table 2-6.

2.4 Capacity and Energy Models:

The Capacity (Reliability) Models used to calculate Loss of Load Expectation (LOLE) identify the necessary "**Reliability Based Need**" to meet the NYCA's Loss of Load Expectation (LOLE) Criterion of 0.1day/year. Whereas the Energy Models identify the necessary "**Economic Based Need**" for achieving a low cost generation dispatch. The main differences in two different types of models used for these two types of studies are summarized in Table 2-7.

This Phase-I study pertains to the Capacity/Reliability Based transmission needs only.

Table 2-5: New Generation Capacity for Scenarios #1 through #4

	INTERNAL					EXTERNAL - FIRM PURCHASE				
	85% OF REQUIREMENT (MW)		**4,263**		4,263	**15% OF REQUIETREMENT (MW**			**752**	752
		LOAD	**NEW GEN**	Units	MW					
SCENARIO-1	ZONE-H	782	**141**	1	250	10%	ISONE	ZONE-K	**500**	500
(85%DOWN	ZONE-I	1,753	**316**	1	250	5%	PJM	ZONE-J	**265**	265
STATE, 15%	ZONE-J	14,326	**2,586**	10	2,500					
EXTERNAL)	ZONE-K	6,757	**1,220**	5	1,250					
	ZONES-TOTAL	23,618	4,263	17	4,250					**765**
	TOTAL NEW CAPACITY		**4,250**					**TOTAL**	**765**	
	50% OF REQRMNT		2,508		2,508	**50% OF REQRMNT**			2,507	2,507
		LOAD	**NEW GEN**	Units	MW					
	ZONE-A	3,123	**550**	2	500	25%	PJM	ZONES-A&C	**1,255**	1,255
SCENARIO-2	ZONE-B	2,365	**416**	2	500	25%	HQ	ZONE-D	**1,260**	1,260
(50% UPSTATE,	ZONE-C	3,323	**585**	2	500					
50% EXTERNAL)	ZONE-D	971	**171**	1	250					
	ZONE-E	1,600	**282**	1	250					
	ZONE-F	2,868	**505**	2	500					
	ZONES-TOTAL	14,250	2,509	10	2,500					2,515
	TOTAL NEW CAPACITY		**2,500**					TOTAL	2,515	
	90% OF REQRMNT		4,514		4,514	**10% OF REQRMNT**			501	501
		LOAD	**NEW GEN**	Units	MW					
	ZONE-A	3,123	**345**	2	500	3.3%	ISONE	ZONES-F&G	**170**	170
	ZONE-B	2,365	**262**	1	250	3.3%	PJM	ZONE-J	**170**	170
	ZONE-C	3,323	**368**	2	500	3.3%	HQ	ZONE-D	**175**	175
SCENARIO-3	ZONE-D	971	**107**	0	-					
(90% ALL	ZONE-E	1,600	**177**	1	250					
ZONES,	ZONE-F	2,868	**317**	1	250					
10% EXTERNAL	ZONE-G	2,948	**326**	1	250					
LOW IMPORT)	ZONE-H	782	**86**	0	-					
	ZONE-I	1,753	**194**	1	250					
	ZONE-J	14,326	**1,584**	6	1,500					
	ZONE-K	6,757	**747**	3	750					
	ZONES-TOTAL	40,816	4,513	18	4,500					515
	TOTAL NEW CAPACITY		**4,500**					TOTAL	515	
	25% OF REQRMNT		1,254		1,254	**75% OF REQRMNT**			3,761	
		LOAD	**NEW GEN**	Units	MW					
	ZONE-A	3,123	**96**	1	250	25%	PJM	ZONE-I/J/K	**1,255**	1,255
	ZONE-B	2,365	**73**	0	-	50%	HQ	ZONE-D	**2,510**	2,510
	ZONE-C	3,323	**102**	1	250					
SCENARIO-4	ZONE-D	971	**30**	0	-					
(25% ALL	ZONE-E	1,600	**49**	0	-					
ZONES,	ZONE-F	2,868	**88**	0	-					
75% EXTERNAL	ZONE-G	2,948	**91**	0	-					
HIGH IMPORTS)	ZONE-H	782	**24**	0	-					
	ZONE-I	1,753	**54**	0	-					
	ZONE-J	14,326	**440**	2	500					
	ZONE-K	6,757	**208**	1	250					
	ZONES-TOTAL	40,816	1,255	5	1,250					3765
	TOTAL NEW CAPACITY		**1,250**					TOTAL	3,765	

Table 2-6: New Generation Capacity for Scenarios #5 and #6

	INTERNAL						EXTERNAL - FIRM PURCHASE					
SCENARIO-5	85% OF REQUIREMENT (MW)		3,714	2,090		3,714	15% OF REQUIREMENT (MW)			1,024	369	655
(85%DOWN				RENEW	CONVENTIONAL						RENEW	CONVENTI
STATE, 15%		LOAD	NEW GEN		Units	MW						
EXTERNAL)	ZONE-H	782	123	-	1	250	10%	ISONE	ZONE-K	683	240	443
	ZONE-I	1,753	276	-	1	250	5%	PJM	ZONE-J	341	129	212
	ZONE-J	14,326	2,253	1,400	8	2,210						
	ZONE-K	6,757	1,063	700	4	1,000						
	ZONES-TOTAL	23,618	3,715	2,100	14	3,710					369	655
	TOTAL NEW CAPACITY		5,810						TOTAL	1,024		
SCENARIO-6	50% OF REQRMNT		3,870	1,514		2,356	50% OF REQUIREMENT			3,870	1,514	2,356
(50% UPSTATE,				RENEW	CONVENTIONAL							
50% EXTERNAL)		LOAD	NEW GEN		Units	MW					RENEW	CNVNTNL
100% GROWTH	ZONE-A	3,123	848	332	2	500	25%	PJM	ZONES-A&C	1,935	757	1,178
ENERGY FROM	ZONE-B	2,365	642	251	2	500	25%	HQ	ZONE-D	1,935	757	1,178
RENEWABLES	ZONE-C	3,323	902	353	2	500						
	ZONE-D	971	264	103	1	106						
	ZONE-E	1,600	435	170	1	250						
	ZONE-F	2,868	779	305	2	500						
	ZONES-TOTAL	14,250	3,870	1,514	10	2,356					1,514	2,356
	TOTAL NEW CAPACITY		3,870						TOTAL	3,870		

Table 2-7: Important Differences between Capacity and Energy Models

Important Differences between Capacity and Energy Models		
	Capacity or Reliability	**Energy or Production Cost**
Index	LOLE, EENS	MWh generation, LMP
Model	Capacity	Energy
8760 hours/yr	Yes	Yes
Generation Maintenance	Yes	Yes
Generating Unit Contingencies	Yes - Random	Yes - Random
Unit Commitment	No	Yes - SCUC/Merit Order
Economic Dispatch	No	Yes - SCED
Individual Branch Contingencies	No	Yes
Branch Ratings	STE	LTE for OHL, STE for UG
Interface Transfer Limits	Emergency Transfers, Both Thermal & Voltage Based. No Tower & Stuck Breaker Contingencies	All Design Contingencies
Notes:		
1. LOLE -- Loss of Load Expectation		
2. EENS -- Expected Energy Not Served		
3. SCUC -- Security Constrained Unit Commitment		
4. SCED -- Security Constrained Economic Dispatch		
5. STE -- Short Term Emergency Loading Limit		
6. LTE -- Long Term Emergency Loading Limit		
7. OHL -- Overhead Transmission Line		
8. UG -- Underground Cables		

The remaining Sections of this report are grouped into two parts followed by conclusions:

1. Part-I EMERGENCY TRANSFER LIMIT CALCULATIONS
2. Part-II LOLE CALCULATIONS

PART I – POWER FLOW ANALYSIS

3 DEVELOPMENT OF POWER FLOW MODELS

This section summarizes the steps taken to update the power flow model of New York State Transmission System. Power flow models were developed for summer peak load conditions for two specific study years: the Intermediate Year and the Horizon Year.

The starting point for the power flow analysis is a power flow model of the existing New York State transmission system for the year 2018[8] provided by the New York Independent System Operator (NYISO). In this power flow model, for 2018 summer peak load conditions, the New York Control Area (NYCA) load plus losses is 37,449 MW. Energy efficiency or emergency demand response programs are not modeled in this case.

Table 3-1 summarizes NYCA generation, load and losses in the above-mentioned power flow model.

Table 3-1: NYISO Power Flow Case (Case sum18tr2-gb-bal-rev1-rev30)

ZONES	DESCRIPTION	GENERATION (MW)	DEMAND (MW)		
			LOAD	LOSSES	LOAD+ LOSSES
A	WEST	4820.2	2807.9	79.8	2887.7
B	GENESEE	760.8	2083.7	77.7	2161.4
C	CENTRAL	6332.2	3081.8	188.7	3270.5
D	NORTH	1182.6	873.4	20.3	893.7
E	MOHAWK VAL.	725.4	1294.9	186.8	1481.7
F	CAPITAL	4056.6	2460.4	107.2	2567.6
G	HUDSON VAL.	2716.5	2596.7	129.0	2725.7
H	MILLWOOD	2175.4	707	52.3	759.3
I	DUNWOODIE	3.0	1604.5	50.3	1654.8
J	NYC	7496.8	12851	152.3	13003.3
K	LI	4627.3	5964.2	79.0	6043.2
NYCA TOTALS		34896.8	36325.5	1123.4	37448.9

3.1 Model Update for the Intermediate Year

The power flow model described in the above section was updated as follows:

1. Several transmission changes were made in the LIPA system (area 11) based on input from LIPA. See Appendix A for a summary of these changes.

2. Loads in the individual NYCA zones (areas 1 through 11) were scaled such that the zonal demands (i.e., load + losses) match the corresponding summer peak values in

[8] Siemens-PTI PSS/E 30 raw data file "sum18tr2-gb-bal-rev1-v30" provided by NYISO on March 11, 2009. Case title:
```
2009 CRPP 2018 GEN BALANCED CASE FROM 2008 FERC 2018 CASE
2018 SUMMER GB LOAD, WITH TO CRP FIRM PLANS
```

Table I-2A of the 2008 Gold Book. Total NYCA Load + Losses = 37,130 MW. Area interchanges were not changed[9].

3. The MVAr outputs of the Fraser and Leeds SVCs and the Marcy STATCOM are set to near zero.
4. The case was solved with phase angle regulators, switched shunts, LTC transformers and area interchange enabled.

Table 3-2 summarizes NYCA generation, load and losses in the updated power flow model.

Table 3-2: Updated Summer Peak Power Flow Case for the Intermediate Year
(Case sum18tr2-gb-bal-rev1-rev30-abb-v3)

ZONES	DESCRIPTION	GENERATION (MW)	DEMAND (MW)		
			LOAD	LOSSES	LOAD+ LOSSES
A	WEST	4808.0	2795.8	79.2	2875.0
B	GENESEE	738.3	2062.8	76.1	2138.9
C	CENTRAL	6152.5	2908.8	181.2	3090.0
D	NORTH	1184.1	874.7	20.3	895.0
E	MOHAWK VAL.	730.5	1297.5	188.3	1485.8
F	CAPITAL	4055.1	2458	107.8	2565.8
G	HUDSON VAL.	2618.3	2499	127.9	2626.9
H	MILLWOOD	2125.3	656.4	50.9	707.3
I	DUNWOODIE	3.0	1595.1	50.2	1645.3
J	NYC	7578.3	12930.7	154.0	13084.7
K	LI	4598.6	5934.4	80.6	6015.0
NYCA TOTALS		34592.0	36013.2	1116.5	37129.7

3.2 Model Update for the Horizon Year

Power flow models for summer peak load conditions in the Horizon Year were developed on the basis of the intermediate year summer peak load case (sum18tr2-gb-bal-rev1-rev30-abb-v3.sav) as described in Section 2 of this report. Power flow cases were developed for six capacity expansion Scenarios as defined in Table 2-5 and Table 2-6Table 2-6).

[9] It should be noted that the resultant load in Zone I (Dunwoodie) in Table 3-2 is 9.4 MW lower than in Table 3-1; this difference should be taken up by slack generator in that zone in order to keep the area interchange unchanged. However, there is no slack generator in Zone I. As a result, the "actual" area interchange value of Zone I has to change in order to reflect the load changes. The dispatch of existing unit in that Zone remains unchanged.

3.2.1 General Steps for Power Flow Model Development

The following sections summarize the steps taken to develop the six power flow cases.

Tables 2-5 and 2-6 show the required generation capacity inside & outside NYCA for Scenarios 1 to 6.

The generator size for conventional units is chosen as 250 MW inside NYCA assuming a typical power factor of ±0.90 (lagging and leading). Wind generators are modeled in multiples of 50 MW assuming a power factor of 0.95 leading and 0.90 lagging. The reactive power limits of the wind generators are adjusted based on their dispatch. Generators outside NYCA were chosen to meet the exact capacity requirement, hence they are not necessarily assumed to have a capacity of 250 MW. Nonetheless, 0.9 power factor was still assumed. Selected locations for the additional generation capacity are not based on any specific known plans. They were identified as representative bus locations within each zone.

The following assumptions were made when developing the individual power flow cases for the 6 Scenarios:

1) Loads in the individual NYCA zones (areas 1 through 11) were scaled such that the zonal demands (i.e., load + losses) match the corresponding summer peak Horizon Year values in Table 2-2. Total NYCA Load + Losses = 40,816 MW. Also, zonal losses as a percentage of the total demand in each zone are assumed to be the same as in the Intermediate Year. Losses are subtracted out from the demand prior to scaling. Constant power factor is assumed when scaling the loads.

2) New generators in each NYCA zone were dispatched so as to meet the load increase in that zone to the extent possible.

3) New generators in NYCA external areas were dispatched only if the internal zonal capacity (new units plus existing units in each zone and neighboring zones) is not able to meet the load increase.

4) Area interchange values were kept unchanged from the Intermediate Year case whenever possible.

5) Existing units were re-dispatched when slack bus generation in each zone exceeded PMAX.

6) Existing capacitors were maximized in the vicinity of the POI (Point of Interconnection) and SVC/STATCOMs

7) The MVAr outputs of the Fraser and Leeds SVCs and the Marcy STATCOM are set to near zero.

8) Per National Grid, the Warren-Falconer 115 kV line rating has been updated as follows:

Summer Rating (Normal/4 hour/15 minute, 35 degree C, in MVA): 220/252/280

9) Cases were solved with phase angle regulators, switched shunts, LTC transformers and area interchange enabled.

In addition, the following updates were performed on all Scenarios to reflect NYPA comments dated 06/12/2009:

10) Parameters of four Gilboa units were updated

11) Willis-Patnode-Duley-Plat & Willis-Ryan-Plat line summer ratings in the North Country were updated

12) Ratings of Niagara 230/115kV transformer AT2 were updated

13) The voltage levels of fake SW buses:101, 102, 105-111, 114-121, 150, 154-158 were updated

14) The units at Beaver Falls (Bus#136823 & #136824) were dispatched to the full capacity of 80MW

Additional updates were preformed to reflect TOs' comments dated 07/29/2009:

15) Per Con Edison, additional area station capacitor banks were added at the Corona 1, Corona 2, and Rockview stations. They were applied to all Scenarios.

16) Per NYPA, the reactive power limits of several existing wind farms were not realistic in relation to their active power dispatch. The reactive limits were updated to reflect the portion of running units with 0.9 power factor.

17) Per National Grid, the initially proposed new thermal unit(s) at Clay #136150 was moved to Scriba #136155 to reflect the proposals from interconnection queue during the study time. This is applicable to Scenarios 2, 3, 4, and 6.

18) Per National Grid, in Scenario6, the initially proposed wind farms, at Indian River #136776, Valley #137246, and Boonville#137221, were moved to Lyme Tap #136816 to reflect the wind interconnection queue. Similarly, wind farm at Dunkirk #135250 was moved to Falconer #135277.

3.2.2 Power Flow Model Development for Horizon Year Scenario 1 (85% NYCA Down State, 15% External)

The tables below show the proposed generator connection points which incorporate suggestions from Con Edison, LIPA and National Grid.

Table 3-3: Scenario 1: NYCA New Generator connection points

Zone#	Zone Name	Bus#	Bus Name	kV	Units	PMAX (MW)
H	MILLWOOD	126262	BUCHANAN N	345	1	250
I	DUNWOODIE	126292	PL VILLE	345	1	250
J	NYC	(Note 1)	E 13TH ST	345	6	1,500
		(Note 2)	W 49TH ST	345	4	1,000
K	LI	129361	RULAND	138	3	750
		129421	HOLLBROOK	138	2	500
TOTALS					17	4,250

Note:

(1) Con Edison indicated that no physical space is available to connect the new generators directly to the East 13th Street 345kV buses. The suggested approach was to model the units with a generator lead(s). As a result, a new bus (#126317) was created which connects the new units with GSUs and East 13th Street 345kV bus with cables.

(2) Con Edison indicated that no physical space is available to connect the new generators directly to the West 49th Street 345kV buses. The suggested approach was to model the units with a generator lead(s). As a result, a new bus (#126474) was created which connects the new units with GSUs and West 49th Street 345kV bus with cables.

Table 3-4: Scenario 1: External New Generator Connection Points

Area	Bus#	Bus Name	kV	Units	PMAX (MW)
ISO-NE	100656	NEW HAVN	345	2	500
PJM (PSEG)	4989	HUDSON1	345	1	265
TOTALS				3	765

The following general steps were taken to develop the Scenario 1 case:

1) No new capacity is proposed in upstate Zones A to G. To meet the upstate zonal load increase, the primary rule is to scale the existing units together with imports from neighboring zones.
2) Zone B (Genesee) does not have any new capacity added and reserve from existing units was not sufficient to meet the zonal load increase. The increase in demand is supplied by importing power from Zone A (West). The area interchange values of both areas were adjusted accordingly.
3) Zones D (North) and E (Mohawk Valley) do not have any new capacity added and reserve from existing units was not sufficient to meet the zonal load increase. The

increase in demand is supplied by importing power from Zone C (Central)[10]. The area interchange values of these areas were adjusted accordingly.

4) Per Con Edison, base case overloads were fixed as noted in the Con Edison system.

Table 3-5 summarizes the load and losses in the Horizon Year Summer Peak Scenario 1 case.

Table 3-5: Load & Losses for Horizon Year Summer Peak Scenario 1 Case

ZONES	NAME	GEN. MW	PROPOSED DEMAND (MW)	HORIZON YEAR SUMMER PEAK SCENARIO 1			DIFF MW
				LOAD	LOSSES	LOAD+ LOSSES	
A	WEST	5286.5	3123.0	3028.4	94.6	3123.0	0.0
B	GENESEE	734.6	2365.0	2271.8	93.3	2365.1	0.1
C	CENTRAL	6581.4	3323.0	3118.6	204.4	3323.0	0.0
D	NORTH	1184.0	971.0	947.6	23.4	971.0	0.0
E	MOHAWK VL	726.8	1600.0	1406.6	193.5	1600.1	0.1
F	CAPITAL	4355.7	2868.0	2743.3	124.8	2868.1	0.1
G	HUDSON VL	2938.0	2948.0	2812.7	135.3	2948.0	0.0
H	MILLWOOD	2198.1	782.0	728.1	53.9	782.0	0.0
I	DUNWOODIE	111.0	1753.0	1700.0	53.0	1753.0	0.0
J	NYC	8819.4	14326.0	14144.8	181.4	14326.2	0.2
K	LI	5341.1	6757.0	6659.0	97.9	6756.9	-0.1
NYCA TOTALS		38276.6	40816.0	39560.9	1255.5	40816.4	0.4

3.2.3 Power Flow Model Development for Horizon Year Scenario 2 (50% NYCA Up State, 50% External)

The tables below show the proposed generator connection points for this generation expansion Scenario.

Table 3-6: Scenario 2: NYCA New Generator Connection Points

Zone#	Zone Name	Bus#	Bus Name	kV	Units	PMAX (MW)
A	WEST	130754	KINTI345	345	1	250
		135250	DUNKIRK	230	1	250
B	GENESEE	149000	ROCHESTER	345	2	500
C	CENTRAL	136155	SCRIBA	345	2	500
D	NORTH	147837	MASS230A	230	1	250
E	MOHAWK VL	137200	EDIC	345	1	250
F	CAPITAL	137455	ATHENS	345	2	500
TOTALS					10	2,500

[10] This assumes that the Hydro Quebec to Zone D interface is loaded at its firm 1200 MW limit. There is an additional 300 MW of emergency assistance capability on this interface that was not modeled.

Table 3-7: Scenario 2: External New Generator Connection Points

Area	Bus#	Bus Name	kV	Units	PMAX (MW)
PJM (PENELEC)	200769	HOMER CY	345	4	1,000
				1	255
HQ	180819	CHA-NY	765	4	1,000
				1	260
TOTALS				10	2,515

The following general steps were taken to develop the Scenario 2 case:

1) New capacity in Zones A to F is used to meet the zonal load increase.
2) Load growth in Zones G (Hudson Valley) and K (LIPA) was supplied by scaling the existing units since no new capacity was added.
3) Zones H (Millwood) and I (Dunwoodie) do not have any new capacity added and reserve from existing units was not sufficient to meet the load increase. As a result, the increase in demand is supplied by importing power from Zones F (Capital) and G (Hudson Valley). The area interchange values of these four areas were adjusted accordingly.
4) Reserve from existing units was not sufficient in Zone J (NYC) to meet the demand. Thus one off-line unit was turned on (bus #126667 SCS18-G1 13.8kV) to provide about 140MW active power.
5) One fictitious switched capacitor of about 860MVAR was added at bus# 126277 FARRAGUT 345kV to get the case to converge. This has been reviewed by Con Edison.
6) Per Con Edison, base case overloads were fixed as noted in the Con Edison system. Since this is a Scenario for the Horizon Year without any new generation additions in Down State, steady state system without overloads was achieved with zero margin (A-B-C wheel had to be re-directed to 200-400-400 schedule).

Table 3-8 summarizes the load and losses in the Horizon Year Summer Peak Scenario 2 case.

Table 3-8: Load & Losses for Horizon Year Summer Peak Scenario 2 Case

ZONES	NAME	GEN. MW	PROPOSED DEMAND (MW)	HORIZON YEAR SUMMER PEAK SCENARIO 2			DIFF MW
				LOAD	LOSSES	LOAD+ LOSSES	
A	WEST	5055.8	3123.0	3035.3	87.7	3123.0	0.0
B	GENESEE	964.4	2365.0	2277.3	87.8	2365.1	0.1
C	CENTRAL	6384.5	3323.0	3128.6	194.4	3323.0	0.0
D	NORTH	1260.0	971.0	947.6	23.4	971.0	0.0
E	MOHAWK VL	843.7	1600.0	1402.9	197.1	1600.0	0.0
F	CAPITAL	4389.9	2868.0	2750.3	117.6	2867.9	-0.1
G	HUDSON VL	3038.8	2948.0	2808.5	139.5	2948.0	0.0
H	MILLWOOD	2173.1	782.0	726.5	55.5	782.0	0.0
I	DUNWOODIE	3.0	1753.0	1699.3	53.9	1753.2	0.2
J	NYC	8819.4	14326.0	14139.5	186.6	14326.1	0.1
K	LI	5340.9	6757.0	6653.8	103.1	6756.9	-0.1
NYCA TOTALS		38273.5	40816.0	39569.6	1246.6	40816.2	0.2

3.2.4 Power Flow Model Development for Horizon Year Scenario 3 (90% NYCA All Zones, 10% External Low Import)

The tables below show the proposed generator connection points for this generation expansion Scenario.

Table 3-9: Scenario 3: NYCA New Generator Connection Points

Zone#	Zone Name	Bus#	Bus Name	kV	Units	PMAX (MW)
A	WEST	130754	KINTI345	345	1	250
		135250	DUNKIRK	230	1	250
B	GENESEE	149000	ROCHESTER	345	1	250
C	CENTRAL	136155	SCRIBA	345	2	500
D	NORTH	147837	MASS230A	230	0	-
E	MOHAWK	137200	EDIC	345	1	250
F	CAPITAL	137455	ATHENS	345	1	250
G	HUDSON V	125000	HURLEY 3	345	1	250
I	DUNWOODIE	126292	PL VILLE	345	1	250
J	NYC	(Note 1) in Table 3-3	E 13TH ST	345	4	1,000
		(Note 2) in Table 3-3	W 49TH ST	345	2	500
K	LI	129361	RULAND	138	2	500
		129421	HOLLBROOK	138	1	250
TOTALS					18	4,500

Table 3-10: Scenario 3: External New Generator Connection Points

Area	Bus#	Bus Name	kV	Units	PMAX (MW)
ISO-NE	102926	NORTHFIELD	345	1	170
PJM	4989	HUDSON1	345	1	170
HQ	180819	CHA-NY	765	1	175
TOTALS				3	515

The following general steps were taken to develop the power flow case:

1) In Scenario 3, Zone D (North) does not have any new capacity added. As a result, the zonal load increase of 76MW is supplied by importing power from area 104 (HQ). The area interchange values of both areas were adjusted accordingly.
2) Similarly Zone H (Millwood) does not have any new capacity added. The zonal load increase of 75MW is supplied from Zone G (Hudson Valley). Accordingly, the area interchange values of both areas were adjusted.
3) Per Con Edison, base case overloads were fixed as noted in the Con Edison system.

Switched capacitors were added at the following locations based on input from Con Edison to allow the case to converge.

Table 3-11: Scenario 3: Added Capacitors for Case Convergence

BUS#	BUS NAME	KV	ZONE NAME	CAP SIZE
126354	YORK	13.8	NYC	20
126389	ROCKVIEW	13.8	DUNWOODIE	40
126607	CORONA 1	27.0	NYC	30
126608	CORONA 2	27.0	NYC	30
126627	PARKVIEW	13.8	NYC	20
126640	MOTTHAVN	13.8	NYC	40
126690	GRASSLND	13.8	DUNWOODIE	40
126717	CHERRY ST	13.8	NYC	20
126731	LEONARD ST 1	13.8	NYC	20
126732	LEONARD ST 2	13.8	NYC	20
126882	GATEWAY	27.0	NYC	30

Table 3-12 summarizes the load and losses in the Horizon Year Summer Peak Scenario 3 case.

Table 3-12: Load & Losses for Horizon Year Summer Peak Scenario 3 Case

ZONES	NAME	GEN. MW	PROPOSED DEMAND (MW)	HORIZON YEAR SUMMER PEAK SCENARIO 3			DIFF MW
				LOAD	LOSSES	LOAD+ LOSSES	
A	WEST	5056.1	3123.0	3035.6	87.6	3123.2	0.2
B	GENESEE	964.5	2365.0	2276.9	88.1	2365.0	0.0
C	CENTRAL	6385.3	3323.0	3128.5	194.3	3322.8	-0.2
D	NORTH	1181.9	971.0	947.2	23.8	971.0	0.0
E	MOHAWK VL	846.0	1600.0	1402.7	197.3	1600.0	0.0
F	CAPITAL	4355.5	2868.0	2750.3	117.6	2867.9	-0.1
G	HUDSON VL	2972.8	2948.0	2806.4	141.6	2948.0	0.0
H	MILLWOOD	2162.9	782.0	727.7	54.2	781.9	-0.1
I	DUNWOODIE	114.3	1753.0	1700.5	52.6	1753.1	0.1
J	NYC	8819.8	14326.0	14148.4	177.7	14326.1	0.1
K	LI	5341.2	6757.0	6659.1	97.9	6757.0	0.0
NYCA TOTALS		38200.3	40816.0	39583.3	1232.7	40816.0	0.0

3.2.5 Power Flow Model Development for Horizon Year Scenario 4 (25% NYCA All Zones, 75% External High Imports)

The tables below show the proposed generator connection points for this generation expansion Scenario.

Table 3-13: Scenario 4: NYCA New Generator connection points

Zone#	Zone Name	Bus#	Bus Name	kV	Units	PMAX (MW)
A	WEST	130754	KINTI345	345	1	250
B	GENESEE					
C	CENTRAL	136155	SCRIBA	345	1	250
D	NORTH					
E	MOHAWK VL					
F	CAPITAL					
G	HUDSON VL					
H	MILLWOOD					
I	DUNWOODIE					
J	NYC	(Note 1) in Table 3-3	E 13TH ST	345	1	250
		(Note 2) in Table 3-3	W 49TH ST	345	1	250
K	LI	129361	RULAND	138	1	250
TOTALS					5	1,250

Table 3-14: Scenario 4: External New Generator connection points

Area	Bus#	Bus Name	kV	Units	PMAX (MW)
PJM (PSEG)	5054	ESSEX	230	3	750
	4989	HUDSON1	345	1	255
				1	250
HQ	180819	CHA-NY	765	9	2,250
				1	260
TOTALS				15	3,765

The following general steps were taken to develop the Scenario 4 case:

1) Zone B (Genesee) does not have any new capacity added and reserve from existing units was not sufficient to supply the zonal load increase. As a result, the increase in demand is supplied by importing power from Zone A (West). The area interchange values of both areas were adjusted accordingly.
2) Zones D (North) and E (Mohawk Valley) do not have any new capacity added and reserve from existing units was not sufficient to meet the zonal load increases. As a result, the increase in demand is supplied by importing power from Zone C (Central)[11]. The area interchange values of these areas were adjusted accordingly.
3) Zones H (Millwood) and I (Dunwoodie) do not have any new capacity added and reserve from existing units was not sufficient to meet the zonal load increase. The increase in demand is supplied by importing power from Zones F (Capital) and G (Hudson Valley). Accordingly, the area interchange values of these four areas were adjusted.
4) Per Con Edison, base case overloads were fixed as noted in the Con Edison system. Additional area station capacitor banks were added at the Corona 1, Corona 2, and Rockview stations.

Similar to Scenario 3, switched capacitors were added at the locations shown in Table 3-11 to facilitate case convergence.

Table 3-15 summarizes the load and losses in the Horizon Year Summer Peak Scenario 4 case.

[11] This assumes that the Hydro Quebec to Zone D interface is loaded at its firm 1200 MW limit. There is an additional 300 MW of emergency assistance capability on this interface that was not modeled.

Table 3-15: Load & Losses for Horizon Year Summer Peak Scenario 4 Case

ZONES	NAME	GEN. MW	PROPOSED DEMAND (MW)	Horizon Year SP SCENARIO 4			DIFF MW
				LOAD	LOSSES	LOAD+ LOSSES	
A	WEST	5286.2	3123.0	3029.0	94.1	3123.1	0.1
B	GENESEE	734.5	2365.0	2273.7	91.2	2364.9	-0.1
C	CENTRAL	6585.7	3323.0	3119.1	203.7	3322.8	-0.2
D	NORTH	1184.0	971.0	947.6	23.4	971.0	0.0
E	MOHAWK VL	722.2	1600.0	1405.7	194.3	1600.0	0.0
F	CAPITAL	4388.4	2868.0	2742.2	125.8	2868.0	0.0
G	HUDSON VL	3037.6	2948.0	2810.3	137.8	2948.1	0.1
H	MILLWOOD	2172.5	782.0	726.5	55.5	782.0	0.0
I	DUNWOODIE	3.0	1753.0	1700.1	52.9	1753.0	0.0
J	NYC	8820.2	14326.0	14142.3	183.6	14325.9	-0.1
K	LI	5341.2	6757.0	6655.1	101.9	6757.0	0.0
NYCA TOTALS		38275.5	40816.0	39551.6	1264.2	40815.8	-0.2

3.2.6 Power Flow Model Development for Horizon Year Scenario 5 with Renewables

The tables below show the proposed generator connection points for this generation expansion Scenario (conventional & renewable generation, respectively).

Table 3-16: Scenario 5: NYCA New Generator connection points (Conventional)

Zone#	Zone Name	Bus#	Bus Name	kV	Units	PMAX (MW)
H	MILLWOOD	126262	BUCHANAN N	345	1	250
I	DUNWOODIE	126292	PL VILLE	345	1	250
J	NYC	(Note 1) in Table 3-3	E 13TH ST	345	4	1,000
			E 13TH ST	345	1	210
		(Note 2) in Table 3-3	W 49TH ST	345	4	1,000
K	LI	129361	RULAND	138	2	500
		129421	HOLLBROOK	138	2	500
TOTALS					15	3,710

Table 3-17: Scenario 5: External New Generator connection points (Conventional)

Area	Bus#	Bus Name	kV	Units	PMAX (MW)
ISO-NE	100656	NEW HAVN	345	1	250
			345	1	193
PJM (PSEG)	4989	HUDSON1	345	1	212
TOTALS				3	655

Table 3-18: Scenario 5: NYCA New Generator connection points (Renewable)

Zone#	Zone Name	Bus#	Bus Name	kV	Units	PMAX (MW)
H	MILLWOOD					
I	DUNWOODIE					
J	NYC	126286	Gowanus	345	1	1400
K	LI	129403	Sterling Rd	138	1	700
TOTALS					2	2,100

Table 3-19: Scenario 5: External New Generator connection points (Renewable)

Area	Bus#	Bus Name	kV	Units	PMAX (MW)
ISO-NE	100656	NEW HAVN	345	1	240
PJM (PSEG)	4989	HUDSON1	345	1	129
TOTALS				2	369

The following general steps were taken to develop the Scenario 5 case:

1) No new capacity is proposed in upstate Zones A to G. To meet the upstate zonal load increase, the primary rule is to scale the existing units together with imports from neighboring zones.
2) Zone B (Genesee) does not have any new capacity added and reserve from existing units was not sufficient to meet the zonal load increase. The increase in demand is supplied by importing power from Zone A (West). The area interchange values of both areas were adjusted accordingly.
3) Zones D (North) and E (Mohawk Valley) do not have any new capacity added and reserve from existing units was not sufficient to meet the zonal load increase. The increase in demand is supplied by importing power from Zone C (Central)[12]. The area interchange values of these areas were adjusted accordingly.
4) In Scenario 5, off-shore wind plants at zones J & K were modeled at 575V bus which is connected to a 34.5kV bus and then to the HV bus (Point Of Interconnection). The assumption is that the new wind units will be GE units. Typical parameters for the wind units and transformers were used. It is also assumed that the new wind units were dispatched at 34% of nameplate so that it lines up with the wind profiles used in GridView. In addition, the model for the Wind Farm interconnected at Gowanus 345kV station was updated to include a long 'generator' lead as per Con Edison.
5) Zone H (Millwood) does not have any new capacity added and reserve from existing units was not sufficient to meet the load increase. As a result, the increase in demand is supplied by importing power from Zone G (Hudson Valley). The area interchange values of these areas were adjusted accordingly.
6) Per Con Edison, additional area station capacitor banks were added at the Corona 1, Corona 2, and Rockview stations.

[12] This assumes that the Hydro Quebec to Zone D interface is loaded at its firm 1200 MW limit. There is an additional 300 MW of emergency assistance capability on this interface that was not modeled.

Table 3-20 summarizes the load and losses in the Horizon Year Summer Peak Scenario 5 case.

Table 3-20: Load & Losses for Horizon Year Summer Peak Scenario 5 Case

ZONES	NAME	GEN. MW	PROPOSED DEMAND (MW)	Horizon Year SP SCENARIO 5			DIFF MW
				LOAD	LOSSES	LOAD+ LOSSES	
A	WEST	5286.1	3123.0	3028.3	94.7	3123.0	0.0
B	GENESEE	734.6	2365.0	2271.6	93.5	2365.1	0.1
C	CENTRAL	6580.8	3323.0	3115.6	207.3	3322.9	-0.1
D	NORTH	1183.9	971.0	947.6	23.4	971.0	0.0
E	MOHAWK VL	723.4	1600.0	1399.7	200.2	1599.9	-0.1
F	CAPITAL	4357.0	2868.0	2739.5	128.5	2868.0	0.0
G	HUDSON VL	2938.5	2948.0	2809.8	138.1	2947.9	-0.1
H	MILLWOOD	2198.0	782.0	727.4	54.6	782.0	0.0
I	DUNWOODIE	111.0	1753.0	1699.5	53.4	1752.9	-0.1
J	NYC	8819.7	14326.0	14145.0	181.1	14326.1	0.1
K	LI	5341.1	6757.0	6659.8	97.2	6757.0	0.0
NYCA TOTALS		38274.1	40816.0	39543.8	1272.0	40815.8	-0.2

3.2.7 Power Flow Model Development for Horizon Year Scenario 6 with Renewables

The tables below show the proposed generator connection points for this generation expansion Scenario (conventional & renewable generation, respectively).

Table 3-21: Scenario 6: NYCA New Generator connection points (Conventional)

Zone#	Zone Name	Bus#	Bus Name	kV	Units	PMAX (MW)
A	WEST	130754	KINTI345	345	1	250
		135250	DUNKIRK	230	1	250
B	GENESEE	149000	ROCHESTER	345	2	500
C	CENTRAL	136155	SCRIBA	345	2	500
D	NORTH	147837	MASS230A	230	1	106
E	MOHAWK	137200	EDIC	345	1	250
F	CAPITAL	137455	ATHENS	345	2	500
TOTALS					10	2,356

Table 3-22: Scenario 6: External New Generator connection points (Conventional)

Area	Bus#	Bus Name	kV	Units	PMAX (MW)
PJM	200769	HOMER CY	345	4	1,000
				1	178
HQ	180819	CHA-NY	765	4	1,000
				1	178
TOTALS				10	2,356

Table 3-23: Scenario 6: NYCA New Generator connection points (Renewables)

Zone#	Zone Name	Bus#	Bus Name	Kv	Units	PMAX (MW)
A	WEST	130756	Stole Road	345	1	132
		135277	Falconer	115	1	200
B	GENESEE	135853	Batavia	115	1	126
		135851	Shelby	115	1	125
C	CENTRAL	130764	Meyer	230	1	150
		130774	Bath	115	1	150
		130803	Flat St. (Prattsburgh Wind Farm)	115	1	53
D	NORTH	147846	Willis W	230	1	23
		147974	Ellenburg II	230	1	20
		131754	Mason Corner	115	1	60
E	MOHAWK	136816	Lyme	115	1	170
F	CAPITAL	137891	Marshville	115	1	305
TOTALS					15	1,514

Table 3-24: Scenario 6: External New Generator connection points (Renewables)

Area	Bus#	Bus Name	kV	Units	PMAX (MW)
PJM	200769	HOMER CY	345	1	757
HQ	180819	CHA-NY	765	1	757
TOTALS				2	1,514

The following general steps were taken to develop the power flow case:

1) New capacity in Zones A to F is used to meet the zonal load increase. Wind units were added and assumed to be 5% dispatch.

2) Load growth in Zones G (Hudson Valley) and K (LIPA) was supplied by scaling the existing units since no new capacity was added.

3) Zones H (Millwood) and I (Dunwoodie) do not have any new capacity added and reserve from existing units was not sufficient to meet the load increase. As a result, the increase in demand is supplied by importing power from Zones F (Capital) and G (Hudson Valley). The area interchange values of these four areas were adjusted accordingly.

4) Reserve from existing units was not sufficient in Zone J (NYC) to meet the demand. Thus one off-line unit was turned on (bus #126667 SCS18-G1 13.8kV) to provide about 170MW active power.

5) In Scenario 6, new on-shore wind farms were modeled at 575V bus which is connected to a 34.5kV bus and then to the HV bus (Point Of Interconnection). The assumption is that the new wind units will be GE units with typical parameters. It is also assumed that these units were dispatched at 5% of nameplate at the peak hour.

6) As in Scenario2, one fictitious switched capacitor of about 860MVAR was added at bus# 126277 FARRAGUT 345kV to get the case to converge.

7) Batch files were provided by Con Edison to fix overloads in Con Edison system.

Table 3-25 summarizes the load and losses in the Horizon Year Summer Peak Scenario 6 case.

Table 3-25: Load & Losses for Horizon Year Summer Peak Scenario 6 Case

ZONES	NAME	GEN. MW	PROPOSED DEMAND (MW)	Horizon Year SP SCENARIO 6			DIFF MW
				LOAD	LOSSES	LOAD+ LOSSES	
A	WEST	5054.9	3123.0	3035.5	87.5	3123.0	0.0
B	GENESEE	964.4	2365.0	2277.0	88.0	2365.0	0.0
C	CENTRAL	6384.4	3323.0	3129.4	193.9	3323.3	0.3
D	NORTH	1259.7	971.0	948.1	22.9	971.0	0.0
E	MOHAWK VL	843.2	1600.0	1401.8	198.2	1600.0	0.0
F	CAPITAL	4390.5	2868.0	2748.2	119.7	2867.9	-0.1
G	HUDSON VL	3038.7	2948.0	2807.5	140.4	2947.9	-0.1
H	MILLWOOD	2172.8	782.0	726.3	55.7	782.0	0.0
I	DUNWOODIE	3.0	1753.0	1698.8	54.2	1753.0	0.0
J	NYC	8819.1	14326.0	14138.7	187.3	14326.0	0.0
K	LI	5341.6	6757.0	6653.4	103.6	6757.0	0.0
NYCA TOTALS		38272.3	40816.0	39564.7	1251.4	40816.1	0.1

3.3 Summary of Interface Flows in Intermediate and Horizon Year Cases

For the purpose of convergence, fictitious capacitors were added in the Horizon Year Cases (Scenarios 2, 3 and 4) to compensate for the reactive power deficiency due to the increasing load demand and line flows. The capacitor size added is shown below in Table 3-26.

Table 3-26: Summary of Added Capacitors for Horizon Year Scenarios

SCENARIO	DESCRIPTION	ADDED CAP(MVAR)	NOTE
1	85% Down State, 15% External	-	
2	50% Up State, 50% External	860	After Con Edison revisions
3	90% NYCA All Zones, 10% External	310	Per Con Edison
4	25% NYCA All Zones, 75% External	310	Same as in Scenario 3
5	Similar to Scenario 1 but with Renewables	-	
6	Similar to Scenario 2 but with Renewables	860	After Con Edison revisions

Table 3-27 compares the cross-state and inter-area interface flows in the base cases for the six Horizon Year cases against the corresponding flows in the Intermediate Year Case. This comparison is for demonstrating that the generation dispatch for each zone was adjusted such that the interface flows and the external area flows from the Intermediate year to the Horizon year Scenarios is kept unchanged to the extent possible.

Table 3-27: Comparison of Interface Flows in Horizon Year Cases and Intermediate Year Case

Interfaces		Int. Year Case	Horizon Year Scenario 1		Horizon Year Scenario 2		Horizon Year Scenario 3		Horizon Year Scenario 4		Horizon Year Scenario 5		Horizon Year Scenario 6	
		Flow	Flow	Dif	Flow	Dif	Flow	Dif	Flow	Dif	Flow	Dif	Flow	Dif
Cross State	Dysinger East	1593	1798	205	1592	-1	1586	-6	1808	216	1798	206	1592	-1
	West Central	171	143	-27	167	-3	162	-9	154	-17	144	-27	167	-4
	Volney East	3598	3797	199	3602	4	3598	0	3801	203	3797	199	3601	3
	MosesSouth	1374	1297	-76	1373	0	1373	0	1297	-76	1297	-76	1373	-1
	TotalEast	5749	5754	5	5752	3	5751	2	5754	5	5751	2	5750	2
	CentralEast	2383	2422	39	2434	51	2428	45	2423	40	2423	40	2440	57
	CE_FraserGilboa	2600	2604	4	2618	18	2603	3	2600	0	2610	10	2627	27
	CE_Group	4218	4222	4	4220	2	4219	1	4223	5	4220	2	4219	1
	F to G	3713	3732	19	3795	82	3741	27	3757	44	3734	21	3804	91
	UPNYSENY	5639	5642	3	5674	35	5638	-1	5674	35	5641	2	5674	35
	UPNYConEd	5082	5083	2	5217	135	5114	33	5215	134	5083	1	5216	135
	Millwd S. CLS	7862	7863	0	7971	109	7859	-4	7969	107	7862	0	7970	108
	Dunwoodie S.	4858	4858	0	4858	1	4857	0	4856	-1	4857	0	4858	0
	I to J	3921	3922	1	3922	0	3921	0	3919	-2	3921	-1	3922	0
	LIPA_Import (1)	1679	1679	0	1679	0	1679	-1	1679	0	1679	0	1679	-1
	I to K	936	936	-1	936	0	936	0	937	1	936	0	936	0
	J to K	-286	-286	0	-286	0	-286	0	-287	-1	-286	0	-286	0
Inter Area	NY-NE (2)	81	81	1	81	0	81	1	81	1	81	0	80	0
	NY-PJM (3)	-1498	-1518	-20	-1504	-5	-1502	-4	-1524	-26	-1520	-21	-1504	-6
	NY-ONT	743	761	18	744	1	747	4	767	23	761	18	744	0
	NY-HQ	-1200	-1200	0	-1200	0	-1278	-78	-1200	0	-1200	0	-1200	0

Note:

1. Includes CSC and Neptune
2. Excludes Cross Sound Cable
3. Excludes Neptune HVDC
4. CSC flow is 330MW, and Neptune is 666MW
5. Sign Convention for Inter-area Interfaces: Positive sign denotes export out of NYCA, Negative sign denotes import into NYCA

4 SECURITY ANALYSIS FOR INTERMEDIATE YEAR

This section presents results obtained from steady-state analysis of the New York State Transmission System for Summer Peak load conditions in the Intermediate Study Year. System performance is evaluated under all-lines in and contingency case conditions and checked against New York State Reliability Criteria.

4.1 Methodology

Power flow analysis was performed on the updated intermediate year summer peak power flow case described in Section 2.1 of this report. The analysis was performed using the AC Contingency Analysis tool in the Siemens-PTI PSS^{TM}MUST program.

For the purposes of this analysis, transmission facilities rated 100 kV and above within NYCA (and tie-lines out of NYCA) were monitored.

For thermal overloads, each branch element (transformer, transmission line, or feeder) in the monitored system was monitored and electrical flows above the applicable branch rating (normal continuous rating - Rate A) under system intact conditions, LTE rating - Rate B) under contingency conditions for overhead transmission lines and STE rating (Rate C) for underground feeders) were flagged. Transmission interfaces were not monitored (thermal transfer limits for interfaces will be determined and presented separately in Section 5).

For bus voltage violations, the following range limits and pre-to-post-contingency voltage change criteria were applied:

- 0.95-1.05 pu for system intact conditions
- 0.90-1.10 pu for contingency conditions (0.95-1.05 pu in the Con Edison system)
- Voltage change criteria of 0.10 pu

In addition several 230 kV and 345 kV buses identified by NYISO for special range limits were checked for voltage violations.

Phase angle regulators (PARs), switched shunts and LTC transformers are modeled as regulating pre-contingency and non-regulating post-contingency.

The following types of contingencies were simulated based on the contingency files provided by NYISO:

1. Outage of branches connected between buses with a base voltage of 100 kV and above (these included outages based on "automatic" N-1 contingency specification[13] in MUST and specific pre-defined branch outages)

[13] Automatic N-1 contingencies were not simulated in the Con Edison system.

2. Generation contingencies
3. Series element contingencies
4. Bus contingencies
5. HVdc contingencies

No stuck-breaker or tower contingencies were simulated.

In addition to these contingencies, other contingencies provided by National Grid associated with wind generation in the North Country were simulated

Appendix A shows the relevant subsystem description, monitored element and contingency description files used in this analysis (these files were derived based on files provided by NYISO).

Note: Some transmission facilities were excluded from monitoring based on input provided by NYCA transmission owners. Also, the transmission owners indicated that some of the automatic N-1 contingencies are not legitimate – these contingencies were excluded from analysis. See Appendix A.4 for a list of excluded monitored elements and contingencies.

4.2 Results

4.2.1 System Intact Conditions

Results of the system intact analysis (with all lines in-service) showed a base case overload on a 115/11.5 kV transformer (#4) at Station 42 in the Rochester Gas & Electric (RGE) system (16% overload approx. based on the transformer's normal rating of 29.7 MVA). No voltage violations were observed under system intact conditions.

4.2.2 Contingency Case Conditions

Results of the contingency analysis showed several thermal and voltage violations. These are listed in Tables 4-1 and 4-2 and are described below.

Table 4-1 shows the overloaded transmission facilities. These violations were submitted to the transmission owners for review.

NYSEG / RGE Systems:

NYSEG indicated that the overloads in the NYSEG and RGE systems are on underlying systems and that these facilities should be ignored when analyzing bulk power system limits. NYSEG requested that these facilities continue to be monitored for potential problems when wind generation is increased in the base case.

Long Island Power Authority System:

Each of the 345/138 kV New Bridge Road transformers becomes overloaded for loss of the parallel bank (15% overload based on the 585 MVA LTE rating). These transformers have a short-term capability of 801 MVA and the overloads can be mitigated by redispatching resources within the system. Also, a post-contingency overload of 3% was observed on the Brookhaven-Riverhead 138 kV line following the loss of the Shoreham-Wildwood 138 kV line.

National Grid System:

Several post-contingency overloads were observed in the National Grid system. National Grid indicated that most of these overloads are dispatch dependent and may be addressed by generation reduction. Specific National Grid comments are summarized below:

- The post-contingency overloads on the Leeds-Pleasant Valley 345 kV and Athens-Pleasant Valley 345 kV lines are dependent on dispatch and expected to decrease if Athens Generation is reduced. At present, there is a temporary SPS in place for the contingencies that cause the overloads.
- The overloads on the following facilities are dispatch dependent and expected to decrease if Athens Generation is reduced:

```
125040 N.CAT. 1      115 137507 BOC 2T       115  2
137507 BOC 2T        115 137510 JMC2+9TP     115  1
137481 JMC1+7TP      115 137490 BLUECIRC     115  1
```

- The overloads on the Reynolds Road 345/115 kV transformer are dependent on local generation, and there is an SPS that ramps down the Besicorp generation (or now called Empire generation – bus# 137558) for the contingencies listed.
- The overload on the Allens F – Colton 115 kV line is driven by generation dispatch; if it turns out to be wind/hydro it may be something the STARS project will need to address.
- The overloads on the Menands-St. Camps 115 kV line are a result of incorrect contingencies.

Table 4-2 lists post-contingency voltage violations. These violations were submitted to the transmission owners for review. The following comments were received.

New York Power Authority:

New York Power Authority indicated that the following voltage violations should be ignored:

- PMLD 3 for the loss of PMLD 1 is a local issue.
- MDTN Tap for loss of the CCRT - 34 is an expected voltage issue.

<u>NYSEG / RGE</u>:

NYSEG/RGE indicated that the following voltage violations should be ignored:

- SLVYN115 for loss of FISHKILL115 to SYLVN115 is a local issue.
- The four WOODA 345 and WOODB345 violations for loss of bus and line tap connections are expected voltage issue.

4.3 Summary

The results presented in this section showed several security violations (thermal and voltage). It should be noted that these violations are for a typical generation dispatch i.e., for a snapshot of system conditions at a given instant in time – it may be possible to mitigate the violations through generation redispatch. Solutions to mitigate these constraints will be developed as part of the Phase II analysis.

Table 4-1: Post-Contingency Overloads - Intermediate Year Summer Peak Conditions

** From bus **	** To bus **	CKT	Owner	Base Case MVA Flow	LTE Rating	Post Cont MVA Flow	Post Cont Loading%	Contingency
125015 AC CBLTP 115	125020 DANSKAMA 115	1	CENT HUD	165.8	211.0	323.6	153.4	125020 DANSKAMA 115 125021 DC CBLTP 115 1
125015 AC CBLTP 115	125020 DANSKAMA 115	1	CENT HUD	165.8	211.0	323.7	153.4	125021 DC CBLTP 115 125041 N.CHELSE 115 1
125015 AC CBLTP 115	125020 DANSKAMA 115	1	CENT HUD	165.8	211.0	215.7	102.2	125002 ROSETON 345 126281 FISHKILL 345 1
125015 AC CBLTP 115	125041 N.CHELSE 115	1	CENT HUD	165.8	211.0	323.7	153.4	125020 DANSKAMA 115 125021 DC CBLTP 115 1
125015 AC CBLTP 115	125041 N.CHELSE 115	1	CENT HUD	165.8	211.0	323.7	153.4	125021 DC CBLTP 115 125041 N.CHELSE 115 1
125015 AC CBLTP 115	125041 N.CHELSE 115	1	CENT HUD	165.8	211.0	215.7	102.2	125002 ROSETON 345 126281 FISHKILL 345 1
125020 DANSKAMA 115	125021 DC CBLTP 115	1	CENT HUD	170.9	199.0	324.3	163.0	125015 AC CBLTP 115 125020 DANSKAMA 115 1
125020 DANSKAMA 115	125021 DC CBLTP 115	1	CENT HUD	170.9	199.0	324.3	163.0	125015 AC CBLTP 115 125041 N.CHELSE 115 1
125020 DANSKAMA 115	125021 DC CBLTP 115	1	CENT HUD	170.9	199.0	222.3	111.7	125002 ROSETON 345 126281 FISHKILL 345 1
125021 DC CBLTP 115	125041 N.CHELSE 115	1	CENT HUD	170.9	253.0	324.3	128.2	125015 AC CBLTP 115 125020 DANSKAMA 115 1
125021 DC CBLTP 115	125041 N.CHELSE 115	1	CENT HUD	170.9	253.0	324.4	128.2	125015 AC CBLTP 115 125041 N.CHELSE 115 1
128847 NWBRG 345	129310 NEWBRGE 138	1	LIPA	333.8	585.0	677.3	115.8	128847 NWBRG 345 129310 NEWBRGE 138 2
128847 NWBRG 345	129310 NEWBRGE 138	2	LIPA	333.8	585.0	677.3	115.8	128847 NWBRG 345 129310 NEWBRGE 138 1
129488 EDWRDSAV 138	129493 RVRHD 138	1	LIPA	133.1	297.0	306.4	103.1	129459 SHOREHAM 138 129475 WILDWOOD 138 1
125040 N.CAT. 1 115	137507 BOC 2T 115	2	NGRID	106.0	120.0	140.5	117.1	125000 HURLEY 3 345 125030 HURLEY 1 115 1
125040 N.CAT. 1 115	137507 BOC 2T 115	2	NGRID	106.0	120.0	135.7	113.1	125000 HURLEY 3 345 137451 LEEDS 3 345 1
126294 PLTVLLEY 345	137451 LEEDS 3 345	2	NGRID	1248.8	1538.0	1790.8	116.4	126294 PLTVLLEY 345 137455 ATHENS 345 1
126294 PLTVLLEY 345	137451 LEEDS 3 345	2	NGRID	1248.8	1538.0	1545.6	100.5	125000 HURLEY 3 345 137451 LEEDS 3 345 1
126294 PLTVLLEY 345	137451 LEEDS 3 345	2	NGRID	1248.8	1538.0	1538.2	100.0	125002 ROSETON 345 126281 FISHKILL 345 1
126294 PLTVLLEY 345	137455 ATHENS 345	1	NGRID	1209.2	1538.0	1753.5	114.0	126294 PLTVLLEY 345 137451 LEEDS 3 345 2
136200 GERES LK 115	136269 SOLVTAP2 115	1	NGRID	103.4	120.9	145.0	120.0	136200 GERES LK 115 136270 CRUC TAP 115 1
136751 ALLENS F 115	136764 COLTON 115	1	NGRID	42.4	128.0	133.2	104.1	136783 MALONE 115 147856 WILL 115 115 1
137454 REYNLD3 345	137528 REY. RD. 115	1	NGRID	338.8	562.0	567.5	101.0	BUS:ALPS_345
137454 REYNLD3 345	137528 REY. RD. 115	1	NGRID	338.8	562.0	567.2	100.9	137450 ALPS345 345 137454 REYNLD3 345 1
137481 JMC1+7TP 115	137490 BLUECIRC 115	1	NGRID	108.4	120.0	122.1	101.7	126294 PLTVLLEY 345 137451 LEEDS 3 345 2
137481 JMC1+7TP 115	137490 BLUECIRC 115	1	NGRID	108.4	120.0	121.4	101.2	126294 PLTVLLEY 345 137455 ATHENS 345 1
137481 JMC1+7TP 115	137490 BLUECIRC 115	1	NGRID	108.4	120.0	120.5	100.4	125000 HURLEY 3 345 137451 LEEDS 3 345 1
137507 BOC 2T 115	137510 JMC2+9TP 115	1	NGRID	106.0	120.0	140.5	117.1	125000 HURLEY 3 345 125030 HURLEY 1 115 1
137507 BOC 2T 115	137510 JMC2+9TP 115	1	NGRID	106.0	120.0	135.7	113.1	125000 HURLEY 3 345 137451 LEEDS 3 345 1
137515 MENANDS 115	137542 ST CAMPS 115	1	NGRID	45.9	114.0	132.2	116.0	137518 NW KRMKL 115 137716 ALB1 115 1
137515 MENANDS 115	137542 ST CAMPS 115	1	NGRID	45.9	114.0	118.7	104.2	137514 MCKOWNVL 115 137518 NW KRMKL 115 1
130813 HICK 115 115	130845 RIDGT115 115	1	NYSEG	71.1	97.0	107.2	110.6	130782 CATON115 115 130813 HICK 115 115 1
130813 HICK 115 115	130845 RIDGT115 115	1	NYSEG	71.1	97.0	108.1	111.5	130782 CATON115 115 130814 HILSD115 115 1
149018 S71 115 115	149035 S69 917 115	1	RGE	17.0	121.5	155.6	128.1	149014 S418 115 115 149016 S67-1115 115 2
149029 S204 911 115	149033 S42 115 115	1	RGE	132.7	207.2	232.6	112.2	149024 GINNA115 115 149196 S124C913 115 1
149029 S204 911 115	149033 S42 115 115	1	RGE	132.7	207.2	226.9	109.5	149033 S42 115 115 149196 S124C913 115 1
149033 S42 115 115	149196 S124C913 115	1	RGE	137.8	207.2	228.8	110.4	149029 S204 911 115 149033 S42 115 115 1
149033 S42 115 115	149196 S124C913 115	1	RGE	137.8	207.2	227.5	109.8	149024 GINNA115 115 149029 S204 911 115 1
149035 S69 917 115	149036 STA 93 115	1	RGE	26.3	143.4	165.1	115.2	149014 S418 115 115 149016 S67-1115 115 2
149036 STA 93 115	149062 S7 115B2 115	1	RGE	33.2	143.4	173.2	120.7	149014 S418 115 115 149016 S67-1115 115 2
126385 E179 ST 138	126730 15055 SR 138	1	CONED	223.4	365.0	417.5	114.4	GEN:NYPA_AS
126581 HG TAP 138	126730 15055 SR 138	1	CONED	223.4	365.0	417.5	114.4	GEN:NYPA_AS
126283 GOTHLS N 345	126286 GOWANUSN 345	1	CONED	471.7	759.0	874.2	115.2	SER:42&26
126285 GOTHLS S 345	126287 GOWANUSS 345	1	CONED	471.7	759.0	881.2	116.1	SER:41&25
126285 GOTHLS S 345	126287 GOWANUSS 345	1	CONED	471.7	759.0	844.9	111.3	BUS:GOWANUS_N_345
126283 GOTHLS N 345	126286 GOWANUSN 345	1	CONED	471.7	759.0	842.5	111.0	BUS:GOWANUS_S_345
126295 RAINEY 345	126561 8E DUM 138	8	CONED	205.7	305.0	311.1	102.0	GEN:RAVNWD 3-New

Table 4-2: Post-Contingency Voltage Violations - Intermediate Year Summer Peak Conditions

Bus #	Bus Name	KV	Area	Zone	System Intact Volt	Vlow	Vhigh	Cont Volt	Drop/Rise	Viol	Contingency Description
130788	COLDS115	115.0	1	149	1.0263	0.9000	1.1000	0.8098	-0.2165	LD	130788 COLDS115 115 135267 CARR CRN 115 1
135263	BERRY RD	115.0	1	145	1.0549	0.9000	1.1000	0.9494	-0.1055	D	135263 BERRY RD 115 135273 DUNKIRK1 115 1
135281	HARTFLD1	115.0	1	145	1.0137	0.9000	1.1000	0.8336	-0.1801	LD	135281 HARTFLD1 115 135286 MOON-162 115 1
135290	COOPER	115.0	1	145	1.0271	0.9000	1.1000	0.8568	-0.1703	LD	135282 HOMERHIL 115 135296 W.OL-155 115 1
135296	W.OL-155	115.0	1	145	1.0300	0.9000	1.1000	0.8541	-0.1759	LD	135282 HOMERHIL 115 135296 W.OL-155 115 1
135301	BETH-150	115.0	1	145	1.0367	0.9000	1.1000	0.8826	-0.1541	LD	135301 BETH-150 115 135450 GRDNVL1 115 1
135302	GIBSONT6	115.0	1	145	1.0284	0.9000	1.1000	0.8734	-0.1550	LD	135302 GIBSONT6 115 147851 NIAG115W 115 1
135367	HARBFRT0	115.0	1	145	1.0366	0.9000	1.1000	0.8832	-0.1534	LD	135301 BETH-150 115 135450 GRDNVL1 115 1
135410	ELM-70	230.0	1	145	1.0204	0.9000	1.1000	0.9173	-0.1031	D	135410 ELM-70 230 135414 HUNTLEY2 230 1
135411	ELM-71	230.0	1	145	1.0009	0.9000	1.1000	0.8848	-0.1161	LD	135413 GRDNVL2 230 135416 SENCA-71 230 1
135412	ELM-72	230.0	1	145	1.0009	0.9000	1.1000	0.8848	-0.1161	LD	135413 GRDNVL2 230 135417 SENCA-72 230 1
135416	SENCA-71	230.0	1	145	1.0012	0.9000	1.1000	0.8844	-0.1168	LD	135413 GRDNVL2 230 135416 SENCA-71 230 1
135417	SENCA-72	230.0	1	145	1.0012	0.9000	1.1000	0.8844	-0.1168	LD	135413 GRDNVL2 230 135417 SENCA-72 230 1
135420	HARPR183	115.0	1	145	1.0252	0.9000	1.1000	0.8738	-0.1514	LD	135461 PACK(S)W 115 148004 CARGR183 115 1
135421	HARPR184	115.0	1	145	1.0237	0.9000	1.1000	0.8102	-0.2135	LD	135421 HARPR184 115 136544 UDG-184 115 1
135466	S215-188	115.0	1	145	1.0176	0.9000	1.1000	0.8852	-0.1324	LD	135466 S215-188 115 135511 NFWWP188 115 1
135466	S215-188	115.0	1	145	1.0176	0.9000	1.1000	0.8785	-0.1391	LD	135511 NFWWP188 115 148006 CARBW188 115 1
135509	NFWWP187	115.0	1	145	1.0215	0.9000	1.1000	0.8916	-0.1299	LD	135509 NFWWP187 115 148002 CARBW187 115 1
135509	NFWWP187	115.0	1	145	1.0215	0.9000	1.1000	0.8312	-0.1903	LD	148002 CARBW187 115 148008 HOOKS187 115 1
135509	NFWWP187	115.0	1	145	1.0215	0.9000	1.1000	0.8017	-0.2198	LD	148007 GRTLK187 115 148008 HOOKS187 115 1
135511	NFWWP188	115.0	1	145	1.0176	0.9000	1.1000	0.8785	-0.1391	LD	135511 NFWWP188 115 148006 CARBW188 115 1
135823	S215-187	115.0	1	145	1.0215	0.9000	1.1000	0.8978	-0.1237	LD	135509 NFWWP187 115 135823 S215-187 115 1
135823	S215-187	115.0	1	145	1.0215	0.9000	1.1000	0.8917	-0.1298	LD	135509 NFWWP187 115 148002 CARBW187 115 1
135823	S215-187	115.0	1	145	1.0215	0.9000	1.1000	0.8312	-0.1903	LD	148002 CARBW187 115 148008 HOOKS187 115 1
135823	S215-187	115.0	1	145	1.0215	0.9000	1.1000	0.8017	-0.2198	LD	148007 GRTLK187 115 148008 HOOKS187 115 1
147959	NCARBON7	115.0	1	157	1.0283	0.9000	1.1000	0.8732	-0.1551	LD	135302 GIBSONT6 115 147851 NIAG115W 115 1
147961	AIRCO197	115.0	1	157	1.0283	0.9000	1.1000	0.8732	-0.1551	LD	135302 GIBSONT6 115 147851 NIAG115W 115 1
147963	TITAN197	115.0	1	157	1.0282	0.9000	1.1000	0.8732	-0.1550	LD	135302 GIBSONT6 115 147851 NIAG115W 115 1
147995	DUPNT183	115.0	1	157	1.0248	0.9000	1.1000	0.8733	-0.1515	LD	135461 PACK(S)W 115 148004 CARGR183 115 1
147996	DUPNT184	115.0	1	157	1.0227	0.9000	1.1000	0.8091	-0.2136	LD	135421 HARPR184 115 136544 UDG-184 115 1
147997	DUPNT187	115.0	1	157	1.0212	0.9000	1.1000	0.8975	-0.1237	LD	135509 NFWWP187 115 135823 S215-187 115 1
147997	DUPNT187	115.0	1	157	1.0212	0.9000	1.1000	0.8913	-0.1299	LD	135509 NFWWP187 115 148002 CARBW187 115 1
147997	DUPNT187	115.0	1	157	1.0212	0.9000	1.1000	0.8308	-0.1904	LD	148002 CARBW187 115 148008 HOOKS187 115 1
147997	DUPNT187	115.0	1	157	1.0212	0.9000	1.1000	0.8013	-0.2199	LD	148007 GRTLK187 115 148008 HOOKS187 115 1
147998	DUPNT188	115.0	1	157	1.0173	0.9000	1.1000	0.8848	-0.1325	LD	135466 S215-188 115 135511 NFWWP188 115 1
147998	DUPNT188	115.0	1	157	1.0173	0.9000	1.1000	0.8782	-0.1391	LD	135511 NFWWP188 115 148006 CARBW188 115 1
148002	CARBW187	115.0	1	157	1.0217	0.9000	1.1000	0.8311	-0.1906	LD	148002 CARBW187 115 148008 HOOKS187 115 1
148002	CARBW187	115.0	1	157	1.0217	0.9000	1.1000	0.8016	-0.2201	LD	148007 GRTLK187 115 148008 HOOKS187 115 1
148004	CARGR183	115.0	1	157	1.0272	0.9000	1.1000	0.8720	-0.1552	LD	135461 PACK(S)W 115 148004 CARGR183 115 1
148008	HOOKS187	115.0	1	157	1.0231	0.9000	1.1000	0.8014	-0.2217	LD	148007 GRTLK187 115 148008 HOOKS187 115 1
148012	OLIN-184	115.0	1	157	1.0229	0.9000	1.1000	0.8092	-0.2137	LD	135421 HARPR184 115 136544 UDG-184 115 1
148014	OLIN-183	115.0	1	157	1.0249	0.9000	1.1000	0.8735	-0.1514	LD	135461 PACK(S)W 115 148004 CARGR183 115 1
135854	BRCKPTHS	115.0	2	173	0.9876	0.9000	1.1000	0.8163	-0.1713	LD	135854 BRCKPTHS 115 135873 SWDN-111 115 1
135857	GENFOOD	115.0	2	173	1.0024	0.9000	1.1000	0.8642	-0.1382	LD	135849 E.GOLAH 115 135895 BARILLA 115 1
135857	GENFOOD	115.0	2	173	1.0024	0.9000	1.1000	0.8628	-0.1396	LD	135857 GENFOOD 115 135895 BARILLA 115 1
135863	N.LAKE 1	115.0	2	173	1.0010	0.9000	1.1000	0.8667	-0.1343	LD	135849 E.GOLAH 115 135895 BARILLA 115 1
135863	N.LAKE 1	115.0	2	173	1.0010	0.9000	1.1000	0.8653	-0.1357	LD	135857 GENFOOD 115 135895 BARILLA 115 1
135877	UNIVRSTY	115.0	2	173	0.9861	0.9000	1.1000	0.8766	-0.1095	LD	135874 SWDN-113 115 135877 UNIVRSTY 115 1
135895	BARILLA	115.0	2	173	1.0032	0.9000	1.1000	0.8642	-0.1390	LD	135849 E.GOLAH 115 135895 BARILLA 115 1
149032	S33 902	115.0	2	153	1.0149	0.9000	1.1000	0.9015	-0.1134	D	149032 S33 902 115 149049 S82 B#3 115 02
136159	BRIDGE 7	115.0	3	146	1.0164	0.9000	1.1000	0.9020	-0.1144	D	136159 BRIDGE 7 115 136189 DEWITT 1 115 1
136166	A/B_LY13	115.0	3	146	0.9906	0.9000	1.1000	0.7470	-0.2436	LD	136166 A/B_LY13 115 136173 ANHBS-13 115 1
136186	CRUCIBLE	115.0	3	146	0.9992	0.9000	1.1000	0.6530	-0.3462	LD	136200 GERES LK 115 136270 CRUC TAP 115 1
136206	HDSN-7	115.0	3	146	1.0162	0.9000	1.1000	0.9021	-0.1141	D	136159 BRIDGE 7 115 136189 DEWITT 1 115 1
136230	PEAT-7	115.0	3	146	1.0150	0.9000	1.1000	0.9008	-0.1142	D	136159 BRIDGE 7 115 136189 DEWITT 1 115 1
136238	SOLVAY-B	115.0	3	146	0.9986	0.9000	1.1000	0.7340	-0.2646	LD	136238 SOLVAY-B 115 136269 SOLVTAP2 115 1
136239	SOLVAY-N	115.0	3	146	0.9995	0.9000	1.1000	0.6538	-0.3457	LD	136200 GERES LK 115 136270 CRUC TAP 115 1
136270	CRUC TAP	115.0	3	146	0.9995	0.9000	1.1000	0.6535	-0.3460	LD	136200 GERES LK 115 136270 CRUC TAP 115 1
147897	SOLVMATT	115.0	3	146	0.9993	0.9000	1.1000	0.6532	-0.3461	LD	136200 GERES LK 115 136270 CRUC TAP 115 1
147925	PMLD 3	115.0	4	158	1.0137	0.9000	1.1000	0.8735	-0.1402	LD	147923 PMLD 1 115 147925 PMLD 3 115 1
137222	CAMDNWIR	115.0	5	147	0.9700	0.9000	1.1000	0.8917	-0.0783	L	137211 TRNG STN 115 137233 ONEIDA 115 1
137230	LEHIGH	115.0	5	147	0.9700	0.9000	1.1000	0.8918	-0.0782	L	137211 TRNG STN 115 137233 ONEIDA 115 1
130822	KLINE115	115.0	6	165	1.0154	0.9000	1.1000	1.2081	0.1927	H	130793 CRARY115 115 130822 KLINE115 115 1
130931	STEPH115	115.0	6	165	0.9965	0.9000	1.1000	0.6891	-0.3074	LD	130931 STEPH115 115 137502 GBSH+LGE 115 1
130932	COWEE 1$	115.0	6	165	0.9965	0.9000	1.1000	0.6891	-0.3074	LD	130931 STEPH115 115 137502 GBSH+LGE 115 1
137501	FRONT ST	115.0	6	148	0.9999	0.9000	1.1000	0.8880	-0.1119	LD	137501 FRONT ST 115 137532 RTRDM1 115 1
137504	GE R&D	115.0	6	148	0.9876	0.9000	1.1000	0.8936	-0.0940	L	137501 FRONT ST 115 137532 RTRDM1 115 1
137531	ROSA RD	115.0	6	148	0.9899	0.9000	1.1000	0.8927	-0.0972	L	137501 FRONT ST 115 137532 RTRDM1 115 1
137868	BROOK1	115.0	6	148	0.9830	0.9000	1.1000	0.3776	-0.6054	LD	137867 BROOK W 115 137868 BROOK1 115 1
137889	KNAPP	115.0	6	148	0.9979	0.9000	1.1000	0.5494	-0.4485	LD	137880 EJW+STWB 115 137902 SCOFIELD 115 1
137889	KNAPP	115.0	6	148	0.9979	0.9000	1.1000	0.6354	-0.3625	LD	137902 SCOFIELD 115 137914 WBURG115 115 1
137896	N. CRK	115.0	6	148	0.9975	0.9000	1.1000	0.5454	-0.4521	LD	137880 EJW+STWB 115 137902 SCOFIELD 115 1
137896	N. CRK	115.0	6	148	0.9975	0.9000	1.1000	0.6319	-0.3656	LD	137902 SCOFIELD 115 137914 WBURG115 115 1
137902	SCOFIELD	115.0	6	148	1.0046	0.9000	1.1000	0.5522	-0.4524	LD	137880 EJW+STWB 115 137902 SCOFIELD 115 1
137912	VAIL 115	115.0	6	148	0.9752	0.9000	1.1000	0.8976	-0.0776	L	137911 VAIL TAP 115 137912 VAIL 115 115 1
137914	WBURG115	115.0	6	148	0.9975	0.9000	1.1000	0.5543	-0.4432	LD	137880 EJW+STWB 115 137902 SCOFIELD 115 1
137914	WBURG115	115.0	6	148	0.9975	0.9000	1.1000	0.6394	-0.3581	LD	137902 SCOFIELD 115 137914 WBURG115 115 1
137915	WEIBEL1	115.0	6	148	0.9775	0.9000	1.1000	0.3688	-0.6087	LD	137867 BROOK W 115 137868 BROOK1 115 1
137919	SMITHBR1	115.0	6	148	0.9794	0.9000	1.1000	0.3718	-0.6076	LD	137867 BROOK W 115 137868 BROOK1 115 1
126260	BOWLINE1	345.0	7	176	1.0439	0.9510	1.0490	1.0570	0.0131	H	126263 BUCHANAN S 345 126290 LADENTWN 345 1
126260	BOWLINE1	345.0	7	176	1.0439	0.9510	1.0490	1.0600	0.0161	H	126290 LADENTWN 345 146750 WHAV345 345 1
126460	38W42	138.0	8	167	1.0070	0.9000	1.1000	0.8865	-0.1205	LD	126458 MLWD TA 138 126460 38W42 138 1
126461	38W41	138.0	8	167	1.0069	0.9000	1.1000	0.8865	-0.1204	LD	126458 MLWD TA 138 126461 38W41 138 1
130842	PAWLN115	115.0	8	174	0.9921	0.9000	1.1000	0.8954	-0.0967	L	125026 FISHKILL 115 131112 SYLVN115 115 1
131112	SYLVN115	115.0	8	174	1.0085	0.9000	1.1000	0.8925	-0.1160	LD	125026 FISHKILL 115 131112 SYLVN115 115 1
126386	ROCK V T1	138.0	9	169	1.0066	0.9000	1.1000	0.8299	-0.1767	LD	126372 DUN SO 138 126386 ROCK V T1 138 1
126387	ROCK V T2	138.0	9	169	1.0066	0.9000	1.1000	0.8299	-0.1767	LD	126372 DUN SO 138 126387 ROCK V T2 138 1
126388	ROCK V T3	138.0	9	169	1.0066	0.9000	1.1000	0.8677	-0.1389	LD	126372 DUN SO 138 126388 ROCK V T3 138 1
126430	GRANHL T1	138.0	9	169	1.0066	0.9000	1.1000	0.8742	-0.1324	LD	126372 DUN SO 138 126430 GRANHL T1 138 1

Table 4-2: Post-Contingency Voltage Violations - Intermediate Year Summer Peak Conditions

Bus #	Bus Name	KV	Area	Zone	System Intact Volt	Vlow	Vhigh	Cont Volt	Drop/Rise	Viol	Contingency Description
126431	GRANHL T2	138.0	9	169	1.0066	0.9000	1.1000	***0.8751***	-0.1315	LD	126372 DUN SO 138 126431 GRANHL T2 138 1
126432	GRANHL T3	138.0	9	169	1.0066	0.9000	1.1000	***0.8740***	-0.1326	LD	126372 DUN SO 138 126432 GRANHL T3 138 1
126433	GRANHL T4	138.0	9	169	1.0066	0.9000	1.1000	***0.8745***	-0.1321	LD	126372 DUN SO 138 126433 GRANHL T4 138 1
126439	HARR TX1	138.0	9	169	0.9989	0.9000	1.1000	***0.8973***	-0.1016	LD	126382 ELMSFD2E 138 126524 38W14 T 138 1
126439	HARR TX1	138.0	9	169	0.9989	0.9000	1.1000	***0.8663***	-0.1326	LD	126439 HARR TX1 138 126524 38W14 T 138 1
126440	HARR TX2	138.0	9	169	0.9993	0.9000	1.1000	***0.8674***	-0.1319	LD	126440 HARR TX2 138 126523 38W13 T 138 1
126441	HARR TX 3	138.0	9	169	0.9989	0.9000	1.1000	***0.8689***	-0.1300	LD	126441 HARR TX 3 138 126522 38W02 T 138 1
126519	WHITE P TX1	138.0	9	169	1.0037	0.9000	1.1000	***0.8811***	-0.1226	LD	126380 ELMSFD1E 138 126519 WHITE P TX1 138 1
126523	38W13 T	138.0	9	169	1.0035	0.9000	1.1000	***0.9022***	-0.1013	D	126383 ELMSFD2W 138 126523 38W13 T 138 1
126524	38W14 T	138.0	9	169	1.0032	0.9000	1.1000	***0.8974***	-0.1058	LD	126382 ELMSFD2E 138 126524 38W14 T 138 1
126670	HARR T4	138.0	9	169	1.0009	0.9000	1.1000	***0.8714***	-0.1295	LD	126319 38W15 T 138 126670 HARR T4 138 1
126708	GRASSL1	138.0	9	169	1.0064	0.9000	1.1000	***0.8504***	-0.1560	LD	126378 EASTVIEW 138 126708 GRASSL1 138 1
126709	GRASSL2	138.0	9	169	1.0064	0.9000	1.1000	***0.8504***	-0.1560	LD	126378 EASTVIEW 138 126709 GRASSL2 138 1
126718	GRASSL3	138.0	9	169	1.0064	0.9000	1.1000	***0.8504***	-0.1560	LD	126378 EASTVIEW 138 126718 GRASSL3 138 1
126747	WHITE P TX2	138.0	9	169	1.0033	0.9000	1.1000	***0.8823***	-0.1210	LD	126522 38W02 T 138 126747 WHITE P TX2 138 1
126748	WHITEP TX2	138.0	9	169	1.0031	0.9000	1.1000	***0.8974***	-0.1057	LD	126382 ELMSFD2E 138 126524 38W14 T 138 1
126748	WHITEP TX2	138.0	9	169	1.0031	0.9000	1.1000	***0.8770***	-0.1261	LD	126524 38W14 T 138 126748 WHITEP TX2 138 1
126749	WHITEP T7	138.0	9	169	1.0035	0.9000	1.1000	***0.9022***	-0.1013	D	126383 ELMSFD2W 138 126523 38W13 T 138 1
126749	WHITEP T7	138.0	9	169	1.0035	0.9000	1.1000	***0.8828***	-0.1207	LD	126523 38W13 T 138 126749 WHITEP T7 138 1
126366	YORK1	138.0	10	159	1.0098	0.9500	1.0500	***0.9378***	-0.0720	L	GEN:RAVNWD 3-New
126367	YORK2	138.0	10	159	1.0102	0.9500	1.0500	***0.9382***	-0.0720	L	GEN:RAVNWD 3-New
126375	YORK3	138.0	10	159	1.0099	0.9500	1.0500	***0.9379***	-0.0720	L	GEN:RAVNWD 3-New
126384	E13 ST	138.0	10	159	1.0096	0.9500	1.0500	***0.9299***	-0.0797	L	GEN:RAVNWD 3-New
126390	E75 ST-1	138.0	10	159	1.0166	0.9500	1.0500	***0.9345***	-0.0821	L	GEN:RAVNWD 3-New
126392	E75 ST-3	138.0	10	159	1.0266	0.9500	1.0500	***0.9444***	-0.0822	L	GEN:RAVNWD 3-New
126394	FGT_Y5	138.0	10	159	1.0149	0.9500	1.0500	***0.9436***	-0.0713	L	GEN:RAVNWD 3-New
126395	FGT_Y7	138.0	10	159	1.0176	0.9500	1.0500	***0.9444***	-0.0732	L	GEN:RAVNWD 3-New
126396	FGT_Y10	138.0	10	159	1.0160	0.9500	1.0500	***0.9444***	-0.0716	L	GEN:RAVNWD 3-New
126397	FGT_Y8	138.0	10	159	1.0133	0.9500	1.0500	***0.9404***	-0.0729	L	GEN:RAVNWD 3-New
126398	FGT_Y9	138.0	10	159	1.0170	0.9500	1.0500	***0.9472***	-0.0698	L	GEN:RAVNWD 3-New
126401	PLYM_X1	138.0	10	159	1.0172	0.9500	1.0500	***0.9391***	-0.0781	L	GEN:RAVNWD 3-New
126409	FGT_X2	138.0	10	159	1.0174	0.9500	1.0500	***0.9393***	-0.0781	L	GEN:RAVNWD 3-New
126478	RAINEY7E	138.0	10	159	1.0181	0.9500	1.0500	***0.9364***	-0.0817	L	GEN:RAVNWD 3-New
126484	SEAPT 5&9	138.0	10	159	1.0163	0.9500	1.0500	***0.9463***	-0.0700	L	GEN:RAVNWD 3-New
126485	38M12 TAP	138.0	10	159	1.0164	0.9500	1.0500	***0.9429***	-0.0735	L	GEN:RAVNWD 3-New
126487	SEPRT 4&8	138.0	10	159	1.0139	0.9500	1.0500	***0.9424***	-0.0715	L	GEN:RAVNWD 3-New
126488	38M15 TAP	138.0	10	159	1.0163	0.9500	1.0500	***0.9463***	-0.0700	L	GEN:RAVNWD 3-New
126489	SEAPT 2&6	138.0	10	159	1.0163	0.9500	1.0500	***0.9428***	-0.0735	L	GEN:RAVNWD 3-New
126501	TRADE TX3	138.0	10	159	1.0160	0.9500	1.0500	***0.9459***	-0.0701	L	GEN:RAVNWD 3-New
126502	TRADE TX2	138.0	10	159	1.0149	0.9500	1.0500	***0.9430***	-0.0719	L	GEN:RAVNWD 3-New
126503	TRADE TX4	138.0	10	159	1.0163	0.9500	1.0500	***0.9428***	-0.0735	L	GEN:RAVNWD 3-New
126504	38M13 TAP	138.0	10	159	1.0150	0.9500	1.0500	***0.9433***	-0.0717	L	GEN:RAVNWD 3-New
126531	W110 2&7	138.0	10	159	1.0259	0.9500	1.0500	***0.9436***	-0.0823	L	GEN:RAVNWD 3-New
126536	EAST75 TAP 4	138.0	10	159	1.0167	0.9500	1.0500	***0.9346***	-0.0821	L	GEN:RAVNWD 3-New
126537	EAST75 TAP 3	138.0	10	159	1.0267	0.9500	1.0500	***0.9446***	-0.0821	L	GEN:RAVNWD 3-New
126538	W42 T2&10	138.0	10	159	1.0170	0.9500	1.0500	***0.9424***	-0.0746	L	GEN:RAVNWD 3-New
126540	W42 T3&7	138.0	10	159	1.0165	0.9500	1.0500	***0.9393***	-0.0772	L	GEN:RAVNWD 3-New
126541	W42 T4&6	138.0	10	159	1.0167	0.9500	1.0500	***0.9393***	-0.0774	L	GEN:RAVNWD 3-New
126543	W49 ST 1	138.0	10	159	1.0171	0.9500	1.0500	***0.9426***	-0.0745	L	GEN:RAVNWD 3-New
126544	W49 ST 2	138.0	10	159	1.0171	0.9500	1.0500	***0.9398***	-0.0773	L	GEN:RAVNWD 3-New
126546	W49 ST 4	138.0	10	159	1.0170	0.9500	1.0500	***0.9399***	-0.0771	L	GEN:RAVNWD 3-New
126549	ASTOR T1 TAP	138.0	10	159	1.0169	0.9500	1.0500	***0.9398***	-0.0771	L	GEN:RAVNWD 3-New
126551	ASTOR T5 TAP	138.0	10	159	1.0170	0.9500	1.0500	***0.9425***	-0.0745	L	GEN:RAVNWD 3-New
126552	ASTOR T2 TAP	138.0	10	159	1.0171	0.9500	1.0500	***0.9398***	-0.0773	L	GEN:RAVNWD 3-New
126554	W65ST2&5	138.0	10	159	1.0165	0.9500	1.0500	***0.9392***	-0.0773	L	GEN:RAVNWD 3-New
126556	W65ST4&7	138.0	10	159	1.0160	0.9500	1.0500	***0.9413***	-0.0747	L	GEN:RAVNWD 3-New
126592	SEAPT T3&10	138.0	10	159	1.0150	0.9500	1.0500	***0.9432***	-0.0718	L	GEN:RAVNWD 3-New
126596	W42 TX7	138.0	10	159	1.0165	0.9500	1.0500	***0.9392***	-0.0773	L	GEN:RAVNWD 3-New
126597	W42 TX6	138.0	10	159	1.0166	0.9500	1.0500	***0.9392***	-0.0774	L	GEN:RAVNWD 3-New
126611	ASTOR T2	138.0	10	159	1.0171	0.9500	1.0500	***0.9397***	-0.0774	L	GEN:RAVNWD 3-New
126628	MHTX1	138.0	10	159	1.0143	0.9500	1.0500	***0.9431***	-0.0712	L	GEN:RAVNWD 3-New
126629	PARK1	138.0	10	159	1.0116	0.9500	1.0500	***0.9399***	-0.0717	L	GEN:RAVNWD 3-New
126630	MOTT TX2	138.0	10	159	1.0142	0.9500	1.0500	***0.9430***	-0.0712	L	GEN:RAVNWD 3-New
126631	MHTX2	138.0	10	159	1.0145	0.9500	1.0500	***0.9433***	-0.0712	L	GEN:RAVNWD 3-New
126632	PARK2	138.0	10	159	1.0122	0.9500	1.0500	***0.9405***	-0.0717	L	GEN:RAVNWD 3-New
126633	MOTT TX1	138.0	10	159	1.0144	0.9500	1.0500	***0.9432***	-0.0712	L	GEN:RAVNWD 3-New
126634	MHTX3	138.0	10	159	1.0141	0.9500	1.0500	***0.9429***	-0.0712	L	GEN:RAVNWD 3-New
126635	PARK3	138.0	10	159	1.0117	0.9500	1.0500	***0.9401***	-0.0716	L	GEN:RAVNWD 3-New
126636	MOTT TX3	138.0	10	159	1.0141	0.9500	1.0500	***0.9429***	-0.0712	L	GEN:RAVNWD 3-New
126637	MHTX4	138.0	10	159	1.0089	0.9500	1.0500	***0.9381***	-0.0708	L	GEN:RAVNWD 3-New
126639	MOTT TX4	138.0	10	159	1.0088	0.9500	1.0500	***0.9380***	-0.0708	L	GEN:RAVNWD 3-New
126726	ASTOR T1	138.0	10	159	1.0169	0.9500	1.0500	***0.9397***	-0.0772	L	GEN:RAVNWD 3-New
126728	ASTOR T5	138.0	10	159	1.0170	0.9500	1.0500	***0.9425***	-0.0745	L	GEN:RAVNWD 3-New
126828	W50-TAP TX 5	138.0	10	159	1.0170	0.9500	1.0500	***0.9398***	-0.0772	L	GEN:RAVNWD 3-New
155073	STLAWL34	230.0	103	1105	1.0413	0.9520	1.0520	***1.0722***	0.0309	H	147839 MOSES E 230 155073 STLAWL34 230 1

5 SECURITY ANALYSIS FOR HORIZON YEAR

This section presents results obtained from steady-state analysis of the New York State Transmission System for Summer Peak load conditions in the Horizon Year. System Power flow analysis is performed on the six power flow cases developed in Section 3.2 based on the methodology presented in Section 4.1. Analysis of the wind cases (Scenarios 5 and 6) will be performed in Phase II of this study.

5.1 Results

5.1.1 System Intact Conditions

Results of the system intact analysis (with all lines in-service) showed some base case overloads mostly on underlying systems (115 kV and below) as in Table 5-1.

Based on information provided by LIPA, the overloads on the step down banks at Holbrook and Port Jefferson in the LIPA system are due to high loads at 69 kV buses in the area. Also the injection of the STARS generation of Zone K in most cases is at Holbrook. LIPA indicated that in order to mitigate these overloads additional stepdown transformers are required at those locations.

Voltage violations were observed under system intact conditions but most of them are marginal as shown in Table 5-2.

These violations should be reviewed by the Transmission Owners.

5.1.2 Contingency Case Conditions

Results of the contingency analysis showed thermal and voltage violations. These are listed in Tables 5-3 and 5-4 and are described below.

Table 5-3 shows the overloaded transmission facilities.

<u>NYSEG / RGE Systems</u>:

As in the intermediate year system, most of the overloads in the NYSEG and RGE systems are on underlying systems and these facilities should be ignored when analyzing bulk power system performance. NYSEG requested that these facilities continue to be monitored for potential problems when wind generation is increased in the base case. The only exception is the transformer from Pannell Road 345kV to Station 122 115kV in Scenarios 3 and 4 following the loss of Ginna units. The maximum overloading is seen to be around 8%.

<u>Long Island Power Authority System</u>:

Each of the 345/138 kV Newbridge Road transformers becomes overloaded for loss of the parallel bank (about 16% overload based on the 585 MVA LTE rating) for all four Scenarios.

Also, a post-contingency overload was observed on the Brookhaven-Riverhead 138 kV line following the loss of the Shoreham-Wildwood 138 kV line.

National Grid System:

Several post-contingency overloads were observed in the National Grid system. Based on comments received from National Grid for the Intermediate Year security analysis, it is our understanding that most of these overloads are dispatch dependent and may be addressed by generation reduction. Other comments are given below:

- The post-contingency overloads on the Leeds-Pleasant Valley 345 kV and Athens-Pleasant Valley 345 kV lines are dependent on dispatch and expected to decrease if Athens Generation is reduced. At present, there is a temporary SPS in place for the contingencies that cause the overloads.
- The overloads on the following facilities are dispatch dependent and expected to decrease if Athens Generation is reduced:

```
125040 N.CAT. 1     115 137507 BOC 2T      115  2
137507 BOC 2T       115 137510 JMC2+9TP    115  1
137481 JMC1+7TP     115 137490 BLUECIRC    115  1
```

- The overloads on the Reynolds Road 345/115 kV transformer are dependent on local generation, and there is an SPS that ramps down the Besicorp generation (or now called Empire generation (bus 137558)) for the contingencies listed.
- The overload on the Allens F – Colton 115 kV line is driven by generation dispatch; if it turns out to be wind/hydro it may be something the STARS project will need to address.
- The overloads on the Menands-St. Camps 115 kV line are a result of incorrect contingencies.

Table 5-4 lists post-contingency voltage violations.

New York Power Authority:

Based on comments received from New York Power Authority as part of the Intermediate Year security analysis, it is our understanding that the following voltage violations can be ignored:

- PMLD 3 for the loss of PMLD 1 is a local issue.
- MDTN Tap for loss of the CCRT - 34 is an expected voltage issue.

NYSEG / RGE:

Based on comments received from NYSEG/RGE as part of the Intermediate Year security analysis, it is our understanding that the following voltage violations can be ignored:

- SLVYN115 for loss of FISHKILL115 to SYLVN115 is a local issue.
- The four WOODA 345 and WOODB345 violations for loss of bus and line tap connections are expected voltage issue.

5.2 Transmission Interface Loadings

Flows on transmission interfaces were monitored under all-lines-in and contingency case conditions in Scenarios 1 through 4 and checked against the corresponding emergency transfer limits derived in Section 6. The intent here is not to check interfaces for possible overload conditions[14] but to identify those interfaces whose flows exceed the previously established transfer limits and have a potential for becoming congested thus resulting in generation curtailment and impacting LOLE. The idea is to compare such interfaces against the interfaces previously flagged as being congested in the LOLE analysis (performed elsewhere in this study – see Part II of this report).

Table 5-5 shows those interfaces whose flows exceed the interface transfer limits. Again, these results should not be reviewed from a deterministic standpoint but from a probabilistic (LOLE) standpoint in the sense that we want to identify which interfaces are congested. For example, Table 5-5 shows that the emergency transfer limit on the F-G interface is 3485 MW[15] and the corresponding base case flow is 3795 MW in the Scenario 2 case. This does not imply that the interface is overloaded. However, it implies that generation will be redispatched (or curtailed) to reduce the flow on this interface below its emergency transfer limit, thus potentially impacting LOLE.

Table 5-5 shows several interfaces whose flows exceed the corresponding transfer limits. Several of these interfaces were also flagged in the LOLE analysis, for example Volney East, UPNY-SENY, F-G, I-K etc. See Section 9 of this report for details. Thus, the results of Table 5-5 support the findings of the LOLE analysis.

5.3 Conclusions

The results presented in this report showed several security violations (thermal and voltage). It should be noted that these violations are for a typical generation dispatch i.e., for a snapshot of system conditions at a given instant in time. It may be possible to mitigate the violations through generation redispatch or through transmission

[14] Flows on some interfaces are limited due to system thermal constraints while flows on other interfaces are limited due to system voltage constraints.
[15] From the Task 5 report, the F-G interface is thermally limited, the limiting element being the Leeds-Pleasant Valley 345 kV line for loss of the Athens-Pleasant Valley 345 kV line.

reinforcements. Solutions to mitigate these constraints will be developed in Phase II of this study based on discussions with the Transmission Owners.

Table 5-1: System Intact Overloads – Horizon Year Summer Peak Conditions (Scenarios 1~4)

** From bus **	** To bus **	CKT	Owner	Normal Rating	Int. Year Loading%	Horizon Year Scenario1 MVA Loading	Horizon Year Scenario1 Loading%	Horizon Year Scenario2 MVA Loading	Horizon Year Scenario2 Loading%	Horizon Year Scenario3 MVA Loading	Horizon Year Scenario3 Loading%	Horizon Year Scenario4 MVA Loading	Horizon Year Scenario4 Loading%
125002 ROSETON 345	125192 ROSE GN2 24.0	2	CENT HUD	614.0	-	647.9	105.5	660.7	107.6	-	-	660.7	107.6
125020 DANSKAMA 115	125021 DC CBLTP 115	1	CENT HUD	178.0	-	191.3	107.5	188.9	106.1	-	-	191.8	107.8
125002 ROSETON 345	125190 ROSE GN1 24.0	1	CENT HUD	614.0	-	-	-	653.0	106.4	-	-	652.0	106.2
126283 GOTHLS N 345	126286 GOWANUSN 345	1	CONED	529.0	-	-	-	537.7	101.6	-	-	-	-
126285 GOTHLS S 345	126287 GOWANUSS 345	1	CONED	529.0	-	-	-	537.7	101.6	-	-	-	-
129421 HOLBROOK 138	129806 HOLBRK1 69.0	1	LIPA	239.0	-	268.8	112.5	251.4	105.2	269.1	112.6	259.3	108.5
129421 HOLBROOK 138	129807 HOLBRK2 69.0	2	LIPA	104.0	-	104.4	100.4	-	-	104.6	100.5	-	-
129448 PT JEFF1 138	129828 PT.JEFF2 69.0	1	LIPA	117.0	-	121.1	103.5	123.8	105.8	120.5	103.0	121.0	103.4
136779 LTL RV-F 115	137043 LITTLE R 23.0	1	NGRID	11.0	106.6	12.8	116.4	12.8	116.1	12.8	116.1	12.8	116.4
136781 LWRNCE-A 115	137153 LAWRENCE 13.2	1	NGRID	10.0	-	10.9	109.4	10.9	109.1	10.9	109.1	10.9	109.3
136782 LWRNCE-B 115	137153 LAWRENCE 13.2	1	NGRID	10.0	-	10.8	108.5	10.8	108.1	10.8	108.1	10.8	108.4
136783 MALONE 115	136918 MALONE 3 34.5	1	NGRID	10.5	103.0	12.1	115.2	12.1	115.2	12.1	115.2	12.1	115.2
136783 MALONE 115	136918 MALONE 3 34.5	2	NGRID	11.9	117.1	15.6	131.0	15.6	131.1	15.6	131.0	15.6	131.0
136791 NICHOLVL 115	136926 NICHOLVI 34.5	1	NGRID	13.8	129.3	19.6	142.2	19.6	142.2	19.6	142.1	19.6	142.2
137484 ALTAMONT 115	137572 ALTAMONT 34.5	1	NGRID	16.8	-	17.0	101.2	17.3	102.9	17.3	102.8	17.0	101.1
135868 PTSFD-23 115	149111 STA 56 34.5	1	RGE	56.0	-	56.2	100.4	56.2	100.3	56.1	100.2	56.3	100.5
135869 PTSFD-24 115	149111 STA 56 34.5	2	RGE	56.0	-	57.9	103.3	57.8	103.2	57.7	103.1	57.9	103.3
136197 FRMGTN-4 115	149141 FRMNGT2 34.5	1	RGE	57.6	-	67.6	117.4	67.3	116.8	67.3	116.8	68.0	118.1
149033 S42 115 115	149181 STA42 B 11.5	4	RGE	29.7	116.1	38.6	129.8	38.9	130.9	38.8	130.7	39.4	132.6
149032 S33 902 115	149172 S33 11T 11.5	11	RGE	33.0	-	34.0	103.1	33.7	102.2	33.7	102.1	34.1	103.3

Note:
1. "-" indicates no violations for this scenario
2. Roseton GSUs' overload were due to the increased dispatch at generators with no addition of new generators in Scenarios 1,2,4
3. The load at Lawrence increased which caused overloading on the GSU. However, the load was not considered as station service load (20MW load against 2MW generatio

Table 5-2: System Intact Voltage Violations – Horizon Year Summer Peak Conditions (Scenarios 1~4)

Bus #	Bus Name	kV	Area	Zone	Vlow	Vhigh	Intermediate Year	Horizon Year System Inta		
								Scenario1	Scenario2	Scenar
135257	SPECMETL	115.0	1	145	0.950	1.050	1.058	1.053	1.058	1.05
135263	BERRY RD	115.0	1	145	0.950	1.050	1.055	1.055	1.055	1.05
135264	BNNT-142	115.0	1	145	0.950	1.050	1.058	1.053	1.057	1.05
135265	BNNT-162	115.0	1	145	0.950	1.050	1.056	1.051	1.056	1.05
135266	BRIGHAM1	115.0	1	145	0.950	1.050	1.058	1.053	1.058	1.05
135273	DUNKIRK1	115.0	1	145	0.950	1.050	1.062	1.056	1.061	1.06
135274	EDNK-161	115.0	1	145	0.950	1.050	1.054	1.054	1.054	1.05
135275	EDNK-162	115.0	1	145	0.950	1.050	1.055	1.055	1.055	1.05
135283	LUDLUM62	115.0	1	145	0.950	1.050	1.057	1.052	1.057	1.05
135293	LUDLUM61	115.0	1	145	0.950	1.050	1.057	1.052	1.057	1.05
149024	GINNA115	115.0	2	153	0.950	1.050	1.052	1.052	1.052	1.05
130827	MILKN115	115.0	3	150	0.950	1.050	1.058	1.054	1.054	1.05
130871	CANADIAC	115.0	3	150	0.950	1.050	1.126	1.103	1.107	1.10
130872	CANADIAS	115.0	3	150	0.950	1.050	1.125	1.105	1.109	1.10
131342	BENET115	115.0	3	150	0.950	1.050	1.057	-	-	-
131344	PALMT115	115.0	3	150	0.950	1.050	1.057	-	-	-
114	RTDM77SW	230.0	6	148	0.950	1.050	-	0.928	0.922	0.92
115	RTDM99SW	230.0	6	148	0.950	1.050	-	0.928	0.922	0.92
130773	BARTN115	115.0	6	165	0.950	1.050	-	0.950	0.950	0.95
137730	ROTRDM.2	230.0	6	148	0.950	1.050	-	0.928	0.922	0.92
126266	DUNWODIE	345.0	9	169	1.003	1.049	-	1.002	1.002	-
126298	SPRBROOK	345.0	9	169	1.003	1.049	-	1.003	1.003	-
126284	GOTHLS R	345.0	10	159	0.950	1.050	1.051	1.052	1.054	1.05
126499	T11MPT	138.0	10	159	0.950	1.050	-	1.051	-	-

Note:
1. "-" indicates no violations for this scenario

Table 5-3: Post-Contingency Overloads – Horizon Year Summer Peak Conditions (Scenarios 1~4)

			Intermediate Year			Horizon Year Scenario 1			Horizon Year Scenario 2			Horizon Year Scenario 3			Horizon Year Scenario 4			
Limiting Element	Owner	LTE/STE Rating	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Limiting Contingency
125015 AC CBLTP 115 125020 DANSKAMA 115 1	CENT HUD	211.0	165.8	323.7	153.4	185.6	363.3	172.2	183.3	360.2	170.7	171.7	337.0	159.7	186.1	364.3	172.7	125021 DC CBLTP 115 125041 N.CHELSE 115 1
125015 AC CBLTP 115 125020 DANSKAMA 115 1	CENT HUD	211.0	165.8	323.6	153.4	185.6	363.1	172.1	183.3	360.2	170.7	171.7	336.6	159.5	186.1	364.0	172.5	125020 DANSKAMA 115 125021 DC CBLTP 115 1
125015 AC CBLTP 115 125020 DANSKAMA 115 1	CENT HUD	211.0	165.8	215.7	102.2	185.6	236.2	111.9	183.3	238.6	113.1	171.7	223.1	105.7	186.1	240.2	113.8	125002 ROSETON 345 126281 FISHKILL 345 1
125015 AC CBLTP 115 125041 N.CHELSE 115 1	CENT HUD	211.0	165.8	323.7	153.4	185.7	363.4	172.2	183.4	360.3	170.7	171.7	337.0	159.7	186.2	364.4	172.7	125021 DC CBLTP 115 125041 N.CHELSE 115 1
125015 AC CBLTP 115 125041 N.CHELSE 115 1	CENT HUD	211.0	165.8	323.7	153.4	185.7	363.1	172.1	183.4	360.2	170.7	171.7	336.6	159.5	186.2	364.1	172.5	125020 DANSKAMA 115 125021 DC CBLTP 115 1
125015 AC CBLTP 115 125041 N.CHELSE 115 1	CENT HUD	211.0	165.8	215.7	102.2	185.7	236.2	111.9	183.4	238.6	113.1	171.7	223.1	105.7	186.2	240.2	113.9	125002 ROSETON 345 126281 FISHKILL 345 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	-	-	-	-	-	-	-	-	-	191.8	199.8	100.4	126262 BUCHANAN N 345 126267 E VIEW 2N 345 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	-	-	-	-	-	-	-	-	-	191.8	199.8	100.4	SER:W93&W79
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	170.9	324.3	163.0	191.3	364.1	183.0	188.9	361.0	181.4	176.9	337.7	169.7	191.8	365.1	183.5	125015 AC CBLTP 115 125041 N.CHELSE 115 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	170.9	324.3	163.0	191.3	363.9	182.8	188.9	360.9	181.4	176.9	337.3	169.5	191.8	364.8	183.3	125015 AC CBLTP 115 125020 DANSKAMA 115 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	170.9	222.3	111.7	191.3	243.4	122.3	188.9	245.9	123.6	176.9	229.9	115.5	191.8	247.6	124.4	125002 ROSETON 345 126281 FISHKILL 345 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	191.3	214.6	107.8	188.9	215.4	108.2	176.9	201.4	101.2	191.8	216.4	108.8	125001 ROCK TAV 345 126297 RAMAPO 345 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	191.3	214.3	107.7	188.9	214.0	107.6	176.9	203.1	102.1	191.8	214.5	107.8	125022 E FISH I 115 126281 FISHKILL 345 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	191.3	206.5	103.8	188.9	204.8	102.9	-	-	-	191.8	207.3	104.2	125020 DANSKAMA 115 125198 DR CBLTP 115 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	191.3	206.5	103.8	188.9	204.8	102.9	-	-	-	191.8	207.3	104.2	125044 REYNOLDS 115 125198 DR CBLTP 115 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	191.3	200.5	100.8	188.9	199.2	100.1	-	-	-	191.8	201.1	101.0	125036 MANCHEST 115 125043 PL.VAL 1 115 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	191.3	200.6	100.8	188.9	201.2	101.1	-	-	-	191.8	202.0	101.5	126294 PLTVLLEY 345 137451 LEEDS 3 345 2
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	191.3	200.1	100.6	188.9	200.9	101.0	-	-	-	191.8	201.6	101.3	126294 PLTVLLEY 345 137455 ATHENS 345 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	191.3	199.3	100.1	-	-	-	-	-	-	191.8	199.8	100.4	125043 PL.VAL 1 115 125054 TODD HIL 115 1
125020 DANSKAMA 115 125021 DC CBLTP 115 1	CENT HUD	199.0	-	-	-	191.3	199.3	100.1	-	-	-	-	-	-	191.8	200.0	100.5	130781 CARML115 115 130865 WOODS115 115 1
125021 DC CBLTP 115 125041 N.CHELSE 115 1	CENT HUD	253.0	170.9	324.4	128.2	191.3	364.1	143.9	189.0	361.0	142.7	177.0	337.7	133.5	191.9	365.1	144.3	125015 AC CBLTP 115 125041 N.CHELSE 115 1
125021 DC CBLTP 115 125041 N.CHELSE 115 1	CENT HUD	253.0	170.9	324.3	128.2	191.3	363.9	143.8	189.0	361.0	142.7	177.0	337.4	133.3	191.9	364.8	144.2	125015 AC CBLTP 115 125020 DANSKAMA 115 1
125027 FORGEBRK 115 125041 N.CHELSE 115 1	CENT HUD	211.0	-	-	-	155.8	213.3	101.1	153.6	211.3	100.1	-	-	-	156.4	214.5	101.7	125026 FISHKILL 115 125041 N.CHELSE 115 1
126266 DUNWODIE 345 126600 REAC71 345 SR	CONED	851.0	-	-	-	-	-	-	747.6	891.6	104.8	-	-	-	-	-	-	126298 SPRBROOK 345 126517 REACM51 345 SR
126266 DUNWODIE 345 126600 REAC71 345 SR	CONED	851.0	-	-	-	-	-	-	747.6	891.6	104.8	-	-	-	-	-	-	126298 SPRBROOK 345 126518 REACM52 345 SR
126266 DUNWODIE 345 126600 REAC71 345 SR	CONED	851.0	-	-	-	698.7	855.0	100.5	747.6	916.4	107.7	697.6	854.1	100.4	694.1	851.0	100.0	126266 DUNWODIE 345 126601 REAC72 345 SR
126266 DUNWODIE 345 126600 REAC71 345 SR	CONED	851.0	-	-	-	698.7	852.9	100.2	747.6	911.0	107.1	697.6	851.9	100.1	-	-	-	126601 REAC72 345 126641 MOTT HAVEN 345 4
126266 DUNWODIE 345 126601 REAC72 345 SR	CONED	851.0	-	-	-	-	-	-	742.5	911.5	107.1	-	-	-	-	-	-	126266 DUNWODIE 345 126600 REAC71 345 SR
126266 DUNWODIE 345 126601 REAC72 345 SR	CONED	851.0	-	-	-	-	-	-	742.5	906.1	106.5	-	-	-	-	-	-	126600 REAC71 345 126641 MOTT HAVEN 345 3
126266 DUNWODIE 345 126601 REAC72 345 SR	CONED	851.0	-	-	-	-	-	-	742.5	885.5	104.1	-	-	-	-	-	-	126298 SPRBROOK 345 126517 REACM51 345 SR
126266 DUNWODIE 345 126601 REAC72 345 SR	CONED	851.0	-	-	-	-	-	-	742.5	885.5	104.1	-	-	-	-	-	-	126298 SPRBROOK 345 126518 REACM52 345 SR
126385 E179 ST 138 126730 15055 SR 138 1	CONED	365.0	223.4	417.5	114.4	-	-	-	221.2	432.9	118.6	-	-	-	215.7	437.2	119.8	GEN:NYPA_AS
126581 HG TAP 138 126730 15055 SR 138 1	CONED	365.0	223.4	417.5	114.4	-	-	-	221.2	432.9	118.6	-	-	-	215.7	437.2	119.8	GEN:NYPA_AS
126600 REAC71 345 126641 MOTT HAVEN 345 3	CONED	851.0	-	-	-	-	-	-	747.6	891.6	104.8	-	-	-	-	-	-	126298 SPRBROOK 345 126517 REACM51 345 SR
126600 REAC71 345 126641 MOTT HAVEN 345 3	CONED	851.0	-	-	-	-	-	-	747.6	891.6	104.8	-	-	-	-	-	-	126298 SPRBROOK 345 126518 REACM52 345 SR
126600 REAC71 345 126641 MOTT HAVEN 345 3	CONED	851.0	-	-	-	698.7	855.0	100.5	747.6	916.4	107.7	697.6	854.1	100.4	694.1	851.0	100.0	126266 DUNWODIE 345 126601 REAC72 345 SR
126600 REAC71 345 126641 MOTT HAVEN 345 3	CONED	851.0	-	-	-	698.7	852.9	100.2	747.6	911.0	107.1	697.6	851.9	100.1	-	-	-	126601 REAC72 345 126641 MOTT HAVEN 345 4
126601 REAC72 345 126641 MOTT HAVEN 345 4	CONED	851.0	-	-	-	-	-	-	742.5	911.5	107.1	-	-	-	-	-	-	126266 DUNWODIE 345 126600 REAC71 345 SR
126601 REAC72 345 126641 MOTT HAVEN 345 4	CONED	851.0	-	-	-	-	-	-	742.5	906.1	106.5	-	-	-	-	-	-	126600 REAC71 345 126641 MOTT HAVEN 345 3
126601 REAC72 345 126641 MOTT HAVEN 345 4	CONED	851.0	-	-	-	-	-	-	742.5	885.5	104.1	-	-	-	-	-	-	126298 SPRBROOK 345 126517 REACM51 345 SR
126601 REAC72 345 126641 MOTT HAVEN 345 4	CONED	851.0	-	-	-	-	-	-	742.5	885.5	104.1	-	-	-	-	-	-	126298 SPRBROOK 345 126518 REACM52 345 SR
128847 NWBRG 345 129310 NEWBRGE 138 1	LIPA	585.0	333.8	677.3	115.8	333.9	676.8	115.7	334.0	683.8	116.9	333.9	676.8	115.7	333.9	676.8	115.7	128847 NWBRG 345 129310 NEWBRGE 138 2
128847 NWBRG 345 129310 NEWBRGE 138 2	LIPA	585.0	333.8	677.3	115.8	333.9	676.8	115.7	334.0	683.8	116.9	333.9	676.8	115.7	333.9	676.8	115.7	128847 NWBRG 345 129310 NEWBRGE 138 1
129234 VLY STRM 138 129271 E.G.C.-2 138 1	LIPA	304.0	-	-	-	262.6	337.2	110.9	-	-	-	262.7	337.3	110.9	216.3	305.0	100.3	128900 BARETG1 20.0 129202 BARRETT1 138 1
129234 VLY STRM 138 129271 E.G.C.-2 138 1	LIPA	304.0	-	-	-	262.6	327.2	107.6	-	-	-	262.7	327.2	107.6	-	-	-	128910 BRTG9-12 13.8 129203 BARRETT2 138 1
129234 VLY STRM 138 129271 E.G.C.-2 138 1	LIPA	304.0	-	-	-	262.6	319.1	105.0	-	-	-	262.7	319.2	105.0	-	-	-	128901 BARETG2 20.0 129203 BARRETT2 138 1
129234 VLY STRM 138 129271 E.G.C.-2 138 1	LIPA	304.0	-	-	-	262.6	312.2	102.7	-	-	-	262.7	312.2	102.7	-	-	-	129270 E.G.C. 138 129580 E.G.C.1 69.0 1
129234 VLY STRM 138 129271 E.G.C.-2 138 1	LIPA	304.0	-	-	-	262.6	309.5	101.8	-	-	-	262.7	309.5	101.8	-	-	-	129276 FREEPORT 138 129310 NEWBRGE 138 1
129265 CARLE PL 138 129270 E.G.C. 138 1	LIPA	303.0	-	-	-	186.7	305.0	100.7	-	-	-	186.6	305.1	100.7	-	-	-	BUS:SHORE_RD_345
129265 CARLE PL 138 129270 E.G.C. 138 1	LIPA	303.0	-	-	-	186.7	304.9	100.6	-	-	-	186.6	305.0	100.7	-	-	-	126266 DUNWODIE 345 128835 SHORE RD 345 1
129341 NRTHPRT1 138 129355 PILGRIM 138 1	LIPA	644.0	-	-	-	-	-	-	418.4	677.3	105.2	-	-	-	414.7	669.2	103.9	129346 NRTHPT3 138 129355 PILGRIM 138 2
129346 NRTHPT3 138 129355 PILGRIM 138 2	LIPA	644.0	-	-	-	-	-	-	419.6	674.3	104.7	-	-	-	415.8	666.1	103.4	129341 NRTHPRT1 138 129355 PILGRIM 138 1
129475 WILDWOOD 138 129493 RVRHD 138 1	LIPA	327.0	-	-	-	215.3	346.7	106.0	212.8	347.6	106.3	215.3	346.8	106.1	212.5	345.4	105.6	129414 BRKHAVEN2 138 129488 EDWRDSAV 138 1
129488 EDWRDSAV 138 129493 RVRHD 138 1	LIPA	297.0	133.1	306.4	103.1	164.1	363.8	122.5	168.5	366.2	123.3	164.2	363.9	122.5	166.4	363.6	122.4	129459 SHOREHAM 138 129475 WILDWOOD 138 1
129488 EDWRDSAV 138 129493 RVRHD 138 1	LIPA	297.0	-	-	-	164.1	322.4	108.5	168.5	325.4	109.5	164.2	322.4	108.6	166.4	322.7	108.6	129475 WILDWOOD 138 129493 RVRHD 138 1
125040 N.CAT. 1 115 137507 BOC 2T 115 2	NGRID	120.0	106.0	140.5	117.1	107.9	148.1	123.4	103.7	144.8	120.7	102.8	147.8	123.1	108.7	149.1	124.3	125000 HURLEY 3 345 125030 HURLEY 1 115 1
125040 N.CAT. 1 115 137507 BOC 2T 115 2	NGRID	120.0	106.0	135.7	113.1	107.9	138.2	115.2	103.7	134.7	112.2	102.8	130.5	108.7	108.7	139.0	115.8	125000 HURLEY 3 345 137451 LEEDS 3 345 1
125040 N.CAT. 1 115 137507 BOC 2T 115 2	NGRID	120.0	-	-	-	107.9	121.5	101.3	-	-	-	-	-	-	108.7	122.2	101.8	125030 HURLEY 1 115 125132 SAUGE115 115 1
126294 PLTVLLEY 345 137451 LEEDS 3 345 2	NGRID	1538.0	-	-	-	-	-	-	-	-	-	1304.9	1540.2	100.1	-	-	-	125000 HURLEY 3 345 125002 ROSETON 345 1
126294 PLTVLLEY 345 137451 LEEDS 3 345 2	NGRID	1538.0	1248.8	1790.8	116.4	1256.5	1808.6	117.6	1285.0	1855.5	120.6	1304.9	1878.2	122.1	1269.9	1830.5	119.0	126294 PLTVLLEY 345 137455 ATHENS 345 1
126294 PLTVLLEY 345 137451 LEEDS 3 345 2	NGRID	1538.0	1248.8	1538.2	100.0	1256.5	1565.0	101.8	1285.0	1608.2	104.6	1304.9	1624.4	105.6	1269.9	1593.5	103.6	125002 ROSETON 345 126281 FISHKILL 345 1
126294 PLTVLLEY 345 137451 LEEDS 3 345 2	NGRID	1538.0	1248.8	1545.6	100.5	1256.5	1560.7	101.5	1285.0	1595.8	103.8	1304.9	1582.1	102.9	1269.9	1574.4	102.4	125000 HURLEY 3 345 137451 LEEDS 3 345 1
126294 PLTVLLEY 345 137455 ATHENS 345 1	NGRID	1538.0	-	-	-	-	-	-	1251.7	1559.9	101.4	1269.8	1574.3	102.4	1231.2	1539.7	100.1	125002 ROSETON 345 126281 FISHKILL 345 1
126294 PLTVLLEY 345 137455 ATHENS 345 1	NGRID	1538.0	-	-	-	-	-	-	1251.7	1546.4	100.5	-	-	-	-	-	-	125000 HURLEY 3 345 137451 LEEDS 3 345 1
126294 PLTVLLEY 345 137455 ATHENS 345 1	NGRID	1538.0	1209.2	1753.5	114.0	1218.2	1772.1	115.2	1251.7	1820.7	118.4	1269.8	1842.2	119.8	1231.2	1793.6	116.6	126294 PLTVLLEY 345 137451 LEEDS 3 345 2
130815 HINMN115 115 135452 LOCKPORT 115 1	NGRID	252.0	-	-	-	-	-	-	-	-	-	-	-	-	182.4	261.6	103.8	GEN:GINNA
130855 STATE115 115 136191 ELBRIDGE 115 1	NGRID	137.0	-	-	-	-	-	-	-	-	-	-	-	-	85.9	144.9	105.8	GEN:GINNA
130867 WYANT115 115 137528 REY. RD. 115 1	NGRID	214.0	-	-	-	147.2	221.3	103.4	145.0	218.1	101.9	145.1	218.7	102.2	147.1	221.2	103.4	137517 N. TROY 115 137544 SYCA-16 115 1
130867 WYANT115 115 137528 REY. RD. 115 1	NGRID	214.0	-	-	-	147.2	221.2	103.4	145.0	218.1	101.9	145.1	218.6	102.1	147.1	221.1	103.3	137528 REY. RD. 115 137544 SYCA-16 115 1
135461 PACK(S)W 115 147851 NIAG115W 115 3	NGRID	275.0	-	-	-	196.4	277.9	101.0	-	-	-	-	-	-	-	-	-	135461 PACK(S)W 115 147851 NIAG115W 115 1
136200 GERES LK 115 136269 SOLVTAP2 115 1	NGRID	120.9	103.4	145.0	120.0	111.5	157.6	130.4	111.8	158.1	130.8	111.8	158.1	130.8	111.5	157.6	130.3	136200 GERES LK 115 136270 CRUC TAP 115 1
136751 ALLENS F 115 136764 COLTON 115 1	NGRID	128.0	42.4	133.2	104.1	45.2	151.5	118.3	43.6	151.5	118.4	43.7	151.4	118.3	45.0	151.5	118.4	136783 MALONE 115 147856 WILL 115 115 1
136751 ALLENS F 115 136795 PARISHVL 115 1	NGRID	144.0	-	-	-	49.3	156.4	108.6	47.7	156.5	108.7	47.8	156.4	108.6	49.1	156.5	108.7	136783 MALONE 115 147856 WILL 115 115 1
136791 NICHOLVL 115 136795 PARISHVL 115 1	NGRID	143.8	-	-	-	49.6	156.9	109.1	48.0	157.0	109.2	48.1	156.9	109.1	49.4	157.0	109.2	136783 MALONE 115 147856 WILL 115 115 1
137229 KELSEY H 115 137235 PORTER 1 115 1	NGRID	120.0	-	-	-	93.3	127.8	106.5	94.9	127.9	106.6	95.0	127.9	106.6	93.5	127.8	106.5	137233 ONEIDA 115 137241 SHRL TAP 115 1
137235 PORTER 1 115 147905 ILION 115 1	NGRID	120.0	-	-	-	92.9	123.8	103.1	92.9	124.1	103.4	93.0	124.3	103.6	92.9	123.8	103.2	137235 PORTER 1 115 137246 VALLEY 115 1
137450 ALPS345 345 137454 REYNLD3 345 1	NGRID	562.0	-	-	-	272.4	570.3	101.5	-	-	-	-	-	-	274.2	577.3	102.7	137454 REYNLD3 345 137528 REY. RD. 115 1
137454 REYNLD3 345 137528 REY. RD. 115 1	NGRID	562.0	338.8	567.5	101.0	417.5	627.2	111.6	422.9	579.1	103.0	426.4	579.7	103.2	414.8	632.5	112.5	BUS:ALPS_345
137454 REYNLD3 345 137528 REY. RD. 115 1	NGRID	562.0	338.8	567.2	100.9	417.5	626.1	111.4	422.9	577.9	102.8	426.4	578.6	102.9	414.8	631.4	112.3	137450 ALPS345 345 137454 REYNLD3 345 1
137481 JMC1+7TP 115 137490 BLUECIRC 115 1	NGRID	120.0	108.4	122.1	101.7	110.5	124.6	103.8	108.2	123.0	102.5	109.8	124.5	103.8	111.3	125.7	104.7	126294 PLTVLLEY 345 137451 LEEDS 3 345 2
137481 JMC1+7TP 115 137490 BLUECIRC 115 1	NGRID	120.0	108.4	121.4	101.2	110.5	123.9	103.2	108.2	122.4	102.0	109.8	123.9	103.2	111.3	125.0	104.1	126294 PLTVLLEY 345 137455 ATHENS 345 1
137481 JMC1+7TP 115 137490 BLUECIRC 115 1	NGRID	120.0	108.4	120.5	100.4	110.5	123.0	102.5	108.2	121.2	101.0	109.8	121.3	101.1	111.3	123.8	103.2	125000 HURLEY 3 345 137451 LEEDS 3 345 1
137481 JMC1+7TP 115 137490 BLUECIRC 115 1	NGRID	120.0	-	-	-	110.5	120.2	100.1	-	-	-	-	-	-	111.3	121.1	100.9	130750 COOPC345 345 130753 FRASR345 345 1
137502 GBSH+LGE 115 137528 REY. RD. 115 1	NGRID	293.0	-	-	-	156.2	304.5	103.9	149.7	303.0	103.4	148.6	303.7	103.6	156.3	305.6	104.3	137454 REYNLD3 345 137528 REY. RD. 115 1

Table 5-3: Post-Contingency Overloads – Horizon Year Summer Peak Conditions (Scenarios 1~4)

			Intermediate Year			Horizon Year Scenario 1			Horizon Year Scenario 2			Horizon Year Scenario 3			Horizon Year Scenario 4			
Limiting Element	Owner	LTE/STE Rating	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Base Case MVA Flow	Post Cont MVA Flow	Post Cont Loading%	Limiting Contingency
137502 GBSH+LGE 115 137717 ALB2 115 1	NGRID	208.0	-	-	-	130.4	213.9	102.8	-	-	-	-	-	-	131.5	215.6	103.7	137502 GBSH+LGE 115 137718 ALB3 115 2
137502 GBSH+LGE 115 137718 ALB3 115 2	NGRID	208.0	-	-	-	130.4	214.1	102.9	-	-	-	-	-	-	131.5	215.9	103.8	137502 GBSH+LGE 115 137717 ALB2 115 1
137507 BOC 2T 115 137510 JMC2+9TP 115 1	NGRID	120.0	106.0	140.5	117.1	107.9	148.1	123.4	103.7	144.8	120.7	102.8	147.8	123.1	108.7	149.1	124.3	125000 HURLEY 3 345 125030 HURLEY 1 115 1
137507 BOC 2T 115 137510 JMC2+9TP 115 1	NGRID	120.0	106.0	135.7	113.1	107.9	138.2	115.2	103.7	134.7	112.2	102.8	130.5	108.7	108.7	139.0	115.8	125000 HURLEY 3 345 137451 LEEDS 3 345 1
137507 BOC 2T 115 137510 JMC2+9TP 115 1	NGRID	120.0	-	-	-	107.9	121.5	101.3	-	-	-	-	-	-	108.7	122.2	101.8	125030 HURLEY 1 115 125132 SAUGE115 115 1
137512 JOHNSON 115 137513 MAPLWOOD 115 1	NGRID	182.0	-	-	-	81.4	205.7	113.0	80.2	206.3	113.3	80.4	206.7	113.6	81.5	206.2	113.3	137501 FRONT ST 115 137532 RTRDM1 115 1
137513 MAPLWOOD 115 137515 MENANDS 115 1	NGRID	124.0	-	-	-	67.1	135.5	109.3	66.1	135.5	109.3	66.2	135.8	109.5	67.3	135.8	109.6	137501 FRONT ST 115 137532 RTRDM1 115 1
137513 MAPLWOOD 115 137515 MENANDS 115 1	NGRID	124.0	-	-	-	67.1	132.1	106.6	66.1	131.3	105.9	66.2	131.6	106.1	67.3	132.4	106.7	137528 REY. RD. 115 137900 REN WAST 115 1
137513 MAPLWOOD 115 137515 MENANDS 115 1	NGRID	124.0	-	-	-	67.1	130.8	105.5	66.1	130.0	104.9	66.2	130.3	105.1	67.3	131.1	105.7	137485 ALTEC 115 137486 ARSENAL 115 1
137513 MAPLWOOD 115 137515 MENANDS 115 1	NGRID	124.0	-	-	-	67.1	130.8	105.5	66.1	130.0	104.8	66.2	130.3	105.1	67.3	131.0	105.7	137485 ALTEC 115 137900 REN WAST 115 1
137515 MENANDS 115 137542 ST CAMPS 115 1	NGRID	114.0	45.9	132.2	116.0	55.4	155.1	136.0	54.2	154.5	135.5	55.0	155.0	135.9	55.5	155.3	136.2	137518 NW KRMKL 115 137716 ALB1 115 1
137515 MENANDS 115 137542 ST CAMPS 115 1	NGRID	114.0	45.9	118.7	104.2	55.4	139.7	122.6	54.2	138.9	121.9	55.0	139.4	122.3	55.5	139.9	122.7	137514 MCKOWNVL 115 137518 NW KRMKL 115 1
137515 MENANDS 115 137542 ST CAMPS 115 1	NGRID	114.0	-	-	-	55.4	114.6	100.5	-	-	-	-	-	-	55.5	116.9	102.6	137488 BETHLEHE 115 137716 ALB1 115 1
137516 N.SCOT1 115 137550 VOORH E 115 1	NGRID	120.0	-	-	-	-	-	-	92.6	120.8	100.7	93.0	121.3	101.1	-	-	-	BUS:RTRDM 77 BUS
137516 N.SCOT1 115 137550 VOORH E 115 1	NGRID	120.0	-	-	-	92.4	131.2	109.4	92.6	132.6	110.5	93.0	132.9	110.7	92.4	131.3	109.4	BUS:RTRDM 99 BUS
137517 N. TROY 115 137544 SYCA-16 115 1	NGRID	197.0	-	-	-	129.9	214.2	108.8	127.7	211.2	107.2	127.7	211.7	107.5	129.8	214.3	108.8	130867 WYANT115 115 137528 REY. RD. 115 1
137517 N. TROY 115 137544 SYCA-16 115 1	NGRID	197.0	-	-	-	129.9	205.3	104.2	127.7	202.1	102.6	127.7	202.6	102.9	129.8	205.2	104.2	130867 WYANT115 115 137543 SYCA-14 115 1
137518 NW KRMKL 115 137716 ALB1 115 1	NGRID	303.0	-	-	-	-	-	-	-	-	-	-	-	-	193.0	305.2	100.7	137488 BETHLEHE 115 137716 ALB1 115 1
137521 PATRN 11 115 137542 ST CAMPS 115 1	NGRID	176.0	-	-	-	76.5	185.8	105.6	-	-	-	-	-	-	77.3	189.3	107.6	137488 BETHLEHE 115 137716 ALB1 115 1
137528 REY. RD. 115 137544 SYCA-16 115 1	NGRID	197.0	-	-	-	129.8	214.1	108.7	127.6	211.1	107.2	127.6	211.6	107.4	129.6	214.2	108.7	130867 WYANT115 115 137528 REY. RD. 115 1
137528 REY. RD. 115 137544 SYCA-16 115 1	NGRID	197.0	-	-	-	129.8	205.2	104.1	127.6	202.0	102.5	127.6	202.5	102.8	129.6	205.1	104.1	130867 WYANT115 115 137543 SYCA-14 115 1
137545 TRINITY 115 137718 ALB3 115 2	NGRID	191.0	-	-	-	121.8	202.1	105.8	118.8	197.3	103.3	118.7	197.4	103.4	122.2	202.8	106.2	137545 TRINITY 115 137717 ALB2 115 1
137897 OGN BRK5 115 137904 SPIER 115 1	NGRID	114.0	-	-	-	64.2	114.0	100.0	64.6	114.7	100.6	64.6	115.0	100.8	64.3	114.2	100.2	137899 QBURY 115 137903 SHERMAN 115 1
130781 CARML115 115 130865 WOODS115 115 1	NYSEG	247.0	-	-	-	142.9	260.7	105.6	140.7	252.4	102.2	144.1	261.6	105.9	143.1	262.0	106.1	125026 FISHKILL 115 131112 SYLVN115 115 1
130781 CARML115 115 130865 WOODS115 115 1	NYSEG	247.0	-	-	-	142.9	256.4	103.8	140.7	251.6	101.9	144.1	258.1	104.5	143.1	256.4	103.8	130865 WOODS115 115 131109 AMWLK115 115 1
130782 CATON115 115 130814 HILSD115 115 1	NYSEG	113.0	-	-	-	61.4	118.4	104.8	61.3	118.6	104.9	61.4	118.7	105.1	61.3	118.3	104.7	130813 HICK 115 115 130845 RIDGT115 115 1
130813 HICK 115 115 130845 RIDGT115 115 1	NYSEG	97.0	71.1	108.1	111.5	73.7	113.6	117.1	74.1	113.9	117.5	74.1	114.0	117.6	73.8	113.6	117.2	130782 CATON115 115 130814 HILSD115 115 1
130813 HICK 115 115 130845 RIDGT115 115 1	NYSEG	97.0	71.1	107.2	110.6	73.7	112.0	115.4	74.1	112.3	115.7	74.1	112.4	115.8	73.8	112.0	115.4	130782 CATON115 115 130813 HICK 115 115 1
130815 HINMN115 115 131611 HARIS115 115 1	NYSEG	287.0	-	-	-	-	-	-	-	-	-	-	-	-	213.0	295.5	103.0	GEN:GINNA
146754 MDTN TAP 345 146772 SHOEMTAP 138 1	O&R	652.0	-	-	-	-	-	-	-	-	-	492.0	659.7	101.2	489.4	653.4	100.2	125001 ROCK TAV 345 126297 RAMAPO 345 1
135861 MORTIMER 115 149031 S33 901 115 1	RGE	197.0	-	-	-	-	-	-	-	-	-	105.2	235.6	119.6	105.4	229.7	116.6	GEN:GINNA
147941 SPENCPRT 115 149012 S113 115 115 1	RGE	123.5	-	-	-	-	-	-	-	-	-	89.5	153.3	124.1	89.5	152.6	123.5	GEN:GINNA
147941 SPENCPRT 115 149012 S113 115 115 1	RGE	123.5	-	-	-	89.6	128.5	104.0	89.5	128.0	103.6	89.5	128.4	103.9	89.5	128.6	104.2	149036 STA 93 115 149062 S7 115B2 115 1
147941 SPENCPRT 115 149017 S70 115 115 1	RGE	123.5	-	-	-	-	-	-	-	-	-	77.0	134.2	108.7	77.1	132.6	107.4	GEN:GINNA
149001 PANNELL3 345 149002 3T@S122 115 3T	RGE	265.0	-	-	-	-	-	-	-	-	-	134.7	285.8	107.8	130.2	266.4	100.5	GEN:GINNA
149002 3T@S122 115 149004 S121 B#2 115 1	RGE	304.0	-	-	-	-	-	-	-	-	-	129.8	325.5	107.1	126.8	324.8	106.8	GEN:GINNA
149012 S113 115 115 149014 S418 115 115 1	RGE	147.4	-	-	-	-	-	-	-	-	-	99.0	160.0	108.6	98.9	161.2	109.4	GEN:GINNA
149013 S37 115 115 149048 S67-2115 115 1	RGE	304.7	-	-	-	-	-	-	-	-	-	197.5	350.6	115.1	197.0	345.0	113.2	GEN:GINNA
149013 S37 115 115 149048 S67-2115 115 1	RGE	304.7	-	-	-	196.6	314.9	103.3	197.4	314.7	103.3	197.5	315.0	103.4	197.0	314.9	103.4	149034 JCT 921 115 149047 S48-1115 115 1
149013 S37 115 115 149048 S67-2115 115 1	RGE	304.7	-	-	-	196.6	314.3	103.2	197.4	314.2	103.1	197.5	314.5	103.2	197.0	314.4	103.2	149011 S82-1115 115 149034 JCT 921 115 1
149014 S418 115 115 149016 S67-1115 115 2	RGE	211.1	-	-	-	-	-	-	-	-	-	152.0	244.6	115.9	152.1	251.9	119.3	GEN:GINNA
149017 S70 115 115 149018 S71 115 115 1	RGE	123.5	-	-	-	32.0	137.1	111.0	32.1	135.7	109.9	32.1	136.7	110.7	32.0	137.6	111.4	149014 S418 115 115 149016 S67-1115 115 2
149018 S71 115 115 149035 S69 917 115 1	RGE	121.5	17.0	155.6	128.1	17.8	184.0	151.4	17.9	182.1	149.9	18.2	183.3	150.9	18.1	184.6	151.9	149014 S418 115 115 149016 S67-1115 115 2
149025 PANNELLI 115 149026 QUAKER 115 1	RGE	248.0	-	-	-	-	-	-	-	-	-	49.0	253.8	102.3	50.1	252.4	101.8	GEN:GINNA
149029 S204 911 115 149033 S42 115 115 1	RGE	207.2	132.7	232.6	112.2	148.1	260.3	125.6	147.9	259.1	125.1	148.5	261.1	126.0	148.6	261.2	126.1	149024 GINNA115 115 149196 S124C913 115 1
149029 S204 911 115 149033 S42 115 115 1	RGE	207.2	132.7	226.9	109.5	148.1	255.3	123.2	147.9	253.7	122.4	148.5	256.1	123.6	148.6	256.3	123.7	149033 S42 115 115 149196 S124C913 115 1
149033 S42 115 115 149196 S124C913 115 1	RGE	207.2	137.8	228.8	110.4	154.0	257.3	124.2	153.9	255.9	123.5	154.6	258.1	124.6	154.6	258.3	124.7	149029 S204 911 115 149033 S42 115 115 1
149033 S42 115 115 149196 S124C913 115 1	RGE	207.2	137.8	227.5	109.8	154.0	254.0	122.6	153.9	253.2	122.2	154.6	254.9	123.0	154.6	254.8	123.0	149024 GINNA115 115 149029 S204 911 115 1
149035 S69 917 115 149036 STA 93 115 1	RGE	143.4	26.3	165.1	115.2	28.2	195.3	136.2	28.2	193.3	134.8	28.5	194.6	135.7	28.5	195.9	136.6	149014 S418 115 115 149016 S67-1115 115 2
149036 STA 93 115 149062 S7 115B2 115 1	RGE	143.4	33.2	173.2	120.7	36.1	204.5	142.6	36.0	202.4	141.2	36.3	203.8	142.1	36.3	205.2	143.1	149014 S418 115 115 149016 S67-1115 115 2

Note:
1. "-" indicates no violations for this scenario
2. Con Edison Cables are not overloaded with STE ratings (rows are hidden)

Table 5-4: Post-Contingency Voltage Violations – Horizon Year Summer Peak Conditions (Scenarios 1~4)

Bus Name	kV	Area	Zone	Vlow	Vhigh	Intermediate Year Intact	Intermediate Year Cont.	Horizon Year Scenario1 Intact	Horizon Year Scenario1 Cont.	Horizon Year Scenario2 Intact	Horizon Year Scenario2 Cont.	Horizon Year Scenario3 Intact	Horizon Year Scenario3 Cont.	Horizon Year Scenario4 Intact	Horizon Year Scenario4 Cont.	Limiting Contingency
COLDS115	115.0	1	149	0.900	1.100	1.026	0.810	1.025	0.669	1.026	0.666	1.026	0.668	1.025	0.669	130788 COLDS115 115 135267 CARR CRN 115 1
HINMN115	115.0	1	149	0.900	1.100	-	-	-	-	-	-	-	-	1.012	0.878	GEN:GINNA
ROBIN115	115.0	1	149	0.900	1.100	-	-	-	-	-	-	-	-	1.026	0.920	GEN:GINNA
A.LUD TP	115.0	1	149	0.900	1.100	-	-	-	-	-	-	-	-	1.023	0.911	GEN:GINNA
A.LUD115	115.0	1	149	0.900	1.100	-	-	-	-	-	-	-	-	1.023	0.911	GEN:GINNA
HARIS115	115.0	1	149	0.900	1.100	-	-	-	-	-	-	-	-	1.022	0.903	GEN:GINNA
LEA12115	115.0	1	149	0.900	1.100	-	-	-	-	-	-	-	-	1.023	0.905	GEN:GINNA
LEA34115	115.0	1	149	0.900	1.100	-	-	-	-	-	-	-	-	1.023	0.904	GEN:GINNA
BERRY RD	115.0	1	145	0.900	1.100	1.055	0.949	-	-	1.055	0.948	1.055	0.948	-	-	135263 BERRY RD 115 135273 DUNKIRK1 115 1
HARTFLD1	115.0	1	145	0.900	1.100	1.014	0.834	1.013	0.822	1.016	0.824	1.016	0.823	1.014	0.820	135281 HARTFLD1 115 135286 MOON-162 115 1
COOPER	115.0	1	145	0.900	1.100	1.027	0.857	1.021	0.824	1.021	0.823	1.021	0.823	1.021	0.823	135282 HOMERHIL 115 135296 W.OL-155 115 1
W.OL-155	115.0	1	145	0.900	1.100	1.030	0.854	1.024	0.821	1.024	0.819	1.024	0.819	1.024	0.820	135282 HOMERHIL 115 135296 W.OL-155 115 1
BETH-150	115.0	1	145	0.900	1.100	1.037	0.883	1.033	0.860	1.034	0.861	1.034	0.860	1.034	0.861	135301 BETH-150 115 135450 GRDNVL1 115 1
GIBSONT6	115.0	1	145	0.900	1.100	1.028	0.873	1.028	0.847	1.028	0.846	1.028	0.846	1.028	0.847	135302 GIBSONT6 115 147851 NIAG115W 115 1
HARBFRT0	115.0	1	145	0.900	1.100	1.037	0.883	1.033	0.860	1.034	0.861	1.034	0.861	1.034	0.861	135301 BETH-150 115 135450 GRDNVL1 115 1
ELM-70	230.0	1	145	0.900	1.100	1.020	0.917	1.017	0.904	1.018	0.907	1.018	0.907	1.018	0.905	135410 ELM-70 230 135414 HUNTLEY2 230 1
ELM-71	230.0	1	145	0.900	1.100	1.001	0.885	0.996	0.875	0.997	0.876	0.997	0.876	0.997	0.875	135413 GRDNVL2 230 135416 SENCA-71 230 1
ELM-72	230.0	1	145	0.900	1.100	1.001	0.885	0.996	0.875	0.997	0.876	0.997	0.876	0.997	0.875	135413 GRDNVL2 230 135417 SENCA-72 230 1
SENCA-71	230.0	1	145	0.900	1.100	1.001	0.884	0.996	0.874	0.998	0.876	0.997	0.875	0.997	0.875	135413 GRDNVL2 230 135416 SENCA-71 230 1
SENCA-72	230.0	1	145	0.900	1.100	1.001	0.884	0.996	0.874	0.998	0.876	0.997	0.876	0.997	0.875	135413 GRDNVL2 230 135417 SENCA-72 230 1
HARPR183	115.0	1	145	0.900	1.100	1.025	0.874	1.024	0.852	1.024	0.852	1.024	0.852	1.024	0.852	135461 PACK(S)W 115 148004 CARGR183 115 1
HARPR184	115.0	1	145	0.900	1.100	-	-	1.024	0.903	1.024	0.902	1.024	0.902	1.024	0.903	135461 PACK(S)W 115 148003 CARGR184 115 1
HARPR184	115.0	1	145	0.900	1.100	1.024	0.810	1.024	0.770	1.024	0.769	1.024	0.769	1.024	0.770	135421 HARPR184 115 136544 UDG-184 115 1
BOCGASES	115.0	1	145	0.900	1.100	-	-	1.027	0.906	1.028	0.907	1.028	0.907	1.028	0.907	135450 GRDNVL1 115 135462 RDGE-145 115 1
GETZTP36	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.004	0.903	GEN:GINNA
GETZTP37	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.004	0.903	GEN:GINNA
LOCKPORT	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.011	0.877	GEN:GINNA
RDGE-145	115.0	1	145	0.900	1.100	-	-	1.030	0.909	1.031	0.910	1.031	0.910	1.031	0.910	135450 GRDNVL1 115 135462 RDGE-145 115 1
S215-188	115.0	1	145	0.900	1.100	1.018	0.879	1.016	0.859	1.016	0.859	1.016	0.859	1.016	0.859	135511 NFWWP188 115 148006 CARBW188 115 1
S215-188	115.0	1	145	0.900	1.100	1.018	0.885	1.016	0.867	1.016	0.866	1.016	0.866	1.016	0.867	135466 S215-188 115 135511 NFWWP188 115 1
SHAW-103	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.016	0.902	GEN:GINNA
SWAN-104	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.012	0.877	GEN:GINNA
S138-37	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.005	0.889	GEN:GINNA
TONCRK37	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.004	0.894	GEN:GINNA
TONCRK36	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.004	0.895	GEN:GINNA
NFWWP187	115.0	1	145	0.900	1.100	1.022	0.802	1.020	0.764	1.020	0.763	1.020	0.763	1.020	0.764	148007 GRTLK187 115 148008 HOOKS187 115 1
NFWWP187	115.0	1	145	0.900	1.100	1.022	0.831	1.020	0.802	1.020	0.802	1.020	0.802	1.020	0.802	148002 CARBW187 115 148008 HOOKS187 115 1
NFWWP187	115.0	1	145	0.900	1.100	1.022	0.892	1.020	0.875	1.020	0.874	1.020	0.874	1.020	0.875	135509 NFWWP187 115 148002 CARBW187 115 1
SHAW-102	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.014	0.900	GEN:GINNA
NFWWP188	115.0	1	145	0.900	1.100	1.018	0.879	1.016	0.859	1.016	0.859	1.016	0.859	1.016	0.859	135511 NFWWP188 115 148006 CARBW188 115 1
S138-36	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.005	0.889	GEN:GINNA
CANFIBRE	115.0	1	145	0.900	1.100	-	-	1.027	0.906	1.028	0.907	1.028	0.907	1.028	0.907	135450 GRDNVL1 115 135462 RDGE-145 115 1
CO-STEEL	115.0	1	145	0.900	1.100	-	-	1.027	0.906	1.028	0.907	1.028	0.907	1.028	0.907	135450 GRDNVL1 115 135462 RDGE-145 115 1
MTNSW	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.012	0.877	GEN:GINNA
S215-187	115.0	1	145	0.900	1.100	1.022	0.802	1.020	0.764	1.020	0.763	1.020	0.763	1.020	0.764	148007 GRTLK187 115 148008 HOOKS187 115 1
S215-187	115.0	1	145	0.900	1.100	1.022	0.831	1.020	0.802	1.020	0.802	1.020	0.802	1.020	0.802	148002 CARBW187 115 148008 HOOKS187 115 1
S215-187	115.0	1	145	0.900	1.100	1.022	0.892	1.020	0.875	1.020	0.874	1.020	0.874	1.020	0.875	135509 NFWWP187 115 148002 CARBW187 115 1
S215-187	115.0	1	145	0.900	1.100	1.022	0.898	1.020	0.882	1.020	0.882	1.020	0.882	1.020	0.882	135509 NFWWP187 115 135823 S215-187 115 1
AYERTP36	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.004	0.903	GEN:GINNA
AYERTP37	115.0	1	145	0.900	1.100	-	-	-	-	-	-	-	-	1.004	0.903	GEN:GINNA
UDG-184	115.0	1	145	0.900	1.100	-	-	1.025	0.903	1.025	0.903	1.025	0.903	1.025	0.903	135461 PACK(S)W 115 148003 CARGR184 115 1
NCARBON7	115.0	1	157	0.900	1.100	1.028	0.873	1.028	0.847	1.028	0.846	1.028	0.846	1.028	0.847	135302 GIBSONT6 115 147851 NIAG115W 115 1
AIRCO197	115.0	1	157	0.900	1.100	1.028	0.873	1.028	0.847	1.028	0.846	1.028	0.846	1.028	0.847	135302 GIBSONT6 115 147851 NIAG115W 115 1
TITAN197	115.0	1	157	0.900	1.100	1.028	0.873	1.028	0.847	1.028	0.846	1.028	0.846	1.028	0.847	135302 GIBSONT6 115 147851 NIAG115W 115 1
DUPNT183	115.0	1	157	0.900	1.100	1.025	0.873	1.023	0.851	1.024	0.851	1.024	0.851	1.024	0.852	135461 PACK(S)W 115 148004 CARGR183 115 1
DUPNT184	115.0	1	157	0.900	1.100	-	-	1.023	0.902	1.023	0.901	1.023	0.901	1.023	0.902	135461 PACK(S)W 115 148003 CARGR184 115 1
DUPNT184	115.0	1	157	0.900	1.100	1.023	0.809	1.023	0.769	1.023	0.768	1.023	0.768	1.023	0.768	135421 HARPR184 115 136544 UDG-184 115 1
DUPNT187	115.0	1	157	0.900	1.100	1.021	0.801	1.019	0.764	1.020	0.763	1.020	0.763	1.020	0.764	148007 GRTLK187 115 148008 HOOKS187 115 1
DUPNT187	115.0	1	157	0.900	1.100	1.021	0.831	1.019	0.802	1.020	0.801	1.020	0.801	1.020	0.802	148002 CARBW187 115 148008 HOOKS187 115 1
DUPNT187	115.0	1	157	0.900	1.100	1.021	0.891	1.019	0.874	1.020	0.874	1.020	0.874	1.020	0.874	135509 NFWWP187 115 148002 CARBW187 115 1
DUPNT187	115.0	1	157	0.900	1.100	1.021	0.898	1.019	0.881	1.020	0.881	1.020	0.881	1.020	0.882	135509 NFWWP187 115 135823 S215-187 115 1
DUPNT188	115.0	1	157	0.900	1.100	1.017	0.878	1.015	0.858	1.015	0.858	1.015	0.858	1.015	0.859	135511 NFWWP188 115 148006 CARBW188 115 1
DUPNT188	115.0	1	157	0.900	1.100	1.017	0.885	1.015	0.866	1.015	0.866	1.015	0.866	1.015	0.866	135466 S215-188 115 135511 NFWWP188 115 1

Bus #	Bus Name	kV	Area	Zone	Vlow	Vhigh	Intermediate Year		Horizon Year Scenario1		Horizon Year Scenario2		Horizon Year Scenario3		Horizon Year Scenario4		Limiting Contingency
							Intact	Cont.	Intact	Cont.	Intact	Cont.	Intact	Cont.	Intact	Cont.	
147997	DUPNT187	115.0	1	157	0.900	1.100	1.021	0.831	1.019	0.802	1.020	0.801	1.020	0.801	1.020	0.802	148002 CARBW187 115 148008 HOOKS187 115 1
147997	DUPNT187	115.0	1	157	0.900	1.100	1.021	0.891	1.019	0.874	1.020	0.874	1.020	0.874	1.020	0.874	135509 NFWWP187 115 148002 CARBW187 115 1
147997	DUPNT187	115.0	1	157	0.900	1.100	1.021	0.898	1.019	0.881	1.020	0.881	1.020	0.881	1.020	0.882	135509 NFWWP187 115 135823 S215-187 115 1
147998	DUPNT188	115.0	1	157	0.900	1.100	1.017	0.878	1.015	0.858	1.015	0.858	1.015	0.858	1.015	0.859	135511 NFWWP188 115 148006 CARBW188 115 1
147998	DUPNT188	115.0	1	157	0.900	1.100	1.017	0.885	1.015	0.866	1.015	0.866	1.015	0.866	1.015	0.866	135466 S215-188 115 135511 NFWWP188 115 1
148002	CARBW187	115.0	1	157	0.900	1.100	1.022	0.802	1.020	0.764	1.020	0.763	1.020	0.763	1.020	0.764	148007 GRTLK187 115 148008 HOOKS187 115 1
148002	CARBW187	115.0	1	157	0.900	1.100	1.022	0.831	1.020	0.802	1.020	0.802	1.020	0.801	1.020	0.802	148002 CARBW187 115 148008 HOOKS187 115 1
148003	CARGR184	115.0	1	157	0.900	1.100	-	-	1.026	0.902	1.026	0.902	1.026	0.901	1.026	0.902	135461 PACK(S)W 115 148003 CARGR184 115 1
148004	CARGR183	115.0	1	157	0.900	1.100	1.027	0.872	1.026	0.850	1.026	0.850	1.026	0.850	1.026	0.850	135461 PACK(S)W 115 148004 CARGR183 115 1
148008	HOOKS187	115.0	1	157	0.900	1.100	1.023	0.801	1.022	0.764	1.022	0.763	1.022	0.763	1.022	0.764	148007 GRTLK187 115 148008 HOOKS187 115 1
148012	OLIN-184	115.0	1	157	0.900	1.100	-	-	1.023	0.902	1.023	0.901	1.023	0.901	1.023	0.902	135461 PACK(S)W 115 148003 CARGR184 115 1
148012	OLIN-184	115.0	1	157	0.900	1.100	1.023	0.809	1.023	0.769	1.023	0.768	1.023	0.768	1.023	0.769	135421 HARPR184 115 136544 UDG-184 115 1
148014	OLIN-183	115.0	1	157	0.900	1.100	1.025	0.874	1.024	0.852	1.024	0.851	1.024	0.851	1.024	0.852	135461 PACK(S)W 115 148004 CARGR183 115 1
119	ROCH SW	345.0	2	153	0.900	1.100	-	-	-	-	-	-	1.038	0.873	1.023	0.805	GEN:GINNA
135849	E.GOLAH	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.987	0.703	0.984	0.624	GEN:GINNA
135850	SOUR-114	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.996	0.848	0.993	0.775	GEN:GINNA
135851	SHEL-113	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.990	0.837	0.987	0.764	GEN:GINNA
135852	BRUNNER	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.996	0.848	0.993	0.775	GEN:GINNA
135853	BATAVIA1	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.992	0.843	0.989	0.763	GEN:GINNA
135854	BRCKPTHS	115.0	2	173	0.900	1.100	0.988	0.816	0.966	0.746	0.972	0.757	0.971	0.754	0.967	0.749	135854 BRCKPTHS 115 135873 SWDN-111 115 1
135854	BRCKPTHS	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.971	0.733	0.967	0.653	GEN:GINNA
135855	EBAT-107	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.992	0.843	0.989	0.763	GEN:GINNA
135856	EBAT-119	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.991	0.823	0.989	0.742	GEN:GINNA
135857	GENFOOD	115.0	2	173	0.900	1.100	1.002	0.863	0.981	0.787	0.986	0.798	0.984	0.793	0.981	0.787	135857 GENFOOD 115 135895 BARILLA 115 1
135857	GENFOOD	115.0	2	173	0.900	1.100	1.002	0.864	0.981	0.789	0.986	0.799	0.984	0.795	0.981	0.789	135849 E.GOLAH 115 135895 BARILLA 115 1
135857	GENFOOD	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.984	0.697	0.981	0.617	GEN:GINNA
135858	GOLAH115	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.988	0.705	0.985	0.626	GEN:GINNA
135859	LAPPINS1	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.987	0.782	0.984	0.699	GEN:GINNA
135861	MORTIMER	115.0	2	173	0.900	1.100	-	-	-	-	-	-	1.004	0.712	1.001	0.639	GEN:GINNA
135862	MUMFORD1	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.983	0.727	0.980	0.646	GEN:GINNA
135863	N.LAKE 1	115.0	2	173	0.900	1.100	1.001	0.865	0.978	0.790	0.984	0.801	0.982	0.796	0.979	0.790	135857 GENFOOD 115 135895 BARILLA 115 1
135863	N.LAKE 1	115.0	2	173	0.900	1.100	-	-	0.978	0.891	0.984	0.899	0.982	0.896	0.979	0.891	135857 GENFOOD 115 135863 N.LAKE 1 115 1
135863	N.LAKE 1	115.0	2	173	0.900	1.100	1.001	0.867	0.978	0.792	0.984	0.802	0.982	0.798	0.979	0.792	135849 E.GOLAH 115 135895 BARILLA 115 1
135863	N.LAKE 1	115.0	2	173	0.900	1.100	-	-	-	-	0.984	0.899	0.982	0.691	0.979	0.610	GEN:GINNA
135864	NAKR-107	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.993	0.872	0.991	0.795	GEN:GINNA
135865	NAKR-108	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.994	0.873	0.992	0.796	GEN:GINNA
135866	NLEROYTA	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.985	0.765	0.982	0.682	GEN:GINNA
135867	OAKFLDTP	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.992	0.862	0.990	0.784	GEN:GINNA
135868	PTSFD-23	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.003	0.689	1.000	0.617	GEN:GINNA
135869	PTSFD-24	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.002	0.700	0.998	0.628	GEN:GINNA
135870	PTSFD-25	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.006	0.717	1.002	0.646	GEN:GINNA
135871	SENECAP	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.993	0.831	0.990	0.750	GEN:GINNA
135872	SOUR-111	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.996	0.848	0.994	0.775	GEN:GINNA
135873	SWDN-111	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.980	0.746	0.977	0.667	GEN:GINNA
135874	SWDN-113	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.975	0.735	0.972	0.658	GEN:GINNA
135875	TELRDTP1	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.998	0.896	0.996	0.822	GEN:GINNA
135876	TELRDTP1	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.999	0.875	0.996	0.803	GEN:GINNA
135877	UNIVRSTY	115.0	2	173	0.900	1.100	0.986	0.877	0.964	0.835	0.970	0.843	0.969	0.841	0.965	0.837	135874 SWDN-113 115 135877 UNIVRSTY 115 1
135877	UNIVRSTY	115.0	2	173	0.900	1.100	-	-	-	-	0.970	0.899	0.969	0.727	0.965	0.648	GEN:GINNA
135880	BIRDSEYE	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.992	0.862	0.990	0.784	GEN:GINNA
135895	BARILLA	115.0	2	173	0.900	1.100	1.003	0.864	0.982	0.789	0.987	0.799	0.985	0.795	0.982	0.789	135849 E.GOLAH 115 135895 BARILLA 115 1
135895	BARILLA	115.0	2	173	0.900	1.100	-	-	-	-	-	-	0.985	0.699	0.982	0.620	GEN:GINNA
147870	AKRON	115.0	2	160	0.900	1.100	-	-	-	-	-	-	0.994	0.879	0.992	0.803	GEN:GINNA
147941	SPENCPRT	115.0	2	160	0.900	1.100	-	-	0.979	0.875	0.984	0.886	0.982	0.880	0.979	0.873	149014 S418 115 115 149016 S67-1115 115 2
147941	SPENCPRT	115.0	2	160	0.900	1.100	-	-	-	-	0.984	0.882	0.982	0.634	0.979	0.556	GEN:GINNA
149000	ROCH 345	345.0	2	153	0.951	1.049	-	-	-	-	-	-	1.038	0.873	1.023	0.805	GEN:GINNA
149001	PANNELL3	345.0	2	153	0.951	1.049	-	-	-	-	-	-	1.038	0.878	1.026	0.821	GEN:GINNA
149002	3T@S122	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.026	0.738	1.020	0.673	GEN:GINNA

Bus #	Bus Name	kV	Area	Zone	Vlow	Vhigh	Intermediate Year Intact	Intermediate Year Cont.	Horizon Year Scenario1 Intact	Horizon Year Scenario1 Cont.	Horizon Year Scenario2 Intact	Horizon Year Scenario2 Cont.	Horizon Year Scenario3 Intact	Horizon Year Scenario3 Cont.	Horizon Year Scenario4 Intact	Horizon Year Scenario4 Cont.	Limiting Contingency
149003	ARS TAP	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.991	0.789	0.990	0.718	GEN:GINNA
149004	S121 B#2	115.0	2	153	0.900	1.100	-	-	-	-	1.024	0.913	1.023	0.699	1.018	0.631	GEN:GINNA
149005	CLYDE199	115.0	2	150	0.900	1.100	-	-	-	-	-	-	0.996	0.770	0.994	0.720	GEN:GINNA
149006	S216	115.0	2	153	0.900	1.100	-	-	-	-	1.027	0.875	1.026	0.588	1.025	0.512	GEN:GINNA
149007	HOUGHTON	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.979	0.802	0.980	0.731	GEN:GINNA
149008	RUS 115	115.0	2	153	0.900	1.100	-	-	-	-	0.979	0.867	0.977	0.598	0.974	0.521	GEN:GINNA
149009	STA 158N	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.991	0.794	0.990	0.723	GEN:GINNA
149010	STA 162	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.998	0.826	0.998	0.758	GEN:GINNA
149011	S82-1115	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.004	0.712	1.001	0.639	GEN:GINNA
149012	S113 115	115.0	2	153	0.900	1.100	-	-	0.993	0.871	0.998	0.882	0.996	0.875	0.993	0.869	149014 S418 115 115 149016 S67-1115 115 2
149012	S113 115	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.996	0.663	0.993	0.586	GEN:GINNA
149013	S37 115	115.0	2	153	0.900	1.100	-	-	-	-	0.995	0.899	0.994	0.668	0.991	0.593	GEN:GINNA
149014	S418 115	115.0	2	153	0.900	1.100	-	-	0.994	0.863	0.999	0.874	0.997	0.868	0.994	0.861	149014 S418 115 115 149016 S67-1115 115 2
149014	S418 115	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.997	0.680	0.994	0.605	GEN:GINNA
149015	S48-2115	115.0	2	153	0.900	1.100	-	-	-	-	0.990	0.889	0.988	0.645	0.985	0.570	GEN:GINNA
149016	S67-1115	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.003	0.704	1.000	0.630	GEN:GINNA
149017	S70 115	115.0	2	153	0.900	1.100	-	-	0.967	0.882	0.972	0.893	0.971	0.887	0.967	0.880	149014 S418 115 115 149016 S67-1115 115 2
149017	S70 115	115.0	2	153	0.900	1.100	-	-	-	-	0.972	0.866	0.971	0.608	0.967	0.530	GEN:GINNA
149018	S71 115	115.0	2	153	0.900	1.100	-	-	0.964	0.899	-	-	-	-	0.964	0.898	149014 S418 115 115 149016 S67-1115 115 2
149018	S71 115	115.0	2	153	0.900	1.100	-	-	-	-	0.969	0.860	0.967	0.596	0.964	0.517	GEN:GINNA
149019	S80 1TR	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.009	0.756	1.009	0.689	GEN:GINNA
149020	S80 2TR	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.008	0.737	1.005	0.666	GEN:GINNA
149021	S80 3TR	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.009	0.756	1.009	0.689	GEN:GINNA
149022	STA 23 1	115.0	2	153	0.900	1.100	-	-	-	-	1.020	0.869	1.019	0.544	1.019	0.464	GEN:GINNA
149023	S23-901	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.999	0.685	0.996	0.612	GEN:GINNA
149024	GINNA115	115.0	2	153	0.900	1.100	-	-	-	-	1.052	0.898	1.052	0.616	1.052	0.540	GEN:GINNA
149025	PANNELLI	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.023	0.739	1.017	0.673	GEN:GINNA
149026	QUAKER	115.0	2	153	0.900	1.100	-	-	-	-	1.024	0.913	1.023	0.699	1.018	0.631	GEN:GINNA
149027	STA 424	115.0	2	153	0.900	1.100	-	-	-	-	1.035	0.886	1.035	0.606	1.034	0.530	GEN:GINNA
149028	S204 908	115.0	2	153	0.900	1.100	-	-	-	-	1.043	0.897	1.043	0.627	1.042	0.553	GEN:GINNA
149029	S204 911	115.0	2	153	0.900	1.100	-	-	-	-	1.044	0.890	1.044	0.595	1.044	0.518	GEN:GINNA
149030	S135	115.0	2	153	0.900	1.100	-	-	-	-	1.039	0.891	1.039	0.616	1.038	0.541	GEN:GINNA
149031	S33 901	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.000	0.692	0.997	0.619	GEN:GINNA
149032	S33 902	115.0	2	153	0.900	1.100	1.015	0.902	0.996	0.859	1.000	0.860	0.999	0.858	0.996	0.855	149032 S33 902 115 149049 S82 B#3 115 02
149032	S33 902	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.999	0.697	0.996	0.624	GEN:GINNA
149033	S42 115	115.0	2	153	0.900	1.100	-	-	-	-	1.021	0.869	1.019	0.544	1.019	0.464	GEN:GINNA
149034	JCT 921	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.998	0.689	0.995	0.616	GEN:GINNA
149035	S69 917	115.0	2	153	0.900	1.100	-	-	-	-	0.973	0.862	0.971	0.595	0.968	0.517	GEN:GINNA
149036	STA 93	115.0	2	153	0.900	1.100	-	-	-	-	0.976	0.864	0.974	0.596	0.971	0.519	GEN:GINNA
149038	KAMIN115	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.989	0.820	0.990	0.751	GEN:GINNA
149039	STA 89	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.003	0.712	1.000	0.640	GEN:GINNA
149040	ALLEGENY	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.988	0.819	0.989	0.750	GEN:GINNA
149045	STA 158S	115.0	2	153	0.900	1.100	-	-	-	-	-	-	0.991	0.794	0.990	0.723	GEN:GINNA
149046	S82-2115	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.004	0.712	1.001	0.639	GEN:GINNA
149047	S48-1115	115.0	2	153	0.900	1.100	-	-	-	-	0.990	0.889	0.988	0.645	0.985	0.570	GEN:GINNA
149048	S67-2115	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.003	0.704	1.000	0.630	GEN:GINNA
149049	S82 B#3	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.004	0.713	1.001	0.640	GEN:GINNA
149062	S7 115B2	115.0	2	153	0.900	1.100	-	-	-	-	0.979	0.867	0.977	0.598	0.974	0.521	GEN:GINNA
149063	S230 115	115.0	2	153	0.900	1.100	-	-	-	-	1.031	0.899	1.030	0.650	1.028	0.577	GEN:GINNA
149067	S80 4TR	115.0	2	153	0.900	1.100	-	-	-	-	-	-	1.011	0.762	1.007	0.693	GEN:GINNA
149196	S124C913	115.0	2	153	0.900	1.100	-	-	-	-	1.030	0.877	1.029	0.560	1.029	0.481	GEN:GINNA
149200	S424-2	115.0	2	153	0.900	1.100	-	-	-	-	1.035	0.886	1.035	0.606	1.034	0.530	GEN:GINNA
130751	CNDGUA_T	230.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	0.997	0.897	GEN:GINNA
130757	WATRC345	345.0	3	150	0.900	1.100	-	-	0.954	0.892	0.956	0.894	0.959	0.898	0.954	0.893	130755 OAKDL345 345 130757 WATRC345 345 1
130764	MEYER230	230.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	0.995	0.885	GEN:GINNA
130774	BATH 115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.018	0.882	GEN:GINNA
130776	BORDR115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.000	0.806	0.998	0.753	GEN:GINNA
130798	EELPO115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.015	0.907	1.014	0.857	GEN:GINNA

Bus #	Bus Name	kV	Area	Zone	Vlow	Vhigh	Intermediate Year Intact	Intermediate Year Cont.	Horizon Year Scenario1 Intact	Horizon Year Scenario1 Cont.	Horizon Year Scenario2 Intact	Horizon Year Scenario2 Cont.	Horizon Year Scenario3 Intact	Horizon Year Scenario3 Cont.	Horizon Year Scenario4 Intact	Horizon Year Scenario4 Cont.	Limiting Contingency
130803	FLATS115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.020	0.898	1.020	0.852	GEN:GINNA
130809	HALEY115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.010	0.844	1.008	0.794	GEN:GINNA
130811	HAMLT115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.009	0.900	GEN:GINNA
130813	HICK 115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.025	0.922	GEN:GINNA
130816	HYATT115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.000	0.850	0.997	0.807	GEN:GINNA
130823	GUARD115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.001	0.811	0.999	0.758	GEN:GINNA
130826	MEYER115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.017	0.868	GEN:GINNA
130830	MONTR115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.018	0.905	GEN:GINNA
130831	MORAI115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.024	0.874	GEN:GINNA
130855	STATE115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.000	0.876	0.999	0.843	GEN:GINNA
130863	WILET115	115.0	3	150	0.900	1.100	-	-	1.002	0.853	1.003	0.851	1.003	0.851	1.002	0.851	130800 ETNA 115 115 130863 WILET115 115 1
130871	CANADIAC	115.0	3	150	0.900	1.100	-	-	1.103	1.115	1.107	1.119	1.105	1.117	1.105	1.116	131345 S.PER115 115 149010 STA 162 115 1
130871	CANADIAC	115.0	3	150	0.900	1.100	-	-	1.103	1.121	1.107	1.122	1.105	1.119	1.105	1.121	130770 SHLDN230 230 131122 WTHRS230 230 1
130871	CANADIAC	115.0	3	150	0.900	1.100	-	-	1.103	1.136	1.107	1.137	1.105	1.134	1.105	1.136	130767 STOLE230 230 130770 SHLDN230 230 1
130871	CANADIAC	115.0	3	150	0.900	1.100	-	-	1.103	1.115	1.107	1.118	1.105	1.116	1.105	1.115	130762 GARDV230 230 130767 STOLE230 230 1
130871	CANADIAC	115.0	3	150	0.900	1.100	-	-	1.103	1.126	1.107	1.127	1.105	1.124	1.105	1.126	130751 CNDGUA_T 230 130764 MEYER230 230 1
130872	CANADIAS	115.0	3	150	0.900	1.100	-	-	1.105	1.116	1.109	1.120	1.107	1.119	1.106	1.118	131345 S.PER115 115 149010 STA 162 115 1
130872	CANADIAS	115.0	3	150	0.900	1.100	-	-	1.105	1.122	1.109	1.124	1.107	1.121	1.106	1.122	130770 SHLDN230 230 131122 WTHRS230 230 1
130872	CANADIAS	115.0	3	150	0.900	1.100	-	-	1.105	1.137	1.109	1.138	1.107	1.136	1.106	1.137	130767 STOLE230 230 130770 SHLDN230 230 1
130872	CANADIAS	115.0	3	150	0.900	1.100	-	-	1.105	1.116	1.109	1.120	1.107	1.118	1.106	1.117	130762 GARDV230 230 130767 STOLE230 230 1
130872	CANADIAS	115.0	3	150	0.900	1.100	-	-	1.105	1.127	1.109	1.129	1.107	1.126	1.106	1.128	130751 CNDGUA_T 230 130764 MEYER230 230 1
130874	GLOBALNY	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.016	0.905	1.016	0.856	GEN:GINNA
130880	AUBST115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.000	0.876	0.999	0.842	GEN:GINNA
130881	CLNTN115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	0.998	0.819	0.996	0.776	GEN:GINNA
130882	WRIGH115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.005	0.889	1.004	0.857	GEN:GINNA
130883	AUB HY $	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.005	0.889	1.004	0.857	GEN:GINNA
130885	ECOGENNY	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.017	0.904	1.016	0.855	GEN:GINNA
131156	SULLIVAN PAR	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.027	0.916	GEN:GINNA
131161	ERWIN	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.027	0.916	GEN:GINNA
131163	TEXAS115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.019	0.897	GEN:GINNA
131164	WERIE115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.029	0.918	GEN:GINNA
131241	GRNDG115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.027	0.903	1.026	0.858	GEN:GINNA
131242	MACDN115	115.0	3	150	0.900	1.100	-	-	-	-	1.023	0.913	1.022	0.697	1.018	0.628	GEN:GINNA
131243	SLEIG115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	1.005	0.719	1.002	0.656	GEN:GINNA
131342	BENET115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.037	0.887	GEN:GINNA
131344	PALMT115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	-	-	1.036	0.885	GEN:GINNA
131345	S.PER115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	0.998	0.826	0.998	0.758	GEN:GINNA
131346	INDEC115	115.0	3	150	0.900	1.100	-	-	-	-	-	-	0.999	0.833	0.999	0.764	GEN:GINNA
135860	LAWLER-1	115.0	3	146	0.900	1.100	-	-	-	-	0.975	0.890	0.974	0.676	0.972	0.608	GEN:GINNA
136159	BRIDGE 7	115.0	3	146	0.900	1.100	1.016	0.902	1.009	0.884	1.010	0.884	1.009	0.884	1.009	0.884	136159 BRIDGE 7 115 136189 DEWITT 1 115 1
136166	A/B_LY13	115.0	3	146	0.900	1.100	0.991	0.747	0.982	0.696	0.982	0.693	0.982	0.693	0.982	0.695	136166 A/B_LY13 115 136173 ANHBS-13 115 1
136167	HOOKRD	115.0	3	146	0.900	1.100	-	-	-	-	0.975	0.893	0.974	0.685	0.972	0.622	GEN:GINNA
136183	CLTNCORN	115.0	3	146	0.900	1.100	-	-	-	-	-	-	0.998	0.819	0.996	0.777	GEN:GINNA
136186	CRUCIBLE	115.0	3	146	0.900	1.100	0.999	0.653	0.997	0.590	0.997	0.588	0.997	0.588	0.997	0.589	136200 GERES LK 115 136270 CRUC TAP 115 1
136194	FARMGTN1	115.0	3	146	0.900	1.100	-	-	-	-	-	-	0.978	0.700	0.977	0.640	GEN:GINNA
136197	FRMGTN-4	115.0	3	146	0.900	1.100	-	-	-	-	-	-	1.001	0.740	0.996	0.678	GEN:GINNA
136206	HDSN-7	115.0	3	146	0.900	1.100	1.016	0.902	1.009	0.885	1.009	0.884	1.009	0.884	1.009	0.884	136159 BRIDGE 7 115 136189 DEWITT 1 115 1
136208	HOGAN-1	115.0	3	146	0.900	1.100	-	-	-	-	0.976	0.891	0.974	0.678	0.972	0.611	GEN:GINNA
136209	HOGAN-2	115.0	3	146	0.900	1.100	-	-	-	-	0.979	0.900	0.978	0.702	0.975	0.636	GEN:GINNA
136213	LAWLER-2	115.0	3	146	0.900	1.100	-	-	-	-	0.978	0.897	0.977	0.696	0.974	0.629	GEN:GINNA
136230	PEAT-7	115.0	3	146	0.900	1.100	1.015	0.901	1.007	0.883	1.008	0.883	1.008	0.883	1.007	0.883	136159 BRIDGE 7 115 136189 DEWITT 1 115 1
136238	SOLVAY-B	115.0	3	146	0.900	1.100	0.999	0.734	0.997	0.691	0.997	0.689	0.997	0.689	0.997	0.690	136238 SOLVAY-B 115 136269 SOLVTAP2 115 1
136239	SOLVAY-N	115.0	3	146	0.900	1.100	1.000	0.654	0.998	0.591	0.998	0.589	0.998	0.589	0.998	0.590	136200 GERES LK 115 136270 CRUC TAP 115 1
136270	CRUC TAP	115.0	3	146	0.900	1.100	1.000	0.654	0.998	0.591	0.998	0.588	0.998	0.588	0.998	0.589	136200 GERES LK 115 136270 CRUC TAP 115 1
147897	SOLVMATT	115.0	3	146	0.900	1.100	0.999	0.653	0.997	0.591	0.997	0.588	0.997	0.588	0.997	0.589	136200 GERES LK 115 136270 CRUC TAP 115 1
136783	MALONE	115.0	4	175	0.900	1.100	-	-	1.010	0.904	1.010	0.903	1.010	0.904	1.010	0.904	136783 MALONE 115 147856 WILL 115 115 1

Bus #	Bus Name	kV	Area	Zone	Vlow	Vhigh	Intermediate Year Intact	Intermediate Year Cont.	Horizon Year Scenario1 Intact	Horizon Year Scenario1 Cont.	Horizon Year Scenario2 Intact	Horizon Year Scenario2 Cont.	Horizon Year Scenario3 Intact	Horizon Year Scenario3 Cont.	Horizon Year Scenario4 Intact	Horizon Year Scenario4 Cont.	Limiting Contingency
147925	PMLD 3	115.0	4	158	0.900	1.100	1.014	0.874	1.008	0.845	1.007	0.844	1.008	0.844	1.008	0.845	147923 PMLD 1 115 147925 PMLD 3 115 1
125056	VINEGAR	115.0	5	177	0.900	1.100	-	-	1.009	0.877	1.009	0.874	1.009	0.874	1.008	0.877	130804 DEL T115 115 130805 FRASR115 115 1
125056	VINEGAR	115.0	5	177	0.900	1.100	-	-	1.009	0.877	1.009	0.875	1.009	0.875	1.008	0.878	130753 FRASR345 345 130805 FRASR115 115 1
130771	MADISONT	115.0	5	151	0.900	1.100	-	-	0.998	0.875	0.998	0.874	0.998	0.874	0.998	0.874	130800 ETNA 115 115 130863 WILET115 115 1
130778	BROTH115	115.0	5	151	0.900	1.100	-	-	0.999	0.876	0.999	0.875	0.999	0.875	0.999	0.875	130800 ETNA 115 115 130863 WILET115 115 1
130779	C.LIN115	115.0	5	151	0.900	1.100	-	-	0.993	0.872	0.994	0.871	0.994	0.870	0.993	0.870	130800 ETNA 115 115 130863 WILET115 115 1
130789	COLER115	115.0	5	151	0.900	1.100	-	-	0.995	0.889	0.995	0.886	0.995	0.886	0.995	0.889	130804 DEL T115 115 130805 FRASR115 115 1
130789	COLER115	115.0	5	151	0.900	1.100	-	-	0.995	0.887	0.995	0.885	0.995	0.884	0.995	0.888	130789 COLER115 115 130804 DEL T115 115 1
130789	COLER115	115.0	5	151	0.900	1.100	-	-	0.995	0.889	0.995	0.887	0.995	0.886	0.995	0.890	130753 FRASR345 345 130805 FRASR115 115 1
130794	DELHI115	115.0	5	151	0.900	1.100	-	-	1.013	0.890	1.013	0.887	1.013	0.887	1.013	0.890	130804 DEL T115 115 130805 FRASR115 115 1
130794	DELHI115	115.0	5	151	0.900	1.100	-	-	1.013	0.890	1.013	0.888	1.013	0.888	1.013	0.891	130753 FRASR345 345 130805 FRASR115 115 1
130796	E.NOR115	115.0	5	151	0.900	1.100	-	-	0.981	0.865	0.981	0.864	0.981	0.864	0.981	0.864	130800 ETNA 115 115 130863 WILET115 115 1
130804	DEL T115	115.0	5	151	0.900	1.100	-	-	1.015	0.889	1.015	0.887	1.015	0.887	1.014	0.890	130804 DEL T115 115 130805 FRASR115 115 1
130804	DEL T115	115.0	5	151	0.900	1.100	-	-	1.015	0.890	1.015	0.888	1.015	0.887	1.014	0.890	130753 FRASR345 345 130805 FRASR115 115 1
130805	FRASR115	115.0	5	151	0.900	1.100	-	-	1.026	0.890	1.026	0.888	1.026	0.888	1.025	0.891	130753 FRASR345 345 130805 FRASR115 115 1
130851	SIDNT115	115.0	5	151	0.900	1.100	-	-	0.987	0.899	0.986	0.897	0.986	0.897	0.986	0.899	130804 DEL T115 115 130805 FRASR115 115 1
130851	SIDNT115	115.0	5	151	0.900	1.100	-	-	0.987	0.900	0.986	0.898	0.986	0.897	0.986	0.900	130753 FRASR345 345 130805 FRASR115 115 1
130852	SIDNY115	115.0	5	151	0.900	1.100	-	-	0.986	0.898	0.986	0.896	0.986	0.896	0.985	0.898	130804 DEL T115 115 130805 FRASR115 115 1
130852	SIDNY115	115.0	5	151	0.900	1.100	-	-	0.986	0.899	0.986	0.897	0.986	0.896	0.985	0.899	130753 FRASR345 345 130805 FRASR115 115 1
130856	STILV115	115.0	5	151	0.900	1.100	-	-	0.975	0.894	0.975	0.892	0.975	0.892	0.975	0.894	130804 DEL T115 115 130805 FRASR115 115 1
130856	STILV115	115.0	5	151	0.900	1.100	-	-	0.975	0.894	0.975	0.893	0.975	0.892	0.975	0.895	130753 FRASR345 345 130805 FRASR115 115 1
130859	VIN T115	115.0	5	151	0.900	1.100	-	-	1.009	0.877	1.009	0.874	1.009	0.874	1.008	0.877	130804 DEL T115 115 130805 FRASR115 115 1
130859	VIN T115	115.0	5	151	0.900	1.100	-	-	1.009	0.877	1.009	0.875	1.009	0.875	1.008	0.878	130753 FRASR345 345 130805 FRASR115 115 1
130864	WNDHT115	115.0	5	151	0.900	1.100	-	-	1.009	0.876	1.009	0.874	1.009	0.874	1.008	0.877	130804 DEL T115 115 130805 FRASR115 115 1
130864	WNDHT115	115.0	5	151	0.900	1.100	-	-	1.009	0.877	1.009	0.875	1.009	0.874	1.008	0.877	130753 FRASR345 345 130805 FRASR115 115 1
131012	AFTON115	115.0	5	151	0.900	1.100	-	-	0.979	0.900	0.979	0.898	0.979	0.898	-	-	130804 DEL T115 115 130805 FRASR115 115 1
131012	AFTON115	115.0	5	151	0.900	1.100	-	-	-	-	0.979	0.898	0.979	0.898	-	-	130753 FRASR345 345 130805 FRASR115 115 1
131655	ANDES115	115.0	5	151	0.900	1.100	-	-	1.013	0.886	1.013	0.884	1.013	0.883	1.012	0.886	130804 DEL T115 115 130805 FRASR115 115 1
131655	ANDES115	115.0	5	151	0.900	1.100	-	-	1.013	0.887	1.013	0.884	1.013	0.884	1.012	0.887	130753 FRASR345 345 130805 FRASR115 115 1
131656	ARKVL115	115.0	5	151	0.900	1.100	-	-	1.012	0.884	1.012	0.882	1.012	0.881	1.012	0.884	130804 DEL T115 115 130805 FRASR115 115 1
131656	ARKVL115	115.0	5	151	0.900	1.100	-	-	1.012	0.884	1.012	0.882	1.012	0.882	1.012	0.885	130753 FRASR345 345 130805 FRASR115 115 1
131657	AXTEL115	115.0	5	151	0.900	1.100	-	-	1.009	0.884	1.010	0.882	1.009	0.881	1.009	0.884	130804 DEL T115 115 130805 FRASR115 115 1
131657	AXTEL115	115.0	5	151	0.900	1.100	-	-	1.009	0.884	1.010	0.882	1.009	0.882	1.009	0.885	130753 FRASR345 345 130805 FRASR115 115 1
131658	BELAY115	115.0	5	151	0.900	1.100	-	-	1.011	0.881	1.011	0.879	1.011	0.879	1.011	0.882	130804 DEL T115 115 130805 FRASR115 115 1
131658	BELAY115	115.0	5	151	0.900	1.100	-	-	1.011	0.882	1.011	0.880	1.011	0.879	1.011	0.882	130753 FRASR345 345 130805 FRASR115 115 1
131659	GRNGR115	115.0	5	151	0.900	1.100	-	-	1.009	0.883	1.009	0.881	1.009	0.880	1.008	0.883	130804 DEL T115 115 130805 FRASR115 115 1
131659	GRNGR115	115.0	5	151	0.900	1.100	-	-	1.009	0.884	1.009	0.881	1.009	0.881	1.008	0.884	130753 FRASR345 345 130805 FRASR115 115 1
131660	HANCO115	115.0	5	151	0.900	1.100	-	-	0.973	0.891	0.973	0.890	0.973	0.889	0.973	0.892	130804 DEL T115 115 130805 FRASR115 115 1
131660	HANCO115	115.0	5	151	0.900	1.100	-	-	0.973	0.892	0.973	0.890	0.973	0.890	0.973	0.892	130753 FRASR345 345 130805 FRASR115 115 1
131661	SHAND115	115.0	5	151	0.900	1.100	-	-	1.010	0.879	1.010	0.877	1.010	0.876	1.010	0.880	130804 DEL T115 115 130805 FRASR115 115 1
131661	SHAND115	115.0	5	151	0.900	1.100	-	-	1.010	0.880	1.010	0.877	1.010	0.877	1.010	0.880	130753 FRASR345 345 130805 FRASR115 115 1
131663	WNDHM115	115.0	5	151	0.900	1.100	-	-	1.009	0.875	1.009	0.873	1.009	0.873	1.008	0.876	130804 DEL T115 115 130805 FRASR115 115 1
131663	WNDHM115	115.0	5	151	0.900	1.100	-	-	1.009	0.876	1.009	0.874	1.009	0.873	1.008	0.876	130753 FRASR345 345 130805 FRASR115 115 1
137211	TRNG STN	115.0	5	147	0.900	1.100	-	-	0.992	0.881	0.990	0.877	0.990	0.877	0.991	0.880	137211 TRNG STN 115 137233 ONEIDA 115 1
137222	CAMDNWIR	115.0	5	147	0.900	1.100	-	-	0.958	0.875	0.957	0.870	0.957	0.870	0.958	0.874	137211 TRNG STN 115 137237 ROME 115 1
137222	CAMDNWIR	115.0	5	147	0.900	1.100	0.970	0.892	0.958	0.861	0.957	0.857	0.957	0.857	0.958	0.860	137211 TRNG STN 115 137233 ONEIDA 115 1
137227	GRIFFISS	115.0	5	147	0.900	1.100	-	-	0.978	0.887	0.977	0.883	0.977	0.883	0.977	0.886	137211 TRNG STN 115 137233 ONEIDA 115 1
137227	GRIFFISS	115.0	5	147	0.900	1.100	-	-	-	-	0.977	0.896	0.977	0.896	0.977	0.899	137211 TRNG STN 115 137237 ROME 115 1
137230	LEHIGH	115.0	5	147	0.900	1.100	-	-	0.958	0.875	0.957	0.870	0.957	0.870	0.958	0.874	137211 TRNG STN 115 137237 ROME 115 1
137230	LEHIGH	115.0	5	147	0.900	1.100	0.970	0.892	0.958	0.861	0.957	0.857	0.957	0.857	0.958	0.860	137211 TRNG STN 115 137233 ONEIDA 115 1
137231	LEVITT	115.0	5	147	0.900	1.100	-	-	0.970	0.888	0.969	0.884	0.969	0.884	0.970	0.887	137211 TRNG STN 115 137237 ROME 115 1
137231	LEVITT	115.0	5	147	0.900	1.100	-	-	0.970	0.874	0.969	0.870	0.969	0.870	0.970	0.873	137211 TRNG STN 115 137233 ONEIDA 115 1
137232	MADISON	115.0	5	147	0.900	1.100	-	-	0.978	0.889	0.977	0.886	0.977	0.886	0.977	0.888	137211 TRNG STN 115 137233 ONEIDA 115 1
137232	MADISON	115.0	5	147	0.900	1.100	-	-	-	-	0.977	0.898	0.977	0.898	-	-	137211 TRNG STN 115 137237 ROME 115 1
137236	REVERE	115.0	5	147	0.900	1.100	-	-	0.977	0.898	0.976	0.893	0.976	0.893	0.977	0.897	137211 TRNG STN 115 137237 ROME 115 1
137236	REVERE	115.0	5	147	0.900	1.100	-	-	0.977	0.884	0.976	0.880	0.976	0.880	0.977	0.883	137211 TRNG STN 115 137233 ONEIDA 115 1
137237	ROME	115.0	5	147	0.900	1.100	-	-	0.978	0.897	0.977	0.892	0.977	0.892	0.978	0.896	137211 TRNG STN 115 137237 ROME 115 1
137237	ROME	115.0	5	147	0.900	1.100	-	-	0.978	0.883	0.977	0.879	0.977	0.879	0.978	0.882	137211 TRNG STN 115 137233 ONEIDA 115 1

Bus #	Bus Name	kV	Area	Zone	Vlow	Vhigh	Intermediate Year Intact	Intermediate Year Cont.	Horizon Year Scenario1 Intact	Horizon Year Scenario1 Cont.	Horizon Year Scenario2 Intact	Horizon Year Scenario2 Cont.	Horizon Year Scenario3 Intact	Horizon Year Scenario3 Cont.	Horizon Year Scenario4 Intact	Horizon Year Scenario4 Cont.	Limiting Contingency
137238	ROME CBL	115.0	5	147	0.900	1.100	-	-	0.973	0.891	0.972	0.886	0.971	0.886	0.972	0.890	137211 TRNG STN 115 137237 ROME 115 1
137238	ROME CBL	115.0	5	147	0.900	1.100	-	-	0.973	0.877	0.972	0.873	0.971	0.873	0.972	0.876	137211 TRNG STN 115 137233 ONEIDA 115 1
137245	TURIN	115.0	5	147	0.900	1.100	-	-	0.978	0.898	0.977	0.894	0.977	0.894	0.978	0.897	137211 TRNG STN 115 137233 ONEIDA 115 1
147872	ANDES C	115.0	5	151	0.900	1.100	-	-	1.013	0.886	1.013	0.884	1.013	0.883	1.012	0.886	130804 DEL T115 115 130805 FRASR115 115 1
147872	ANDES C	115.0	5	151	0.900	1.100	-	-	1.013	0.887	1.013	0.884	1.013	0.884	1.012	0.887	130753 FRASR345 345 130805 FRASR115 115 1
147876	AXTELL C	115.0	5	151	0.900	1.100	-	-	1.009	0.884	1.010	0.882	1.009	0.881	1.009	0.884	130804 DEL T115 115 130805 FRASR115 115 1
147876	AXTELL C	115.0	5	151	0.900	1.100	-	-	1.009	0.884	1.010	0.882	1.009	0.882	1.009	0.885	130753 FRASR345 345 130805 FRASR115 115 1
147933	S.KORT C	115.0	5	151	0.900	1.100	-	-	1.011	0.886	1.011	0.884	1.011	0.884	1.010	0.887	130804 DEL T115 115 130805 FRASR115 115 1
147933	S.KORT C	115.0	5	151	0.900	1.100	-	-	1.011	0.887	1.011	0.884	1.011	0.884	1.010	0.887	130753 FRASR345 345 130805 FRASR115 115 1
114	RTDM77SW	230.0	6	148	0.900	1.100	-	-	0.928	0.864	0.922	0.856	0.926	0.860	0.927	0.862	BUS:RTRDM 99 BUS
114	RTDM77SW	230.0	6	148	0.900	1.100	-	-	0.928	0.898	0.922	0.889	0.926	0.892	0.927	0.896	137454 REYNLD3 345 137528 REY. RD. 115 1
114	RTDM77SW	230.0	6	148	0.900	1.100	-	-	0.928	0.899	0.922	0.891	0.926	0.895	0.927	0.898	102385 BRSWAMP 230 137730 ROTRDM.2 230 1
114	RTDM77SW	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.896	-	-	-	-	GEN:SEABROOK
114	RTDM77SW	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.896	-	-	-	-	GEN:SEAB&OMS
114	RTDM77SW	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.899	-	-	-	-	BUS:N.S._99
114	RTDM77SW	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.899	-	-	-	-	BUS:N.S._77
115	RTDM99SW	230.0	6	148	0.900	1.100	-	-	0.928	0.898	0.922	0.889	0.926	0.892	0.927	0.896	137454 REYNLD3 345 137528 REY. RD. 115 1
115	RTDM99SW	230.0	6	148	0.900	1.100	-	-	0.928	0.899	0.922	0.891	0.926	0.895	0.927	0.898	102385 BRSWAMP 230 137730 ROTRDM.2 230 1
115	RTDM99SW	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.896	-	-	-	-	GEN:SEABROOK
115	RTDM99SW	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.896	-	-	-	-	GEN:SEAB&OMS
115	RTDM99SW	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.899	-	-	-	-	BUS:RTRDM 77 BUS
115	RTDM99SW	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.899	-	-	-	-	BUS:N.S._99
115	RTDM99SW	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.899	-	-	-	-	BUS:N.S._77
130822	KLINE115	115.0	6	165	0.900	1.100	1.015	1.208	1.007	1.143	1.010	1.125	1.009	1.138	1.005	1.139	130793 CRARY115 115 130822 KLINE115 115 1
130931	STEPH115	115.0	6	165	0.900	1.100	0.997	0.689	0.988	0.599	0.990	0.604	0.989	0.596	0.986	0.591	130931 STEPH115 115 137502 GBSH+LGE 115 1
130932	COWEE 1$	115.0	6	165	0.900	1.100	0.997	0.689	0.988	0.599	0.990	0.604	0.989	0.596	0.986	0.591	130931 STEPH115 115 137502 GBSH+LGE 115 1
137498	ELNORA	115.0	6	148	0.900	1.100	-	-	0.968	0.860	0.968	0.858	0.967	0.857	0.966	0.857	137501 FRONT ST 115 137532 RTRDM1 115 1
137498	ELNORA	115.0	6	148	0.900	1.100	-	-	0.968	0.899	0.968	0.898	0.967	0.897	0.966	0.897	137501 FRONT ST 115 137531 ROSA RD 115 1
137501	FRONT ST	115.0	6	148	0.900	1.100	1.000	0.888	0.989	0.843	0.990	0.841	0.988	0.839	0.988	0.840	137501 FRONT ST 115 137532 RTRDM1 115 1
137504	GE R&D	115.0	6	148	0.900	1.100	0.988	0.894	0.974	0.849	0.975	0.848	0.974	0.846	0.973	0.847	137501 FRONT ST 115 137532 RTRDM1 115 1
137504	GE R&D	115.0	6	148	0.900	1.100	-	-	0.974	0.895	0.975	0.893	0.974	0.892	0.973	0.893	137501 FRONT ST 115 137531 ROSA RD 115 1
137504	GE R&D	115.0	6	148	0.900	1.100	-	-	-	-	0.975	0.899	0.974	0.898	0.973	0.898	137504 GE R&D 115 137531 ROSA RD 115 1
137508	INMAN RD	115.0	6	148	0.900	1.100	-	-	0.965	0.900	0.966	0.898	0.965	0.896	0.964	0.898	137512 JOHNSON 115 137513 MAPLWOOD 115 1
137508	INMAN RD	115.0	6	148	0.900	1.100	-	-	0.965	0.872	0.966	0.870	0.965	0.869	0.964	0.869	137501 FRONT ST 115 137532 RTRDM1 115 1
137511	FRT FERY	115.0	6	148	0.900	1.100	-	-	0.975	0.883	0.976	0.881	0.975	0.879	0.973	0.881	137512 JOHNSON 115 137513 MAPLWOOD 115 1
137512	JOHNSON	115.0	6	148	0.900	1.100	-	-	0.978	0.881	0.978	0.880	0.978	0.877	0.976	0.880	137512 JOHNSON 115 137513 MAPLWOOD 115 1
137531	ROSA RD	115.0	6	148	0.900	1.100	0.990	0.893	0.977	0.848	0.977	0.846	0.976	0.845	0.976	0.846	137501 FRONT ST 115 137532 RTRDM1 115 1
137531	ROSA RD	115.0	6	148	0.900	1.100	-	-	0.977	0.895	0.977	0.894	0.976	0.892	0.976	0.893	137501 FRONT ST 115 137531 ROSA RD 115 1
137540	SIL. TAP	115.0	6	148	0.900	1.100	-	-	0.971	0.886	0.972	0.884	0.971	0.882	0.969	0.884	137512 JOHNSON 115 137513 MAPLWOOD 115 1
137730	ROTRDM.2	230.0	6	148	0.900	1.100	-	-	0.928	0.864	0.922	0.856	0.926	0.860	0.927	0.862	BUS:RTRDM 99 BUS
137730	ROTRDM.2	230.0	6	148	0.900	1.100	-	-	0.928	0.898	0.922	0.889	0.926	0.892	0.927	0.896	137454 REYNLD3 345 137528 REY. RD. 115 1
137730	ROTRDM.2	230.0	6	148	0.900	1.100	-	-	0.928	0.899	0.922	0.891	0.926	0.895	0.927	0.898	102385 BRSWAMP 230 137730 ROTRDM.2 230 1
137730	ROTRDM.2	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.896	-	-	-	-	GEN:SEABROOK
137730	ROTRDM.2	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.896	-	-	-	-	GEN:SEAB&OMS
137730	ROTRDM.2	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.899	-	-	-	-	BUS:RTRDM 77 BUS
137730	ROTRDM.2	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.899	-	-	-	-	BUS:N.S._99
137730	ROTRDM.2	230.0	6	148	0.900	1.100	-	-	-	-	0.922	0.899	-	-	-	-	BUS:N.S._77
137849	FAGE DRY	115.0	6	148	0.900	1.100	-	-	-	-	0.960	0.898	0.959	0.898	-	-	137876 CHURCH-W 115 137911 VAIL TAP 115 1
137849	FAGE DRY	115.0	6	148	0.900	1.100	-	-	-	-	0.960	0.899	0.959	0.898	-	-	137532 RTRDM1 115 137876 CHURCH-W 115 1
137860	AMST 115	115.0	6	148	0.900	1.100	-	-	0.985	0.874	0.985	0.870	0.984	0.869	0.984	0.875	137532 RTRDM1 115 137860 AMST 115 115 1
137874	CENTER-S	115.0	6	148	0.900	1.100	-	-	-	-	0.960	0.897	0.959	0.896	-	-	137876 CHURCH-W 115 137911 VAIL TAP 115 1
137874	CENTER-S	115.0	6	148	0.900	1.100	-	-	-	-	0.960	0.898	0.959	0.897	-	-	137532 RTRDM1 115 137876 CHURCH-W 115 1
137875	CHURCH-E	115.0	6	148	0.900	1.100	-	-	0.982	0.876	0.982	0.872	0.981	0.871	0.981	0.876	137532 RTRDM1 115 137860 AMST 115 115 1
137876	CHURCH-W	115.0	6	148	0.900	1.100	-	-	0.980	0.897	0.980	0.893	0.979	0.892	0.979	0.897	137532 RTRDM1 115 137876 CHURCH-W 115 1
137881	GROOMS	115.0	6	148	0.900	1.100	-	-	0.966	0.890	0.966	0.889	0.966	0.887	0.964	0.889	137512 JOHNSON 115 137513 MAPLWOOD 115 1
137881	GROOMS	115.0	6	148	0.900	1.100	-	-	0.966	0.887	0.966	0.885	0.966	0.884	0.964	0.884	137501 FRONT ST 115 137532 RTRDM1 115 1
137889	KNAPP	115.0	6	148	0.900	1.100	0.998	0.635	0.983	0.495	0.983	0.492	0.983	0.491	0.983	0.488	137902 SCOFIELD 115 137914 WBURG115 115 1
137896	N. CRK	115.0	6	148	0.900	1.100	0.998	0.632	0.982	0.491	0.982	0.487	0.982	0.486	0.982	0.483	137902 SCOFIELD 115 137914 WBURG115 115 1

ABB

Bus #	Bus Name	kV	Area	Zone	Vlow	Vhigh	Intermediate Year Intact	Intermediate Year Cont.	Horizon Year Scenario1 Intact	Horizon Year Scenario1 Cont.	Horizon Year Scenario2 Intact	Horizon Year Scenario2 Cont.	Horizon Year Scenario3 Intact	Horizon Year Scenario3 Cont.	Horizon Year Scenario4 Intact	Horizon Year Scenario4 Cont.	Limiting Contingency
137906	STONER	115.0	6	148	0.900	1.100	-	-	0.961	0.897	0.961	0.893	0.959	0.892	0.961	0.897	137876 CHURCH-W 115 137911 VAIL TAP 115 1
137906	STONER	115.0	6	148	0.900	1.100	-	-	0.961	0.898	0.961	0.894	0.959	0.893	0.961	0.898	137532 RTRDM1 115 137876 CHURCH-W 115 1
137911	VAIL TAP	115.0	6	148	0.900	1.100	-	-	0.964	0.896	0.963	0.892	0.962	0.891	0.963	0.896	137876 CHURCH-W 115 137911 VAIL TAP 115 1
137911	VAIL TAP	115.0	6	148	0.900	1.100	-	-	0.964	0.897	0.963	0.893	0.962	0.892	0.963	0.897	137532 RTRDM1 115 137876 CHURCH-W 115 1
137912	VAIL 115	115.0	6	148	0.900	1.100	0.975	0.898	0.960	0.862	0.960	0.860	0.959	0.857	0.960	0.863	137911 VAIL TAP 115 137912 VAIL 115 115 1
137912	VAIL 115	115.0	6	148	0.900	1.100	-	-	0.960	0.895	0.960	0.891	0.959	0.890	0.960	0.895	137876 CHURCH-W 115 137911 VAIL TAP 115 1
137912	VAIL 115	115.0	6	148	0.900	1.100	-	-	0.960	0.896	0.960	0.892	0.959	0.891	0.960	0.896	137532 RTRDM1 115 137876 CHURCH-W 115 1
137914	WBURG115	115.0	6	148	0.900	1.100	0.998	0.639	0.983	0.501	0.983	0.498	0.983	0.497	0.983	0.494	137902 SCOFIELD 115 137914 WBURG115 115 1
126250	RAMAPO 5	500.0	7	176	1.000	1.150	-	-	-	-	1.012	0.997	-	-	-	-	GEN:IND PT 3
126250	RAMAPO 5	500.0	7	176	1.000	1.150	-	-	-	-	1.012	0.993	-	-	-	-	GEN:IND PT 2
126250	RAMAPO 5	500.0	7	176	1.000	1.150	-	-	-	-	1.012	1.000	-	-	-	-	126260 BOWLINE1 345 146750 WHAV345 345 10
126260	BOWLINE1	345.0	7	176	0.951	1.049	1.044	1.060	1.041	1.054	1.040	1.057	1.041	1.056	1.040	1.054	126290 LADENTWN 345 146750 WHAV345 345 1
126260	BOWLINE1	345.0	7	176	0.951	1.049	1.044	1.057	1.041	1.053	1.040	1.051	1.041	1.053	1.040	1.052	126263 BUCHANAN S 345 126290 LADENTWN 345 1
146754	MDTN TAP	345.0	7	155	0.900	1.100	-	-	1.022	0.908	1.020	0.916	1.020	0.904	1.019	0.902	SER:CMT34&MTR34
146762	CONGERS	138.0	7	155	0.900	1.100	-	-	0.989	0.888	-	-	0.988	0.883	0.991	0.888	146762 CONGERS 138 146774 BOW138 138 1
146776	WNYA138	138.0	7	155	0.900	1.100	-	-	0.984	0.887	-	-	0.983	0.883	0.986	0.887	146762 CONGERS 138 146774 BOW138 138 1
126460	38W42	138.0	8	167	0.900	1.100	1.007	0.887	1.004	0.847	1.004	0.846	1.006	0.848	1.006	0.851	126458 MLWD TA 138 126460 38W42 138 1
126461	38W41	138.0	8	167	0.900	1.100	1.007	0.887	1.004	0.847	1.004	0.846	1.006	0.848	1.006	0.851	126458 MLWD TA 138 126461 38W41 138 1
130758	WOODA345	345.0	8	167	0.900	1.100	-	-	1.002	0.891	0.999	0.886	1.002	0.888	1.000	0.886	BUS:WOODA_345
130758	WOODA345	345.0	8	167	0.900	1.100	-	-	1.002	0.899	0.999	0.899	1.002	0.898	1.000	0.899	126305 WOOD A 345 130758 WOODA345 345 1
130759	WOODB345	345.0	8	167	0.900	1.100	-	-	1.002	0.893	1.000	0.886	1.002	0.889	1.002	0.885	BUS:WOODB_345
130759	WOODB345	345.0	8	167	0.900	1.100	-	-	1.002	0.899	1.000	0.897	1.002	0.897	1.002	0.896	126306 WOOD B 345 130759 WOODB345 345 1
130781	CARML115	115.0	8	174	0.900	1.100	-	-	1.011	0.889	1.031	0.909	1.011	0.886	1.010	0.885	130781 CARML115 115 130865 WOODS115 115 1
130842	PAWLN115	115.0	8	174	0.900	1.100	-	-	0.978	0.869	0.989	0.889	0.980	0.868	0.978	0.867	130842 PAWLN115 115 131112 SYLVN115 115 1
130842	PAWLN115	115.0	8	174	0.900	1.100	0.992	0.895	0.978	0.843	0.989	0.864	0.980	0.841	0.978	0.840	125026 FISHKILL 115 131112 SYLVN115 115 1
131110	CROTN115	115.0	8	174	0.900	1.100	-	-	0.988	0.900	-	-	0.989	0.898	0.988	0.897	130781 CARML115 115 130865 WOODS115 115 1
131112	SYLVN115	115.0	8	174	0.900	1.100	1.009	0.893	0.999	0.839	1.007	0.861	1.000	0.838	0.998	0.836	125026 FISHKILL 115 131112 SYLVN115 115 1
131114	TILYF115	115.0	8	174	0.900	1.100	-	-	0.982	0.895	-	-	0.983	0.893	0.982	0.892	125026 FISHKILL 115 131112 SYLVN115 115 1
131114	TILYF115	115.0	8	174	0.900	1.100	-	-	-	-	-	-	0.983	0.899	0.982	0.898	130781 CARML115 115 130865 WOODS115 115 1
131115	UNION115	115.0	8	174	0.900	1.100	-	-	1.000	0.892	1.019	0.911	1.001	0.890	1.000	0.889	130781 CARML115 115 130865 WOODS115 115 1
131118	CROTON $	115.0	8	174	0.900	1.100	-	-	0.988	0.900	-	-	0.989	0.898	0.988	0.897	130781 CARML115 115 130865 WOODS115 115 1
126362	CEDAR TX2	138.0	9	169	0.900	1.100	-	-	0.994	0.888	0.990	0.883	0.996	0.889	0.993	0.887	126362 CEDAR TX2 138 126512 38W04 138 1
126382	ELMSFD2E	138.0	9	169	0.900	1.100	-	-	-	-	1.001	0.899	-	-	-	-	126378 EASTVIEW 138 126382 ELMSFD2E 138 1
126386	ROCK V T1	138.0	9	169	0.900	1.100	1.007	0.830	0.995	0.886	0.995	0.880	-	-	-	-	126372 DUN SO 138 126386 ROCK V T1 138 1
126387	ROCK V T2	138.0	9	169	0.900	1.100	1.007	0.830	0.995	0.886	0.995	0.880	-	-	-	-	126372 DUN SO 138 126387 ROCK V T2 138 1
126430	GRANHL T1	138.0	9	169	0.900	1.100	1.007	0.874	0.995	0.836	0.995	0.833	0.997	0.838	0.997	0.839	126372 DUN SO 138 126430 GRANHL T1 138 1
126431	GRANHL T2	138.0	9	169	0.900	1.100	1.007	0.875	0.995	0.837	0.995	0.834	0.997	0.840	0.997	0.840	126372 DUN SO 138 126431 GRANHL T2 138 1
126432	GRANHL T3	138.0	9	169	0.900	1.100	1.007	0.874	0.995	0.836	0.995	0.833	0.997	0.838	0.997	0.838	126372 DUN SO 138 126432 GRANHL T3 138 1
126433	GRANHL T4	138.0	9	169	0.900	1.100	1.007	0.875	0.995	0.837	0.995	0.833	0.997	0.839	0.997	0.839	126372 DUN SO 138 126433 GRANHL T4 138 1
126439	HARR TX1	138.0	9	169	0.900	1.100	0.999	0.866	0.997	0.840	0.994	0.834	1.003	0.848	1.002	0.847	126439 HARR TX1 138 126524 38W14 T 138 1
126439	HARR TX1	138.0	9	169	0.900	1.100	0.999	0.897	0.997	0.871	0.994	0.864	1.003	0.878	1.002	0.877	126382 ELMSFD2E 138 126524 38W14 T 138 1
126439	HARR TX1	138.0	9	169	0.900	1.100	-	-	-	-	0.994	0.898	-	-	-	-	126378 EASTVIEW 138 126382 ELMSFD2E 138 1
126440	HARR TX2	138.0	9	169	0.900	1.100	0.999	0.867	0.997	0.842	0.995	0.835	1.003	0.849	1.003	0.849	126440 HARR TX2 138 126523 38W13 T 138 1
126440	HARR TX2	138.0	9	169	0.900	1.100	-	-	0.997	0.877	0.995	0.870	1.003	0.884	1.003	0.883	126383 ELMSFD2W 138 126523 38W13 T 138 1
126441	HARR TX 3	138.0	9	169	0.900	1.100	0.999	0.869	0.997	0.844	0.994	0.837	1.003	0.851	1.002	0.850	126441 HARR TX 3 138 126522 38W02 T 138 1
126441	HARR TX 3	138.0	9	169	0.900	1.100	-	-	0.997	0.883	0.994	0.877	1.003	0.890	1.002	0.890	126381 ELMSFD1W 138 126522 38W02 T 138 1
126519	WHITE P TX1	138.0	9	169	0.900	1.100	1.004	0.881	1.002	0.858	1.000	0.854	1.008	0.865	1.008	0.865	126380 ELMSFD1E 138 126519 WHITE P TX1 138 1
126522	38W02 T	138.0	9	169	0.900	1.100	-	-	1.002	0.883	1.000	0.877	1.008	0.891	1.007	0.890	126381 ELMSFD1W 138 126522 38W02 T 138 1
126523	38W13 T	138.0	9	169	0.900	1.100	1.004	0.902	1.002	0.877	0.999	0.870	1.008	0.884	1.007	0.883	126383 ELMSFD2W 138 126523 38W13 T 138 1
126524	38W14 T	138.0	9	169	0.900	1.100	1.003	0.897	1.002	0.871	0.999	0.864	1.008	0.878	1.007	0.877	126382 ELMSFD2E 138 126524 38W14 T 138 1
126524	38W14 T	138.0	9	169	0.900	1.100	-	-	-	-	0.999	0.899	-	-	-	-	126378 EASTVIEW 138 126382 ELMSFD2E 138 1
126670	HARR T4	138.0	9	169	0.900	1.100	1.001	0.871	0.999	0.846	0.996	0.840	1.005	0.854	1.004	0.853	126319 38W15 T 138 126670 HARR T4 138 1
126708	GRASSL1	138.0	9	169	0.900	1.100	1.006	0.850	1.006	0.835	1.003	0.831	-	-	-	-	126378 EASTVIEW 138 126708 GRASSL1 138 1
126709	GRASSL2	138.0	9	169	0.900	1.100	1.006	0.850	1.006	0.835	1.003	0.831	-	-	-	-	126378 EASTVIEW 138 126709 GRASSL2 138 1
126714	38W09 T	138.0	9	169	0.900	1.100	-	-	0.996	0.897	0.992	0.890	0.997	0.898	0.994	0.895	126513 38W09 138 126714 38W09 T 138 1
126718	GRASSL3	138.0	9	169	0.900	1.100	1.006	0.850	1.006	0.835	1.003	0.831	-	-	-	-	126378 EASTVIEW 138 126718 GRASSL3 138 1
126743	CEDAR TX3	138.0	9	169	0.900	1.100	-	-	0.992	0.885	0.988	0.880	0.994	0.886	0.991	0.885	126513 38W09 138 126743 CEDAR TX3 138 1
126747	WHITE P TX2	138.0	9	169	0.900	1.100	1.003	0.882	1.002	0.859	0.999	0.855	1.008	0.867	1.007	0.867	126522 38W02 T 138 126747 WHITE P TX2 138 1

Zone	Vlow	Vhigh	Intermediate Year Intact	Intermediate Year Cont.	Horizon Year Scenario1 Intact	Horizon Year Scenario1 Cont.	Horizon Year Scenario2 Intact	Horizon Year Scenario2 Cont.	Horizon Year Scenario3 Intact	Horizon Year Scenario3 Cont.	Horizon Year Scenario4 Intact	Horizon Year Scenario4 Cont.	Limiting Contingency
169	0.900	1.100	-	-	1.002	0.883	0.999	0.877	1.008	0.891	1.007	0.890	126381 ELMSFD1W 138 126522 38W02 T 138 1
169	0.900	1.100	1.003	0.877	1.001	0.853	0.999	0.848	1.008	0.860	1.007	0.860	126524 38W14 T 138 126748 WHITEP TX2 138 1
169	0.900	1.100	1.003	0.897	1.001	0.871	0.999	0.864	1.008	0.878	1.007	0.877	126382 ELMSFD2E 138 126524 38W14 T 138 1
169	0.900	1.100	-	-	-	-	0.999	0.899	-	-	-	-	126378 EASTVIEW 138 126382 ELMSFD2E 138 1
169	0.900	1.100	1.004	0.883	1.002	0.860	0.999	0.856	1.008	0.867	1.007	0.867	126523 38W13 T 138 126749 WHITEP T7 138 1
169	0.900	1.100	1.004	0.902	1.002	0.877	0.999	0.870	1.008	0.884	1.007	0.883	126383 ELMSFD2W 138 126523 38W13 T 138 1
169	0.900	1.100	-	-	0.997	0.898	0.993	0.891	0.999	0.899	0.996	0.896	126511 38W03 138 126831 WASH T2 138 1
169	0.900	1.100	-	-	0.996	0.897	0.992	0.890	0.998	0.898	0.995	0.895	126510 38W10 138 126832 WASH T3 138 1
169	0.900	1.100	-	-	0.996	0.898	0.992	0.891	0.998	0.899	0.995	0.896	126512 38W04 138 126833 WASH T4 138 1
159	0.950	1.050	-	-	-	-	-	-	-	-	1.003	0.940	126298 SPRBROOK 345 126301 TREMONT 345 1
159	0.950	1.050	-	-	1.001	0.926	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.001	0.926	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.926	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.029	1.062	1.035	1.065	-	-	1.031	1.051	SER:41&25
159	0.950	1.050	-	-	-	-	0.986	0.950	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	-	-	0.986	0.950	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	-	-	0.986	0.950	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	-	-	0.986	0.950	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	-	-	0.986	0.949	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	-	-	0.986	0.949	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	-	-	1.026	0.941	-	-	-	-	BUS:E13TH_45_345
159	0.950	1.050	-	-	-	-	1.045	0.945	-	-	1.045	0.950	BUS:E13TH_48_345
159	0.950	1.050	-	-	1.003	0.928	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.927	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.927	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.927	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.927	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.927	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.927	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.926	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.927	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.016	1.100	1.013	1.076	1.018	1.155	1.016	1.145	BUS:GOWANUS_N_345
159	0.950	1.050	-	-	1.016	1.100	1.013	1.076	1.018	1.155	1.016	1.145	BUS:GOWANUS_N_345
159	0.950	1.050	-	-	1.020	0.789	1.016	0.764	1.012	0.798	1.018	0.795	BUS:GOWANUS_S_345
159	0.950	1.050	-	-	1.016	1.099	1.014	1.075	1.020	1.154	1.018	1.144	BUS:GOWANUS_N_345
159	0.950	1.050	-	-	1.016	1.099	1.014	1.075	1.020	1.154	1.018	1.144	BUS:GOWANUS_N_345
159	0.950	1.050	-	-	-	-	1.014	0.950	-	-	-	-	BUS:GOWANUS_S_345
159	0.950	1.050	-	-	1.002	0.927	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.002	0.927	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	-	-	0.986	0.950	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	-	-	0.986	0.950	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	-	-	0.986	0.949	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	-	-	0.986	0.949	-	-	-	-	GEN:NYPA_AS
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.929	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.928	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.004	0.928	-	-	-	-	-	-	BUS:E13TH_47_345
159	0.950	1.050	-	-	1.012	0.788	1.008	0.763	1.005	0.797	1.010	0.795	BUS:GOWANUS_S_345
1105	0.952	1.052	1.041	1.072	1.045	1.077	1.043	1.077	1.043	1.077	1.045	1.077	147839 MOSES E 230 155073 STLAWL34 230 1
1105	0.952	1.052	-	-	1.045	1.061	-	-	1.043	1.058	1.045	1.060	147839 MOSES E 230 147840 MOSES W 230 1

Table 5-5: Interfaces Loaded Above Emergency Transfer Limits

Interface	Forward MW Limit	Horizon Year Scenario 1	Horizon Year Scenario 2	Horizon Year Scenario 3	Horizon Year Scenario 4	Limiting Contingency
Interface 3 VOLNEY EAST	3952.0	-	-	-	3957.4	91 JEFFERSN 500 126250 RAMAPO 5 500 1
Interface 3 VOLNEY EAST		-	-	-	3956.8	126250 RAMAPO 5 500 126296 RAM PAR 345 1
Interface 3 VOLNEY EAST		4195.9	4032.6	4026.0	4204.7	HQ-NY-765-New
Interface 3 VOLNEY EAST		4140.3	3957.7	-	-	GEN:SEABROOK
Interface 3 VOLNEY EAST		4140.3	3957.7	-	-	GEN:SEAB&OMS
Interface 3 VOLNEY EAST		4094.2	-	-	4101.6	GEN:MLS3&OMS
Interface 3 VOLNEY EAST		4015.9	-	-	3995.5	GEN:MILLST 3
Interface 3 VOLNEY EAST		3994.2	-	-	3993.0	GEN:IND PT 3
Interface 3 VOLNEY EAST		3979.5	-	-	3974.8	GEN:IND PT 2
Interface 3 VOLNEY EAST		3973.8	-	-	3982.2	137454 REYNLD3 345 137558 GBSH345 345 1
Interface 3 VOLNEY EAST		3965.2	-	-	3972.2	GEN:VT YANK
Interface 5 TOTAL EAST	6270.0	7022.1	6926.7	7018.3	6754.0	GEN:MILLST 3
Interface 5 TOTAL EAST		7018.0	7033.6	7020.4	-	GEN:SEABROOK
Interface 5 TOTAL EAST		7018.0	7033.6	7020.4	-	GEN:SEAB&OMS
Interface 5 TOTAL EAST		6906.5	6910.0	6903.0	6916.5	GEN:MLS3&OMS
Interface 5 TOTAL EAST		6733.6	6707.3	6728.5	6719.7	GEN:IND PT 3
Interface 5 TOTAL EAST		6707.2	6671.9	6702.0	6685.0	GEN:IND PT 2
Interface 5 TOTAL EAST		6357.4	6360.5	6354.4	6365.9	GEN:VT YANK
Interface 5 TOTAL EAST		6327.3	6281.1	6277.3	6339.7	137454 REYNLD3 345 137558 GBSH345 345 1
Interface 5 TOTAL EAST		6295.4	6273.2	-	6284.7	126260 BOWLINE1 345 146750 WHAV345 345 10
Interface 6 CENTRAL EAST	2604.0	2743.5	2750.3	2746.7	2745.6	130750 COOPC345 345 147833 MARCY T1 345 1
Interface 6 CENTRAL EAST		2726.9	2742.8	2738.3	2729.5	130753 FRASR345 345 137200 EDIC 345 1
Interface 6 CENTRAL EAST		2703.3	2721.4	2714.8	-	GEN:SEABROOK
Interface 6 CENTRAL EAST		2703.3	2721.4	2714.8	-	GEN:SEAB&OMS
Interface 6 CENTRAL EAST		2661.4	2676.9	2670.9	2663.2	GEN:MLS3&OMS
Interface 6 CENTRAL EAST		2613.8	2622.2	2608.5	-	GEN:MILLST 3
Interface 7 CE+Fras-gilb	2916.0	3189.5	3190.8	3184.2	3184.9	130750 COOPC345 345 130753 FRASR345 345 1
Interface 7 CE+Fras-gilb		3014.8	3032.0	3015.1	-	GEN:SEABROOK
Interface 7 CE+Fras-gilb		3014.8	3032.0	3015.1	-	GEN:SEAB&OMS
Interface 7 CE+Fras-gilb		2955.7	2970.1	2954.3	2952.8	GEN:MLS3&OMS
Interface 8 CE-GROUP	4587.0	4616.7	4628.6	4622.7	-	GEN:SEABROOK
Interface 8 CE-GROUP		4616.7	4628.6	4622.7	-	GEN:SEAB&OMS
Interface 8 CE-GROUP		4589.6	4596.3	4592.3	4593.5	GEN:MLS3&OMS
Interface 9 MARCY-SOUTH	1686.0	1795.8	1780.4	1793.0	1800.8	BUS:N.S._99
Interface 9 MARCY-SOUTH		1765.2	1740.8	1753.9	1770.8	137451 LEEDS 3 345 147831 GILB 345 345 1
Interface 9 MARCY-SOUTH		1757.0	1744.9	1758.2	1761.7	BUS:N.S._77
Interface 9 MARCY-SOUTH		1751.1	1737.3	1738.6	1754.1	125000 HURLEY 3 345 137451 LEEDS 3 345 1
Interface 9 MARCY-SOUTH		1746.4	1729.6	1749.2	1747.3	126294 PLTVLLEY 345 137451 LEEDS 3 345 2
Interface 9 MARCY-SOUTH		1739.9	1724.4	1743.7	1741.1	126294 PLTVLLEY 345 137455 ATHENS 345 1
Interface 9 MARCY-SOUTH		1724.4	1712.1	1725.9	1729.5	137453 N.SCOT99 345 147833 MARCY T1 345 1
Interface 9 MARCY-SOUTH		1710.7	1698.4	1712.8	1715.8	137200 EDIC 345 137452 N.SCOT77 345 1
Interface 9 MARCY-SOUTH		1706.2	1692.4	1725.1	1710.0	125000 HURLEY 3 345 125002 ROSETON 345 1
Interface 9 MARCY-SOUTH		1696.3	-	1697.2	1695.6	GEN:IND PT 3
Interface 9 MARCY-SOUTH		1695.3	-	1696.0	1693.8	GEN:IND PT 2
Interface 9 MARCY-SOUTH		1688.2	-	1690.0	1694.5	91 JEFFERSN 500 126250 RAMAPO 5 500 1
Interface 9 MARCY-SOUTH		1688.0	-	1689.8	1694.2	126250 RAMAPO 5 500 126296 RAM PAR 345 1
Interface 10 F-To-G	3485.0	3732.1	3795.3	3740.6	3757.1	** Base Case **
Interface 11 UPNY-SENY OP	5124.0	5641.5	5674.4	5638.1	5674.3	** Base Case **
Interface 12 UPNY-CONED O	5392.0	-	-	-	5467.7	GEN:NYPA_AS
Interface 12 UPNY-CONED O		5897.5	5998.3	5921.2	6008.1	GEN:IND PT 3
Interface 12 UPNY-CONED O		5889.2	5982.5	5913.2	5990.6	GEN:IND PT 2
Interface 12 UPNY-CONED O		5394.4	5506.1	5419.1	5513.0	128842 NEPTCONV 345 128847 NWBRG 345 1
Interface 14 I-to-K	1293.0	1360.8	1362.4	1360.7	1363.8	128842 NEPTCONV 345 128847 NWBRG 345 1
Interface 21 F-NE	800.0	960.1	945.4	952.3	-	GEN:SEABROOK
Interface 21 F-NE		960.1	945.4	952.3	-	GEN:SEAB&OMS
Interface 29 ZoneD-NE	150.0	210.5	211.4	210.8	-	GEN:SEABROOK
Interface 29 ZoneD-NE		210.5	211.4	210.8	-	GEN:SEAB&OMS
Interface 29 ZoneD-NE		168.0	167.5	167.2	168.2	GEN:MLS3&OMS
Interface 29 ZoneD-NE		164.7	159.7	163.2	154.2	GEN:MILLST 3
Interface 29 ZoneD-NE		160.8	161.1	160.8	161.2	GEN:VT YANK
Interface 29 ZoneD-NE		0.0	0.0	0.0	0.0	100511 GRAND IS 115 147852 PLAT T#3 115 1
Interface 29 ZoneD-NE		-0.1	-0.1	-0.1	-0.1	147852 PLAT T#3 115 147922 PLAT 115 115 3
Interface 33 PJME-NYE	1500.0	1716.1	1613.0	1737.3	-	GEN:MILLST 3
Interface 33 PJME-NYE		1524.6	1527.3	1520.7	-	GEN:SEABROOK
Interface 33 PJME-NYE		1524.6	1527.3	1520.7	-	GEN:SEAB&OMS

Note:
1. "-" indicates no violations for this scenario

6 TRANSFER LIMITS FOR INTERMEDIATE YEAR

This section describes the calculation of transfer limits for key interfaces in the New York State Transmission System for summer peak load conditions in the Intermediate Year. The purpose of these calculations is to establish emergency transfer limits for use in subsequent LOLE analysis.

Transfer limits are established for interfaces within NYCA as well as interfaces between NYCA and neighboring systems. Both thermally-constrained and voltage-constrained interfaces are studied. The limits are then compared against corresponding limits for study year 2013 posted in the NYISO 2009 Reliability Needs Assessment (RNA) Report (reference [1]).

6.1 Description of Power Flow Model

Transfer limits were computed based on the Intermediate Year power flow model described in Section 3.1 of this report.

Table 6-1 compares the summer peak generation and demand in the Intermediate Year power flow model against the corresponding values in the year 2013 (it should be noted that the transfer limits calculated in the NYISO 2009 RNA study were based on a 2013 summer peak case). Total generation increase from 2013 to the Intermediate Year is approx. 1100 MW while the corresponding load increase is approx. 2350 MW. This is an important observation and should be put in perspective when comparing the limits calculated in this section against the 2013 limits (calculated in the NYISO 2009 RNA Study).

Table 6-2 summarizes the base case interface flows in the Intermediate Year summer peak case. Table 6-3 summarizes the phase angle regulator schedules for selected PARs.

6.2 Calculation of Emergency Thermal Transfer Limits

6.2.1 Methodology

Emergency transfer limits were established using the Linear FCITC Calculation tool in the PSS^{TM}MUST Program (version 9.0).

The emergency transfer limit is the transfer level at which:

- a branch is loaded at its normal rating (Rate A) for pre-contingency conditions, or
- a branch is loaded at its short-term emergency rating (Rate C) following a contingency

For the purposes of this analysis, transmission facilities rated 100 kV and above within NYCA (and tie-lines out of NYCA) were monitored. Engineering judgment was used to identify limiting transmission facilities. Generally, “direct tie” facilities or facilities in the vicinity of the interface being studied that became loaded at their Rate A or Rate C ratings as described above were flagged.

The following types of contingencies were simulated based on the contingency files provided by NYISO. In addition to these contingencies, other contingencies provided by National Grid associated with wind generation in the North Country were simulated.

1. Outage of branches connected between buses with a base voltage of 100 kV and above (these included outages based on "automatic" N-1 contingency specification[16] in MUST and specific pre-defined branch outages)
2. Generator outages
3. Series element contingencies
4. Bus contingencies
5. HVdc contingencies

Phase angle regulators maintain their scheduled power flow pre-contingency but are fixed at their corresponding pre-contingency angle post-contingency.

Appendix A shows the relevant subsystem description, monitored element and contingency description files used in this analysis (these files were derived based on files provided by NYISO).

Limits for interfaces within NYCA (Cross-state Interfaces) were evaluated in the predominant west-to-east/north-to-south direction based on source/sink assumptions provided by the NYISO.

For inter-area interfaces, bi-directional transfer limits were determined and the source/sink assumptions were chosen so as to stress the interface under study in the direction of the transfer. For example, when studying the NY-IESO interface, generation in NYCA was increased with a corresponding reduction in IESO generation.

6.2.2 Cross-State Interfaces

Table 6-4 summarizes the emergency thermal transfer limits obtained from the MUST analysis for the cross-state interfaces (full MUST output for the various interfaces is provided in Appendix B). For comparison purposes, corresponding limits from Table C-3 of the NYISO 2009 RNA report are also summarized (again, the RNA limits are for the year 2013). The last two columns summarize the differences between the two sets of limits both in MW and as a percentage of the 2009 RNA limits.

[16] Automatic N-1 contingencies were not simulated in the Con Edison system.
Also, some automatic N-1 contingencies in NYCA were excluded from analysis based on transmission owner input. See Appendix A.4 for a list of excluded monitored elements and contingencies.

Limits for the upstate interfaces were calculated without making any adjustments to the base case. Limits for the downstate interfaces are sensitive to phase angle regulator settings in Con Edison and LIPA and were calculated as described below:

Interface limits for the UPNY-ConEd Open, Millwood South Closed, Dunwoodie South Plan and I to J interfaces were calculated with Con Edison PARs optimized based on input from Con Edison to regulate flows on following branches as follows:

- 126298 - 126301 (Sprainbrook to Tremont) – Increase from 400 MW to 460MW
- 126298 - 126847 (Sprainbrook to Academy) – Increase from 400 MW to 460 MW
- 126374 - 126485 (Dunwoodie South to East 179th Street) – Increase from 120 MW to 200 MW

Limits for the "I to K" interface were computed by adjusting the E. Garden City PARs to regulate the flow on the Y49 cable (Sprainbrook-EGC 345) to its maximum flow limit of 637 MW. The limiting facility for this interface is the Y50 cable (Dunwoodie-Shore Road 345). The power flow case shows a normal rating of 599 MVA for this facility while the RNA limit is based on a normal rating of 653 MVA[17]. As shown in Table 6-4, the interface limit of 1238 MW is based on a normal rating of 599 MVA for Y50 where as the 1292 MW limit is based on the 653 MVA normal rating.

Limits for the "Long Island Import" interface were calculated by adjusting the PARs controlling the LIPA import to allow for maximum emergency transfer capability into LIPA as follows:

	Emergency
Jamaica – Lake Success 138 kV	85 MW
Jamaica – Valley Stream 138 kV	90 MW
Sprainbrook – EGC 138 kV	637 MW
Norwalk Harbor 138 kV – Northport	450 MW[18]

The limiting facility for this interface is the Y50 cable (Dunwoodie-Shore Road 345). See Appendix B. As shown in Table 6-4, the interface limit of 2851 MW is based on a normal rating of 599 MVA for Y50 where as the 2905 MW limit is based on the 653 MVA normal rating. The 2905 MW limit matches the LIPA Import capability provided by LIPA.

Note: In Table 6-4, the RNA limit of 2741 MW for the LIPA Import interface is based on the old 286 MVA rating for the Norwalk Harbor-Northport 138 kV cables.

[17] LIPA indicated that the 599 MVA rating for Y50 is based on a 100% loss factor while the 653 MVA rating is based on a 70% loss factor and rapid oil circulation.
[18] Note: As per LIPA, the total NNC rating in the Intermediate and Horizon years would be 450 MVA.

In general, the following observations are made from Table 6-4.

1. Emergency transfer limits for the upstate interfaces increased slightly going from study year 2013 to the Intermediate Year. For example, compare the limits for Dysinger East (6.2% increase), West Central (2.8% increase), Volney East (3.8% increase) and Central East (11.4% increase). This may be a consequence of reduced load growth in the upstate zones compared to the downstate zones going from 2013 to the Intermediate Year.

2. The limits for the UPNY-ConEd interface showed an 8.3% decrease.

3. Limits for the rest of the downstate interfaces, for example, Millwood South Closed, Dunwoodie South, I to J, I to K and LIPA import did not exhibit significant changes. These interfaces are sensitive to the Con Edison and LIPA PAR schedules which were optimized based on input from the transmission owners.

It is not possible to match the RNA limits exactly because of differences in base case modeling assumptions (load levels, generation dispatches, base case interface flows etc). Again, it should be noted that the RNA limits presented in are for the year 2013 where as the limits calculated in this study are for the Intermediate Year.

6.2.3 Inter-Area Interfaces

Table 6-5 summarizes the emergency thermal transfer limits obtained from the MUST analysis for the interfaces between NYCA and neighboring control areas (full MUST output for the various interfaces is provided in Appendix C). For comparison purposes, corresponding limits from Figure C-1 (bubble diagram) of the NYISO 2009 RNA report are also summarized. The last two columns of Table 6-5 summarize the differences between the two sets of limits both in MW and as a percentage of the 2009 RNA limits.

NYISO indicated that the limits posted in Figure C-1 of the 2009 RNA report are a compilation of transfer limits obtained from several different studies at varying system load levels and dispatch Scenarios. Further details were not readily available.

For the purposes of this study, facilities external to NYCA were not monitored (other than "direct tie" facilities). It should be noted here that there may be facilities in neighboring systems that could become limiting and thus reduce the inter-area limits. However, such facilities were not considered in this analysis mainly because the results of Table 6-5 showed reasonable agreement between the Intermediate Year limits and the RNA limits (there are a few interfaces where the limits do not match and these are discussed in subsequent paragraphs).

6.2.3.1 New York – New England Analysis

Note: In order to be consistent with the RNA study, the Cross Sound Cable was excluded from the NY-NE and NE-NY interface definitions.

New York to New England: The transfer limit is 2044 MW and the limiting facility is the Greenbush-Reynolds Road 115 kV line that becomes loaded at its Rate C rating following the loss of the New Scotland-Alps 345 kV line.

New England to New York: Transfers from New England to New York are constrained by the Long Mountain-Pleasant Valley 345 kV line. This line becomes loaded at its normal rating at a NE-NY transfer level of 1728 MW.

Figure C-1 of the 2009 RNA report shows two sets of transfer limits for the above interfaces:

NY to NE: 2036 MW (sum of transfer limits on individual tie lines) and 1525 MW (the 1525 MW limit may be a simultaneous limit; according to reference [2], this limit was extracted from an ISO-NE report entitled “New England 2008 Analyses for Interface Limits for use in Transportation Models with Simultaneous Impacts”; this report was not available). The 2044 MW limit shown in Table 6-5 compares well with the 2036 MW limit.

NE to NY: 1686 MW (sum of transfer limits on individual tie lines) and 1200 MW. (as per reference [2], the 1200 MW limit was extracted from the ISO-NE report mentioned in the preceding paragraph). The 1728 MW limit compares well with the 1686 MW limit.

6.2.3.2 New York – Ontario IESO Analysis

There are two interconnections between NYCA and IESO: i) a free flowing interconnection at Niagara (Zone A), and ii) PAR controlled interconnections between Moses (Zone D) and St. Lawrence (L33P and L44P).

The St. Lawrence interconnection is thermally constrained and is limited to 400MW for flows into or out of Zone D. The flow on the L33P and L44P interconnections at St. Lawrence is zero MW in the base case.

The transfer limits for transfers between Zone A and Ontario given in Table 6-5 are seen to be comparable to the RNA limits.

6.2.3.3 New York – PJM Analysis

There are five interconnections between NYCA and PJM:

1. PAR controlled and VFT interconnections between PJM East and NY East (Zones G and J)
2. Neptune HVdc interconnect
3. Free-flowing interconnection between PJM West and Zone A
4. Free-flowing interconnection between PJM West and Zone C
5. Free-flowing interconnection between PJM Central and Zone C

<u>Note</u>: In order to be consistent with the RNA study, the Neptune HVdc interconnection was excluded from the interface definitions between New York and PJM.

The interface limits on the NY East ↔ PJM East interface were not calculated as it is a controlled interface. Appendix D gives some notes on the transfer limits for this interface.

Limits for the free-flowing interconnections between PJM and NY are calculated as described below:

Zone A to PJM West: This interface comprises three facilities: Stolle Road – Homer City 345 kV, Falconer-Warren 115 kV, and South Ripley – Erie 230 kV. The transfer limit is calculated to be 98 MW and the limiting facility is the Falconer-Warren 115 kV line that becomes loaded at its Rate C rating following the loss of the Erie – South Ripley 230 kV line and the N. Waverly – E. Sayre 115 kV line. The transfer limit was recalculated with the Falconer-Warren 115 kV line opened [19] and found to be 494 MW which is approximately 10% below the RNA limit of 550 MW.

National Grid indicated that the Falconer-Warren 115 line would be reconductored in the future with 795 ACSR conductor and that the line will not be opened for transfers between NY and PJM. The line ratings after reconductoring are anticipated to be:

Summer Rating (Normal/4 hour/15 minute, 35 degree C, in MVA): 220/252/280

The Zone A to PJM West transfer was repeated with the Falconer-Warren 115 line rating modeled as shown above. This increased the Zone A to PJM West transfer limit to 650 MVA.

PJM West to Zone A: The transfer limit is calculated to be 492 MW and the limiting facility is the Falconer-Warren 115 kV line that becomes loaded at its Rate C rating following the loss of the Homer City – SW 345 kV line. This is approximately 10% below the RNA limit of 550 MW. Note: Opening up the Falconer-Warren 115 kV line resulted in a limit of 957 MW which is well above the RNA limit (based on input received from National Grid, the current practice of opening the line may not be acceptable in the future after reconductoring). See results in Appendix C.

Zone C to PJM West: This interface comprises of a single transmission line: Watercure-Homer City 345 kV. The transfer limit is calculated to be 22 MW and the limiting facility is the Oakdale – Goudey 115 kV line that becomes loaded at its Rate C rating following the loss of the Hillside – E. Towanda 230 kV line. The transfer limit was recalculated with the three PJM-NY 115 kV lines opened (see footnote below) and found to be 177 MW which is approximately 11% below the RNA limit of 200 MW.

PJM West to Zone C: The analysis was performed with and without the previously mentioned three PJM-NY 115 kV lines. In each case, the transfer limit was found to be 755 MW which is approximately 6% below the RNA limit of 800 MW.

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[19] In accordance with NYISO and PJM Operating Procedures, the 115kV interconnections between PJM and New York (Warren - Falconer, North Waverly - East Sayre, and Laurel Lake - Goudey) may be opened provided there are no unacceptable impacts on system reliability.

Zone C to PJM Central: This interface comprises three transmission lines: Hillside – E. Towanda 230, Goudey – Laurel Lake 115, and N. Waverly – E. Sayre 115. The transfer limit is calculated to be 397 MW and the limiting facility is the pre-contingency overload on the N. Waverly – E. Sayre 115 kV line (32% above the RNA limit of 300 MW). No further information was available on the RNA limit. Opening up the N. Waverly – E. Sayre 115 kV line 115 kV line gave a limit of 483 MW (see Appendix C) which is well above the limit posted in the RNA.

PJM Central to Zone C: The transfer limit is calculated to be 184 MW and the limiting facility is the Watercure 345/230 kV transformer that became loaded at its Rate C rating following the loss of the Oakdale – Watercure 345 kV line. This limit is approx. 8% below the RNA limit of 200 MW.

NY to PJM and PJM to NY: Transfer limits were also computed for the NY-PJM and PJM-NY interfaces and are tabulated in Table 6-5. Corresponding RNA limits were not available for these interfaces.

Note: NY to PJM transfers were studied by developing a sensitivity case (with assistance from Con Edison) with Ramapo PARs exporting 1000 MW to PJM.

Table 6-1: Comparison of Generation and Load Levels in 2013 and Intermediate Year Summer Peak Cases

ZONES	DESCRIPTION	2013 SUMMER PEAK (1)		INTERMEDIATE YEAR SUMMER PEAK	
		GEN. DISPATCH MW	DEMAND MW	GEN. DISPATCH MW	DEMAND MW
A	WEST	5036	2690	4808	2875
B	GENESEE	689	1959	738	2139
C	CENTRAL	5923	2896	6153	3090
D	NORTH	1236	856	1184	895
E	MOHAWK VAL.	642	1410	731	1486
F	CAPITAL	3466	2335	4055	2566
G	HUDSON VAL.	2918	2427	2618	2627
H	MILLWOOD	2169	669	2125	707
I	DUNWOODIE	3	1613	3	1645
J	NYC	7477	12547	7578	13085
K	LI	3927	5377	4599	6015
NYCA TOTALS		33486	34779	34592	37130

(1): From Tables C-1 and C-2 of NYISO 2009 RNA Report

Table 6-2: Summary of Base Case Interface Flows in Intermediate Year Summer Peak Case

Interface	Flow (MW)
Cross-state Interfaces	
Dysinger East	1593
West Central	171
Moses South	1374
Volney East	3598
Total East (Closed)	5749
Central East	2383
Central East + Fraser-Gilboa	2600
CE Group	4218
F to G	3713
UPNY-SENY Open	5639
UPNY-ConEd Open	5082
Millwood South Closed	7862
Dunwoodie South Plan	4858
I to J	3921
I to K (Y49/Y50)	936
LI Import (includes CSC and Neptune)	1746
Inter-area Interfaces	
NY-NE (excl. Cross Sound Cable)	81
NY-PJM (excl. Neptune HVdc)	-1498
NY-IESO	743
NY-HQ	-1200
Cross Sound Cable	-330
Neptune HVDC	-666

Sign Convention for Inter-area Interfaces:
Positive sign denotes export out of NYCA
Negative sign denotes import into NYCA

Table 6-3: PAR Schedules in Intermediate Year Summer Peak Case

Phase Angle Regulator	MW
Inghams (CD-E)	120
Sandbar PAR (PV-20)	105
St. Lawrence-Moses L33P	0
St. Lawrence-Moses L34P	0
Norwalk Harbor-Northport	100
Jamaica-Valley Stream	-122
Jamaica-Lake Success	-164
Hudson-Farragut (B3402)	333
Hudson-Farragut (C3403)	333
Linden-Goethals	334
Waldwick-Hawthorne	330
Waldwick-Fairlawn	345
Waldwick-Hillsdale	325
Ramapo PAR #1 (+ to NYCA)	500
Ramapo PAR #2 (+ to NYCA)	500
East Garden City #1 (+ to LIPA)	230
East Garden City #2 (+ to LIPA)	230
Sprainbrook-Tremont 345 kV	400
Sprainbrook-Academy 345 kV	400
Dunwoodie-E.179th Street 138kV	120

Table 6-4: Emergency Thermal Transfer Limits (Cross State Interfaces)

Interface	STARS 2018 Su Peak Case		NYISO 2009 RNA (2013 Limits)		Difference	
					MW	%
Dysinger East	3266	1a	3075	1	191	6.2%
West Central	1877	1a	1825	1	52	2.8%
Moses South	2660	7	2675	7	-15	-0.6%
Volney East	4540	2	4375	2	165	3.8%
Total East (Closed)	6696	2	6625	2	71	1.1%
Central East	3007	3	2700	3	307	11.4%
Central East + Fraser-Gilboa	3209	2	3075	2	134	4.4%
CE Group	5165	2	5150	2	15	0.3%
F to G	3485	4	3450	4	35	1.0%
UPNY-SENY Open	5124	4	5150	4	-26	-0.5%
UPNY-ConEd Open	5821	5	6350	5	-529	-8.3%
Millwood South Closed	9793	8	9850	8	-57	-0.6%
Dunwoodie South Plan	5780	6a	5725	6	55	1.0%
I to J	4460	6a	4400	6	60	1.4%
I to K (Y49/Y50) with Y49 flow set to 637 MW	1238	10a	1290	10	-52	-4.0%
I to K (Y49/Y50) with Y49 flow set to 637 MW and Y50 RateA=653 MVA	1293	10	1290	10	3	0.2%
LI Import (with Y49 flow set to 637 MW and Y50 Rate A=653 MVA)	2090	10	2090	10	0	0.0%
LI Import (with LIPA imports maximized)	2686	10a	2741	10	-55	-2.0%
LI Import (with LIPA imports maximized and Y50 RateA=653 MVA)	2741	10	2741	10	0	0.0%

Limiting Facility		Limiting Rating MVA	Contingency
1	Stolle-Meyer 230	430	Pre-disturbance
1a	Stolle-High Sheldon 230	430	Pre-disturbance
2	Coopers Corners-Frasers 345	1207	Pre-disturbance
3	New Scotland77-Leeds 345	1724	L/O New Scotland99-Leeds 345
4	Pleasant Valley-Leeds 345	1725	L/O Athens-Pleasant Valley 345
5	Middletown Tap-Coopers Corners 345	1793	L/O Rock Tavern-Coopers Corners 345
6	Dunwoodie-Mott Haven 345	795	Pre-disturbance
6a	Dunwoodie-Mott Haven 345	783	Pre-disturbance
7	Moses-Adirondack 230	440	L/O Massena-Marcy & Massena-Chateaguay
8	Roseton-Fishkill 345	1936	Pre-disturbance
9	Rainey-Mott_H 345	1196	L/O Rainey-Mott_H 345
10	Dunwoodie-Shore Rd 345	653	Pre-disturbance
10a	Dunwoodie-Shore Rd 345	599	Pre-disturbance
11	Hudson-Farragut 345 ckt 1	536	Pre-disturbance

Notes:

a. RNA limits are based on Table C-3 in Appendix C of 2009 NYISO RNA report.

b. Limits for interfaces "I to K" and LI Import (with LIPA Imports maximized) obtained from Figure C-1 of 2009 NYISO RNA Report

c. Transfer limit of 5125 MW on UPNY-SENY Open is without Jefferson-Ramapo 500 included in the interface definition. NYISO indicated that the UPNY-SENY definition in the 2009 RNA MARS analysis did not include the Jefferson-Ramapo 500 kV line.

d. Plattsburgh-Sandbar 115 kV line was removed from Central East, Central East + Fraser-Gilboa and CE Group interface definition at the request of NYISO.

Table 6-5: Emergency Thermal Transfer Limits (Inter-Area Interfaces)

Interface	STARS 2018 Su Peak Case		NYISO 2009 RNA (2013 Limits)	Difference MW	Difference %
NY-NE	2044 Note a	1	2036 =150+800+800+286	8	0.4%
NE-NY	1728 Note a	2	1686 =0+800+600+286	42	2.5%
Zone A - ON	1604	3	1550	54	3.5%
ON - Zone A	1391	4	1450	-59	-4.1%
Zone A - PJM West	98	6a	550	-452	-82.2%
Zone A - PJM West (Falconer-Warren 115 O/S)	494	9	550	-56	-10.2%
Zone A - PJM West with Falconer-Warren 115 reconductored	650	6b	N/A	N/A	N/A
PJM West - Zone A	492	6	550	-58	-10.6%
PJM West - Zone A with Falconer-Warren 115 reconductored	974	13	N/A	N/A	N/A
Zone C - PJM West	22	11	200	-179	**-89.3%**
Zone C - PJM West (3-115-O/S)	177	12	200	-23	-11.3%
PJM West - Zone C	755	5	800	-45	-5.6%
PJM West - Zone C (3-115-O/S)	755	5	800	-45	-5.6%
Zone C - PJM Central	397	8	300	97	**32.2%**
PJM Central - Zone C	184	7	200	-16	-8.2%
NY-PJM	1156	8	Note a		
NY-PJM (3-115-O/S)	1524	10	Note a		
PJM-NY	1765	6	Note a		
PJM-NY (3-115-O/S)	2352	5	Note a		
PJM-NY with Falconer-Warren 115 reconductored	2426	5	Note a		

Note: RNA limits are based on Figure C-1 in Appendix C of 2009 NYISO RNA report.

	Limiting Facility	Limiting Rating MVA	Contingency
1	Greenbush-Reynolds Road 115 kV	318	L/O Alps-New Scotland 345
2	CTNY398-Pleasant Valley 345	1195	Pre-contingency
3	Niagara - Beck (PA27) 230	528	L/O Packard-Beck (BP76) 230
3a	Niagara - Beck (PA27) 230	528	L/O Niagara - Beck (PA 302) 345
4	Packard 230/115 kV (North) transformer	141	Pre-contingency
5	Homer City-Watercure 345	755	Pre-contingency
6	Warren-Falconer 115	116	L/O Homer City - SW 345
6a	Warren-Falconer 115	116	L/O Erie-S. Ripley 230 and L/O N.Waverly-
6b	Warren-Falconer 115	280	L/O Erie-S. Ripley 230 and L/O N.Waverly-
7	Watercure 345/230 kV transformer	600	L/O Oakdale-Watercure 345
8	N. Waverly-E.Sayre 115	90	Pre-contingency
9	Erie - S. Ripley 230	199	Pre-contingency
10	Hillside - E.Towanda 230	483	Pre-contingency
11	Oakdale-Goudey 115	239	L/O Hillside-E.Towanda 230
12	Goudey-S.Owego 115	143	L/O Oakdale-Watercure 345
13	Stolle Road - Pavement Road 115	179	L/O Stolle Road - Gardenville 115

Notes:

a. PJM-NY interface limit is not posted in the 2009 RNA report.

6.3 Calculation of Emergency Voltage Transfer Limits

6.3.1 Methodology

Emergency voltage transfer limits were calculated using the PV Analysis tool of PSS/E^{TM} (version 30).

The limits were calculated by preparing a series of power flow cases with increasing MW transfers across the interfaces being studied and subjecting them to severe (voltage-wise) contingencies. The monitored buses were then reviewed for violations of post-contingency minimum voltage criteria and/or voltage collapse.

The testing followed NYISO practices and procedures discussed in Attachment E of the NYISO Transmission Expansion and Interconnection Manual [3]. MW transfers were increased until the point of voltage collapse was reached. In power flow analysis, this point is the highest transfer level for which a solution can be achieved. There is no solution beyond this transfer level because there are no more dispatchable reactive power resources available to support the transfer. Upon plotting the specific bus voltage (y-axis) against the pre-contingency MW transfer level (x-axis), the impending voltage collapse can be identified as the knee point on the PV curve. Based on the maximum sustainable pre-contingency MW transfer (i.e. the transfer level for which a solution can be achieved post contingency; with any further increases in power transfer rendering the system un-solvable due to reactive power deficiency), a reduced pre-contingency transfer level based on a 5% safety margin is determined. This reduced transfer is then compared against the pre-contingency MW transfer level which corresponds to a post-contingency minimum voltage at the monitored buses. In order to ensure that a voltage-based transfer limit is computed with a margin of safety, the lower of the two power transfers (i.e. 95% of that corresponding to voltage collapse point or that obtained by applying the relevant post-contingency low voltage limit) is chosen as the voltage-limited interface maximum transfer level.

The following assumptions were made for the analysis:

1. Phase angle regulators ("PARs"), switched shunts and LTC transformers are modeled as regulating pre-contingency and non-regulating post-contingency.

2. SVC and FACTS devices are set to near zero pre-contingency and allowed to operate full range post-contingency.

Transfer limits were evaluated in the predominant west-to-east/north-to-south direction. Monitored buses and contingencies simulated for each interface are given in Appendix E.

6.3.2 Results

Table 6-6 summarizes the emergency voltage transfer limits on the Intermediate Year summer peak case (detailed PV curves for each interface are given in Appendix E). For comparison purposes, corresponding limits from Table C-4 of the NYISO 2009 RNA report are also summarized (as before, the RNA limits are for the year 2013). The last two columns summarize the differences between the two sets of limits both in MW and as a percentage of the RNA limits. Limits for most interfaces are comparable to the 2013 RNA limits. As mentioned previously, it is not possible to match the RNA limits exactly because of differences in base case modeling assumptions (load levels, generation dispatches, base case interface flows etc.)

Limits for Central East, CE+Fraser-Gilboa and CE-Group interfaces are shown with and without the Plattsburgh-Sandbar line included in the interface definitions. NYISO indicated that the Plattsburgh-Sandbar line was excluded from the interface definitions in the 2009 RNA MARS analysis as there is a separate transmission path between Zone D and NE to represent that line.

The UPNY-SENY interface includes the Jefferson-Ramapo 500 kV line in the interface definition.

Table 6-7 shows the PV curves for the Dysinger East interface at the Rochester 345 kV bus for different contingencies. For each contingency, the post-contingency voltage at Rochester 345 kV is plotted against the pre-contingency MW flow on the interface. The most limiting contingency is the loss of Ginna generation (LOG02). Note from Table 6-7 that for this particular contingency, the nose of the curve is approx. 2636 MW. The pre-contingency transfer that corresponds to 95% of 2636 MW is 2504 MW. The post-contingency voltage at the 2504 MW transfer level is above the post-contingency low voltage limit (328 MW). Thus, the emergency voltage transfer limit is 2504 MW which is close to the 2550 MW limit reported in the NYISO 2009 RNA report.

Similarly, Table 6-8 shows the PV curves for the West Central interface at the Rochester 345 kV bus for different contingencies. As before, the most limiting contingency is the loss of Ginna generation (LOG02). The emergency voltage transfer limit is 1132 MW which is 20% below the 1425 MW limit reported in the 2009 RNA report. This was discussed with the STARS WG and was found to be legitimate.

Marcy South Interface: This interface comprises the tie-lines from Zone E to Zone G (Coopers Corners-Rock Tavern 345 kV lines). NYISO indicated that this interface is voltage-constrained. Table 6-6 shows the emergency voltage transfer limits for this interface. These limits were compared against the results from the NYISO 2006 RNA and found to be comparable.

TransÉnergie-New York Interface: The power flow between TransÉnergie and NYISO over the Chateauguay-Massena 765 kV interconnection #7040 is controlled by the HVdc facilities at Chateauguay and radial generation at Beauharnois. NYISO indicated that this interface is voltage constrained. For transfers to New York, NYISO indicated that the operating limit is set at 1500 MW based on internal NYISO conditions particularly voltage profiles in the central New York 345 kV system. Also, NYISO indicated that the interface limit for transfers to TransÉnergie is 1000 MW (winter voltage limit).

Table 6-6: Emergency Voltage Transfer Limits

Interfaces	Post-Contingency Low (A)				95% Voltage Collapse (B)			2018 Limit	2009 RNA	Diff %
	MW Flow	Limiting bus	Limit. Volt.	Con	MW Flow	Con	Tip of Curve	Min(A,B)	2013 Limits	
Dysinger East	2833	Rochester 345	328	WC12	2504	LOG02	2636	2504	2550	-1.8
West Central	1400	Rochester 345	328	WC12	1134	LOG02	1194	1134	1425	-20.4
Moses South	2025	Porter 2 230	218	CE20	1971	CE08&CE07	2075	1971	2000	-1.4
Volney East	-	-	-	-	3952	CE15	4160	3952	3750	5.4
Total East	6600[e]	New Scotland 345	328	CE08	6270	CE18	6600	6270	6425	-2.4
Central East	2925[e]	New Scotland 345	328	CE08	2740	CE18	2884	2740	2800	-2.2
Central East (Note N)	2795[e]	New Scotland 345	328	CE08	2604	CE18	2741	2604	2800	-7.0
CE+Fraser-Gilboa	3285[e]	New Scotland 345	328	CE08	3059	CE18	3220	3059	3050	0.3
CE+Fraser-Gilboa (Note N)	3160[e]	New Scotland 345	328	CE08	2916	CE18	3069	2916	3050	-4.4
CE-Group	5070[e]	New Scotland 345	328	CE08	4722	CE18	4970	4722	4525	4.3
CE-Group (Note N)	4900[e]	New Scotland 345	328	CE08	4587	CE18	4828	4587	4525	1.4
F to G	3893	Pleasant Valley 345	328	CE18	3760	CE18&LOG09	3958	3760	3800	-1.1
UPNY-SENY	7152	Pleasant Valley 345	328	CE18&CE19	6528	UC20&UC26	6872	6528	6150	6.2
UPNY-ConED	5636	Sprain Brook 345	328	UC20	5392	UC20&UC26	5676	5392	5500	-2.0
Millwood South Closed	8518	Sprain Brook 345	328	UC20	8161	UC20&UC26	8590	8161	8450	-3.4
I to J+K	5413	Sprain Brook 345	328	UC20	8161	UC20&UC26	8590	5413	5365	0.9
Marcy South	1740	Pleasant Valley 345	328	CE18	1686	CE18	1775	1686	1700	-0.8

2013 RNA limits based on Table C-3 in Appendix C of NYISO 2009 RNA report.

RNA Limits for Marcy South interface are for year 2011 and were extracted from NYISO 2006 RNA report.

Note:

CE07	L/O M SOUTH N.
CE08	L/O M SOUTH S.
CE15	STK MARCY R3108 BKR
CE18	L/O TWR 34/42 S. at Coopers Corners
CE19	L/O TWR 34/42 N. at Coopers Corners
CE20	STK EDIC R70 BRKR
UC20	L/O TWR W89/W90 at Pleasantville
UC26	L/O TWR 67/68 at Ladentown
WC12	L/O KIN-ROCH-PARM
LOG02	L/O GINNA GENERATION
LOG09	L/O RAVENSWOOD 3
-	Not Applicable
e	Extrapolated limit
(N)	Plattsburgh-Sandbar line removed in the interface definition per NYISO input

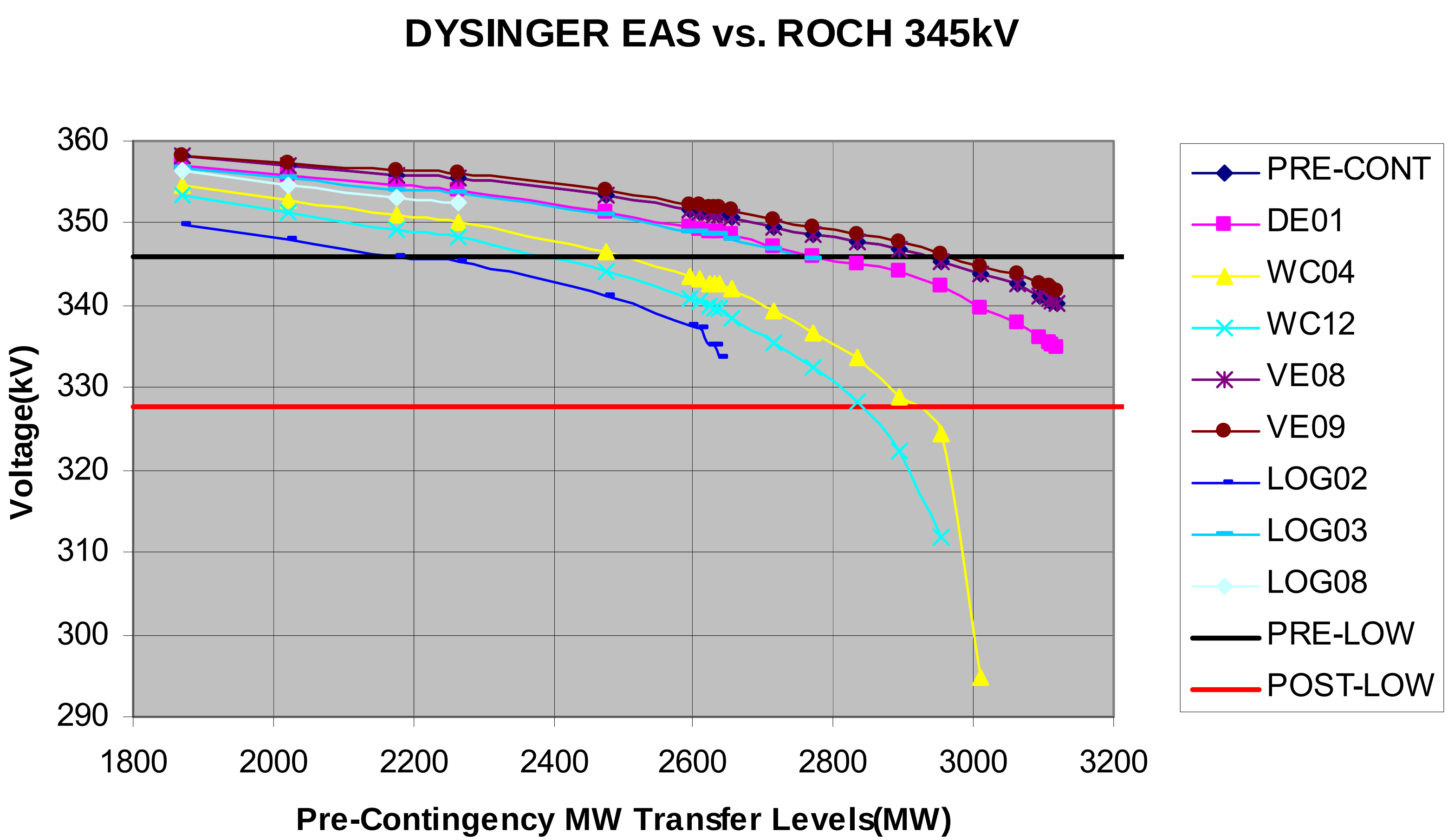

Table 6-7: PV Curves for Dysinger East Interface

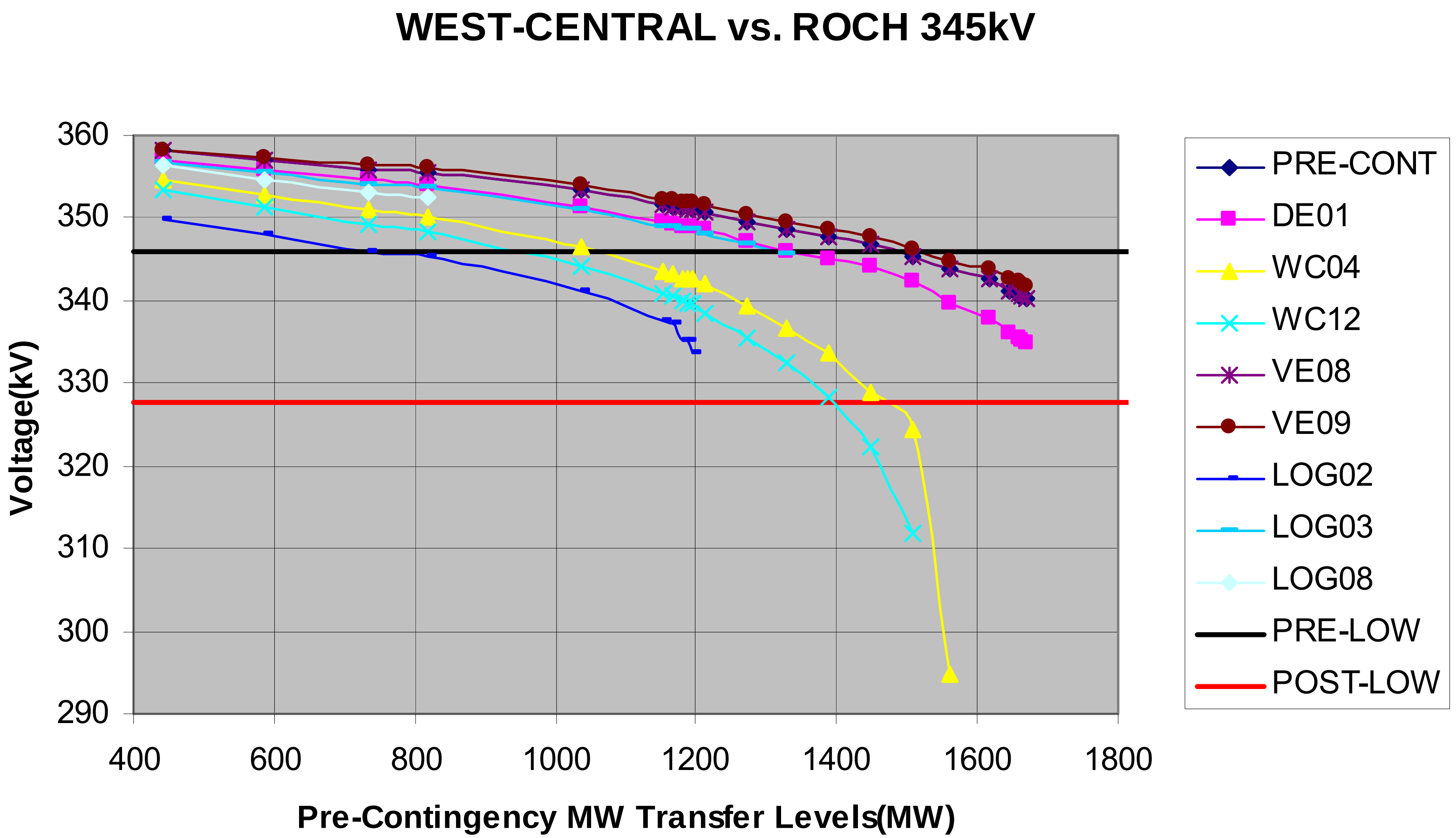

Table 6-8: PV Curves for West Central Interface

6.4 Calculation of Reverse Limits

The cross-state interface limits presented in Sections 6.2 and 6.3 were evaluated in the predominant west-to-east/north-to-south direction. In addition to these limits, the STARS Working Group recommended that “reverse limits” be calculated for two interfaces by simulating transfers in the east-to-west/south-to-north direction. The two interfaces are:

- LIPA Export
- West Central

6.4.1 LIPA Export

This is a thermally constrained interface and comprises ties out of Zone K (LIPA) to ISO New England, PJM and the rest of NYCA (Zones A through J). Transfers to ISO New England are regulated (PAR controlled flows on the Northport-Norwalk Harbor 138 kV cables and HVDC flows on the Cross Sound Cable) as are the transfers to PJM (over the Neptune HVDC cable). Thus, for the purposes of this study, exports to ISO-NE and PJM are not evaluated.

Exports from Zone K to the rest of NYCA are evaluated by first maximizing flows on the PAR controlled interface between Zones K and J and then simulating a transfer between Zones K and I until a transmission facility becomes limiting.

Maximum LIPA Export to NYCA is then determined as the summation of the flows on the interface between Zones K and J and Zones K and I. i.e.,

Maximum LIPA Export to NYCA = Zone K to J flow + Zone K to I flow

For the purposes of this analysis, a sensitivity case was developed by Long Island Power Authority by making the following adjustments to the Intermediate Year power flow case described in Section 3.1:

- Nassau generation is maximized
- Lake Success PAR to Jamaica 138 kV set to: 237 MW
- Valley Stream PAR to Jamaica 138 kV set to: 269 MW

A transfer was simulated from Zone K to Zones H and I using PSS^{TM}MUST and the Zone K to I interface limit was established as 6 MW (see Appendix F). The Maximum LIPA Export to NYCA limit was established as follows:

Interface	Emergency Thermal Transfer Limit
K to I	6 MW
K to J (controlled interface)	506 MW (237+269=506)
Maximum LIPA Export to NYCA	512 MW

The 512 MW limit was discussed with LIPA and found to be reasonable considering the load growth in the Western Nassau area (by way of comparison, the corresponding limit in the year 2008 was 538 MW per LIPA). The limit posted in Figure C-1 of the 2009 RNA report is given as 576 MW (this is shown as interface "LI Sum").

6.4.2 West Central

Emergency thermal and voltage transfer limits were calculated for the West Central interface in the reverse direction. Results are given below (details are given in Appendix F).

Emergency Thermal Transfer Limit (reverse): 2105 MW
Emergency Voltage Transfer Limit (reverse): 2200 MW

By comparison, the West Central reverse limit posted in Figure C-1 of the 2009 RNA report is 1300 MW. No additional information was available on the basis of the RNA limits. It is assumed that the differences in limits are a consequence of differences in modeling assumptions (generation dispatch, load level, flows, voltages etc.).

6.5 Consolidation of Emergency Thermal and Voltage Transfer Limits

Emergency thermal and emergency voltage transfer limits for the cross-state interfaces are consolidated and presented in Table 6-9 . The most limiting of the two transfer limits is shown in the last column.

Table 6-9: Consolidation of Emergency Thermal and Voltage Transfer Limits (Cross State Interfaces)

Interface	STARS 2018 Summer Peak Case			NYISO 2009 RNA (2013 Limits)		
	Emergency Thermal Transfer Limit (MW)	Emergency Voltage Transfer Limit (MW)	Min (Thermal, Voltage)	Emergency Thermal Transfer Limit (MW)	Emergency Voltage Transfer Limit (MW)	Min (Thermal, Voltage)
Dysinger East	3266	2504	2504 (V)	3075	2550	2550 (V)
West Central	1877	1134	1134 (V)	1825	1425	1425 (V)
Moses South	2660	1971	1971 (V)	2675	2000	2000 (V)
Volney East	4540	3952	3952 (V)	4375	3750	3750 (V)
Total East (Closed)	6696	6270	6270 (V)	6625	6425	6425 (V)
Central East	3007	2604	2604 (V)	2700	2800	2700 (T)
Central East + Fraser-Gilboa	3209	2916	2916 (V)	3075	3050	3050 (V)
CE Group	5165	4587	4587 (V)	5150	4525	4525 (V)
F to G	3485	3760	3485 (T)	3450	3800	3450 (T)
UPNY-SENY Open	5124	6528	5124 (T)	5150	6150	5150 (T)
UPNY-ConEd Open	5821	5392	5392 (V)	6350	5500	5500 (V)
Millwood South Closed	9793	8161	8161 (V)	9850	8450	8450 (V)
Dunwoodie South Plan	5780	N/A	5780 (T)	5725	N/A	5725 (T)
I to J	4460	N/A	4460 (T)	4400	N/A	4400 (T)
I to K (Y49/Y50) with Y49 flow set to 637 MW	1238	N/A	1238 (T)	1290	N/A	1290 (T)
I to K (Y49/Y50) with Y49 flow set to 637 MW and Y50 RateA=653 MVA	1293	N/A	1293 (T)	1290	N/A	1290 (T)
I to J+K	N/A	5413	5413 (V)	N/A	5365	5365 (V)
LI Import (with LIPA imports maximized)	2851	N/A	2851 (T)	2741	N/A	2741 (T)
LI Import (with LIPA imports maximized and Y50 RateA=653 MVA)	2905	N/A	2905 (T)	2741	N/A	2741 (T)
Marcy South	N/A	1686	1686 (V)	N/A	1700	1700 (V)

2013 RNA limits based on Tables C-3 and C-4 of NYISO 2009 RNA report.
RNA Limits for Marcy South interface are for year 2011 and were extracted from NYISO 2006 RNA report.
(T) = Thermally-constrained
(V) = Voltage-constrained
N/A: Not applicable

PART II – LOLE ANALYSIS

BENCHMARKING OF RESOURCE RELIABILITY MODEL

GridView [20] uses a sequential Monte Carlo simulation to capture a spectrum of uncertainties, such as, generator and transmission forced outages, load forecast errors, fuel forecast errors, wind forecast error, etc. It calculates two most important reliability indices, namely, Loss of Load Expectation (LOLE) and Expected Energy Not Served (EENS) for the system under study. The Monte Carlo process simulates the random outages of generating units and transmission equipment for every hour in a year at a given load for many repetitive trials. Hourly analysis of a system/market is performed by solving unit commitment and economic dispatch while observing transmission security constraints and aggregating the results for the entire year. By simulating the system condition (load – generation balance) for each hour, the expected behavior of generating resources under a variety of conditions can be studied.

The resource model utilizes the multi-area features to account for the impact of inter-zonal transmission constraints and the intra-zonal transmission branch thermal limit violations. In the Resource Reliability Model for GridView, the transmission system is explicitly represented; not a transportation model as used in other types of multi-area reliability assessment programs. With the detailed modeling of the transmission network, whether or not all resources are fully deliverable within each of these areas/zones is considered simultaneously with the available generation resources. Also, specific transmission interface and branch limits, utilization and required capability to achieve a target reliability index can be determined. At the beginning of this study, for the purpose of validating the Resource Reliability Model of the NYCA system, the results from the ABB's Gridview software was benchmarked against the results provided by NYISO (using GE-MARS program).

The input data for the NYCA resource model for the benchmark case was provided by NYISO in text and spreadsheet formats. The model development and testing of different conditions are discussed in Appendix-I. The calculated LOLE values from the GridView software was compared to the NYISO calculated values (from GE-MARS software) for the following conditions:

- NYCA Isolated System with Generator Multi-State Transition Rate Only- with and without EOP
- NYCA Isolated System Including Generator and Transmission Transition Rates, Derating and Load Uncertainty – again with and without EOP
- NYCA Isolated System Including Generator and Transmission Transition Rates, Derating and Load Uncertainty with Line Limit Enforced - with EOP

The results from GridView software for the NYCA system compared reasonably well with the values calculated from the other software program.

[20] ABB's commercial software for Resource and Transmission Studies

7 NYCA RESOURCE RELIABILITY MODEL UPDATE FOR FUTURE STUDY YEARS

The main purpose of this study is to determine long-term reliability and cost-effective alternatives for the NYCA transmission system considering different capacity and transmission expansion and retirement plans. The study will also identify zones of potential “bottled” generation on the bulk power system, and identify limitations of the current transmission system to meet future renewable generation development.

The reliability criterion (or adequacy metric) used by NYCA is Loss of Load Expectation (LOLE) Index. The LOLE value should be less than or equal to one day in 10 years (i.e. once in 10 years) or 0.1 day per year.

The primary tool used for LOLE calculation for this study is GridView, an ABB’s reliability analysis and market simulation software. In this computer program a full representation of the transmission network (as in the PSS/E power flow cases) is used. In addition to the detailed transmission network representation, the GridView model contains transmission constraints, including interfaces, contingency constraints, monitored lines, nomograms and emergency operating procedures (EOP).

7.1 Reliability Model Update and Assumption

The resource model from the 2009 Reliability Needs Assessment (RNA) study was converted to GridView database and benchmarked (described in Appendix I) for the Intermediate Year of this study. Then, the database was updated with the Intermediate Year PSS/E v30 powerflow case[21]. The area loads and generation capacity was updated as described in Section 2. Main data assumptions are summarized in the following subsections.

7.1.1 Load Level

The hourly (8760 hours) load profiles from the 2009 RNA study model were used. For each NYCA zone load profile; the coincident peak demand, non-coincident peak demand and annual energy values were adjusted for the Intermediate and Horizon Years to match the values in Table 2-2. Load forecast uncertainty (seven values with its probability), as in the 2009 RNA model, was also included in the GridView model. The load level for external regions (PJM, ISONE, Ontario and Quebec) is same as in the 2009 RNA study.

7.1.2 Generation Capacity

The capacity value in the 2009 RNA study (Table 2-3) for the Intermediate Year is 40,452MW. The forced and partial outage data, for the generating units, are same as in

[21] Siemens-PTI PSS/E 30 raw data file "sum18tr2-gb-bal-rev1-v30" provided by NYISO on March 11, 2009. Case title: 2009 CRPP 2018 GEN BALANCED CASE FROM 2008 FERC 2018 CASE 2018 SUMMER GB LOAD, WITH TO CRP FIRM PLANS

the 2009 RNA study database. Each unit is represented with multi-state outage model with “equivalent forced outage rate on demand” (EFORd). The Special Case Resource (SCR) and Emergency Operating Procedure (EOP) included in the Gridview model are same as in the 2009 RNA study. Renewable (wind) resource units are modeled with the given hourly MW wind generation, but without explicit forced outage rates.

The new capacity requirement is 5,015 MW for the Horizon Year (Table 2-4) for the first four Scenarios, 6,828MW for Scenario #5 and 7,740MW for Scenario #6 (Section 2.2).

7.1.3 Transmission System

A detailed representation of the NYISO, PJM, ISO-NE, Ontario and Hydro Quebec transmission system, as in the Intermediate Year Summer peak load power flow base case is used to model the transmission system in GridView. This loadflow contains a detailed representation of the NYISO and neighboring areas’ transmission and distribution network down to the 69KV voltage level. The thermal limits of all 115kV and above transmission lines are enforced. All the interface limits and interface conditional constrains are also enforced

All NYISO transmission interfaces (Dysinger East, West Central, Volney East, Moses South, Central East, Total East, UPNY SENY, UPNY CONED, Millwood South, Dunwoodie South, LIPA Import), Inter-Area transmission interfaces to and from PJM, ISO-NE and Canada are modeled with transition rates and dynamic transition rate as in 2009 RNA study also monitored.

For the Horizon Year reference case, the transmission system is the same as in Intermediate Year Reference Case (Phase-I part of the study is under the assumption of “as is transmission”).

7.1.4 External Area Modeling

For long-term planning purposes, it is important to assume that all the interconnected areas plan to achieve the target resource reliability criterion (LOLE of 1 day in ten years). This is not only customary, but also appropriate. The external areas included in the GridView model are, PJM, ISONE, Ontario and Hydro Quebec. The generating units in these external areas were represented as in the power flow case. However, the other parameters such as unit forced outage rates (FOR) for these external generating units were not available due to confidentiality issues. Hence, an equivalent representation of the external region’s capacity and unit force outage rate (FOR), as described in the Appendix-J, was adopted. Load in each of the four external areas was adjusted, with repeated and iterative run of GridView, so that an LOLE of 0.1 days/year is achieved on multi-area or interconnected operation basis (mutual assistance to the area experiencing capacity shortage, but without load shedding within the provider’s area). The calculated LOLE values achieved, at the end of this repetitive GridView, runs for the four external area models are shown in Table 7-1.

Table 7-1: External Area Modeling

Area	Load (MW)	Capacity without FOR (MW)	Capacity with FOR (MW)	Intermediate Year LOLE (Days/year)
PJM- Mid-Atlantic	64,890	61,851	4,266	0.096
New England	31,660	30,286	1,830	0.119
Ontario	24,040	22,778	1,500	0.116
Quebec	34,300	33,230	1,750	0.096

7.1.5 NYCA LOLE Calculation Assumptions

The LOLE is calculated both for the entire system and the individual zones by using the GridView model described in the earlier sections. All the pre-calculated interface limits and the branch limits as in the power flow cases are enforced. Sequential Monte-Carlo simulation is used for simulating the forced outages of generators. Sufficient number of Monte-Carlo trials was simulated to reach at least a standard error of 0.05 (convergence criteria).

A full transmission network of NYCA was included in the GridView model. For each hour (and Monte Carlo trial), a dc power flow solution is solved. In order to enforce the various Interface and branch flow limits simultaneously, Linear Programming algorithm (LP) is used to get a solved solution. This is similar to SCUC/SCED used for generation production cost calculations, but with no generation cost curves and other related assumptions. Any load shedding due to insufficient generation is to be resorted as a last option. In addition, it is necessary to distinguish utilization of the different power flow paths, such as internal, external assistance, loop flow or wheeling etc. Within the GridView model, the approach used to differentiate the various flow paths may be explained through a priority set-up, in the following order:

i) All available generation within each zone is utilized first to meet its zonal native load in terms of LP algorithm. This may be called priority zero.

   If the load and generation balance is achieved and if there are no overloads on branches or exceeding Interface limits, the LP converges and the simulation for that Monte Carlo trial is complete. Otherwise the subsequent priorities go into effect until either NYCA load-generation balance is achieved or there are no other options (priorities) left, except load shedding.

ii) When there is generation deficiency in more than one zone (within NYCA), the surplus generation in other zones is allocated to the deficient zones in proportion to corresponding deficient generation amount. This is priority one.

   If the load and generation balance is achieved and if there are no overloads on branches or exceeding Interface limits, the LP converges and the simulation for that Monte Carlo trial (and hour) is complete.

When there is a constraint, for example on Volney Interface (or any branch overload), then the generation down stream from that constraint is utilized to the maximum extent possible.

iii) If the NYCA load is still not fully met, then any resource available in the neighboring area (directly connected to NYCA) is utilized next. This is priority level two.

Assistance to a neighboring area is provided by the exporting area only when its own native load at that hour is met to the maximum extent possible. This applies to any assistance NYCA may provide to its neighbors as well.

iv) Indirect (or Wheeling) assistance is priority three.

Some examples are; Ontario to NYCA through PJM, Zone G to Zone J through PJM or Zone G to Zone K through NE. Because of the various interface limits encountered in these paths, the chances of these loops flows or wheeling occurring is the lowest; but will occur before load shedding.

7.1.6 NYCA LOLE of Intermediate Year Reference Case

With all the updates described above, the Intermediate Year reference case was simulated; LOLE was calculated and shown in Table 7-2 below.

Table 7-2: LOLE of Intermediate Year Reference Case

Zone	LOLE (days/year)
A	-
B	0.07
C	-
D	-
E	0.17
F	-
G	0.14
H	0.00
I	0.17
J	0.19
K	0.15
NYCA	0.19

The Intermediate Year reference case result (0.19day/year) is slightly less than the LOLE of 0.22 day/year in Table 4-8 of RNA 2009 report. The difference may be directly attributed to higher NYCA peak load in the RNA 2009 case (37,784 MW vs. 37,130 MW in the GridView Intermediate case).

7.2 New Generation for Six Scenarios for Horizon Year LOLE Calculation

The new capacity requirement (Table 7-3) is 5,015 MW for the Horizon Year for the first four Scenarios, 7,065MW for Scenario #5 and 7,740MW for Scenario #6.

The new generation units assumed for the first four Scenarios are shown in Table 7-4. Generic units of 250MW (6% FOR) are assumed for the new generation, unless only smaller amounts are indicated. For the next two Scenarios #5 and #6, the new generation units assumed are shown in Table 7-5.

Table 7-3 New Capacity Requirement Summary for Different Scenarios for the Horizon Year.

	PEAK LOAD (MW)	GENERATION ADDITION (MW) SCENARIO-1	SCENARIO-2	SCENARIO-3	SCENARIO-4	SCENARIO-5		SCENARIO-6	
		Thermal	Thermal	Thermal	Thermal	Renew	Thermal	Renew	Thermal
ZONE-A	3,123	-	500	500	250	-	-	332	500
ZONE-B	2,365	-	500	250	-	-	-	251	500
ZONE-C	3,323	-	500	500	250	-	-	353	500
ZONE-D	971	-	250	-	-	-	-	103	106
ZONE-E	1,600	-	250	250	-	-	-	170	250
ZONE-F	2,868	-	500	250	-	-	-	305	500
ZONE-G	2,948	-	-	250	-	-	-	-	-
ZONE-H	782	250	-	-	-	-	250	-	-
ZONE-I	1,753	250	-	250	-	-	250	-	-
ZONE-J	14,326	2,500	-	1,500	500	1,400	2,210	-	-
ZONE-K	6,757	1,250	-	750	250	700	1,000	-	-
ZONES-TOTAL	40,816	4,250	2,500	4,500	1,250	2,100	3,710	1,514	2,356
ISONE		500	-	170	-	240	597	-	-
PJM		265	1,255	170	1,255	129	289	757	1,178
HQ		-	1,260	175	2,510	-	-	757	1,178
IMPORTS-TOTAL		765	2,515	515	3,765	369	886	1,514	2,356
TOTAL		5,015	5,015	5,015	5,015	2,469	4,596	3,028	4,712
						TOTAL	7,065	**TOTAL**	7,740

Table 7-4: New Generation Capacity for Scenarios 1 to 4

	INTERNAL					**EXTERNAL - FIRM PURCHASE**				
	85% OF REQUIREMENT (MW)		**4,263**		4,263	**15% OF REQUIETREMENT (MW**			**752**	752
		LOAD	**NEW GEN**	Units	MW					
SCENARIO-1	ZONE-H	782	**141**	1	250	10%	ISONE	ZONE-K	**500**	500
(85%DOWN	ZONE-I	1,753	**316**	1	250	5%	PJM	ZONE-J	**265**	265
STATE, 15%	ZONE-J	14,326	**2,586**	10	2,500					
EXTERNAL)	ZONE-K	6,757	**1,220**	5	1,250					
	ZONES-TOTAL	23,618	4,263	17	4,250					**765**
	TOTAL NEW CAPACITY		**4,250**					**TOTAL**	**765**	
	50% OF REQRMNT		2,508		2,508	**50% OF REQRMNT**			2,507	2,507
		LOAD	**NEW GEN**	Units	MW					
	ZONE-A	3,123	**550**	2	500	25%	PJM	ZONES-A&C	**1,255**	1,255
SCENARIO-2	ZONE-B	2,365	**416**	2	500	25%	HQ	ZONE-D	**1,260**	1,260
(50% UPSTATE,	ZONE-C	3,323	**585**	2	500					
50% EXTERNAL)	ZONE-D	971	**171**	1	250					
	ZONE-E	1,600	**282**	1	250					
	ZONE-F	2,868	**505**	2	500					
	ZONES-TOTAL	14,250	2,509	10	2,500					2,515
	TOTAL NEW CAPACITY		**2,500**					TOTAL	2,515	
	90% OF REQRMNT		4,514		4,514	**10% OF REQRMNT**			501	501
		LOAD	**NEW GEN**	Units	MW					
	ZONE-A	3,123	**345**	2	500	3.3%	ISONE	ZONES-F&G	**170**	170
	ZONE-B	2,365	**262**	1	250	3.3%	PJM	ZONE-J	**170**	170
	ZONE-C	3,323	**368**	2	500	3.3%	HQ	ZONE-D	**175**	175
SCENARIO-3	ZONE-D	971	**107**	0	-					
(90% ALL	ZONE-E	1,600	**177**	1	250					
ZONES,	ZONE-F	2,868	**317**	1	250					
10% EXTERNAL	ZONE-G	2,948	**326**	1	250					
LOW IMPORT)	ZONE-H	782	**86**	0	-					
	ZONE-I	1,753	**194**	1	250					
	ZONE-J	14,326	**1,584**	6	1,500					
	ZONE-K	6,757	**747**	3	750					
	ZONES-TOTAL	40,816	4,513	18	4,500					515
	TOTAL NEW CAPACITY		**4,500**					TOTAL	515	
	25% OF REQRMNT		1,254		1,254	**75% OF REQRMNT**			3,761	
		LOAD	**NEW GEN**	Units	MW					
	ZONE-A	3,123	**96**	1	250	25%	PJM	ZONE-I/J/K	**1,255**	1,255
	ZONE-B	2,365	**73**	0	-	50%	HQ	ZONE-D	**2,510**	2,510
	ZONE-C	3,323	**102**	1	250					
SCENARIO-4	ZONE-D	971	**30**	0	-					
(25% ALL	ZONE-E	1,600	**49**	0	-					
ZONES,	ZONE-F	2,868	**88**	0	-					
75% EXTERNAL	ZONE-G	2,948	**91**	0	-					
HIGH IMPORTS)	ZONE-H	782	**24**	0	-					
	ZONE-I	1,753	**54**	0	-					
	ZONE-J	14,326	**440**	2	500					
	ZONE-K	6,757	**208**	1	250					
	ZONES-TOTAL	40,816	1,255	5	1,250					3765
	TOTAL NEW CAPACITY		**1,250**					TOTAL	3,765	

ABB

Table 7-5: New Generation Capacity for Scenarios 5 & 6

	INTERNAL						**EXTERNAL - FIRM PURCHASE**					
SCENARIO-5 (85%DOWN STATE, 15% EXTERNAL)	**85% OF REQUIREMENT (MW)**		**3,104**	**4,005**		3,104	**15% OF REQUIETREMENT (MW**			1,255	**707**	**548**
					CONVENTIONAL							
		LOAD	**NEW GEN**	**RENEW**	Units	MW					**RENEW**	**CNVNTNL**
	ZONE-H	782	**123**	-	1	250	10%	ISONE	ZONE-K	**837**	240	597
	ZONE-I	1,753	**276**	-	1	250	5%	PJM	ZONE-J	**418**	129	289
	ZONE-J	14,326	**2,253**	**1,400**	8	2,210						
	ZONE-K	6,757	**1,063**	**700**	4	1,000						
	ZONES-TOTAL	23,618	3,715	2,100	14	3,710					369	886
	TOTAL NEW CAPACITY		**5,810**						TOTAL	**1,255**		
SCENARIO-6 (50% UPSTATE, 50% EXTERNAL) - 100% GROWTH ENERGY FROM RENEWABLES	**50% OF REQRMNT**		3,870	1,514		2,356	**50% OF REQRMNT**			3,870	1,514	2,356
					CONVENTIONAL							
		LOAD	**NEW GEN**	**RENEW**	Units	MW					**RENEW**	**CNVNTNL**
	ZONE-A	3,123	**848**	**332**	2	500	25%	PJM	ZONES-A&C	**1,935**	**757**	**1,178**
	ZONE-B	2,365	**642**	**251**	2	500	25%	HQ	ZONE-D	**1,935**	**757**	**1,178**
	ZONE-C	3,323	**902**	**353**	2	500						
	ZONE-D	971	**264**	**103**	1	106						
	ZONE-E	1,600	**435**	**170**	1	250						
	ZONE-F	2,868	**779**	**305**	2	500						
	ZONES-TOTAL	14,250	3,870	1,514	10	2,356					1,514	2,356
	TOTAL NEW CAPACITY		**3,870**						TOTAL	3,870		

8 NYCA SYSTEM ADEQUACY DETERMINATION FOR THE INTERMEDIATE YEAR

8.1 NYCA LOLE for the Intermediate Year

The load and generation by individual zones are shown in Table 8-1 (same as Table 2-3). The Intermediate Year reference database (Section 7) was updated with new transfer limits (calculated in Section 6). The interfaces with new transfer limits are shown in Table 8-2 and in Figure 8-1 (In NYCA bubble diagram the new transfer limits are shown in purple color. Other values are from 2009 RNA report).

The calculated LOLE values for each zone and the entire NYCA system is shown in Table 8-3. The NYCA LOLE of 0.2 day/year in the above table is almost same as the benchmarking result of 0.19.

Regarding the differences in the zonal LOLE results, in the GridView simulations the surplus zonal capacity is prorated among generation deficient (both with and without generator unit outages) zones. Our understanding is that in the RNA Studies, a preset rule is used for this sharing. This is one of the main factors that contributes to differences in zonal LOLE values shown in the Table 8-3 with the results in the RNA 2009 report.

Table 8-1: Load and Generation for Intermediate Year

Zone	Capacity at Peak (MW)	SCR/EOP (MW)	Total Capacity (MW)	Peak Load (MW)
A	4,664	503	5,167	2,960
B	733	210	942	2,210
C	6,774	221	6,995	3,157
D	1,685	144	1,829	973
E	955	104	1,059	1,544
F	3,804	204	4,008	2,627
G	2,934	130	3,065	2,655
H	2,116	10	2,125	738
I	1	100	102	1,664
J	9,206	1,098	10,304	13,086
K	6,598	417	7,015	6,095
NYCA	39,469	3,141	42,610	37,130

Table 8-2: Interfaces with New Transfer Limits

Interface	New Limits (MW)	Old Limits (MW)	Change (MW)
Dysinger East	2504	2550	-46
West Central	1134	1770	-636
Moses South	1971	2600	-629
Volney East	3952	4375	-423
Total East (Closed)	6270	6425	-155
CE Group	4587	4500	87
F to G	3485	3450	35
UPNY-SENY Open	5124	5150	-26
UPNY-ConEd Open	5392	5000	392
Millwood South Closed	8161	8450	-289
I to J	4460	4400	60
I to K (Y49/Y50)	1293	1290	3
I to J+K	5413	5440	-27
Marcy South	1686	1700	-14
Zone A - Ontario	1604	1550	54
Ontario - Zone A	1391	1450	-59
Zone A - PJM West	650	550	100
PJM West - Zone A	974	550	424
Zone C - PJM West (3-115-O/S)	177	200	-23
PJM West - Zone C (3-115-O/S)	755	800	-45
Zone C - PJM Central	397	300	97
PJM Central - Zone C	184	200	-16
SWCT (NE) to K	450	286	164

Table 8-3: LOLE of Intermediate Year Reference Case

Zones	**LOLE (days/year)**
A	-
B	0.09
C	-
D	-
E	0.18
F	0.00
G	0.15
H	0.00
I	0.19
J	0.20
K	0.15
NYCA	0.20

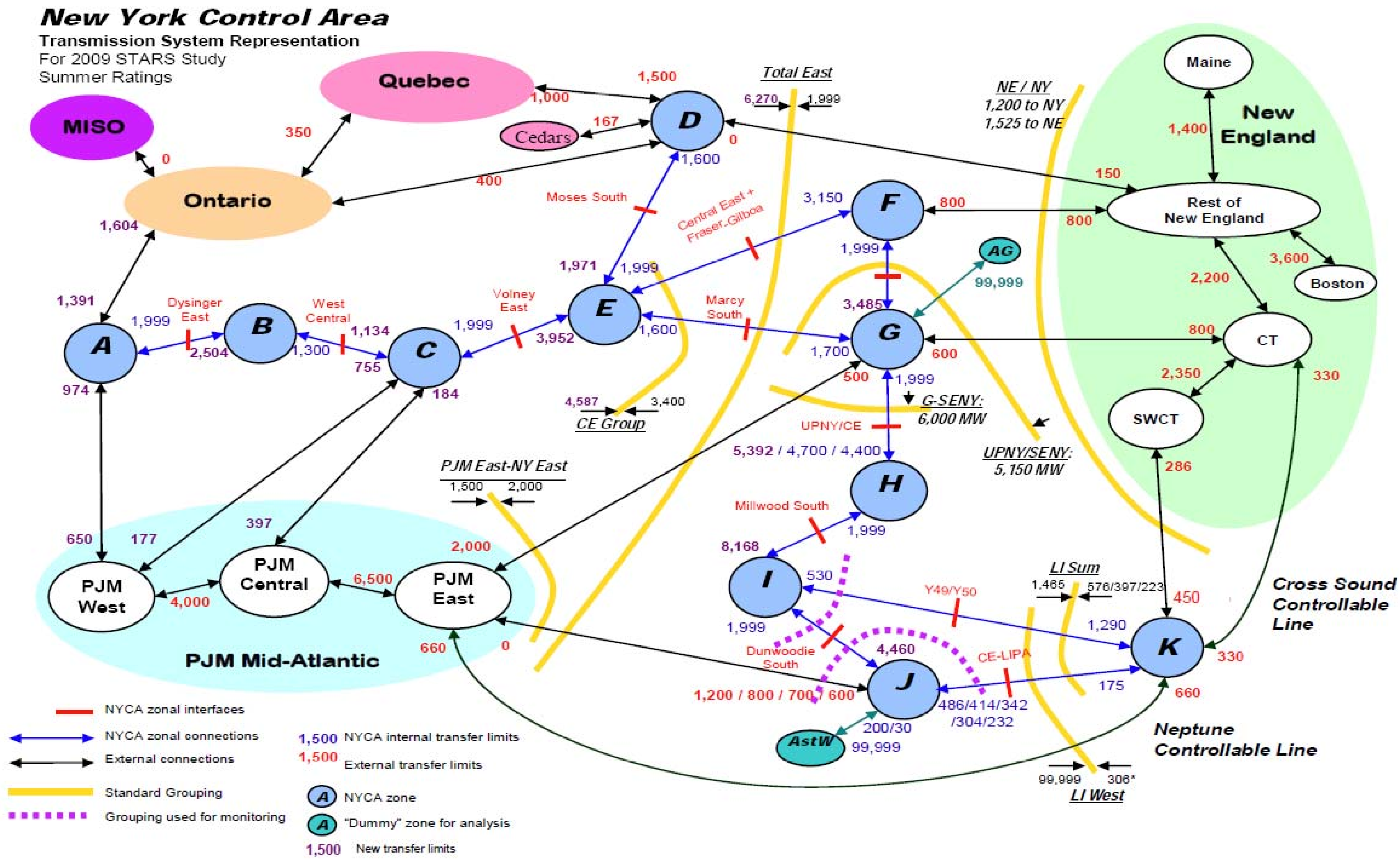

Figure 8-1: NYCA Transmission System Bubble Diagram for Intermediate Year
(Newly calculated transfer limits are in purple color)

8.2 NYCA Interface Flows

The existing transmission is constrained due to the flow limits (thermal and/or voltage). Statistics for various transmission constraints, as encountered during the MonteCarlo trials, were calculated. The **number of days *of hitting a limit at the daily peak hour*** during the one year period is calculated; Considering only the daily peak hour is consistent with the LOLE definition. If we consider all the hours in the year, two factors obscure the effect of interface limit on the LOLE;

i) since the instances of interface limit hits during the non-peak hours are counted, the importance of the particular interface may be exaggerated

ii) averaging over 8760 hours will dilute the importance of the interfaces which are limiting only during the daily peak hour.

The number of days, of hitting a limit at the daily peak hour (for the Intermediate year and the various interfaces), are shown in Table 8-4.

Table 8-4: NYCA Interface Limiting for Intermediate Year (at daily peak hour)

Interface		Number of Days hitting limit per Year	probability of hitting limit
Name	Limit (MW)		
Volney East	3952	221.1	61%
West Central	1134	95.3	26%
I to J	4460	79.6	22%
I to K (Y49/Y50)	1293	62.4	17%
F to G	3485	14.3	4%
UPNY-SENY	5124	0.6	0%
Central East + Fraser-Gilboa	2916	0.4	0%
Marcy South	1686	0.1	0%
CE Group	4587	0.0	0%
NE-K	450	0.0	0%
PJME-J	1200	0.0	0%
HQ-D	1500	0.0	0%
OH-D	400	0.0	0%

The probability of Volney East Interface becoming limited is the highest among all interfaces. The average hourly flow pattern (chronological hours) for this interface is shown in Figure 8-2. This is a capacity based flow, not an economic generation dispatch based flow. The flows shown in these figures include additional flows triggered by random generation outages. The actual utilization (probable from the capacity point of view) or ***"Usefulness of Interface for Reliability"*** of the interface can be better observed from a duration type of curve as shown in Figure 8-3. The calculated value of utilization of Volney East interface is 97.4%. The top horizontal line part of the duration curves show the Interface flow limit enforced by GridView during the LOLE calculation.

Similarly the average hourly power flows of other limiting interfaces in Table 8-4 are shown in chronological and duration curve formats in Figures 8-4 to 8-21.

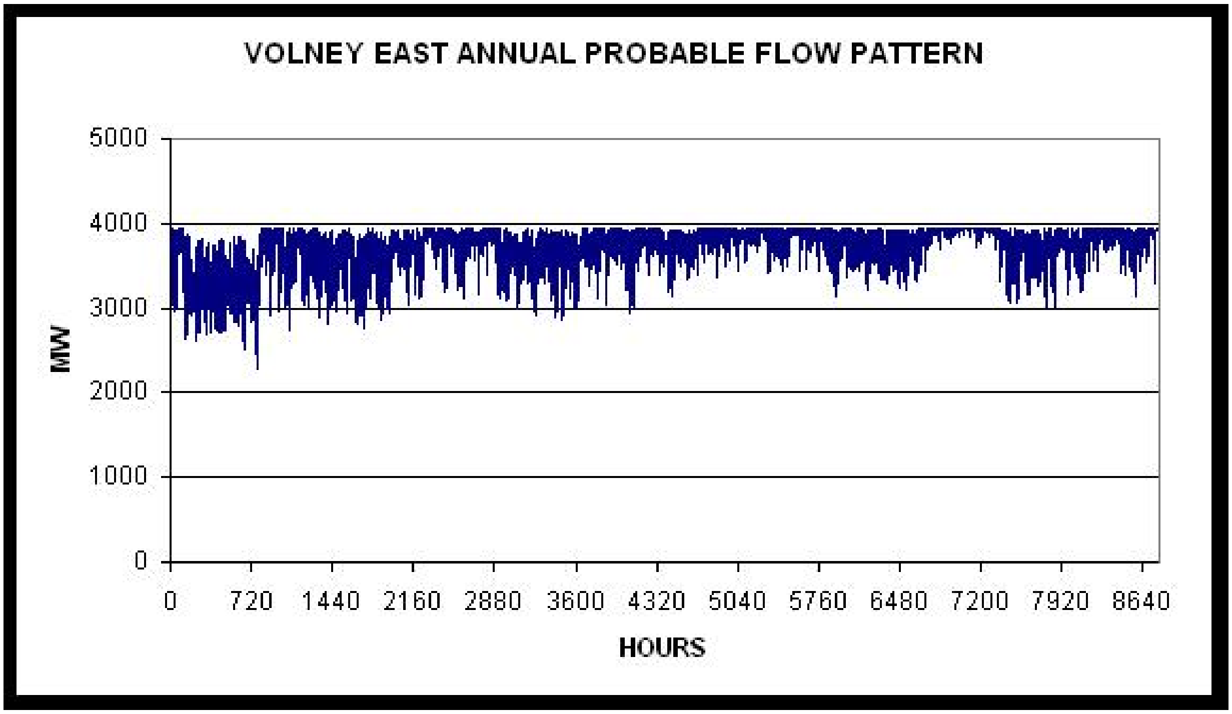

Figure 8-2

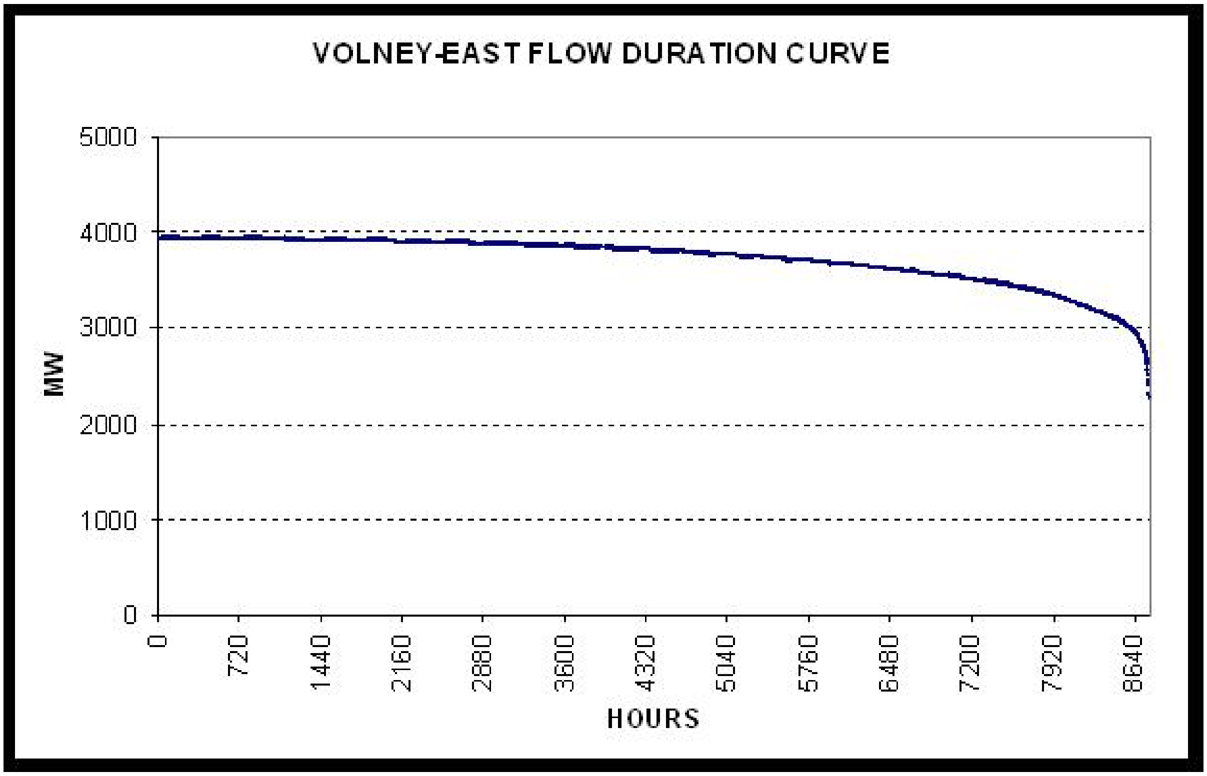

Figure 8-3

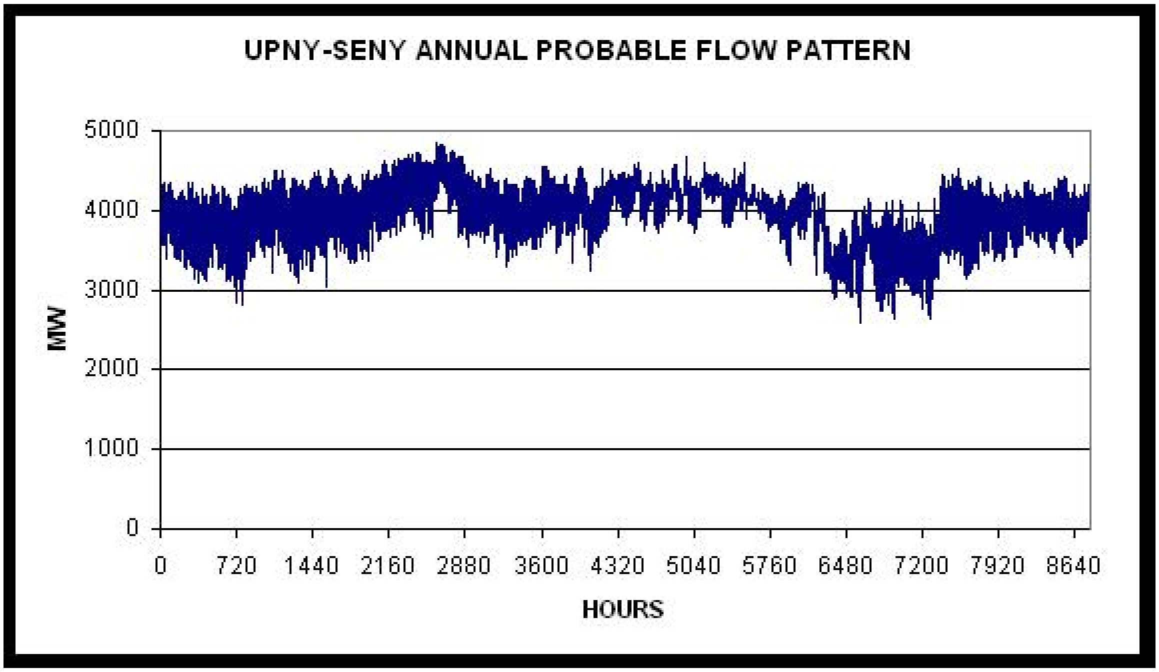

Figure 8-4

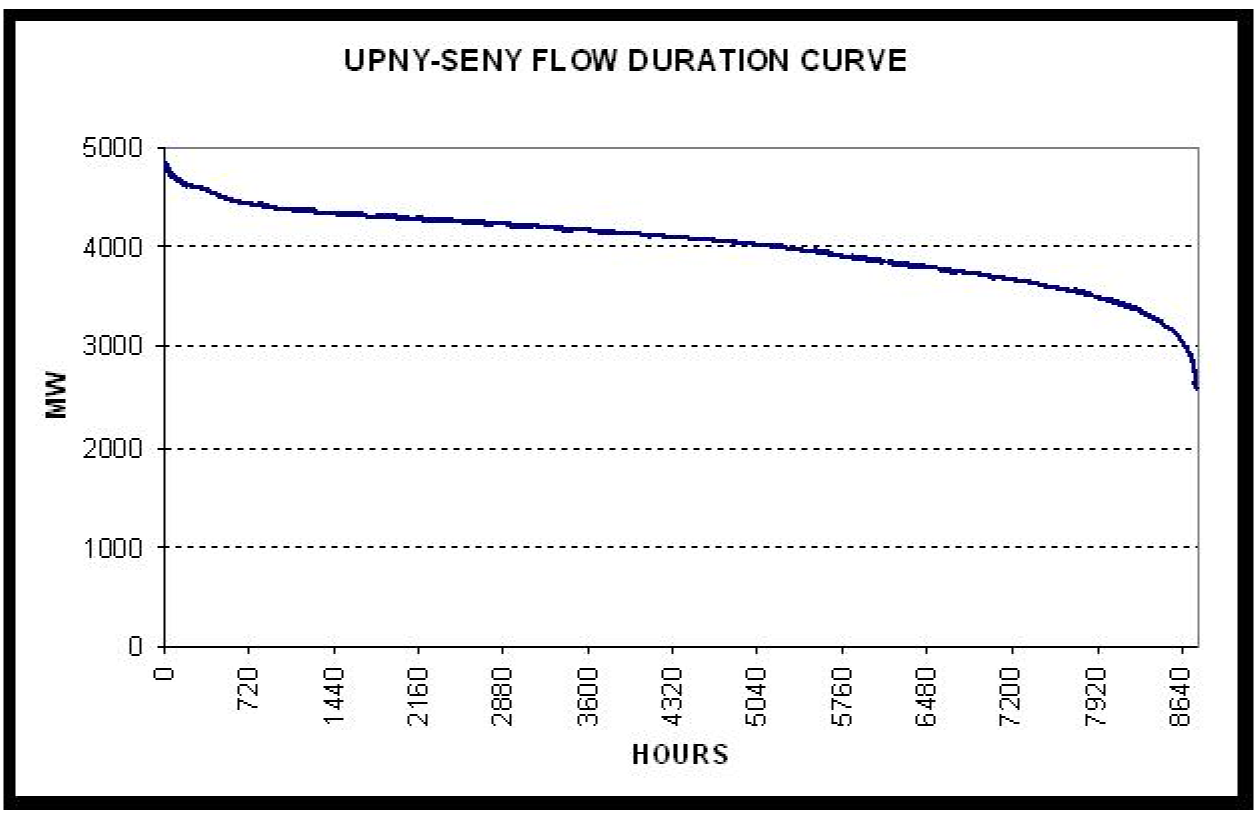

Figure 8-5

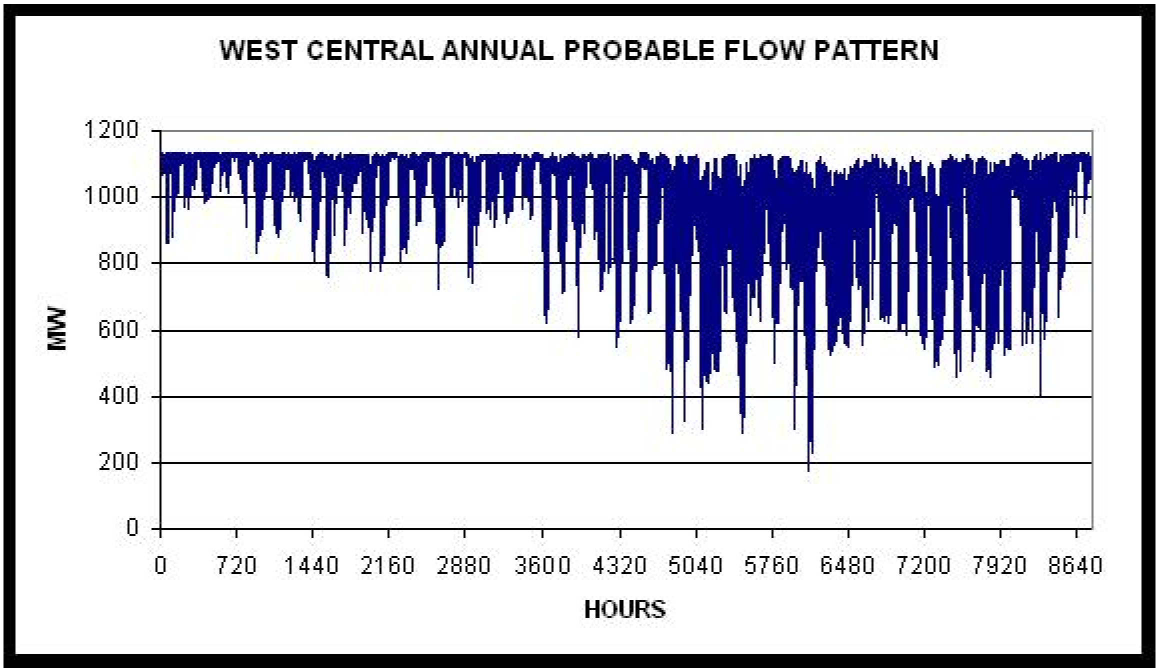

Figure 8-6

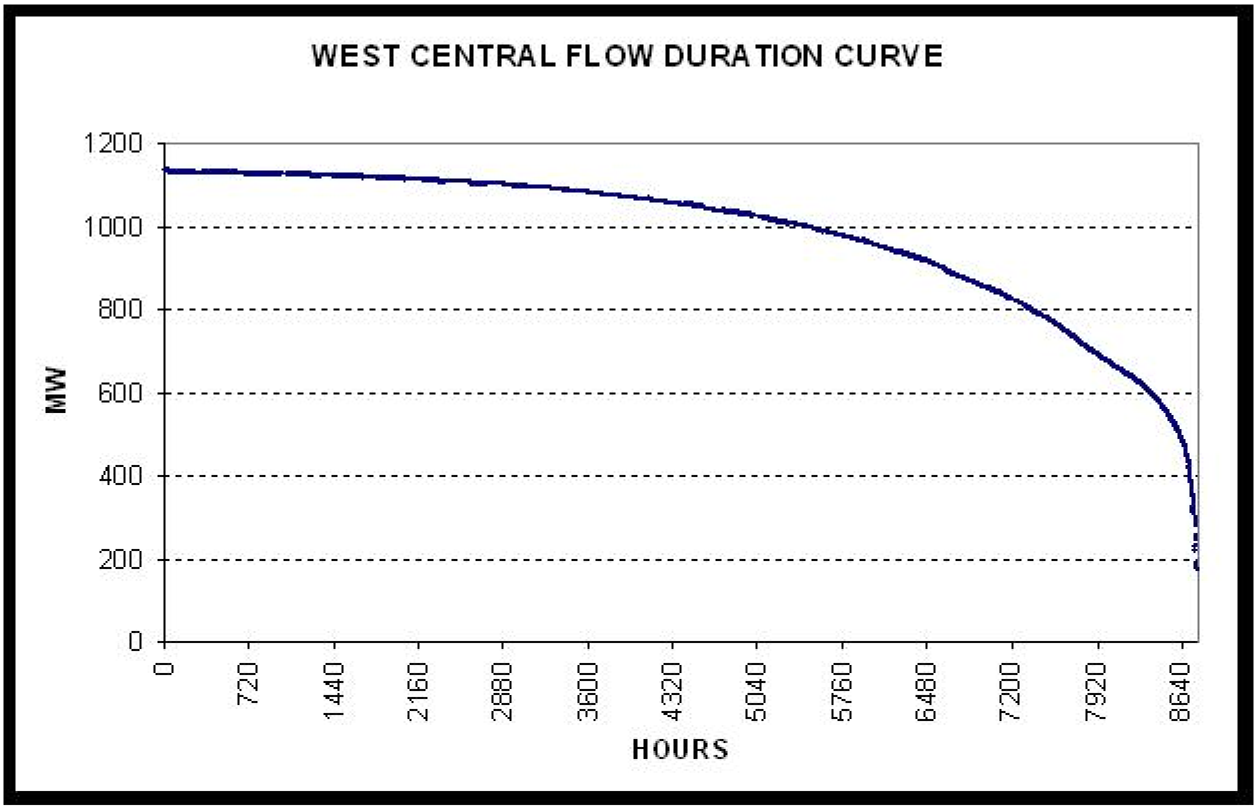

Figure 8-7

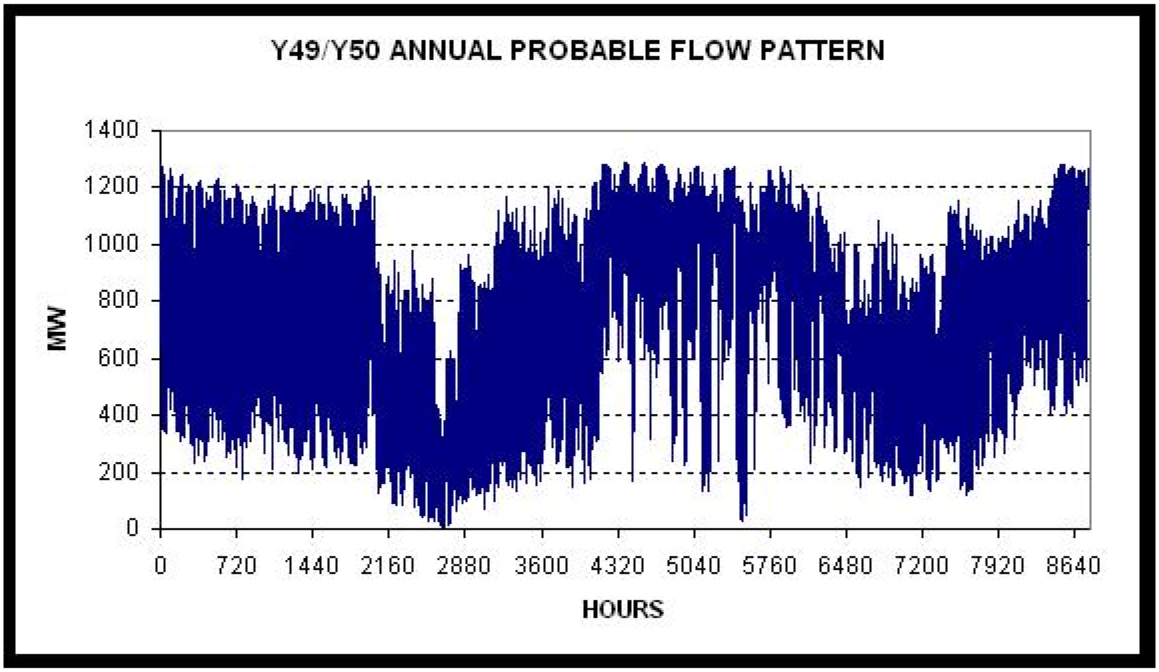

Figure 8-8

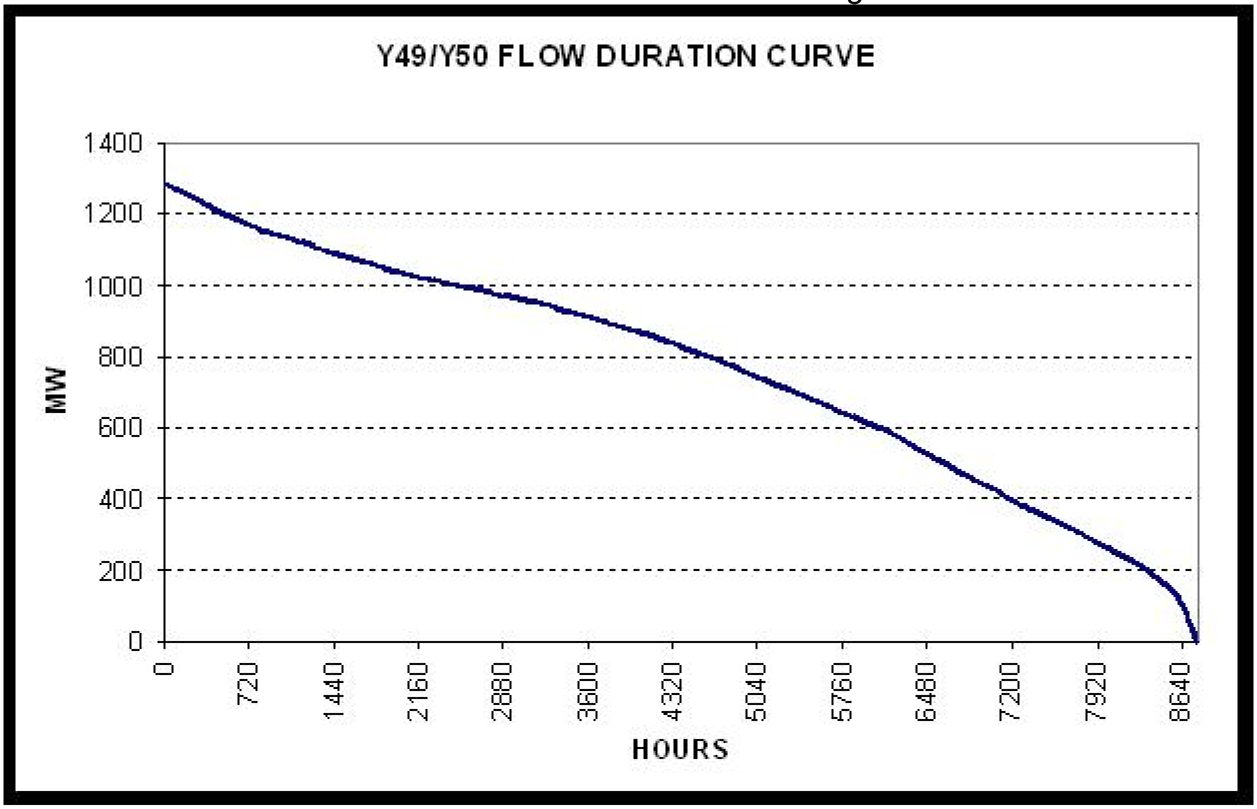

Figure 8-9

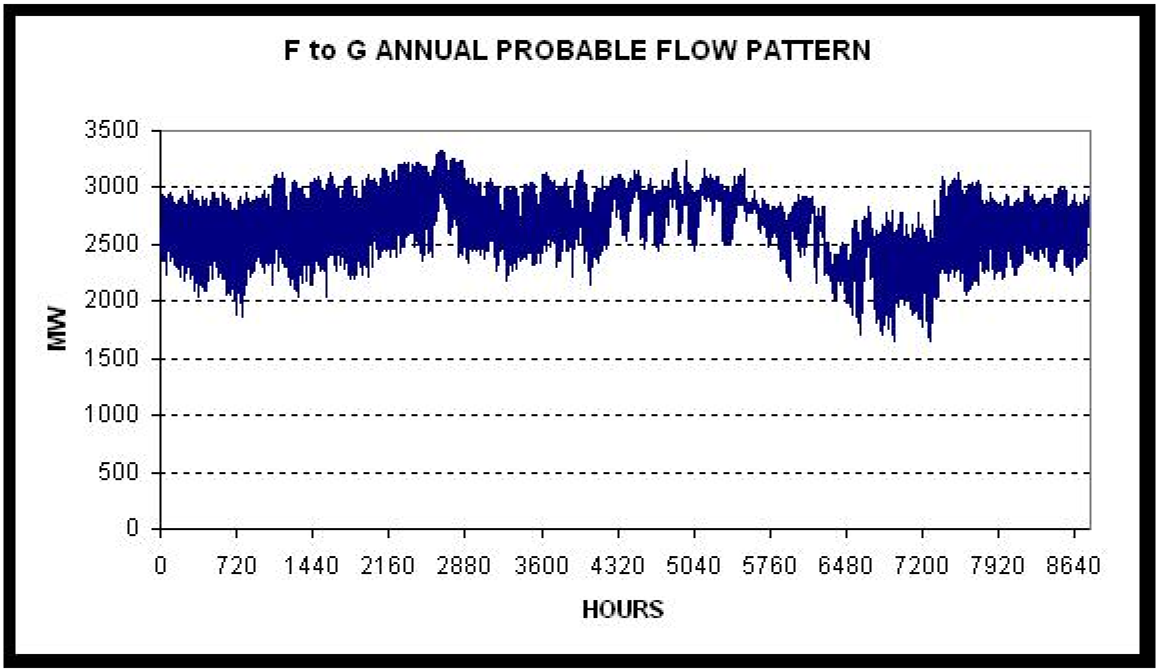

Figure 8-10

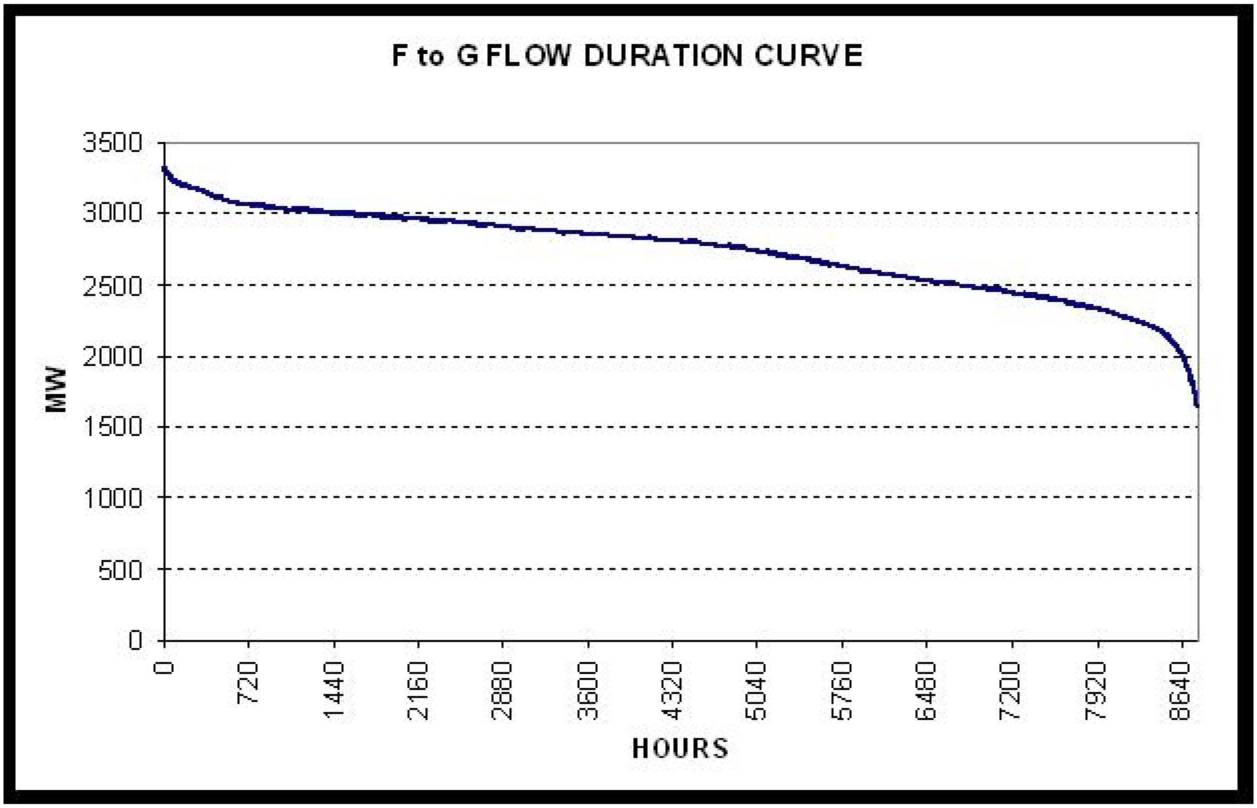

Figure 8-11

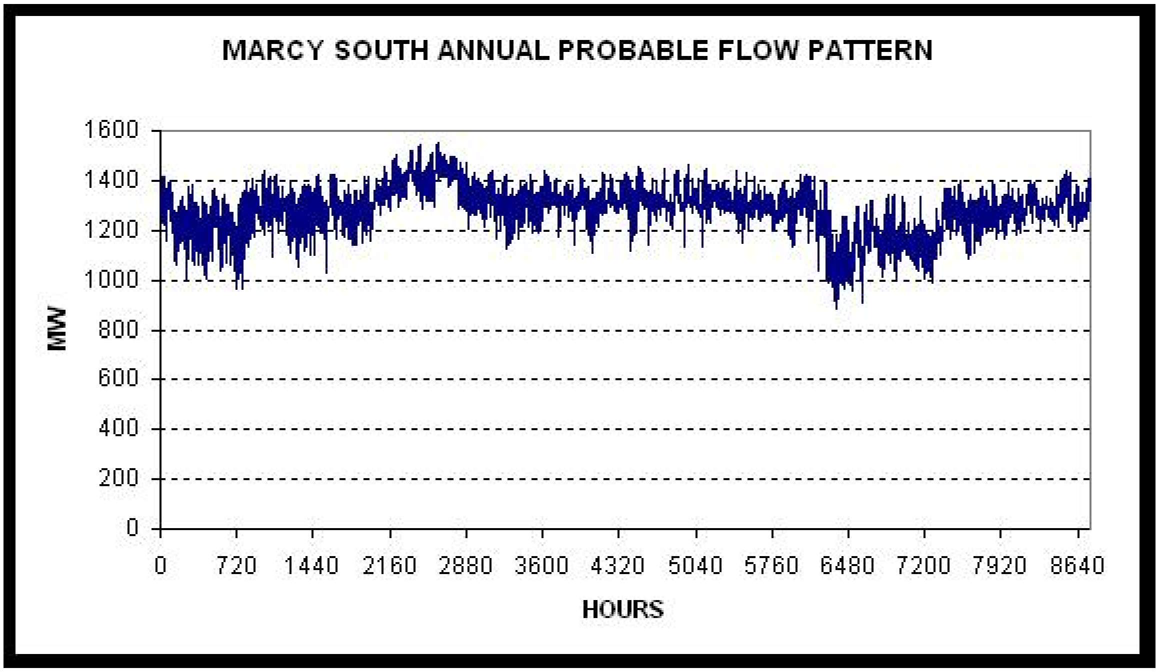

Figure 8-12

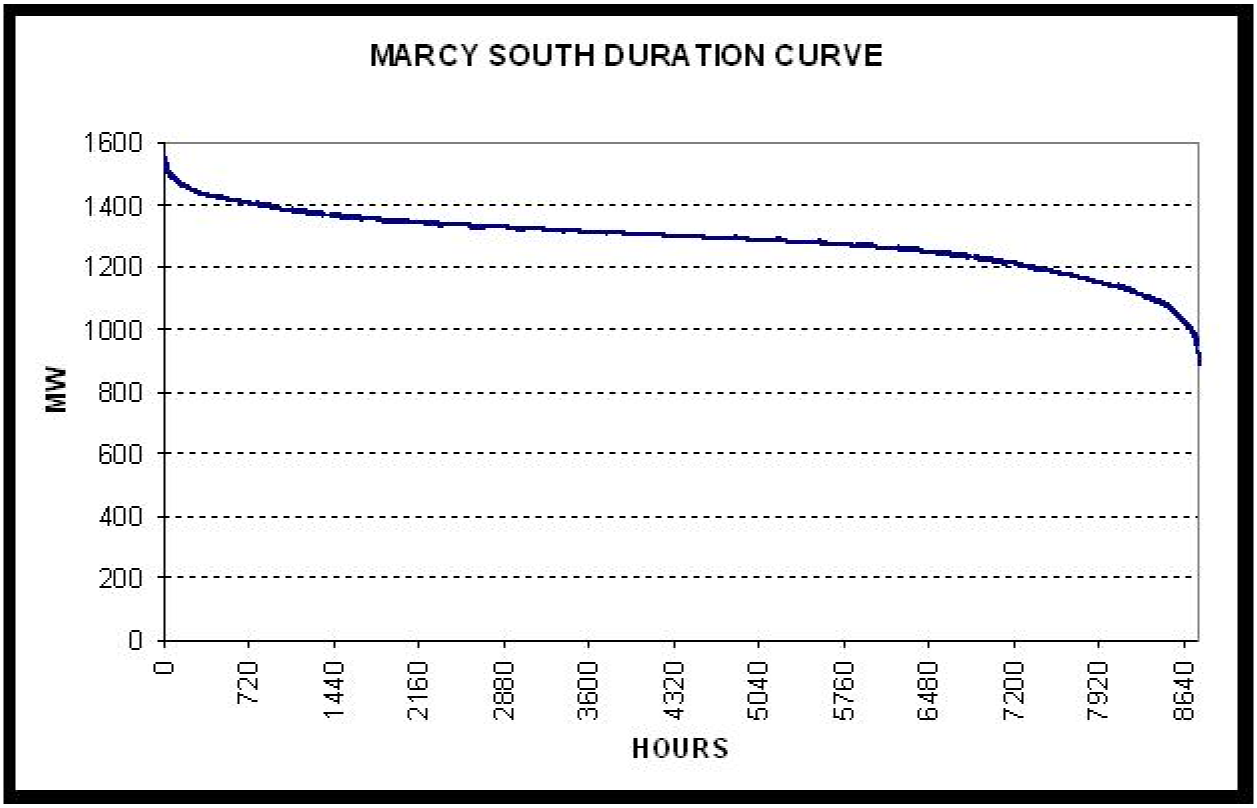

Figure 8-13

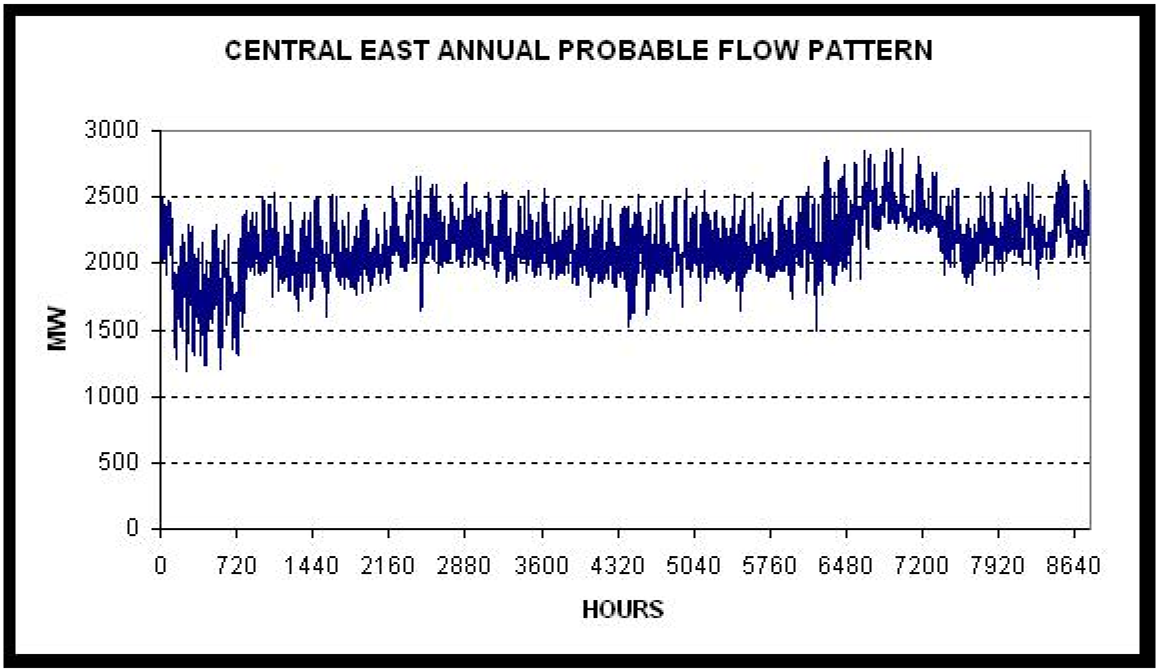

Figure 8-14

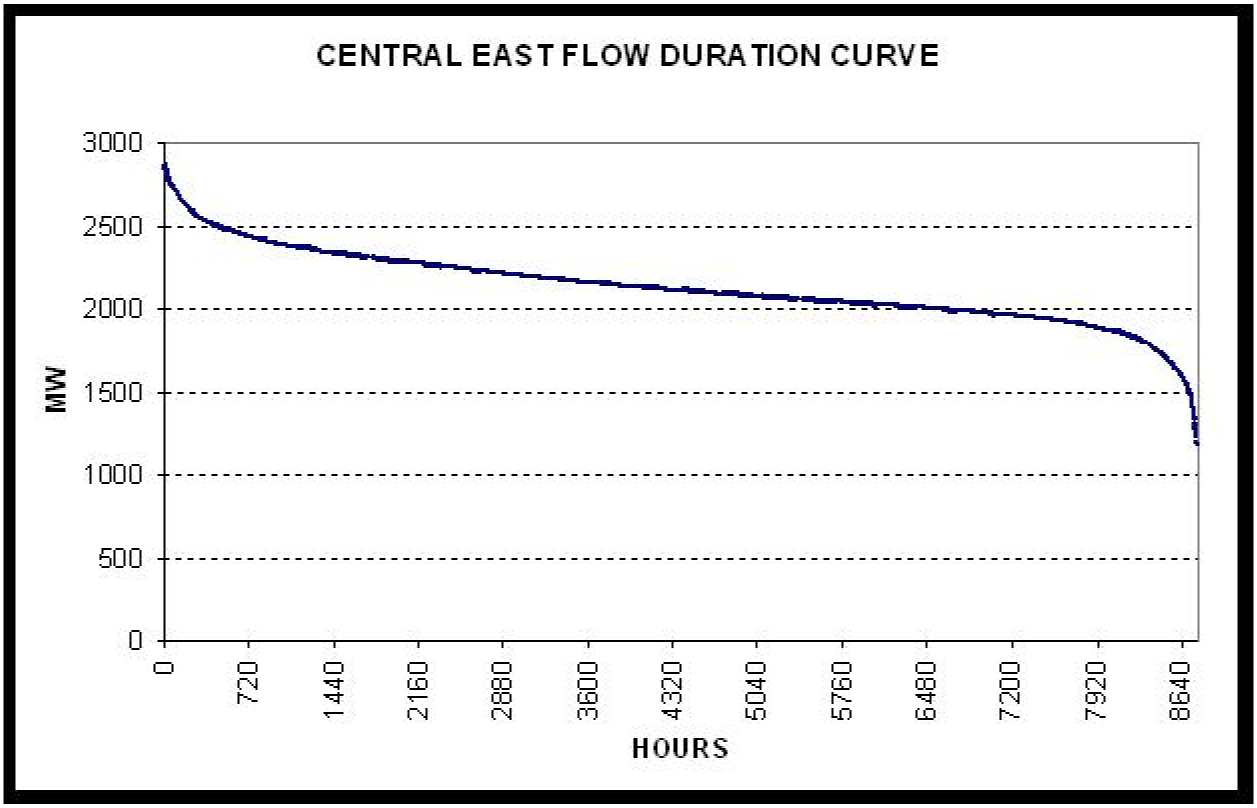

Figure 8-15

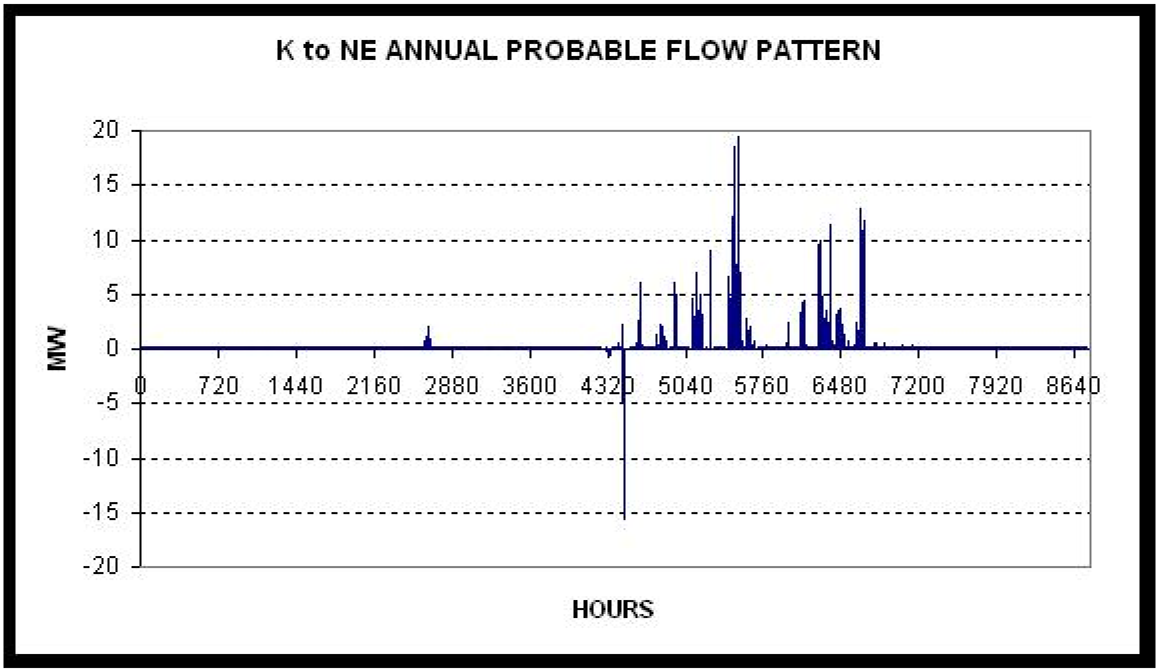

Figure 8-16

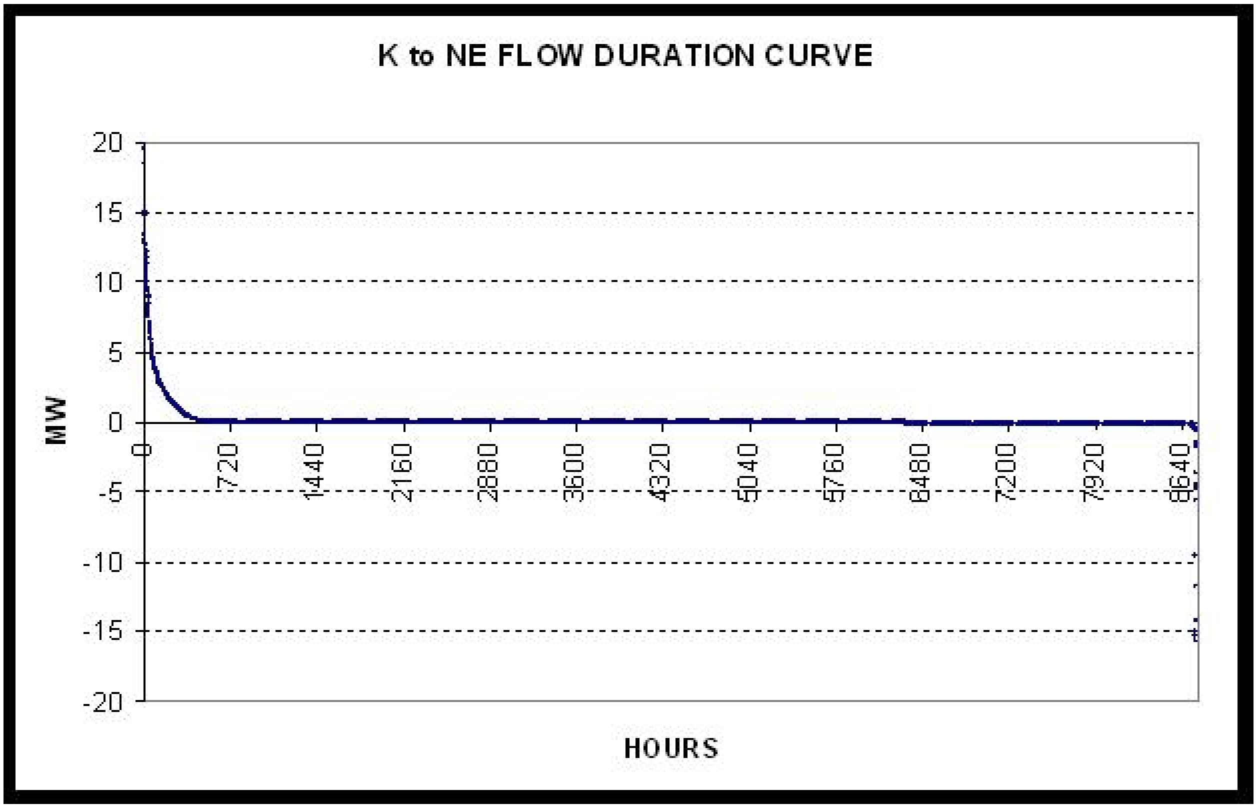

Figure 8-17

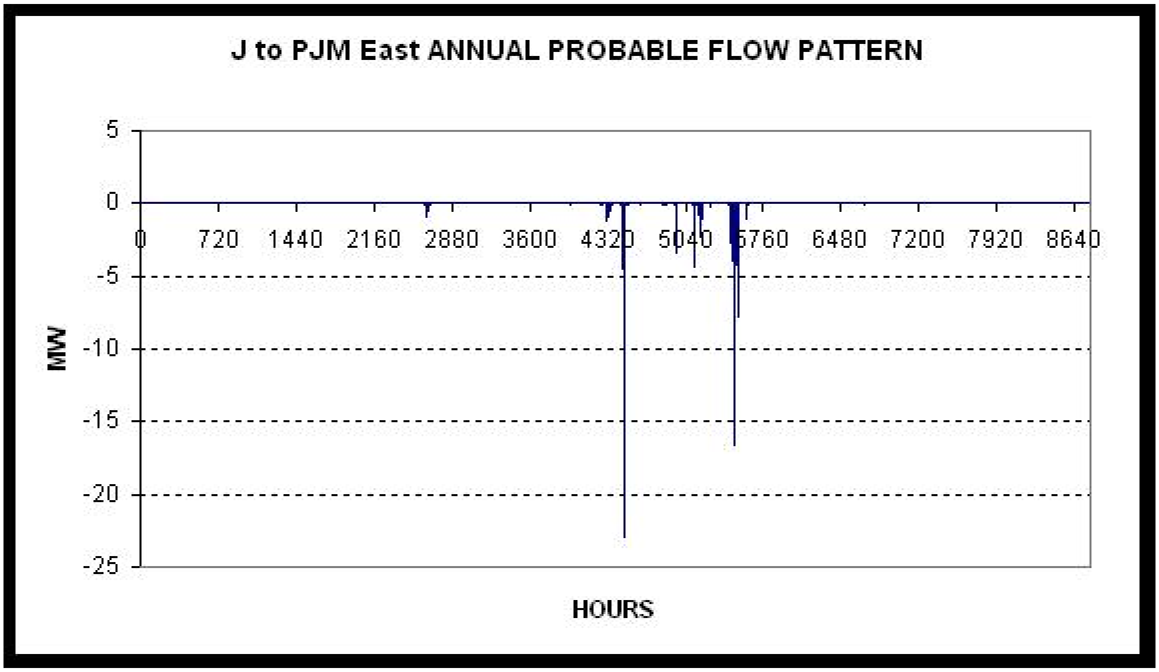

Figure 8-18

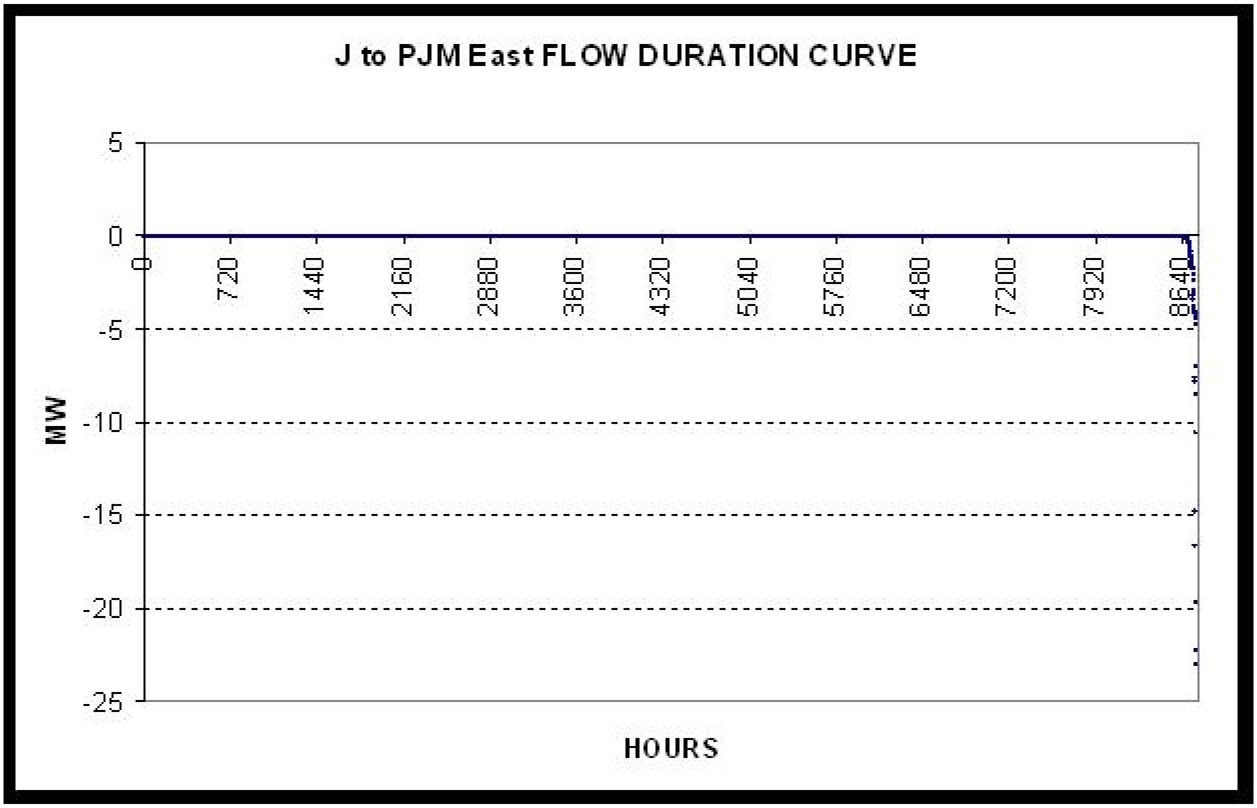

Figure 8-19

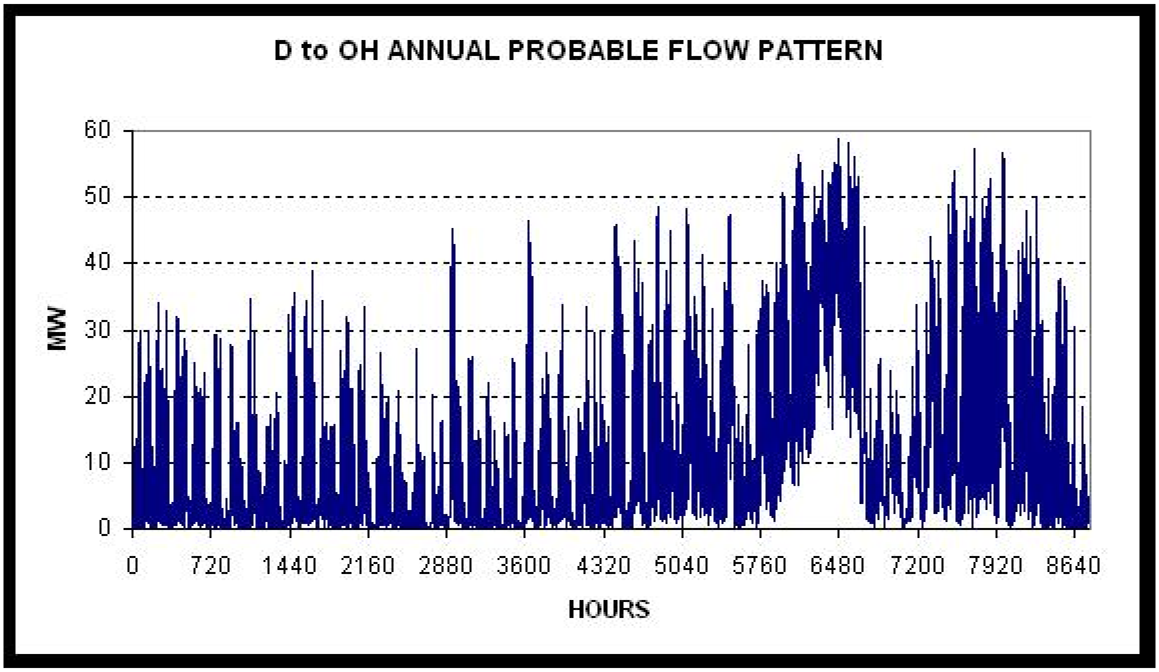

Figure 8-20

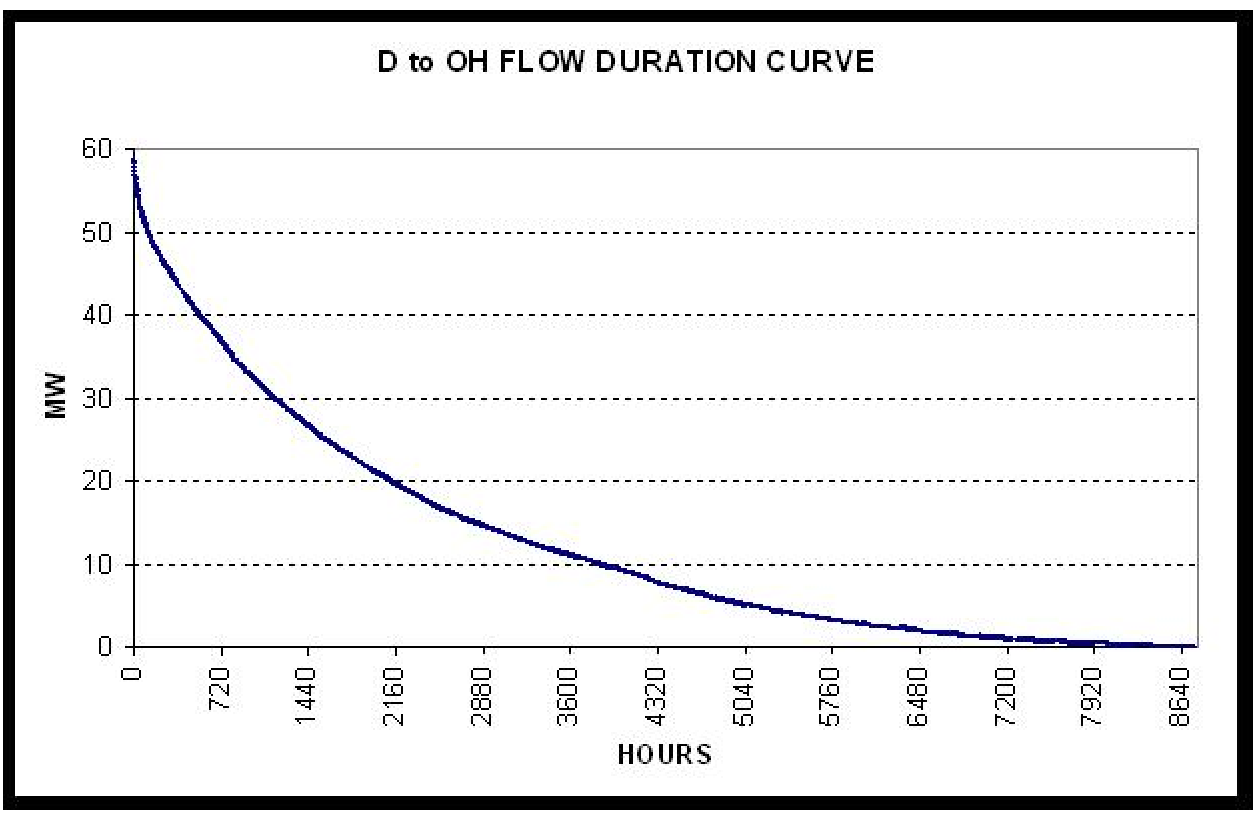

Figure 8-21

8.3 Sensitivity Case:

The calculated LOLE value of 0.2 day/year is higher than the target range. The higher LOLE value could be due to several reasons, such as, insufficient generation capacity, constrained transmission interfaces (both inside NYCA and to outside areas), transmission branch limits or a combination of these.

In order to understand the impact of transmission limits, a sensitivity case with no transmission limits (free flow) inside NYCA (both interfaces and branches) was simulated. The external tie limits were not changed. The result shows, that with no transmission constraints inside NYCA, the LOLE is reduced from 0.2 to 0.14 days/year (Table 8-5), which is closer to the LOLE target, but still higher. One of the reasons is that the reserve margin is about 14.6%, with SCR/EOP included.

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Table 8-5: Sensitivity Case LOLE for Intermediate Year (free flow)

Intermediate Year's LOLE (days/year)		
Zones	As Is	Without NYCA Transmission Limits
A	-	-
B	0.09	0.05
C	-	-
D	-	-
E	0.18	0.13
F	0.00	0.00
G	0.15	0.10
H	0.00	-
I	0.19	0.11
J	0.20	0.14
K	0.15	0.10
NYCA	**0.20**	**0.14**

To bring LOLE further down to the acceptable limit, sensitivity cases were run and the results showed that with HQ – D interface limit increased 250 MW, the NYCA LOLE with come down to 0.09.

9 NYCA SYSTEM ADEQUACY DETERMINATION FOR THE HORIZON YEAR

The adequacy of the NYCA system for the horizon year is determined by calculating the LOLE and comparing with reliability target of 0.1 days per year. The anticipated load and new capacity requirement are shown in Table 2-4. Horizon Year consisted of 6 specific Scenarios, as described in Section 2 of this report. The generation additions by zones, for the 6 Scenarios, are listed in Tables 2-5 and 2-6. For Scenarios 5 and 6 with 25% RPS, NYCA average wind curve was used for all on-shore new wind units and average off-shore wind curve, provided by LIPA, was used for all off-shore new wind units. An overall comparison of the reliability of the system with the "as is transmission" is presented first, followed by discussion of various sensitivity cases and the new transmission capability required for those Scenarios which do not meet the target LOLE index.

9.1 LOLE Overview for Six Scenarios

The LOLE index was calculated, similar to the Intermediate Year, for all the 6 Scenarios (Table 9-1). The calculated LOLE values show that the postulated generation development for Scenarios #1 and #5 meet NYCA's target reliability index of 0.1day/year. It may be recalled that for Scenarios #1 and #5, most (85%) of new generation capacity was added to down-state load zones. In Scenario #3 (LOLE above the reliability threshold), the new generation (90%) was distributed proportionally to each zone; there by giving an even distribution across the state. Scenario #4 with a heavy emphasis of depending on imports (75% of new need) shows that the existing transmission constraints adversely impact the reliability of the system. The lowest reliability Scenario is #2 with 50% of generation in the upstate zones and the other 50% from external imports. As far as the major load centers are concerned, this Scenario is like depending upon 100% the new capacity needs from outside. The LOLE value for Scenario #6 (similar to Scenario#2, but with more wind) is a bit higher, because the installed generation capacity considered for wind Scenarios is in up-state. Similar comparison can be made between LOLEs for Scenarios #1 and #5.

In Table 9-1, some of the zonal LOLEs are higher than the NYCA LOLE. Even though we are simulating all the 8760 hours of the year in the GridView, the LOLE is calculated based on load shedding event at the peak hour of the day. This is according to the NYCA definition of LOLE calculation. Similarly for the zonal LOLEs only load shedding at the daily peak hour of that particular zone is counted as a load shedding event. Because, the daily zonal peak hour and NYCA peak hour are not always coincident, the NYCA LOLE result could be slightly different from zonal LOLE. If we calculated LOLE on the basis of 8760 hours, then the total LOLE is sum of the load shedding incidents in all the zones through out the year.

Table 9-1: Calculated LOLE values for Six Scenarios (Horizon Year)

Zones	Horizon Year's LOLE (days/year)					
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
A	-	-	-	-	-	-
B	0.02	0.68	0.06	0.14	0.04	0.73
C	-	-	-	-	-	-
D	-	-	-	-	-	-
E	0.06	1.47	0.17	0.39	0.07	1.59
F	-	0.00	0.00	0.01	0.00	-
G	0.06	1.38	0.18	0.38	0.07	1.48
H	-	0.00	0.00	0.00	-	0.00
I	0.06	1.62	0.16	0.39	0.07	1.74
J	0.06	1.75	0.19	0.44	0.07	1.88
K	0.04	1.71	0.19	0.47	0.05	1.87
NYCA	0.06	1.68	0.20	0.44	0.07	1.82

Scenario 1: In this Scenario, 85% of new thermal generation (4,250 MW) is added to down-state zones, the major load centers. With the As-Is transmission configuration this scenario has a higher level of reliability (indicated by a lower LOLE), with the calculated value of LOLE well below the requirement of 0.1 day/year, when compared to the other scenarios. There is no need for higher transfers from other external areas or internal zones. In fact, the amount new generation added could be reduced by a small amount. No new transmission is suggested for reliability purposes.

Scenario 2: In this Scenario, the calculated LOLE for the NYCA is 1.68 days/year which is above the reliability criterion limit of 0.1days/year. This scenario requires additional transmission to reach design criteria. With only 50% of new thermal generation (2,500 MW) added to up-state and 50% dependency on external area resources, the simulation results showed that the transmission is constraining inside NYCA as well as with the outside areas (PJM to NYCA, HQ to NYCA). New transmission is required to improve the reliability of the system.

The LOLE of zones B and E are much higher in Scenario-2 as compared to Scenario-1, even though 500 MW and 250 MW new generation was added to zones B and E as compared to no new generation in Scenario 1 for these two zones. First of all,
Scenario-1 has 1,750 MW more new capacity added within NYCA than in Scenario-2 and hence, more is available to share within NYCA, especially with emergency support or flow direction being from down-state to up-state (lower chances of transmission constraints). Secondly, in the GridView runs, the surplus capacity available within any zone is prorated among all the deficient zones, so the zones J and K with much higher load will get a higher share of outside help than zones B and E. The stipulation is to meet the target reliability index for the whole NYCA system, but not necessarily for individual zones, prorating the surplus capacity on zonal load basis is an appropriate allocation approach.

In the Horizon Year, both Zones B and E have a generation deficiency to meet the respective zonal peak loads. With non-coincident peaks of 2,444 MW and 1,662 MW, the generation deficiency is approximately 61% and 36% respectively. With the addition of 500 MW and 250 MW in Scenario-2, the deficiency would be reduced to about 41% and 21%, respectively; but still dependent on support from other zones. Hence, the prorating logic kicks-in to allocate a lower amount of surplus capacity (1700MW less within NYCA, as compared to Scenario-1) resulting in higher LOLEs for these two zones in Scenario-2.

Scenario 3: In this Scenario, 90% of new thermal generation (4,500 MW) is added to all zones in proportion to the respective zonal loads. The LOLE is higher than the 0.1day/yr requirement, but not much higher. The new transmission requirements in this scenario are expected to be modest. This is a somewhat uniform allocation of generation throughout the state and hence, gives an LOLE of 0.1day/year or better for certain zones.

Scenario 4: In this Scenario, only 25% of new thermal generation (1,250 MW) is added within NYCA zones and the remaining 75% of the new generation obtained from external areas. Even though the in-state generation addition is only 1250MW; about 650 MW thermal generation is added to the two dominant load zones J and K. In Scenario-2, no new generation is added in the down-state zones. Hence, the LOLE is much lower as compared to Scenario-2.

Scenario 5: This Scenario is similar to Scenario-1, but with about 540 MW conventional generation capacity (in zones J & K) replaced by 2,100MW wind generation units (off-shore). The contribution from these wind generation units, during the peak hours, is a bit higher than the 540MW of replaced conventional capacity. Hence, the calculated LOLE value is about the same; because of a major part of the new wind capacity is directly connected to zone J.

Scenario 6: This Scenario is similar to Scenario-2, but with about 144 MW conventional generation capacity is replaced by 1,514 MW wind capacity in the upstate; so the LOLE of Scenario 6 is close to value of Scenario 2. Even though wind replacement capacity is about 10 times the conventional generation capacity it is replacing, the reliability benefit is very small due to two main reasons; i) the land or terrestrial based wind farms have lower output during the peak hours with lower annual capacity factors as compared to off-shore wind farms, and ii) upstate location of wind resources are in the middle of zones with lower load.

9.2 NYCA Interface Flows:

The hourly flow (chronological hours) pattern for Volney East interface in all four Scenarios is shown in Figure 9-1. This is a capacity based flow (not an economic generation dispatch flow) and hence, includes the probability of generation outages. The flow pattern for each Scenario is seen to hang down from the limit (as enforced in the GridView simulation). As can be seen in this figure, for Scenario-1 (new generation in down state), during the months of January and October, the Volney East interface is used below its transfer limit. Whereas for Scenario-2, the flow is almost to the limit all the time.

The actual utilization (probable from the capacity point of view) or ***"Usefulness of Interface for Reliability"*** of the interface can be better observed from a duration type of curve as shown in Figure 9-2. The curve for Scenario-2 is almost a flat curve at the Interface limit, whereas the lowest probability of being limited for Scenario-1 is clearly evident. The areas (usefulness) under these curves are 90.6%, 98.2%, 95.4% and 97.5% for the four Scenarios respectively. The hours (on the x-axis) for different scenarios are non-coincident, for example, hour#10 for Scenario-1 does not necessarily denote the same instant of time for the other scenarios.

Similarly the mean hourly powerflow of other limiting interfaces are shown in chronological and duration curve formats in Figures 9-3 to 9-26. The interface flows of Scenario 5 & 6 are almost identical to the flows of Scenario 1 & 2, so they were not plotted.

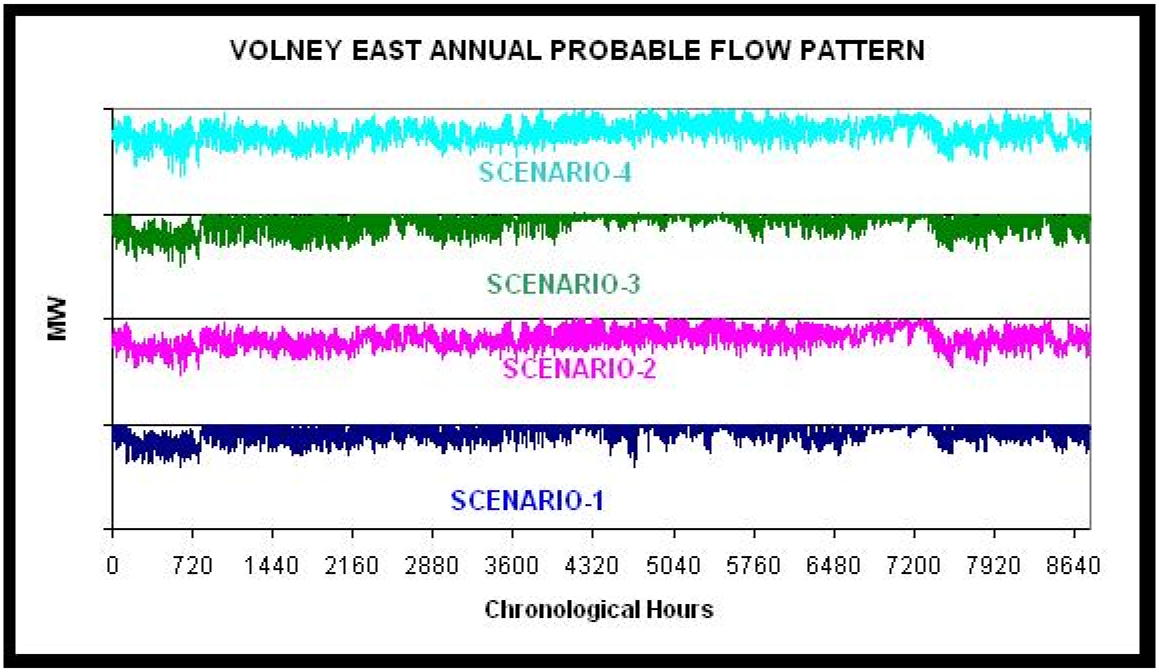


Figure 9-1

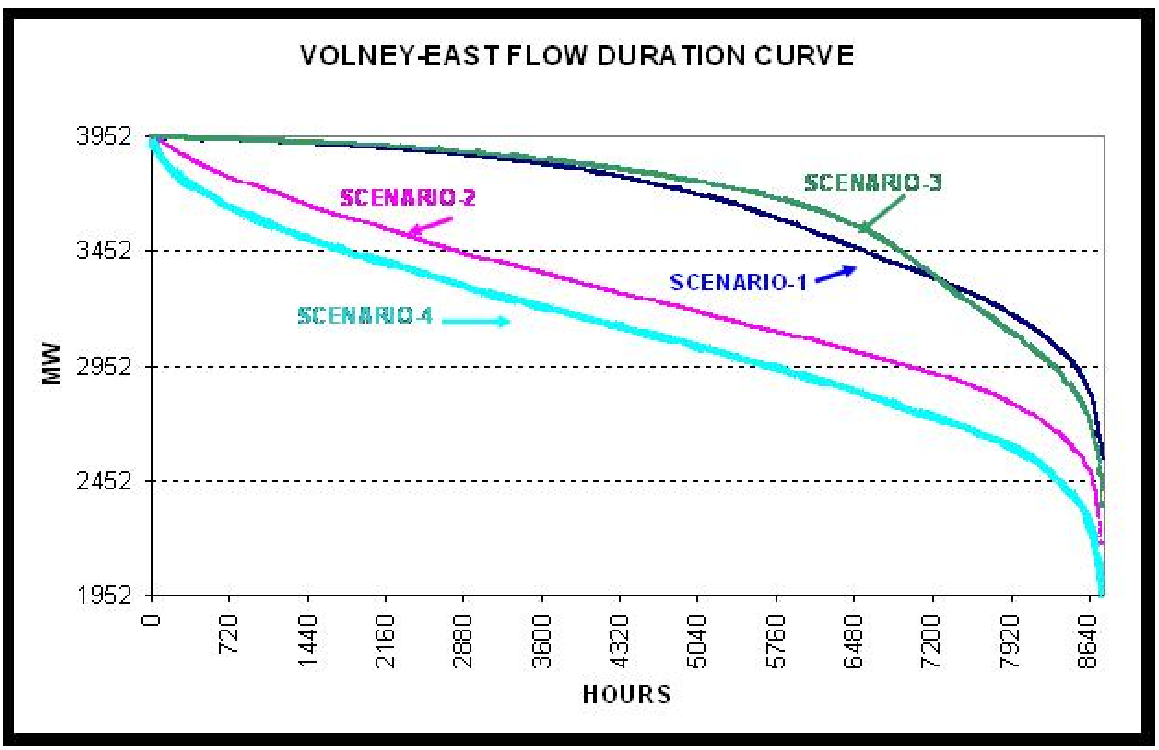


Figure 9-2

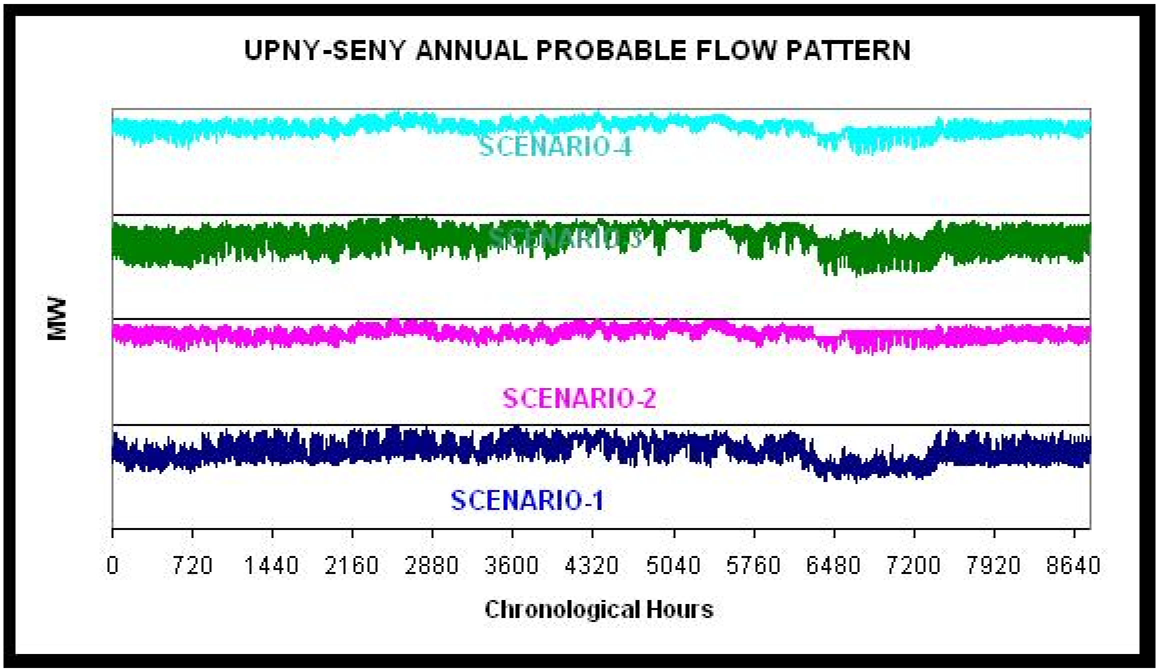


Figure 9-3

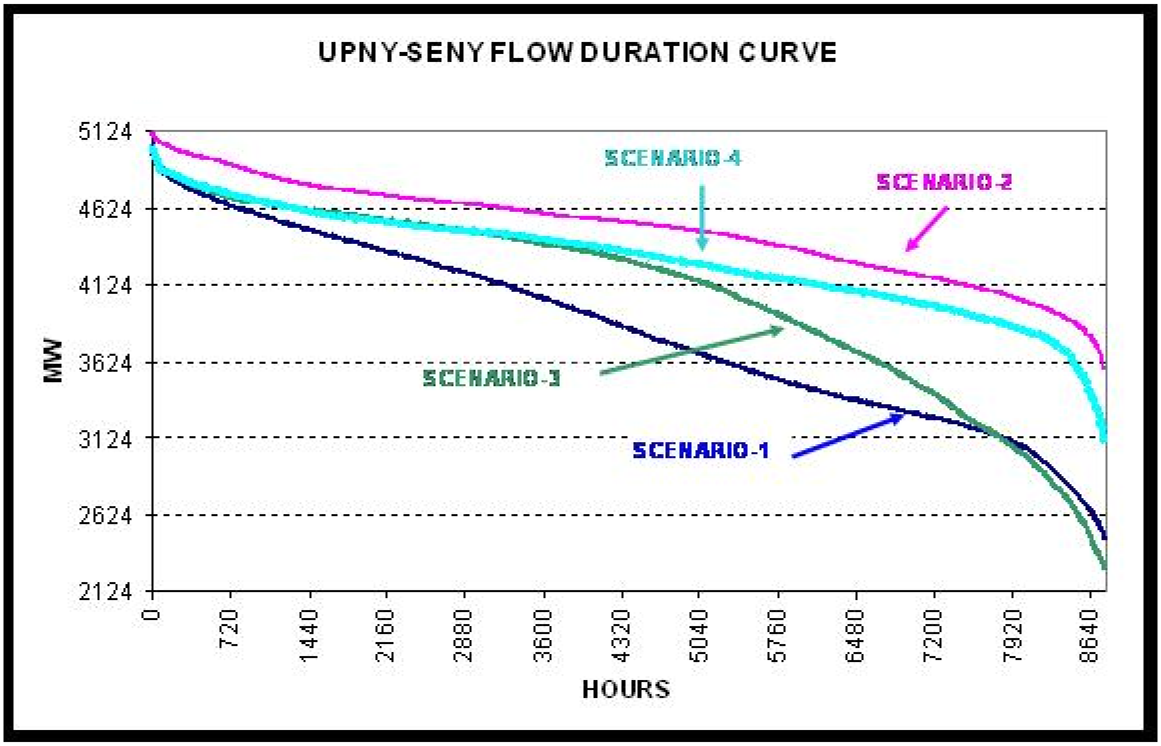
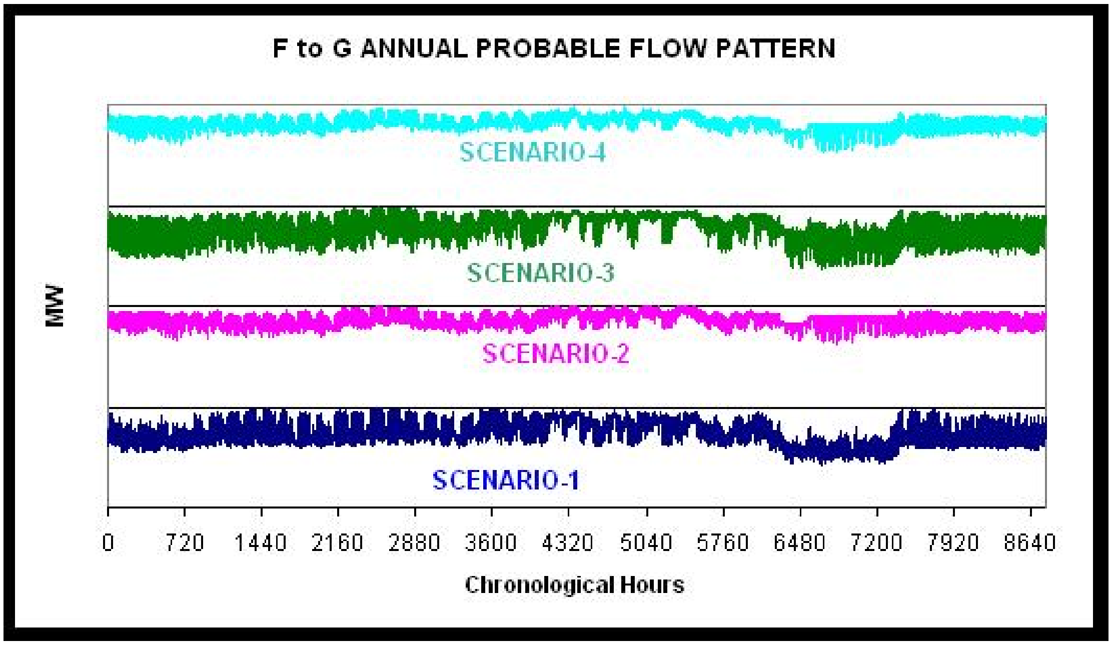


Figure 9-4



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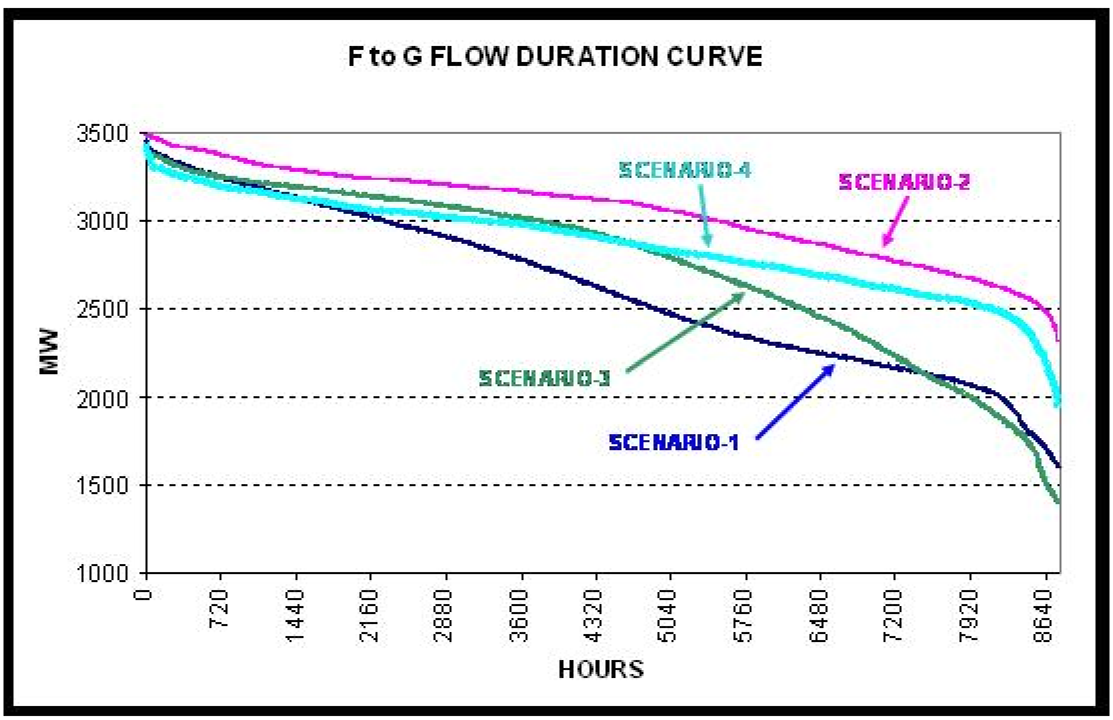


Figure 9-6

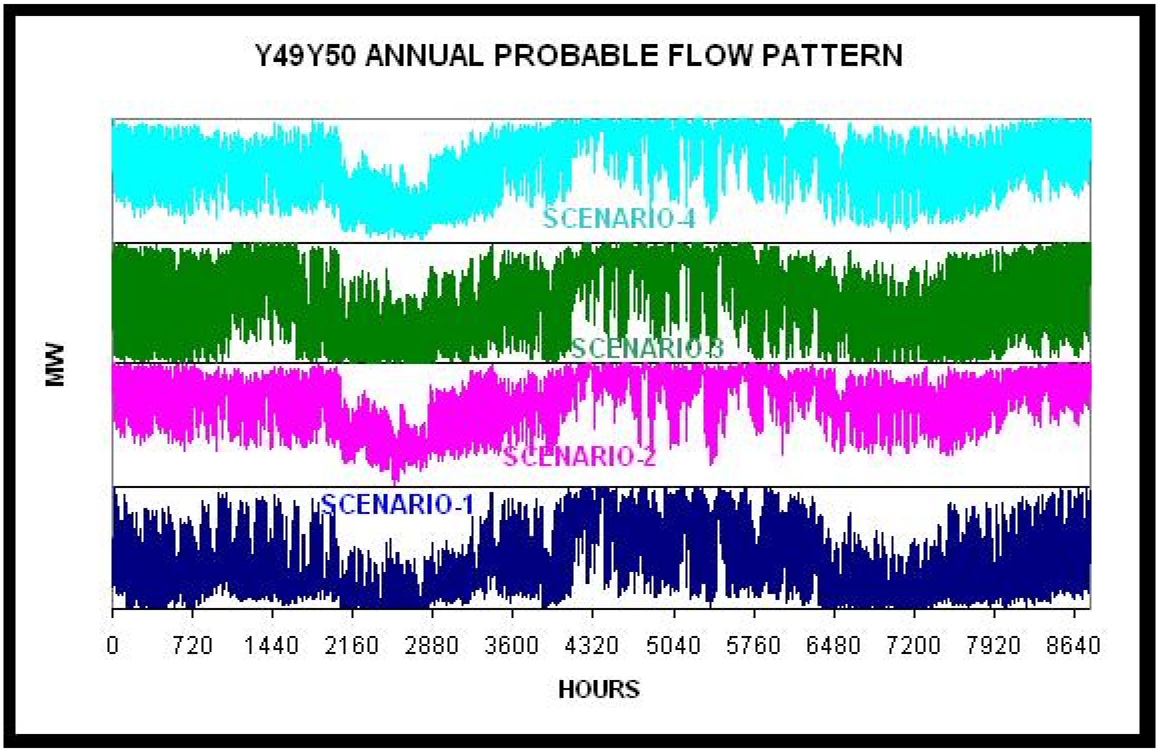
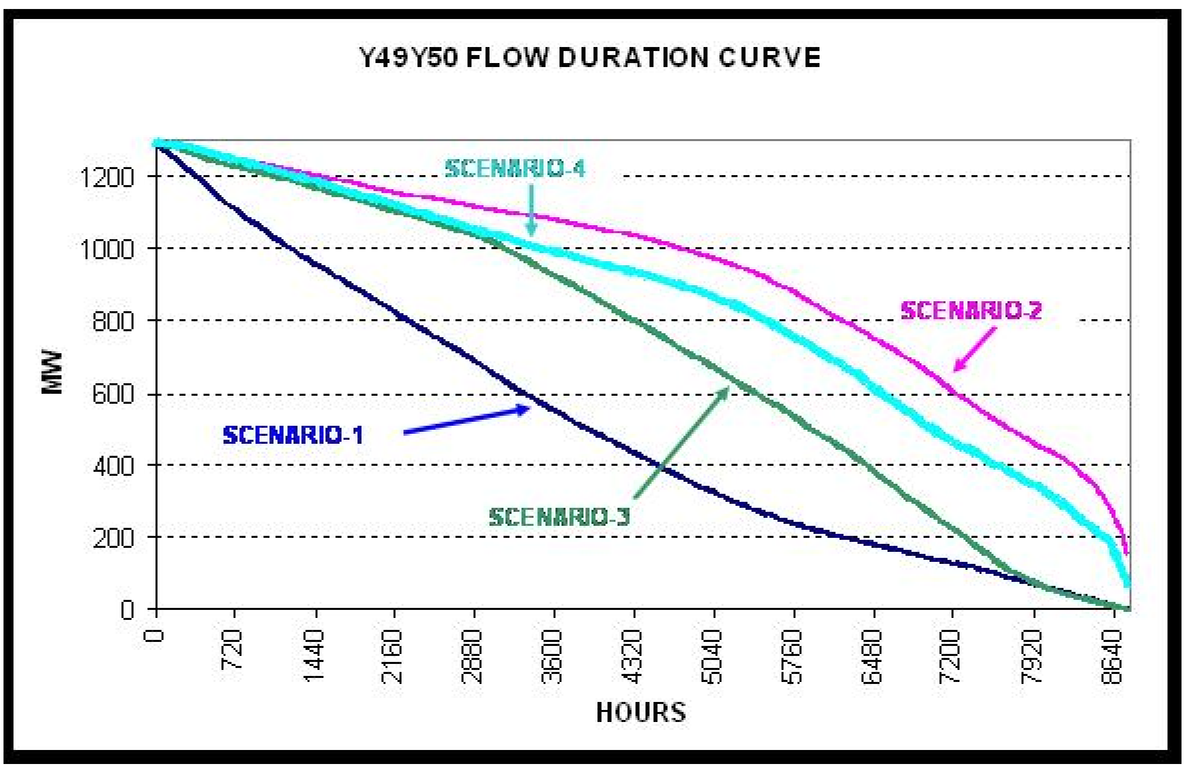


Figure 9-7



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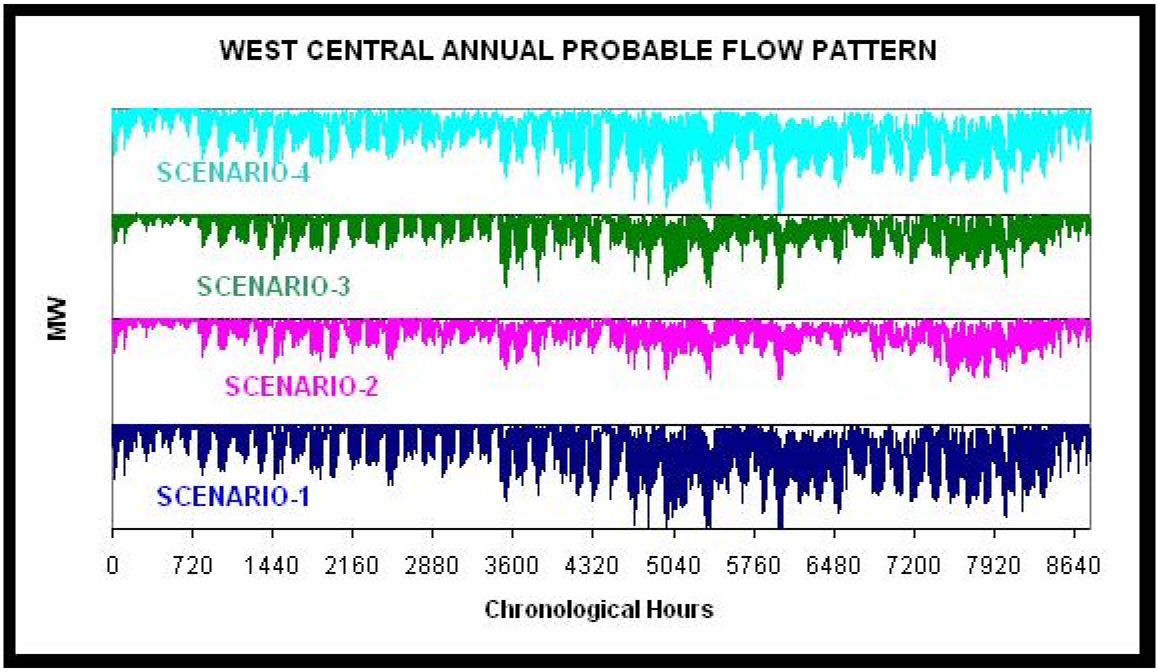


Figure 9-9

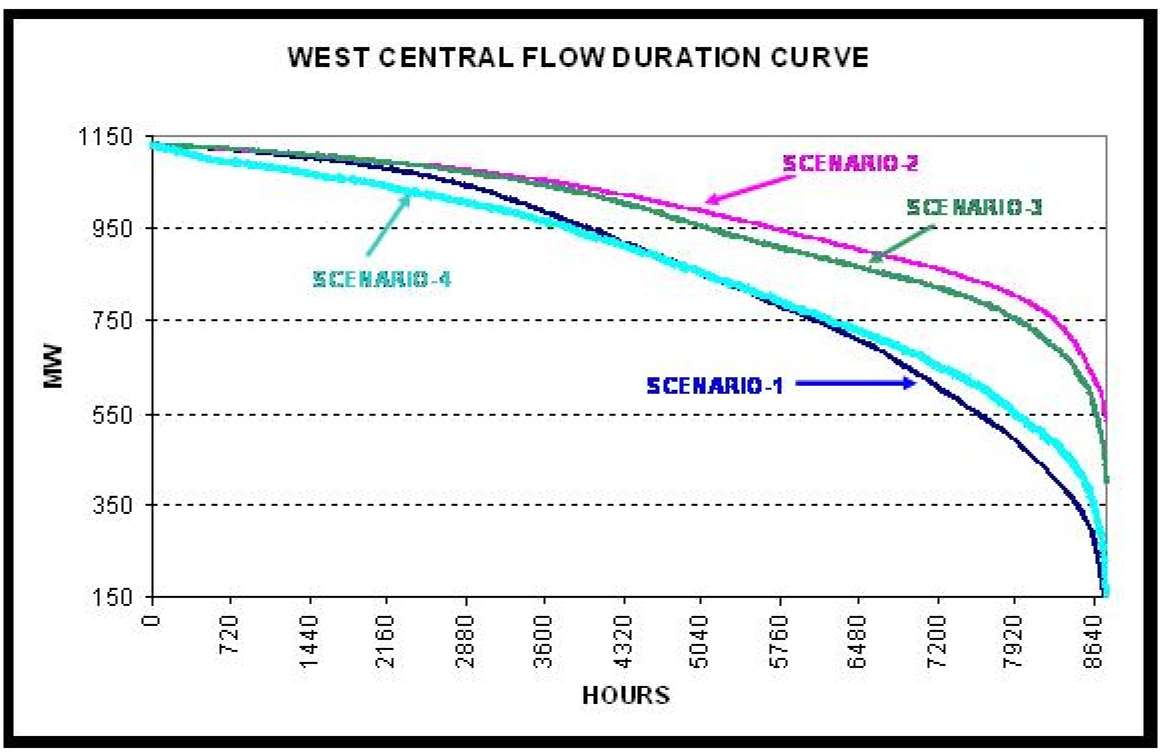
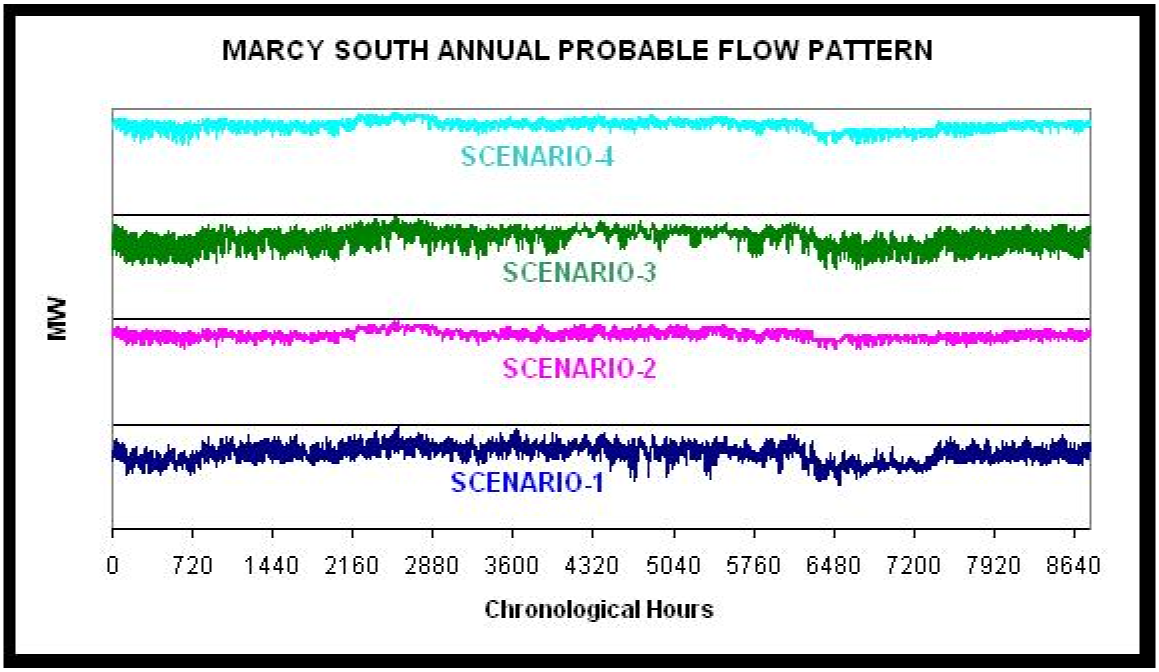


Figure 9-10



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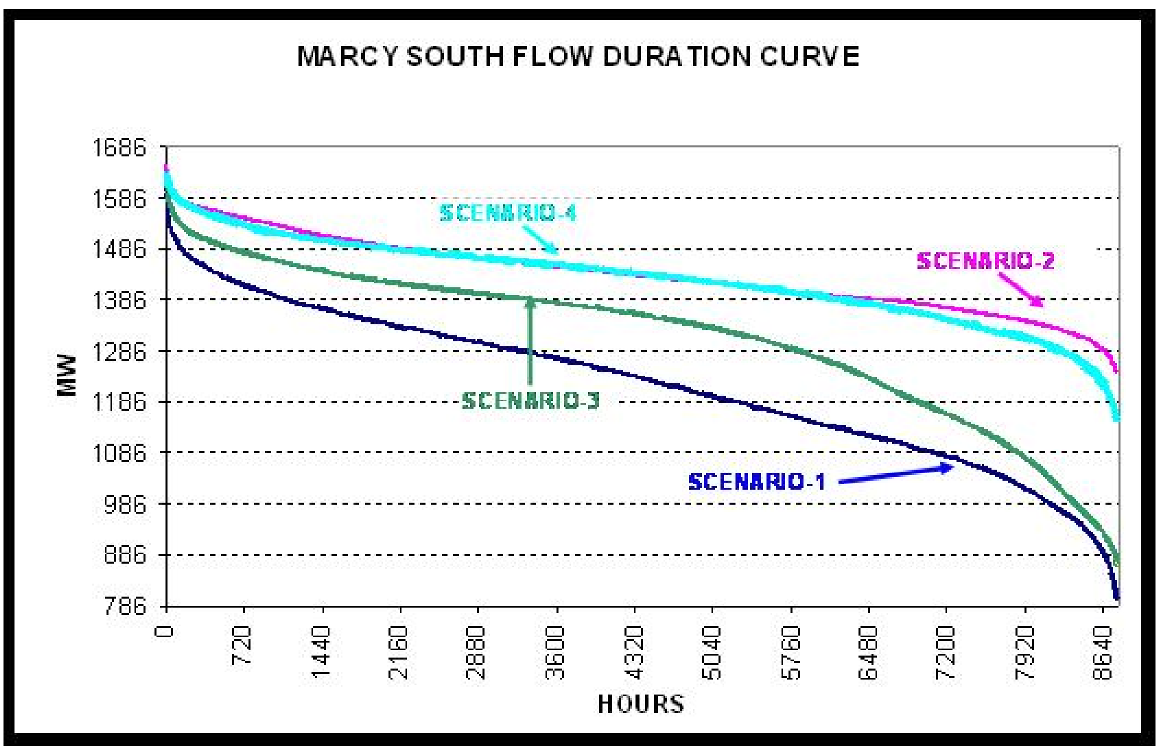

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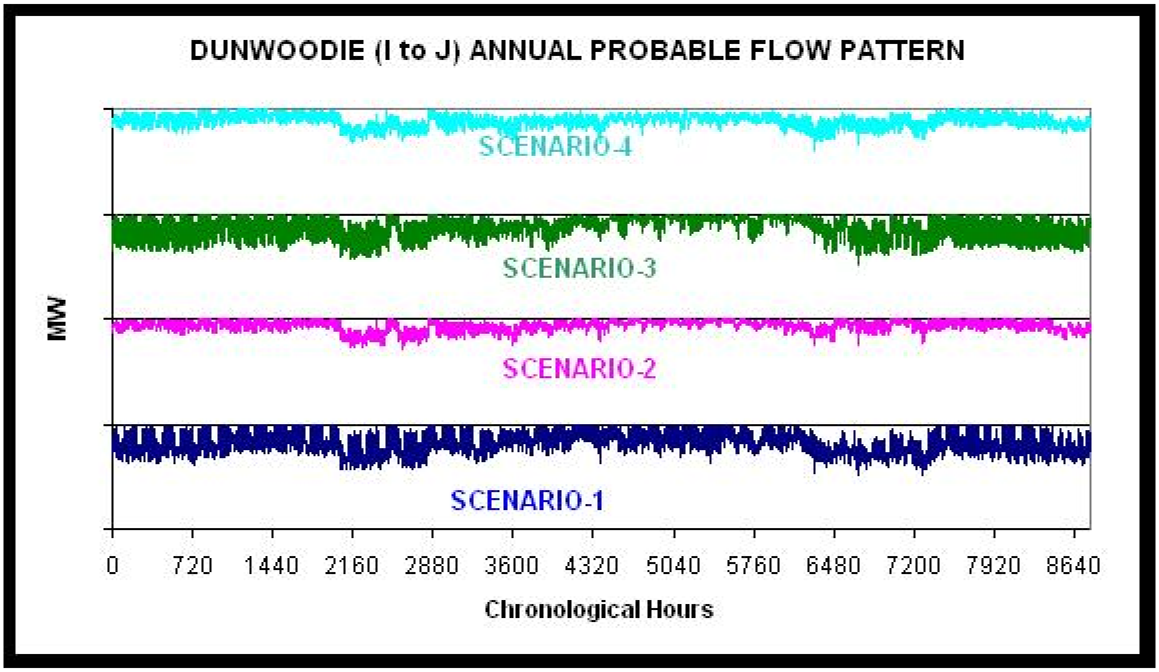


Figure 9-13

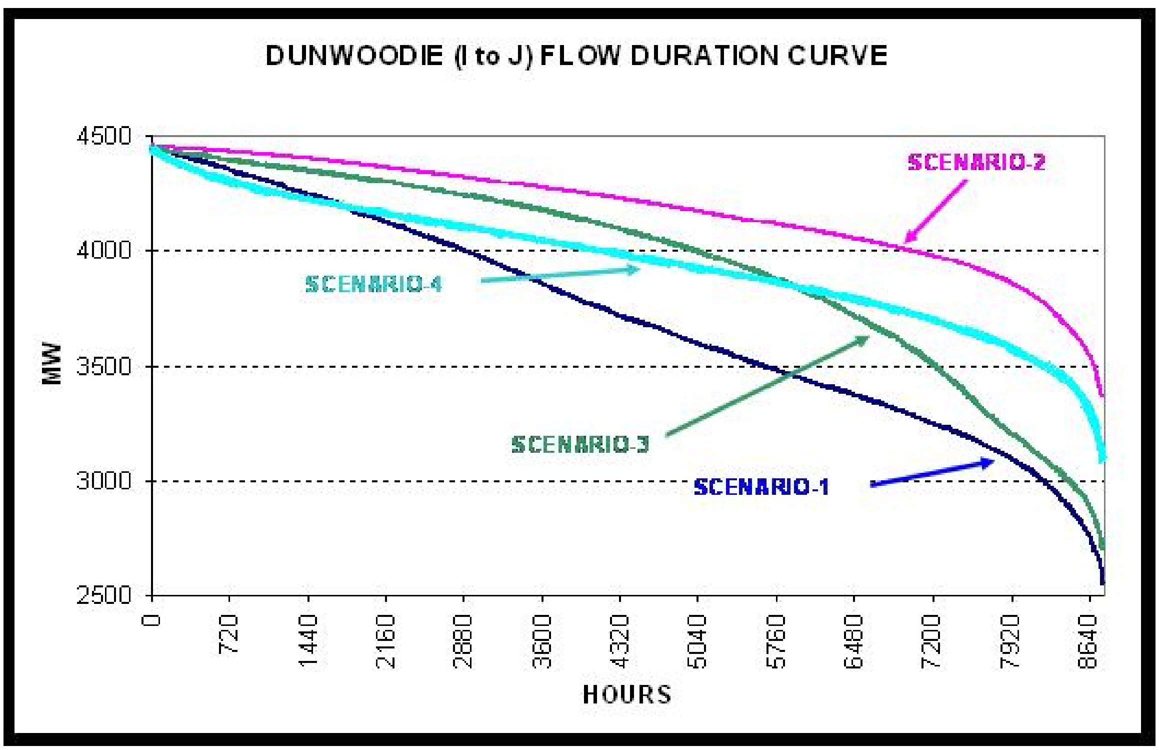


Figure 9-14

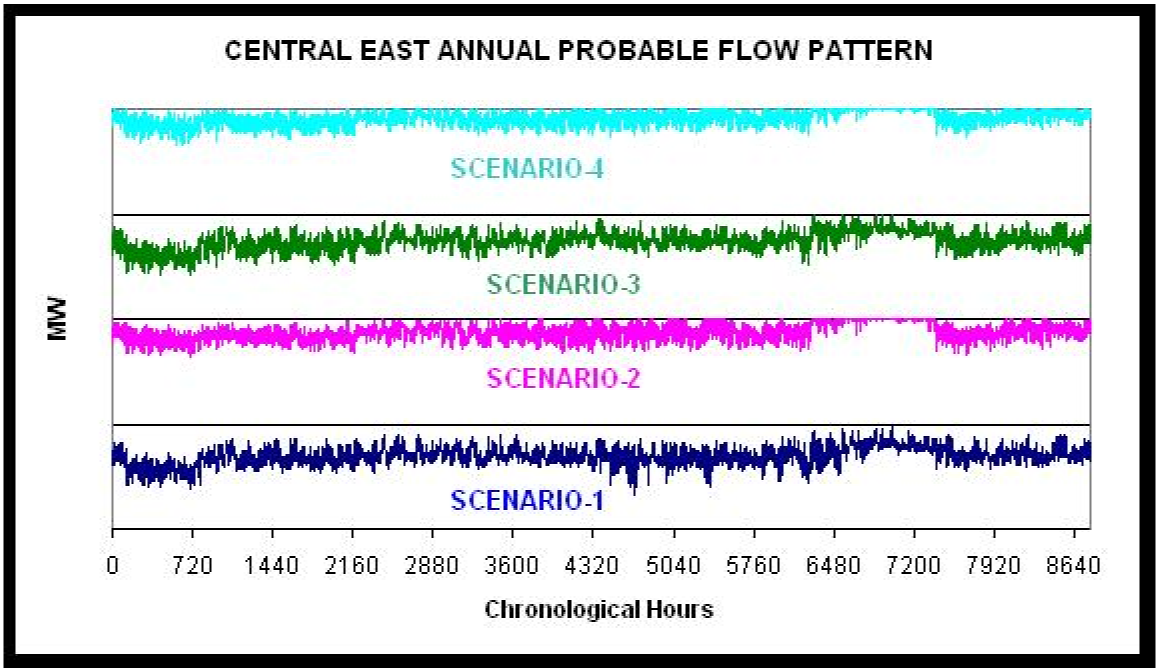


Figure 9-15

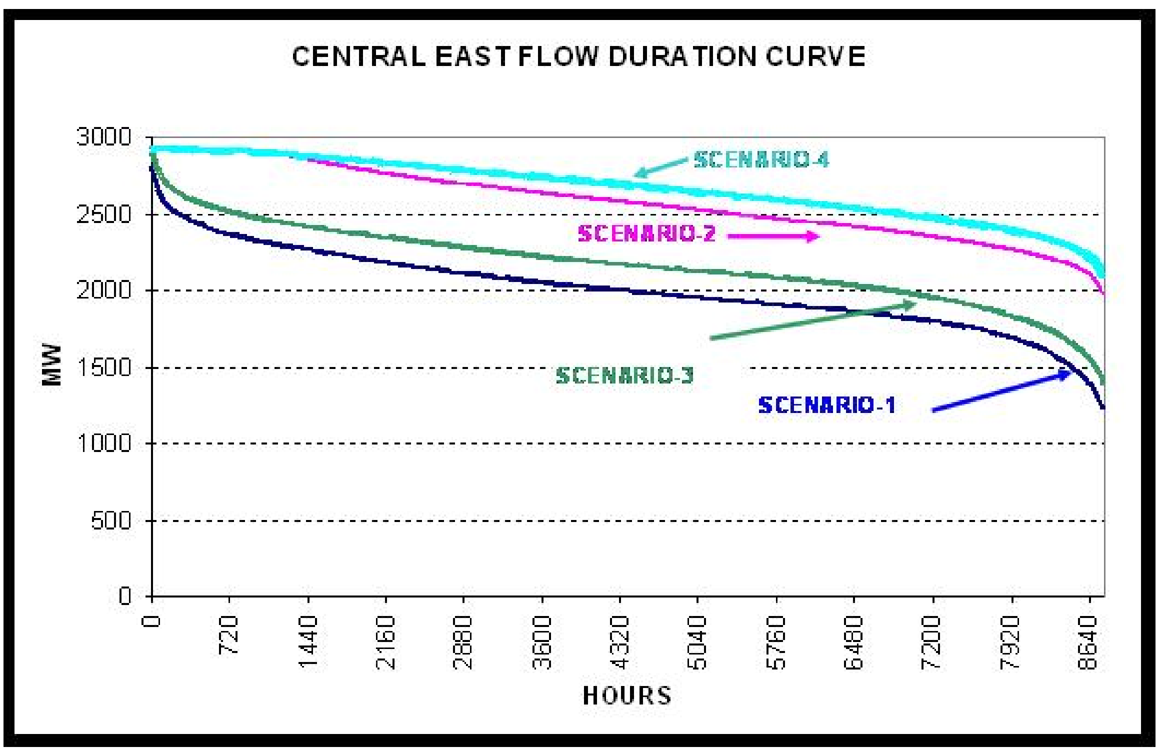
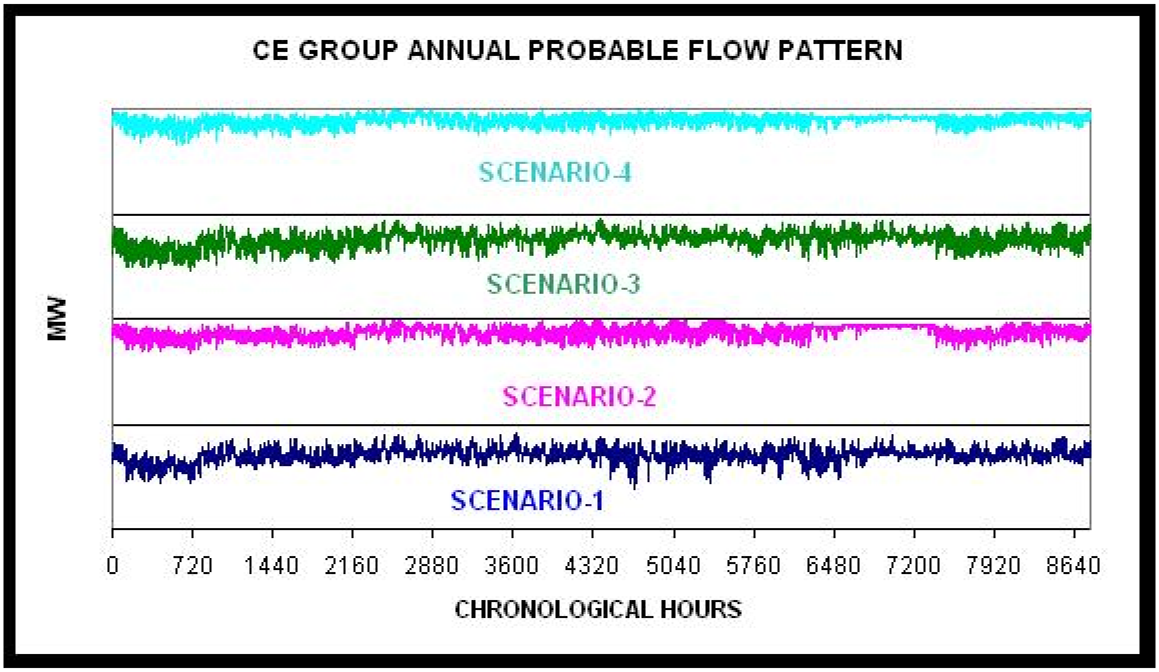


Figure 9-16



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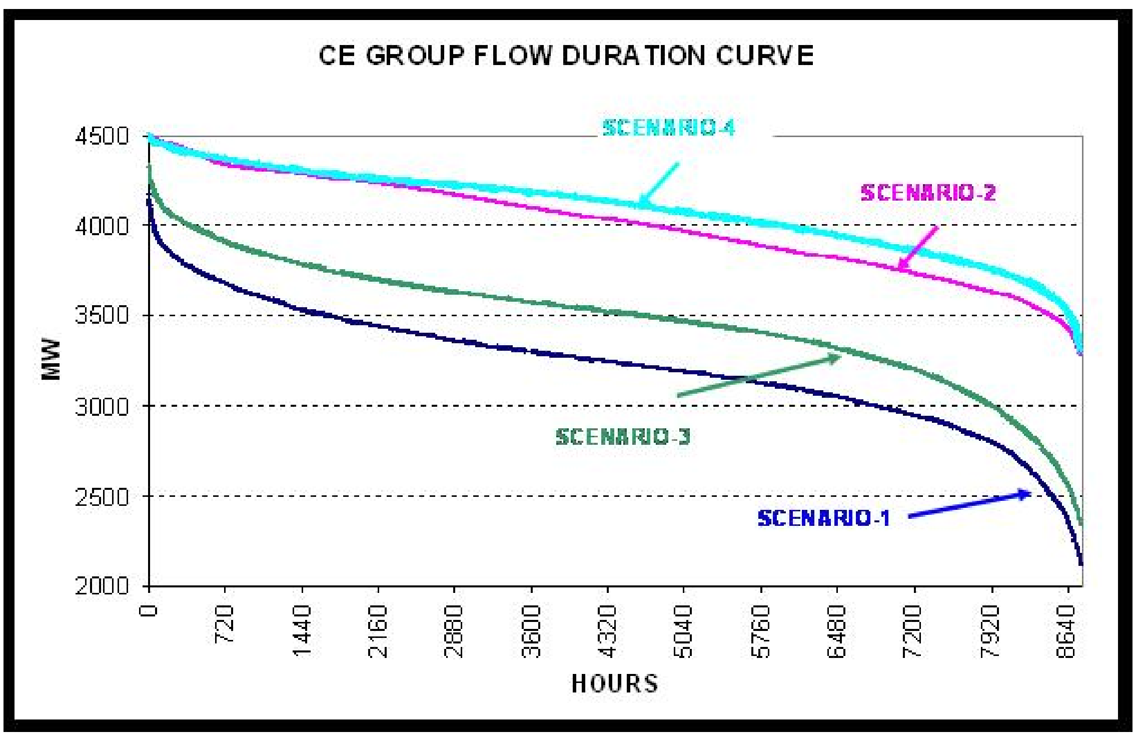


Figure 9-18

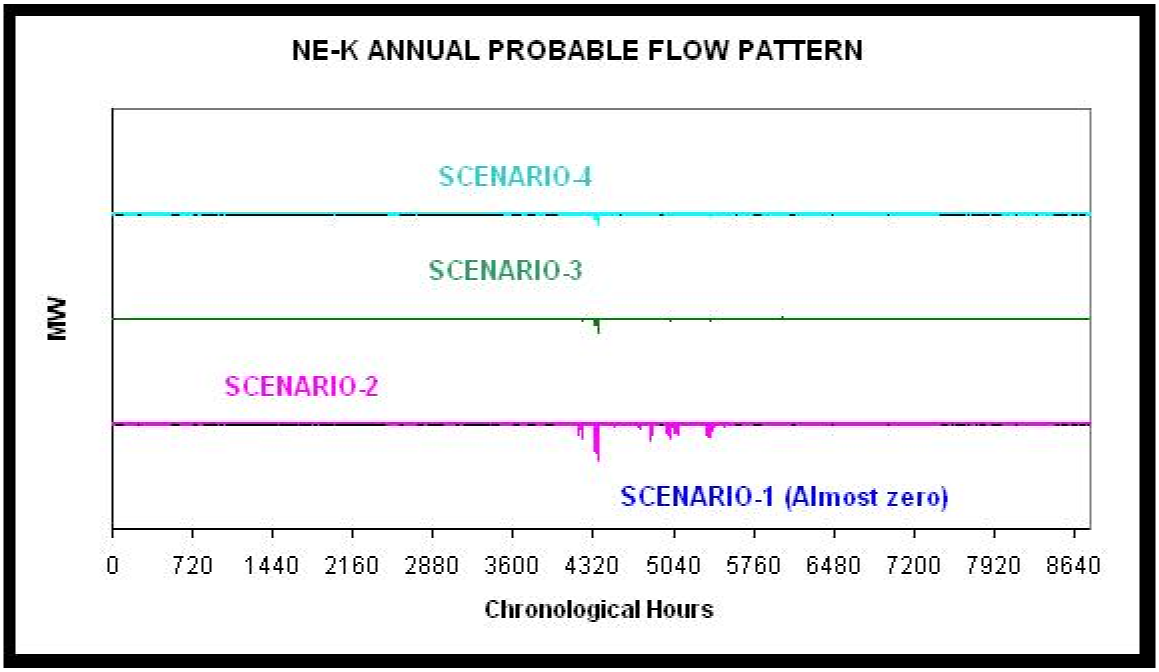


Figure 9-19

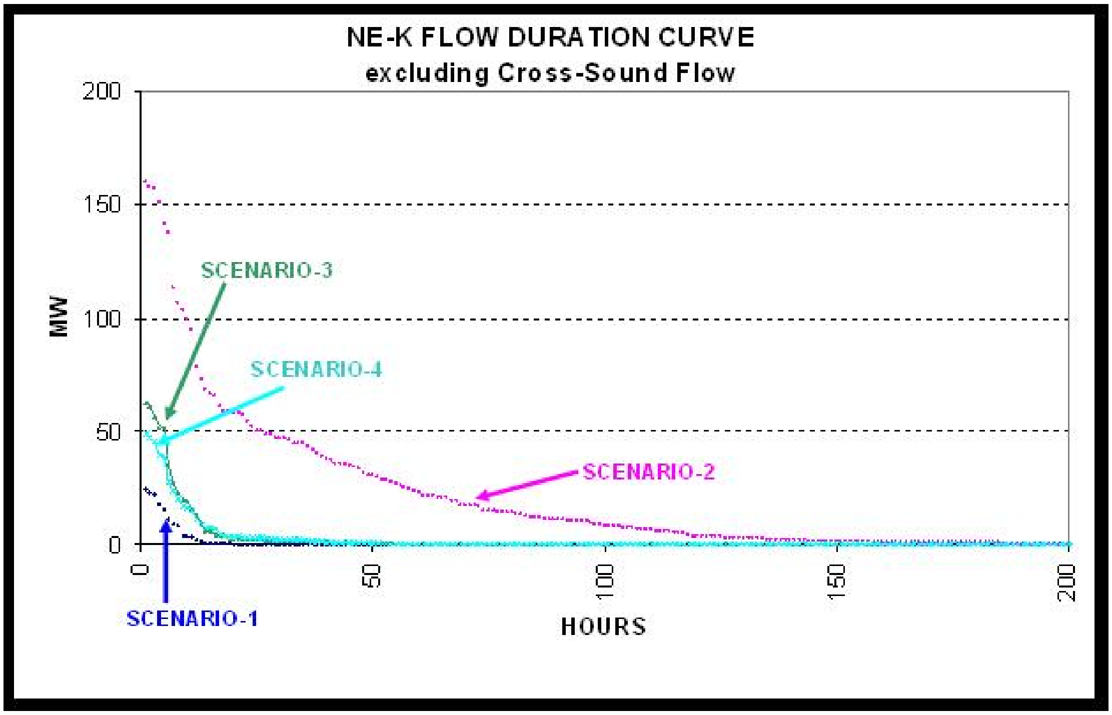
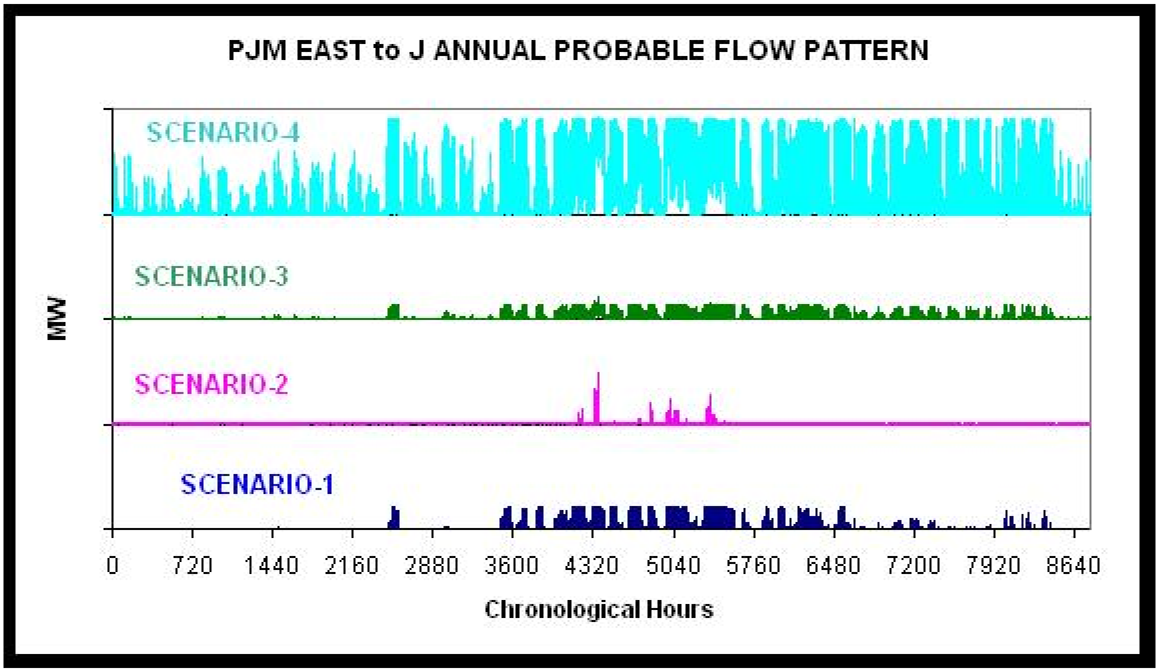


Figure 9-20



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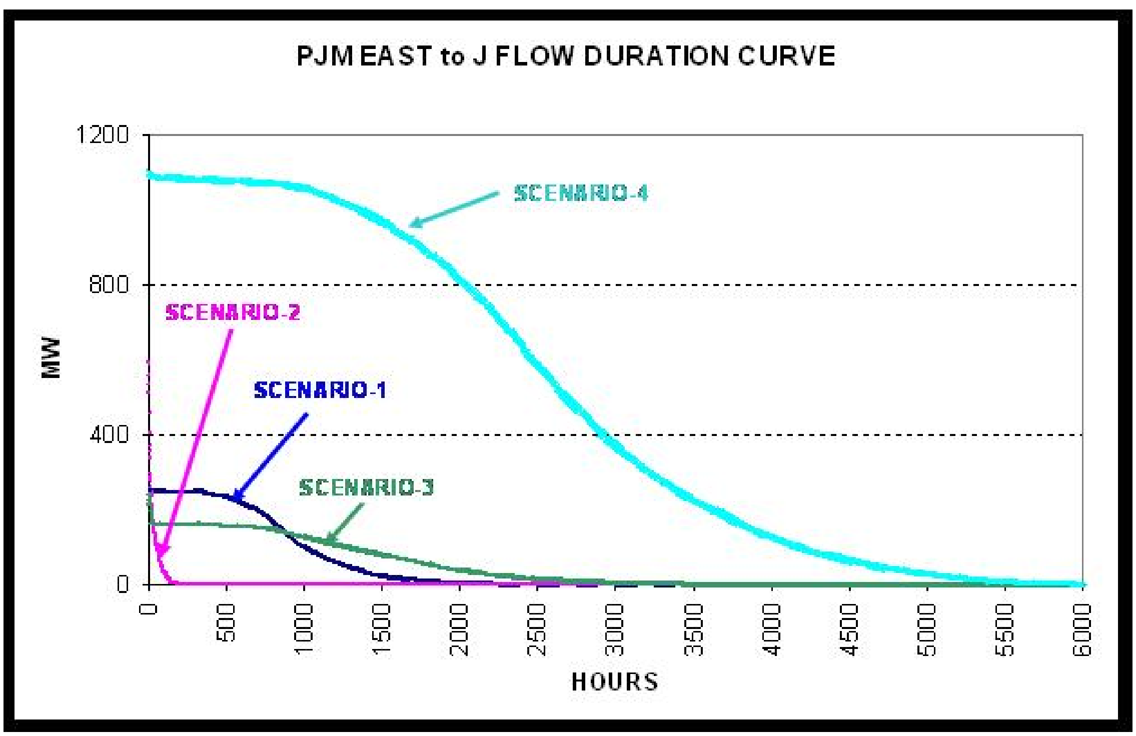

Figure 9-22

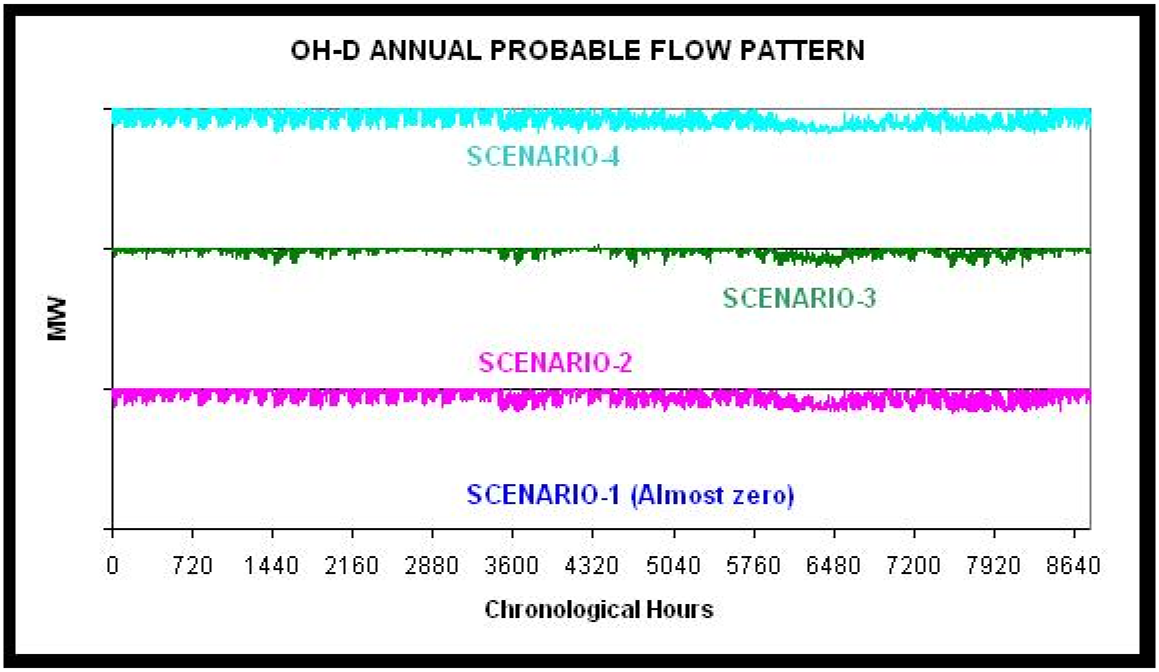

Figure 9-23

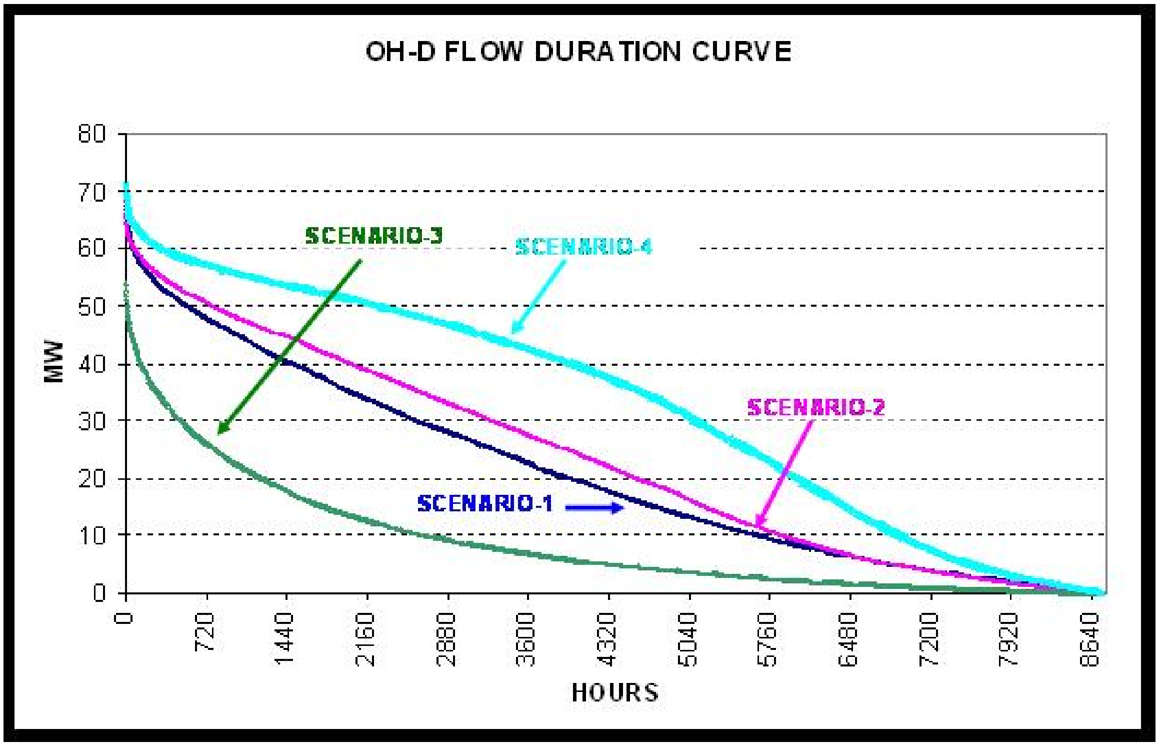

Figure 9-24

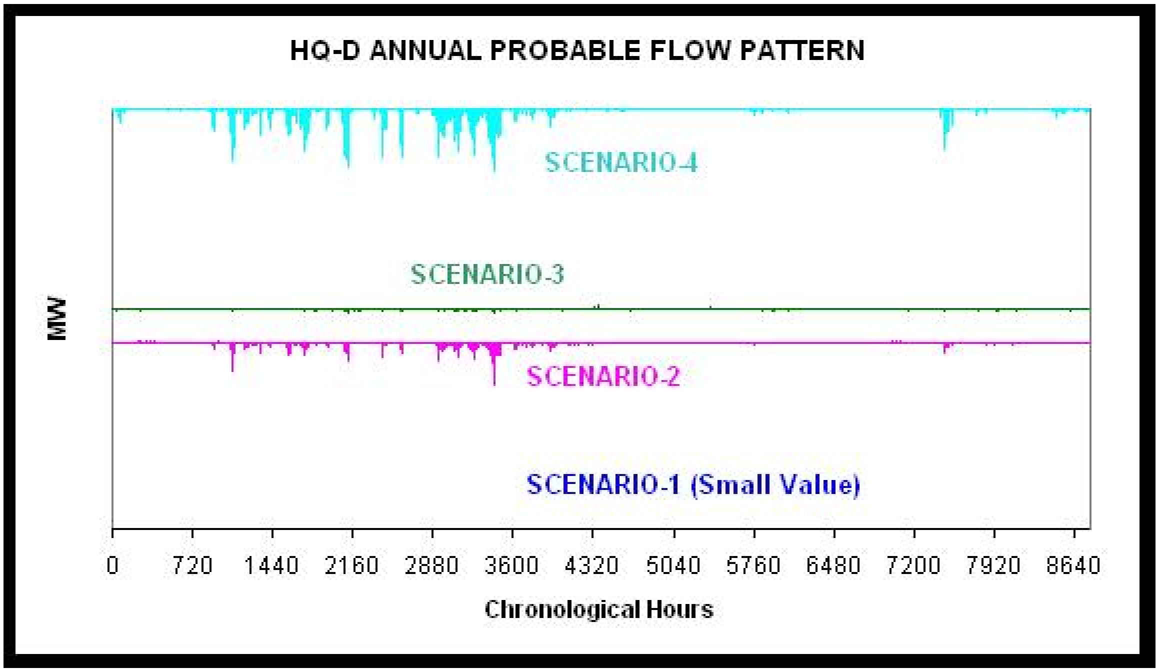

Figure 9-25

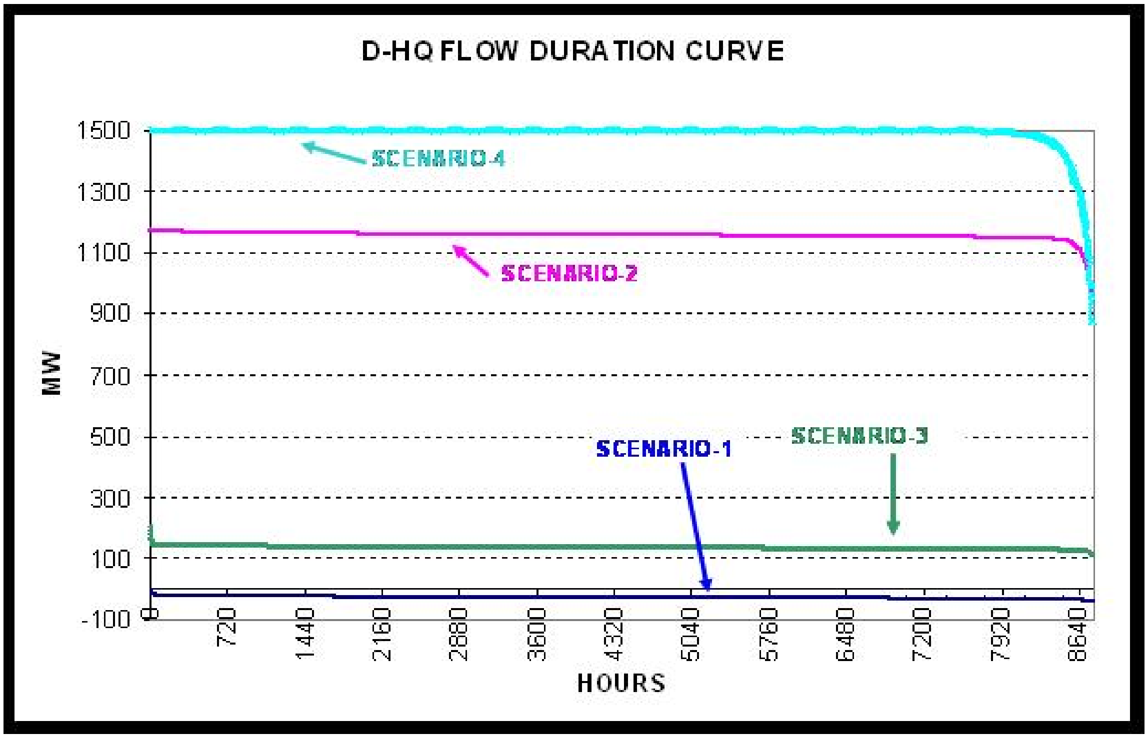

Figure 9-26

9.3 Interface Constraints Overview for Six Scenarios

The existing transmission is constrained due to the flow limits (thermal and/or voltage). Statistics for various transmission constraints, as encountered during the MonteCarlo trials, were calculated. The **number of days *of hitting a limit at the daily peak hour*** during the one year period was calculated. Considering only the daily peak hour is consistent with the LOLE definition. If we consider all the hours in the year, two factors obscure the effect of interface limit on the LOLE;

iii) since the instances of interface limit hits during the non-peak hours are counted, the importance of the particular interface may be exaggerated

ii) averaging over 8760 hours will dilute the importance of the interfaces which are limiting only during the daily peak hours.

The number of days of hitting a limit at the daily peak hours (for the Horizon year and the various interfaces) are shown in Table 9-2. In the last column, an average number of days hitting the limit for the first four scenarios are shown, in the descending order. The averaging is same as saying that the probability of any one of these four scenarios is same or equal. Other arguments for putting different weights for these scenarios can be made. But with a 20+ years horizon, treating various scenarios on an equal basis is a reasonable view, since the actual outcome will be different, but bounded by the four scenarios.

Table 9-2: NYCA Interface Limiting for Horizon Year (at daily peak hour)

Interface		Hitting Limit (days/year)						
Name	Limit (MW)	# 1	# 2	# 3	# 4	# 5	# 6	Avg for #1-#4
Volney East	3952	187.2	61.2	230.6	24.5	177.548	68.4	125.9
I to K (Y49/Y50)	1293	50.8	120.6	119.0	117.6	53.9	116.4	102.0
I to J	4460	63.0	151.8	118.1	45.2	45.8	147.8	94.5
F to G	3485	34.6	105.7	58.7	37.3	32.7	94.7	59.1
Central East + Fraser-Gilboa	2916	0.2	108.3	2.2	118.5	0.3	100.1	57.3
West Central	1134	36.1	85.3	62.6	37.2	35.8	95.9	55.3
UPNY-SENY Open	5124	0.2	38.9	4.2	25.6	0.1	40.2	17.2
Marcy South	1686	0.0	6.7	1.2	7.2	0.0	10.3	3.8
CE Group	4587	0.0	5.9	0.0	8.0	0.0	2.2	3.5
HQ-D	1500	0.0	0.0	0.0	363.7	0.0	56.3	90.9
PJME-J	1200	0.0	0.5	0.0	99.0	0.0	0.5	24.9
NE-K	450	0.0	0.3	0.1	0.0	0.1	0.3	0.1
OH-D	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0

9.4 Additional Transmission Capacity for Scenarios 2, 3, 4 and 6

As mentioned earlier, the reliability criterion is met for Scenarios 1 & 5. The LOLEs for Scenarios 2,3,4 and 6 are above the desired value. In order to estimate the additional transmission capacity needed to reduce the LOLE for these four Scenarios, the GridView simulations were repeated, but without internal NYCA transmission limits (free flow). The recalculated values of LOLE for the four Scenarios (#2, 3, 4 and #6) are 0.1, 0.03, 0.14 and 0.09 days/year, respectively. In those four sensitivity runs all transmission limits between NYCA and external systems were still enforced.

Scenario 2: the sensitivity run showed that most of unreliability is due to internal transmission constraints. By upgrading all transmission limits to the maximum free flow values the LOLE will meet reliability criteria of 0.1.

Scenario 3: the sensitivity run indicated that in this scenario all transmission constraints do not have to be alleviated in order to achieve LOLE of 0.1, mainly due to the fact that new generation was also added in down-state zones. Several sensitivity simulations were run with various transmission interface limits upgrade values and it was found that by increasing all congested internal NYCA interface limits (listed in Table 9-2) by 500 MW the LOLE will be 0.09.

Scenario 4: since only 25% of new generation capacity was added inside NYCA, even with all internal transmission upgrades the LOLE value of 0.14 is still above the limit. To identify additional MW amount that NYCA needs in order to have LOLE value down to 0.1, several sensitivities were simulated and results showed that with additional 250 MW generation's capacity NYCA LOLE would be 0.1 days/year. So in addition to all NYCA transmission upgrades HQ-D interface would need to be upgrade to 1750 MW limit in order to achieve the LOLE of 0.1 days/year.

Scenario 6: similar to scenario 2 by upgrading all transmission limits to the maximum free flow values the LOLE will be 0.09.

The LOLE of all above scenarios are shown in Table 9-3.

Table 9-3: LOLE of Scenarios 2, 3, 4 and 6 with Sensitivity

Zones	Horizon Year LOLE (days/year)							
	Scenario 2		Scenario 3		Scenario 4		Scenario 6	
	With NYCA Transmission Limits	Without NYCA Transmission Limits	With NYCA Transmission Limits	With NYCA congested Transmission Limits increased 500 MW	With NYCA Transmission Limits	Without NYCA Transmission Limits and HQ-D limit of 1750 MW	With NYCA Transmission Limits	Without NYCA Transmission Limits
A	-	-	-	-	-	-	-	-
B	0.68	0.04	0.06	0.02	0.14	0.03	0.73	0.03
C	-	-	-	-	-	-	-	-
D	-	-	-	-	-	-	-	-
E	1.47	0.09	0.17	0.07	0.39	0.10	1.59	0.08
F	0.00	-	0.00	0.00	0.01	-	-	-
G	1.38	0.10	0.18	0.08	0.38	0.10	1.48	0.09
H	0.00	-	0.00	0.00	0.00	-	0.00	-
I	1.62	0.08	0.16	0.07	0.39	0.08	1.74	0.08
J	1.75	0.10	0.19	0.08	0.44	0.10	1.88	0.09
K	1.71	0.09	0.19	0.08	0.47	0.09	1.87	0.09
NYCA	1.68	0.10	0.20	0.09	0.44	0.10	1.82	0.09

9.5 Interface Upgrades Priority

In order to identify most cost effective transmission upgrade for the reliability purpose (LOLE of 0.1 days/year), several criteria are used to rank individual transmission upgrades needs for each scenarios: number of days hitting limit, maximum additional MW needed and the usefulness of additional MW upgrades.

The duration curves of all interface flows above their limits (normalized to percentage of interface limit) are shown in Figure 9-27 for scenario 2, Figure 9-28 for scenario 3 and Figure 9-29 for scenario 4.

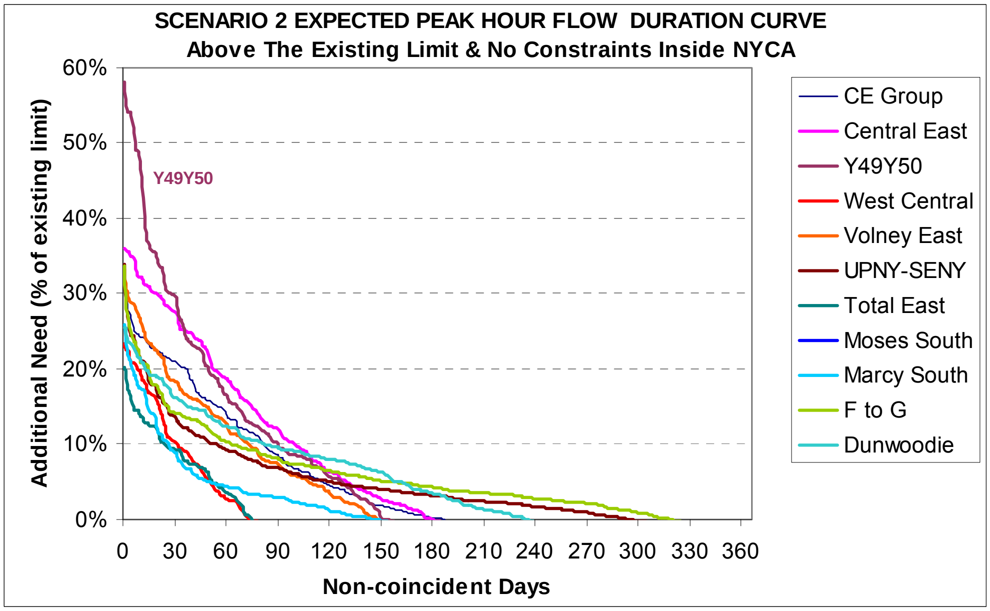

Figure 9 - 27 Expected Interface Flows above Their Limit for Scenario-2

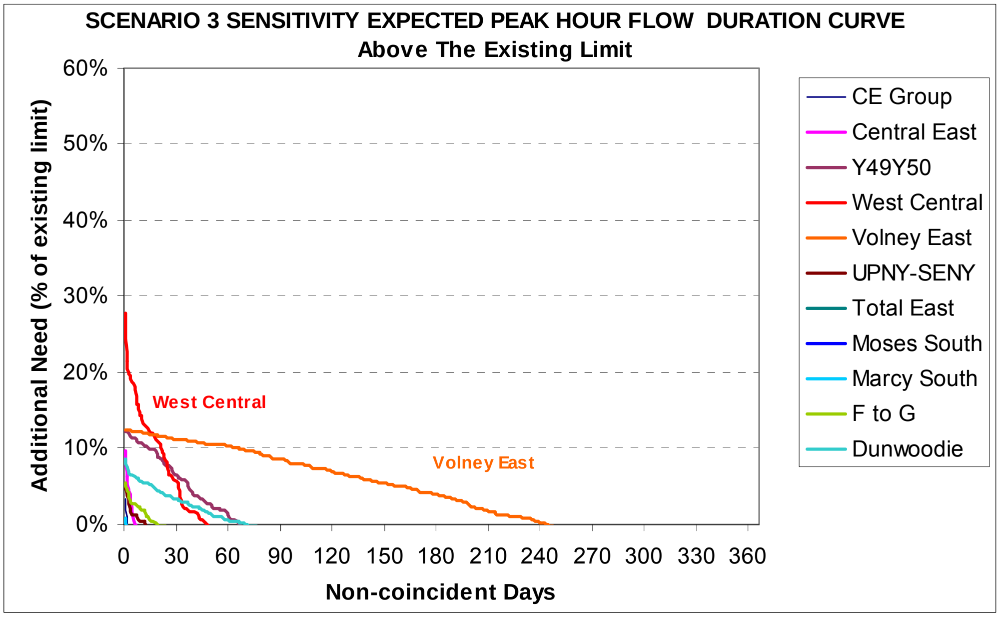

Figure 9-28 Expected Interface Flows above Their Limit for Scenario-3

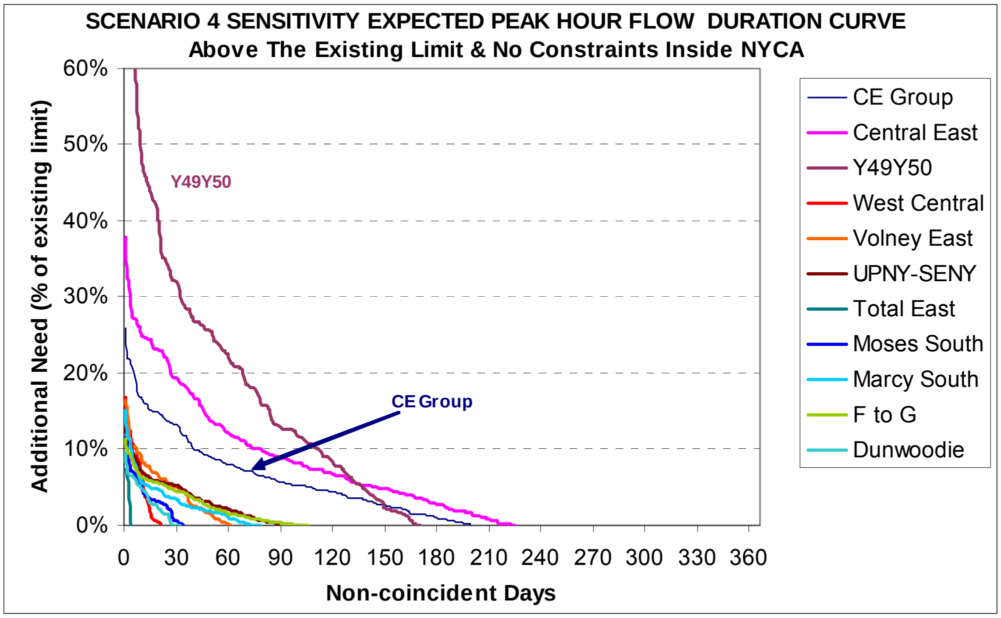

Figure 9-29 Expected Interface Flows above Their Limit for Scenario-4

The maximum additional MW transmission upgrades needed with their utilization/ usefulness are calculated, ranked and shown in Table 9-4 for scenario 2, Table 9-5 for scenario 3 and Table 9-6 for scenario 4.

The usefulness number is a measure of how much additional MW was used on average among those hours that flow went above the existing limit. For example the usefulness of 42.3% for West Central interface in Table 9-4 means on average 42.3%*265=112 MW additional MW is needed for 73 days (or daily peak hours).

Table 9-4: Maximum MW Interface Upgrades for Scenarios 2

INTERFACE	MAX-FLOW (MW)	LIMIT (MW)	Additional Need	
			MW	Usefulness *
West Central	1,399	1134	265	42.3%
Total East	7,544	6270	1,274	40.4%
Central East	3,963	2916	1,047	39.0%
I to J	5,595	4460	1,135	34.5%
Volney East	5,266	3952	1,314	34.5%
CE Group	6,047	4587	1,460	31.7%
Y49Y50	2,045	1293	752	29.3%
Marcy South	2,121	1686	435	21.9%
F to G	4,656	3485	1,171	20.0%
UPNY-SENY	6,859	5124	1,735	17.7%
Moses South	1,751	1971	(220)	NA

Table 9-5: Maximum MW Interface Upgrades for Scenarios 3

INTERFACE	MAX-FLOW (MW)	LIMIT (MW)	Additional Need MW	Additional Need Usefulness *
Marcy South	1,701	1686	15	100.0%
CE Group	4,737	4587	150	56.4%
Volney East	4,444	3952	492	54.0%
Y49Y50	1,452	1293	159	49.1%
Central East	3,195	2916	279	45.5%
F to G	3,672	3485	187	40.5%
I to J	4,846	4460	386	35.4%
UPNY-SENY	5,373	5124	249	34.3%
West Central	1,450	1134	316	31.1%
Total East	4,984	6270	(1,286)	NA
Moses South	593	1971	(1,378)	NA

Table 9-6: Maximum MW Interface Upgrades for Scenarios 4

INTERFACE	MAX-FLOW (MW)	LIMIT (MW)	Additional Need MW	Additional Need Usefulness *
Total East	6,726	6270	456	72.4%
I to J	4,884	4460	424	37.6%
West Central	1,326	1134	192	37.5%
Moses South	2,199	1971	228	33.7%
Volney East	4,600	3952	648	31.0%
F to G	3,884	3485	399	26.4%
UPNY-SENY	5,826	5124	702	26.3%
CE Group	5,772	4587	1,185	25.5%
Y49Y50	2,265	1293	972	25.1%
Central East	4,022	2916	1,106	24.6%
Marcy South	1,943	1686	257	21.9%
HQ - D	1,750	1500	550**	99%

To understand transmission upgrade needs, the results of all four scenarios were put together (scenarios 5 and 6 are very similar to scenarios 1 and 2, hence were not included) by various measures. Table 9-7 shows the interface ranking based on number of days hitting limit. Table 9-8 shows the maximum additional MW needs for each interface and average additional MW needs based of all four scenarios, since each of scenarios has equal probability. Since scenario 1 does not require any transmission upgrade in order to meet LOLE requirement, the average additional MW needs for scenarios (2-4), that require transmission upgrade were also computed and shown in the table. Similarly Table 9-9 shows utilization percentage of additional MW needs for each interface and average value of all four scenarios and average value for only 3 upgrade –required scenarios (2-4).

Table 9-7: Priority based on number of Days Hitting the Limit

Priority Based on Number of Days Hitting the Limit				
	#1	#2	#3	#4
I to J	2	1	3	3
Y49Y50	3	2	2	2
Volney East	1	6	1	7
Central East	7	3	7	1
F to G	5	4	5	4
West Central	4	5	4	5
UPNY-SENY	6	7	6	6
Marcy South	-	8	8	9
CE Group	-	9	-	8

Table 9-8: Priority based on MW Interface Upgrade Need

Priority Based on new MW Need						
Interface	**#1**	**#2**	**#3**	**#4**	**AVG (1-4)**	**AVG (2-4)**
CE Group	**0**	**1,460**	**150**	**1,185**	**699**	**932**
UPNY-SENY	**0**	**1,735**	**249**	**702**	**672**	**895**
Volney East	**0**	**1,314**	**492**	**648**	**613**	**818**
Central East	**0**	**1,047**	**279**	**1,106**	**608**	**811**
I to J	**0**	**1,135**	**386**	**424**	**486**	**648**
Y49Y50	**0**	**752**	**159**	**972**	**471**	**628**
F to G	**0**	**1,171**	**187**	**399**	**439**	**586**
Total East	**0**	**1274**	**0**	**456**	**432**	**576**
West Central	**0**	**265**	**316**	**192**	**193**	**258**
Marcy South	**0**	**435**	**15**	**257**	**177**	**236**
Moses South	**0**	**0**	**0**	**228**	**57**	**76**
HQ - D	**0**	**0**	**0**	**550**	**138**	**183**

Table 9-9: Priority based on Utilization of MW Interface Upgrade

Priority Based on Utilization above Existing Limit						
Interface	**#1**	**#2**	**#3**	**#4**	**AVG (1-4)**	**AVG (2-4)**
Marcy South	0%	21.9%	100.0%	21.9%	36.0%	47.9%
Volney East	0%	34.5%	54.0%	31.0%	29.9%	39.8%
CE Group	0%	31.7%	56.4%	25.5%	28.4%	37.9%
Total East	0%	40%	0%	72.4%	28.2%	37.6%
West Central	0%	42%	31%	37.5%	27.7%	37.0%
Central East	0%	39%	46%	24.6%	27.3%	36.4%
I to J	0%	35%	35%	37.6%	26.9%	35.8%
Y49Y50	0%	29%	49%	25.1%	25.9%	34.5%
F to G	0%	20%	41%	26.4%	21.7%	29.0%
UPNY-SENY	0%	18%	34%	26.3%	19.6%	26.1%
Moses South	0%	0%	0%	33.7%	8.4%	11.2%
HQ - D	0%	0%	0%	99%	25%	33.0%

9.6 Key Findings

The need for long term expansion of the NYCA transmission grid is highly dependent on assumptions of load growth, location and magnitude of future resource capacity additions, and assumed emergency assistance from neighboring control areas.

New resource capacity, assumed in Downstate (Scenario 1), was shown to mitigate or eliminate the need for transmission expansion for the study horizon (without consideration of aged infrastructure, which is considered in Phase II). Conversely assumption with new resource capacity in Upstate (Scenario 2), showed the need to expand the transmission system to satisfy system reliability requirements. Even with 90% of new resource capacity added to all zones in proportion to the respective zonal loads (Scenario 3) there is need to upgrade the transmission system in order to meet system reliability requirement. Relying on external import for new resource capacity will require not only NYCA transmission system upgrade but also import/export interfaces.

10 REFERENCES

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