



NYISO Fault Current Assessment 2017

**A Report by the
New York Independent System Operator**

April 2017

Caution and Disclaimer

The contents of these materials are for informational purposes and are provided “as is” without representation or warranty of any kind, including without limitation, accuracy, completeness or fitness for any particular purposes. The New York Independent System Operator, Inc. (NYISO) assumes no responsibility to the reader or any other party for the consequences of any errors or omissions. The NYISO may revise these materials at any time in its sole discretion without notice to the reader.

TABLE OF CONTENTS

SECTION	PAGE
1. INTRODUCTION	4
2. SUMMARY OF FINDINGS	4
3. SYSTEM REPRESENTATION AND BASE STUDY ASSUMPTIONS	4
4. DISCUSSION AND RESULTS	5
5. CONCLUSIONS AND RECOMMENDATIONS	7

ATTACHMENTS

1. BUS FAULT SUMMARY	8
2. OPERATING GUIDELINES	

INTRODUCTION

The following report highlights the significant results of the fault current screening analysis completed for the 2017 period. The purposes of this analysis is to document significant changes in fault current levels statewide, identify selected critical substations with potentially overdutied circuit breakers, refer these substations to the respective owners, and recommend remedial actions.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Fault current assessments are intended to be conservative in nature in order to provide an adequate margin of design safety and reliability. For example, this assessment has assumed that all generation and transmission facilities are in service, while in actual operations it is highly likely that some generation and transmission facilities are out of service due to transmission constraints, economic generation dispatch, or forced outages. For this assessment the NYISO has not taken into account other factors such as reclosing, circuit breaker age, or fault current asymmetry which may lower breaker ratings or increase fault levels interrupted by the breakers. Facility owners have the responsibility for rating their equipment correctly, and as such shall routinely evaluate the interrupting capability of the circuit breakers using their own methods or industry standards. The following findings and recommendations are presented based on the analysis and results documented in this report:

The NYISO performed a sensitivity analysis for various possible Astoria configurations. The sensitivity analysis shows that when Astoria 3 and 5 dual yard steam units are operating on the Astoria East bus together with all other Astoria East units running, the Astoria East 138 kV circuit breakers 6W, 7W, 8W, 2E, 3E, 7E, and 8E would be overdutied.

The NYISO recommends continued application of the Interim Operating Protocol for Astoria East and West 138 kV Stations Fault Current Mitigation approved by the Operating Committee on May 6, 2010 to prevent overduty conditions at the Astoria East 138 kV station. The Interim Operating Protocol indicates that the acceptable Astoria West station configuration will be all three (3) units of the NYPA 500 MW combined cycle plant, two (2) Astoria Generating Company L.P. dual yard units (Astoria 3, 4 or 5), and the NRG GT 10-13 units. The acceptable Astoria East station configuration will be all three (3) units of the Astoria East Energy 500 MW combined cycle plant, one (1) Astoria Generating Company L.P. dual yard unit (Astoria 3, 4 or 5), the Astoria Generating Company L.P. Astoria 2 unit, and the NRG GT 2, 3, 4, 5, 7 and 8 units, unless for reliability reasons a different configuration for each station is required.

Astoria 4, NRG GT10-13 and NRG GT 5, 7 and 8 has deactivated or mothballed since the approval of the Interim Operating Protocol.

SYSTEM REPRESENTATION AND BASE STUDY ASSUMPTIONS

I. System Representation

The NYISO 2017 Statewide Short Circuit representation is captured in the Aspen Oneliner file, NYISO_SPRING_UPDATE_2017_SC_Final_C.OLR, dated April 25, 2017, and was used as the model for this study. This representation includes all system changes through the Summer Capability Period¹ ending October 31, 2017. The starting point for this representation was the NYISO 2016 Statewide Short Circuit representation, with updates to reflect the planned system listed in the NYISO 2017 Load and Capacity Data Report (“Gold Book”), as well as other updates provided by the New York Transmission Owners to appropriately reflect the conditions expected for the 2017 Summer Capability Period.

The adjacent control area data for PJM, ISO-NE, and Ontario used in this representation is the latest available data as of April 11, 2017.

Significant changes in the 2017 NYISO Statewide Short Circuit Representation from 2016 include:

- Greenidge 4 in service
- Jericho Rise wind farm in service
- Auburn Transmission Project (NYSEG and National Grid: State St.-Elbridge 115 kV)
- Clarington TS two new auto transformers (Hydro One)

II. Base Study Assumptions

The short circuit levels for the initial screening analysis were calculated using the ASPEN OneLiner[®] program and the “NYISO Guideline for Fault Current Assessment.” The short circuit levels presented have been determined for all facilities scheduled in-service during 2017.

III. Operating Guidelines

Attachment II contains the operating guidelines for the operation of series reactors required for fault current mitigation, as provided by the Transmission Owner of the equipment that the series reactors protect.

DISCUSSION AND RESULTS

I. Fault Current Calculation

As stated above, the baseline fault levels were calculated in accordance with the methodology in the “NYISO Guideline for Fault Current Assessment” (Guideline #4-1) set forth in the NYISO Transmission Expansion and Interconnection Manual, version 2.1, Attachment I.

Consistent with generally accepted practices for short circuit studies, Guideline #4-1 requires that transmission lines and transformers be modeled in their normal operating condition, with all generating units modeled as in-service. This configuration, regardless of whether or not the

¹ Capitalized terms not otherwise defined herein have the meaning set forth in the NYISO's Tariffs – NYISO's Market Administration and Control Area Services Tariff (Services Tariff) and NYISO's Open Access Transmission Tariff (OATT).

system can actually be operated in such a manner, provides an adequate design margin of safety and reliability by yielding the worst case and most conservative fault levels.

II. Circuit Breaker Rating

The lowest circuit breaker ratings for each of the selected substations were obtained from the applicable transmission and generation owners. The ratings are the nameplate symmetrical rating, the de-rated symmetrical value as determined by the owner, or the approximate symmetrical value converted from a total current basis.

Circuit breakers rated on a total current basis were converted to an approximate symmetrical current rating by using the nominal voltage of the substation.

Advanced circuit breaker rating techniques such as asymmetrical current analyses, de-rating for reclosing and de-rating for age were not considered by the NYISO for this screening analysis, although each circuit breaker owner should consider these techniques when performing their own analysis.

III. Analysis

A. Bus Fault Summary

The first step in the procedure for identifying potentially overdutied circuit breakers is to generate a bus fault summary. The bus fault summary yielded the three-line-to-ground (3LG), double-line-to-ground (2LG), and single-line-to-ground (SLG) fault values at each selected substation. The results of the bus fault summary were compared to the lowest rated breaker within the substations, and if any of the bus faults exceeded the lowest rated breaker, an individual breaker analysis (IBA) was performed to determine if any circuit breakers were actually overdutied.

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

The complete results of the bus fault summary for the 142 stations that the NYISO studied are shown in Attachment 1. Of the 142 stations, one (1) was identified as having a bus fault in excess of the lowest circuit breaker rating, and required a more detailed analysis as outlined in the next section.

B. Detailed Analysis of Stations Identified in the Bus Fault Summary

The next step in the procedure for identifying potentially overdutied circuit breakers is to share the results of the screening study for buses exceeding the station's lowest circuit breaker rating with the facility owners to perform an IBA at each of the substations to determine if any of the circuit breakers were indeed overdutied.

The results of the IBA showed zero (0) of the one (1) stations with bus fault levels greater than their lowest breaker rating had any overdutied circuit breakers.

NYISO performed a sensitivity analysis for various possible Astoria configurations. The sensitivity analysis shows that when Astoria 3 and 5 dual yard steam units are operating on the Astoria East bus together with all other Astoria East units running, the Astoria East 138 kV circuit breakers 6W, 7W, 8W, 2E, 3E, 7E, and 8E would be overdutied.

The Interim Operating Protocol for Astoria East and West Stations Fault Current Mitigation approved by the Operating Committee on May 6, 2010 prevents overduty conditions at Astoria East 138 kV stations.

CONCLUSIONS AND RECOMMENDATIONS

The 2017 Fault Current Assessment has identified the following significant changes in fault current, statewide, in comparison to 2016:

- Fault currents significantly increased at S Ripley 230 kV due to PJM updates
- Fault currents significantly increased at E 13 St 138 kV due to modeling corrections
- Fault currents significantly increased at Elbridge 345 kV due to the Auburn transmission project
- Fault currents significantly decreased at Niagara E 230 kV, Niagara W 230 kV and St Lawrence 230 kV due to Hydro One updates
- Fault currents significantly increased at Patnode 230 kV, and Willis 230 kV due to Hydro One updates
- Fault currents significantly increased at Rotterdam 230 kV due to impedance correction of a transformer

Fault current assessments are intended to be conservative in nature in order to provide an adequate margin of design safety and reliability. No breakers were found overdutied.

The NYISO recommends continued application of the Interim Operating Protocol for Astoria East and West Fault Current Mitigation approved by the Operating Committee on May 6, 2010 to prevent overduty conditions at Astoria East station for certain Astoria East and West configurations.

Attachment 1 – 2017 Bus Fault Summary

Substation Name	Nominal kV	Lowest Rated CB (kA)	TO	2017 Max Bus Fault (kA)	2016 Max Bus Fault (kA)	2017-2016 Delta (kA)	IBA Required	Breaker(s) Overdutied
MARCY	765	63	NYPA	9.8	9.9	-0.1	N	N
MASSENA	765	63	NYPA	7.8	8.2	-0.4	N	N
ACADEMY	345	63	CE	32.4	32.7	-0.3	N	N
AES SOMERSET	345	40	NYSEG	17.7	17.6	0.1	N	N
ALPS	345	40	N Grid	17.6	17.5	0.1	N	N
ASTORIA ANNEX	345	63	NYPA	45.6	45.7	-0.1	N	N
ATHENS	345	48.8	N Grid	34.1	34.1	0.0	N	N
BOWLINE 2	345	40	O R	27.0	27.3	-0.3	N	N
BOWLINE 1	345	40	O R	27.2	27.4	-0.2	N	N
BUCHAN N	345	63	CE	29.3	29.6	-0.3	N	N
BUCHAN S	345	63	CE	38.8	39.1	-0.3	N	N
CLARKS CORNERS	345	40	NYSEG	11.8	11.7	0.1	N	N
CLAY	345	49.1	N Grid	33.3	33.1	0.2	N	N
COOPERS CORNERS	345	40	NYSEG	18.1	18.2	-0.1	N	N
DEWITT	345	40	N Grid	19.2	18.9	0.3	N	N
DUNWOODIE	345	63	CE	50.4	50.7	-0.3	N	N
E FISHKILL	345	63	CE	39.6	39.9	-0.3	N	N
EDIC	345	40	N Grid	33.3	33.3	0.0	N	N
E GARDEN CITY	345	63	NYPA	25.2	25.4	-0.2	N	N
ELBRIDGE	345	40	N Grid	17.5	16.1	1.4	N	N
FARRAGUT	345	63	CE	58.6	58.6	0.0	N	N
FITZPATRICK	345	37	GEN OWNER	41.5	41.5	0.0	Y	N
FRESHKILLS	345	63	CE	26.7	26.9	-0.2	N	N
FRASER	345	40	NYSEG	19.1	19.1	0.0	N	N
GILBOA	345	50	NYPA	25.5	25	0.5	N	N
GOETHALS N	345	63	CE	29.1	29.2	-0.1	N	N
GOWANUS N	345	63	CE	27.8	28	-0.2	N	N
HURLEY	345	40	CHG&E	17.2	17.3	-0.1	N	N
INDEPENDENCE	345	41.9	N Grid	38.6	38.5	0.1	N	N
LADENTOWN	345	63	O R	39.9	40.3	-0.4	N	N
LAFAYETTE	345	40	N Grid	18.4	17.9	0.5	N	N
LEEDS	345	40	N Grid	34.7	34.8	-0.1	N	N
MARCY 345	345	63	NYPA	32.5	32.6	-0.1	N	N
MIDDLETOWN TP	345	63	NYPA	18.8	19	-0.2	N	N
MILLWOOD	345	63	CE	44.6	45	-0.4	N	N
MOTT HAVEN	345	63	CE	48.8	48.9	-0.1	N	N
NEWBRIDGE	345	57.3	LIPA	8.6	8.6	0.0	N	N
NIAGARA	345	63	NYPA	32.1	32.9	-0.8	N	N

Substation Name	Nominal kV	Lowest Rated CB (kA)	TO	2017 Max Bus Fault (kA)	2016 Max Bus Fault (kA)	2017-2016 Delta (kA)	IBA Required	Breaker(s) Overdutied
NINE MILE PT #1	345	50	GEN OWNER	43.6	43.5	0.1	N	N
N SCOTLAND 77B	345	40	N Grid	31.4	31.2	0.2	N	N
N SCOTLAND 99B	345	40	N Grid	31.4	31.3	0.1	N	N
OAKDALE	345	40	NYSEG	12.7	12.7	0.0	N	N
OSWEGO	345	40.6	N Grid	32.7	32.5	0.2	N	N
PLEASANT VALLEY	345	63	CE	40.9	41.2	-0.3	N	N
PLEASANTVILLE-2	345	63	CE	21.8	22	-0.2	N	N
RAINEY	345	63	CE	55.1	55.1	0.0	N	N
RAMAPO	345	63	CE	45.0	45.5	-0.5	N	N
REYNOLDS	345	40	N Grid	14.8	14.7	0.1	N	N
ROCK TAVERN	345	63	CHG&E	31.8	32.3	-0.5	N	N
ROSETON	345	63	CHG&E	35.8	36.1	-0.3	N	N
S.MAHWAH-A	345	40	O R	34.7	35.2	-0.5	N	N
S.MAHWAH-B	345	40	O R	34.4	34.8	-0.4	N	N
S080 345KV	345	40	RGE	17.2	16.8	0.4	N	N
S122	345	40	RGE	17.4	16.7	0.7	N	N
SCRIBA	345	48.3	N Grid	47.0	47	0.0	N	N
SHORE RD	345	63	LIPA	27.6	27.9	-0.3	N	N
SPRAIN BROOK	345	63	CE	51.7	52.1	-0.4	N	N
STOLLE ROAD	345	40	NYSEG	4.7	5	-0.3	N	N
VOLNEY	345	44.8	N Grid	36.7	36.7	0.0	N	N
W 49 ST	345	63	CE	50.4	50.5	-0.1	N	N
WATERCURE	345	40	NYSEG	8.4	8.3	0.1	N	N
ADIRONDACK	230	33.1	N Grid	9.4	9.4	0.0	N	N
CANANDAIGUA	230	40	NYSEG	6.3	6.3	0.0	N	N
CHASES LAKE	230	40	N Grid	8.9	8.9	0.0	N	N
DULEY	230	40	NYPA	7.6	7.4	0.2	N	N
DUNKIRK	230	29.6	N Grid	9.6	9.4	0.2	N	N
GARDENVILLE 1	230	32.2	N Grid	18.7	18.8	-0.1	N	N
HIGH SHELDON	230	40	NYSEG	9.6	9.6	0.0	N	N
HILLSIDE	230	35.86	NYSEG	12.7	12.5	0.2	N	N
HUNTLEY 70	230	35.8	N Grid	17.1	17.2	-0.1	N	N
MEYER	230	40	NYSEG	6.9	6.8	0.1	N	N
NIAGRA E	230	63	NYPA	52.9	54.1	-1.2	N	N
NIAGRA W	230	63	NYPA	52.9	54.1	-1.2	N	N
PACKARD 6	230	50	N Grid	39.5	39.7	-0.2	N	N
PATNODE	230	63	NYPA	10.6	9.3	1.3	N	N
PORTER	230	21.1	N Grid	19.5	19.5	0.0	N	N
ROBINSON RD.	230	43	NYSEG	14.0	14	0.0	N	N
ROTTERDAM66H	230	40	N Grid	14.2	13.2	1.0	N	N
ROTTERDAM77H	230	23.6	N Grid	14.2	13.1	1.1	N	N

Substation Name	Nominal kV	Lowest Rated CB (kA)	TO	2017 Max Bus Fault (kA)	2016 Max Bus Fault (kA)	2017-2016 Delta (kA)	IBA Required	Breaker(s) Overdutied
ROTTERDAM99H	230	23.2	N Grid	14.2	13.2	1.0	N	N
RYAN	230	40	NYPA	10.8	10.5	0.3	N	N
S RIPLEY	230	40	N Grid	10.3	9	1.3	N	N
ST LAWRN 230	230	33.1	NYPA	32.0	33.1	-1.1	N	N
STOLLE ROAD	230	40	NYSEG	13.1	13.2	-0.1	N	N
STONEYRIDGE	230	40	NYSEG	7.0	6.9	0.1	N	N
STONY CREEK	230	40	NYSEG	8.2	8.2	0.0	N	N
WATERCURE	230	40	NYSEG	12.6	12.4	0.2	N	N
WETHERSFIELD	230	40	NYSEG	7.9	7.9	0.0	N	N
WILLIS	230	33.1	NYPA	13.5	12.5	1.0	N	N
AST-EAST-E	138	63	CE	53.1	53.3	-0.2	N	N
AST-WEST-N	138	63	CE	44.3	44.3	0.0	N	N
BARRETT 2	138	57.8	LIPA	48.3	48.6	-0.3	N	N
BROOK HAVEN	138	37	LIPA	26.4	26.8	-0.4	N	N
BUCHANAN	138	40	CE	15.8	15.7	0.1	N	N
CORONA N.	138	63	CE	52.2	52.4	-0.2	N	N
DUNWOODIE N	138	40	CE	34.3	34.3	0.0	N	N
DUNWOODIE S	138	40	CE	30.4	30.6	-0.2	N	N
E 13 ST	138	63	CE	49.6	47.4	2.2	N	N
E 179 ST	138	63	CE	48.4	48.6	-0.2	N	N
E 75 ST TAP	138	63	CE	9.0	9.1	-0.1	N	N
EASTVIEW	138	63	CE	36.7	36.9	-0.2	N	N
E GARDEN CITY-1	138	80	LIPA	69.4	70.3	-0.9	N	N
ELWOOD 1	138	63	LIPA	38.1	38.4	-0.3	N	N
ELWOOD 2	138	63	LIPA	37.8	38.1	-0.3	N	N
FOX HILLS 2	138	40	CE	33.2	33.7	-0.5	N	N
FRESHKILLS	138	40	CE	36.0	36.1	-0.1	N	N
FREEMPORT	138	63	LIPA	35.6	35.9	-0.3	N	N
GREENLWN	138	63	LIPA	28.8	29.1	-0.3	N	N
GREWOOD	138	63	CE	49.6	49.7	-0.1	N	N
HAUPAGUE	138	63	LIPA	21.8	22	-0.2	N	N
HELLGATE 6	138	63	CE	40.8	40.8	0.0	N	N
HOLBROOK	138	63	LIPA	47.9	48.5	-0.6	N	N
HOLTSGT-NYPA	138	63	LIPA	44.2	44.8	-0.6	N	N
HUDSON E	138	63	CE	39.2	39.4	-0.2	N	N
JAMAICA	138	63	CE	49.2	49.3	-0.1	N	N
LAKE SUCCESS	138	63	LIPA	38.2	38.8	-0.6	N	N
MILLWOOD	138	40	CE	19.3	19.3	0.0	N	N
MOTT HAVEN	138	50	CE	13.7	13.3	0.4	N	N
NEWBRIDGE	138	80	LIPA	68.1	69	-0.9	N	N
NORTH PORT1	138	63	LIPA	59.1	59.5	-0.4	N	N
OAKWOOD	138	63	LIPA	27.9	28.2	-0.3	N	N

Substation Name	Nominal kV	Lowest Rated CB (kA)	TO	2017 Max Bus Fault (kA)	2016 Max Bus Fault (kA)	2017-2016 Delta (kA)	IBA Required	Breaker(s) Overdutied
PILGRIM	138	63	LIPA	58.7	59.3	-0.6	N	N
PT JEFFERSON	138	63	LIPA	31.8	32.1	-0.3	N	N
QUEENS BRIDGE	138	63	CE	42.6	42.6	0.0	N	N
RIVERHEAD	138	63	LIPA	17.6	17.4	0.2	N	N
RULAND RD	138	63	LIPA	45.1	45.7	-0.6	N	N
SPRAIN BROOK TR N7	138	63	CE	26.7	26.9	-0.2	N	N
SPRAIN BROOK TR S6	138	63	CE	29.0	29	0.0	N	N
SHERMAN CREEK	138	63	CE	45.4	45.5	-0.1	N	N
SHORE RD1	138	57.8	LIPA	47.7	48.2	-0.5	N	N
SHOREHAM1	138	52.2	LIPA	27.1	27.7	-0.6	N	N
SYOSSET	138	63	LIPA	33.8	34.1	-0.3	N	N
TREMONT11	138	63	CE	42.5	42.7	-0.2	N	N
TREMONT12	138	63	CE	42.5	42.6	-0.1	N	N
VERNON E	138	63	CE	43.9	43.8	0.1	N	N
VERNON W	138	63	CE	34.7	34.7	0.0	N	N
VALLEY STRM2	138	63	LIPA	53.3	53.8	-0.5	N	N
WADING RIVER1	138	56.4	LIPA	24.9	25.8	-0.9	N	N
WILDWOOD	138	63	LIPA	27.1	27.6	-0.5	N	N
CLAY	115	44.4	N Grid	38.4	37.8	0.6	N	N
PORTER	115	55.6	N Grid	41.4	41.5	-0.1	N	N
E RIVER	69	50	CE	49.7	49.7	0.0	N	N