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NYISO FAULT DUTY
ASSESSMENT
SUMMER 2004

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1. INTRODUCTION

The following report, prepared by NYISO Operations Engineering Staff, highlights the significant results of the fault duty screening analysis completed for the Summer 2004 capability period (through October 31, 2004). 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 remedial actions.

2. SUMMARY 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 will implement the NYISO Procedure for Day-Ahead and Real-time Assessment of Fault Duty until installation of the ConEdison Fault Current Management Plan (FCMP) has been completed.

The NYISO further recommends that:

- The overdutied circuit breakers at Fitzpatrick, Nine Mile Point 1 and Packard should be upgraded or replaced, or other means of acceptable mitigation should be installed, as soon as possible.

3. SYSTEM REPRESENTATION AND BASE STUDY ASSUMPTIONS

I. System Representation

The NYISO 2004 Statewide Short Circuit representation, dated April 1, 2004, Revision 1, was used for this study. This representation includes all system changes, known as of April 1, through the summer capability period ending October 31, 2004. This representation was developed from the NYISO 2003 Statewide Short Circuit representation, with updates from the NYCA transmission owners and the adjacent Areas for 2004.

The adjacent Area representations used in the April 1, 2004 representation were obtained from the respective Area Reliability Coordinators and/or the interconnecting transmission owners.¹

Significant changes to the New York Control Area (NYCA) in the 2004 NYISO Statewide Short Circuit Representation from 2003 include:

New Keyspan Ravensood Unit 4 (250MW)
New Series Reactor in ConEdison 138kV Feeder 15055
ConEdison Hell Gate Transformer Reconfiguration
New LIPA Freeport GT, and several new LIPA Substations
National Grid Packard 230-115kV Transformer #2 Retirement
NYPA Plattsburgh 115 kV PAR Out-of-Service

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 initial short circuit levels presented have been determined for all facilities scheduled in service during the Summer 2004 period.

¹ The PJM, ISO-NE and Ontario data included in the NYISO 2004 base case is representative of Summer 2004 conditions. The Hydro-Quebec data is based on 2003 conditions, as an HQ 2004 representation was not available at the commencement of the study.

4. DISCUSSION AND RESULTS

I. Fault Current Calculation

The initial baseline fault levels were calculated using the “NYISO Guideline for Fault Current Assessment”, as previously stated.

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 and generation 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 implemented by the NYISO for this screening 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 produces 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 113 stations that the NYISO studied are shown in Attachment 1. Of these 113 stations, 12

were identified as having a bus fault in excess of the lowest circuit breaker rating, as compared to 16 stations in 2003.

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 refer the results of the screening study to the facility owners for confirmation, 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 below shows 7 of the 12 stations with overdutied circuit breakers:

Nine Mile Point 1 / Constellation

For a close-in single line to ground (1LG) fault on the line side of breaker R915 with the R925 and R80 breakers at Clay opening first, the breaker would have to interrupt 43.6 kA. The breakers at NMP 1 are rated 25,000 MVA, and using the nominal system voltage this converts to a simple symmetrical rating of 41.8 kA, which below the maximum fault current the breaker would have to interrupt.

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 41.0 kA, and for a three phase (3LG) fault the breaker would have to interrupt 37.4 kA. Both of these are over the nameplate rating of 37 kA.

Northport / LIPA

The breakers at Northport were determined under their ratings based on IBA at this station.

Volney / National Grid

The worst-case fault at Volney is a double-line-to-ground (2LG) fault; however, National Grid 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 36.8 kA, which is under the lowest breaker rating at the station.

Packard / National Grid

Despite the retirement of Packard 230-115kV transformer #2, 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, which is below the 3LG fault current the breakers will have to interrupt.

Buchanan South, Dunwoodie and Jamaica / Con Edison

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

Farragut, Greenwood, Ramapo and Sprain Brook / Con Edison

For each of these stations, individual breaker analysis determined that there are breakers overdutied by 0.04% to 1.1%. The most severe overduty is at Sprain Brook 345kV where the worst case fault duty is 63.7 kA (101.1%) for multiple breakers.

Farragut and Ramapo 345kV stations both have indicated over duty of 0.04%. At Farragut, all of the circuit breakers are 63 kA, and the worst case fault duty is 63.3 kA (100.5%) for multiple breakers. Two circuit breakers at Ramapo are rated 40kA, and all other breakers are rated 63 kA; the fault duty for one of the 40 kA breakers is 40.2 kA (100.4%).

At Greenwood, all of the circuit breakers are 63 kA, except for the bus tie which is 45 kA. The fault duty for the bus tie breaker is just over 45 kA (100.04%).

Table I below summarizes the over-dutied substations:

Table I
Substation Fault Duty Summary

Substation Name	Voltage (kV)	Lowest Breaker Rating (kA)	Max. Fault Current (kA)	Percent Fault Duty (%)
Farragut	345	63	63.3	100
Fitzpatrick	345	37	37.4	101
Greenwood	138	45	45.0	100
Nine Mile Point 1	345	41.8	43.6	104
Packard	230	37.6	38.9	103
Ramapo	345	40	40.2	100
Sprain Brook	345	63	63.7	101

5. CONCLUSIONS AND DETAILED RECOMMENDATIONS

The 2004 Fault Duty Assessment shows that overall there has been a slight increase in available fault current in Upstate New York, which is why the Upstate results are very similar this year as compared to last. Conversely, there has been a slight decrease in available fault current in Downstate New York, mainly due to installation of the initial element (5% series reactor in 138kV circuit 15055 at East 179th Street) of the ConEdison Fault Current Management Plan, which is why there are fewer affected Downstate substations and circuit breakers this year as compared to last.

It should be stressed that fault duty 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 has conducted historical fault duty benchmarking analyses and confirmed that, as expected, the actual calculated fault levels across the State are considerably lower than the results obtained using the worst-case assumption of all facilities in service.

Based on the above, the NYISO recommends the following for the referenced overdutied stations:

1. **Farragut, Greenwood, Ramapo & Sprain Brook:** The NYISO will implement its “NYISO Procedure for Day-Ahead and Real-time

Assessment of Fault Duty” prior to completion of the ConEdison Fault Current Management Plan. This will allow for new generation to interconnect - and existing generation to be dispatched - within the ConEdison service territory to provide much needed capacity and energy, but still respect potential overduty conditions.

2. **Fitzpatrick, Nine Mile Point 1 & Packard:** Entergy, Constellation and National Grid should replace the overdutied circuit breakers at their respective stations as soon as possible. National Grid has ordered replacement circuit breakers for Packard and it is expected that the replacement will take place over a two year period, based on equipment lead times, engineering, construction and outage scheduling.

Attachment 1

Substation Bus Fault Summary Base Case Fault Levels

Substation Name	Voltage (kV)	Lowest Breaker Rating (kA)	Fault Current (kA)	Over Lowest Breaker (Y/N)
Adirondack	230	25	8.3	N
AES Somerset	345	40	17.8	N
Alps	345	40	15.2	N
Astoria East	138	45	44.5	N
Astoria West	138	45	35.0	N
Barrett	138	57.8	45.3	N
Bowline 1	345	40	28.2	N
Bowline 2	345	40	28.1	N
Brookhaven	138	35.4	22.7	N
Buchanan N.	345	40	30.2	N
Buchanan S.	345	40	41.3	Y
Buchanan	138	40	15.9	N
Clay	345	40	33.9	N
Coopers Corners	345	37	15.6	N
Corona	138	45	44.0	N
Dewitt	345	40	20.1	N
Dunkirk	230	37	15.0	N
Dunwoodie	345	63	63.5	Y
Dunwoodie No.	138	40	33.3	N
Dunwoodie So.	138	40	31.7	N
East 13th	138	63	44.7	N
East 15th Street	345	none	58.4	NOTE 1
East 179th	138	63	42.6	N
East Fishkill	345	63	40.0	N
East Garden City	138	63	60.3	N
East Garden City	345	54.8	9.9	N
Eastview	138	63	38.2	N
Eastview	345	none	38.1	NOTE 1
Edic	345	37	32.0	N
Elbridge	345	40	16.6	N
Farragut	345	63	63.3	Y
Fitzpatrick	345	37	42.8	Y
Fox Hills	138	40	33.7	N
Fraser	345	37	17.2	N
Freeport	138	63	30.4	N
Fresh Kills	138	40	36.3	N
Fresh Kills	345	63	24.3	N
Gardenville	230	37	22.4	N
Gilboa	345	40	22.1	N

Goethals N.	345	40	23.6	N
Goethals S.	345	63	24.1	N
Gowanus N.	345	40	19.4	N
Gowanus S.	345	40	19.6	N
Greenwood	138	45	50.9	Y
Hillside	230	37	11.5	N
Holbrook	138	52.2	42.8	N
Huntley	230	37	27.1	N
Hurley Avenue	345	40	17.1	N
Independence	345	50	39.5	N
Jamaica	138	40	46.6	Y
Ladentown	345	63	41.2	N
Lafayette	345	40	18.6	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	37	6.1	N
Millwood	138	20	19.6	N
Millwood	345	63	49.4	N
New Scotland	345	37	29.8	N
Newbridge Road	138	63	59.1	N
Niagara	230	63	56.0	N
Niagara	345	63	32.8	N
Nine Mile Point 1	345	41.8	45.0	Y
Northport	138	57.8	58.2	Y
Oakdale	230	none	6.4	NOTE 1
Oakdale	345	37	12.4	N
Oswego	345	37	32.9	N
Packard	230	37.6	42.8	Y
Pilgrim	138	57.8	56.3	N
Pleasant Valley	345	63	40.8	N
Pleasantville	345	63	23.2	N
Poletti	345	63	47.4	N
Port Jefferson	138	63	31.3	N
Porter	230	25	18.8	N
Queensbridge	138	45	34.2	N
Rainey	345	63	62.2	N
Ramapo	345	40	44.3	Y
Ramapo	500	none	11.1	NOTE 1
Reynolds Road	345	none	11.8	NOTE 1
Riverhead	138	36.1	14.6	N
Robinson Road	230	43	14.4	N
Rock Tavern	345	38	26.8	N
Roseton	345	38	35.1	N
Rotterdam	230	25	12.3	N
Ruland	138	57.8	39.5	N
Scriba	345	50	48.5	N
Sherman Creek	138	63	39.0	N

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Shore Road	138	57.8	48.8	N
Shore Road	345	63	30.6	N
Shoreham	138	52.2	22.9	N
South Mahwah	345	40	34.9	N
South Ripley	230	40	9.2	N
Sprain Brook	345	63	64.3	Y
St. Lawrence	230	37	32.1	N
Station 122	345	40	16.9	N
Station 80	345	25	16.6	N
Stolle Road	230	37	13.0	N
Stolle Road	345	40	3.9	N
Tremont	138	63	38.0	N
Tremont	345	none	37.0	NOTE 1
Valley Stream	138	57.8	49.4	N
Vernon East	138	40	38.3	N
Vernon West	138	40	32.8	N
Volney	345	37	37.4	Y
Watercure	230	33	11.5	N
Watercure	345	37	7.7	N
West 49th Street	345	63	58.2	N
West Haverstraw	345	none	29.6	NOTE 1
Willis	230	37	9.7	N
Wood Street A	345	none	22.5	NOTE 1
Wood Street B	345	none	26.0	NOTE 1

NOTES:

1. No circuit breaker is located at this substation.