FINAL REPORT

REVIEW OF DUNKIRK MOTHBALL NOTICE – Part 1

Version 0

July 27, 2012

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Version	Date	Modification	Author(s)	Reviews and Approvals by
0	July 27, 2012	Initial Document	J. Maher	C. Sedewitz, Director Transmission Planning

1. Executive Summary

This report reviews the system impact of the shutdown of coal fired generation at the Dunkirk facility in Western NY. Notice was received on March 14 2012 that NRG plans to place the units in protective layup for an unknown amount of time.

The following analysis shows that loss of these units would result in thermal and voltage problems [redacted] in Western NY. Chief among these concerns are low 230kV voltages at Gardenville and Huntley for various N-1 single element, N-1 multiple element and N-1-1 multiple element outages. [redacted] was the identification that many low voltage conditions that have been identified as existing on the 115kV system following an outage would be worse following the loss of support at Dunkirk. Some of these concerns are present even with Dunkirk generation in service, but the hours of exposure and load shedding that would be required to correct the system problems at peak times would both increase.

Once this determination was made, a review was begun to determine if running one or more units at Dunkirk could either correct or significantly reduce the exposure to these problems. This analysis has concluded that during peak periods, [redacted] This level of generation also reduces the exposure to outages on the 115kV system. Based on a review of the study results, it was concluded that for the summer, support of the 230kV voltages was critical and would require use of at least one 230kV connected unit and a second unit at either voltage. For the winter, the more critical issue is supporting the local 115kV voltages, which could be better achieved using two 115kV connected units. Two units would not be necessary during off peak periods.

In additional to these needs identified by this assessment, the risk of unplanned long duration outages of generators [redacted] or the failure of transformers or other major system components has also been considered. To protect against these concerns, it is recommended that a third unit also be available for summer periods. Based on feedback from System Operators, it is recommended that this third unit be the second 115kV connected machine.

System reinforcements will be necessary to restore the system to an acceptable level of service following the retirement of the units. The specific long term upgrades that would be necessary have not been identified. However, this study did examine the impact of completing several short duration projects. These included installation of 115kV capacitor banks at Gardenville, Dunkirk and Homer Hill, installation of 230kV bus tie breakers at Huntley and Packard and changing the transmission line supply for several distribution stations. Studies determined that completing these projects would allow the number of units necessary for system operation to be reduced to one, year round. No additional unit would be required to protect for an unexpected failure. A review of options to correct the thermal and voltage concerns that are present if no units were in service will be the subject of a follow up study and is not discussed here.

As noted in this assessment, loss of these units increases the reliance on the local 115kV connected generators. It is expected that they would need to run more often to support the system. If one or more of these local plants were not available for some reason, [redacted] area voltage problems would develop during contingency conditions. [redacted] The weakened system would also result in an increased exposure (severity and number of hours per year) to these voltage concerns. Again, it would be expected that major system reinforcements, likely with lead times in excess of five years, would be necessary to correct these.

Therefore based on the system analysis presented in this report, it is recommended that at least two Dunkirk units be available to system operators for the winter of 2012-2013. Assuming that the proposed quick upgrades or system reinforcements discussed above are completed by June 1, 2013, the number of units that need to remain in service following June 1 can be reduced to one. Absent any of these projects, the number of units that would have been required would have been three.

Additional upgrades are currently being reviewed to determine what will be necessary to reduce the number of units to zero. It is expected that this will require at least the completion of the Five Mile Road 345/115kV station that is expected to be completed by June 2015 in and possibly other system reinforcements.

2. Introduction

This report examines the impact of the announced closure of the generation at the Dunkirk facility in western NY. This includes the shutdown of all four units. The second phase of this study was a review of the system with one or more of the units remaining in service, to assess the need to run generation until permanent reinforcements could be implemented. The third phase of analysis looked at the impact of completing several short duration projects to determine if the number of units needed to support the system could be reduced.

3. Study Details

This review was done using the summer and winter 2012 cases that were used in the 2011 needs assessment of the area. Information on these cases, including load levels, forecasts and generation dispatch can be found in sections 4 and 5 of the 2011 Needs Assessment report[1]. It is believed that the load magnitude and distribution across the system used in the 2011 study is representative of the peak loads that would be expected for the summer of 2013. The following sections discuss important aspects of or changes to the base cases.

3.1. System Generation

Four system base case conditions were reviewed as shown in the table below. All analysis assumes that the 230kV connected generation at Huntley, the 115kV connected generation at Indeck Yerkes and the 115kV connected generation at Oxbow power (both connected to the system near Huntley) were in service. [redacted]

All wind generation at Arcade and Steel winds was modeled as out of service.

The study was done with cases that included the Warren – Falconer #171 out of service in the base case. Additional information on this circuit can be found in section 4.7 of the 2011 Needs Assessment.

Table 1: Study Base Case Conditions

Huntley Units 67 and 68	Indeck Yerkes	Oxbow Power	Indeck Olean	Line 171	Jamestown Net Load
In Service	In Service	In Service	In Service	Out of Service	~0 MW
In Service	In Service	In Service	In Service	Out of Service	~75-80 MW
In Service	In Service	In Service	Out of Service	Out of Service	~0 MW
In Service	In Service	In Service	Out of Service	Out of Service	~75-80 MW

3.2. Jamestown Generation and Load

As noted in the table above, two Jamestown net load levels were reviewed. One condition assumed that the net load at Jamestown was 75-80 MW. This is consistent with Jamestown's typical net demand seen by the system and is for conditions with Jamestown running at least one generator. Jamestown has three generators, two of which are coal fired (25 MW each), the last being natural gas fired (45 MW).

No testing was done with Jamestown at their full load of about 100 MW, which was the second condition studied in the 2011 needs assessment. Instead testing was done with a Jamestown net load of approximately 0 MW, which represents a case with all

[1] 2011 Western Division Area Review Part 1 – Needs Assessment version 0, dated August 24, 2011

three of the Jamestown generators in service. While it is not Jamestown's typical practice to run this much generation, system operators can call on Jamestown to run generation to support the system. Some preliminary information has been received suggesting that one of the coal units may be retired. If this is the case, then the 0 MW cases will no longer be applicable.

During testing, an N-1 outage of any of the Jamestown generators was reviewed.

3.3. Huntley Capacitor Bank and Use of the Mobile Capacitor Banks

The current schedule for the completion of the installation of a permanent 115kV 75 MVAr capacitor bank at Huntley has the bank in service in the spring of 2013. Associated with this project is the removal of the two 52.5 MVAr mobile capacitor banks at Huntley. These units would then be available for installation at a new location as soon as winter 2012/13.

Due to concerns with low 230kV voltage at Gardenville, the plan has been to install these units at Gardenville. Initially testing for this assessment was done without these mobile units at Gardenville, partially due to uncertainty with the project schedule. This analysis found that one of the most significant issues the system would experience without the Dunkirk generation was low 230kV voltages at Gardenville. To help partially address this, study base cases were revised to include the installation of the mobile capacitors banks at Gardenville. Later phases of this study review the impact of installing permanent capacitor banks at Gardenville and moving the mobiles to another location. This is discussed later in this report.

3.4. Gardenville 230/115kV Transformers

System Operators frequently adjust the LTC settings of the National Grid and NYSEG 230/115kV transformers at Gardenville. This is done to maintain the 115kV voltages at an acceptable level. For nearly all hours between June 2003 and September 2010, the 115kV voltage at Gardenville was above 102% of nominal. The voltages were at 103%-105% of nominal about 96% of the time. In all study base cases, the transformers were adjusted to hold the 115kV voltage to about 104.5%. This did not result in any 230kV pre-contingency voltages being outside acceptable limits, but did contribute to some of the low post-contingency 230kV voltages. If the transformers had not been adjusted, the 230kV voltages would have been better post-contingency, but the 115kV voltages would have been much worse post-contingency.

3.5. Dunkirk 230/115kV Transformers

System Operators almost never adjust the LTC settings of the 230/115kV transformers at Dunkirk. Typically, the generation is used to manage the 115kV and 230kV voltages. Loss of these machines will require that LTC adjustment begin being used. In the first two phases of the analysis (loss of all units and review of the system with one or more units in service) the LTC's were left at their current setting, as this was believed to be the best alternative. When considering the impact of doing the short duration projects, it was found that the system response could be improved by adjusting these settings. For each season, year and dispatch, the voltages in the area were reviewed and a setting chosen to hold the Dunkirk 115kV voltage up around 105%. Today operating procedures allow the voltages to be held higher, up to 107%, but 105% was used to maintain some system margin.

3.6. Beck – Packard #76

The Beck – Packard 230kV line #76 is currently out of service due to the failure of the voltage regulating transformer at Beck. [redacted] A project to replace the regulator is expected to be complete in late 2012 or early 2013. As such, the line was modeled as in service in all study base cases. It is not believed that whether the line is in or out of service would have any material impact on the results of this study.

4. Study Methodology

4.1. Voltage Criteria

The voltage and thermal criteria normally used in planning studies is detailed in section 6 of the 2011 Needs Assessment. However, during initial work on this analysis, it was decided that this study should be performed to mirror the analysis that is done by system operators, thus turning this into more of an operating study instead of a planning study.

There are two main differences between an operating study and a planning study; the types of contingencies tested and the limits used.

When operators are securing the system, the voltages used to determine if action needs to be taken are detailed in Power Control Order 2-1. The voltage thresholds are divided into two limits; the Emergency Low Limit (ELL) and the Load Shed Limit (LSL). The limits are applied as follows:

- If the real time voltages or the predicted post contingency voltages are below the ELL, all possible actions short of load shedding are taken to raise the voltage.
- If the predicted post-contingency voltages are below the LSL and all possible actions short of load shedding have already been taken, a contingency plan is developed that would be implemented if the contingency/low voltages actually occurred. Pre-contingency load shedding would not be performed.
- If the real time voltage fell below the LSL and all possible actions short of load shedding have already been taken, load shedding would be done.

For this study, the LSL was the main voltage threshold used to determine if the system response to a contingency was acceptable. All pre-contingency voltages were monitored to ensure that they remained above the ELL for all hours. Post-contingency results showing voltages below the ELL but above the LSL are discussed, but are provided for information only. It is acknowledged that accepting this analysis will mean that there will be hours where the system voltages would be predicted to fall below the ELL for contingency conditions. However all voltages would be above the LSL for contingency conditions and above the ELL with all lines in service.

The ELL and LSL for each of the 230kV and 115kV buses within National Grid's control in western NY are shown in the table below.

For screening purposes, the voltage limits used for NYSEG buses in the area were 217kV and 207kV for the Stolle and Robinson Rd 230kV buses and 108kV and 100kV for the Stolle, Robinson Rd and Erie 115kV buses. National Grid limits were used for the jointly owned buses at Gardenville.

Table 2: Study Voltage Levels

Station	Voltage	Emergency Low Limit (kV)	Emergency Low Limit (pu)	Load Shed Limit (kV)	Load Shed Limit (pu)
Dunkirk - Gen In Service	230	[redacted]	[redacted]	[redacted]	[redacted]
Huntley - Gen In Service	230	[redacted]	[redacted]	[redacted]	[redacted]
Dunkirk - Gen Out of Service	230	[redacted]	[redacted]	[redacted]	[redacted]
Huntley - Gen Out of Service	230	[redacted]	[redacted]	[redacted]	[redacted]
Packard	230	[redacted]	[redacted]	[redacted]	[redacted]
Gardenville	230	[redacted]	[redacted]	[redacted]	[redacted]
Stolle Rd	230	[redacted]	[redacted]	[redacted]	[redacted]
Robinson Rd	230	[redacted]	[redacted]	[redacted]	[redacted]
Dunkirk - Gen In Service	115	[redacted]	[redacted]	[redacted]	[redacted]
Dunkirk - Gen Out of Service	115	[redacted]	[redacted]	[redacted]	[redacted]
Gardenville	115	[redacted]	[redacted]	[redacted]	[redacted]
Homer Hill	115	[redacted]	[redacted]	[redacted]	[redacted]
Huntley	115	[redacted]	[redacted]	[redacted]	[redacted]
Lockport	115	[redacted]	[redacted]	[redacted]	[redacted]
Walck Rd - Gen In Service	115	[redacted]	[redacted]	[redacted]	[redacted]
Walck Rd - Gen Out of Service	115	[redacted]	[redacted]	[redacted]	[redacted]
Andover	115	[redacted]	[redacted]	[redacted]	[redacted]
Arcade	115	[redacted]	[redacted]	[redacted]	[redacted]
Falconer	115	[redacted]	[redacted]	[redacted]	[redacted]
Packard	115	[redacted]	[redacted]	[redacted]	[redacted]
Packard	115	[redacted]	[redacted]	[redacted]	[redacted]
Stolle Rd	115	[redacted]	[redacted]	[redacted]	[redacted]
Robinson Rd	115	[redacted]	[redacted]	[redacted]	[redacted]
Erie	115	[redacted]	[redacted]	[redacted]	[redacted]

4.2. Thermal Criteria

For this analysis, loadings that were above the elements normal rating pre-contingency or above the elements STE rating post contingency are noted as unacceptable. If the loading was above the elements LTE rating, this is noted but depending on the condition, may be considered acceptable.

4.3. Contingencies Tested

The contingencies secured for depend on the voltage level. NYISO operators will secure the NPCC Bulk Power System (BPS) in Western NY for all required contingencies, including any single line outage, any double circuit tower outage, any bus fault and any fault with a breaker failure.

Operators will also secure the BPS system for an N-1-1 condition if the first outage is a planned outage (such as a maintenance condition) or in real time following an actual unplanned outage. Operators will not secure the system for an N-1-1 condition where the first outage is not planned and has not actually occurred. For example if line Y is planned to be out of service, operators will review the system and secure the system for an outage of line Y followed by any other contingency. A second example could start with line Y unexpectedly tripping. Operators would review how the system would respond following any other contingency and take action if necessary. If this condition were to occur in real time, the system changes that operators could use to solve the problem could be limited. For instance, when the line trips, it is found that the next contingency would create thermal or voltage problems, which could be corrected if a generator were in service. If this generator could not be started in a reasonable amount of time, this would not be an acceptable solution to the real time problem.

For the non-BPS system, operators will secure for any single element outage such as a line, transformer or critical generator tripping. In most cases, the system would not be secured for a double circuit tower outage, bus fault or a fault with a breaker failure. Operators will secure for an N-1-1 outage of a single element followed by another single element only if the first element outage is planned or out of service in real time.

This study considers these various outages conditions by breaking the analysis into several levels. The analysis indicates if the contingency being considered is a single element outage, N-1 multiple element outage with normal clearing (such as a double circuit tower outage or a bus fault), an N-1 multiple element outage with breaker failure (such as a bus fault with a breaker failure which results in an outage to multiple bus sections) or an N-1-1 outage.

5. System Response for Outage of all Dunkirk Generation

The following tables show the results of testing for the system with all Dunkirk units out of service and for comparison purposes the cases with all Dunkirk units in service. The results are presented for a limited number of contingencies that were found to result in the worst system response. Other contingencies may have also resulted in low voltages or overloads. During the analysis, some of the contingencies did not converge; this is indicated by NC in the tables. Only thermal overloads for the summer cases are provided.

For the selected contingencies, values are shown in the tables if the voltages fell below the Operators Emergency Low Limit.

All tables within this report use a short description to indicate the contingency being presented. Space constraints prevent fully describing the contingency. A full description for each outage can be found in Appendix C of the 2011 Needs Assessment. All contingencies listed in Appendix C were tested as part of this assessment.

Note that in some tables within this report, low voltages are noted that may be below 85% and in some instances below 60%. While the system model was able to converge and provide a solution, it should not be expected that the real system would behave in a similar manner. It is difficult to determine how the actual system would respond to contingencies that result in voltages this low.

The results can be summarized as follows:

- For the existing system, the 230kV voltages are above the Emergency Low Limit for all winter cases and contingencies and above the Load Shed Limit for all summer cases and contingencies.
- For the cases with the Dunkirk units out of service, many contingencies resulted in the 230kV voltages falling below the Emergency Low Limit with many falling below the Load Shed Limit.
- There are problems on the 115kV system whether the Dunkirk units are in service or not for both the summer and winter. The issues that exist in the area with the Dunkirk units in service are documented in the 2011 Western Division Area Review Needs Assessment.
- The 115kV problems are much more severe in cases with the Dunkirk units out of service, both in terms of the voltage magnitude and number of contingencies that create

problems. From this it can be assumed that the number of hours of exposure and the amount of load shedding that would be required to address the 115kV issues would be greater with Dunkirk out of service.

- Thermal loadings on some circuits, especially in the Niagara area, do increase. In some instances, the loadings will surpass the LTE ratings. [redacted] An operating exception in the NYSRC rules allows these facilities to be loaded up to their STE rating.
- Only one case resulted in loadings above the facilities STE rating. [redacted]

In all tables within this report, the abbreviations are as follows. As a reminder, descriptions to all contingency abbreviations can be found in the appendix to the 2011 Western Division Area Review Part 1 – Needs Assessment.

AND = Andover

DUN = Dunkirk

FAL = Falconer

GV= Gardenville (National Grid)

GVNY = Gardenville (NYSEG)

HH = Homer Hill

HUN = Huntley

NC = Non-Convergence of power flow contingency case

PK = Packard

STLE = Stolle Road.

Table 3: Summer 230kV Analysis: Indeck in Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Summer 2012	Summer 2012
Indeck Olean	In Service	In Service
Line #171	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage
Pre-contingency	-	[redacted]
68 230	-	[redacted]
37 NYSEG	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
68+160	-	[redacted]
37+67	-	[redacted]
DUN 230-2	-	[redacted]
DUN 230-1	-	-
HUN230 BS67/68	-	[redacted]
PK230 2+4	-	[redacted]
HUN 230-1+2	[redacted]	[redacted]

Table 4: Summer 230kV Analysis: Indeck in Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Summer 2012	Summer 2012
Indeck Olean	In Service	In Service
Line #171	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage
Pre-contingency	-	[redacted]
68 230	-	[redacted]
37 NYSEG	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
68+160	-	[redacted]
37+67	-	[redacted]
DUN 230-2	-	[redacted]
DUN 230-1	-	-
HUN230 BS67/68	-	[redacted]
PK230 2+4	-	[redacted]
HUN 230-1+2	[redacted]	[redacted]

Table 5: Summer 230kV Analysis: Indeck Out of Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Summer 2012	Summer 2012
Indeck Olean	Out of Service	Out of Service
Line #171	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage
Pre-contingency	-	[redacted]
68 230	-	[redacted]
37 NYSEG	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
68+160	-	[redacted]
37+67	-	[redacted]
DUN 230-2	-	[redacted]
DUN 230-1	-	[redacted]
HUN230 BS67/68	-	[redacted]
PK230 2+4	-	[redacted]
HUN 230-1+2	[redacted]	[redacted]

Table 6: Summer 230kV Analysis: Indeck Out of Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Summer 2012	Summer 2012
Indeck Olean	Out of Service	Out of Service
Line #171	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage
Pre-contingency	-	[redacted]
68 230	-	[redacted]
37 NYSEG	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
68+160	-	[redacted]
37+67	-	[redacted]
DUN 230-2	-	[redacted]
DUN 230-1	-	[redacted]
HUN230 BS67/68	-	[redacted]
PK230 2+4	-	[redacted]
HUN 230-1+2	[redacted]	[redacted]

Table 7: Winter 230kV Analysis: Indeck in Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Winter 2012	Winter 2012
Indeck Olean	In Service	In Service
Line #171	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage
Pre-contingency	-	-
68 230	-	-
37 NYSEG	-	-
77+78 230	-	-
77+80 230	-	-
78+79 230	-	-
79+80 230	-	[redacted]
68+160	-	-
37+67	-	-
DUN 230-2	-	[redacted]
DUN 230-1	-	-
HUN230 BS67/68	-	-
PK230 2+4	-	-
HUN 230-1+2	-	[redacted]

Table 8: Winter 230kV Analysis: Indeck In Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Winter 2012	Winter 2012
Indeck Olean	In Service	In Service
Line #171	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage
Pre-contingency	-	[redacted]
68 230	-	-
37 NYSEG	-	-
77+78 230	-	-
77+80 230	-	-
78+79 230	-	-
79+80 230	-	[redacted]
68+160	-	-
37+67	-	-
DUN 230-2	-	[redacted]
DUN 230-1	-	-
HUN230 BS67/68	-	-
PK230 2+4	-	[redacted]
HUN 230-1+2	-	-

Table 9: Winter 230kV Analysis: Indeck Out of Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Winter 2012	Winter 2012
Indeck Olean	Out of Service	Out of Service
Line #171	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage
Pre-contingency	-	[redacted]
68 230	-	[redacted]
37 NYSEG	-	-
77+78 230	-	[redacted]
77+80 230	-	-
78+79 230	-	-
79+80 230	-	[redacted]
68+160	-	-
37+67	-	-
DUN 230-2	-	[redacted]
DUN 230-1	-	-
HUN230 BS67/68	-	-
PK230 2+4	-	[redacted]
HUN 230-1+2	-	[redacted]

Table 10: Winter 230kV Analysis: Indeck Out of Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Winter 2012	Winter 2012
Indeck Olean	Out of Service	Out of Service
Line #171	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage
Pre-contingency	-	[redacted]
68 230	-	[redacted]
37 NYSEG	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
68+160	-	[redacted]
37+67	-	[redacted]
DUN 230-2	-	[redacted]
DUN 230-1	-	[redacted]
HUN230 BS67/68	-	[redacted]
PK230 2+4	-	[redacted]
HUN 230-1+2	-	[redacted]

Table 11: Summer 115kV Analysis: Indeck in Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Summer 2012	Summer 2012
Indeck Olean	In Service	In Service
Line #171	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage
Pre-contingency	-	-
68 230	-	-
37 NYSEG	-	-
66 NYSEG	-	-
151	-	[redacted]
152	-	-
167	-	-
HH CAP	-	-
AND CAP	-	-
FAL CAP	-	-
DUN TB31/41	-	-
INDECKO	-	[redacted]
JAMESTOWNU1/3	-	-
151 GV	-	[redacted]
152 GV	-	-
160 DUN	-	-
161 DUN	-	-
162 DUN	-	-
73+74 230	-	-
77+78 230	-	[redacted]
77+80 230	-	-
78+79 230	-	-
79+80 230	-	[redacted]
37+67	-	-
151+152	[redacted]	[redacted]
152+167	-	[redacted]
141+142	-	-
153+154	-	-
161+162	-	-
DUN 230-1	-	-
DUN 230-2	-	[redacted]
DUN 115-1	-	[redacted]
DUN 115-2	-	[redacted]
HUN230 BS67/68	-	-
FAL BUS1	-	[redacted]
FAL BUS2	-	[redacted]
HH BUS1	-	[redacted]
HH BUS2	-	-
GV230 BS1	-	-
GVNY230 BS7	-	-
GV115 BS3	-	-
GV115 BS4	-	[redacted]
STLE 230 BUS	-	-

Table 12: Summer 115kV Analysis: Indeck in Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Summer 2012	Summer 2012
Indeck Olean	In Service	In Service
Line #171	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage
Pre-contingency	-	-
68 230	-	[redacted]
37 NYSEG	-	[redacted]
66 NYSEG	-	[redacted]
151	-	[redacted]
152	-	[redacted]
167	-	-
HH CAP	-	[redacted]
AND CAP	-	[redacted]
FAL CAP	-	[redacted]
DUN TB31/41	-	[redacted]
INDECKO	-	[redacted]
JAMESTOWNU1/3	-	[redacted]
151 GV	-	[redacted]
152 GV	-	[redacted]
160 DUN	-	[redacted]
161 DUN	-	[redacted]
162 DUN	-	[redacted]
73+74 230	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
37+67	-	[redacted]
151+152	[redacted]	[redacted]
152+167	-	[redacted]
141+142	-	[redacted]
153+154	-	[redacted]
161+162	-	[redacted]
DUN 230-1	-	[redacted]
DUN 230-2	-	[redacted]
DUN 115-1	-	[redacted]
DUN 115-2	[redacted]	[redacted]
HUN230 BS67/68	-	[redacted]
FAL BUS1	-	[redacted]
FAL BUS2	-	[redacted]
HH BUS1	-	[redacted]
HH BUS2	-	[redacted]
GV230 BS1	-	[redacted]
GVNY230 BS7	-	[redacted]
GV115 BS3	-	[redacted]
GV115 BS4	-	[redacted]
STLE 230 BUS	-	[redacted]

Table 13: Summer 115kV Analysis: Indeck Out of Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Summer 2012	Summer 2012
Indeck Olean	Out of Service	Out of Service
Line #171	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage
Pre-contingency	-	[redacted]
68 230	-	[redacted]
37 NYSEG	-	[redacted]
66 NYSEG	-	[redacted]
151	[redacted]	[redacted]
152	[redacted]	[redacted]
167	-	[redacted]
HH CAP	-	[redacted]
AND CAP	-	[redacted]
FAL CAP	-	[redacted]
DUN TB31/41	-	[redacted]
INDECKO	-	-
JAMESTOWNU1/3	-	[redacted]
151 GV	[redacted]	[redacted]
152 GV	[redacted]	[redacted]
160 DUN	-	[redacted]
161 DUN	-	[redacted]
162 DUN	-	[redacted]
73+74 230	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
37+67	-	[redacted]
151+152	[redacted]	[redacted]
152+167	[redacted]	[redacted]
141+142	-	[redacted]
153+154	[redacted]	[redacted]
161+162	-	[redacted]
DUN 230-1	-	[redacted]
DUN 230-2	-	[redacted]
DUN 115-1	-	[redacted]
DUN 115-2	[redacted]	[redacted]
HUN230 BS67/68	-	[redacted]
FAL BUS1	-	[redacted]
FAL BUS2	-	[redacted]
HH BUS1	-	[redacted]
HH BUS2	-	[redacted]
GV230 BS1	-	[redacted]
GVNY230 BS7	-	[redacted]
GV115 BS3	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]
STLE 230 BUS	-	[redacted]

Table 14: Summer 115kV Analysis: Indeck Out of Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Summer 2012	Summer 2012
Indeck Olean	Out of Service	Out of Service
Line #171	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage
Pre-contingency	-	[redacted]
68 230	-	[redacted]
37 NYSEG	-	[redacted]
66 NYSEG	-	[redacted]
151	[redacted]	[redacted]
152	[redacted]	[redacted]
167	-	[redacted]
HH CAP	[redacted]	[redacted]
AND CAP	[redacted]	[redacted]
FAL CAP	-	[redacted]
DUN TB31/41	-	[redacted]
INDECKO	-	-
JAMESTOWNU1/3	-	[redacted]
151 GV	[redacted]	[redacted]
152 GV	[redacted]	[redacted]
160 DUN	[redacted]	[redacted]
161 DUN	-	[redacted]
162 DUN	-	[redacted]
73+74 230	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
37+67	-	[redacted]
151+152	[redacted]	[redacted]
152+167	[redacted]	[redacted]
141+142	-	[redacted]
153+154	[redacted]	[redacted]
161+162	[redacted]	[redacted]
DUN 230-1	-	[redacted]
DUN 230-2	-	[redacted]
DUN 115-1	-	[redacted]
DUN 115-2	[redacted]	[redacted]
HUN230 BS67/68	-	[redacted]
FAL BUS1	[redacted]	[redacted]
FAL BUS2	[redacted]	[redacted]
HH BUS1	-	[redacted]
HH BUS2	[redacted]	[redacted]
GV230 BS1	-	[redacted]
GVNY230 BS7	-	[redacted]
GV115 BS3	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]
STLE 230 BUS	-	[redacted]

Table 15: Winter 115kV Analysis: Indeck In Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Winter 2012	Winter 2012
Indeck Olean	In Service	In Service
Line #171	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage
Pre-contingency	-	-
68 230	-	-
37 NYSEG	-	-
66 NYSEG	-	-
151	-	[redacted]
152	-	-
167	-	-
HH CAP	-	-
AND CAP	-	-
FAL CAP	-	-
DUN TB31/41	-	-
INDECKO	-	[redacted]
JAMESTOWNU1/3	-	-
151 GV	-	[redacted]
152 GV	-	-
160 DUN	-	-
161 DUN	-	-
162 DUN	-	-
73+74 230	-	-
77+78 230	-	-
77+80 230	-	-
78+79 230	-	-
79+80 230	-	-
37+67	-	-
151+152	[redacted]	[redacted]
152+167	-	-
141+142	-	-
153+154	-	-
161+162	-	-
DUN 230-1	-	-
DUN 230-2	-	-
DUN 115-1	-	-
DUN 115-2	-	[redacted]
HUN230 BS67/68	-	-
FAL BUS1	-	-
FAL BUS2	-	-
HH BUS1	-	[redacted]
HH BUS2	-	-
GV230 BS1	-	-
GVNY230 BS7	-	-
GV115 BS3	-	-
GV115 BS4	-	[redacted]
STLE 230 BUS	-	-

Table 16: Winter 115kV Analysis: Indeck In Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Winter 2012	Winter 2012
Indeck Olean	In Service	In Service
Line #171	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage
Pre-contingency	-	-
68 230	-	-
37 NYSEG	-	-
66 NYSEG	-	-
151	[redacted]	[redacted]
152	-	-
167	-	-
HH CAP	-	-
AND CAP	-	[redacted]
FAL CAP	-	-
DUN TB31/41	-	-
INDECKO	-	[redacted]
JAMESTOWNU1/3	-	-
151 GV	[redacted]	[redacted]
152 GV	-	[redacted]
160 DUN	-	[redacted]
161 DUN	-	-
162 DUN	-	-
73+74 230	-	[redacted]
77+78 230	-	-
77+80 230	-	-
78+79 230	-	-
79+80 230	-	[redacted]
37+67	-	-
151+152	[redacted]	[redacted]
152+167	-	[redacted]
141+142	-	-
153+154	-	[redacted]
161+162	-	[redacted]
DUN 230-1	-	-
DUN 230-2	-	[redacted]
DUN 115-1	-	[redacted]
DUN 115-2	[redacted]	[redacted]
HUN230 BS67/68	-	-
FAL BUS1	-	[redacted]
FAL BUS2	-	[redacted]
HH BUS1	[redacted]	[redacted]
HH BUS2	-	-
GV230 BS1	-	-
GVNY230 BS7	-	-
GV115 BS3	-	[redacted]
GV115 BS4	-	[redacted]
STLE 230 BUS	-	-

Table 17: Winter 115kV Analysis: Indeck Out of Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Winter 2012	Winter 2012
Indeck Olean	Out of Service	Out of Service
Line #171	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage
Pre-contingency	-	-
68 230	-	[redacted]
37 NYSEG	-	[redacted]
66 NYSEG	-	[redacted]
151	[redacted]	[redacted]
152	[redacted]	[redacted]
167	-	[redacted]
HH CAP	-	[redacted]
AND CAP	[redacted]	[redacted]
FAL CAP	-	[redacted]
DUN TB31/41	-	[redacted]
INDECKO	-	-
JAMESTOWNU1/3	-	[redacted]
151 GV	[redacted]	[redacted]
152 GV	[redacted]	[redacted]
160 DUN	[redacted]	[redacted]
161 DUN	-	[redacted]
162 DUN	-	[redacted]
73+74 230	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
37+67	-	[redacted]
151+152	[redacted]	[redacted]
152+167	[redacted]	[redacted]
141+142	-	[redacted]
153+154	[redacted]	[redacted]
161+162	-	[redacted]
DUN 230-1	-	[redacted]
DUN 230-2	-	[redacted]
DUN 115-1	-	[redacted]
DUN 115-2	[redacted]	[redacted]
HUN230 BS67/68	-	[redacted]
FAL BUS1	[redacted]	[redacted]
FAL BUS2	[redacted]	[redacted]
HH BUS1	-	[redacted]
HH BUS2	-	[redacted]
GV230 BS1	-	[redacted]
GVNY230 BS7	-	[redacted]
GV115 BS3	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]
STLE 230 BUS	-	[redacted]

Table 18: Winter 115kV Analysis: Indeck Out of Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
Season/year	Winter 2012	Winter 2012
Indeck Olean	Out of Service	Out of Service
Line #171	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage
Pre-contingency	-	-
68 230	-	[redacted]
37 NYSEG	-	[redacted]
66 NYSEG	-	[redacted]
151	[redacted]	[redacted]
152	[redacted]	[redacted]
167	[redacted]	[redacted]
HH CAP	[redacted]	[redacted]
AND CAP	[redacted]	[redacted]
FAL CAP	-	[redacted]
DUN TB31/41	-	[redacted]
INDECKO	-	-
JAMESTOWNU1/3	-	[redacted]
151 GV	[redacted]	[redacted]
152 GV	[redacted]	[redacted]
160 DUN	[redacted]	[redacted]
161 DUN	-	[redacted]
162 DUN	-	[redacted]
73+74 230	-	[redacted]
77+78 230	-	[redacted]
77+80 230	-	[redacted]
78+79 230	-	[redacted]
79+80 230	-	[redacted]
37+67	-	[redacted]
151+152	[redacted]	[redacted]
152+167	[redacted]	[redacted]
141+142	[redacted]	[redacted]
153+154	[redacted]	[redacted]
161+162	[redacted]	[redacted]
DUN 230-1	-	[redacted]
DUN 230-2	-	[redacted]
DUN 115-1	[redacted]	[redacted]
DUN 115-2	[redacted]	[redacted]
HUN230 BS67/68	-	[redacted]
FAL BUS1	[redacted]	[redacted]
FAL BUS2	[redacted]	[redacted]
HH BUS1	-	[redacted]
HH BUS2	[redacted]	[redacted]
GV230 BS1	-	[redacted]
GVNY230 BS7	-	[redacted]
GV115 BS3	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]
STLE 230 BUS	-	[redacted]

Table 19: Summer Thermal Analysis: Indeck In Service, Jamestown ~0 MW

	Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
	Season/year	Summer 2012	Summer 2012
	Indeck Olean	In Service	In Service
	Line #171	Out of Service	Out of Service
	Jamestown Load	~0 MW	~0 MW
Element	Contingency	% of LTE	% of LTE
Huntley - Gardenville #80	79 230	-	-
Niagara - Packard #62	61+64 230	-	-
Gardenville - Dunkirk #141	73+74 230	-	-
Niagara - Gardenville #180	77+78 230	-	-
Packard - Erie #181	77+78 230	-	[redacted]
Packard - Gardenville #182	77+78 230	-	-
Huntley - Gardenville #80	78+79 230	-	-
Niagara - Gardenville #180	79+80 230	-	[redacted]
Packard - Erie #181	79+80 230	-	[redacted]
Packard - Gardenville #182	79+80 230	-	[redacted]
Packard - Gardenville #182	180+181	-	-
Packard - Erie #181	180+182N	-	[redacted]
Packard - Erie #181	180+182S	-	[redacted]
Dunkirk TB #41/31	DUN TB31/41	-	-
Dunkirk TB #41	DUN 230-1	-	-
Niagara - Packard #192	191	[redacted]	[redacted]
Niagara - Packard #191	192	-	[redacted]
Niagara - Packard #192	61+191	[redacted]	[redacted]
Niagara - Packard #192	101+191	[redacted]	[redacted]
Niagara - Packard #191	192+195	-	[redacted]

Table 20: Summer Thermal Analysis: Indeck In Service, Jamestown ~70 MW

	Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
	Season/year	Summer 2012	Summer 2012
	Indeck Olean	In Service	In Service
	Line #171	Out of Service	Out of Service
	Jamestown Load	~70 MW	~70 MW
Element	Contingency	% of LTE	% of LTE
Huntley - Gardenville #80	79 230	-	[redacted]
Niagara - Packard #62	61+64 230	-	-
Gardenville - Dunkirk #141	73+74 230	-	-
Niagara - Gardenville #180	77+78 230	-	[redacted]
Packard - Erie #181	77+78 230	-	[redacted]
Packard - Gardenville #182	77+78 230	-	-
Huntley - Gardenville #80	78+79 230	-	-
Niagara - Gardenville #180	79+80 230	-	[redacted]
Packard - Erie #181	79+80 230	-	[redacted]
Packard - Gardenville #182	79+80 230	-	[redacted]
Packard - Gardenville #182	180+181	-	-
Packard - Erie #181	180+182N	-	[redacted]
Packard - Erie #181	180+182S	-	[redacted]
Dunkirk TB #41/31	DUN TB31/41	-	-
Dunkirk TB #41	DUN 230-1	-	-
Niagara - Packard #192	191	[redacted]	[redacted]
Niagara - Packard #191	192	-	[redacted]
Niagara - Packard #192	61+191	[redacted]	[redacted]
Niagara - Packard #192	101+191	[redacted]	[redacted]
Niagara - Packard #191	192+195	-	[redacted]

Table 21: Summer Thermal Analysis: Indeck Out of Service, Jamestown ~0 MW

	Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
	Season/year	Summer 2012	Summer 2012
	Indeck Olean	Out of Service	Out of Service
	Line #171	Out of Service	Out of Service
	Jamestown Load	~0 MW	~0 MW
Element	Units 1-4 IS	Units 1-4 OOS	% of LTE
Huntley - Gardenville #80	79 230	-	[redacted]
Niagara - Packard #62	61+64 230	-	[redacted]
Gardenville - Dunkirk #141	73+74 230	-	-
Niagara - Gardenville #180	77+78 230	-	[redacted]
Packard - Erie #181	77+78 230	-	[redacted]
Packard - Gardenville #182	77+78 230	-	[redacted]
Huntley - Gardenville #80	78+79 230	-	-
	79+80 230	-	[redacted]
	79+80 230	-	[redacted]
	79+80 230	-	[redacted]
Packard - Gardenville #182	180+181	-	[redacted]
Packard - Erie #181	180+182N	-	[redacted]
Packard - Erie #181	180+182S	-	[redacted]
Dunkirk TB #41/31	DUN TB31/41	-	-
Dunkirk TB #41	DUN 230-1	-	-
Niagara - Packard #192	191	[redacted]	[redacted]
Niagara - Packard #191	192	-	[redacted]
Niagara - Packard #192	61+191	[redacted]	[redacted]
Niagara - Packard #192	101+191	[redacted]	[redacted]
Niagara - Packard #191	192+195	-	[redacted]

Table 22: Summer Thermal Analysis: Indeck Out of Service, Jamestown ~70 MW

	Dunkirk Status	Units 1-4 IS	Units 1-4 OOS
	Season/year	Summer 2012	Summer 2012
	Indeck Olean	Out of Service	Out of Service
	Line #171	Out of Service	Out of Service
	Jamestown Load	~70 MW	~70 MW
Element	Units 1-4 IS	Units 1-4 OOS	% of LTE
Huntley - Gardenville #80	79 230	-	[redacted]
Niagara - Packard #62	61+64 230	-	[redacted]
Gardenville - Dunkirk #141	73+74 230	-	[redacted]
	77+78 230	-	[redacted]
	77+78 230	-	[redacted]
Packard - Gardenville #182	77+78 230	-	[redacted]
Huntley - Gardenville #80	78+79 230	-	[redacted]
Niagara - Gardenville #180	79+80 230	-	[redacted]
Packard - Erie #181	79+80 230	-	[redacted]
Packard - Gardenville #182	79+80 230	-	[redacted]
Packard - Gardenville #182	180+181	-	[redacted]
Packard - Erie #181	180+182N	-	[redacted]
Packard - Erie #181	180+182S	-	[redacted]
Dunkirk TB #41/31	DUN TB31/41	-	[redacted]
Dunkirk TB #41	DUN 230-1	-	[redacted]
Niagara - Packard #192	191	[redacted]	[redacted]
Niagara - Packard #191	192	-	[redacted]
Niagara - Packard #192	61+191	[redacted]	[redacted]
Niagara - Packard #192	101+191	[redacted]	[redacted]
Niagara - Packard #191	192+195	-	[redacted]

6. Review of Dunkirk Generation Needs

Analysis similar to the previous section was done for several possible combinations of Dunkirk generation. This was done to determine what combinations would result in acceptable system operation while long term system reinforcements are developed and constructed. As discussed earlier in this document, acceptable voltages are defined as being above the LSL post-contingency and above the ELL pre-contingency.

This analysis was split into three sections. The first discusses what generation would need to be in service to keep the 230kV voltages above their load shed limit for any N-1 contingency, including double circuit tower outages, bus faults and line, transformer or bus faults with a breaker failure. The next section discusses the system issues on the 115kV system. The final section discusses some limited N-1-1 conditions, focusing on their impact on the 230kV system.

In order to simplify this discussion, the tables in the following sections only provide a pass/fail indication. If one contingency resulted in a voltage that was 0.1% below the load shed limit, it resulted in Fail being indicated.

For those tests that resulted in a Fail, an indication is provided of how many hours per summer or winter season the contingency would have resulted in voltages below the load shed limit. This testing was done by scaling all conforming loads in the Western zone down in increments until the voltages reached an acceptable level. A load duration curve, created from four years of Zone A load data, was then used to estimate the number of hours where the load surpassed the capability. This was done using four years of zonal loads, averaged together to represent a typical year. All NYSEG, NYPA, sub-transmission and National Grid conforming load in zone A and B was scaled. The transmission connected customers were not scaled up or down. Some customers have higher loads in off peak periods, which could negatively affect the voltage problems; this was ignored. The scaling included the Arcade and Jamestown load. The Jamestown load noted in the table is the net load in the initial case and was lower as the load was scaled down.

As the load was scaled down, the pre-contingency voltage had to be within acceptable limits. If the voltage was above limits, capacitor banks at Gardenville, Falconer or Homer Hill were adjusted. The tap settings on the Gardenville transformers were also adjusted as appropriate. In many cases, this greatly increased the number of hours that generation was found to be needed to support the local 115kV system.

The testing does not reflect the generation changes that are observed during off peak periods. If one or more units were not in service, the results will change. The testing also does not reflect the fact that on any day, one or more system elements, including lines, transformers, generators or capacitor banks, could be out of service. These results are for N-1 conditions only.

6.1. Use of Dunkirk Generation in Real Time Operation

As discussed above, estimates for the number of hours of exposure are provided below. An indication of the hours of exposure is not the same thing as the number of hours that generation would need to be in service. While this is generally true for all generation, it is especially relevant when discussing use of generation at Dunkirk.

[redacted]

If the operators see one hour in their security analysis where the voltage is anticipated to be below the emergency low limits, generation would be called to run. If they are called, they run for 24 hours. Thus, an estimate of the number of hours does not reflect how many total hours or days generation would operate to support the system, which could be substantially longer. [redacted] The tables below only show the hours of exposure to the problems, not the number of hours that generation may be in service to support the system.

6.2. Review of Dunkirk Generation Needs for 230kV System Operation

The following tables summarize the conditions for which generation at Dunkirk would be needed to support the 230kV voltages under contingency conditions. This can be summarized as follows

- For conditions [redacted] at least one generator at either voltage would be required for 50 hours in the summer and at least two generators would be required for 25 of those hours. The two generators must include at least one 230kV connected unit. No generation was required for the winter.
- For conditions [redacted] at least one generator at either voltage would be required for 100 hours in the summer and at least two generators would be required for 25 of those hours. The two generators must include at least one 230kV connected unit. No generation was required for the winter.
- For conditions [redacted] at least one generator at either voltage would be required for 200 hours in the summer and at least two generators would be required for 50 of those hours. To provide adequate support the two generators should be the two 230kV connected units. One generator at either voltage would be required for 20 hours in the winter.
- For conditions [redacted] at least one generator at either voltage would be required for 200 hours in the summer and at least two generators at either voltage would be required for 100 of those hours. Three generators at either voltage would be required for 25 of those hours. One generator connected to the 115kV system would be required for 20 hours in the winter; one 230kV unit would not be enough.

Table 23: Generation Needs: Summer, Indeck In Service, Jamestown ~0 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with breaker failure	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 24: Generation Needs: Summer, Indeck In Service, Jamestown ~70 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with breaker failure	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 25: Generation Needs: Summer, Indeck Out of Service, Jamestown ~0 MW

Operator Load Shed Limits

Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with breaker failure	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 26: Generation Needs: Summer, Indeck Out of Service, Jamestown ~70 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-	Units 1/2/4	Units 2-	Units 3-	Units 2+4	Units 1+2	Units 2	Units 4	Units 1-4

	4 OOS	OOS	4 OOS	4 OOS	OOS	OOS	OOS	OOS	IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with breaker failure	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 27: Generation Needs: Winter, Indeck In Service, Jamestown ~0 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-	Units 1/2/4	Units 2-	Units 3-	Units 2+4	Units 1+2	Units 2	Units 4	Units 1-4

	4 OOS	OOS	4 OOS	4 OOS	OOS	OOS	OOS	OOS	IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with breaker failure	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 28: Generation Needs: Winter, Indeck In Service, Jamestown ~70 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS

Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with breaker failure	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 29: Generation Needs: Winter, Indeck Out of Service, Jamestown ~0 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV	0	1	0	0	1	2	2	1	2

Units In Service									
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with breaker failure	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 30: Generation Needs: Winter, Indeck Out of Service, Jamestown ~70 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2

Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 230kV voltages within load shed limit for N-1 multiple element outage with breaker failure	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

6.3. Review of Dunkirk Generation Needs for 115kV System Operation

An analysis similar to that discussed in the preceding section was also done for the 115kV system. These results are more complicated as even with all Dunkirk generation in service some problems exist. Depending on the season and status of generation at Jamestown and Indeck Olean, as many as eight different contingencies resulted in voltages below the load shed limit for the system with all generation at Dunkirk in service. [redacted]

Because of the problems that exist with all units in service, it is difficult to use only the Pass/Fail results to recommend how many units would be required. Instead, the review focused on restoring the system to the same level of exposure, using the estimated hours of risk. Based on the hours of risk, the following would be recommended. In the tables that follow, red indicates that the system is performing worse than the existing system with all Dunkirk generation in service. Green indicates that the system performance is similar to the existing system with all Dunkirk generation in service.

When reviewing these results, testing considered an N-1 multiple element outage with normal clearing, such as a double circuit tower outage or a bus fault. However, it should be noted that these contingencies are not normally secured for by system operators on the 115kV system.

- [redacted] at least two generators at either voltage would be required for 20 hours in the winter. One generator at either voltage would be required for 25 hours in the summer. This generation would result in all voltages being above the load shed limits for all hours.
- [redacted], at least two generators at either voltage would be required for 25 hours in the summer. This would result in all voltages being above the load shed limits for the summer. For the winter, at least one generator would be required for 75 hours. For up to 20 hours per winter there would continue to be an exposure to only multiple element contingencies (no single element contingencies) that cannot be corrected even by using all four Dunkirk units. The exposure to these problems would only be marginally reduced by using two Dunkirk units. Even less reduction was observed when going from two units to three or four units. The system performance was observed to be better when using at least one 115kV unit.
- [redacted] at least two generators at either voltage would be required for 25 hours in the summer. This would result in all voltages being above the load shed limits for the summer for any single element outage. For up to 200 hours per summer there would continue to be an exposure to only multiple element contingencies (no single element contingencies) that cannot be corrected even by using all four Dunkirk units. For the winter, at least one generator would be required for 175 hours. For up to 20 hours per winter, there would continue to be an exposure to single element contingencies and over 1000 hours there would be an exposure to multiple element contingencies that cannot be corrected even by using all four Dunkirk units. The exposure to these problems would only be marginally reduced by using two Dunkirk units. Even less reduction was observed when going from two units to three or four units. The system performance was

observed to be better when using at least one 115kV unit.

- [redacted] at least one generator at either voltage would be required for 100 hours in the summer and two would be required for 25 of those hours. This would result in all voltages being above the load shed limits for the summer for any single element outage. For up to 200 hours per summer there would continue to be an exposure to only multiple element contingencies (no single element contingencies) that cannot be corrected even by using all four Dunkirk units. For the winter, at least one generator would be required for 400 hours. For up to 20 hours per winter, there would continue to be an exposure to single element contingencies and over 1000 hours there would be an exposure to multiple element contingencies that cannot be corrected even by using all four Dunkirk units. The exposure to these problems would only be marginally reduced by using two Dunkirk units. Even less reduction was observed when going from two units to three or four units. The system performance was observed to be better when using at least one 115kV unit

Table 31: Local Generation Needs: Summer, Indeck In Service, Jamestown ~0 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 115kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 32: Local Generation Needs: Summer, Indeck In Service, Jamestown ~70 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 115kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 33: Local Generation Needs: Summer, Indeck Out of Service, Jamestown ~0 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 115kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 34: Local Generation Needs: Summer, Indeck Out of Service, Jamestown ~70 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 115kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 35: Local Generation Needs: Winter, Indeck In Service, Jamestown ~0 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 115kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 36: Local Generation Needs: Winter, Indeck In Service, Jamestown ~70 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 115kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 37: Local Generation Needs: Winter, Indeck Out of Service, Jamestown ~0 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 115kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 38: Local Generation Needs: Winter, Indeck Out of Service, Jamestown ~70 MW

Operator Load Shed Limits									
Dunkirk Status	Units 1-4 OOS	Units 1/2/4 OOS	Units 2-4 OOS	Units 3-4 OOS	Units 2+4 OOS	Units 1+2 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	1	0	0	1	2	2	1	2
Dunkirk 115kV Units In Service	0	0	1	2	1	0	1	2	2
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 115kV voltages above Operating Emergency Low Limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within load shed limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

6.4. Summary of N-1 System Needs

The key points from the previous sections are summarized here in order to make a recommendation on the minimum number of units that are required to support the system.

- The 230kV problems were found to be much worse in the summer, while the local 115kV problems were generally worse in the winter.
- For most base case conditions, two generators would be enough to correct the 230kV voltages above the load shed limits for the summer. Generally less than two units would be required to correct the winter voltages above the load shed limits.
- For most base case conditions, two generators would be enough to reduce the exposure to 115kV problems to a level similar to that of running all four units. Use of two units corrects nearly all post-contingency voltages above the load shed limits for a single element outage, which is the type of contingency for which the system is secured. Not all voltage problems for multiple element outages can be corrected, even by using all four units.
- The greatest correction to the 230kV voltages was provided by the 230kV connected units. The greatest correction to the 115kV voltages was provided by the 115kV connected units. [redacted]
- A review of thermal results from this testing and operator experience has shown [redacted]

Based on a review of all of these points, the ideal configuration to address the N-1 voltage concerns on the 230kV and 115kV system while also managing the overload concerns is one 230kV connected unit and one 115kV connected unit. This is somewhat of a compromise between the needs of the summer and the needs of the winter. The winter results would be better with two 115kV units, but the summer requires the use of at least one 230kV unit to support the 230kV voltages. Based on a review of bus fault impacts [redacted] This recommendation is revisited in later sections of this report, when the system improvement associated with several interim transmission projects is discussed.

The following tables show the voltage issues that would remain for conditions with two, three or four units in Service at Dunkirk. The information is provided for three or four units in service to show that additional generation does not provide significant benefits. These tables show the voltages that fall below the Emergency Low Limits, not just the Load Shed Limits. If the voltage was below the Load Shed Limit, or the case did not converge, this is indicated by red type.

Table 39: Remaining System Issues: Summer, Indeck In Service, Jamestown ~0 MW

Dunkirk Status	Units 2+4 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	1	2
Dunkirk 115kV Units In Service	1	1	2	2
Season/year	Summer 2012	Summer 2012	Summer 2012	Summer 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~0 MW	~0 MW	~0 MW	~0 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage
77+78 230	-	-	-	-
79+80 230	[redacted]	-	[redacted]	-
PK230 2+4	-	-	-	-
HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]

Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	-	-	-	-
152	-	-	-	-
167	-	-	-	-
HH CAP	-	-	-	-
AND CAP	-	-	-	-
151 GV	-	-	-	-
152 GV	-	-	-	-
160 DUN	-	-	-	-
161 DUN	-	-	-	-
77+78 230	-	-	-	-
79+80 230	-	-	-	-
37+67	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	-	-	-	-
141+142	-	-	-	-
153+154	-	-	-	-
161+162	-	-	-	-
DUN 230-1	-	-	-	-
DUN 115-1	-	-	-	-
DUN 115-2	-	-	-	-
FAL BUS1	-	-	-	-
FAL BUS2	-	-	-	-
HH BUS1	-	-	-	-
HH BUS2	-	-	-	-
GV115 BS3	-	-	-	-
GV115 BS4	-	-	-	-

Table 40: Remaining System Issues: Summer, Indeck In Service, Jamestown ~70 MW

Dunkirk Status	Units 2+4 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	1	2
Dunkirk 115kV Units In Service	1	1	2	2
Season/year	Summer 2012	Summer 2012	Summer 2012	Summer 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~70 MW	~70 MW	~70 MW	~70 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage
77+78 230	-	-	-	-
79+80 230	[redacted]	-	[redacted]	-
PK230 2+4	-	-	-	-
HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]

Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	-	-	-	-
152	-	-	-	-
167	-	-	-	-
HH CAP	-	-	-	-
AND CAP	-	-	-	-
151 GV	-	-	-	-
152 GV	-	-	-	-
160 DUN	-	-	-	-
161 DUN	-	-	-	-
77+78 230	-	-	-	-
79+80 230	-	-	-	-
37+67	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	-	-	-	-
141+142	-	-	-	-
153+154	-	-	-	-
161+162	-	-	-	-
DUN 230-1	-	-	-	-
DUN 115-1	-	-	-	-
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	-	-	-	-
FAL BUS2	-	-	-	-
HH BUS1	-	-	-	-
HH BUS2	-	-	-	-
GV115 BS3	-	-	-	-
GV115 BS4	-	-	-	-

Table 41: Remaining System Issues: Summer, Indeck Out of Service, Jamestown ~0 MW

Dunkirk Status	Units 2+4 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	1	2
Dunkirk 115kV Units In Service	1	1	2	2
Season/year	Summer 2012	Summer 2012	Summer 2012	Summer 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~0 MW	~0 MW	~0 MW	~0 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage
77+78 230	[redacted]	-	-	-
79+80 230	[redacted]	-	[redacted]	-
PK230 2+4	[redacted]	-	[redacted]	-
HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]

Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	[redacted]	[redacted]	[redacted]	[redacted]
152	-	-	-	[redacted]
167	-	-	-	-
HH CAP	-	-	-	-
AND CAP	-	-	-	-
151 GV	[redacted]	[redacted]	[redacted]	[redacted]
152 GV	[redacted]	[redacted]	[redacted]	[redacted]
160 DUN	-	-	-	-
161 DUN	-	-	-	-
77+78 230	-	-	-	-
79+80 230	[redacted]	-	-	-
37+67	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	[redacted]	[redacted]	[redacted]	[redacted]
141+142	-	-	-	-
153+154	[redacted]	[redacted]	[redacted]	[redacted]
161+162	-	-	-	-
DUN 230-1	-	-	-	-
DUN 115-1	[redacted]	-	-	-
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	-	-	-	-
FAL BUS2	-	-	-	-
HH BUS1	-	-	-	-
HH BUS2	-	-	-	-
GV115 BS3	[redacted]	[redacted]	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]	[redacted]	[redacted]

Table 42: Remaining System Issues: Summer, Indeck Out of Service, Jamestown ~70 MW

Dunkirk Status	Units 2+4 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	1	2
Dunkirk 115kV Units In Service	1	1	2	2
Season/year	Summer 2012	Summer 2012	Summer 2012	Summer 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~70 MW	~70 MW	~70 MW	~70 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage
77+78 230	[redacted]	-	[redacted]	-
79+80 230	[redacted]	[redacted]	[redacted]	-
PK230 2+4	[redacted]	-	[redacted]	-
HUN 230-1+2	[redacted]	[redacted]	[redacted]	-

Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	[redacted]	[redacted]	[redacted]	[redacted]
152	[redacted]	[redacted]	[redacted]	[redacted]
167	-	-	-	-
HH CAP	[redacted]	[redacted]	-	[redacted]
AND CAP	[redacted]	[redacted]	[redacted]	[redacted]
151 GV	[redacted]	[redacted]	[redacted]	[redacted]
152 GV	[redacted]	[redacted]	[redacted]	[redacted]
160 DUN	-	[redacted]	[redacted]	[redacted]
161 DUN	-	-	-	-
77+78 230	[redacted]	-	-	-
79+80 230	[redacted]	-	-	-
37+67	[redacted]	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	[redacted]	[redacted]	[redacted]	[redacted]
141+142	-	-	-	-
153+154	[redacted]	[redacted]	[redacted]	[redacted]
161+162	[redacted]	[redacted]	[redacted]	[redacted]
DUN 230-1	[redacted]	-	-	-
DUN 115-1	[redacted]	[redacted]	[redacted]	
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS2	[redacted]	[redacted]	[redacted]	[redacted]
HH BUS1	-	-	-	-
HH BUS2	[redacted]	[redacted]	[redacted]	[redacted]
GV115 BS3	[redacted]	[redacted]	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]	[redacted]	[redacted]

Table 43: Remaining System Issues: Winter, Indeck In Service, Jamestown ~0 MW

Dunkirk Status	Units 2+4 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	1	2
Dunkirk 115kV Units In Service	1	1	2	2
Season/year	Winter 2012	Winter 2012	Winter 2012	Winter 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~0 MW	~0 MW	~0 MW	~0 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage
77+78 230	-	-	-	-
79+80 230	-	-	-	-
PK230 2+4	-	-	-	-
HUN 230-1+2	-	-	-	-

Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	-	-	-	-
152	-	-	-	-
167	-	-	-	-
HH CAP	-	-	-	-
AND CAP	-	-	-	-
151 GV	-	-	-	-
152 GV	-	-	-	-
160 DUN	-	-	-	-
161 DUN	-	-	-	-
77+78 230	-	-	-	-
79+80 230	-	-	-	-
37+67	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	-	-	-	-
141+142	-	-	-	-
153+154	-	-	-	-
161+162	-	-	-	-
DUN 230-1	-	-	-	-
DUN 115-1	-	-	-	-
DUN 115-2	-	-	-	-
FAL BUS1	-	-	-	-
FAL BUS2	-	-	-	-
HH BUS1	-	-	-	-
HH BUS2	-	-	-	-
GV115 BS3	-	-	-	-
GV115 BS4	-	-	-	-

Table 44: Remaining System Issues: Winter, Indeck In Service, Jamestown ~70 MW

Dunkirk Status	Units 2+4 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	1	2
Dunkirk 115kV Units In Service	1	1	2	2
Season/year	Winter 2012	Winter 2012	Winter 2012	Winter 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~70 MW	~70 MW	~70 MW	~70 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage
77+78 230	-	-	-	-
79+80 230	-	-	-	-
PK230 2+4	-	-	-	-
HUN 230-1+2	-	-	-	-

Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	[redacted]	[redacted]	[redacted]	[redacted]
152	-	-	-	-
167	-	-	-	-
HH CAP	-	-	-	-
AND CAP	-	-	-	-
151 GV	-	-	-	[redacted]
152 GV	-	-	-	-
160 DUN	-	-	-	-
161 DUN	-	-	-	-
77+78 230	-	-	-	-
79+80 230	-	-	-	-
37+67	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	-	-	-	-
141+142	-	-	-	-
153+154	-	-	-	-
161+162	-	-	-	-
DUN 230-1	-	-	-	-
DUN 115-1	-	-	-	-
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	-	-	-	-
FAL BUS2	-	-	-	-
HH BUS1	[redacted]	[redacted]	[redacted]	[redacted]
HH BUS2	-	-	-	-
GV115 BS3	-	-	-	-
GV115 BS4	-	-	-	-

Table 45: Remaining System Issues: Winter, Indeck Out of Service, Jamestown ~0 MW

Dunkirk Status	Units 2+4 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	1	2
Dunkirk 115kV Units In Service	1	1	2	2
Season/year	Winter 2012	Winter 2012	Winter 2012	Winter 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~0 MW	~0 MW	~0 MW	~0 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage
77+78 230	-	-	-	-
79+80 230	-	-	-	-
PK230 2+4	-	-	-	-
HUN 230-1+2	-	-	-	-

Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	[redacted]	[redacted]	[redacted]	[redacted]
152	[redacted]	[redacted]	[redacted]	[redacted]
167	-	-	-	-
HH CAP	-	-	-	-
AND CAP	[redacted]	[redacted]	[redacted]	[redacted]
151 GV	[redacted]	[redacted]	[redacted]	[redacted]
152 GV	[redacted]	[redacted]	[redacted]	[redacted]
160 DUN	[redacted]	[redacted]	[redacted]	[redacted]
161 DUN	-	-	-	-
77+78 230	-	-	-	-
79+80 230	-	-	-	-
37+67	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	[redacted]	[redacted]	[redacted]	[redacted]
141+142	-	-	-	-
153+154	[redacted]	[redacted]	[redacted]	[redacted]
161+162	[redacted]	[redacted]	[redacted]	
DUN 230-1	-	-	-	-
DUN 115-1	[redacted]	[redacted]	-	-
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS2	[redacted]	[redacted]	[redacted]	[redacted]
HH BUS1	-	-	-	-
HH BUS2	-	-	-	-
GV115 BS3	[redacted]	[redacted]	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]	[redacted]	[redacted]

Table 46: Remaining System Issues: Winter, Indeck Out of Service, Jamestown ~70 MW

Dunkirk Status	Units 2+4 OOS	Units 2 OOS	Units 4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	1	2
Dunkirk 115kV Units In Service	1	1	2	2
Season/year	Winter 2012	Winter 2012	Winter 2012	Winter 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~70 MW	~70 MW	~70 MW	~70 MW
Contingency	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage	Lowest 230kV Voltage
77+78 230	-	-	-	-
79+80 230	-	-	-	-
PK230 2+4	-	-	-	-
HUN 230-1+2	-	-	-	-

Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	[redacted]	[redacted]	[redacted]	[redacted]
152	[redacted]	[redacted]	[redacted]	[redacted]
167	[redacted]	[redacted]	[redacted]	[redacted]
HH CAP	[redacted]	[redacted]	[redacted]	[redacted]
AND CAP	[redacted]	[redacted]	[redacted]	[redacted]
151 GV	[redacted]	[redacted]	[redacted]	[redacted]
152 GV	[redacted]	[redacted]	[redacted]	[redacted]
160 DUN	[redacted]	[redacted]	[redacted]	[redacted]
161 DUN	[redacted]	[redacted]	[redacted]	[redacted]
77+78 230	-	-	-	-
79+80 230	[redacted]	-	-	-
37+67	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	[redacted]	[redacted]	[redacted]	[redacted]
141+142	[redacted]	[redacted]	[redacted]	[redacted]
153+154	[redacted]	[redacted]	[redacted]	[redacted]
161+162	[redacted]	[redacted]	[redacted]	[redacted]
DUN 230-1	[redacted]	-	-	-
DUN 115-1	[redacted]	[redacted]	[redacted]	[redacted]
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS2	[redacted]	[redacted]	[redacted]	[redacted]
HH BUS1	[redacted]	-	[redacted]	-
HH BUS2	[redacted]	[redacted]	[redacted]	[redacted]
GV115 BS3	[redacted]	[redacted]	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]	[redacted]	[redacted]

6.5. Review of Selected N-1-1 Conditions

Some selected N-1-1 contingencies were reviewed as part of this analysis. From previous studies, it is known that a few combinations are critical. For the first contingency, [redacted] For the second contingency, four were tested. [redacted] The two first contingencies with the four second contingencies resulted in eight possibilities.

For nearly all summer cases, these contingencies resulted in voltages below the load shed limit. Only the case [redacted] resulted in voltages above the load shed limit for all eight contingencies. [redacted] In fact, many of the cases failed to converge. The voltages were below the Emergency Low Limit for all combinations reviewed. The following tables show the results for these N-1-1 combinations with three or four units at Dunkirk, results for one or two units in service are not provided as they all failed or did not converge. Winter results were much better than the summer though many still failed to pass the testing.

Table 47: Results of N-1-1 Testing: Summer, Indeck In Service, Jamestown ~0 MW

Operator Load Shed Limits			
Dunkirk Status	Units 4 OOS	Units 2 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	2
Dunkirk 115kV Units In Service	2	1	2
Season/year	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]

Table 48: Results of N-1-1 Testing: Summer, Indeck In Service, Jamestown ~70 MW

Operator Load Shed Limits			
Dunkirk Status	Units 4 OOS	Units 2 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	2
Dunkirk 115kV Units In Service	2	1	2
Season/year	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]

Table 49: Results of N-1-1 Testing: Summer, Indeck Out of Service, Jamestown ~0 MW

Operator Load Shed Limits			
Dunkirk Status	Units 4 OOS	Units 2 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	2
Dunkirk 115kV Units In Service	2	1	2
Season/year	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]

Table 50: Results of N-1-1 Testing: Summer, Indeck Out of Service, Jamestown ~70 MW

Operator Load Shed Limits			
Dunkirk Status	Units 4 OOS	Units 2 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	1	2	2
Dunkirk 115kV Units In Service	2	1	2
Season/year	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]

6.6. Additional Considerations

The previous sections recommended that at least two units be available to system operators to support the system for N-1 outages. The fact that the system would still be vulnerable to several N-1-1 contingencies is also discussed. However other system failures could create concerns that justify having additional generators available.

The biggest concern is that one of the Dunkirk units selected to be available fails. Alternatively, a critical component such as a GSU or breaker at Dunkirk could fail resulting in the generation being unavailable. For these conditions, the system would be vulnerable to voltages below the load shed limit for N-1 contingencies.

The previous analysis shows how [redacted] It would be possible for equipment failures at one of these locations to occur, increasing the exposure to low voltages. [redacted] This is also supported by the study results, which show the voltages to be worse for outages [redacted]

It would also be possible for a failure of a major piece of equipment to result in system concern that would necessitate having additional units available. Primary among the concerns [redacted]. However, other transformer failures [redacted] could also be a concern. Failures of other types of equipment, such as tower collapses or breaker failures may also result in problems. Some of these transformer failures could take up to several months to address.

Because of these additional concerns, it is recommended that a third unit be available. Based on operator feedback, focusing on the risk to the area load, especially for some of these potential failures, [redacted]

7. Review of Short Duration Projects

Based on the analysis discussed above, several projects were identified that may reduce the exposure to the problems created by the Dunkirk shutdown and may reduce the number of units required for system operation. Each of the sections below describes the project and then the final section reviews the system impact of the all the combined projects.

7.1. Winter 2012-2013

As discussed in the following sections, several projects can be implemented that will reduce the generation at Dunkirk necessary to mitigate area voltage and thermal problems. None of these projects can be completed prior to the winter of 2012-2013. Thus, the recommendations made in the previous sections are unaffected. For the winter of 2012-2013, at least two units will need to remain in service.

7.2. Gardenville Capacitor Banks

The 2011 study of the area discussed the same low 230kV voltage issues discussed within this report. That study concluded that in order to bring the 230kV voltages back within criteria, three 75 MVAr capacitor banks needed to be installed at Gardenville. These were planned to be added as part of the Gardenville rebuild project.

The shutdown of the Dunkirk generation has accelerated this need and increased it to four capacitor banks. Engineering review has concluded that four capacitor banks can be added to each of the four bus sections at the existing Old and New Gardenville stations. Each capacitor bank will be 75 MVAr, the same as the long term planned size. It is expected that all four will be in service June 1, 2013.

The long term plan will also be modified so that the rebuild project includes all four capacitor banks. The plan originally just included the space for a future fourth bank.

7.3. Homer Hill Capacitor Bank

The 2011 study of the area also discussed the need to reinforce the 115kV system in the Homer Hill area. One of the recommended projects to achieve this is installation of a second 115kV capacitor bank at Homer Hill. Initially this new capacitor bank will be operated at 25.6 MVAr. The installation of this second capacitor bank triggers the need to add a breaker and reactor to the existing bank. The original plan was to have the new capacitor in service in the spring of 2013, and then the existing capacitor bank immediately coming out of service until the fall of 2013. The shutdown of Dunkirk has resulted in a revision to this plan. Both the installation of the new capacitor bank and the upgrades to the existing one will be completed by June 1, 2013.

7.4. Dunkirk Capacitor Banks

With projects to add capacitor banks to Huntley, Gardenville and Homer Hill completed, the 52.5 MVAr mobile capacitor banks can be installed at a new location. The only available National Grid stations in western NY where these capacitors could be installed are Huntley, Dunkirk and Lockport. Of these options, the best location by far to mitigate the shutdown of Dunkirk is at Dunkirk. Engineering review has concluded that both 52.5 MVAr capacitor banks can be installed at Dunkirk, one on each of the 115kV buses. It is expected that this can be completed by June 1, 2013.

7.5. Huntley Bus Tie Breaker

One of the most significant contingencies, especially as a second outage in an N-1-1 combination is [redacted]

[redacted] It is expected that this can be completed by June 1, 2013.

7.6. Packard Bus Tie Breaker

Packard is a straight bus, similar to Huntley [redacted] To prevent this outage, a rearrangement of the equipment at Packard will be done. The existing station is three bus sections. [redacted] It is expected that this can be completed by June 1, 2013.

7.7. Distribution Station Supply Changes

One of the real time concerns that system operates deal with in this area is overloads [redacted] This overload is the result of both the load connected to the lines and the through flow on the lines. To help reduce the overloads it was identified that [redacted] reducing the amount of load connected to these circuits.

[redacted] It is expected that all of these changes can be completed by June 1, 2013.

7.8. Thermal Rating Changes

In addition to the loading [redacted] system operators are often concerned with [redacted] This connection will be replaced increasing the capability of the bank by a small amount.

The change to the [redacted] These will be replaced to increase the capability of the lines.

7.9. System Impact of Changes

This section includes a large number of tables summarizing the voltage and thermal results for N-1 conditions and a Pass/Fail summary of N-1-1 conditions following the completion of the above projects. The Pass/Fail summaries are also provided for the N-1 analysis.

Due to the complexity and volume of analysis provided, the key points are summarized here in order to make a recommendation on the minimum number of units that are required to support the system.

- Following completion of the proposed reinforcements, all 230kV voltages will be above the Emergency Low Limits for any N-1 contingency, including multiple element outages even with no Dunkirk units in service.
- For nearly all N-1 conditions, including multiple element outages, the reinforced system with one 115kV unit running performed better than the existing system with all four units running.
- For all N-1-1 conditions the reinforced system with one 115kV unit running performed equal to or better than the existing system with all four units running.
- Comparing the reinforced system with no Dunkirk units to the existing system with all four units in service produced mixed results for N-1 contingencies. For some N-1 conditions, including N-1 multiple element outages, the reinforced system with no Dunkirk generation running performed worse than the existing system with all four units running. For some N-1 contingencies, the reinforced system with no Dunkirk generation running performed better than the existing system with all four units running.
- For most N-1-1 conditions, the reinforced system with no Dunkirk generation running performed worse than the existing system with all four units running.
- From a thermal perspective, the reinforced system with zero units running performed similar to the reinforced system with one unit running. However these cases did perform slightly worse than the existing system with all four units running. No loadings were above the STE ratings, but some elements were loaded above their LTE ratings.

Based on a review of all of these points, the ideal configuration to address the N-1 and N-1-1 voltage concerns on the 230kV and 115kV system while also managing the overload [redacted]. [redacted]

Additional risk, above what is present for the existing system with all units running would be experienced if no generation were in service. This would include additional risk of an unplanned or long term failure of a generator or transformer.

The following tables show the voltage issues that would remain following the above system reinforcements for conditions with zero or one unit in service at Dunkirk. For comparison purposes, the right most columns in each table show the response of the existing system with all four units in service. Only contingencies that resulted in low voltages in one of the reinforced cases are discussed in the table. Other contingencies could have resulted in low voltages in the cases representing the existing system.

These tables show the voltages that fall below the Emergency Low Limits, not just the

Load Shed Limits. If the voltage was below the Load Shed Limit, or the case did not converge, this is indicated by red type.

Note that for all cases, all 230kV voltages have been corrected above the Emergency Low Limit by these projects. Only 115kV low voltage issues were identified.

In the tables showing thermal overloads, the loading on the Niagara – Packard 115kV circuits are indicated. As indicated previously in this report, an operating exception in the NYSRC rules allows these facilities to be loaded up to their STE rating. The overloads can be corrected by generation dispatch adjustments at Niagara. However, the limiting equipment on the line is terminal equipment at Niagara, owned by NYPA, which could be replaced to reduce the overload below the STE rating.

Table 51: Remaining System Issues: Summer, Indeck In Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~0 MW	~0 MW	~0 MW	~0 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	-	-	-	-
152	-	-	-	-
151 GV	-	-	-	-
152 GV	-	-	-	-
160 DUN	-	-	-	-
79+80 230	-	-	-	-
151+152	[redacted]	-	-	[redacted]
152+167	-	-	-	-
153+154	-	-	-	-
161+162	-	-	-	-
DUN 230-2	-	-	-	-
DUN 115-1	-	-	-	-
DUN 115-2	[redacted]	-	-	-
FAL BUS1	-	-	-	-
FAL BUS2	-	-	-	-
GV115 BS3	-	-	-	-
GV115 BS4	-	-	-	-
HH BUS1	[redacted]	-	-	-

Table 52: Remaining System Issues: Summer, Indeck In Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~70 MW	~70 MW	~70 MW	~70 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	-	-	-	-
152	-	-	-	-
151 GV	-	-	-	-
152 GV	-	-	-	-
160 DUN	-	-	-	-
79+80 230	-	-	-	-
151+152	[redacted]	-	[redacted]	[redacted]
152+167	-	-	-	-
153+154	-	-	-	-
161+162	-	-	-	-
DUN 230-2	-	-	-	-
DUN 115-1	-	-	-	-
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	-	-	-	-
FAL BUS2	-	-	-	-
GV115 BS3	-	-	-	-
GV115 BS4	-	-	-	-
HH BUS1	[redacted]	-	[redacted]	-

Table 53: Remaining System Issues: Summer, Indeck Out of Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~0 MW	~0 MW	~0 MW	~0 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	[redacted]	-	-	[redacted]
152	-	-	-	[redacted]
151 GV	-	-	-	[redacted]
152 GV	-	-	-	[redacted]
160 DUN	-	-	-	[redacted]
79+80 230	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	[redacted]	-	-	[redacted]
153+154	-	-	-	[redacted]
161+162	-	-	-	[redacted]
DUN 230-2	-	-	-	-
DUN 115-1	-	-	-	-
DUN 115-2	[redacted]	-	[redacted]	[redacted]
FAL BUS1	-	-	-	[redacted]
FAL BUS2	-	-	-	[redacted]
GV115 BS3	-	-	-	[redacted]
GV115 BS4	-	-	-	[redacted]
HH BUS1	-	-	-	-

Table 54: Remaining System Issues: Summer, Indeck Out of Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~70 MW	~70 MW	~70 MW	~70 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	[redacted]	[redacted]	[redacted]	[redacted]
152	-	-	-	[redacted]
151 GV	[redacted]	-	[redacted]	[redacted]
152 GV	[redacted]	-	-	[redacted]
160 DUN	-	-	-	[redacted]
79+80 230	[redacted]	-	-	[redacted]
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	[redacted]	[redacted]	[redacted]	[redacted]
153+154	-	-	-	[redacted]
161+162	-	-	-	-
DUN 230-2	-	-	-	[redacted]
DUN 115-1	[redacted]	[redacted]	[redacted]	[redacted]
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	-	-	-	[redacted]
FAL BUS2	[redacted]	-	-	[redacted]
GV115 BS3	[redacted]	-	-	[redacted]
GV115 BS4	[redacted]	-	-	[redacted]
HH BUS1	[redacted]	-	-	[redacted]

Table 55: Remaining System Issues: Winter, Indeck In Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~0 MW	~0 MW	~0 MW	~0 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	-	-	-	-
152	-	-	-	-
151 GV	-	-	-	-
152 GV	-	-	-	-
160 DUN	-	-	-	-
79+80 230	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	-	-	-	-
153+154	-	-	-	-
161+162	-	-	-	-
DUN 230-2	-	-	-	-
DUN 115-1	-	-	-	-
DUN 115-2	[redacted]	-	-	-
FAL BUS1	-	-	-	-
FAL BUS2	-	-	-	-
GV115 BS3	-	-	-	-
GV115 BS4	-	-	-	-
HH BUS1	[redacted]	-	[redacted]	-

Table 56: Remaining System Issues: Winter, Indeck In Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~70 MW	~70 MW	~70 MW	~70 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	-	-	-	[redacted]
152	-	-	-	-
151 GV	-	-	-	-
152 GV	-	-	-	-
160 DUN	-	-	-	-
79+80 230	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	-	-	-	-
153+154	-	-	-	-
161+162	-	-	-	-
DUN 230-2	-	-	-	-
DUN 115-1	-	-	-	-
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	-	-	-	-
FAL BUS2	-	-	-	-
GV115 BS3	-	-	-	-
GV115 BS4	-	-	-	[redacted]
HH BUS1	[redacted]	[redacted]	[redacted]	[redacted]

Table 57: Remaining System Issues: Winter, Indeck Out of Service, Jamestown ~0 MW

Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~0 MW	~0 MW	~0 MW	~0 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	[redacted]	[redacted]	[redacted]	[redacted]
152	[redacted]	-	-	[redacted]
151 GV	[redacted]	[redacted]	[redacted]	[redacted]
152 GV	[redacted]	-	[redacted]	[redacted]
160 DUN	-	-	-	[redacted]
79+80 230	-	-	-	-
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	[redacted]	-	[redacted]	[redacted]
153+154	[redacted]	-	[redacted]	[redacted]
161+162	-	-	-	[redacted]
DUN 230-2	-	-	-	-
DUN 115-1	[redacted]	[redacted]	-	-
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	-	-	-	[redacted]
FAL BUS2	-	-	-	[redacted]
GV115 BS3	[redacted]	-	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]	[redacted]	[redacted]
HH BUS1	[redacted]	-	-	-

Table 58: Remaining System Issues: Winter, Indeck Out of Service, Jamestown ~70 MW

Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown	~70 MW	~70 MW	~70 MW	~70 MW
Contingency	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage	Lowest 115kV Voltage
151	[redacted]	[redacted]	[redacted]	[redacted]
152	[redacted]	-	[redacted]	[redacted]
151 GV	[redacted]	[redacted]	[redacted]	[redacted]
152 GV	[redacted]	[redacted]	[redacted]	[redacted]
160 DUN	[redacted]	[redacted]	[redacted]	[redacted]
79+80 230	[redacted]	-	-	[redacted]
151+152	[redacted]	[redacted]	[redacted]	[redacted]
152+167	[redacted]	[redacted]	[redacted]	[redacted]
153+154	[redacted]	-	-	[redacted]
161+162	[redacted]	[redacted]	[redacted]	[redacted]
DUN 230-2	[redacted]	-	-	-
DUN 115-1	[redacted]	[redacted]	[redacted]	[redacted]
DUN 115-2	[redacted]	[redacted]	[redacted]	[redacted]
FAL BUS1	[redacted]	-	-	[redacted]
FAL BUS2	[redacted]	[redacted]	[redacted]	[redacted]
GV115 BS3	[redacted]	[redacted]	[redacted]	[redacted]
GV115 BS4	[redacted]	[redacted]	[redacted]	[redacted]
HH BUS1	[redacted]	[redacted]	[redacted]	[redacted]

Table 59: Summer Thermal Analysis: Indeck In Service, Jamestown ~0 MW

Dunkirk Status		Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service		0	0	1	2
Dunkirk 115kV Units In Service		0	1	0	2
System		Reinforced	Reinforced	Reinforced	Existing
Season/year		Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean		In Service	In Service	In Service	In Service
Line #171		Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load		~0 MW	~0 MW	~0 MW	~0 MW
Element	Contingency	% of LTE	% of LTE	% of LTE	% of LTE
Niagara - Gardenville #180	77+78 230	-	-	-	-
Niagara - Gardenville #180	79+80 230	[redacted]	-	-	-
Packard - Erie #181	79+80 230	[redacted]	-	-	-
Packard - Gardenville #182	79+80 230	-	-	-	-
Packard - Erie #181	180+182N	[redacted]	[redacted]	[redacted]	-
Packard - Erie #181	180+182S	[redacted]	[redacted]	[redacted]	-
Dunkirk TB #41/31	DUN TB31/41	-	-	-	-
Dunkirk TB #31	DUN 115-1	-	-	-	
Dunkirk TB #41	DUN 230-1	-	-	-	-
Niagara - Packard #192	191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #191	192	[redacted]	-	-	-
Niagara - Packard #192	61+191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #192	101+191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #191	192+195	[redacted]	-	-	-

Table 60: Summer Thermal Analysis: Indeck In Service, Jamestown ~70 MW

Dunkirk Status		Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service		0	0	1	2
Dunkirk 115kV Units In Service		0	1	0	2
System		Reinforced	Reinforced	Reinforced	Existing
Season/year		Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean		In Service	In Service	In Service	In Service
Line #171		Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load		~70 MW	~70 MW	~70 MW	~70 MW
Element	Contingency	% of LTE	% of LTE	% of LTE	% of LTE
Niagara - Gardenville #180	77+78 230	-	-	-	-
Niagara - Gardenville #180	79+80 230	[redacted]	[redacted]	-	-
Packard - Erie #181	79+80 230	[redacted]	-	-	-
Packard - Gardenville #182	79+80 230	-	-	-	-
Packard - Erie #181	180+182N	[redacted]	[redacted]	[redacted]	-
Packard - Erie #181	180+182S	[redacted]	[redacted]	[redacted]	-
Dunkirk TB #41/31	DUN TB31/41	-	-	-	-
Dunkirk TB #31	DUN 115-1	-	-	-	
Dunkirk TB #41	DUN 230-1	-	-	-	-
Niagara - Packard #192	191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #191	192	[redacted]	-	-	-
Niagara - Packard #192	61+191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #192	101+191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #191	192+195	[redacted]	-	-	-

Table 61: Summer Thermal Analysis: Indeck Out of Service, Jamestown ~0 MW

Dunkirk Status		Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service		0	0	1	2
Dunkirk 115kV Units In Service		0	1	0	2
System		Reinforced	Reinforced	Reinforced	Existing
Season/year		Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean		Out of Service	Out of Service	Out of Service	Out of Service
Line #171		Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load		~0 MW	~0 MW	~0 MW	~0 MW
Element	Contingency	% of LTE	% of LTE	% of LTE	% of LTE
Niagara - Gardenville #180	77+78 230	-	-	-	-
Niagara - Gardenville #180	79+80 230	[redacted]	[redacted]	-	-
Packard - Erie #181	79+80 230	[redacted]	[redacted]	-	-
Packard - Gardenville #182	79+80 230	-	-	-	-
Packard - Erie #181	180+182N	[redacted]	[redacted]	[redacted]	-
Packard - Erie #181	180+182S	[redacted]	[redacted]	[redacted]	-
Dunkirk TB #41/31	DUN TB31/41	-	-	-	-
Dunkirk TB #31	DUN 115-1	-	-	-	
Dunkirk TB #41	DUN 230-1	-	-	-	-
Niagara - Packard #192	191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #191	192	[redacted]	[redacted]	-	-
Niagara - Packard #192	61+191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #192	101+191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #191	192+195	[redacted]	[redacted]	-	-

Table 62: Summer Thermal Analysis: Indeck Out of Service, Jamestown ~70 MW

	Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
	Dunkirk 230kV Units In Service	0	0	1	2
	Dunkirk 115kV Units In Service	0	1	0	2
	System	Reinforced	Reinforced	Reinforced	Existing
	Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2012
	Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
	Line #171	Out of Service	Out of Service	Out of Service	Out of Service
	Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW
Element	Contingency	% of LTE	% of LTE	% of LTE	% of LTE
Niagara - Gardenville #180	77+78 230	[redacted]	-	-	-
Niagara - Gardenville #180	79+80 230	[redacted]	[redacted]	-	-
Packard - Erie #181	79+80 230	[redacted]	[redacted]	-	-
Packard - Gardenville #182	79+80 230	[redacted]	-	-	-
Packard - Erie #181	180+182N	[redacted]	[redacted]	[redacted]	-
Packard - Erie #181	180+182S	[redacted]	[redacted]	[redacted]	-
Dunkirk TB #41/31	DUN TB31/41	-	-	[redacted]	-
Dunkirk TB #31	DUN 115-1	[redacted]	-	[redacted]	
Dunkirk TB #41	DUN 230-1	-	-	[redacted]	-
Niagara - Packard #192	191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #191	192	[redacted]	[redacted]	[redacted]	-
Niagara - Packard #192	61+191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #192	101+191	[redacted]	[redacted]	[redacted]	[redacted]
Niagara - Packard #191	192+195	[redacted]	[redacted]	-	-

In the following tables, NA indicates that the contingency is “Not Applicable” as the addition of bus tie breakers at Huntley and Packard has eliminated this contingency.

Table 63: Results of N-1-1 Testing: Summer, Indeck In Service, Jamestown ~0 MW

Operator Load Shed Limits				
Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]

Table 64: Results of N-1-1 Testing: Summer, Indeck In Service, Jamestown ~70 MW

Operator Load Shed Limits				
Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]

Table 65: Results of N-1-1 Testing: Summer, Indeck Out of Service, Jamestown ~0 MW

Operator Load Shed Limits				
Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]

Table 66: Results of N-1-1 Testing: Summer, Indeck Out of Service, Jamestown ~70 MW

Operator Load Shed Limits				
Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]

Table 67: Results of N-1-1 Testing: Summer, Indeck In Service, Jamestown ~0 MW

Operator Load Shed Limits				
Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]

Table 68: Results of N-1-1 Testing: Summer, Indeck In Service, Jamestown ~70 MW

Operator Load Shed Limits				
Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2012
Indeck Olean	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW
37+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
66+HUN 230-1+2	[redacted]	[redacted]	[redacted]	[redacted]
37+79+80	[redacted]	[redacted]	[redacted]	[redacted]
66+79+80	[redacted]	[redacted]	[redacted]	[redacted]
37+77+78	[redacted]	[redacted]	[redacted]	[redacted]
66+77+78	[redacted]	[redacted]	[redacted]	[redacted]
37+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]
66+PK230 2+4	[redacted]	[redacted]	[redacted]	[redacted]

Table 69: Results of N-1-1 Testing: Summer, Indeck Out of Service, Jamestown ~0 MW

Operator Load Shed Limits				
Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW
37+HUN 230-1+2				
66+HUN 230-1+2				
37+79+80				
66+79+80				
37+77+78				
66+77+78				
37+PK230 2+4				
66+PK230 2+4				

Table 70: Results of N-1-1 Testing: Summer, Indeck Out of Service, Jamestown ~70 MW

Operator Load Shed Limits				
Dunkirk Status	Units 1-4 OOS	Units 2-4 OOS	Units 1+2+4 OOS	Units 1-4 IS
Dunkirk 230kV Units In Service	0	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2
System	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2012
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW
37+HUN 230-1+2				
66+HUN 230-1+2				
37+79+80				
66+79+80				
37+77+78				
66+77+78				
37+PK230 2+4				
66+PK230 2+4				

Table 71: Pass/Fail Summary: Summer, Indeck In Service, Jamestown ~0 MW, Emergency Low Limits

Operator Emergency Low Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 72: Pass/Fail Summary: Summer, Indeck In Service, Jamestown ~0 MW, Load Shed Limits

Operator Load Shed Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 73: Pass/Fail Summary: Summer, Indeck In Service, Jamestown ~70 MW, Emergency Low Limits

Operator Emergency Low Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 74: Pass/Fail Summary: Summer, Indeck In Service, Jamestown ~70 MW, Load Shed Limits

Operator Load Shed Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 75: Pass/Fail Summary: Summer, Indeck Out of Service, Jamestown ~0 MW, Emergency Low Limits

Operator Emergency Low Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 76: Pass/Fail Summary: Summer, Indeck Out of Service, Jamestown ~0 MW, Load Shed Limits

Operator Load Shed Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 77: Pass/Fail Summary: Summer, Indeck Out of Service, Jamestown ~70 MW, Emergency Low Limits

Operator Emergency Low Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 78: Pass/Fail Summary: Summer, Indeck Out of Service, Jamestown ~70 MW, Load Shed Limits

Operator Load Shed Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013	Summer 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 79: Pass/Fail Summary: Winter, Indeck In Service, Jamestown ~0 MW, Emergency Low Limits

Operator Emergency Low Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 80: Pass/Fail Summary: Winter, Indeck In Service, Jamestown ~0 MW, Load Shed Limits

Operator Load Shed Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 81: Pass/Fail Summary: Winter, Indeck In Service, Jamestown ~70 MW, Emergency Low Limits

Operator Emergency Low Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 82: Pass/Fail Summary: Winter, Indeck In Service, Jamestown ~70 MW, Load Shed Limits

Operator Load Shed Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	In Service	In Service	In Service	In Service	In Service	In Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 83: Pass/Fail Summary: Winter, Indeck Out of Service, Jamestown ~0 MW, Emergency Low Limits

Operator Emergency Low Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 84: Pass/Fail Summary: Winter, Indeck Out of Service, Jamestown ~0 MW, Load Shed Limits

Operator Load Shed Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW	~0 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 85: Pass/Fail Summary: Winter, Indeck Out of Service, Jamestown ~70 MW, Emergency Low Limits

Operator Emergency Low Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 86: Pass/Fail Summary: Winter, Indeck Out of Service, Jamestown ~70 MW, Load shed Limits

Operator Load Shed Limits						
Dunkirk 230kV Units In Service	0	0	1	0	1	2
Dunkirk 115kV Units In Service	0	1	0	2	1	2
System	Reinforced	Reinforced	Reinforced	Reinforced	Reinforced	Existing
Season/year	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013	Winter 2013
Indeck Olean	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Line #171	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service	Out of Service
Jamestown Load	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW	~70 MW
All 230kV and 115kV voltages within applicable Operating low limit pre-contingency	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 single element outage	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All 115kV voltages within applicable Operating low limit for N-1 multiple element outage with normal clearing	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

8. Summary

Based on the system analysis, it is recommended that at least two Dunkirk units be available to system operators for the winter of 2012-2013. Assuming that the proposed quick upgrades are completed by June 1, 2013, the number of units that need to remain in service following June 1 can be reduced to one. Absent any of these projects, the number of units that would have been required would have been three.

Additional upgrades are currently being reviewed to determine what will be necessary to reduce the number of units to zero. It is expected that this will require at least the completion of the Five Mile Road 345/115kV station that is expected to be completed by June 2015. However, additional reinforcements may also be required.

REVIEW OF DUNKIRK MOTHBALL NOTICE – Part 2

REVIEW OF ADDITIONAL SOLUTIONS ASSOCIATED WITH DUNKIRK MOTHBALL NOTICE

Version 0

September 26, 2012

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Change Control

Version	Date	Modification	Author(s)	Reviews and Approvals by
0	9/26/12	Initial Document	J. Maher	J. Hipius & C. Sedewitz

1. Executive Summary

This study is the second part of the assessment of the impact of the shutdown of coal fired generation at the Dunkirk facility. It reviews the recommended system upgrades necessary to completely mitigate the impact. Notice was received on March 14, 2012 that NRG plans to place the units in protective layup (mothball) for an unknown amount of time.

Before NRG;s announcement, National Grid performed a study of Western NY in 2011; the study reviewed the weaknesses of the existing system and made recommendations to address these needs. The 2011 study determined that severe post-contingency low voltages exist today and will get worse though time. The 2011 study was done with all generation at Dunkirk in service. The 2011 Western Division Solution Study, which had assumed all Dunkirk generation was in-service, recommended system upgrades to address concerns in western NY including a new 345/115kV substation near Homer Hill, reconductoring of line #171, a second Homer Hill capacitor bank and a second bus tie at Dunkirk.

After the NRG announcement, National Grid immediately began its analysis of the impact of the plant mothball or shutdown. This analysis was document in two parts to aid in the decision making process. The analysis documented in the first part of this study showed that the shutdown of the generation at Dunkirk would have an immediate negative impact on the system. It was originally found that three Dunkirk units would need to be in service to support the area in the summer and that two would be required in the winter. The Part I Study then concluded that several projects could be completed prior to June 2013 that would reduce the dependency to one Dunkirk 115kV connected generator. The projects, referred to as the interim solutions, included addition of 230kV breakers at Huntley and Packard, installation of National Grid's mobile capacitor banks at Dunkirk and moving three distribution stations served from Gardenville – Dunkirk lines #141 and #142 to other circuits. The interim solutions and running generation did not fix all area issues, merely restored the system to a state similar to the existing system with all four Dunkirk units running in year 2013. Thus, these interim projects do not eliminate the need to complete the upgrades recommended in the 2011 area study.

This second part of the assessment of the impact the Dunkirk shutdown will have on the system looks at the area following all upgrades recommended in Part 1 Study and the 2011 Western NY Area Study. These previously identified projects were included in the base cases, as the 2011 area study determined that they are the most effective options to address the existing area problems. The short duration projects recommended in the first part of this study were also included in study base cases, as it is expected that they will be complete by spring 2013. No mobile capacitor banks at Dunkirk were included in study base cases to determine if there is a continued need for reactive support.

This analysis found that the shutdown results in low voltages for several contingencies in the Dunkirk and Falconer areas and overloads in three locations. One overload was between Five Mile Rd and Homer Hill (both lines) and the other two were between the Niagara/Packard area and the Gardenville/Erie [redacted]

The method of identifying recommended reinforcements was broken into three levels, similar to the 2011 study of the area. However, the level names are not the same as was used in the previous 2011 study as these were found to be overly complicated. The first level plan (called plan A1) was to address the N-1 low voltages and overloads with Indeck Olean in service. The second level plan (called plan A2) was to address the N-1 low voltages and overloads with Indeck Olean out of service. The fifth level plan (called A5) was to address the N-1-1 low voltages and overloads with Indeck Olean out of service. All of these levels assumed that Jamestown was at a 75-80 MW load level. Plans were not developed solely for the third, fourth or sixth levels. Though plans were developed for the fourth and sixth levels in the 2011 area study, they were not the recommended solutions. As will be seen, the first level recommendations addressed all of the concerns in the third level cases.

Through the course of the study, it was determined that though the first level plan (A1) addressed all N-1 events, it left the system exposed to N-1-1 overloads that surpassed the STE rating. The case started with all generation at Indeck Olean and Jamestown in service, [redacted] following adoption of the expected BES definition and the revised TPL standards. Therefore, while a plan for this level is discussed in this report, it is not the recommended solution. It was also found that the difference between the second level (A2) recommendation and the fifth level recommendation (A5) would be minimal and thus it is recommended to eliminate the exposure to the N-1-1 low voltages by proceeding with the fifth level plan (A5). The recommendation to proceed with this plan (A5) will leave the system in a state similar to the state it would have been in after completion of the projects recommended in the 2011 area study, had Dunkirk not shutdown.

The projects recommended to address the needs discussed within this report are:

- Addition of two 33.3 MVAr capacitor banks on the two Dunkirk 115kV bus sections. This project should be implemented as soon as possible. ($2.5M)
- Addition of a second 75 MVAr capacitor bank at the Huntley 115kV switchyard. This project should be implemented as soon as possible. ($1.4M)
- Reconductoring of the two 115kV lines between Five Mile Rd and Homer Hill, each approximately 7.4 miles in length. This project is recommended to be executed such that it is complete when Five Mile Rd comes into service. If the project cannot be completed by the time Five Mile Rd is completed, a review of the risk associated with the outage/overload and the cost of continued operation of generation at Dunkirk will have to be undertaken to determine when the shutdown of the generation can occur. ($17M-$19M)
- Reconductoring of one mile of the Niagara – Gardenville #180 line. To facilitate the retirement of the generation as soon as possible, this project is recommended to be implemented such that it is complete at or before Five Mile Rd coming into service. If the project cannot be completed by the time Five Mile Rd is completed, a review of the risk associated with the outage/overload and the cost of continued operation of generation will have to be undertaken to determine when the shutdown of the generation can occur. ($3.7M)
- Reconductoring of 14 miles of the Packard – Erie #181 line. To facilitate the retirement of the generation as soon as possible, this project is recommended to be implemented such that it is complete at or before Five Mile Rd coming into service. If the project cannot be completed by the time Five Mile Rd is completed, a review of the risk associated with the outage/overload and the cost of continued operation of generation at Dunkirk will have to be undertaken to determine when the shutdown of the generation can occur. ($35M-$40M)

The expected cost of this set of projects is in the range of **$60M-$67M** based on investment grade estimates with a range of -50% - +200%.

Following the addition of these projects to the study base cases, no N-1 thermal or voltage problems will be present. N-1-1 testing was then performed. This testing determined that while N-1-1 problems do exist, they are for combinations of single element outages followed by a multiple element outage; tested per the NPCC requirements. These overloads or low voltages were on non-BPS elements and thus correction of these issues is not mandatory. Further review of these issues will be done in the next area study to confirm that there will be sufficient time for operators to take corrective actions following the second event. Some minor N-1-1 problems were also found in cases with all generation at the City of Jamestown and Indeck Olean out of service. This is considered a sixth level case, and the low voltages or overloads are not recommended for correction.

2. Introduction

This study examines the impact of the announced closure of the generation at the Dunkirk facility in western NY. It summarizes the third and fourth phases of this study, which is a determination of what projects would be necessary to address all required N-1 and N-1-1 conditions with all Dunkirk generation out of service. The first two phases were documented in part 1 of this study.

3. Study Details

This review was done using the summer and winter 2016 and 2021 cases that were used in the 2011 needs assessment of the area. Information on these cases, including load levels, forecasts and generation dispatch can be found in sections 4 and 5 of the 2011 Needs Assessment report. It is believed that the load magnitude and distribution across the system used in the 2011 study is representative of the peak loads that would be expected for the summer of 2013.

The starting point of this assessment was the system with the recommended reinforcements, as shown in the executive summary of the 2011 Western NY Solution Report in service. These upgrades include:

- Construction of a new 345/115kV station north of Homer Hill station connecting to the Homer City – Stolle 345kV line #37 and the Gardenville – Homer Hill #151 and #167 circuits. This station, referred to as Five Mile Rd, includes a single 345/115 standard size 448 MVA transformer and a single 25 MVAr capacitor bank
- Installation of a second 33.3 MVAr capacitor bank at Homer Hill station and reinstallation of the previously removed capacitor cans to increase the size of the existing capacitor bank from 27 MVAr to its designed size of 32 MVAr
- Reconductoring the Warren – Falconer #171 line
- Closure of the Normally Open switch at Andover station and reinstallation of the previously removed capacitor cans to increase the size of the Andover capacitor bank from 10 MVAr back to its designed size of 15 MVAr
- Installation of a second breaker in series with the existing Dunkirk 115kV bus tie breaker [redacted]

The 2011 needs study also noted that the following projects are being implemented for capacity or condition reasons and were thus included in the study base cases:

- Addition of a single 75 MVAr capacitor bank at Huntley
- Reconductoring on 0.3 miles of Gardenville – Erie #54
- A complete rebuild of the Gardenville 115kV station including replacement of TB #3 and #4 with larger units and installation of four 75 MVAr capacitor banks

In addition to these system upgrades, the following system changes or upgrades were recommended in the July 27, 2012 report titled "Review of Dunkirk Mothball Notice-Part 1" and are associated with the shutdown of the Dunkirk generation. Note that the installation of the mobile capacitor banks at any station is not included in the base cases to determine if the need exists for permanent reinforcements.

- Addition of a 230kV breaker at Huntley, which creates a new bus section. Bus section 68 (left side of station) will be lines #78, #79 and generator 68. The middle bus section will be cable #70. Bus section 67 (right side of station) will be lines #77, #80 and generator 67. [redacted]

- Addition of a 230kV breaker at Packard, which creates a new bus section. Bus section 4 (left side of station) will be lines #62, #77 and TB #4. Bus section 3 (the middle bus section) will be line #76. Bus section 2 (right side of station) will be lines #61, #78 and TB#2. [redacted]
- Moving three distribution stations served from Gardenville – Dunkirk #141 and #142 to other circuits. The three changes are moving Bennett Rd station from line #142 to line #161, moving Station #139 from circuits #141 and #142 to circuits #149 and #150 and moving Station 55 from circuits #141 and #142 to circuits #145 and #146

3.1. Discussion of Case Levels

As a reminder, the 2011 Solution Study for the area broke the analysis into six levels to help quantify risk. These same levels are used within this study and are shown in the table below. To clarify the discussion, the second level plus was renamed to the fifth level and the fourth level plus was renamed to the sixth level.

To simplify the analysis, plans were only developed for three conditions (not all six). Plans were developed for the first, second and fifth levels, but not the third, fourth and sixth levels.

One plan will be developed to address the First level needs, which essentially corrects all concerns that exist for N-1 conditions with Indeck Olean in service. Within this report, this plan will be referred to as the A1 plan.

The second plan to be developed will address all Second level needs. Within this report, this plan will be referred to as the A2 plan.

A third plan will be developed to address all fifth level needs. Within this report, this plan will be referred to as the A5 plan.

A third, fourth and sixth level plan will not be developed at this time. This is consistent with the recommendation of the 2011 area study. These levels were the cases with Jamestown's load at ~100 MW. As will be seen, the plans developed happen to address most of the concerns with Jamestown at ~100 MW. This was not by design, but rather due to the lumpiness of transmission solutions. The analysis of the recommended plans will demonstrate what risks will remain following the completion of the upgrades. The 2012 study of the region will further review potential solutions to the fourth and sixth level if necessary.

Table 1: Summary of Plans Developed

Case Level	Indeck Olean	Line 171	Jamestown Net Load	All Lines in Service	Single Element Outage (N-1)	Multiple Element Outage (N-1)	Multiple Element Outage (N-1-1)
Level 1	In	In	~75-80 MW	First Level	First Level	First Level	Fifth Level
Level 2	Out	In	~75-80 MW	First Level	First Level	Second Level	Fifth Level
Level 3	In	In	~100-105 MW	First Level	Third Level	Third Level	Sixth Level
Level 4	Out	In	~100-105 MW	Fourth Level	Fourth Level	Fourth Level	Sixth Level

3.2. System Generation

Four system base case conditions were reviewed as shown in the table below. All analysis assumes that the 230kV connected generation at Huntley, the 115kV connected generation at Indeck Yerkes and the 115kV connected generation at Oxbow power (both connected to the system near Huntley) were in service. [redacted] This is consistent with what was done in the 2011 Western Division Solution Study.

All wind generation at Arcade and Steel winds was modeled as out of service due to wind generations uncertain nature, especially as its typical output during system peak conditions is very low.

Table 2: Study Base Case Conditions

Huntley Units 67 and 68	Indeck Yerkes	Oxbow Power	Indeck Olean	Line 171	Jamestown Net Load
In Service	In Service	In Service	In Service	Reconductored	~75-80 MW
In Service	In Service	In Service	In Service	Reconductored	~100-105 MW
In Service	In Service	In Service	Out of Service	Reconductored	~75-80 MW
In Service	In Service	In Service	Out of Service	Reconductored	~100-105 MW

3.3. Gardenville 230/115kV Transformers

System Operators frequently adjust the LTC settings of the National Grid and NYSEG 230/115kV transformers at Gardenville. [redacted] For nearly all hours between June 2003 and September 2010, the 115kV voltage at Gardenville was above 102% of nominal. The voltages were at 103%-105% of nominal about 96% of the time. In all study base cases, the transformers were adjusted to hold the 115kV voltage to about 104.5%. The LTC setting was also chosen so that voltages at all major buses in the system were kept below 105%. This did not result in any 230kV pre-contingency voltages being outside acceptable limits.

3.4. Dunkirk 230/115kV Transformers

Historically, System Operators have almost never adjusted the LTC settings of the 230/115kV transformers at Dunkirk. Typically, the generation is used to manage the 115kV and 230kV voltages. Loss of these machines will require that LTC adjustment begin being used. For each season, year and dispatch, the voltages in the area were reviewed and a setting chosen to hold the Dunkirk 115kV voltage up around 104%. Today, per the Power Control Procedures, operators actually hold the voltage higher, up to 107%, but 104% was used to maintain some system margin. The LTC setting was also chosen so that voltages at all other major buses in the system were kept below 105%.

3.5. Five Mile Rd 345/115kV Transformer

For each season, year and dispatch, the voltages in the area were reviewed and a LTC setting chosen to hold the Five Mile Rd 115kV voltage up around 104%. The LTC setting was also chosen so that voltages at all major buses in the system were kept below 105%.

Prior to beginning this review, impedance calculations were reviewed and updated based on the planned location for the new station. This has resulted in some changes from the analysis shown in the 2011 area study report.

4. Study Methodology

The study methodology is similar to that used in the 2011 area Needs Assessment and Solution Study and is documented in sections 3, 4, 5 and 6 of the 2011 Western Division Area Review Part 1 – Needs Assessment Study. These descriptions are not repeated here. In addition to this methodology, when running N-1-1 analysis, the operator emergency low limits and load shed limits, as discussed in the first part of this study, were used.

5. System Response for Outage of all Dunkirk Generation

5.1. N-1 System Conditions

The following tables show the results of N-1 testing for the system with all Dunkirk units out of service and the planned area upgrades completed.

All tables within this report use a short description to indicate the contingency being presented. Space constraints prevent fully describing the contingency. A full description for each outage can be found in Appendix C of the 2011 Needs Assessment. All contingencies listed in Appendix C were tested as part of this assessment.

Table 3: Summary of N-1 Voltage Needs Identified with Dunkirk Out of Service

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 4: Summary of N-1 Thermal Needs Identified with Dunkirk Out of Service

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-

Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

5.2. N-1-1 System Conditions

In addition to the N-1 needs identified, several N-1-1 conditions were reviewed. N-1-1 analysis can be very burdensome to run and review. To reduce the time to run the analysis and to limit the results that needed to be reviewed and presented here, the full N-1-1 analysis was initially only run on two cases, a summer 2021 and a winter 2021 case. Both initial cases assumed that Indeck Olean was out of service and that the Jamestown load was approximately 100 MW. This analysis identified the contingencies that resulted in system problems. A reduced number of N-1-1 combinations were then run on all other cases.

When presenting results, only voltages that were below the operators load shed limit (see discussion in the first part of the Dunkirk Mothball Study) and overloads that surpassed the element's STE rating are shown. No overloads that are on facilities shown in the tables above in section 5.1 for N-1 conditions are repeated in this section [redacted]

[redacted] From the N-1 analysis for the second level cases, it can also be observed that if the case had assumed Indeck Olean was in service [redacted] It is expected that correction of the overload on these lines will be mandatory when considering the expected definition of BES and the proposed revisions to the TPL standards (TPL-001-2).

Finally only applicable N-1-1 combinations and impacts are described here. As discussed in the 2011 Western NY Needs and Solutions studies, the applicable contingencies are as follows:

1. Loss of any single transmission circuit, transformer, generator or DC line operated at any voltage, followed by any other single transmission circuit, transformer, generator or DC line operated at any voltage. The system response at all 100kV and above elements is considered.
2. Loss of any BPS element, followed by any design contingency at any voltage. The system response on all BPS elements is considered. The impact of this combination on non-BPS elements is not addressed in this study and typically not considered. However, if system impacts are considered severe then a business case to review and address them would be performed on a case by case basis.
3. Loss of any long lead time item operated at any voltage, followed by any design contingency at any voltage. Long lead time items include generators, equipment at gas insulated substations, underground cables, and large power transformers. The system response at all 100kV and above elements is considered.

As can be inferred by #1 and #2 above, correction of the impact of a single element outage, followed by a multiple element outage on a non-BPS facility is not mandatory and is not discussed in the following tables. Note that the Dunkirk 230kV bus is not BPS.

Table 5: Summary of N-1-1 Voltage Needs Identified with Dunkirk Out of Service

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 6: Summary of N-1-1 Thermal Needs Identified with Dunkirk Out of Service

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

5.3. Sensitivity to Interim Conditions

To assess the need for continued operation of the Dunkirk generation and to provide some insight to the risk associated with the low voltages and overloads identified, two sensitivity cases were tested. These cases included the two 52.5 MVAr mobile capacitor banks installed at Dunkirk and Dunkirk 115kV unit #1 in service.

The sensitivity testing only reviewed the summer 2016 peak load cases. One case had Indeck Olean in service, the other had Indeck Olean out of service. Both cases tested had one Jamestown generator in service, for a net load of about 80 MW.

It was found that there were no N-1 voltages outside of planning criteria.

The table below shows all N-1 thermal overloads found.

No voltages were below the load shed limit for any applicable N-1-1 contingency and none of the tested N-1-1 outages resulted in loading over STE on the applicable facilities. N-1-1 testing with Dunkirk Unit #1 as the first contingency was not competed.

Only a desktop review of the winter performance was completed. It is expected that there would be no unacceptable N-1 or N-1-1 thermal overloads or low voltages in the same winter cases. Additional testing would be necessary to confirm this.

Table 7: Summary of N-1 Thermal Needs Identified with Dunkirk Unit 1 In Service

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Summer Peak 2016
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]

5.4. Niagara – Packard Overloads

[redacted] These overloads are not discussed in this report. This is because a NYSRC operating exception exists that allows these lines to be operated up to their STE rating as generation adjustment can occur very quickly that will correct the overloads.

As described in the 2011 Western NY Needs Assessment, N-1-1 overloads in the Niagara/Packard area can all be mitigated [redacted] These concerns are not discussed here.

[redacted] Some contingencies did not result in National Grid equipment surpassing its LTE rating. No National Grid equipment surpassed its STE rating. [redacted]

6. Solutions to Additional First Level (A1) Needs

As a reminder, the following tables show the additional N-1 low voltages and overloads that were determined to be first level (A1) needs. Notice that the thermal overloads only develop in the summer and that the voltage problems tended to be worse in the summer.

Table 8: Summary of Voltage Needs Identified In First Level Cases

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 9: Summary of Thermal Needs Identified In First Level Cases

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

6.1. Dunkirk Area Low Voltages

[redacted] The simplest solution to correct these issues is to add a capacitor bank to the 115kV bus at Dunkirk. Area power factor correction was reviewed and it was determined that it would not fully address the low 230kV voltages.

The recommended capacitor bank size is 33.3 MVAr, the same as the unit planned for Homer Hill. It was found that using a 54 MVAr unit, the same size as the bank recently installed at Clay, would be oversized for this location; up to 45 MVAr could be installed. Based on a review of other levels, including N-1-1 conditions, the recommended location for the capacitor is on bus section 1. However, either bus section would be acceptable. [redacted] This may suggest that the ideal configuration would be the installation of two capacitor banks; this will be discussed later in the report.

This project may help mitigate the need to run generation at Dunkirk while the other permanent solutions are put into place. For this reason, this project should be completed as soon as possible.

Following addition of this project, all 230kV voltages were above 95%.

The expected cost of this project is **$1.3M** and is expected to take **1-2 years** to implement.

6.2. Packard – Erie and Niagara – Gardenville Overloads

The loss of generation resulted in two overloads in the Frontier region. [redacted] The overloads were found in all four levels and for both summer 2016 and 2021. The magnitude of the overload was found to decline in future years, likely due to dispatch and transfer level changes between 2016 and 2021. This suggests that the overload could be more or less severe for other dispatches then the one reviewed in this study. For N-1 conditions, none of the overloads surpassed the STE rating of either line.

[redacted]

Screening of several options, such as reconnecting load taps to other lines, installation of reactors, power factor correction and changing line terminals at each end of the line did not result in any acceptable alternatives, beyond reconductoring the lines or using retired in place circuits as discussed below. Many of these options would reduce the loading on line #181 but increase it on other lines like #180, #182 or even some of the lines connecting to Huntley. As these lines can be heavily loaded during contingency conditions, these increases would not eliminate the need to reconductor circuits, just change which circuits would require the reconductoring. [redacted]

[redacted] With Dunkirk in service, the reduced flow into Stolle from Homer City is made up by subsequent flow increases on the lines from the north (#180, #181, #182). However, the line loading increase is not enough to cause overloads during contingency conditions. With the shutdown of Dunkirk, more power will be flowing across the system from the sources in the north to the loads in the south. In addition, more power will be supplied to the Southwest area from Five Mile. [redacted] The preferred timing for the reconductoring the #181 line is therefore tied to both the full shutdown of Dunkirk generation and the installation of Five Mile Road substation. Therefore, reconductoring is recommended to be completed concurrently with the completion of Five Mile Rd.

The overload [redacted] s related to increased north to south flow associated with the generation shutdown. To facilitate the retirement of the generation as soon as possible, this project will need to be executed as soon as possible. However, since it was not apparent in the 2013 case in the Dunkirk Mothball Part 1 study, it is recommended that the reconductoring be done by June 2015, consistent with the target date for other major system reinforcements in the area.

6.2.1. Niagara – Gardenville Overloads

The overload on line #180 was found to be on a one mile section of 350 copper conductor located just south of the Ellicott junction. Replacement of this conductor will reduce the loading [redacted] rating, addressing the immediate overload concerns on this line. Additional work may be required in the future to reduce the loading further. The next most limiting element is over 11 miles of 400 copper conductor. Other system changes, including the project to address the #181 overload may help mitigate this overload further [redacted] The recommended size of the replacement wire is at least 636 ACSR, but to insure adequate future capacity and to align with the National Grid standard sizes, 795 ACSR is preferred.

An alternative to this could be utilizing the retired in place 69kV circuit #92. This line shares double circuit towers with the #182 circuit and is 400 Copper (up from the 350 Copper on line #180) in this section. Lines #180 and #182 are on the same double circuit towers from the Packard area until the lines cross Grand Island. At this point, they separate onto different double circuit towers, each sharing a tower with a retired in place 69kV line. It would be possible to keep the lines on the same towers from the Grand Island crossing, all the way to the point in the right of way that line #181 turns and heads toward Erie Station. There is no 350 Copper conductor used on this path. Utilizing this alternate path would correct all loadings [redacted]

Due to the expected concerns with utilizing retired in place assets that are believed to be past their useful life, and the fact that this would only reduce the loading [redacted] this option is not recommended. This leaves only the reconductoring option to be a viable alternative.

The expected cost of reconductoring is **$3.7M** and is expected to take **3-5 years** to implement.

6.2.2. Packard – Erie Overloads

The overload on line #181 was found to be on a 14 mile section of 350 copper and 636 aluminum conductor located between Packard and Station 130, which is just south of the Ellicott junction. Replacement of this conductor will address the overloads. The recommended size of the replacement wire is at least 795 ACSR.

An alternative to this could be utilizing the retired in place 69kV circuit #105. The #181 and #105 circuits share double circuit towers from Packard until Ellicott Junction. Bussing these two lines together would correct most of the overloads. Some reconductoring would be required on the 1.1 mile section between Ellicott junction and Station #130. Reconductoring leaves the circuits impedance relatively unchanged. However, bussing the lines greatly reduces the impedance of the circuit (cuts it in half). Because the impedance is cut in half, the loading on the line increases, to the point that it would trigger the need to do additional reconductoring of a 1.2 mile section between Station #130 and the ECWA Ball Pumping station. At this station, the loading reduces to a point that further reconductoring would not immediately be required. However, additional work on the 1.2 mile section between the pump station and Youngmann station might be needed in the future.

Due to the expected concerns with utilizing retired in place assets that are believed to be past their useful life, the bussing option is not recommended. This leaves only the reconductoring option to be a viable alternative.

The expected cost of reconductoring is **$35M-$40M** and is expected to take **5-7 years** to implement.

6.2.3. Packard – Erie and Niagara – Gardenville Overloads

In an attempt to address both of the overloads between Packard and Erie and between Niagara and Gardenville, an option to utilize the retired in place elements discussed above to create a new line from Packard to Gardenville was reviewed. This option merely energizes the retired in place wire, while doing minimal replacement of structures or conductor. This option would require a new breaker position at Packard and Gardenville. It was found that while it addressed the #181 line overloads and one of the two #180 line overloads [redacted]

As discussed, there are concerns with using retired in place assets that are believed to be past their useful life. Because of the remaining overload, the concern with the condition of the existing equipment and the need to add new terminal equipment, this option is not recommended.

6.3. N-1 and N-1-1 System Results for First Level Plan (A1)

The tables below summarize the N-1 and N-1-1 issues that remain following completion of the recommended projects. The recommended projects to address the First Level, N-1, needs include:

- Addition of 33.3 MVAr capacitor bank on the Dunkirk 115kV bus. ($1.3M)
- Reconductoring of one mile of the Niagara – Gardenville #180 line. ($3.7M)
- Reconductoring of 14 miles of the Packard – Erie #181 line. ($35M-$40M)

Note that many of the N-1 issues in the third and fourth level cases have also been addressed by these upgrades.

As N-1 overloads exist on the Five Mile Rd – Homer Hill circuits, N-1-1 overloads on these same lines are not indicated. [redacted]

When considering the as drafted definition of BES and the as drafted revisions to the TPL standards (TPL-001-2), it is expected that because the overloads on the Five Mile – Homer Hill lines surpasses STE for multiple N-1-1 conditions, that correction of this overload will be required in the future to address the minimum reliability standards. Thus, the A1 plan does not adequately address the N-1-1 reliability issues and is not the preferred plan.

Table 10: Summary of Remaining N-1 Voltage Needs Identified Following Plan A1

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None					
Out of Service	Reconductored	~75-80 MW	None					
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 11: Summary of Remaining N-1 Thermal Needs Identified Following Plan A1

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None					
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	None					
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	SW[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 12: Summary of Remaining N-1-1 Voltage Needs Identified Following Plan A1

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]				[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]				[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]				[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]		[redacted]		-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]				[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]				[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]				[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]				[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]		[redacted]		[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]		[redacted]	-	-

Table 13: Summary of Remaining N-1-1 Thermal Needs Identified Following Plan A1

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None						
Out of Service	Reconductored	~75-80 MW	None						
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]			[redacted]	-

7. Solutions to Additional Second Level (A2) Needs

As a reminder, the following shows the N-1 low voltages and overloads that were determined to be additional second level needs or A2 needs. A review of the solutions for this level did not initially include the projects discussed in the previous section. As discussed above, the First Level plan (A1) is not adequate to address the future minimum reliability requirements as an N-1-1 loading over STE would still exist following completion of that plan.

Table 14: Summary of Voltage Needs Identified in Second Level Cases

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 15: Summary of Thermal Needs Identified in Second Level Cases

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

7.1. Dunkirk Area Low Voltages and Frontier Overloads

The previous section described the recommended correction for low voltages in the Dunkirk area and overloads on the #181 and #180 circuits. Only one substantial difference exists between the First level needs and the Second Level needs. This is an overload on the lines between Five Mile Rd and Homer Hill.

As the other needs are relatively the same, the recommendations to correct these problems has not changed and are:

- Addition of 33.3 MVAr capacitor bank on the Dunkirk 115kV bus. ($1.3M)
- Reconductoring of one mile of the Niagara – Gardenville #180 line. ($3.7M)
- Reconductoring of 14 miles of the Packard – Erie #181 line. ($35M-$40M)

7.2. Homer Hill Area Overloads

The only difference between the first level needs and the second level needs is the overloads between Five Mile Rd and Homer Hill. In the cases with Indeck Olean out of service, the lines between Five Mile Rd and Homer Hill (in this study numbered #163 and #164) were overloaded for an outage of the parallel line or a stuck breaker at Five Mile Rd. This overload surpassed STE in many of the cases and was present in both 2016 and 2021. While the loading was more severe in the summer, it was still found to be over LTE in the winter. As the problem is found for a single element outage in a level two case, correction is recommended.

For an N-1-1 outage of the 345kV line between Five Mile Rd and Stolle, followed by an outage of one of the 115kV lines between Five Mile and Homer Hill, the remaining line between Five Mile and Homer Hill would overload [redacted] N-1-1 outages of line #171, #67 and #996 instead of line #37 also caused loading on lines #163 or #164 [redacted] It was also found that in cases with Indeck Olean in service, an N-1-1 outage of Indeck Olean followed by an outage of line #163 would result in line #164 being above its STE rating.

These lines are on the same double circuit structures for the entire 7.4 miles between Five Mile and Homer Hill. They are currently 336 ACSR conductor. Screening several options only resulted in one acceptable alternative, reconductoring of the lines.

Testing showed that reconductoring with a 556 ACSR conductor would only reduce the overload to about 85% of LTE, thus not providing for the future capability that would likely be needed over the 40 or 80 year life of the line. At least a 636 ACSR conductor is recommended, but to insure adequate future capacity and to align with the National Grid standard sizes, 795 ACSR is preferred.

It was also noted that this project would result in some improvement to the area voltages and that the larger the conductor size, the greater this improvement.

The expected cost of this project, based on using a 795 ACSR conductor, is **$17M-$19M, depending on the conductor used** and is expected to take **5-6 years** to implement. Opportunities to separate the lines onto separate structures will be reviewed, but it is expected that the alternative will be cost prohibitive and would need additional, difficult to obtain right of way. The cost for this variation is $27M.

Because the overload would develop immediately upon completing Five Mile Rd, this reconductoring should be completed concurrently with Five Mile.

7.3. N-1 and N-1-1 System Results for Second Level Plan (A2)

The tables below summarize the N-1 and N-1-1 issues that remain following completion of the recommended projects. The recommended projects to address the Second Level needs include:

- Addition of 33.3 MVAr capacitor bank on the Dunkirk 115kV bus. ($1.3M)
- Reconductoring of one mile of the Niagara – Gardenville #180 line. ($3.7M)
- Reconductoring of 14 miles of the Packard – Erie #181 line. ($35M-$40M)
- Reconductoring of the two 115kV lines between Five Mile Rd and Homer Hill, approximately 7.4 miles in length. ($17M-$19M)

Table 16: Summary of Remaining N-1 Voltage Needs Identified Following Plan A2

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None					
Out of Service	Reconductored	~75-80 MW	None					
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 17: Summary of Remaining N-1 Thermal Needs Identified Following Plan A2

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None					
Out of Service	Reconductored	~75-80 MW	None					
In Service	Reconductored	~100-105 MW	None					
Out of Service	Reconductored	~100-105 MW	None					

Table 18: Summary of Remaining N-1-1 Voltage Needs Identified Following Plan A2

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-	-

Table 19: Summary of Remaining N-1-1 Thermal Needs Identified Following Plan A2

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None						
Out of Service	Reconductored	~75-80 MW	None						
In Service	Reconductored	~100-105 MW	None						
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-	-

8. Solutions to Additional Fifth Level (A5) Needs

As discussed in section 3.1, plans are developed within this report for the First Level, Second Level and Fifth Level needs. This section examines the options for the Fifth level. This level plan will need to address all N-1 and N-1-1 issues found in the first and second level cases, with the N-1-1 issues driving many of the recommendations. The issues requiring correction are shown in the following tables. The results in these tables do not include any of the upgrades discussed in previous sections. From a desktop review of the needs that require correction, four separate solution sets were developed.

From the analysis for the two sets of N-1 plans discussed in earlier sections of this report (A1 and A2 plans), it can be seen that nearly all of the N-1-1 issues have been addressed; only a few N-1-1 low voltage issues remain. The A2 plan was used as the starting point for one of the fifth Level solutions, with additional projects added to address the remaining issues; this new option is referred to as the A5-1 plan.

[redacted] The second solution set reviewed for this level attempted to address this by starting with a new 230kV path from Packard to Gardenville and then adding in additional projects to address the remaining issues; this option is referred to as the A5-2 plan.

The earlier analysis also showed that many of the overloads and low voltages could be traced back [redacted] this option is referred to as the A5-3 plan. The fourth option reviewed the addition of a new 345kV line from a point called Dysinger to Stolle; this option is referred to as the A5-4 plan.

Table 20: Summary of Voltage Needs Identified in First and Second Level Cases

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 21: Summary of Thermal Needs Identified in First and Second Level Cases

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 22: Summary of N-1-1 Voltage Needs Identified in First and Second Level Cases

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 23: Summary of N-1-1 Thermal Needs Identified in First and Second Level Cases

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-

8.1. Second Level Solution to Fifth Level Needs (A5-1)

Earlier in this study, a set of upgrades was recommended to address the second level N-1 problems (A2). This option for a fifth level solution (A5-1) started with these upgrades and added additional projects to address the remaining N-1-1 issues. The remaining N-1-1 issues were low Gardenville and Huntley 230kV voltages for N-1-1 outages[redacted] The recommended projects to address the Second Level needs and the stating point for this fifth Level solution includes:

- Addition of 33.3 MVAr capacitor bank on the Dunkirk 115kV bus. ($1.3M)
- Reconductoring of one mile of the Niagara – Gardenville #180 line. ($3.7M)
- Reconductoring of 14 miles of the Packard – Erie #181 line. ($35M-$40M)
- Reconductoring of the two 115kV lines between Five Mile Rd and Homer Hill, approximately 7.4 miles in length. ($17M-$19M)

Review of the remaining issues started using a 2021 summer peak case with Indeck Olean out of service. It was found that the remaining issues are low voltages. An attempt was made to address them with the addition of capacitor banks. Very few locations are left to add blocks of reactive compensation to the transmission system, as it is unwise to add more than one capacitor bank to any single bus section. The first two proposed additions were at the Huntley 115kV bus and the Dunkirk 115kV bus. With these additions, all voltages and thermal overloads for N-1-1 conditions in the second level cases have been mitigated to an acceptable point. The few remaining N-1-1 low voltages are in fourth level cases, which do not require correction. The complete summary of area performance is in the following tables. Thus the complete option for the Fifth Level Needs is:

- Addition of two 33.3 MVAr capacitor banks on the Dunkirk 115kV bus. ($2.5M)
- Reconductoring of one mile of the Niagara – Gardenville #180 line. ($3.7M)
- Reconductoring of 14 miles of the Packard – Erie #181 line. ($35M-$40M)
- Reconductoring of the two 115kV lines between Five Mile Rd and Homer Hill, approximately 7.4 miles in length. ($17M-$19M)
- Addition of a second 75 MVAr capacitor bank on the Huntley 115kV bus ($1.4M)

The expected cost of this set of projects is **$60M-$67M**.

Table 24: Summary of Remaining N-1 Voltage Needs Identified Following Solution A5-1

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None					
Out of Service	Reconductored	~75-80 MW	None					
In Service	Reconductored	~100-105 MW	None					
Out of Service	Reconductored	~100-105 MW	None					

Table 25: Summary of Remaining N-1 Thermal Needs Identified Following Solution A5-1

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None					
Out of Service	Reconductored	~75-80 MW	None					
In Service	Reconductored	~100-105 MW	None					
Out of Service	Reconductored	~100-105 MW	None					

Table 26: Summary of Remaining N-1-1 Voltage Needs Identified Following Solution A5-1

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None						
Out of Service	Reconductored	~75-80 MW	None						
In Service	Reconductored	~100-105 MW	None						
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 27: Summary of Remaining N-1-1 Thermal Needs Identified Following Solution A5-1

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None						
Out of Service	Reconductored	~75-80 MW	None						
In Service	Reconductored	~100-105 MW	None						
Out of Service	Reconductored	~100-105 MW	None						

8.2. New 230kV Line Solution (A5-2)

This option examined the impact of adding a new 230kV line to the area. It is expected that obtaining the necessary right of way to construct a new line between Niagara or Packard and Gardenville would be very difficult. So a plan was developed that would utilize existing right of way in a new way.

Today three 115kV lines travel between the Niagara/Packard area and either Gardenville or Erie, lines #180, #181 and #182. Each of these lines is on double circuit towers. The fourth line sharing the double circuit towers with these three is a de-energized retired in place circuit. The proposed plan to construct a new 230kV line is to remove one of the two double circuit tower lines and replace it with a new single circuit 230kV line. This will result in the removal of the retired in place circuit and elimination of one of the three energized 115kV lines.

All analysis on this option was done assuming no more than three of the four capacitor banks at Gardenville were in service. From this, it can be concluded that selection of this option would allow a reduction in the number of Gardenville capacitor banks.

8.2.1. 115kV Line Impacts

This plan will require the reconnection of the existing 115kV lines in a new configuration. Two configurations are available, either a Packard – Gardenville circuit and a Niagara – Erie circuit or a Packard – Erie circuit and a Niagara – Gardenville circuit. For purposes of this study, the option for a Niagara – Erie and a Packard – Gardenville circuit was studied. If an engineering or commercial reason exists to consider the other alternative, further study work would be required to confirm that it would be acceptable.

8.2.2. Niagara – Packard 230kV Line Impacts

[redacted]

An operating exception exists on all lines connected to Niagara that allows their post-contingency loading to be up to the STE limit, as generation reduction at Niagara can be done to reduce the loading. Therefore, this overload is noted in the tables below, but is considered acceptable. It is expected that this option would make the predicted overload more common in real time system operation.

If it is decided that this overload is not acceptable, a desktop review has suggested three alternatives. The first is to reconductor the line, it is currently limited by 3.4 miles of 1431 ACSR conductor. This option would also likely require the replacement of terminal equipment at Niagara. The second is to separate lines #61 and #64 onto separate towers. They are on the same towers for about 1.4 miles. The third is to extend the new 230kV line to Niagara instead of Packard. It is expected that the third option will be most difficult and the first option would be the least impactful, however engineering review of all three would be necessary.

8.2.3. Five Mile – Homer Hill Overloads

During initial testing of this option, it was confirmed that the new 230kV line would have no impact on the post-contingency overloads on the Five Mile – Homer Hill circuits. With Indeck Olean out of service, an outage of one of the lines or a stuck breaker contingency at Five Mile Rd would result in the other line surpassing STE. To address this, the option to reconductor these lines was include in this solution set.

8.2.4. Remaining Voltage Problems

Initial testing of this option also determined that following the addition of the 230kV line and the Five Mile – Homer Hill reconductoring, one additional low voltage concern still exists. [redacted] These low voltages are similar to those discussed earlier in this report and are corrected by the addition of a single 115kV capacitor bank at Dunkirk.

8.2.5. Results

The following tables show the result of testing with the proposed solution applied. The solution includes the following.

- Addition of 33.3 MVAr capacitor bank on the Dunkirk 115kV bus. ($1.3M)
- Reconductoring of the two 115kV lines between Five Mile Rd and Homer Hill, approximately 7.4 miles in length. ($17M-$19M)
- Reconfiguration of the existing right of way between Packard and Gardenville such that one 115kV line and one de-energized line are removed, the remaining two 115kV lines are reconfigured and a new 230kV line is added. ($75M)

The expected cost of this set of projects is **$93M-$95M.**

Recall that because of the operating exception that exists at Niagara, the loading over LTE but less than STE on the lines connected to Niagara shown in the table below is acceptable.

Most of the low voltages shown in the tables could be addressed by the addition of a second 115kV capacitor bank at Dunkirk. However, addressing these was not required as they are for N-1-1 conditions with Jamestown at ~100 MW, which would be addressed by a sixth level plan. The loading over STE for N-1-1 conditions on #141 and #142 also does not require correction as it would only need to be addressed in a sixth level plan.

Table 28: Summary of Remaining N-1 Voltage Needs Identified Following Solution A5-2

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None					
Out of Service	Reconductored	~75-80 MW	None					
In Service	Reconductored	~100-105 MW	None					
Out of Service	Reconductored	~100-105 MW	None					

Table 29: Summary of Remaining N-1 Thermal Needs Identified Following Solution A5-2

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-

Table 30: Summary of Remaining N-1-1 Voltage Needs Identified Following Solution A5-2

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None						
Out of Service	Reconductored	~75-80 MW	None						
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-	-
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-	-

Table 31: Summary of Remaining N-1-1 Thermal Needs Identified Following Solution A5-2

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None						
Out of Service	Reconductored	~75-80 MW	None						
In Service	Reconductored	~100-105 MW	None						
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-

8.3. Addition of Transformation at Stolle Rd (A5-3)

A review of the N-1 and N-1-1 issues found within this study indicated that many of the concerns started with outages in the Stolle area, resulted in low voltages in the Stolle area or were related to reduced flow into Stolle. This option attempts to address these concerns by reinforcing the Stolle area with new transformation. Initially, this option started with a single 345/230kV transformer, which was in addition to the two 345/115kV transformers that exist today. Then testing was done with various combinations of one or two 345/230kV transformers and/or one or two 230/115kV transformers. There are eight possible combinations of one or two transformers. For each combination, LTC settings were adjusted to hold all voltages to an acceptable level and to control reactive power flows.

To determine if this option would be effective to correct the area concerns, two N-1-1 contingencies were tested using the summer 2021 case with Indeck Olean out of service and Jamestown's net load at ~75 MW. The N-1-1 contingencies tested were an outage of either line #37 or line #66 followed by the 79/80 double circuit tower outage. [redacted] Therefore, for this testing, the #37 line outage is an outage of the Homer City – Five Mile Rd section or the Five Mile Rd – Stolle section of the line only.

For the transformers, a size similar to the new National Grid 230/115kV transformers at Gardenville [redacted] and the existing Niagara 345/230kV transformers was selected [redacted] These results would be affected by variations on these sizes.

As each variation seemed to result in an acceptable response, the next test performed was an N-1 double circuit tower outage of lines #180 and #182. [redacted] Because of this, this option will need to include reconductoring of that line.

Table 32: Remaining Concerns for Indicated Contingency

345/230kV Transformers	230/115kV Transformers	#37+ 79+80 DCT	#66+ 79+80 DCT	180+182S
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Testing was also done to review the impact that the addition of Stolle transformation would have on the overloads between Five Mile Rd and Homer Hill. The new transformation does not reduce the overload and may result in some increases in the overload for some of the N-1 and N-1-1 conditions.

Next testing was done on the case with a 345/230kV transformer, the Five Mile – Homer Hill lines reconductored and line #181 reconductored. It was found that for a [redacted] This was still not acceptable so a Dunkirk capacitor bank would need to be added.

Based on the results of this screening, this option would need to consist of the following projects. The addition of a single 345/230kV transformer could be replaced by a 230/115kV transformer.

- Addition of a 345/230kV transformer at Stolle
- Addition of 33.3 MVAr capacitor bank on the Dunkirk 115kV bus.
- Reconductoring of the two 115kV lines between Five Mile Rd and Homer Hill, approximately 7.4 miles in length
- Reconductoring of 14 miles of the Packard – Erie #181 line

This option is basically the same as the option discussed in section 8.1, only in place of the simple addition of capacitor banks at Dunkirk and Huntley, a complicated project to add a 345/230kV transformer to Stolle is added. The addition of the Stolle transformer does not mitigate the need for any of the other projects, except the minor reconductoring of line #180. Because of this, this option will be much more expensive and complicated than the option in section 8.1. For this reason, this option is not considered further. As National Grid does not own Stolle Rd, it was not possible to complete investment grade cost estimates for this option, it was only assumed that the cost of the two capacitor banks would be less than the transformer addition.

8.4. Addition of a Dysinger – Stolle 345kV Line (A5-4)

This option examines the impact of adding a 345kV circuit from Stolle Rd north to a point referred to as Dysinger. This is a point on the Niagara – Rochester 345kV lines where the Robinson – Stolle 230kV line #66 crosses the right of way and where one of the 345kV lines from Niagara turns and heads north to Somerset. For purposes of this study, it was assumed that the new line would connect only to the Niagara – Rochester 345kV line #2 (neither of the other lines connected to Somerset), via a three breaker ring station. It is also assumed that the 345kV at Stolle Rd would have to be expanded to a four breaker ring configured in such a way that no stuck breaker contingencies would result in an outage to either both transformers or both lines. A straight bus configuration with two bus tie breakers would also be acceptable.

Screening of this option was started by reviewing the loading on the Five Mile – Homer Hill 115kV circuits. It was found that for an outage of one line, the other would overload to 110% of its STE rating. This is an increase above what was discussed earlier. Thus, this option would also require a reconductoring of both of these circuits.

Following the addition of the reconductoring, the next outage screened was a double circuit tower outage of 230kV lines #73 and #74. For this outage, the 230kV voltage at Dunkirk would fall to 93.7%. As discussed earlier, this would require the installation of a capacitor bank at Dunkirk. It was also found that for an N-1-1 outage of a Dunkirk transformer (either one) followed by a Dunkirk bus fault (either one), the 115kV voltage at Dunkirk would be below the load shed limit. The solution to this discussed above is a second Dunkirk capacitor bank.

Following these upgrades, all voltages and loadings would be within acceptable limits. However for an N-1 outage of lines #180 and #182 (double circuit tower outage), line

#181 would continue to load to 98% of LTE. It is expected that this would need to be addressed in future years.

This plan would thus consist of:

- Addition of two 33.3 MVAr capacitor banks on the two Dunkirk 115kV bus sections. ($2.5M)
- Reconductoring of the two 115kV lines between Five Mile Rd and Homer Hill, approximately 7.4 miles in length. ($17M-$19M)
- Addition of a new 345kV line from a new three breaker ring bus constructed at the point commonly referred to as Dysinger to Stolle with expansion of the Stolle 345kV bus to a four breaker ring.

Based on a $3M to $10M per mile cost of 345kV construction, cost of only the new 345kV line (estimated to be at least 22 miles long) would be over $70M, possibly as high as $200M. Thus expected cost of this complete set of projects is in excess of **$90M** possibly as high as $220M. As this cost is much higher than the other options considered, this option is not the recommended approach for the area. In addition to the high cost, it is expected that if this option were selected, line #181 would still have to be reconductored at some point outside the study horizon, further increasing the cost.

Table 33: Summary of Remaining N-1 Voltage Needs Identified Following Solution A5-4

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None					
Out of Service	Reconductored	~75-80 MW	None					
In Service	Reconductored	~100-105 MW	None					
Out of Service	Reconductored	~100-105 MW	None					

Table 34: Summary of Remaining N-1 Thermal Needs Identified Following Solution A5-4

Indeck Olean	Line 171	Jamestown Net Load	Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~75-80 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
In Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 35: Summary of Remaining N-1-1 Voltage Needs Identified Following Solution A5-4

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None						
Out of Service	Reconductored	~75-80 MW	None						
In Service	Reconductored	~100-105 MW	None						
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 36: Summary of Remaining N-1-1 Thermal Needs Identified Following Solution A5-4

Indeck Olean	Line 171	Jamestown Net Load	First Outage	Second Outage	Element	Winter Peak 2016	Winter Peak 2021	Summer Peak 2016	Summer Peak 2021
In Service	Reconductored	~75-80 MW	None						
Out of Service	Reconductored	~75-80 MW	None						
In Service	Reconductored	~100-105 MW	None						
Out of Service	Reconductored	~100-105 MW	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

9. Non-Wires Alternatives

The following sections discuss how non-wires alternatives (NWA), such as demand side management or distributed generation might be used to address the needs discussed within this report. For purposes of this review all analysis was performed with a summer 2016 case with Indeck Olean out of service and Jamestown at 75-80 MW (second level case). It was found that all summer problems were worse than those observed in the winter were.

9.1. Low Voltage Concerns

As discussed within the earlier sections, many of the plans include the addition of capacitor banks to support post contingency voltages. It is expected that the addition of two permanent capacitor banks at Dunkirk and a second capacitor bank at Huntley could all be in service by spring 2014. In addition, the mobile capacitor banks can and are utilized in western NY to support the system while these permanent upgrades are put into place. Because of these points, review of NWA to address the voltage needs or to reduce the need to run generation at Dunkirk was not undertaken. It is also expected that the cost to install capacitor banks would be comparable to the annual cost of doing a NWA.

9.2. Overloads on Five Mile – Homer Hill Circuits

To review the amount of NWA needed to address this overload concern, a review was performed to find out how much load would have to be reduced in the Homer Hill area to keep the loading on the Five Mile – Homer Hill circuits below LTE for an N-1 stuck breaker at Five Mile Rd. An N-1 outage of one of the lines between Five Mile and Homer Hill would also result in the overload; the stuck breaker was just used for screening, as the overload was slightly worse.

First, a test was performed to scale the entire western division down until the problem was corrected. It was found that the load had to be reduced to 62% of its initial value (peak) to correct the loading to 100% of its LTE rating. This suggests that the problem would be present over 1850 hours each summer.

Next, only the load between Dunkirk, Falconer, Homer Hill and Gardenville was scaled. This scaling included all customer loads and all municipal loads. It was found that the load had to be reduced to less than 74% of its initial value to correct the overload.

Based on these two tests, the use of NWA to address the area concerns was not considered a viable option. The reductions in these various targeted areas were larger than 20% of the total load in the targeted area of need. This value is used as a guideline by National Grid to determine if NWA are viable options as documented in National Grid's "Guidelines for Consideration of Non-Wires Alternatives in Transmission and Distribution Planning," Issue 1, approved February 2011. The number of hours of exposure also makes NWA impractical.

9.3. Overloads on Lines #181 and #180

To review the amount of NWA needed to address this overload concern, a review was performed to find out how much load would have to be reduced in the area supplied by lines #180, #181 and #182, including NYSEG's Erie area, to keep the loading on the Packard – Erie #181 circuit below LTE [redacted]

[redacted]

First, a test was performed to scale the entire western division down until the problem was corrected. It was found that the load had to be reduced to 84% of its initial value (peak) to correct the loading to 100% of its LTE rating. This suggests that the problem would be present over 240 hours each summer.

Next, only the load connected to line #181 was reduced. This scaling included all loads at National Grid's Station 130, Station 124 (served from Youngmann) and Station 58 (served from Youngmann) and customer stations Erie County Water Authority's (ECWA) Ball Pump Station and Veridian/Calspan. Only about 3 MW of the over 100 MW of load supplied by this line is at these two customer stations.

The review also scaled the load at a proposed station at Frankhauser Rd, which is planned to be completed in 2014. Approximately 35 MW of load will be moved to Frankhauser Rd Station from National Grid stations 130 (27%), 124 (9%), 58 (5%), 54 (12%), 224 (17%) and 140 (30%). Today the load at Stations 54 and 140 is supplied by circuits #38 and #39 and Station 224 is supplied by circuits #36 and #37.

Initially the load connected to NYSEG's 34.5kV network, [redacted] was not scaled.

The load at the National Grid distribution and customer stations had to be reduced [redacted] to reduce the loading on the line below its LTE rating.

Next, scaling of the NYSEG 34.5kV network was reviewed. [redacted]

Based on these tests, the use of NWA to address the area concerns was not considered a viable option. The reductions in the targeted area were larger than 20% of the total load in the targeted area of need. This value is used as a guideline by National Grid to determine if NWA are viable options as documented in National Grid's "Guidelines for Consideration of Non-Wires Alternatives in Transmission and Distribution Planning," Issue 1, approved February 2011. The number of hours of exposure also makes NWA impractical.

10. Summary

Based on the system analysis and a review of the potential cost of area upgrades, the recommendation is to address all N-1 problems and greatly mitigate the N-1-1 exposure by implementing the A5-1 plan. This plan includes:

- Addition of two 33.3 MVAr capacitor banks on the two Dunkirk 115kV bus sections. This project should be implemented as soon as possible. ($2.5M)
- Addition of a second 75 MVAr capacitor bank at the Huntley 115kV switchyard. This project should be implemented as soon as possible. ($1.4M)
- Reconductoring of the two 115kV lines between Five Mile Rd and Homer Hill, each approximately 7.4 miles in length. This project is recommended to be executed such that it is complete when Five Mile Rd comes into service. If the project cannot be completed by the time Five Mile Rd is completed, a review of the risk associated with the

outage/overload and the cost of continued operation of generation at Dunkirk will have to be undertaken to determine when the shutdown of the generation can occur. ($17M-$19M)

- Reconductoring of one mile of the Niagara – Gardenville #180 line. To facilitate the retirement of the generation as soon as possible, this project is recommended to be implemented such that it is complete at or before Five Mile Rd coming into service. If the project cannot be completed by the time Five Mile Rd is completed, a review of the risk associated with the outage/overload and the cost of continued operation of generation will have to be undertaken to determine when the shutdown of the generation can occur. ($3.7M)
- Reconductoring of 14 miles of the Packard – Erie #181 line. To facilitate the retirement of the generation as soon as possible, this project is recommended to be implemented such that it is complete at or before Five Mile Rd coming into service. If the project cannot be completed by the time Five Mile Rd is completed, a review of the risk associated with the outage/overload and the cost of continued operation of generation at Dunkirk will have to be undertaken to determine when the shutdown of the generation can occur. ($35M-$40M)

The expected cost of this set of projects is in the range of **$60M-$67M** based on investment grade estimates with a range of -50% - +200%.