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NYISO SHORT CIRCUIT ASSESSMENT SUMMER 2003

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Presented to the
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1. INTRODUCTION

The following report, prepared by NYISO Operations Engineering Staff, highlights the significant results of the short circuit screening analysis completed for the Summer 2003 capability period (through October 31, 2003). The purpose of this analysis is to identify selected critical bulk power substations with potentially over-dutied circuit breakers, refer these substations to the respective owners, and recommend possible actions.

It should be noted that the intent of this analysis is to identify potential areas of overduty concern, and the ultimate responsibility for final determination as to whether or not equipment is actually overdutied rests with the owner of the equipment.

2. RECOMMENDATIONS

The following recommendations are presented based on the analysis and results documented in this report.

The NYISO shall take the following steps:

- The NYISO should closely monitor generation dispatch in the Southeastern New York zones during peak periods until installation of the ConEdison Fault Current Management Plan (FCMP) has been completed;
- The NYISO should closely monitor the generation dispatch in the Oswego complex to monitor the overduty at Fitzpatrick;
- The NYISO should closely monitor the generation dispatch in western New York to monitor the overduty at Packard;
- The NYISO should develop a Fault Current Operating Procedure to allow for future generation and/or transmission additions / changes until key elements of the FCMP are installed;
- The NYISO should coordinate with PJM to monitor the status of generating units in Northern New Jersey to monitor the overduty at Ramapo and Farragut.

The NYISO further recommends that:

- The overduty circuit breakers at Fitzpatrick and Packard should be upgraded or replaced, or other means of acceptable mitigation should be installed;
- The NYISO should investigate with the local transmission owners the feasibility of transmission reconfiguration options to address the overduty at critical BPS locations.

3. SYSTEM REPRESENTATION AND BASE STUDY ASSUMPTIONS

I. System Representation

The NYISO 2003 Statewide Short Circuit representation, dated April 15, 2003, was used for this study. This representation includes all system changes, known as of April 15, through the summer capability period ending October 31, 2003. The basis for this representation was the NYISO 2002 Statewide Short Circuit representation, with updates from the NYCA transmission owners and the adjacent control Areas for 2003.

The adjacent Area representations used in the April 15 representation were obtained from the respective Area coordinators and/or the transmission owners.[1]

Significant changes to the New York Control Area (NYCA) in the 2003 NYISO Statewide Short Circuit Representation from 2002 include:

Bowline Point 345/138kV Transformer (400 MVA)
NEG/Athens Generating Station (1080 MW)
LIPA GTs at Stony Brook, Far Rockaway, Freeport and Greenport

II. Base Study Assumptions

The short circuit levels used for the initial screening analysis were calculated using the ASPEN OneLiner® program and the "NYISO Guideline for Fault Current Assessment". The initial short circuit levels presented have been determined for all facilities scheduled in service during the Summer 2003 period.

[1] The PJM and HQ data included in the NYISO 2003 base case is representative of Summer 2003 conditions. The Ontario data is representative of the previous year's conditions, as an Ontario 2003 representation was not available at the commencement of the study. The New England data is also representative of the previous year's conditions, and was obtained from the respective transmission owners, as ISO-NE did not have an Area-wide representation at the commencement of this study.

4. DISCUSSION AND RESULTS

I. Fault Current Calculation

The initial baseline fault levels were calculated using the "NYISO Guideline for Fault Current Assessment".

The Guideline, in general terms, requires that all lines, feeders and generating units be placed in service, as is the accepted practice for short circuit studies. By assuming all lines, feeders and generating units are in service, regardless of whether or not the system can actually be operated that manner, provides an adequate design margin of safety and reliability by yielding the worst case, most conservative fault levels.

II. Circuit Breaker Rating

The lowest circuit breaker ratings shown for each of the selected bulk power substations were obtained from the NY transmission owners. The ratings shown 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, derating for reclosing and derating for age - were not used in this screening analysis.

III. Analysis

A. Bus Fault Summary

The first step in the procedure for identifying potentially overdutied circuit breakers was to generate a bus fault summary. The bus fault summary calculates the three-line-to-ground (3LG), double-line-to-ground (2LG), and single-line-to-ground (SLG) fault values at each selected substations and compares the results to the lowest breaker ratings within the substations. If the lowest breaker rating at a specific station is exceeded, then a more detailed analysis is required to determine if any circuit breakers are actually overdutied.

The complete results of the bus fault summary for the 129 stations that the NYISO studied are shown in Attachment 1. Of these 129 stations, 16 were identified as having a bus fault in excess of the lowest circuit breaker rating; Table I below details these 16 stations.

TABLE I
Substation Bus Fault Summary
Base Case Fault Levels

Substation Name	Voltage (kV)	Lowest Breaker Rating (kA)	Fault Current (kA)	Bus Fault => 100% Of Rating (Y/N)
Astoria East	138	45	52.6	**Y**
Barrett	138	38.7	44.8	**Y**
Buchanan S.	345	40	41.3	**Y**
Corona	138	45	51.0	**Y**
Dunwoodie	345	63	64.0	**Y**
Farragut	345	63	63.6	**Y**
Fitzpatrick	345	37	42.6	**Y**
Greenwood	138	45	50.4	**Y**
Jamaica	138	40	47.6	**Y**
Northport	138	56.2	58.1	**Y**
Packard	230	37	43.5	**Y**
Pilgrim	138	55.8	55.9	**Y**
Port Jefferson	138	19.1	26.6	**Y**
Ramapo	345	40	44.4	**Y**
Sprain Brook	345	63	64.8	**Y**
Volney	345	37	37.3	**Y**

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

The next step in the procedure for identifying potentially overdutied circuit breakers was to refer the results of the screening study to the facility owners, and perform individual breaker analysis (IBA) at each of the substations in question to determine if any of the circuit breakers are indeed overdutied.

The results of the IBAs and more detailed analyses show 7 of the 16 stations as overdutied, shown below, sorted by owner and station:

Fitzpatrick / Entergy

For a close-in single line to ground (1LG) fault on the line side of breaker 10052 at Fitzpatrick with breakers R10 and R935 at Edic opening first the breaker would have to interrupt 40.9 kA, and for a three phase (3LG) fault the breaker would have to interrupt 37.3 kA.

In discussions with the owner, the breaker has multiple ratings including 37 kA 3LG and 41 kA 1LG; therefore, the breaker is slightly over its rating for a 3LG fault (100.8% duty).

Northport and Pilgrim / LIPA

Northport and Pilgrim were determined under their ratings based on IBAs at these stations conducted during the Class of 2002 ATBA/ATRA, which showed that for higher fault levels the stations were not overdutied.

Barrett and Port Jefferson / LIPA

Barrett and Port Jefferson are not overdutied; the bus tie breakers are the limiting breakers.

Volney / Niagara Mohawk

The worst-case fault at Volney is a double-line-to-ground (2LG) fault; however, Niagara Mohawk does not consider 2LG faults. This philosophy is consistent with ANSI C37, which provides breaker rating standards for 1LG and 3LG faults, only. The next highest fault at Volney is a 3LG fault of 36.7 kA, which is under the lowest breaker rating at the station.

Packard / Niagara Mohawk

Five circuit breakers at Packard 230 kV are very close if not in excess of their rating, depending on rating method and conversion from a total current basis to a symmetrical current basis. Breakers 304, 506, 3630, R3330, and R3530 are 15,000 MVA breakers, and using the nominal system voltage of 230 kV, this converts to a simple symmetrical rating of 37.7 kA.

For a close-in 3LG fault on the line side of breaker 3630 the breaker would have to interrupt 39.5 kA (104.8% duty), and for a close in fault on the line side of either breaker R3330 or R3530 they would have to interrupt 38.6 kA (102.4% duty).

Niagara Mohawk has indicated that they are proposing to replace or upgrade these breakers beginning next year.

Buchanan South, Dunwoodie, Greenwood and Jamaica / Con Edison

Buchanan South, Dunwoodie, Greenwood and Jamaica were determined under their ratings as a result of IBAs at each of these stations.

Astoria East and Corona 138kV / Con Edison

With respect to these two stations, the bus tie breaker at each is overdutied. All of the circuit breakers are rated 63 kA except for the bus tie breakers, which are rated 45 kA; the maximum fault duty the bus tie breakers would see is 47.1 kA (104.7%) and 45.5 kA (101.1%), respectively.

Farragut, Ramapo, and Sprain Brook 345kV / Con Edison

With respect to Farragut, all of the circuit breakers are 63 kA, and the worst-case fault duty is 63.6 kA (101.0%) for multiple breakers.

With respect to Ramapo, all of the circuit breakers are 63 kA, except for two that are 40 kA. One of these two 40 kA breakers will see 40.1 kA (100.5%).

With respect to Sprain Brook, all of the circuit breakers are 63 kA, and the worst-case fault duty is 64.0 kA (101.7%) for multiple breakers.

5. CONCLUSIONS AND RECOMMENDATIONS

It was observed during the creation of the NYISO short circuit representation – which initially was created by merging the individual transmission owners' cases into a single case – that there were instances where higher fault currents resulted when boundary equivalents were replaced by updated equivalents or detailed representations and, conversely, there were instances where lower fault currents resulted.

It should also be stressed that short circuit studies are intended to be conservative in nature in order to provide an adequate margin of design safety and reliability. The above Assessment makes the conservative assumption that all generation and transmission is in service, when in actual real time operation, not all generation and transmission is in service given transmission constraints, economic generation dispatch and forced outage rates. The NYISO reviewed the historical generation dispatch on the four peak days of 2002 and the peak day of June 26, 2003, and confirmed that: (1.) not all generation was in service in all areas of the State on those days; and (2.) as expected, the actual calculated fault levels across the State were considerably lower than the results obtained using the worst-case assumption of all generation in service.

I. Fitzpatrick

The potential overduty at Fitzpatrick does not appear to be caused by any one recent system change or addition; but most likely caused by gradual updates in the system representation. The overduty would exist only when all generators in the Oswego complex (five large steam turbine generators and all six generators in the Sithe/Independence combined cycle facility) are in service. Since this is a likely scenario on a peak load day, the facility owner should consider either upgrading or replacing the overdutied breaker at this station, or develop other means of acceptable mitigation.

In the interim, the NYISO should closely monitor the generation dispatch in the Oswego complex to address the overduty at Fitzpatrick.

II. Packard

The potential overduty at Packard appears to be caused by gradual changes in the system configuration, including the closing of the Niagara 230 kV bus tie and work associated with upgrading the Niagara generators. The overduty would exist when all generation on the 230kV system in the vicinity of Packard is in service. The facility owner should consider either upgrading or replacing the overdutied breakers at this station, or develop other means of acceptable mitigation.

In the interim, the NYISO should investigate with the local transmission owners the feasibility of opening the Niagara 230 kV bus tie breakers to address the overduty at Packard.

III. Astoria East, Corona, Farragut, Ramapo and Sprain Brook

The general causes of the potential overduties at these substations appear to be consistent with the Fitzpatrick and Packard, and also generator additions in and around the metropolitan NYC area.

Most, if not all, of these potential overduties will be eliminated with the installation of the ConEdison Fault Current Management Plan. Since key 345kV elements of the Plan will not be available for service until the end of the year 2004, other means of temporary operating procedures need to be explored.

It should also be noted that ConEdison and the NYISO are currently working on several technical updates and enhancements to the latest version of the NYISO Statewide short circuit representation. The preliminary results show that although these changes generally lower the fault levels in and around the stations, the stations are still overdutied with these updates and assuming all generators are in service.

As mentioned above, the NYISO reviewed the historical generation dispatch in and around these stations. The NYISO found that when the generation is dispatched consistent with the four peak load days of 2002 and the peak day of June 26, 2003, the potential overduties do not exist. More significantly the fault currents decrease significantly with the 2002 and 2003 peak load dispatch, with sufficient margin for the 2003 generation and transmission additions outlined in section 3.I.

Based on the analysis and conclusions above, the following are recommended for the overdutied substations for the Summer 2003 period, and prior to installation of the ConEdison FCMP:

1. The Security Constrained Unit Commitment (SCUC) will be run using normal assumptions regarding transmission availability and without any associated adjustments for a presumption of Short Circuit overduty induced limitations. At the completion of the Security Constrained Unit Commitment (SCUC) process the NYISO shall determine if a potential short circuit overduty condition exists based on the day-ahead generation commitment and the NYISO will notify the affected transmission facility owner(s). The affected transmission owners will advise the NYISO of the status of anticipated local mitigation actions for the indicated period;

2. These transmission owner mitigation actions shall include, but are not limited to, the expected operation of the Y49 series reactor for the indicated period as agreed to by Con Edison and LIPA Operations.

3. On peak load days, the NYISO shall monitor generation dispatch results of anticipated real-time commitment and will determine if a potential short circuit overduty condition exists based on the hour-ahead commitment and the NYISO will notify the affected transmission facility owner(s).

4. During peak load conditions the NYISO should coordinate with PJM to monitor the status of generating units in Northern New Jersey to monitor the overduty at Ramapo and Farragut.

5. The NYISO shall develop a Fault Current Operating Procedure for new and proposed generation and transmission additions and / or changes in the NYCA that becomes commercially available prior to installation of the key elements of the Con Edison Fault Current Management Plan. This procedure shall use in-place market processes, including Day-Ahead Margin Preservation rules to assure that any unit that is committed by SCUC and subsequently must be de-committed due to a short circuit overduty concern will be financially made whole, to insure that system reliability and financial commitments are not adversely impacted.

Attachment 1

Substation Bus Fault Summary
Base Case Fault Levels

Substation Name	Voltage (kV)	Lowest Breaker Rating (kA)	Fault Current (kA)	Bus Fault >= 100% Of Rating (Y/N)
Adirondack	230	25	8.3	N
AES Somerset	345	30	17.7	N
Alps	345	40	15.2	N
Astoria East	138	45	52.6	**Y**
Astoria West	138	45	43.8	N
Barrett	138	38.7	44.8	**Y**
Bowline 1	345	40	30.4	N
Bowline 2	345	40	30.2	N
Brookhaven	138	35.3	22.3	N
Buchanan N.	345	40	30.4	N
Buchanan S.	345	40	41.3	**Y**
Buchanan	138	40	15.8	N
Clay	345	40	33.7	N
Coopers Corners	345	30	15.5	N
Corona	138	45	51.0	**Y**
Dewitt	345	40	20.0	N
Dunkirk	230	37	15.0	N
Dunwoodie	345	63	64.0	**Y**
Dunwoodie No.	138	40	34.1	N
Dunwoodie So.	138	40	32.2	N
East 13th	138	63	44.5	N
East 15th Street	345	none	58.6	NOTE 1
East 179th	138	63	52.5	N
East Fishkill	345	63	39.9	N
East Garden City	138	63	59.4	N
East Garden City	345	58.6	9.8	N
Eastview	138	63	38.0	N
Eastview	345	none	38.1	NOTE 1
Edic	345	37	32.0	N
Elbridge	345	40	16.5	N
Farragut	345	63	63.6	**Y**
Fitzpatrick	345	37	42.6	**Y**
Fox Hills	138	40	33.4	N
Fraser	345	29	17.2	N
Freeport	138	63	30.2	N
Fresh Kills	138	40	36.0	N
Fresh Kills	345	63	24.2	N
Gardenville	230	37	22.5	N

Gilboa	345	40	22.0	N
Goethals N.	345	40	23.5	N
Goethals S.	345	63	24.0	N
Gowanus N.	345	40	19.3	N
Gowanus S.	345	40	19.4	N
Greenwood	138	45	50.4	**Y**
Hillside	230	31	11.8	N
Holbrook	138	52	41.2	N
Huntley	230	37	27.3	N
Hurley Avenue	345	40	17.1	N
Independence	345	50	39.4	N
Jamaica	138	40	47.6	**Y**
Ladentown	345	63	41.8	N
Lafayette	345	40	18.5	N
Lake Success	138	57.8	39.1	N
Leeds	345	37	33.7	N
Marcy	345	63	31.2	N
Marcy	765	63	9.6	N
Massena	765	63	7.7	N
Meyer	230	30	6.1	N
Millwood	138	20	19.4	N
Millwood	345	63	49.4	N
New Scotland	345	37	29.8	N
Newbridge Road	138	63	58.2	N
Niagara	230	63	56.2	N
Niagara	345	63	32.8	N
Nine Mile Point 1	345	n/a	44.9	NOTE 2
Northport	138	56.2	58.1	**Y**
Oakdale	230	none	6.5	NOTE 1
Oakdale	345	30	12.5	N
Oswego	345	37	32.8	N
Packard	230	37	43.5	**Y**
Pilgrim	138	55.8	55.9	**Y**
Pleasant Valley	345	63	40.7	N
Pleasantville	345	63	23.1	N
Poletti	345	63	47.4	N
Port Jefferson	138	19.1	26.6	**Y**
Porter	230	25	18.8	N
Queensbridge	138	45	42.8	N
Rainey	345	63	62.5	N
Ramapo	345	40	44.4	**Y**
Ramapo	500	none	11.1	NOTE 1
Reynolds Road	345	none	11.7	NOTE 1
Riverhead	138	35.9	14.2	N
Robinson Road	230	32	14.4	N
Rock Tavern	345	38	26.7	N
Roseton	345	38	35.0	N
Rotterdam	230	25	12.4	N
Ruland	138	52	38.6	N
Scriba	345	50	48.4	N

Sherman Creek	138	63	46.3	N
Shore Road	138	57.8	48.7	N
Shore Road	345	63	30.6	N
Shoreham	138	52	22.6	N
South Mahwah	345	40	34.9	N
South Ripley	230	40	9.0	N
Sprain Brook	345	63	64.8	**Y**
St. Lawrence	230	37	32.1	N
Station 122	345	40	16.5	N
Station 80	345	25	15.9	N
Stolle Road	230	28	13.1	N
Stolle Road	345	n/a	3.9	NOTE 2
Tremont	138	63	45.3	N
Tremont	345	none	37.2	NOTE 1
Valley Stream	138	57.8	49.0	N
Vernon East	138	40	32.5	N
Vernon West	138	40	32.8	N
Volney	345	37	37.3	**Y**
Watercure	230	27	11.8	N
Watercure	345	29	7.8	N
West 49th Street	345	63	58.4	N
West Haverstraw	345	none	31.7	NOTE 1
Willis	230	37	9.7	N
Wood Street A	345	none	22.4	NOTE 1
Wood Street B	345	none	25.9	NOTE 1

NOTES:
1. No circuit breaker is located at this substation.
2. Circuit breaker rating not on file with NYISO.

Appendix I – ASPEN One Liner Raw Output – Bus Fault Summary

Appendix II – NYISO Guideline for Fault Current Assessment