Hecate Energy
Cider Solar Farm

Appendix 21-A: Interconnection System Impact Study

EBIZ LABS

New York ISO Queue #811
Cider Solar Project

Interconnection System Impact Study

Final Draft Report

June 2, 2020

Legal Notice

This document, prepared by EBiz Labs, Inc. (EBL), is on account of work sponsored by New York Independent System Operator (NYISO), and solely for the benefit of NYISO. Neither EBL nor NYISO, nor any person or persons acting on behalf of either party,

(a) Makes any warranty, expressed or implied, with respect to the use of any information or methods disclosed in this document; or
(b) Assumes any liability with respect to the use of any information or methods disclosed in this document.

Any recipient of this document, by their acceptance or use of this document, releases EBiz Labs, Inc. and New York ISO from any liability for direct, indirect, consequential or special loss or damage whether arising in contract, warranty, express or implied, tort or otherwise, and irrespective of fault, negligence, and strict liability.

Document History

Status	Version	Date	Description of Revision
Draft	1	04/06/2020	First Draft Report Created
Draft	2	04/27/2020	Revised draft to address NYISO initial review / comments
Draft	3	05/18/2020	Revised draft to address TO review / comments
Draft	3.1	05/19/2020	Minor editorial updates
Draft	Final	06/02/2020	Updated one-line diagram and baselined final document

Table of Contents

List of Tables

List of Figures

Appendices

Executive Summary

Hecate Energy Cider Solar, LLC (the “Developer”) has proposed connecting the Cider Solar Project (the “Project”) to the New York State Transmission System (“NYSTS”). The proposed Project, to be located in Genesee County, New York is a photovoltaic generation plant, and is expected to have a maximum potential generating capacity of 500 MW in summer (at 90^{o}F) and 500 MW in winter (at 10^{o}F).

The Connecting Transmission Owner (“CTO”) is the New York Power Authority (“NYPA”). The proposed Point of Interconnection(s) (“POI”) will be on the NYPA Kintigh to New Rochester 345 kV line (about 30.19 miles west of New Rochester).

The Project has a proposed In-Service Date of August 31, 2023 and a Commercial Operation Date of December 31, 2023.

A System Reliability Impact Study (“SRIS” or the “Study”) was conducted by EBiz Labs for the Project in accordance with the New York Independent System Operator (“NYISO”) Applicable Reliability Standards set forth under Attachment X of the NYISO Open Access Transmission Tariff (“OATT”). The Study assessed the impact of the Project on the base case power system, including the following Affected Systems: NYSEG/RG&E, National Grid, Ontario-IESO, and NextEra Energy Transmission of New York.

The Study performed power flow, short circuit, NPCC A-10 testing, and stability analyses, with and without the Project, to determine the incremental impact of the Project on the NYSTS. The Study was performed in accordance with applicable NERC, NPCC, NYSRC, NYISO, CTO and Affected System(s) reliability and design standards.

The results are based on specific system conditions, study assumptions, and dispatch patterns modeled in the study cases. The Study was based on the system representation in the 2022 power flow base cases from the NYISO Class Year 2017 ATBA (the Base Cases). The Study was conducted using the power flow, stability, and short circuit Base Cases provided by the NYISO, and includes the representation of proposed projects that have already been cost allocated, up to and including Class Year 2015 (as listed in Appendix A of the scope). The Q545A Empire State Line Alt transmission project was modeled as in-service.

This report includes a description of the proposed facilities and the conceptual design of the interconnection to the system. It includes a breaker one-line diagram depicting the proposed facilities and their integration with the existing facilities. It provides a list of the facilities (CTO Attachment Facilities and System Upgrade Facilities) required to reliably interconnect the Project to the NYSTS. A non-binding good faith estimates of the cost and time to construct those facilities is provided as well.

<u>Study Findings:</u>

Power Flow Analysis

Summer Peak

- N-0
  - The N-0 pre-contingency analysis with the addition of the Project did not identify any thermal or voltage violations.
  - The project slightly increases the thermal loadings of the lines near the POI but does not create any thermal overloads.
- N-1
  - The N-1 contingency analysis included comparison of the post-contingency branch loadings and bus voltages between pre and post-Project conditions, in the Study Area. For the summer peak conditions tested, the addition of Project did not create any new overloads in the post contingency conditions.
  - The Project did not create any new voltage violations in the post-contingency conditions.
  - No new thermal or voltage violations were found as a result of the addition of the Project
- N-1-1
  - The N-1-1 contingency analysis included comparison of the post-contingency branch loadings and bus voltages between pre and post-Project conditions, in the Study Area. For the summer peak conditions tested, the addition of Project did not create any new significant overloads or voltage violations in the post-contingency conditions.

Winter Peak

- N-0
  - The N-0 pre-contingency analysis with the addition of the Project did not identify any thermal or voltage violations.
  - The Project slightly increases the thermal loadings of the lines near the POI but does not create any thermal overloads.
- N-1
  - The N-1 contingency analysis included comparison of the post-contingency branch loadings and bus voltages between pre- and post-Project conditions, in the Study Area. For the winter peak conditions tested, the addition of Project did not create any new overloads in the post-contingency conditions.
  - The Project did not create any new voltage violations in the post-contingency conditions.
  - No new thermal or voltage violations were found as a result of addition of this Project.

Transfer Limit Analysis

Transfer limit analysis was performed for summer peak cases for both pre-project and post-project cases. The Project reduces the ON-NY thermal transfer limit by 39 MW and increases the NY-ON thermal transfer limit by 50 MW. The ON-NY thermal transfer reduction can be reduced to less than 25 MW by adjusting the Dysinger PAR. Based on recent previous studies, the Project will not adversely impact the Dysinger-East and West – Central interfaces.

Stability Analysis

The purpose of this analysis was to identify any stability criteria violations after addition of the Project. The local stability contingencies, and design criteria contingencies provided by the NYISO and NYPA were simulated for summer peak and light load condition and the results showed that the Project has no adverse impact on the stability performance of the system. The system response was stable and positively damped for all the studied faults.

The critical clearing time ("CCT") analysis was performed for summer and light load condition by applying a 3-phase fault at the Q811-POI 345 kV bus. The addition of the Project has no adverse impact on the critical clearing times. The Project passed the post-transition LVRT requirement test.

There were no stability criteria violations observed due to addition of the Project. Hence, the Project does not have any adverse impact on the stability performance and damping of the NYSTS.

NPCC A-10 BPS Testing

Testing of the NPCC Bulk Power System (BPS) classification of the Q811 POI 345 kV bus was performed according to the NPCC A-10 criteria and requirements. Results indicate that the Q811 POI 345 kV station does not need to be classified as NPCC BPS based on transient stability and steady state tests.

Short Circuit Analysis

Short circuit analysis was performed to assess the impact of the Project on the adequacy of existing circuit breakers and related equipment in the Study Area. The results indicate that the Project increases fault duties in the Study Area by 100 A or more but does not cause any fault interrupting device to exceed its interrupting capability.

Extreme Contingency Assessment

The Study evaluated the summer peak system performance under representative Extreme Contingencies within the Study Area. Power flow and stability analysis was conducted for the selected extreme contingencies in the Study Area.

There were no power flow and stability criteria violations observed due to addition of the Project. Hence, the Project does not have any adverse impact on the NYSTS performance for the extreme contingencies tested.

Cost Estimate and Time to Construct

Stand Alone System Upgrade Facilities (SA SUFs), Connecting Transmission Owner Attachment Facilities (CTOAFs) and System Upgrade Facilities (SUFs) are required to interconnect the Project to the 345 kV POI.

NYISO estimated that the non-binding, good faith cost of a 345 kV 3-breaker ring switching station that is required to interconnect the Project is $19 Million, based on cost estimates of previous similar Projects.

NYISO also estimated that the time required to construct the ring station is approximately 12 to 18 months.

1 Introduction

Hecate Energy Cider Solar, LLC (the “Developer”) has proposed connecting the Cider Solar Project (the “Project”) to the New York State Transmission System (“NYSTS”). The proposed Project, to be located in Genesee County, New York is a photovoltaic generation plant, and will consist of two hundred and five (205) TMEIC, PVH-L2700GR inverters and is expected to have a maximum[1] potential generating capacity of 500 MW in summer (at 90°F) and 500 MW in winter (at 10°F).

The Connecting Transmission Owner (“CTO”) is the New York Power Authority (“NYPA”). The proposed Point of Interconnection(s) (“POI”) will be on the NYPA Kintigh to New Rochester 345 kV line (about 30.19 miles west of New Rochester).

The Project has a proposed In-Service Date of August 31, 2023 and a Commercial Operation Date of December 31, 2023.

A System Reliability Impact Study (“SRIS” or the “Study”) was conducted for the Project in accordance with the New York Independent System Operator (“NYISO”) Applicable Reliability Standards set forth under Attachment X of the NYISO Open Access Transmission Tariff (“OATT”).

The purpose of this study is to evaluate the impact of the proposed interconnection of the Project on the reliability of the NYSTS. The study assessed the impact of the Project on the base case power system, including the following Affected Systems: NYSEG/RG&E, National Grid, Ontario-IESO, and NextEra Energy Transmission of New York. The main objectives of this study are to:

I. Confirm that the proposed facilities comply with the applicable reliability standards.
II. Assess the impact of the proposed project on the reliability of the pre-existing power system and on the transfer limits of the interfaces.
III. Determine any System Upgrade Facilities that would be required to eliminate any adverse impacts that the Project could have on the reliability of the New York State Transmission System in accordance with applicable reliability standards, guidelines and study practices, and as described under section 2.4.1 of the “*NYISO Transmission Planning Guideline #1-1*”.

[1] For temperature sensitive output projects, the MW values represent the Maximum Summer Peak Net Output that can be achieved between 85 and 95°F, and the Maximum Winter Peak Net Output that can be achieved between 10 and 35°F.

To achieve these study objectives, the system performance was assessed both prior to (without) and after (with) the addition of the Cider Solar Project for the following conditions:

- System Intact (All lines in service)
- Single-element, Multiple-element contingencies
- N-1-1 Power Flow Analysis
- Extreme Contingency Assessment
- Short circuit (three-phase, double line to ground, and single-line-to-ground faults)
- NPCC A-10 Testing
- Transient Stability

The Study performed power flow, short circuit, NPCC A-10 testing, and stability analyses, with and without the Project, to determine the incremental impact of the Project on the NYSTS. The Study was performed under the NYISO's Minimum Interconnection Standard (MIS), which is designed to ensure reliable access by the proposed project to the NYSTS.

These analyses were conducted in accordance with the applicable North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Council (NPCC), New York State Reliability Council (NYSRC) and NYPA reliability and design standards, and in accordance with applicable NYISO and Affected Systems study guidelines, procedures and practices.

2 Project Description and Modeling

2.1 Project Description

The Project, located in Genesee County, New York, is expected to have a maximum potential generating capacity of 500 MW in summer and winter. The Project is a Photovoltaic Solar PV facility consisting of two hundred and five (205) TMEIC, PVH-L2700GR inverters. The Project has a proposed In-Service Date of August 31, 2023 and a Commercial Operation Date of December 31, 2023.

Figure 2-1 shows the conceptual single line diagram of the Project based on information provided by the Developer.

2.2 Study Area

The Study evaluated the impact of the Project on the 115 kV and above portions of the NYSTS in the following NYCA load zones: West (Zone A), Genesee (Zone B), and Central (Zone C) that are most likely to be affected by the Project; the Study also evaluated the impact of the Project on the local (i.e., below 115 kV, as applicable) system in the electrical proximity to the POI.

2.3 Modeling Assumptions

Phase angle regulators ("PARs"), switched shunts, and LTC transformers were modeled as regulating pre-contingency and non-regulating post-contingency. The Study used PAR schedules established by the NYISO in coordination with the neighboring ISOs through the NERC and NPCC base case development processes. PARs may be adjusted as necessary to relieve pre-contingency overloads. SVC and FACTS devices were set to zero pre-contingency and allowed to operate to full range post-contingency.

2.4 Project Modeling

The Project was modeled based on the information provided by the Developer. The Power flow representations for the pre-Project and post-Project cases in PSS/E are presented in Figures 2-2 and 2-3 respectively. The Project was dispatched at 100% of the proposed MW output and set to regulate voltage at the generator terminals within the reactive power capability range.

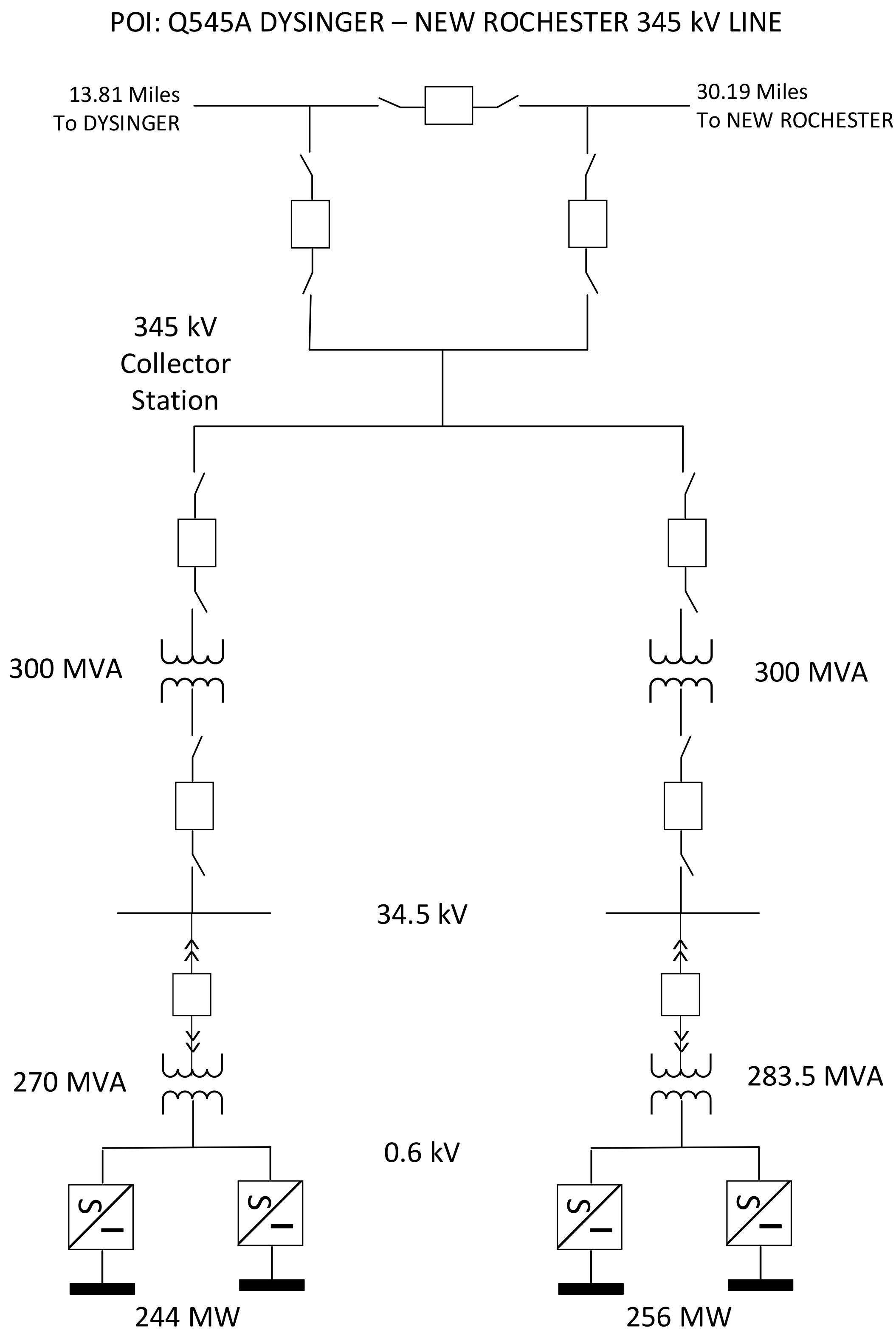

Figure 2-1: Project One-Line Diagram

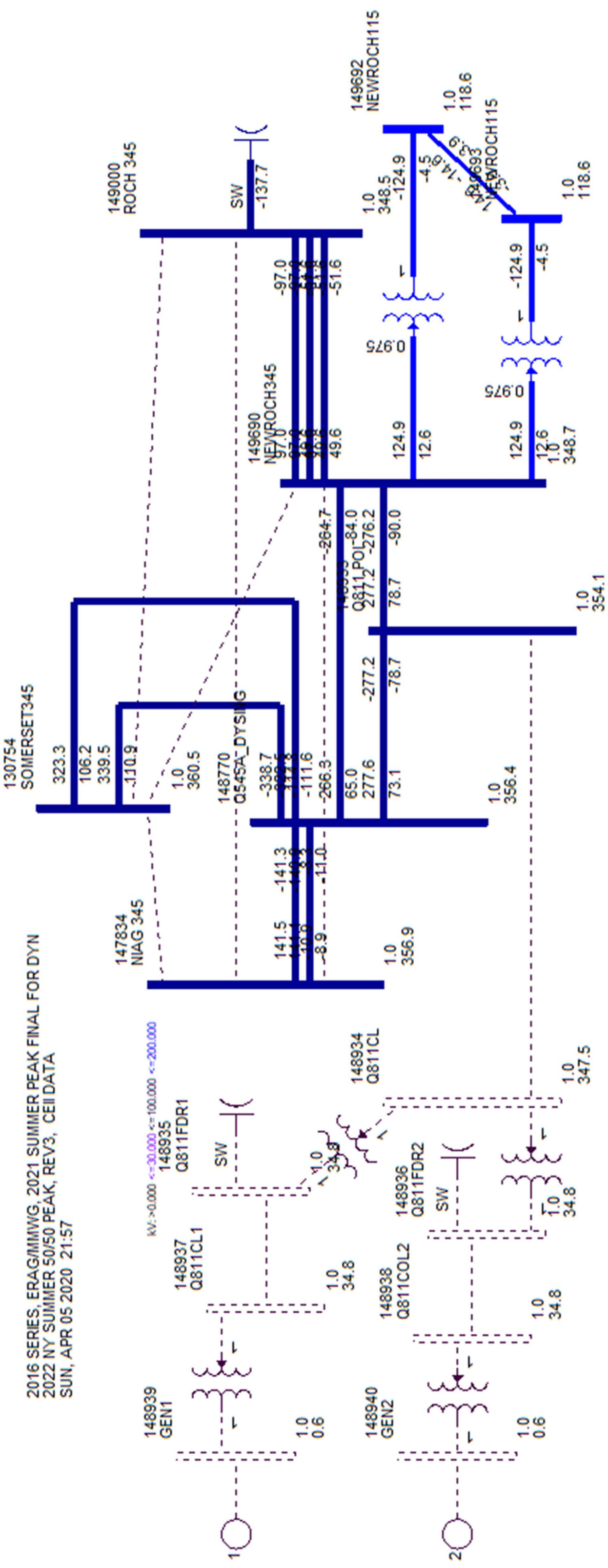

Figure 2-2: Pre-Project Representation in PSS/E

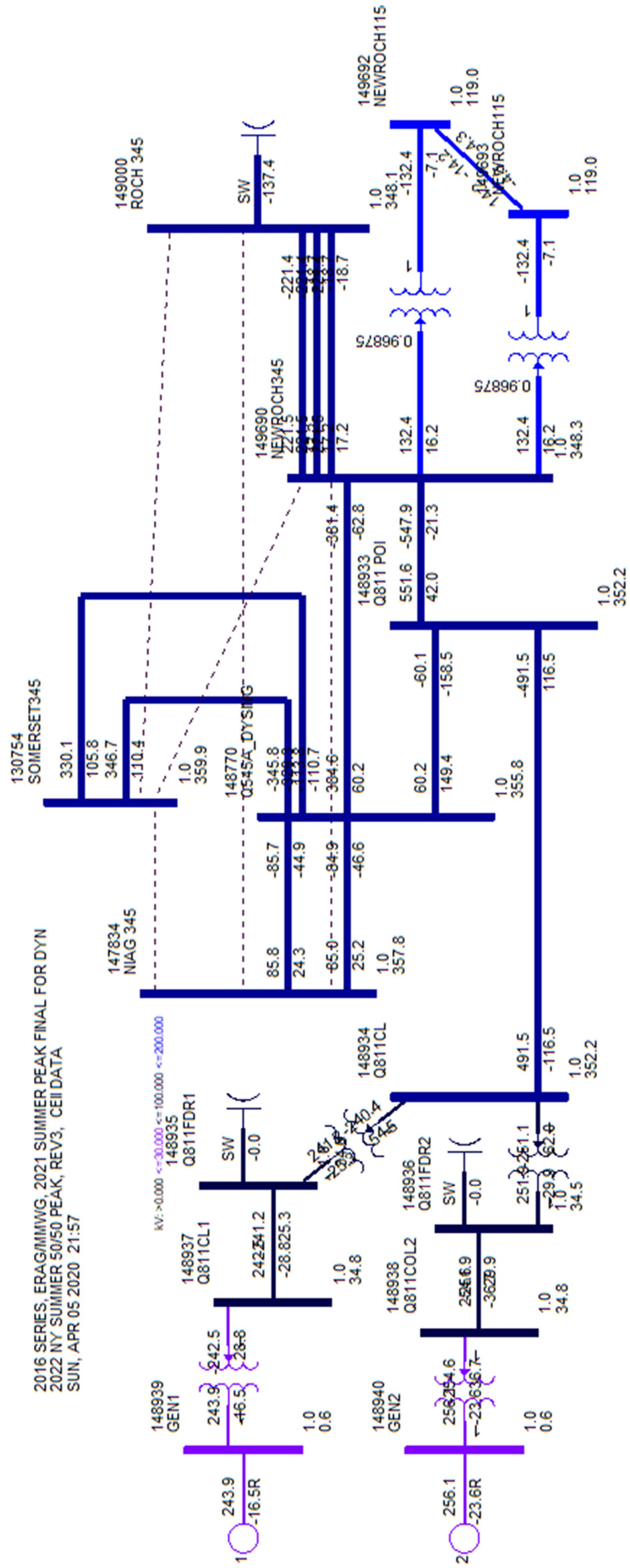

Figure 2-3: Post-Project Representation in PSS/E

Table 2-1 shows the modeling details for the equivalent generators. Table 2-2 shows the transformer modeling data and Table 2-3 shows the equivalent circuit modeling data.

Table 2-1: PSSE Power Flow Case: Generator Modeling Data

Bus # Name and KV	Pmax (MW)	Pmin (MW)	Qmax (Mvar)	Qmin (Mvar)	Mbase (MVA)
148939 GEN1 0.60	243.9	0	102.0	-102.0	270.0
148940 GEN2 0.60	256.1	0	107.1	-107.1	283.5

Table 2-2: PSSE Power Flow Case: Transformer Modeling Data

Transformer Name	Primary (kV)	Secondary (kV)	R1 (pu)	X1 (pu)	MVA Rating
Q811GSU1	34.50	0.60	0.0066	0.0571	270
Q811GSU2	34.50	0.60	0.0066	0.0571	283.5
PSU1	345.00	34.50	0.0023	0.0899	300
PSU2	345.00	34.50	0.0023	0.0899	300

Table 2-3: PSSE Power Flow Case: Branch Modeling Data

From Bus No and Name	To Bus No and Name	Voltage (kV)	R1 (pu)	X1 (pu)	B1 (pu)	MVA Rating (A/B/C)
1468933 Q811POI	148934 Q811CL	345	0.0000	0.000006	0.00006	600/600/600
148935 Q811FDR1	148937 Q811CL1	34.5	0.0022	0.0023	0.0479	0/0/0
148936 Q811FDR2	148938 Q811CL2	34.5	0.0041	0.0046	0.0968	0/0/0
148770 Q545A_DYSING	148933 Q811 POI	345.0	0.000569	0.006822	0.103056	1301/1501/1685
148933 Q811 POI	149690 NEWROCH345	345.0	0.001245	0.014914	0.225294	1301/1501/1685

3 Base Case Development

3.1 Base Case Origin, Year, and Included Projects

The Study was based on the system representation in the 2022 power flow base cases from the NYISO Class Year 2017 ATBA (the Base Cases). The Study was conducted using the power flow, stability, and short circuit Base Cases provided by the NYISO, and included the representation of proposed projects that have already been cost allocated, up to and including Class Year 2015 (as listed in Appendix A of the scope document). The Q545A Empire State Line Alt transmission project was modeled as in-service. The Study results are based on specific system conditions, study assumptions, and dispatch patterns modeled in the Study cases. It is to be noted that this is a pre-Project to post-Project comparison study, and hence no efforts were made to optimize, and fine tune the cases. The preliminary impact of the proposed projects was evaluated for summer peak, winter peak and light load for the following base case conditions:

See Appendix A for the detailed description of the study cases

3.2 Generation Re-dispatch

Table 3-1, Table 3-2 and Table 3-3 below, respectively shows the generation dispatch that was performed to accommodate the Project for the summer peak, winter peak, and light load cases.

Table 3-1: Summer Peak Generation Redispatch Summary

Bus Number	Generator	Pre-Project MW	Post-Project MW	Delta MW
136703	OSWGO 6G 22.000	823.2	523.2	-300.0
146840	BOW2 20.000	480.0	380.0	-100.0
146841	BOW1 20.000	480.0	380.0	-100.0
148939	GEN1 0.6000	0	243.9	243.9
148940	GEN2 0.6000	0	256.1	256.1

Table 3-2: Winter Peak Generation Redispatch Summary

Bus Number	Generator	Pre-Project MW	Post-Project MW	Delta MW
146840	BOW2 20.000	545.0	295.0	-250.0
146841	BOW1 20.000	529.0	279.0	-250.0
148939	GEN1 0.6000	0	243.9	243.9
148940	GEN2 0.6000	0	256.1	256.1

Table 3-3: Light Load Generation Redispatch Summary

Bus Number	Generator	Pre-Project MW	Post-Project MW	Delta MW
125192	ROSE GN2 24.000	509.0	359.0	-150.0
146840	BOW2 20.000	415.1	240.1	-175.0
146841	BOW1 20.000	500.0	325.0	-175.0
148939	GEN1 0.6000	0	243.9	243.9
148940	GEN2 0.6000	0	256.1	256.1

4 Steady State Analysis

The steady state analyses were evaluated in accordance with the NYISO Transmission Planning Guideline #1-1, Section 2.4.11. Steady state voltage and thermal analysis examined system performance without the proposed Project in order to establish a baseline for comparison. System performance was then re-evaluated with the Project and compared with the previous baseline performance to demonstrate the impact of the Project on area transmission reliability.

The monitored facilities for the steady state analyses included the 115 kV and above systems in West, (Zone A), Genesee (Zone B) and Central (Zone C) regions; and the local 34.5- 100 kV systems in the vicinity of the project. The monitor file can be found in Appendix B-2; the subsystem files can be found in Appendix B-3 and Appendix B-4.

4.1 Steady State Solution Parameters and Modeling Assumptions

The following solution parameters and modeling assumptions were made for this Study in accordance with the NYISO analysis practices:

- Phase angle regulators (“PARs”), switched shunts, and LTC transformers were modeled to regulate in pre-contingency conditions and not regulate post-contingency. The study used PAR schedules established by the NYISO in coordination with neighboring ISOs through the NERC and NPCC base case development process.
- SVC and FACTS devices were set to zero pre-contingency and allowed to operate to full range post-contingency.
- For evaluating projects located in Long Island (Zone K), the dynamic devices within Long Island area will be offline in both pre- and post-contingency conditions in power flow analysis, while set to zero at dynamic initialization.

4.2 Steady State Voltage Criteria

Transmission voltage levels must be maintained within a prescribed bandwidth to ensure proper operation of electrical equipment at both the transmission and customer voltage ranges. Equipment damage and widespread power outages are more likely to occur when transmission- level voltages are not maintained within pre-defined limits. According to the FERC 715 filing, the following voltage criteria were used for this analysis:

<u>NYPA</u>

- Pre and Post-Contingency Voltage Criteria for NYPA buses is according to OP1 limit
- Pre and Post-Contingency Voltage Criteria for non NYPA buses is:
    - 0.95 – 1.05 pu for regulated buses (typically 115 kV and above)
    - 0.90 – 1.05 pu for non-regulated buses (typically below 115 kV)

Voltages impacted by the Project by more than 0.001 pu were reported.

4.3 Steady State Thermal Criteria

The NYISO follows a planning philosophy whereby normal thermal ratings shall not be violated under all-lines-in conditions, and the applicable emergency rating shall not be violated under contingency conditions. Table 4-1 represents the thermal loading performance criteria applied to transmission lines and transformers in this study. The use of long-time emergency (LTE) thermal ratings in planning studies recognizes the limited line switching, re-dispatch and system re- configuration options available to operators. These ratings provide adequate flexibility to system operations to address unique circumstances encountered on a day-to-day basis.

Table 4-1: Thermal Performance Criteria

System Condition	Time Interval	Maximum Allowable Facility Loading
Pre-Contingency (all-lines-in)	Continuous	Normal Rating (Rate A)
Post-Contingency	Up to four hours	Long Time Emergency (LTE) Rating (Rate B)

4.4 Steady State Contingency List

In accordance with NPCC criteria and NYSRC reliability rules, several types of contingencies were simulated for the voltage and thermal analysis:

- Loss of 115 kV or greater lines and transformers.
- Multiple Elements – Bus Faults and Stuck Breakers.
- Loss of Generation.
- Loss of Series element or single element.
- Bus Faults.
- Struck Breakers.
- Loss of HVDC.
- Loss of Tower or double circuits.
- Single breaker contingency.

The contingency file used for the steady state voltage and thermal analysis is included in Appendix B-1.

4.5 Steady State Analysis Results (N-0, N-1)

The analysis was first done without the Project, and then with the Project to identify the incremental reliability impact of the addition; those scenarios where the project's addition would worsen a pre-existing condition, or create a new violation, were identified and further evaluated for identification of potential mitigation solutions under the MIS.

4.5.1 N-0 Pre-Contingency Analysis - Summer Peak & Winter Peak

N-0 Thermal Analysis results

The addition of Project impacts the base case (pre-contingency) loadings in the summer peak and winter peak cases; however, it does not cause any new thermal violations in the Study Area for the studied conditions.

Table 4-2 and Table 4-3 below, shows the list of pre-contingency branch loadings with highest Project impacts in the local area, identified by comparing the power flows with and without the Project for summer peak and winter peak cases respectively.

Detailed results for summer peak and winter peak cases are included in Appendix C-1 and Appendix D-1, respectively.

Table 4-2: N-0 Pre-Contingency Branch Loadings - Summer Peak

Monitored Facility	Rate Base (MVA)	OFF %Loading	ON %Loading	Delta %Loading
148933 Q811 POI 345 149690 NEWROCH345 345 2	1301	22.09	41.77	19.68
130826 MEYER115 115 131345 S.PER115 115 1	82	35.9	44.85	8.95
148770 Q545A_DYSING 345 149690 NEWROCH345 345 1	1301	21.12	29.45	8.33
147850 NIAG115E 115 147842 NIAGAR2W 230 1	186	37.39	44.84	7.45
136197 FRMGTN-4 115 149025 PANNELLI 115 1	207	21.94	29.15	7.21
130836 N.WAV115 115 131018 LOUNS115 115 1	111	32.66	39.63	6.97
130848 S.OWE115 115 131850 CNYOG115 115 1	112	26.76	33.65	6.89
131018 LOUNS115 115 131850 CNYOG115 115 1	112	28.59	35.42	6.83
135861 MORTIMER 115 149011 S82-1115 115 1	414	47.98	53.95	5.97
130766 ROBIN230 230 147841 NIAGAR2E 230 1	496	49.26	54.88	5.62
135868 PTSFD-23 115 149049 S82 B#3 115 23	145	34.32	39.78	5.46

Table 4-3: Pre-Contingency Branch Loadings - Winter Peak

Monitored Facility	Rate Base (MVA)	OFF %Loading	ON %Loading	Delta %Loading
148933 Q811 POI 345 149690 NEWROCH345 345 2	1301	25.11	46.04	20.93
148770 Q545A_DYSING 345 149690 NEWROCH345 345 1	1301	24.04	32.77	8.73
130776 BORDR115 115 136197 FRMGTN-4 115 1	187	23.87	32.37	8.5
131018 LOUNS115 115 131850 CNYOG115 115 1	112	21.52	29.76	8.24
130848 S.OWE115 115 131850 CNYOG115 115 1	112	20.17	28.4	8.23
130826 MEYER115 115 131345 S.PER115 115 1	106	33.26	40.78	7.52
131122 WTHRS230 230 131870 S.PER230 230 1	506	21.5	28.71	7.21
136197 FRMGTN-4 115 149025 PANNELLI 115 1	258	27.73	34.6	6.87
135868 PTSFD-23 115 149049 S82 B#3 115 23	145	34.91	41.59	6.68
135861 MORTIMER 115 135869 PTSFD-24 115 1	156	20.89	27.23	6.34
135860 LAWLER-1 115 135861 MORTIMER 115 1	168	26.38	32.64	6.26
135861 MORTIMER 115 136213 LAWLER-2 115 1	166	31.16	37.24	6.08

N-0 Voltage Analysis results

No voltage criteria violations were found pre-contingency in the study area with and without the Project for summer peak and winter peak cases. Summarized voltage impact results for the summer peak and winter peak cases are shown in Table 4-4 and Table 4-5 respectively. Detailed summer peak and winter peak voltage impact results are included in Appendix C-3 and Appendix D-3 respectively.

Table 4-4: : N-0 Pre-Contingency Bus Voltages - Summer Peak

Bus #	Bus Name	Base kV	Base Volt OFF	Base Volt ON	Delta V
148934	Q811CL	345		1.0207	
148938	Q811COL2	34.5		1.0101	
148937	Q811CL1	34.5		1.0088	
149051	S143	34.5	0.9789	0.9849	0.006
149177	C736T133	34.5	0.9881	0.994	0.0059
149050	BRISTLMT	34.5	1.0038	1.0097	0.0059
149197	S146	34.5	1.0041	1.01	0.0059
149042	S8132	34.5	1.0045	1.0103	0.0058
149198	S145	34.5	0.961	0.9664	0.0054
149199	TURPHANE	34.5	0.9576	0.963	0.0054
149176	S7108	34.5	1.023	1.028	0.005
149041	S8132VR	34.5	0.9098	0.9148	0.005

Bus #	Bus Name	Base kV	Base Volt OFF	Base Volt ON	Delta V
149169	S144	34.5	1.024	1.029	0.005
148933	Q811 POI	345	1.0264	1.0208	-0.0056
130750	COOPC345	345	1.0312	1.0273	-0.0039

Table 4-5: N-0 Pre-Contingency Bus Voltages - Winter Peak

Bus #	Bus Name	Base kV	Base Volt OFF	Base Volt ON	Delta V
148934	Q811CL	345		1.0101	
148938	Q811COL2	34.5		1.0072	
148937	Q811CL1	34.5		1.0057	
149050	BRISTLMT	34.5	0.9924	0.9978	0.0054
149197	S146	34.5	0.9961	1.0015	0.0054
149051	S143	34.5	1.0061	1.0114	0.0053
149177	C736T133	34.5	1.011	1.0162	0.0052
149042	S8132	34.5	1.0214	1.0265	0.0051
130750	COOPC345	345	1.025	1.0185	-0.0065
148933	Q811 POI	345	1.0159	1.0102	-0.0057
137451	LEEDS 3	345	1.0388	1.0338	-0.005

4.5.2 N-1 Post –Contingency Analysis Summer peak & Winter Peak

N-1 Thermal Analysis results

Post-contingency thermal analysis was performed by comparing the system performance with and without the Project for the summer peak and winter peak cases.

Table 4-6 summarizes the post-contingency thermal loading comparison for the summer peak case. Detailed summer peakpost-contingency thermal impacts due to the Project are presented in Appendix C-2. The Packard to Niagara West #2 230 kV was overloaded at 101.45% of LTE for the loss of Tower Contingency: 61&64. This overload and the other observed minimal overloads can be mitigated by turning OFF generation at Niagara. However, the NYSRC reliability rules exception rule#13 can be applied to allow the facilities connected to Niagara to go up to STE ratings. The Pannell to Quaker 115 kV line overload was also observed in pre-project case and hence cannot be attributed to the Project.

Table 4-6: Post-Contingency Thermal Loading Comparison - Summer Peak

Monitored Facility	Rate Cont (MVA)	Cont Name	OFF %Loading	ON %Loading	Delta %Loading
149025 PANNELLI 115 149026 QUAKER 115 1	246.9	149004 S121 B#2 115 149025 PANNELLI 115 1	130.85	132.63	1.78
149004 S121 B#2 115 149025 PANNELLI 115 1	304.7	149025 PANNELLI 115 149026 QUAKER 115 1	110.34	111.85	1.51
135415 PACKARD2 230 147842 NIAGAR2W 230 2	717	T:61&64	94.52	101.45	6.93
131297 SLEIG234 34.5 131243 SLEIG115 115 1	43	131242 MACDN115 115 149026 QUAKER 115 1	99.42	100.01	0.59
131297 SLEIG234 34.5 131243 SLEIG115 115 1	43	131308 MACEDN34 34.5 131242 MACDN115 115 1	99.42	100.01	0.59
135415 PACKARD2 230 147842 NIAGAR2W 230 1	727	T:62&BP76	87.83	95.26	7.43

Table 4-7 summarizes the post-contingency thermal loading comparison for the winter peak case. Detailed winter peak post-contingency thermal impacts due to the Project are presented in Appendix D-2. The Project does not cause any new thermal violations.

Table 4-7: Post-Contingency Thermal Loading Comparison - Winter Peak

Monitored Facility	Rate Cont (MVA)	Cont Name	OFF %Loading	ON %Loading	Delta %Loading
135436 SAWYER23 23.0 135308 SAWYERB2 230 1	149	T:77&80	103.48	103.57	0.09
135436 SAWYER23 23.0 135309 SAWYERB3 230 1	149	T:77&78	102.38	102.46	0.08
135322 CUBA 34.5 135359 NILEREG 34.5 1	24	135272 DUGN-157 115 135289 NILE115 115 1	99.33	99.17	-0.16

The addition of the Project has minimal impact on the thermal loadings for post-contingency conditions in the summer peak and winter peak cases. The results show that the addition of the Project does not cause any significant adverse thermal impacts.

N-1 Voltage Analysis Results

Results of the summer peak case post-contingency analysis show that the Project worsened the pre-existing post-contingency low voltages at Sawyer 230 kV bus #1 and bus #2. The Project improves the voltages at few 115 kV local buses as shown in below table. Below Table 4-8 show buses with highest delta impact for summer peak cases. Detailed summer post-contingency voltage impact results are included in Appendix C-4.

Table 4-8: N-1 Post-Contingency Voltages - Summer Peak

Bus Name	Base kV	Cont Name	Cont Volt OFF	Cont Volt ON	Delta V
SAWYERB1	230	T:77&78	0.8289	0.8236	-0.0053
SAWYERB2	230	T:77&78	0.8289	0.8236	-0.0053
MACDN115	115	131242 MACDN115 115 149026 QUAKER 115 1	0.8821	0.8865	0.0044
FARMNGTN TP2	115	136050 FARMNGTN TP2 115 136209 HOGAN-2 115 1	0.9235	0.9307	0.0072
FARMNGTN TP2	115	135861 MORTIMER 115 136213 LAWLER-2 115 1	0.9181	0.9257	0.0076
HOGAN-2	115	135861 MORTIMER 115 136213 LAWLER-2 115 1	0.916	0.9236	0.0076
LAWLER-2	115	135861 MORTIMER 115 136213 LAWLER-2 115 1	0.9158	0.9235	0.0077
FARMGTN1	115	135860 LAWLER-1 115 135861 MORTIMER 115 1	0.9322	0.9403	0.0081
HOGAN-1	115	135860 LAWLER-1 115 135861 MORTIMER 115 1	0.922	0.9301	0.0081
LAWLER-1	115	135860 LAWLER-1 115 135861 MORTIMER 115 1	0.9217	0.9298	0.0081
HOOKRD	115	135860 LAWLER-1 115 135861 MORTIMER 115 1	0.9255	0.9337	0.0082
HOOKRD	115	135860 LAWLER-1 115 136208 HOGAN-1 115 1	0.9375	0.946	0.0085
HOGAN-1	115	135860 LAWLER-1 115 136208 HOGAN-1 115 1	0.9348	0.9435	0.0087

Results of the winter peak case post-contingency analysis show that the Project worsened the pre-existing post-contingency low voltages at Wilet 115 kV bus. Table 4-9 shows summary voltage results for buses with highest post-contingency impact for the winter peak case. Detailed winter peak post-contingency voltage impact results are included in Appendix D-4.

Table 4-9: N-1 Post-Contingency Voltages - Winter Peak

Bus #	Bus Name	Base kV	Cont Name	Cont Volt OFF	Cont Volt ON	Delta V
130863	WILET115	115	130800 ETNA 115 115 130863 WILET115 115 1	0.8077	0.8025	-0.005
131021	ROBBL115	115	130835 N.END115 115 130838 OAKDL115 115 1	0.9484	0.9449	-0.004
130863	WILET115	115	130817 JENN 115 115 130819 KATEL115 115 1	0.9287	0.9253	-0.003
130835	N.END115	115	130835 N.END115 115 130838 OAKDL115 115 1	0.948	0.9446	-0.003
131020	RANGH115	115	130835 N.END115 115 130838 OAKDL115 115 1	0.9509	0.9477	-0.003
135307	SAWYERB1	230	T:77&80	0.9637	0.9607	-0.003
130809	HALEY115	115	130776 BORDR115 115 130823 GUARD115 115 1	0.9471	0.9442	-0.003
130823	GUARD115	115	130776 BORDR115 115 130823 GUARD115 115 1	0.9463	0.9435	-0.003
130819	KATEL115	115	130819 KATEL115 115 130838 OAKDL115 115 1	0.8754	0.8726	-0.003

From the above results it can be concluded that the project did not cause any new voltage violations in the summer peak and winter peak cases.

5 N-1-1 Power Flow Analysis

The Project was evaluated for selected N-1-1 contingencies within the study area. Power flow analysis was performed for the pre-Project and post-Project summer peak cases. The analysis was performed for several first element contingencies. The second contingencies tested were valid single branch elements tested under N-1 analysis that included all design and local criteria contingencies provided by the CTO and NYISO. Thermal impacts of the Project for N-1-1 post-contingency conditions are summarized in the following sections. The security constrained dispatch (SCD) analysis was run such that generations were allowed to be re-dispatched to secure thermal violations on facilities after first level contingencies. The study area monitored was for system elements at 100 kV and above. The overloads that could not be mitigated with generation re-dispatch under N-1 analysis were excluded for N-1-1 analysis. The base case solution settings discussed in section 4.1 were applied for post N-1 and pre N-1-1 conditions. The same solution options used under N-1 were applied for the second contingency analysis to identify N-1-1 thermal issues.

5.1 N-1-1 Post-Contingency Analysis

Table 5-1 and Table 5-2 respectively lists the N-1-1 thermal and voltage violations that were caused by the addition of the Project. The tables include the thermal loadings above 100% of Rate B(LTE) for the monitored element and worst post contingency voltage for the buses evaluated.

The thermal violations can be mitigated by dispatching the Niagara units, or alternatively by applying the NYSRC Reliability rules exception #13 which allows the facilities connected to Niagara go up to STE. All the thermal overloads are on the facilities connected to Niagara.

Detailed N-1-1 thermal results are posted in Appendix C5.

Table 5-1: N-1-1 Summer Peak Thermal Analysis Results

First Level Scenario	Monitored Facility	Cont Name	LTE (MVA)	OFF %Loading	ON %Loading	Delta %Loading
NIAGARA - PACKARD 230 61	135415 PACKARD2 230 147842 NIAGAR2W 230 1	T:62&BP76	727	109.48	117.02	7.54
L/O Dysinger 345 kV PAR	135415 PACKARD2 230 147842 NIAGAR2W 230 1	T:62&BP76	727	96.85	102.3	5.45
Q811POI - NEWROCH 345	135415 PACKARD2 230 147842 NIAGAR2W 230 1	T:62&PA27	727	91.84	103.55	11.71
NIAGARA - PACKARD 230 61	135415 PACKARD2 230 147842 NIAGAR2W 230 2	T:61&64	717	114.7	121.83	7.13
Q811POI - NEWROCH 345	135415 PACKARD2 230 147842 NIAGAR2W 230 2	T:61&64	717	99.14	104.6	5.46
L/O Dysinger 345 kV PAR	135415 PACKARD2 230 147842 NIAGAR2W 230 2	T:61&64	717	98.5	102.53	4.03

First Level Scenario	Monitored Facility	Cont Name	LTE (MVA)	OFF %Loading	ON %Loading	Delta %Loading
L/O Dysinger 345 kV PAR	135415 PACKARD2 230 147842 NIAGAR2W 230 2	T:61&191	717	98.14	106.8	8.66
NEWROCH - Q545A_DYSING 345	135415 PACKARD2 230 147842 NIAGAR2W 230 2	SB:ROB230_64B142	717	95.88	101.28	5.4
Q811POI - NEWROCH 345	135415 PACKARD2 230 147842 NIAGAR2W 230 2	SB:ROB230_B16542	717	95.8	102.88	7.08
Q811POI - NEWROCH 345	135415 PACKARD2 230 147842 NIAGAR2W 230 2	SB:ROB230_656442	717	95.78	102.86	7.08
NEWROCH - Q545A_DYSING 345	135415 PACKARD2 230 147842 NIAGAR2W 230 2	T:61&64	717	95.77	102.85	7.08
Q811POI - NEWROCH 345	135415 PACKARD2 230 147842 NIAGAR2W 230 2	NIAGARA - PACKARD 230 61	717	94.8	101.77	6.97
Q811POI - NEWROCH 345	135415 PACKARD2 230 147842 NIAGAR2W 230 2	NIAGARA - ROBINSON 345 64	717	89.91	102.1	12.19
Q811POI - NEWROCH 345	135460 PACK(N)E 115 147850 NIAG115E 115 1	SB:NIAG_115_1508	301	97.08	102.11	5.03
L/O Dysinger 345 kV PAR	135460 PACK(N)E 115 147850 NIAG115E 115 2	T:61&191	301	98.55	109.71	11.16
Q811POI - NEWROCH 345	147850 NIAG115E 115 147842 NIAGAR2W 230 1	SB:PA230_R506	233	100.05	112.93	12.88
Q811POI - NEWROCH 345	147850 NIAG115E 115 147842 NIAGAR2W 230 1	T:62&BP76	233	91.42	100.59	9.17

The N-1-1 power flow voltage analysis was performed for pre-project and post-project summer peak cases. The voltage impacts of the Project for N-1-1 post-contingency conditions are summarized in Table 5-2. The complete list of results is included in Appendix C6.

The N-1-1 post-contingency voltage results in Table 5-2 shows that the voltage results for summer peak case identified few buses that are outside the voltage criteria with delta less than 0.005 p.u. The observed minimal low voltages in post-project conditions can be mitigated by adjusting switched shunts.

Table 5-2: N-1-1 Summer Peak Voltage Analysis Results

First Level Scenario	Bus #	Bus Name	Base kV	Cont Name	Cont Volt OFF	Cont Volt ON	Delta V
GEN:KINTIGH_LOG01	135278	NORCNSTA	115	ERIE E - 4 MILE 230	1.0615	1.0613	-0.0002
L/O Dysinger 345 kV PAR	130863	WILET115	115	T:40&41_CE07	0.9452	0.9434	-0.0018
L/O Dysinger 345 kV PAR	130756	STOLE345	345	SB:5MILE_R800	0.9494	0.9475	-0.0019
L/O Dysinger 345 kV PAR	135001	Q545A_ESTSTO	345	SB:5MILE_R800	0.9494	0.9475	-0.0019
L/O Dysinger 345 kV PAR	135614	REACTOR	230	OE:HNTLEY_70	0.9512	0.9487	-0.0025
L/O Dysinger 345 kV PAR	135000	Q545A_DYSING	345	SB:5MILE_R800	0.951	0.9483	-0.0027

For N-1-1 conditions studied, the identified violations can be mitigated by generation re-dispatch and switched shunt adjustments that are allowed under MIS. Hence, no adverse N-1-1thermal and voltage impacts were found as a result of the addition of the Project.

6 Transfer Limit Analysis

Transfer limit analysis for the Dysinger East (DE) and West Central (WC) Interfaces were not performed in this study because, based on the recent SRIS transfer analysis results of similar projects proposed to interconnect in the proximity of the Project POI, it is very unlikely for the Project to significantly impact the transfer capability of the two interfaces. However, Thermal Transfer Limit analysis was performed for the Ontario-New York and New York-Ontario (ON-NY/NY-ON) interfaces. Appendix H contains summary transfer limit analysis results for the DE and WC interfaces that were performed for the Q721 Project.

The ON-NY/NY-ON Thermal Transfer Analysis proceeded as follows:

Thermal transfer limit analysis is based on DC (linear) power flow, which assumes that voltages, reactive flows, or losses do not change with increased transfer levels. Power transfers were simulated between respective interface's sending and receiving subsystems,.. All 115 kV and above facilities in the vicinity of the subject interfaces were monitored. In accordance with NPCC Criteria and NYSRC Reliability Criteria, the following types of contingencies were simulated in the NYSTS.

1. Outage of branches connected between buses with a base voltage > 100 kV
2. Generator outages
3. Series element contingencies
4. Bus contingencies
5. HVDC contingencies
6. Tower contingencies
7. Stuck breaker contingencies

The above contingencies were considered in determining the normal transfer limits. Tower and stuck breaker contingencies were not considered when determining emergency thermal transfer limits.

The purpose of this analysis is to access the impact of the project on the bulk network by comparing system performance with pre-Project and post- Project cases, rather than calculating precise transfer limits levels. In this analysis no effort was made to optimize transfers in order to maximum transfer limits. The results presented reflect the particular assumptions followed in this study.

The Pre- and Post-Project normal and emergency transfer limits on the studied interfaces were computed.

The normal transfer limit is the transfer level at which:

- a branch is loaded at its normal rating for pre-contingency conditions, or
- a branch is loaded at its LTE rating following a contingency

The emergency transfer limit is the transfer level at which:

- a branch is loaded at its normal rating for pre-contingency conditions, or
- a branch is loaded at its STE rating following a contingency

The analysis was performed for pre-project and post-project cases. The complete results are included in Appendix Gand summarized in Table 6-1 for Normal Transfers (LTE rating) and Table 6-2 for Emergency Transfers (STE Rating). Overall, the project decreased transfer on ON-NY interface by 39 MW. Though the 39 MW impact is above the 25 MW criteria, adjusting the Dysinger 345 kV PAR reduces the impact to less than 25 MW. Hence, the Project impact to the ON-NY interface limit is not a significant impact on the NYSTS transfer capability.

Dysinger PAR Schedule was adjusted to increase the flow from 400 MW to 480 MW. Adjusting the PAR schedule by 80 MW reduces the Project impact on ON-NY transfer limit to 21 MW. Hence, the Project impact to the ON-NY interface limit is not a significant impact on the NYSTS transfer capability. The Project dispatch pattern as shown in Section 3.2 of this report.

Table 6-1: Normal Thermal Transfer Limits (MW)

	Case 1	Case 2	
Interface Name	OFF -Without the Project	ON - With the Project	**Impact (MW)**
New York – Ontario	1630(2)	1680(2)	50
Ontario - New York	2080(3)	2041(3)	-39

2. 147842 NIAGAR2W 230 157063 BECK_#2_PA27 230 1 at 460 MVA LTE Rating FLO 345kV PA302 line

3. 157063 BECK#2_PA27 230 147842 NIAGAR2W 230 1 at 460 MVA LTE Rating FLO 157052 BECK_#2_TS 220 157058 BECK_#2_L301 220 1

Table 6-2: Emergency Thermal Transfer Limits (MW)

	Case 1	Case 2	
Interface Name	OFF -Without the Project	ON - With the Project	**Impact (MW)**
New York – Ontario	1868(2)	1962(2)	94
Ontario - New York	2482(3)	2443(3)	-39

2. 147842 NIAGAR2W 230 157063 BECK_#2_PA27 230 1 at 558 MVA STE Rating in Base Case

3. 157063 BECK#2_PA27 230 147842 NIAGAR2W 230 1 at 558 MVA STE Rating FLO 157052 BECK_#2_TS 220 157058 BECK_#2_L301 220 1

7 Stability Analysis

The purpose of this analysis was to evaluate the impact of the Project on system performance within the Study Area under summer peak and light load conditions. The dynamic simulations were conducted with the Project in service. If stability issues were found with the Project in service, corresponding analysis would be performed pre-Project to assess Project's stability impact on the power system.

The analysis was performed first for post-Project cases. If the results identified violations, the analysis was then performed on a case-by-case basis for pre-Project cases.

7.1 Stability Simulation Results

System stability was analyzed for local contingencies relevant to the Project POI and Study Area for light load and summer peak base cases. The contingency definitions were provided by NYISO and NYPA.

Table 5-1 and 5-2 lists the local contingencies and design criteria contingencies analyzed and their respective results.

The stability analysis results indicate that the system remained stable and positively damped for all the tested Local faults with the addition of the Project for the summer peak and light load conditions. It can be concluded that the Project does not have any adverse impact on the stability performance and damping of the NYSTS.

The stability analysis results indicate that the system remained stable and positively damped for all the tested design criteria faults with the addition of the Project for the summer peak and light load conditions tested. It can be concluded that the Project does not have any adverse impact on the stability performance and damping of the NYSTS.

Stability simulation plots for summer peak and light load conditions for all the faults simulated are included in Appendix E-1 and E-2.

Table 7-1: Stability Simulation Results for Local Contingencies Faults

ID	Event Descriptions	Light Load Post-Project	Summer peak Post-Project
LC01	3PH-NC @Q811-POI on Q811-POI – NEWROCH345 345 kV Line	Stable	Stable
LC02	3PH-NC @Q811-POI on Q811-POI – Q545A_DYSING 345 kV Line	Stable	Stable
LC03	3PH-BUS FAULT @ Q811 POI 345kV bus	Stable	Stable
LC04	3PH-NC NEWROCH345 on the on NEWROCH345 – Q811 POI 345 kV Line	Stable	Stable
LC05	3PH-NC @Q545A_DYSING on Q545A_DYSING – Q811 POI 345 kV Line	Stable	Stable
LC06	3PH-STK @Q811-POI on Q811-POI – NEWROCH345 345 kV Line WITH Q811 POI stuck breakr	Stable	Stable
LC07	3PH-STK @Q811-POI on Q811-POI – Q545A_DYSING 345 kV Line WITH Q811 POI stuck breakr	Stable	Stable

Table 7-2: Stability Simulation Results for Design Criteria Faults

Fault ID	Fault Description	Light Load Post-Project	Summer Peak Post-Project
WC01Q339.IDV	3PH-NC@NIAGARA – L/O NIAGARA-NEW ROCHESTER (NR-2)	Stable	Stable
WC01ARQ339.IDV	3PH-NC NIAGARA – L/O NIAGARA-NEW ROCHESTER (NR-2) W/RCL	Stable	Stable
WC02Q339.IDV	3PH-NC@NEWROCH - L/O NIAGARA-NEWROCH (NR-2)	Stable	Stable
WC02ARQ339.IDV	3PH-NC@NEWROCH - L/O NIAGARA-NEWROCH (NR-2) W/RCL	Stable	Stable
WC03.IDV	3PH-NC@NIAGARA – L/O NIAGARA-SOMERSET (NS-1/38)	Stable	Stable
WC03AR.IDV	3PH-NC@NIAGARA – L/O NIAGARA-SOMERSET (NS-1/38) W/RCL	Stable	Stable
WC04Q339.IDV	3PH-NC@NEWROCH - L/O SOMERSET-NEWROCH (SR-1/39)	Stable	Stable
WC04ARQ339.IDV	3PH-NC@NEWROCH - L/O SOMERSET-NEWROCH (SR-1/39) W/RCL	Stable	Stable
WC05Q339.IDV	SLG-STK@NIA345 (BKR#3108) – L/O NIAG-NEWROCH (NR-2) / BKUP CLR NIA AT#4	Stable	Stable
WC06.IDV	SLG-STK@SOMERSET (BKR#38/B312) – L/O NIAGARA-SOMERSET (NS-1/38)	Stable	Stable
WC07.IDV	3PH-NC@ROCHESTER – L/O ROCHESTER-PANNELL (RP-1)	Stable	Stable
WC07AR.IDV	3PH-NC@ROCHESTER – L/O ROCHESTER-PANNELL (RP-1) W/RCL	Stable	Stable
WC08.IDV	3PH-NC@PANNELL – L/O PANNELL-CLAY (PC-1)	Stable	Stable
WC08AR.IDV	3PH-NC@PANNELL – L/O PANNELL-CLAY (PC-1)	Stable	Stable
WC09.IDV	3PH-NC@PANNELL – L/O ROCHESTER-PANNELL (RP-1)	Stable	Stable
WC09AR.IDV	3PH-NC@PANNELL – L/O ROCHESTER-PANNELL (RP-1) W/RCL	Stable	Stable
WC10.IDV	SLG-STK@ROCHESTER (BKR#3508) – L/O ROCHESTER-PANNELL (RP-1) / BKUP CLR SR1-39	Stable	Stable
WC10Q339.IDV	SLG-STK@ROCHESTER (BKR#3508) – L/O ROCHESTER-PANNELL (RP-1) / BKUP CLR NEWROCH	Stable	Stable
WC11.IDV	SLG-STK@PANNELL (BKR#3808) – L/O ROCHESTER-PANNELL (RP-1) / BKUP CLR PC-1	Stable	Stable
WC12Q339.IDV	SLG-STK@ROCH (BKR#3508) – L/O ROCHESTER -NEWROCH (SR-1/39) / BKUP CLR RP-1	Stable	Stable
WC13.IDV	3PH-NC@NIAGARA 345KV – L/O BECK-NIAGARA 345KV	Stable	Stable
WC14Q339.IDV	SLG-STK@ROCH (BKR#3502) – L/O ROCH-NEWROCH (SR-1/39) / BKUP CLR ROCH T1 & NR-2	Stable	Stable
WC15.IDV	LLG@BECK – L/O NIAGARA-PACKARD (PA27 & BP76) DCT	Stable	Stable
WC19.idv	LLG@NIAGARA230 - L/O NIAGARA-PACKARD (61) & NIAGARA-ROBINSON (64) DCT	Stable	Stable
WC20.idv	LLG@NIAGARA230 - L/O NIAGARA-PACKARD (62) & NIAGARA-BECK (PA27) DCT	Stable	Stable
WC21.idv	LLG@PACKARD230 - L/O NIAGARA-PACKARD (62) & PACKARD-BECK (BP76) DCT	Stable	Stable
WC22.idv	3PH-NC@SOMERSET/SOMERSET - NIAGARA (NS-1/38)(NC)	Stable	Stable
WC23Q339.idv	3PH-NC@SOMERSET - L/O SOMERSET-NEWROCH (SR-1/39)	Stable	Stable
WC24.idv	3PH-NC@SOMERSET - L/O SOMERSET-SOMERSET GEN (SR-1/39)	Stable	Stable

7.2 Critical Clearing Time Analysis

A Critical Clearing Time (CCT) Analysis was performed to determine the impact of the proposed Project on critical clearing times in the local area. The CCT analysis was conducted for two (2) system conditions –Light Load and Summer Peak conditions. The faults were simulated on both Pre- and Post-Project cases, and then the Critical Clearing Time from the Post- Project case was compared to that from Pre-Project case.

Critical Clearing Time analysis was performed by applying a three-phase-to-ground fault and clearing the fault at a certain clearing time. If the system remained stable, additional simulations were performed with increasing fault duration by 5 cycles at a time until instability occurred. Simulations were run for 55 cycles to determine the CCT at the Q811 POI 345kV bus.

For Summer Peak conditions tested Clearing time was greater than 28 cycles for pre-Project and 27 cycles post-Project cases when the 3-phase fault was applied at the Q811 POI 345kV bus. The Project impacts the CCT by 1 cycle. Somerset Generation tripped in both summer peak and light load conditions.

For Light Load conditions tested Clearing time was greater than 40 cycles for post-Project and less than 40 cycles pre-Project cases when the 3-phase fault was applied at the Q811 POI 345kV bus. The Project has positive impact on the CCT.

CCT Summary for summer peak and light load cases as shown below in Table 7-3. The stability plots are included in Appendix E3 for summer peak and Appendix E4 for light load conditions.

Table 7-3 Critical Clearing Time Assessment

Bus tested	Summer peak (cycles)		Light Load (cycles)	
	OFF	ON	OFF	ON
Q811 POI 345kV Bus	28	27	<40	>40

The Project low-voltage ride-through capabilities can be analyzed by looking at the CCT Plots. When a three-phase fault is applied at the POI bus, the terminal voltages of the equivalent PV generators reach to a minimum value during the fault and then recover, and the Project remains on-line and stable. Thus, the Project meets the Post-Transition LVRT Standard.

8 NPCC A-10 Analysis

The NPCC A-10 testing was completed in accordance with the approved criteria for the summer peak cases to evaluate the Project's impact on the Bulk Power System (BPS). The study reviewed existing and proposed stations within the proximity of the Project to identify any existing or new stations that could be classified as BPS due to the addition of the Project.

The analyses were performed on the summer peak cases with and without the Project, in accordance with the approved NPCC A-10 criteria described in the NPCC Document A-10 "Classification of Bulk Power System Elements".

8.1 A-10 testing Methodology:

Both transient stability and steady-state tests are used to determine the impact on system performance resulting from power system faults. Testing is based on application of a bus fault at a single voltage level that is not cleared locally.

A transient stability test is performed first to identify buses at which faults may cause a significant adverse impact outside of the local area. For those buses which are not classified as bulk power system in the transient stability test, a steady state test is used to identify buses at which contingency may cause a significant adverse impact outside of the local area.

Step 1: Transient Stability Test

Apply a three-phase fault for about 10 seconds or any other specified clearing time as specified by the CTO at the bus that is being tested. Do not open any of the elements connected to the bus for the duration of the fault. After the specified clearing time, simulate tripping of all terminals of each element connected to the bus under test. In cases where there is no fault interrupting device at the remote terminal of an element, open all terminals of all elements between the bus under test and the interrupting device that will be opened to clear the fault.

If the fault has a significant adverse impact outside of the local area, the bus is classified as part of the bulk power system. For buses not classified as BPS in this test, continue with the Steady-State test as described below.

Step 2: Steady State Test

Simulate the post contingency steady-state conditions based on the outcome of fault applied to the bus under test. Open the same elements that were opened to clear fault in the transient stability test above. Post-contingency conditions shall reflect operation of all automatic devices.

Thermal loadings and Voltages will be assessed for significant adverse impacts outside the local area following automatic actions. In cases where a power flow solution is not obtained, other techniques can be used to assess the impact of the event on the power system. If the test results indicate that the fault has a significant adverse impact outside the local area, the bus can be classified as part of the bulk power system.

8.2 A-10 test results

As per the first step of the A-10 criteria, a Transient Stability test was performed by applying a three-phase fault at the Q811 POI 345 kV bus for 10 seconds. After 10 seconds, all the remote terminals of each element connected to the bus were disconnected. The stability analysis resulted in the solution that was not converging. Conservative fault clearing time of 30 cycles was assumed, Transient Stability test was performed by applying a three-phase fault at the Q811 POI bus for 30 cycles. After 30 cycles, all the remote terminals of each element connected to the bus were disconnected. The stability analysis found that the response was stable for post-Project case. The generation that tripped was Q811 Project, and Somerset generation. Appendix E6 contains stability plots for A-10 BPS testing.

As per the second step of the A-10 criteria, steady state test was performed by opening the same elements that were opened to clear the fault in the Transient Stability analysis at Q811 POI 345kV bus. Voltages and thermal loading were assessed for significant adverse impact outside of the local area in accordance with the approved NPCC A-10 criteria.

The results for the BPS Steady State analysis showed no significant voltage violations or any thermal overloads greater that 125% of STE. Appendix C9 contains steady state results for A-10 BPS testing.

In conclusion, this BPS test showed that there was no adverse impact outside the local area and that Q811 POI 345kV station can remain as non-BPS station.

9 Short Circuit Analysis

Short circuit analysis was performed to evaluate the impact of the Project on System Protection and adequacy of existing circuit breakers, other fault current interrupting devices, and related equipment within the Study Area and to identify adverse impact of 100 A or more. This analysis was performed in accordance with the NYISO Guideline for Fault Current Assessment and Connecting Transmission Owner and Affected System(s) criteria.

9.1 Model Development

Short circuit analysis evaluated the impact of the Project on the adequacy of existing circuit breakers and related equipment in the Study area. Aspen OneLiner cases, pre-project and post-project, were evaluated.

Following assumptions were made on the system conditions:

- LTC transformer tap ratios were set to 1:1 and 30 degrees phase shifts in delta-wye transformer connections were modeled.
- All shunts, loads and transformer magnetizing branches were ignored.
- Generators were modeled using sub-transient saturated reactance and internal voltages of all generators were set to one per unit.

9.2 Short Circuit Results

Three-phase-to-ground, two- phase-to-ground, single-phase-to-ground, and line-to-line faults were simulated at 34.5 kV and above substations in the Study Area to identify substations where the impact of the Project is 100 amps or more. At each substation, the highest of these three fault currents were compared against the lowest breaker rating in the respective substation to determine if circuit breakers might be overdutied. The impact at a substation was deemed to be significant if the fault current exceeds the lowest breaker rating.

Table 9-1 summarizes results of the short circuit study showing the impact of the Project on buses with fault current increase of 100 amps and above. The Project increases the fault duties at nearby buses, however, the increase does not cause the total bus fault to exceed the lowest fault interrupting device (FID) rating at the impacted substations.

Detailed short circuit analysis results can be found in Appendix-F.

Table 9-1: Fault Current Summary Without and With the Project (In Amperes)

		Pre-Project Results			Post-Project Results			Delta (Amps)				Amps	Max Fault Current as
BUS	KV	3LG	2LG	1LG	3LG	2LG	1LG	3LG	2LG	1LG	Max	LBR	%LBR
S255	345	18119	18597	18751	18361	18960	19196	241.9	363.4	445.3	445.3	63000	30.47
S080 345kV	345	18145	18619	18770	18377	18959	19179	231.4	340.1	409.1	409.1	40000	47.947
NIAGARA 345	345	32045	33598	34158	32271	33923	34517	225.6	324.3	359.3	359.3	63000	54.789
NIAGRA E 230	230	48883	52891	54101	49048	53122	54314	164.8	230.8	213.5	230.8	63000	86.213
NIAGRA W 230	230	48883	52891	54101	49048	53122	54314	164.9	230.8	213.5	230.8	63000	86.213
AES SOMERSET	345	17822	20701	21585	18022	20894	21696	199.5	193	111.8	199.5	40000	54.24
CB438	230	42325	44527	44095	42440	44670	44223	114.9	142.8	127.5	142.8	40000	111.68
S122	345	17561	17473	16354	17689	17602	16471	128	128.4	116.7	128.4	50000	35.378
S082 B1	115	37004	36226	31694	37108	36284	31713	104	58.3	18.8	104	40000	92.769
S082 B2	115	36949	36184	31666	37053	36242	31685	103.8	58.3	18.8	103.8	40000	92.633
MORTIMER N	115	36949	36163	31643	37053	36221	31662	103.4	58	18.8	103.4	62000	59.762
S082 B3	115	36831	36082	31594	36934	36139	31613	103	57.7	18.3	103	34667	106.54
MORTIMER S	115	36744	35946	31476	36846	36002	31495	101.7	56.8	18.3	101.7	62000	59.429

10 Extreme Contingency Assessment

The Study evaluated the summer peak system performance under representative Extreme Contingencies within the Study Area. Analysis was performed using the methodology described in the Power Flow Analysis and Stability Analysis sections. PSS®E was used to evaluate representative extreme contingencies within the Study Area for the summer peak condition, both with and without the Project. The results were then compared in order to determine the impact of the Project.

Using the location of the Project, the extreme contingencies were selected and simulated as depicted in Table 10-1.

Table 10-1: List of selected Extreme Contingencies

Contingency Name	Contingency Description
EC01.IDV	L/O NYPP-OH TIES AT NIAGARA/ L/O PA27, BP76, AND (2) BECK-NIAGARA
EC02.IDV	L/O NIAGARA SUBSTATION AND GENERATION PLANT/ L/O Niag 345, 230 and 115 kV, Lew plant
EC03Q339B.IDV	L/OR.O.W. WEST OF ROCHESTER /NEWROCH-NIAGARA, AND NEWROCH-KINTIGH
EC04.IDV	L/O R.O.W EAST OF ROCHESTER/ (2) ROCHESTER-PANNELL LINES
EC33Q339.IDV	3PH-STK@ROCHESTER – L/O ROCHESTER-PANNELL RP-1 / BKUP CLR SR1-39
EC46.IDV	L/O STATION 80 SUBSTATION
EC47Q339.IDV	L/O STATION 255 SUB-STATION (NEWROCH345)

10.1 Steady-State Analysis

While performing the steady state analysis, both the branches and voltages in the Study Area were analyzed. Branch loading was determined as a percentage of the relevant short-term emergency (STE) rating for post-contingency system conditions

The Project thermal impact for the extreme contingencies simulated is shown in Table 10-2. In some cases where the extreme contingencies were tested, the buses were already loaded over 100% without the project, and this situation continued post Project. Some of these values are shown in Table 10.2 for records, however these were ignored for purposes of the steady state thermal impact analysis. The Project itself did not cause any overload under these extreme contingencies tested.

Also, the Project was identified to not have significant incremental voltage impacts on the buses in the Study Area. Voltage impacts for these contingencies are shown in Table 10-3 below. The Project helps mitigate some of the low voltage violations. Detailed thermal and voltage analysis results for extreme contingencies can be found in Appendix C7 and C8 respectively.

Table 10-2: Thermal Impact Under Extreme Contingencies

Monitored Facility	Rate C (MVA)	Cont Name	OFF %Loading	ON %Loading	Delta %Loading
130815 HINMN115 115 135452 LOCKPORT 115 1	280	EC47:L/O ENTIRE STATION NEWROCH345	60.79	73.63	12.84
130815 HINMN115 115 135452 LOCKPORT 115 1	280	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	60.79	73.63	12.84
130815 HINMN115 115 131611 HARIS115 115 1	306	EC47:L/O ENTIRE STATION NEWROCH345	67.18	78.66	11.48
130815 HINMN115 115 131611 HARIS115 115 1	306	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	67.18	78.66	11.48
148770 Q545A_DYSING 345 135000 Q545A_DYSING 345 1	840	EC47:L/O ENTIRE STATION NEWROCH345	64.52	75.11	10.59
148770 Q545A_DYSING 345 135000 Q545A_DYSING 345 1	840	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	64.52	75.11	10.59
130801 PAVMT115 115 130857 STOLE115 115 1	179	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	102.9	103.9	0.92
135415 PACKARD2 230 157062 BECK_#2_BP76 230 1	587	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	152.8	152.5	-0.34

Table 10-3: Voltage Impact Under Extreme Contingencies

Bus #	Bus Name	Base kV	Cont Name	Cont Volt OFF	Cont Volt ON	Delta V
135863	N.LAKE 1	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9021	0.9473	0.0452
135857	GENFOOD	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9036	0.9483	0.0447
135895	BARILLA	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9045	0.9491	0.0446
136209	HOGAN-2	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9057	0.9494	0.0437
135862	MUMFORD1	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.8991	0.9419	0.0428
136050	FARMNGTN TP2	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.894	0.9359	0.0419
135866	NLEROYTA	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.898	0.9389	0.0409
135859	LAPPINS1	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9002	0.9404	0.0402
135856	EBAT-119	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9068	0.9454	0.0386
135871	SENECAP	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9084	0.9468	0.0384
135855	EBAT-107	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9072	0.9453	0.0381
135853	BATAVIA1	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9072	0.9453	0.0381
135851	SHEL-113	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9088	0.9466	0.0378
135850	SOUR-114	115	EC02:L/O NIAGARA SUBSTATION & GENERATION PLANT	0.9085	0.9461	0.0376

Bus #	Bus Name	Base kV	Cont Name	Cont Volt OFF	Cont Volt ON	Delta V
147941	SPENCPRT	115	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	0.9548	0.9495	-0.0053
149017	S70 115	115	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	0.945	0.9396	-0.0054
149018	S71 115	115	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	0.9427	0.9371	-0.0056
149017	S70 115	115	EC47:L/O ENTIRE STATION NEWROCH345	0.9457	0.9401	-0.0056
149036	STA 93	115	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	0.9468	0.9412	-0.0056
149008	RUS 115	115	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	0.9479	0.9423	-0.0056
149062	S7 115B2	115	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	0.948	0.9424	-0.0056
149035	S69 917	115	EC03Q339:L/O R.O.W. WEST OF ROCHESTER	0.9461	0.9405	-0.0056
149035	S69 917	115	EC47:L/O ENTIRE STATION NEWROCH345	0.9464	0.9408	-0.0056
149036	STA 93	115	EC47:L/O ENTIRE STATION NEWROCH345	0.9471	0.9415	-0.0056
149008	RUS 115	115	EC47:L/O ENTIRE STATION NEWROCH345	0.9481	0.9425	-0.0056
149018	S71 115	115	EC47:L/O ENTIRE STATION NEWROCH345	0.9432	0.9375	-0.0057
149062	S7 115B2	115	EC47:L/O ENTIRE STATION NEWROCH345	0.9482	0.9425	-0.0057

10.2 Stability Analysis

The system response to the extreme contingencies studied was stable with the Project modeled in service. The stability simulation results for these tested contingencies tested are shown in Table 10-4. Appendix E5 contains plots for each contingency simulation. The Project does not have an adverse impact on the stability performance of the system under the studied extreme contingency conditions.

Table 10-4: Stability Simulation Results for Extreme Contingencies

Contingency Name	Contingency Description	Summer Peak – Post Project
EC01.IDV	L/O NYPP-OH TIES AT NIAGARA/ L/O PA27, BP76, AND (2) BECK-NIAGARA	Stable
EC02.IDV	L/O NIAGARA SUBSTATION AND GENERATION PLANT/ L/O Niag 345, 230 and 115 kV, Lew plant	Stable
EC03Q339B.IDV	L/OR.O.W. WEST OF ROCHESTER /NEWROCH-NIAGARA, AND NEWROCH-KINTIGH	Stable
EC04.IDV	L/O R.O.W EAST OF ROCHESTER/ (2) ROCHESTER-PANNELL LINES	Stable
EC33Q339.IDV	3PH-STK@ROCHESTER – L/O ROCHESTER-PANNELL RP-1 / BKUP CLR SR1-39	Stable
EC46.IDV	L/O STATION 80 SUBSTATION	Stable
EC47Q339.IDV	L/O STATION 255 SUB-STATION (NEWROCH345)	Stable

11 Preliminary Cost Estimate and Time to Construct

Stand Alone Connecting Transmission Owner Attachment Facilities (CTOAFs) and System Upgrade Facilities (SUFs) are required to interconnect the Project to the 345 kV point of interconnection.

NYISO prepared a preliminary non-binding, good faith, cost estimate for a 345 kV 3-breaker ring switching station that is required to interconnect the Project to the NYSTS, based on cost estimates of previous similar Projects. NYISO estimated that the cost of the 3-breaker ring station is approximately 19 million dollars ($19M). NYISO also estimated that the time required to interconnect the 3-breaker ring station is approximately 12 to 18 months.

12 Conclusions

The study results found that the addition of the project causes post-contingency thermal overloads on few branches. The thermal overloads can be resolved by dispatching down Niagara generation units accordingly or by applying the NYSRC Reliability rules exception #13.

The study revealed that the Project has no adverse impact on the reliability of the New York State Transmission System. Steady state voltage and thermal analysis, short circuit, and stability simulations were evaluated in making this determination.

The Q811 Cider Solar Project System Reliability Impact Study revealed that the Project has no significant adverse impact on the reliability of the New York State transmission system. Steady state voltage and thermal (N-0, N-1, N-1-1) analysis, Extreme contingency analysis, NPCC A-10 testing, transfer limit analysis, short circuit, and stability analyses were evaluated with the addition of Project in making this determination.